DISCUSSION PAPER SERIES

IZA DP No. 4205

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Christine Harbring
Bernd Irlenbusch

June 2009

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

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Christine Harbring
University of Cologne
and IZA

Bernd Irlenbusch
London School of Economics
and IZA

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IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 4205
June 2009

ABSTRACT

Sabotage in Tournaments: Evidence from a Laboratory Experiment*

Although relative performance schemes are pervasive in organizations reliable empirical data on induced sabotage behavior is almost non-existent. We study sabotage in tournaments in a controlled laboratory experiment and are able to confirm one of the key insights from theory: effort and sabotage increase with the wage spread. Additionally, we find that even in the presence of tournament incentives, agents react reciprocally to higher wages, which mitigates the sabotage problem. Destructive activities are reduced by explicitly calling them by their name 'sabotage'. Communication among principal and agents curbs sabotage due to agreements on flat prize structures and increased output.

JEL Classification: M52, J33, J41, L23, C72, C91

Keywords: sabotage, tournament, reciprocity, relative performance scheme, experiment

Corresponding author:

Bernd Irlenbusch
London School of Economics
Department of Management
Houghton Street
London WC2A 2AE
United Kingdom
E-mail: b.irlenbusch@lse.ac.uk

* We thank Christian Grund, Matthias Kräkel, Ed Lazear, Reinhard Selten, and Dirk Sliwka for very valuable comments. All errors are our own. We are grateful to Andrea Bäcker for research assistance and to Sebastian Kube who programmed the experimental software. Financial support by the *Deutsche Forschungsgemeinschaft* through grants KR2077/2-1, IR43/1-1, HA 4462/1-2 and the *European Union* through the EU-TMR Research Network ENDEAR (FMRXCT98-0238) is gratefully acknowledged. Bernd Irlenbusch thanks the Max Planck Institute for Research on Collective Goods in Bonn for its hospitality during the academic year 2007/2008 when this paper was drafted.

In modern organizations, rewards based on relative performance are widely accepted as an essential component in the toolbox of incentive designers (Edward P. Lazear, 1999). According to estimates, a quarter of the Fortune 500 companies link parts of the individual merit of employees to a relative performance evaluation, for example by ‘forced rankings’ (Jeffrey Pfeffer and Robert I. Sutton, 1999). Internal promotion tournaments can also be regarded as relative performance schemes. The advantages credited to these schemes are manifold, ranging from diminishing the influence of global shocks, the sufficiency of ordinal ranking of output rather than absolute measurement, and the mitigation of hidden action problems. But incentive designers are also aware of a severe potential drawback: sabotage (Lazear 1989, Gary Charness and David I. Levine 2004). Sabotage can emerge when agents are able to deteriorate their competitors’ performance and thereby increase their own chances of a higher position in the ranking, for example, by refusing to cooperate, by concealing viable information, by transferring false or misleading information or even by destroying work tools needed by others.[1] Since sabotage can seriously harm the performance of organizations, it is of eminent importance to understand how different design characteristics of relative compensation schemes affect the behavior of agents. Unfortunately, sabotage activities can hardly be observed. For natural reasons agents engaging in sabotage are very careful in hiding their activities. This turns the task of collecting reliable field data on sabotage into an almost unsolvable challenge.

To overcome this problem we study sabotage behavior in a controlled laboratory experiment. An experiment has the decisive advantage that one can precisely observe the effort and sabotage levels exerted by agents. Additionally, we are able to monitor how different design

[1] Outside of organizations sabotage also appears to be omnipresent whenever relative performance evaluation is encountered. For a prominent example from sports recall the Tonya-Harding-Nancy-Kerrigan case where Harding’s rival Kerrigan was injured in an attack hatched by Harding’s ex-husband to keep Kerrigan off the Olympic ice skating team in 1994. Or remember the fictitious, but very illustrative chariot race with Charlton Heston in *Ben Hur* when he is sabotaged by his competitor Messala who mounted blades on the hubs, designed to chew up opposing chariots. Other examples can be found in presidential election campaigns where tremendous effort is exerted to damage the other candidates’ reputation by negative campaigning.

characteristics of relative performance schemes *ceteris paribus* affect behavior (for a discussion of the power of experiments in personnel and labor economics see Armin Falk and Ernst Fehr, 2003). In our experiment a principal can offer a tournament contract to a group of three agents. The contract specifies the total wage sum and the wage spread. The wage spread is the difference between the winner prize and the two loser prizes. The agent who obtains the highest output will be rewarded with the winner prize and the other two agents will receive the loser prize. After having seen the contract, the agents simultaneously choose (productive) effort and (destructive) sabotage. Effort increases the own output and sabotage reduces the output of the two other agents. Exerting effort and sabotage is costly for agents. The principal is rewarded proportionally to the total output reduced by a fraction of the wage costs. To the best of our knowledge, we are the first who provide clean evidence for one of the key insights from tournament theory, i.e., individual effort *and* sabotage levels *ceteris paribus* increase with the wage spread (Lazear, 1989). We can confirm that the incentive effects of the wage spread do not differ for different wage sums. Additionally, we are able to document that also in the presence of tournament incentives agents react reciprocally to a higher wage sum by increasing effort.[2] Interestingly, they keep their sabotage activity constant. Increasing effort indeed serves two goals: to reciprocate to the kind act of the principal and to increase the chances of winning the tournament. Reducing sabotage would only serve the first goal but would be detrimental for the second one. To attach some flavor of a (morally and legally) reprehensible deed to the destructive activity (compare Klaus Abbink and Heike Hennig-Schmidt, 2006), we frame the setting, in an additional treatment, as an employment situation by explicitly speaking of ‘employer’ and ‘employees’ and by calling the two activities ‘effort’ and ‘sabotage’. This framing significantly reduces sabotage. The same is true for a third

[2] Reciprocal reactions of workers under experimental fixed wage contracts are well documented (see, for example, Fehr, Georg Kirchsteiger, and Arno Riedl, 1993, Fehr, Simon Gächter, and Kirchsteiger, 1997, Fehr, Erich Kirchler, Andreas Weichbold, and Gächter, 1998, Fehr and Falk, 1999, Fehr and Gächter, 2000, Charness 2004, Jordi Brandts and Charness, 2004, Bernd Irlenbusch and Dirk Sliwka, 2005, Charness and Peter Kuhn, 2007).

treatment in which we allow the four players to communicate with each other by broadcasting text messages. Communication curbs sabotage since players agree on flat prize structures and increased output which is in line with previous findings that 'cheap-talk' often helps to improve efficiency (for a survey, see Vincent P. Crawford, 1998).

