

Reputation and Contract Design

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Abstract

This paper considers a principal-agent relationship in which the principal observes a signal about the agent's prior performance with other principals before offering a contract. Principals make contracts conditional on agents' track records. Unless agents have a poor record most principals pay high wages and abstain from controlling. In contrast, if principals do not receive any information about agents' past behavior, almost all principals control and pay low wages. This is indeed profit maximizing. The possibility to observe agents' past behavior increases average effort by 60 percent. This outcome results from the interaction of a sorting and an incentive effect. *[100 words]*

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1. Introduction

This paper considers a principal-agent relationship in which the principal observes a signal about the agent's prior performance with other principals before offering a contract. This is a very common situation. Employers read letters of reference or report cards before they employ a worker, buyers on ebay see how a prospective seller has been rated by other customers, and students may see the teaching evaluation of a professor before they register for class. We conducted a series of simple experiments to study how actual principals use this information when they design their contract offers.

We show that the principals make contracts conditional on agents' track records. In our experiments contract design has two dimensions: First, the principal chooses a fixed wage that he pays to the agent. Second, the principal decides whether to control the agent by restricting his action set in order to enforce a minimum standard of effort. While control raises the minimum effort level it also imposes an efficiency loss that is proportional to the agent's effort. We find that unless agents have a poor track record most principals pay high wages and abstain from controlling. In contrast, if the principals do not receive any information about their agents' past behavior, almost all principals control and pay low wages. Indeed, these are the profit maximizing contract offers.

If all players are fully rational and purely self-interested, a simple backward induction argument shows that principals should *always* choose to control the agent and pay the lowest acceptable wage. This prediction of standard contract theory is challenged by recent experimental studies on several counts.

First, experiments on gift exchange games show that if agents are offered generous fixed wages at least some of them reciprocate and choose more effort (see e.g. Fehr, Kirchsteiger and Riedl, 1993). Second, there are a few recent papers (Falk and Kosfeld, 2006, Fehr and Rockenbach, 2003) suggesting that there are „hidden costs of control“: if the

principal controls the agent may withdraw voluntary effort because he feels mistrusted. Third, there are some experiments (e.g. Bolton, Katok and Ockenfels, 2004) suggesting that reputation helps to sustain cooperation in one-shot interactions.

To the best of our knowledge our paper is the first to study how these three factors – reciprocity, control, and information about agent’s past behavior – interact and how they affect optimal contract design. First, we show that higher wages induce more effort, but this effect on its own is too small to be profitably exploited by the principals. Thus, if principals cannot observe the agent’s record, almost all of them offer control contracts with low wages. Second, controlling the agent does not crowd out voluntary cooperation. For any wage level agents work more if they are controlled. This is independent of whether the agents can build a reputation or not. Thus, in contrast to Falk and Kosfeld (2006) we do not find “hidden costs of control.” Third, past record is an informative signal about the agents’ future behavior. Many principals understand this and offer trust contracts with high wages to agents with a good or medium reputation and control contracts with low wages to agents with a poor reputation. Finally, we disentangle the sorting effect (principals offer generous trust contracts only to those agents who are likely to reciprocate) and the incentive effect (agents invest in their reputation to get higher wages in the future). We can show that the two effects are strong complements.

Our paper is closely related to three different literatures. First, there is a large literature on gift exchange games. Fehr, Riedl and Kirchsteiger (1993) and others have shown that higher wages induce more effort on average. More recently, however, Fehr, Klein and Schmidt (2007) have shown that the effect is typically too small to be profitably exploited by the principal. This is confirmed by our results in the base treatment where agents cannot build a reputation. However, the reputation treatment shows that paying high wages can be profitable if the agent can acquire a reputation for good performance.

Second, there are a few recent papers on the “hidden cost of control”. Falk and Kosfeld (2006) consider a dictator game in which the receiver can control the proposer by forcing him to give a minimum amount. They find that the receiver is offered more if he does not control the proposer. They also consider a gift exchange game that is similar to our base treatment. Here they find “hidden costs of control” for high but not for low wages. However, they do not discuss whether these effects are significant and whether it is profitable for the principal to abstain from controlling. In our gift exchange setting we do not find hidden costs of control. We also show that in the treatment without reputation effects the principal should control the agent even if control causes an efficiency loss.

Finally, there are several experimental papers that discuss the impact of reputation on cooperation in one-shot interactions. Keser (2002) and Bolton, Katok and Ockenfels (2004) consider trust games and show that the provision of feedback about the agents’ past behavior has strong positive effects on efficiency. Huck, Ruchala and Tyran (2006) consider a market for experience goods. Similar to our results they show that reputation does have a strong positive effect, but does not suffice to achieve efficiency.¹ There is also a large theoretical literature starting with the seminal paper by Kreps, Milgrom, Roberts and Wilson (1982) showing that in finitely repeated games with incomplete information the possibility of reputation building can have a dramatic effect on efficiency. However, none of these papers considers the question of optimal contract design nor do they consider the principal’s option to control the agent.

The remainder of the paper is organized as follows. Section 2 outlines the experimental design and procedural details. In Section 3 we discuss the behavioral predictions of the self-interest model, of models of fairness, and of the notion of ‘strong reciprocity.’ Section 4 presents the experimental results in the base and the reputation treatment. Section 5

¹ Huck et al. (2006) are mainly interested in the effect of competition between agents. They show that if principals can choose agents and agents have to compete for principals, a small amount of information about agent’s performance is sufficient to achieve full efficiency.

identifies the sorting and the incentive effect as driving forces behind the treatment effect and shows that they are strong complements. Section 6 concludes.

2. Experimental Design and Procedures

Consider a principal who hires an agent to carry out production. The agent generates a monetary gross profit of $b \cdot e$ if he expends effort e . The parameter b indicates the efficiency of the relationship. Gross profits accrue directly to the principal, while the agent incurs private effort costs $c(e) = e$, measured in monetary terms. Thus, the principal prefers the agent to choose high effort levels, but the agent prefers low effort.

The principal can offer an employment contract to the agent that specifies a fixed wage w and a desired, non-binding effort level \tilde{e} . The wage has to cover at least the costs of the desired effort. The contract cannot be conditional on effort, nor on effort costs, nor on gross profits. These variables are observable by both parties, but they cannot be verified to the courts. If the agent rejects the contract offer, no wage is paid, no effort is exerted, and both parties receive their reservation utilities of 0. If the agent accepts, the principal must pay the offered wage - irrespective of the actual effort chosen by the agent. Payoffs are given by $\Pi = b \cdot e - w$ for the principal and $U = w - e$ for the agent.

There are two types of contracts that the principal can offer: a *trust contract (TC)* and a *control contract (CC)*. These contract types differ in two dimensions:

1. *Minimum effort level*: In a TC the agent can choose an effort level between 1 and 10, whereas in a CC he must choose an effort level of at least 3, given he accepts the contract.
2. *Efficiency*: In a TC the efficiency of the relationship is given by $b = 5$, whereas in a CC the efficiency parameter is only $b = 4$.

Table 1 summarizes the differences between TCs and CCs, and the principal's and agent's payoff functions.

	Trust Contract (TC)	Control Contract (CC)
feasible effort levels	$e \in \{1, \dots, 10\}$	$e \in \{3, \dots, 10\}$
efficiency	$b = 5$	$b = 4$
per-period payoff if the contract is accepted	$\Pi = 5 \cdot e - w$ $U = w - e$	$\Pi = 4 \cdot e - w$ $U = w - e$
per-period payoff if the contract is rejected	$\Pi = U = 0$	$\Pi = U = 0$

TABLE 1: Contracts and payoff functions

We conducted two treatments, the *base treatment* and the *reputation treatment*. Each treatment lasted for 15 periods and involved 18 principals and 18 agents per session. In each period, a principal was randomly matched with a new agent to eliminate repeated game effects. In the base treatment, a principal did not receive any information about his current agent. In the reputation treatment, a principal was informed about his current agent's effort choices in the last three periods.² Note that a principal did neither observe the types of contract, nor the wage offers, nor the desired effort levels that his current agent faced in the last three periods. Agents knew that future principals would be able observe their current effort choice. Apart from the information that was given to the principals in the reputation treatment, the two treatments were identical. Figure 1 summarizes the sequence of events in each period.

² If the agent did not choose an effort level because he rejected a contract, the principal received this information. In periods 1-3 a principal could only be informed about the effort levels that were available by then.

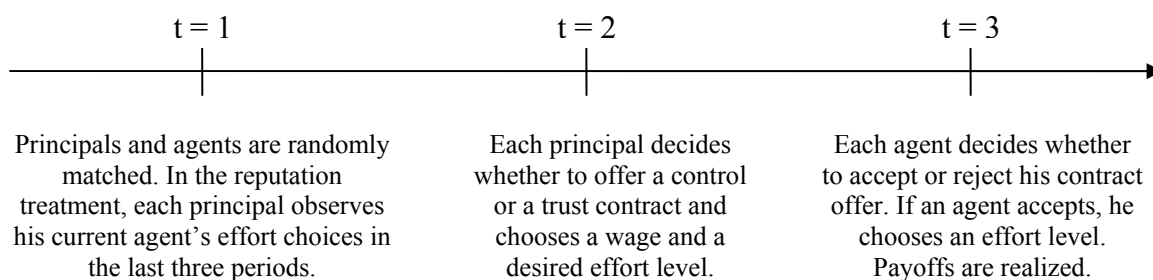


FIGURE 1: The sequence of events in each of the 15 periods

Let us briefly discuss two important features of the experimental design. First, the design captures a fundamental trade-off between control and efficiency. Control forces the agent to obey some minimum standards, but it also restricts his ability to react in a flexible and efficient way to a changing environment. For example, the principal can regulate working hours to monitor attendance, impose reporting obligations to better assess performance, or establish strict production procedures to govern the agent's action directly. However, regulated working hours force the agent to work when he might not be most productive, reporting obligations absorb the agent's time and attention, and strict production procedures forfeit other possibly more efficient practices. The harder the agent works, the more costly it is to restrict his actions. This is captured by the reduction of the efficiency parameter b .