Reliable empirical data on sabotage behavior in tournaments is almost non-existent. In an early questionnaire study, Robert W. Drago and Gerald T. Garvey (1998) present evidence on the influence of incentives on helping effort in work groups. Workers were asked about the inclination of others in their group to help. The results suggest that helping effort is reduced when incentives in promotion tournaments are strong. Since helping effort can be seen as opposite behavior to sabotage the tendency to behave destructively towards colleagues seems to increase with higher prize spreads. One has to bear in mind that these results are based on non-incentivized answers to sensitive questions that might be biased by other factors, like corporate culture or variations in sympathy towards colleagues. We are only aware of one empirical field study that deals with effort *and* sabotage in a competition. Luis Garicano and Ignacio Palacios-Huerta (2006) investigate an exogenous change in the reward structure of the FIFA (*Fédération Internationale de Football Association*) regulations on 'sabotage' in soccer games. The number of forwards and the number of shots on goals are taken as proxies for the amount of productive effort and the number of defenders and yellow cards measure sabotage. Exploiting data from a concurrently conducted competition involving the same teams in which the prize structure did not change they employ a difference-in-difference approach and report a tendency that proxies for both activities increase with the introduction of a higher prize spread. This is a quite interesting and very important result especially if one is interested in competitions between teams. It is, however, not straightforward how their findings relate to tournament theory. As is almost always the case with field data, one has to rely on proxies to measure essential elements of the model as effort, sabotage, and output. Additionally it is almost impossible to observe cost functions for effort and sabotage and what the payoff functions of the principals and agents actually are. In a recent paper Jeffrey Carpenter, Peter Hans Matthews, and John Schirm (forthcoming) very nicely illustrate how ‘office politics’ are able to reverse the incentive effects of tournaments. In their real-effort experiment agents can influence the performance measurement of their competitors. Quite interestingly, the anticipation of the harmful influence of competitors discourages agents to exert effort in the first place. Thus, sabotage from tournament incentives might be detrimental not only because of destroying output but, additionally, because of preventing agents from exerting productive effort. Few other experiments investigate sabotage behavior.[3] Harbring, Irlenbusch, Matthias Kräkel, and Reinhard Selten (2007) study a Tullock-contest with heterogeneous agents in which sabotage can be individually addressed. They find that sabotage systematically varies with the composition of different types of contestants, for example, whether there are more underdogs than favorites or vice versa. Falk, Fehr, and David Huffman (2008) compare tournaments with and without sabotage possibilities. In their study the two agents have a binary choice whether they want to sabotage or not, i.e., sabotage cannot be gradually increased by an agent. Deciding to sabotage means to destroy all the output of the competitor. The data convincingly demonstrates that the possibility to engage in sabotage induces the principal to choose smaller prize spreads since the frequency of sabotage choices is lower for low spreads. Harbring and Irlenbusch (2005, 2008) vary the number of agents, the fraction of winner prizes or the magnitude of the winner prizes (without keeping the wage sum constant). It is shown that while tournament size has virtually no effect on behavior, a balanced fraction of winner and loser prizes appears to enhance productive activities. Higher winner prizes increase effort and sabotage, but it is not clear whether this is caused by the higher wage sum or the higher wage spread.

[3] A number of experimental studies deal with the analysis of productive effort choice in various tournament settings, for example, Clive Bull, Andrew Schotter, and Keith Weigelt (1987), Schotter and Weigelt (1992), Frans van Dijk, Joep Sonnemans, and Frans van Winden (2001), Christine Harbring and Irlenbusch (2003), Alannah Orrison, Schotter, and Weigelt (2004). They all do not tackle the sabotage problem. For an overview and comparisons see Harbring and Irlenbusch (2005).

In this paper, we introduce a sabotage experiment by allowing the principal to design a tournament contract along two orthogonal dimensions, the prize spread and the total sum of prizes. Sabotage might be reduced by communication between the principal and the agents or by making the agents aware that the destructive activity actually is ‘sabotage’. These ways of potentially curbing sabotage are analyzed in two additional treatments. The rest of the paper proceeds as follows. In section I, we introduce a simple tournament model that serves as the baseline for our experiment. Section II describes the experimental setting and different treatments. Section III presents our findings and section IV concludes.

I. A Simple Model of Tournaments with Sabotage

We employ a simple two-stage game with 4 players, 3 agents and one principal. As shown in Figure 1 the principal selects a wage contract in the first stage and in the second stage agents can exert two activities: productive effort and sabotage.

Figure 1 about here

The principal can offer a wage contract by specifying one of two possible wage sums $W \in \{300, 600\}$ as well as the compression of wages. In the simplest case she selects full wage compression, i.e., a fixed wage of $W/3$ for each agent. If unequal wages are specified we assume that the three agents compete in a tournament for a winner prize M. The two losing agents receive a loser prize m with $0 < m < M$. We denote the wage spread ($M - m$) by Δ with $(3m + \Delta) = W$, i.e., the sum of winner and loser prizes equals the wage sum.

A strategy of an agent i is constituted by a pair (e_i, s_i) where $e_i \in [0, \ldots, 100]$ denotes effort and $s_i \in [0, \ldots, 50]$ is the sabotage activity which reduces the output of the two other agents. Exerting effort and sabotage is costly for each agent i. The costs are assumed to be symmetric and are described by the functions $C_e(e_i)=e_i^2/70$ and $C_s(s_i)=s_i^2/20$, respectively.[4] The output y_i of agent i is determined by the following production function

$$y_i = e_i + \varepsilon_i - \sum_{j \neq i} s_j$$

with ε_i as a random variable which is uniformly distributed over the interval [-60, +60] and assumed to be i.i.d. for each agent i. The random component, ε_i, resembles production luck or measurement error of output. The expected payoff for agent i is given by

$$E\Pi_i(e_i, e_{-i}, s_i, s_{-i}) = f^w(e_i, e_{-i}, s_i, s_{-i})\, M + [1 - f^w(e_i, e_{-i}, s_i, s_{-i})]\, m - C_e(e_i) - C_s(s_i)$$

with $f^w(e_i, e_{-i}, s_i, s_{-i})$ denoting the probability for agent i to receive the winner prize if the other two agents choose effort levels e_{-i} and sabotage activities s_{-i}.