A second important feature of employment relations is that a principal sometimes has the opportunity to receive information about the agent's past performance. For example, the principal may see letters of reference, he may have talked to a previous principal about the agent, or he may have observed the agent directly in his previous position. However, this information is incomplete. Even if the principal receives an accurate signal about the agent's previous performance, he does not observe which contract induced the observed behavior and how well the agent was treated. This is reflected in the experimental design where the principal observes the agent's actions but not the contracts he was offered.

The experiments proceeded as follows:³ Sessions lasted about 2 to 2½ hours and took place in January 2007 at the Institute for Empirical Research in Economics at the University of Zurich. Subjects were students from the University of Zurich and the Swiss Federal Institute of Technology. On average, subjects earned about CHF 40 (about \$32), which includes a show-up fee of CHF 15 (about \$12). The experimental currency were ‘points’, and 10 points were converted to CHF1.25 (about \$1).

We conducted 6 sessions with 36 participants each. Upon arrival at the lab, half of the subjects were randomly and anonymously assigned the role of a principal, the other half the role of an agent. The experiment was framed as an employment relationship. Principals were called ‘employers’ and agents ‘employees.’ Value laden terms like control, trust, or efficiency were not used. For example, the control (trust) contract was called “employment contract with (without) limitation of possible effort choices.” Each subject participated in both treatments. To control for order effects the base treatment was played first in half of the sessions, while the reputation treatment was played first in the other half. While playing the first treatment, subjects did not know that a second treatment was going to be played. After the first treatment was completed, they were informed that the experiment continued with a second treatment and that the session would definitely end thereafter. Subjects that were a principal (agent) in the first treatment remained a principal (agent) in the second treatment (no role reversal).⁴

³ The experiments were computerized with the software z-Tree (Fischbacher 2007). The recruitment was done with the software ORSEE (Greiner 2004).

⁴ Before the beginning of each treatment subjects received detailed written instructions. Subjects also had to answer control questions to ensure their understanding of the instructions. Finally, a summary of the instructions was read aloud to reiterate the basic features of the experiment and to establish common knowledge that all subjects received the same instructions. The instructions pointed out that subjects could make losses during the experiment. Losses had to be covered with the show-up fee. If losses exceed the show-up fee, subjects would be asked whether they wanted to continue with the experiment. If they wanted to continue, they would have to inject own money. While it happened that subjects cut into their show-up fees at some point during the experiment, it never happened that losses exceeded the show-up fee. The instructions (in German and translated to English) are available at <http://www.et.vwl.uni-muenchen.de/...>

3. Behavioral Predictions

The central question addressed by the experiments is what kind of contract the principal should use in order to induce the agent to work hard, depending on what he observes about the agent's past performance. Different theoretical approaches offer different answers to this question.

3.1. Predictions of the self-interest model

The standard neoclassical approach assumes that all people are fully rational and only interested in maximizing their own material payoff. In this case the (second best) optimal contract is straightforward. In the base treatment, the agent always chooses the effort level that minimizes his cost, which is $e = 1$ in a TC and $e = 3$ in a CC. Furthermore, he accepts all contract offers that yield a non-negative payoff. Therefore, the principal offers a wage that holds the agent down to his reservation payoff of 0. The contract that maximizes the principal's profit is thus a CC with a wage of $w = 3$. This yields a profit of $\Pi = 4 \cdot 3 - 3 = 9$. Offering a TC with a wage of $w = 1$ yields a profit of only $\Pi = 5 \cdot 1 - 1 = 4$. This prediction is not affected by the possibility of reputation building. In the last period of the reputation treatment, agents have no reputation to lose and will thus choose the minimum effort level. Principals anticipate this and offer a CC with a wage of $w = 3$. By backward induction, this outcome is the unique prediction also for all previous periods.

Hypothesis 1 (Self-interest Model): *If agents are paid fixed wages and have a finite horizon they always choose minimum effort levels. Therefore, in both treatments, principals should offer control contracts with a wage of 3.*

3.2. Predictions of models of fairness

Models of outcome based fairness (e.g. Rabin 1993, Fehr and Schmidt 1999, Dufwenberg and Kirchsteiger 2004) predict that at least some agents reciprocate to high wages with high effort levels. They also predict that controlling the agent does not affect his motivation as long as he is offered a fair wage.⁵ However, previous experiments have shown that it crucially depends on the details of the gift exchange game whether the share of reciprocal agents (typically about 40 percent) suffices to render generous wage offers profitable. Results from experiments with comparable payoff functions (e.g. Fehr, Klein, and Schmidt 2007) indicate that the effect of fairness is not sufficient to sustain high effort levels in our base treatment, neither with a TC nor with a CC. Indeed, the model of inequity aversion by Fehr and Schmidt (1999), which can easily be applied to the current experiment, predicts that CCs with low wages are optimal. But, wages have to be sufficiently high to induce agents to accept them. A control contract with a wage of 7.5 splits the surplus equally if the agent chooses the minimum effort of 3. Thus wages above 7 are very likely to be accepted.