To provide a benchmark for behavior in the experiment let us have a look at the equilibrium prediction. For simplicity we assume that all players are rational, risk-neutral, and purely money-maximizing.[5] The expected payoff of an agent i can be written as

$$E\Pi_i(e_i, e_{-i}, s_i, s_{-i}) = m + f^w(e_i, e_{-i}, s_i, s_{-i})\Delta - e_i^2/70 - s_i^2/20.$$

If the principal chooses full wage compression $\Delta = 0$ (*fixed wages*) agents should exert no activity at all. For positive prize spreads the first-order conditions are given by

$$\frac{\partial f^w(e_i, e_{-i}, s_i, s_{-i})}{\partial e_i}\Delta = \frac{2e_i}{70} \text{ and } \frac{\partial f^w(e_i, e_{-i}, s_i, s_{-i})}{\partial s_i}\Delta = \frac{2s_i}{20}.$$

Provided our assumptions one can show that in a symmetric equilibrium the marginal probabilities of winning depend on the size of the interval from which the random component in the production function is drawn, i.e., one can show that (see, for example, Orrison, Schotter, and Weigelt 2004, Harbring and Irlenbusch 2008)

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[4] We assume that sabotage is costlier than productive effort resembling the fact that in the workplace an agent must exert some extra effort to conceal the destructive activity. Note that we implement identical cost functions for all agents. Lazear (1989) provides an analysis for heterogeneous personalities like ‘doves’ and ‘hawks’ by assuming differences in marginal costs of sabotage. A similar approach is taken in Harbring et al. (2007).

[5] For an illuminating analysis for inequity-averse agents see Christian Grund and Sliwka (2005).

$$\frac{\partial f^{w}(e_i, e_{-i}, s_i, s_{-i})}{\partial e_i} = \frac{\partial f^{w}(e_i, e_{-i}, s_i, s_{-i})}{\partial s_i} = \frac{1}{\bar{\varepsilon}}$$

with $\bar{\varepsilon}$ denoting the size of the interval from which each ε_i is drawn. Thus, our first order conditions reduce to

$$e^* = \frac{7\Delta}{24} \quad \text{and} \quad s^* = \frac{\Delta}{12}.$$

Note that an additional unit of effort has the same effect on improving the own position in the ranking as has one additional unit of sabotage. Thus, in equilibrium the marginal costs of the two activities have to be equal. To ensure that an interior solution exists and that agents have no incentive to deviate to activities of zero, the expected gain of an agent must not be lower than his cost, i.e., $\Delta / 3 \geq C_e(e^*) + C_s(s^*)$. Additionally, the equilibrium effort level must lie in the feasible interval, i.e., $e^* < 100$. An analogous statement must hold for sabotage, i.e., $s^* < 50$.

We assume that the principal's expected payoff increases in the total output of the agents

$$E\Pi_P(e, s) = \tau\left[E\left(\sum_i y_i\right)\right] - \theta W = \tau\left(\sum_i e_i - 2\sum_i s_i\right) - \theta W .$$

$\tau > 0$ indicates how much the principal values one unit of output. We assume that the principal suffers a cost proportionally to the promised wage sum and denote the fraction of the wage costs the principal has to bear by θ ($0 < \theta \leq 1$). One interpretation would be that the principal is a manager who implements the wage system and is rewarded in proportion to the output and the wage costs of his team.

Thus, in the symmetric tournament equilibrium the principal receives the following expected payoff depending on her choice of the prize spread Δ and the total wage sum W:

$$E\Pi_P(e^*, s^*) = \frac{45\tau\Delta}{\bar{\varepsilon}} - \theta W .$$

This reflects the standard tournament result that the principal's payoff increases with the prize spread. Note that *ceteris paribus* the principal's payoff is unaffected by the wage sum. If the principal anticipates the derived behavior of the agents and aims at maximizing her payoff, she chooses the highest possible wage spread and the lowest possible wage sum.

II. Experimental Design and Procedure

Table 1 summarizes the design alternatives for the wage contracts. The principal can choose a wage sum $W \in \{300, 600\}$ as well as one of the five prize spreads Δ_j with $j = 0, \ldots, 4$. A prize spread of zero is denoted by Δ_0, i.e., all players receive the same fixed wage irrespective of the output they have achieved. Additionally, we allow the principal not to offer any contract at all, which results in a payoff of zero for the principal as well as all agents.

Table 1 about here

In the experiment, the value τ of one unit of output for the principal is set to $\tau = 3$ and the cost parameter is set to $\theta = 0.3$. Table 2 provides the corresponding effort and sabotage equilibrium predictions as well as the resulting expected output.

Table 2 about here

We consider five treatments.[6] We have one *Baseline* and two main treatments, *Chat* and *Framing*. The three treatments exactly follow the model described so far. Two additional treatments serve as a robustness check and are only briefly mentioned. In *NoSabo* agents can only choose productive effort, but no sabotage. In *W300* the principal cannot choose a high wage sum, i.e., the wage sum is fixed and equal to 300.

[6] Translations of the instruction sheets can be found in the supplementary material. Original instructions in German are available from the authors upon request.

Baseline

In this treatment we avoid any value-laden terms. We do not speak of 'sabotage' or 'principal' or 'agents'. Instead we speak of players as being of type I and type II. The player of type I has to choose between a high or a low transfer and has to specify a spread. Players of type II choose two numbers A and B.

Chat

All four players are allowed to broadcast text messages during the whole game. Players cannot be individually addressed but each message can be read by all other players (including the principal). All messages appear in a communication window on the screen similar to a chat forum. Participants are not allowed to use abusive language, to reveal their real identity or to refer to any activity after the experiment.

Framing

The setting is framed as an employment situation. Roles of the 'employer' or one of the three 'employees' are assigned. The employer chooses an 'employment contract' with a 'high wage' or a 'low wage'. Employees choose a 'work' intensity and a 'sabotage' level.

The experiment was conducted in the *Laboratory for Experimental Research* at the University of Bonn and the *Laboratory for Experimental Research* at the University of Erfurt. All sessions were computerized and the software was developed by using RatImage (Abbink and Abdolkarim Sadrieh, 1995). Recruitment was done by ORSEE (Ben Greiner, 2004). In total, 336 students of different disciplines were involved. Each candidate was allowed to participate in one session only. To resemble the fact that tournaments are often repeatedly conducted with the same contestants – think, for example, of 'seller-of-the-year' contests – and to allow for learning a session consisted of 30 repetitions (rounds) of the same tournament setting with fixed matching and roles.[7] After each round all players observed the own payoff, the output of each agent and the principal's payoff. Each session lasted for about 2 hours and participants earned 19.4 Euro on average. After the instructions were read to the participants they were randomly and anonymously matched to groups of four. Roles as principal and agents were also randomly allocated. Each group constitutes a statistically independent observation. We collected 24 observations with 96 subjects for each of the treatments *Baseline* and *NoSabo* and 12 observations with 48 subjects for each of the other three treatments. In the experiment the payoffs were given in 'Talers', all subjects received an endowment of 1,200 Talers and at the end Talers were converted into Euro by a previously known exchange rate of 200 Talers per 1 Euro. All subjects were paid anonymously.

III. Results

A. Tournament Incentives

According to our analysis in section I, effort and sabotage should increase with widening the prize spread. This prediction is in line with the behavior we observe. Figures 2 and 3 show average effort and sabotage activities depending on the prize spread and the wage sum.

Figures 2 and 3 about here

Table 3 summarizes the results of a regression analysis. We use random effects estimates with robust standard errors for groups. In models (1) individual effort is the dependent variable. In panel [A] the variables "Δ_j" are dummy variables taking the value "1" if the respective prize

[7] One could argue that repeated tournaments are especially prone to collusion since agents might (implicitly) agree on exerting low effort and winning the prize in turns. In our data we do not observe indications for collusion. Even in the *Chat* treatment agents do not discuss this possibility. This might be due to the fact that in our setting agents do not have the possibility to exclusively communicate with each other, i.e., to exclude the principal from their communication (for studies on collusion in tournaments, see Harbring, 2006, and Matthias Sutter and Christina Strassmair, 2009).

spread $j = 1, \ldots, 4$ is chosen by the principal and "0" otherwise. The category omitted here is the fixed wage with Δ_0 which serves as the reference situation. We find that the coefficients of the dummy variables for the prize spreads are all highly significantly positive. Thus, effort is higher with tournament incentives than with fixed wages. For example, relative to fixed wages effort increases by 7.149 *ceteris paribus* if a tournament is implemented with the lowest positive prize spread Δ_1. Coefficients are increasing with an increasing prize spread, though not significantly for all comparisons made in pairs. The coefficient for Δ_1 is significantly smaller than that for Δ_2 (Wald test, two-sided, Prob > chi^2 = 0.000) and the coefficient for Δ_2 is significantly smaller than the one for Δ_3 (Wald test, two-sided, Prob > chi^2 = 0.027). The difference between the coefficients for Δ_3 and Δ_4 is not significant (Wald test, two-sided, Prob > chi^2 = 0.112). The prize spread coefficients in model (2) with individual sabotage as a dependent variable are all highly significantly positive. The coefficients again tend to increase with the prize spread (Δ_1 vs. Δ_3: Wald test, Prob > chi^2 = 0.012 and Δ_2 vs. Δ_4: Wald test, Prob > chi^2 = 0.001). These results are also confirmed by the regressions reported in panel [B]. The coefficients for the variable "Δ" indicate the changes of the respective dependent variable for an increase of one unit of Δ. Effort and sabotage significantly increase in the wage spread Δ. The increases, however, are smaller than predicted by the model discussed in section I. The corresponding increases for effort should be 0.292 per unit of Δ and 0.083 for sabotage. As can be seen from Table 3, panel [B], the actual increases are 0.110 for effort and 0.041 for sabotage. We also checked whether the tournament incentives are different for different wage levels by introducing interaction variables into the regressions which interact the dummy variable "High Wage Sum" (taking the value 1 for cases in which the high wage level is chosen and 0 for the low wage level) and the variables "Δ_j" and "Δ". The resulting coefficients are not significant confirming the theoretical prediction that tournament incentives are the same for different wage sums.[8]

OBSERVATION 1: *Effort and sabotage increase with the prize spread.*

Output results from effort and sabotage and is predicted to increase with widening the prize spread. The average output per prize spread in each treatment is depicted in Figure 4. Model (3) in Table 3, panel [B] confirms that output is increasing in "Δ" although the actual increase appears to be rather small compared to the theoretical prediction of 0.125. Models (4) explain the difference of marginal costs of effort and marginal costs of sabotage which should be equal to zero in equilibrium. All coefficients in panel [A] capturing the effects of the prize spreads compared to fixed wages are negative indicating that sabotage is increasing stronger than effort if tournament incentives are implemented (except for Δ_3).

Figure 4 about here

B. Reciprocity

From standard tournament theory one would expect that effort and sabotage only increase with the wage spread but not with the wage sum. As discussed above, we know from many experiments, however, that an intentionally chosen high wage can indeed induce agents to reciprocate with kindness. Kindness of an agent towards the principal could take two forms in our setting: higher effort and lower sabotage. Both would increase the principal's payoff but the effects on the chances of winning the tournament are different. A decrease of sabotage

[8] We additionally conduct non-parametric tests comparing average effort and sabotage for fixed wages vs. tournament incentives (i.e., contracts with positive wage spread). By applying the Wilcoxon Signed Rank-test for dependent pairs we can confirm the results from the regressions: effort and sabotage are higher under tournament incentives than under fixed wages in all treatments (except for effort in *Chat*). Note that some observations must be omitted from the analysis since one can only compare averages for different contracts in groups in which both types of contracts are actually chosen by the principal.

reduces the own chances of winning. Exerting higher effort serves the purpose of being kind towards the principal *and* at the same time increases the own chances of winning. Figure 2 indeed shows that effort is higher for the high wage sum than for the low wage sum in all three treatments. The same is not true for sabotage (see Figure 3). The highly significant coefficients for "High Wage Sum" in Table 3 validate that effort is significantly higher for the high wage level than for low wages. We do not find a corresponding effect for sabotage.[9]

OBSERVATION 2: *Effort increases with the wage sum, but sabotage does not.*

C. Reduction of Sabotage

Hitherto we have not analyzed possible differences between the treatments. We do so by applying the Mann Whitney U-Test (see Table 4). Our results indicate that sabotage is reduced by framing the situation as an employment context and explicitly using the term 'sabotage'. The results from non-parametric tests show that sabotage is significantly lower in *Framing* than in *Baseline* particularly if high wages and fixed wages are selected. The dummy variable "Framing" is also significantly negative in models (2) in Table 3. This reduction in sabotage leads to an increase in output as well as to an improvement of the relation of effort and sabotage (see models (3) and (4) in Table 3 and also non-parametric results in Table 4).

OBSERVATION 3: *Framing the situation as an employment situation and explicitly calling sabotage by its name reduces destructive activities compared to a neutral framing.*

Table 4 about here

[9] To check whether the increase in effort is indeed due to reciprocity and not a repeated game effect we ran OLS regressions (with robust standard errors for groups) for last-round behavior with the same variables as depicted by Table 3. Also in the last round effort is significantly higher for the high wage sum than for low wages, but sabotage does not differ. Additionally, we conducted a treatment *W300* in which the wage sum was fixed to the low wage level of 300, i.e., the principal could only choose the prize spread, but not the wage sum. We do not find any significant differences in effort and sabotage levels between *W300* and the low wage level in *Baseline*.