How is this prediction affected by the possibility to build a reputation? The reputation treatment could give rise to two new effects.

- *Sorting Effect:* Principals may offer high wages and trust contracts only to those agents who have shown to be trustworthy in the past.
- *Incentive Effect:* Agents anticipate that they will be offered more generous contracts in the future if they work harder today. Therefore, even selfish agents may work hard (except for the last period).

⁵ The reason is that in all of these models fairness is evaluated by the outcomes. Thus, if the wage is fair, controlling the agent has no impact on the perceived fairness of the situation. In the Fehr and Schmidt (1999) model a control contract would even increase effort of the fair-minded agents. The reason is that because of the smaller efficiency parameter b they have to work harder to equalize payoffs.

Hypothesis 2 (Fairness Models): Control contracts with a wage of 7 are optimal in the base treatment which induces agents to accept and choose $e=3$. In the reputation treatment principals should offer trust contracts with high wages if and only if the agent has a good reputation. Otherwise they should stick to the control contract.

Thus, models of fairness predict that control contracts with low wages are optimal in the base treatment. In reputation treatment principals should offer trust contracts with high wages if and only if the agent has a good reputation.

3.3 Predictions of the notion of strong reciprocity

The notion of ‘strong reciprocity’ (Fehr and Rockenbach 2003, Falk and Kosfeld 2006) predicts that the CC entails hidden costs of control. Reciprocal agents might choose lower effort levels under a CC, because controlling could be perceived as a signal of distrust—especially since control is costly to the principal and reduces efficiency. The notion of strong reciprocity predicts that, for given wage levels, reciprocal agents choose higher effort levels under a TC than under a CC. These hidden costs of control could be amplified in the reputation treatment. If the principal controls an agent who worked hard in the past, the agent knows that the principal knows that he is a trustworthy, hard-working agent. Such an agent might be especially offended by being controlled.

Hypothesis 3 (Strong Reciprocity): Control contracts crowd out voluntary effort provision. This hidden cost of control is stronger in the reputation treatment than in the base treatment. If the minimal enforceable effort level is not too high, principals should use trust contracts in both treatments.

4. Experimental Results

4.1 The Base Treatment

***Result 1 (Dominance of Control Contracts):** If agents cannot build a reputation, the large majority (81 percent) of contract offers are control contracts.*

In the first period, 60 percent of the principals choose the CC. This fraction rises quickly and reaches almost 90 percent in the last four periods (see Figure 3 below). 56 percent of the principals experiment and choose the trust contract at least once, but almost all of them eventually turn to the control contract. To understand why control contracts are so popular consider the effort choices of the agents.

***Result 2 (Effort Choice):** Average effort increases with wage, but the effect is small. For any given wage, control contracts induce agents to spend more effort than trust contracts. Hence, there are no hidden costs of control.*

Figure 2 displays the average effort chosen by the agents for different wage intervals. It shows that on average effort increases with wage and that agents work harder under a CC than under a TC for any wage interval.

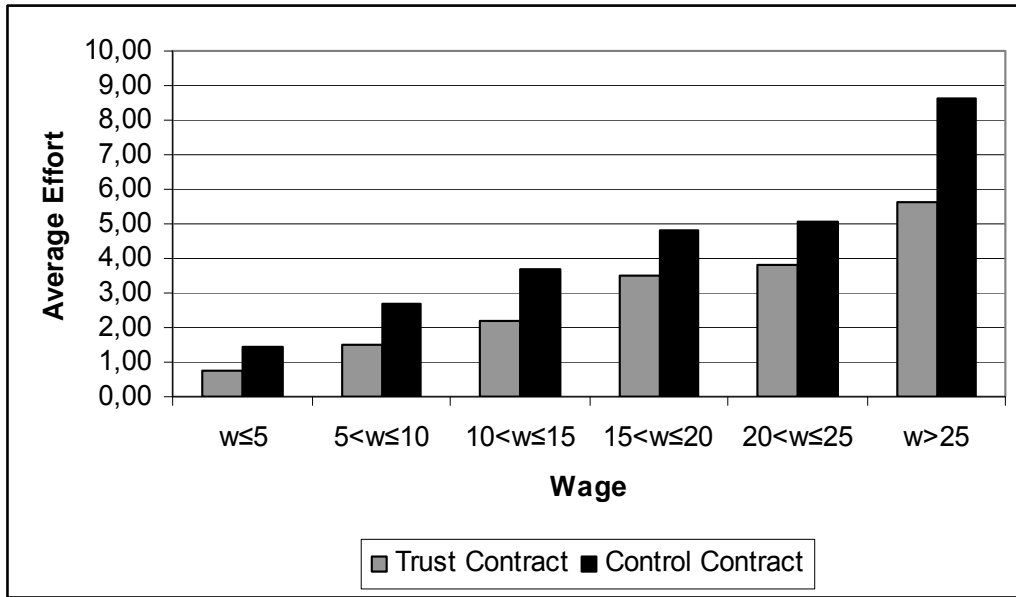


FIGURE 2: Average effort choices in the base treatment under TC and CC

This is confirmed by a simple OLS regression of effort as a function of wages and contract type.⁶ Table 2 shows that the positive slope of the wage-effort relation is significantly reduced if a control contract is offered (0.13 versus 0.20). However, the CC also raises the intercept by 2.6 units, which reflects the fact that the CC forces the agents to work at least 3 rather than 1. This second effect dominates the effect on the slope of the wage-effort relation for all reasonable wage levels (for all $w \leq 37$). Thus, we do not find the ‘hidden costs of control’ observed by Falk and Kosfeld (2006).⁷ It could be argued that the reduced slope of the wage-effort relationship indicates that control crowds out some voluntary effort provision. However, this difference disappears in a Tobit regression.

⁶ In all regressions we analyze the pooled data from the sessions in which the base treatment was played first and the sessions in which it was played second. In the appendix we report separate effort regressions and show that there are no order effects.

⁷ Falk and Kosfeld (2006, p. 1625ff) consider a control treatment with a gift exchange game that is similar to our experiment in the base treatment. In their experiment the principal was restricted to offer wages of 10, 30, 60 or 120. Average efforts are 10.7, 12.6, 19.1 and 31 if the principal controls and 5.0, 10.1, 20.9 and 32.6 if the principal does not control (p. 1626). Thus, average effort is lower without control for wages of 10 and 30, but a little higher for wages of 60 and 120. Falk and Kosfeld do not report whether these differences are significant or whether it pays for the principal to relinquish control.

independent variables \ dependent variable	OLS (robust)	OLS (robust)	OLS (robust)	OLS (robust)
	effort	effort	effort	profit
wage	0.20***	0.19***	0.19***	-0.01
control*wage	-0.07***	-0.08***	-0.07***	-0.27**
control	2.62***	2.64***	2.63***	7.76***
constant	-0.42	-0.49	-0.67	-1.93
desired effort	—	0.02	0.03	—
period dummies	—	—	not sig.	—
# of obs.	1353	1353	1353	1620
R ²	0.26	0.26	0.26	0.10

TABLE 2: Determinants of effort and principal's profit in the base treatment⁸

Result 3 (Optimal and Actual Contract Choice): *Even though control contracts cause an efficiency loss they are more profitable for the principal. Paying high wages is not profitable. However the principal has to pay at least a wage of 7 to make sure that his contract is accepted. Most principals choose contracts optimally.*

The regression results of Table 2 also show that principals' expected profits are maximized by choosing a CC and paying low wages. When a principal offers a TC, he must increase the wage by five units to receive one additional unit of effort. Thus, with $b = 5$ the principal is just indifferent whether or not to increase the wage. If he offers a CC, he has to raise the wage by 7.7 units to increase the agent's effort by one unit while the marginal benefit of effort is only $b = 4$. Thus, increasing the wage in a CC reduces the principal's profit.

⁸ In the effort regressions we consider accepted contracts only as no effort is chosen in rejected contracts.

But the principal has to ensure that his contract offer gets accepted. While almost all TCs got accepted (3 rejections out of 312), 20 percent of all CCs got rejected (264 out of 1308). The acceptance probability of CCs falls sharply for wages below 7.⁹ The profit maximizing strategy of the principal would have been to offer a CC with a wage that just ensures acceptance. Principals seem to understand this. The average wage offer in a CC was 7.9 which yielded an average profit of 3.6. On the other hand, those principals who chose a TC offered significantly higher wages (on average 22.3) and made an average loss of 2.2. The OLS regression of principal's profits on wages and contract type reported in Table 2 confirms that if principals pay higher wages, (some) agents react by spending more effort, but the effect is so small that it is not profitable for the principals to rely on it.

The experimental results of the base treatment show that control contracts with low wages are optimal if agents cannot build a reputation, that the large majority of principals chooses contracts optimally, and that there are no hidden costs of control. This is consistent with the predictions of the self-interest model (Hypothesis 1) and models of fairness (Hypothesis 2), but not consistent with the notion of strong reciprocity (Hypothesis 3). The self-interest model predicts in addition that paying higher wages has no impact on effort and that the principal should offer a wage that holds the agent down to his reservation utility. However, we observe that an increase of wages has (on average) a significantly positive (but small) effect on effort, and that principals have to pay wages that give agents significantly more than their reservation utility in order to make them accept the contract. This is consistent with models of fairness.