Introducing communication among the principal and the three agents has a considerable impact on behavior. Effort significantly increases and sabotage significantly decreases which *ceteris paribus* results in significantly higher output of roughly 17.5 (Table 3). Also the relation of effort and sabotage is improved significantly compared to *Baseline* (Models (4) in Table 3). The regression results are all confirmed by non-parametric testing (Table 4).

OBSERVATION 4: *Communication reduces sabotage and increases effort compared to a treatment without communication.*

The positive effect of the dummy variable "Chat" on effort and the negative effect on sabotage disappear in our last-round regressions which indicates that the cooperation enhancing effect of communication only survives as long as the interaction is repeated. Whether the increases in effort and the reduction in sabotage come with different contracts chosen by the principals is investigated in the next section.

D. Contracts

Figure 5 provides the frequencies of the different contracts chosen by the principals. The contract with the largest prize spread and the low wage level favored by our analysis in section I is clearly not the most frequent choice in any of the treatments.[10]

Figure 5 and Table 5 about here

Non-parametric testing of the frequencies of each contract type shows that tournament incentive contracts are more frequently chosen than fixed wages in *Baseline* and *Framing* (see Table 5). In *Chat* the high fixed wage is more frequently selected by the principal than the

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[10] We also conducted the treatment *NoSabo* in which agents could only choose effort, but no sabotage. In this setting tournament incentive contracts are selected in about 85% of the cases and the highest prize spread with the low wage level is indeed the contract which is most frequently chosen by the principal. This result is in line with the findings from Falk et al. (2008).

tournament incentive contracts with the high wage sum (Wilcoxon Signed Rank-Test, $\alpha = 0.0995$, two-tailed). The high fixed wage is even chosen in almost 50% of the cases in *Chat* (see Figure 5).

Table 6 about here

While in *Baseline* and in *Framing* low wages are more often selected than high wages, the opposite is the case in *Chat* (Table 5). It seems that in *Baseline* and *Framing* the choice of contracts is closer to the theoretical prediction than in *Chat*: More incentive contracts are selected than fixed wages and more low wages are implemented than high wages. Table 6 shows the comparison across treatments.

OBSERVATION 5: *Communication leads participants to coordinate on high fixed wages.*

IV. Concluding Remarks

Organizations are well advised to take the problem of sabotage seriously. We have unambiguously shown that agents react to increases in tournament incentives by exerting more effort, but also more sabotage. Both increases, however, seem to be less steep than suggested by theory. Secondly, and probably undervalued by standard tournament theory, our study shows that agents react reciprocally to higher wages by exerting higher effort even in the presence of tournament incentives. However, sabotage is not reduced. Making agents aware that destructive activities are in fact 'sabotage', for example by using a language that leaves no doubt about the immorality of the activity, tends to mitigate the problem. This finding might explain why codes of corporate conducts devote a considerable part of their content to advising employees against 'uncooperative' behavior within the company. Interestingly, we find that introducing a communication device – or bringing the setting closer to reality where communication seems to be a natural option – drastically reduces the number of tournament incentive contracts. Apparently, in our repeated setting, principal and agents are able to endogenously coordinate on high fixed wages that yield high effort and low sabotage in return. This agreement in fact raises efficiency, i.e., payoffs for principals and agents are significantly higher in *Chat* than in *Baseline*. The fact that many companies are reluctant to excessively use relative performance evaluation schemes, like “rank and yank” systems, seems to reflect our finding.

We provide clean empirical evidence on sabotage in tournaments. Our experimental approach enables us directly to relate incentivized behavior with tournament theory. Of course, findings from the laboratory might not be transferable to organizations on a one-to-one basis. Facing the inherent problems of collecting reliable data on sabotage, however, makes conducting comprehensive studies in the laboratory appear as a valuable – not to say a mandatory – step towards a better understanding of behavior under relative performance evaluation schemes.