⁹ While almost no CC with a wage of 8 or higher got rejected, the acceptance rates for wages of 7, 5, and 3 were 94, 60, and 8 percent, respectively.

4.2 The Reputation Treatment

Result 4 (Reputation and Contract Choice): *In the reputation treatment most principals condition their contract choices on agents' reputation, offering trust contracts to agents with medium and high past effort choices much more often than to agents with low past effort choices. On average, this leads to a considerably higher share of trust contracts in the reputation treatment than in the base treatment.*

In the reputation treatment the principal observes his agent's effort choices of the last three periods (if available). To aggregate this information we construct a 'reputation index' that is the average of the observed effort choices. We speak of a low reputation if the index ≤ 3 , of a medium reputation if $3 < \text{index} \leq 6$, and of a high reputation if the index > 6 .

Figure 3 shows a histogram of fractions of TCs, both in the base treatment and in the reputation treatment. On average, the fraction of TCs is more than twice as high in the reputation treatment as in the base treatment. Moreover, in the reputation treatment, the fraction of TCs increases with the reputation index. Principals offer TCs almost three times more often to agents with high reputation than to agents with low reputation. Thus, principals make their contract offers contingent on agents' reputation. (See also Table 3 below).

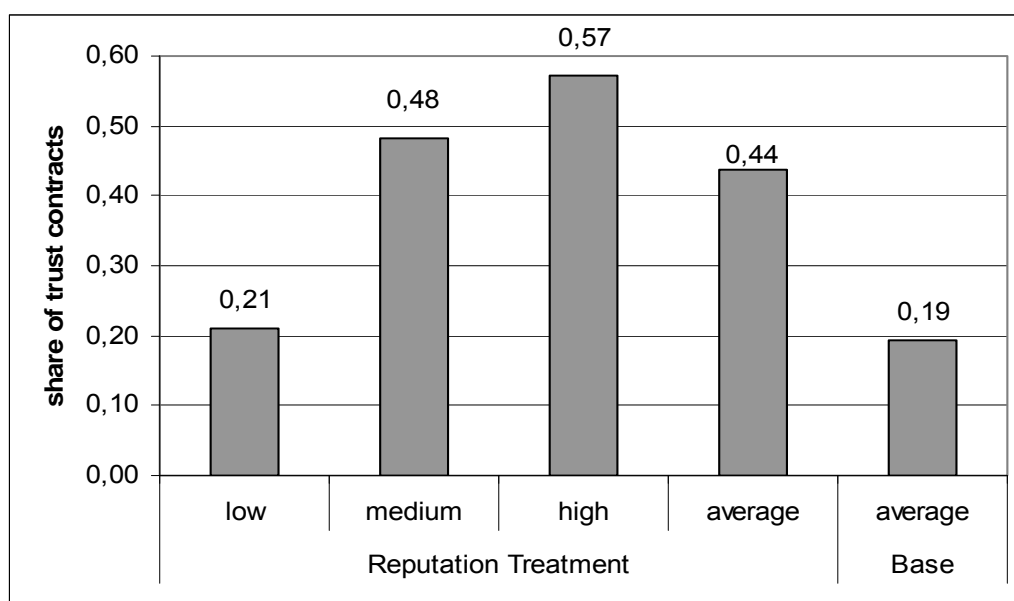


FIGURE 3: Average share of trust contracts.

Figure 4 shows the fraction of TCs over time. In the first period of both treatments, the fraction of TCs is about 40 percent. While this fraction falls to about 10 percent in the base treatment, it rises to about 50 percent in the reputation treatment and never falls below 40 percent, except for the last period.¹⁰

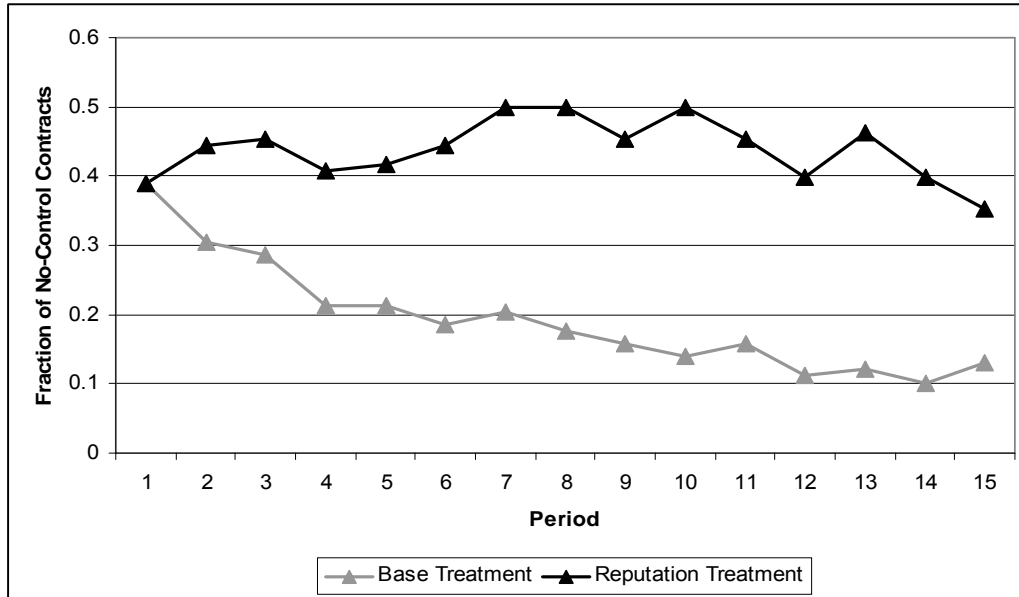


FIGURE 4: Fraction of TC in the base- and reputation treatment.

Result 5 (Reputation and Wage Offers): *In the reputation treatment principals condition their wage offers on the agents' record, offering higher wages to agents with a medium or high reputation. On average, this leads to much higher wage offers than in the base treatment.*

Result 5 is supported by Figure 5 showing a histogram of average wage offers, both in the base and in the reputation treatment. On average, wages are 40 percent higher in the reputation treatment than in the base treatment. Moreover, in the reputation treatment wages increase with reputation. Principals offer wages that are almost two times higher to agents with high reputation than to agents with low reputation.

¹⁰ Figure A1 in the appendix shows the fraction of TCs for both treatment orders. While there are no order effects in the reputation treatment, in the base treatment the fraction of TCs is higher in sessions in which the base treatment was played first. However, the time trend is very similar: over time the fraction of TCs significantly decreases. We thus pool the data from both treatment orders in our analysis.

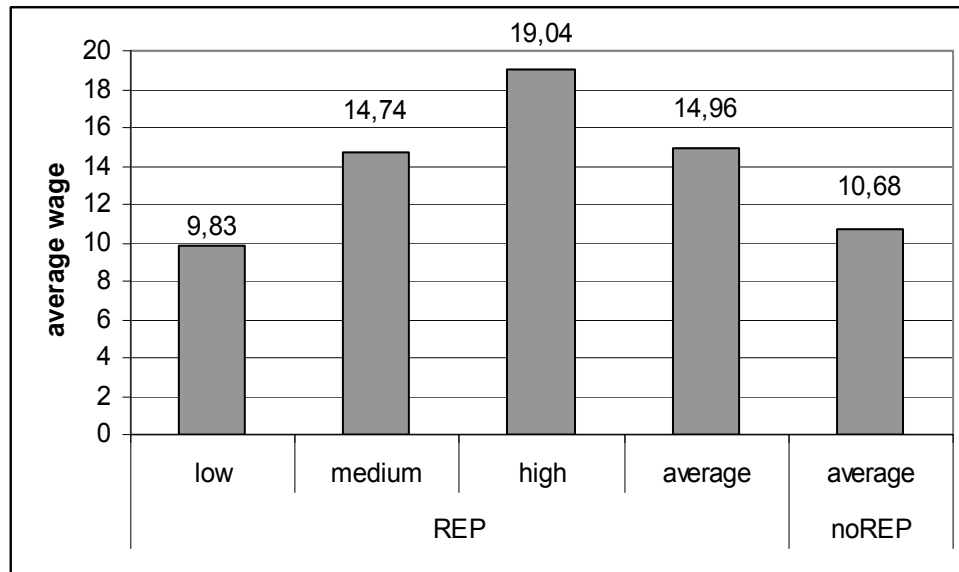


FIGURE 5: Average wages in the reputation and base treatment.

Table 3 shows how the agent's reputation index affects contract choice. The higher the agent's reputation index the less likely it is that a control contract is offered. The OLS regression on wages shows that the reputation index has a highly significant and positive effect on the wage offers of the principals, too. Furthermore, if a CC is offered, wages are significantly lower. This strongly supports Results 4 and 5.

independent variables \ dependent variable	Probit	OLS (robust)	OLS (robust)
	control	control	wage
reputation-index	-0.15***	-0.07***	1.01***
control	—	—	-10.28***
constant	0.97***	0.87***	15.24***
(pseudo) R ²	0.05	0.07	0.53
# of obs.	1478	1478	1478