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Figures

Figure 1: Sequence of the game

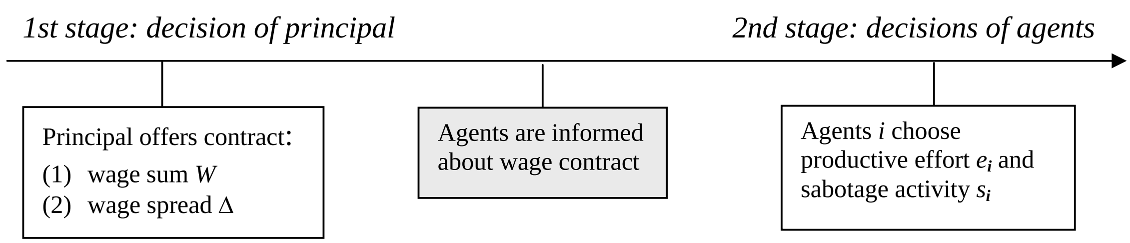


Figure 2: Average effort depending on contract and treatment

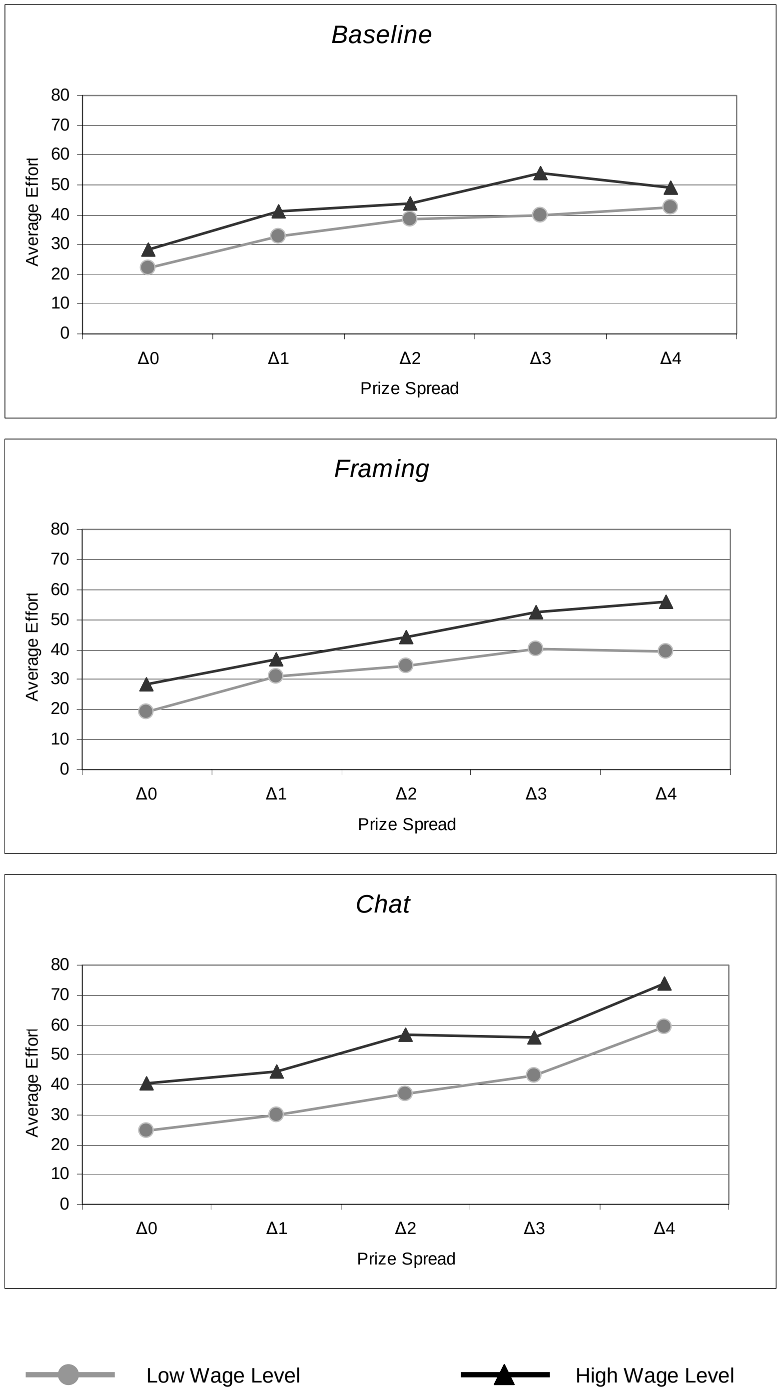


Figure 3: Average sabotage depending on contract and treatment

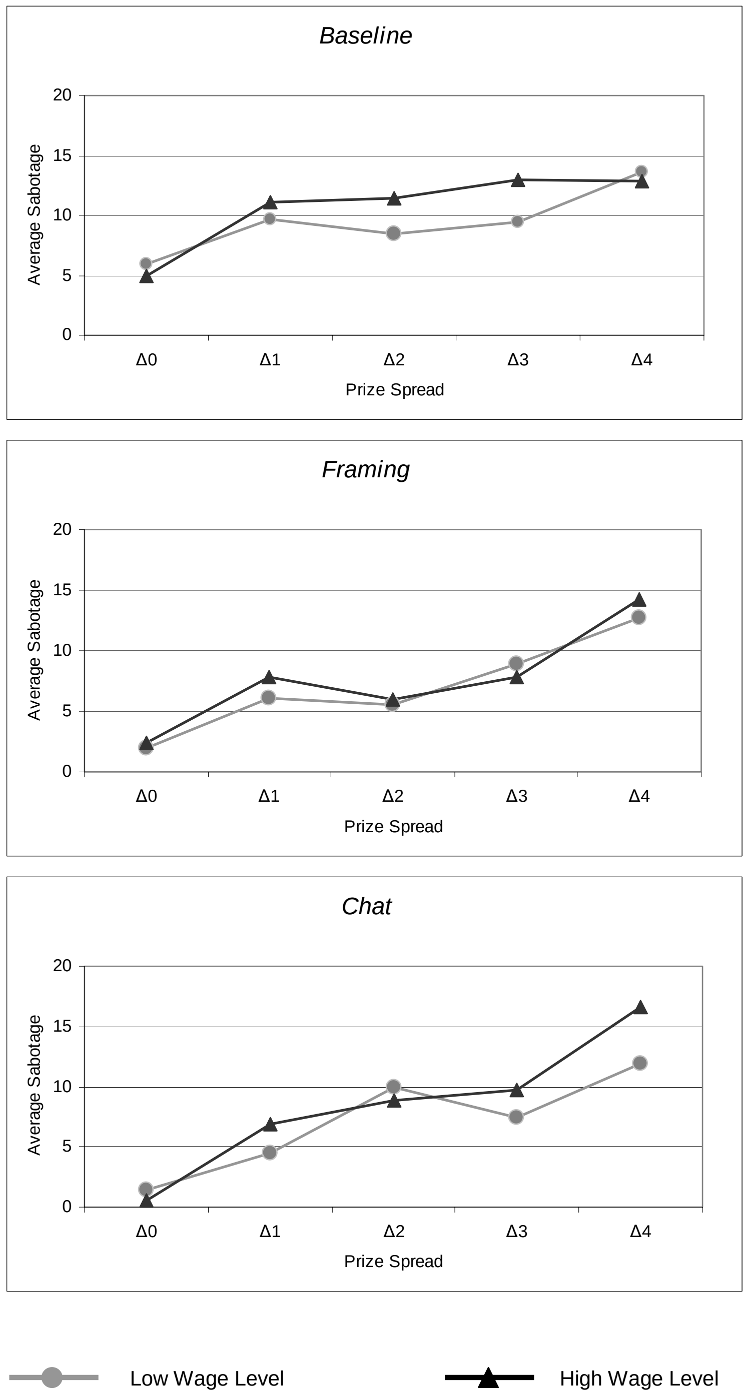


Figure 4: Average output depending on contract and treatment

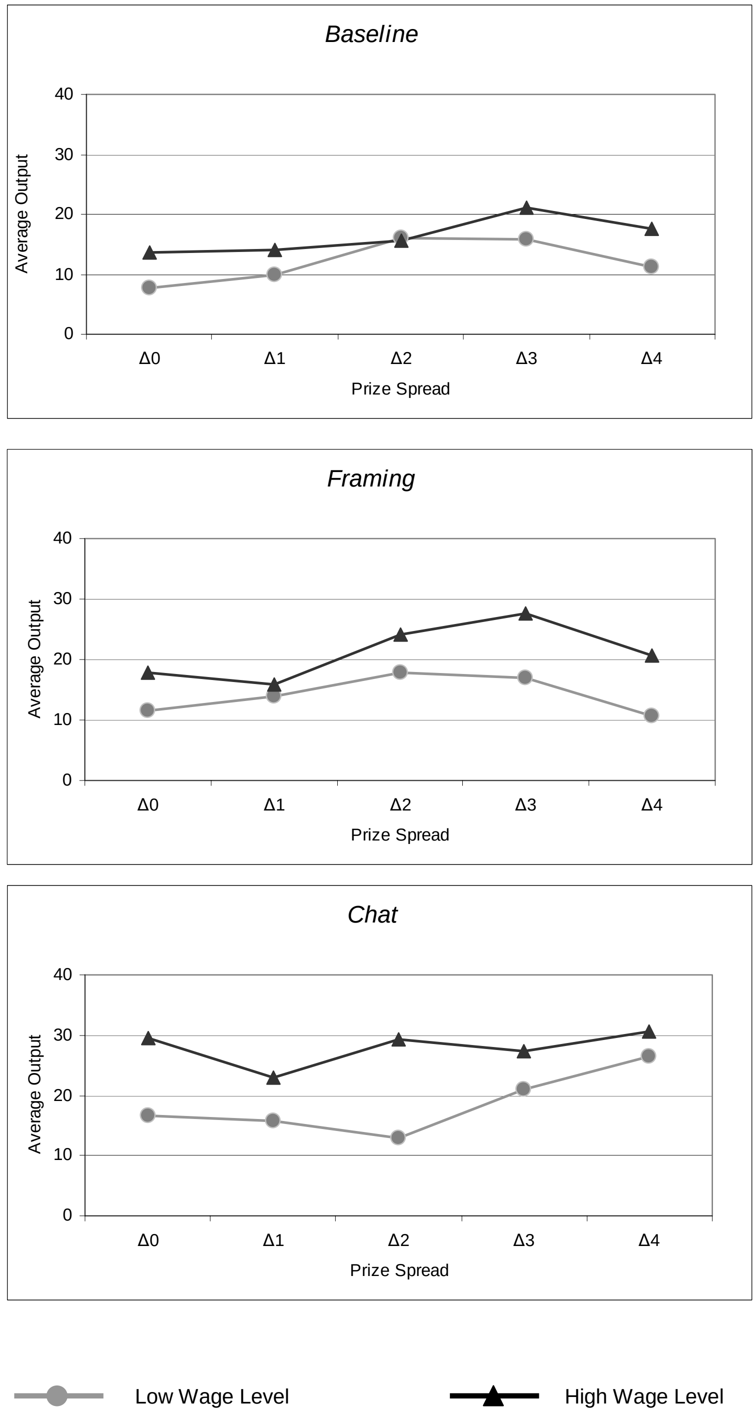
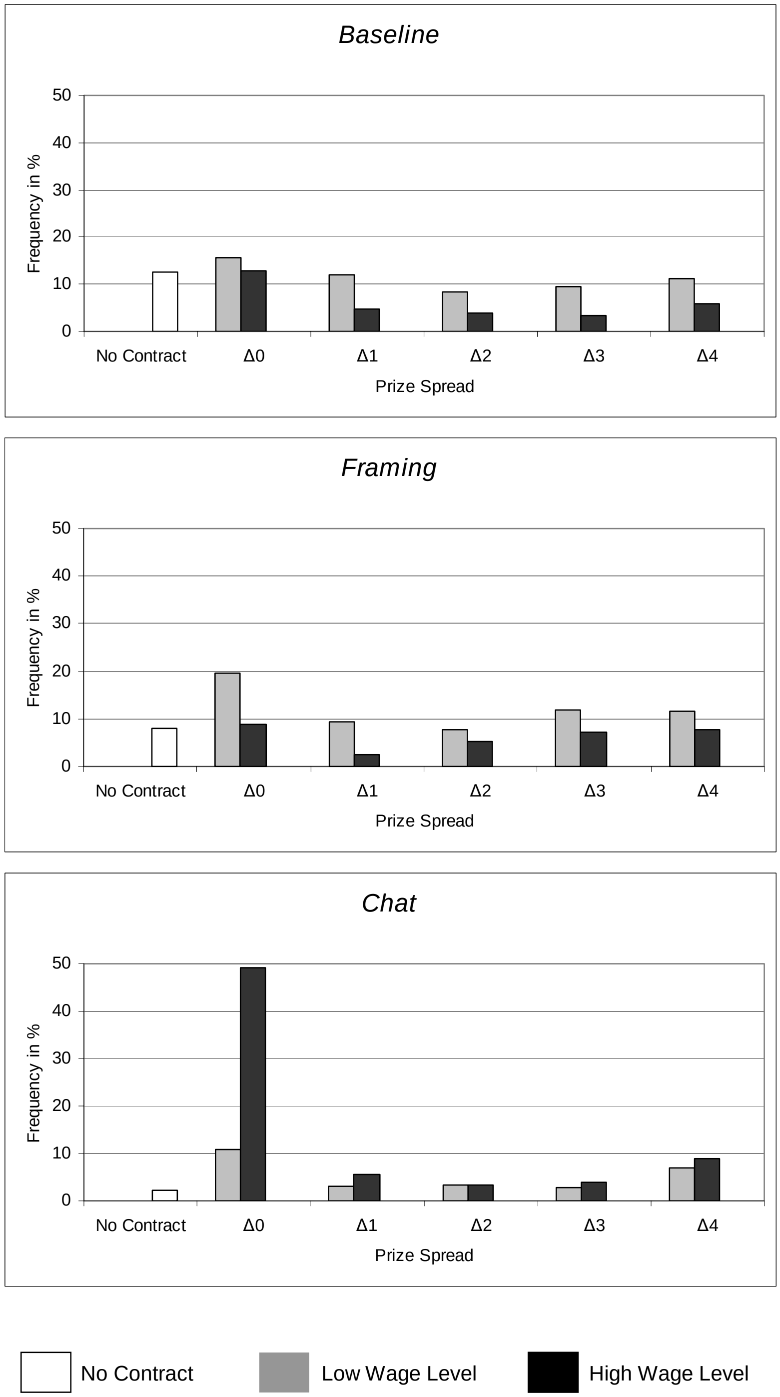


Figure 5: Frequencies of contracts chosen by the principals in each treatment



Tables

Table 1: Design alternatives for wage contracts

	Prize differential Δ_j	Low wage level $W = 300$		High wage level $W = 600$	
Fixed Wages	$\Delta_0 = 0$	100 for each agent		200 for each agent	
		Loser prize m	Winner prize M	Loser prize m	Winner prize M
Tournament Incentives	$\Delta_1 = 48$	84	132	184	232
	$\Delta_2 = 96$	68	164	168	264
	$\Delta_3 = 144$	52	196	152	296
	$\Delta_4 = 192$	36	228	136	328

Table 2: Equilibrium predictions for each prize spread

	Fixed Wages	Tournament Incentives			
	Δ_0	Δ_1	Δ_2	Δ_3	Δ_4
Effort	0	14	28	42	56
Sabotage	0	4	8	12	16
Output	0	6	12	18	24

Table 3: Regression results

[A] Dependent variable:	(1) Effort	(2) Sabotage	(3) Output	(4) MC(Effort) – MC (Sabo)
Δ_1	7.149***	4.351***	-1.505	-0.229***
	(2.480)	(0.680)	(2.360)	(0.078)
Δ_2	13.430***	5.319***	2.802	-0.147*
	(2.490)	(0.740)	(2.420)	(0.084)
Δ_3	17.580***	6.360***	4.902*	-0.132
	(2.290)	(1.130)	(2.640)	(0.110)
Δ_4	20.880***	8.153***	4.721	-0.212*
	(2.820)	(1.180)	(3.100)	(0.120)
High Wage Sum	8.936***	0.519	7.887***	0.203***
	(1.340)	(0.450)	(1.300)	(0.046)
Framing	0.222	-2.561**	5.348*	0.262**
	(2.300)	(1.110)	(3.220)	(0.130)
Chat	10.450***	-3.464***	17.410***	0.646***
	(3.700)	(1.300)	(3.920)	(0.140)
Round	-0.452***	-0.084**	-0.285***	-0.005
	(0.077)	(0.033)	(0.098)	(0.004)
Constant	27.730***	6.375***	14.940***	0.153
	(2.340)	(1.050)	(2.700)	(0.110)
R^2	0.127	0.154	0.066	0.079
Observations	3699	3699	3699	3699

[B] Dependent variable:	(1) Effort	(2) Sabotage	(3) Output	(4) MC(Effort) – MC (Sabo)
Δ	0.110***	0.041***	0.030**	-0.001
	(0.013)	(0.006)	(0.015)	(0.001)
High Wage Sum	8.805***	0.413	7.966***	0.210***
	(1.350)	(0.440)	(1.340)	(0.048)
Framing	0.188	-2.646**	5.481*	0.270**
	(2.370)	(1.100)	(3.220)	(0.13)
Chat	9.965***	-3.811***	17.630***	0.667***
	(3.740)	(1.330)	(3.990)	(0.150)
Round	-0.452***	-0.089***	-0.275***	-0.004
	(0.077)	(0.033)	(0.096)	(0.004)
Constant	28.720***	7.276***	14.130***	0.091
	(2.200)	(1.000)	(2.530)	(0.100)
R^2	0.125	0.149	0.065	0.076
Observations	3699	3699	3699	3699

Random effects estimates with robust standard errors for groups are reported. Models (1) – (3) explain individual effort, sabotage, and output. Model (4) explains the difference between marginal costs of effort and marginal costs of sabotage.

*	*weakly significant:*	$0.05 < \alpha \leq 0.10$
* *	*significant:*	$0.01 < \alpha \leq 0.05$
* * *	*highly significant:*	$\alpha \leq 0.01$

Table 4: Comparisons between treatments

	Baseline	vs.	*Framing*	*Baseline*	vs.	*Chat*
Effort	**34.3**	**<**	**35.0**	**34.3**	**<****	**43.6**
Low Wage Level	32.1	<	33.9	32.1	<	39.2
High Wage Level	39.1	<	40.2	39.1	<	46.8
Fixed Wages	24.9	>	22.2	24.9	<*	35.5
Tournament Incentives	37.9	<	39.4	37.9	<*	46.8
Sabotage	**9.5**	**>***	**7.1**	**9.5**	**>*****	**4.4**
Low Wage Level	9.4	>	9.0	9.4	>**	5.5
High Wage Level	10.6	>**	7.9	10.6	>***	3.9
Fixed Wages	5.7	>*	2.3	5.7	>	1.4
Tournament Incentives	11.0	>	9.9	11.0	>***	8.2
Output	**15.4**	**<***	**20.8**	**15.4**	**<*****	**34.7**
Low Wage Level	13.3	<	15.9	13.3	<***	28.1
High Wage Level	18.0	<**	24.4	18.0	<***	38.9
Fixed Wages	13.6	<	17.6	13.6	<***	32.6
Tournament Incentives	16.0	<	19.6	16.0	<***	30.4

Comparisons between treatments: By using the Mann Whitney U-Test (two-tailed) we report the level of significance at which the null hypothesis can be rejected in favor of the alternative hypothesis that average values are above *Baseline* (<) or below *Baseline* (>):

* *weakly significant:* $0.05 < \alpha \leq 0.10$

* * *significant:* $0.01 < \alpha \leq 0.05$

* * * *highly significant:* $\alpha \leq 0.01$

Table 5: Comparison of contract percentages *within* each treatment

	Baseline	*Framing*	*Chat*
Low Wage Level	56.6	60.2	26.9
	>**	>**	<***
High Wage Level	31.0	31.7	70.8
Fixed Wages	28.7	28.5	60.0
	<**	<**	>
Tournament Incentives	58.9	63.4	37.8
No Contract	12.5	8.1	2.2

Comparisons within a treatment: By using the Wilcoxon Signed Rank Test (two-tailed) we state the level of significance at which the null hypothesis can be rejected in favor of the alternative hypothesis that the frequency of the type of contract is above (>) or below (<) the second type of contract:

*	*weakly significant:*	$0.05 < \alpha \leq 0.10$
* *	*significant:*	$0.01 < \alpha \leq 0.05$
* * *	*highly significant:*	$\alpha \leq 0.01$

Table 6: Comparison of contract percentages *between* treatments

	Baseline	vs.	*Framing*	*Baseline*	vs.	*Chat*
Low Wage Level	56.6	<	60.2	56.6	>***	29.9
High Wage Level	31.0	<	31.7	31.0	<***	70.8
Fixed Wages	28.7	>	28.5	28.7	<**	60.0
Tournament Incentives	58.9	<	63.4	58.9	>*	37.8
No Contract	12.5	>	8.1	12.5	>***	2.2

Comparisons between treatments: By using the Mann Whitney U-Test (two-tailed) we report the level of significance at which the null hypothesis can be rejected in favor of the alternative hypothesis that average values are above *Baseline* (<) or below *Baseline* (>):

*	*weakly significant:*	$0.05 < \alpha \leq 0.10$
* *	*significant:*	$0.01 < \alpha \leq 0.05$
* * *	*highly significant:*	$\alpha \leq 0.01$