TABLE 3: The sorting effect of reputation

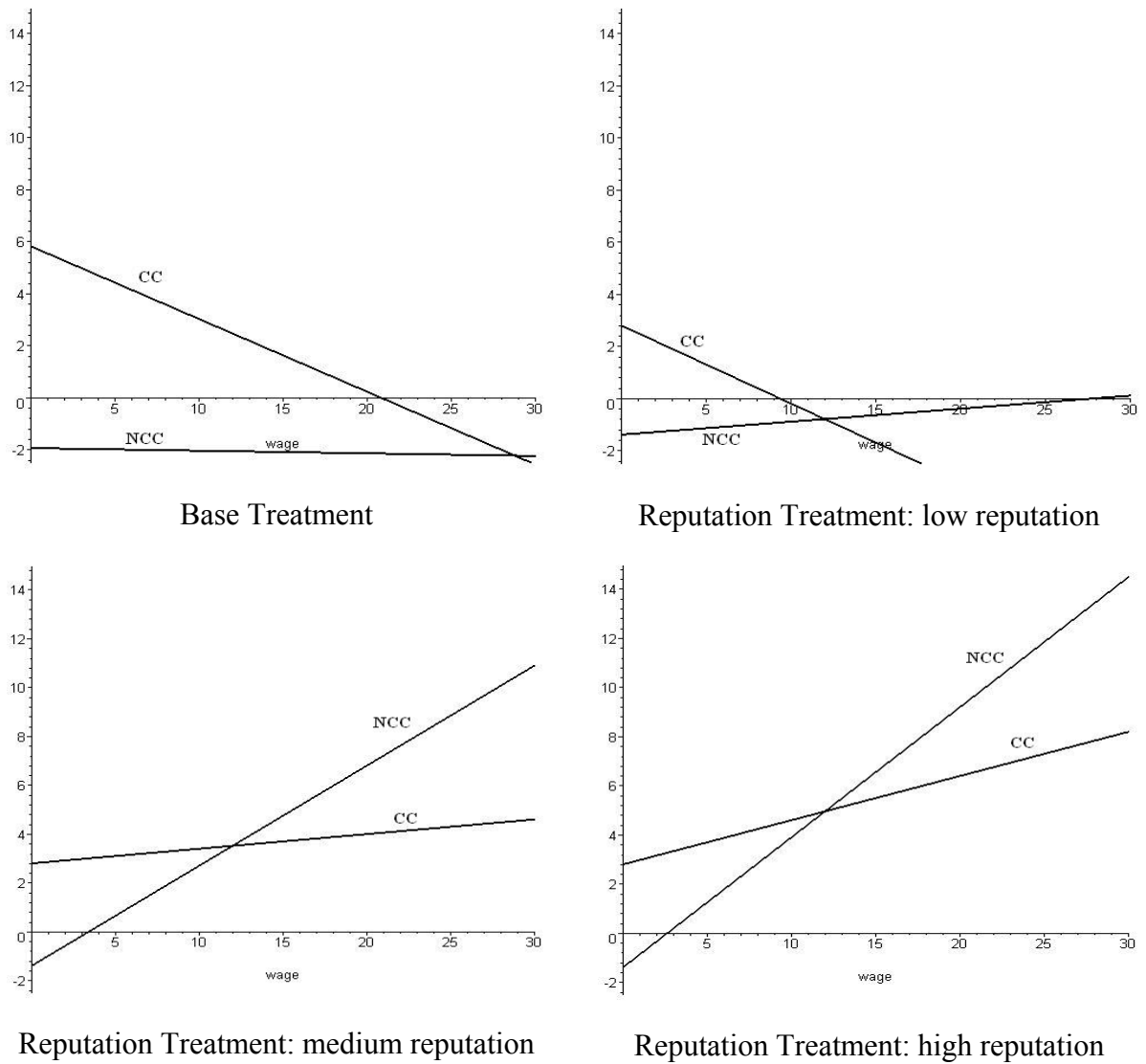


FIGURE 6: Principals' average profit as a function of wage for CCs and TCs.

Figure 6 shows OLS regression lines of the principals' profit as a function of wages for CCs and TCs.¹¹ In the base treatment (top left panel), the principals' profit maximizing contract is a CC with a low wage. This is also the profit maximizing contract offer in the reputation treatment for agents with low reputation (top right panel). When agents have a medium or high reputation in the reputation treatment, the profit maximizing contract is a TC with high wages (bottom panels). When principals offer the respective optimal contracts, their profits are much higher with medium- and high-reputation agents than with low-reputation agents or in the base treatment. This is summarized in our next result.

¹¹ The regression is reported in Table 4 below.

Result 6 (Optimal Contract Choices): *In the base treatment, the principals' average profit is highest if they offer a CC with a relatively low wage. In contrast, in the reputation treatment, the principals' average profit when facing an agent with a medium or high reputation is highest if the principal offers a trust contract with a relatively high wage.*

Even though trust contracts with high wages are optimal in the reputation treatment if agents have a medium or high reputation, not all principals offer such contracts. There is a gap of about 30 percentage points between the fraction of agents with medium or high reputation (between 70 and 80%) and the fraction of trust contracts (between 40 and 50%).

Figure 7 shows the fraction of medium- and high reputation agents and the fraction of TCs in the reputation treatment.

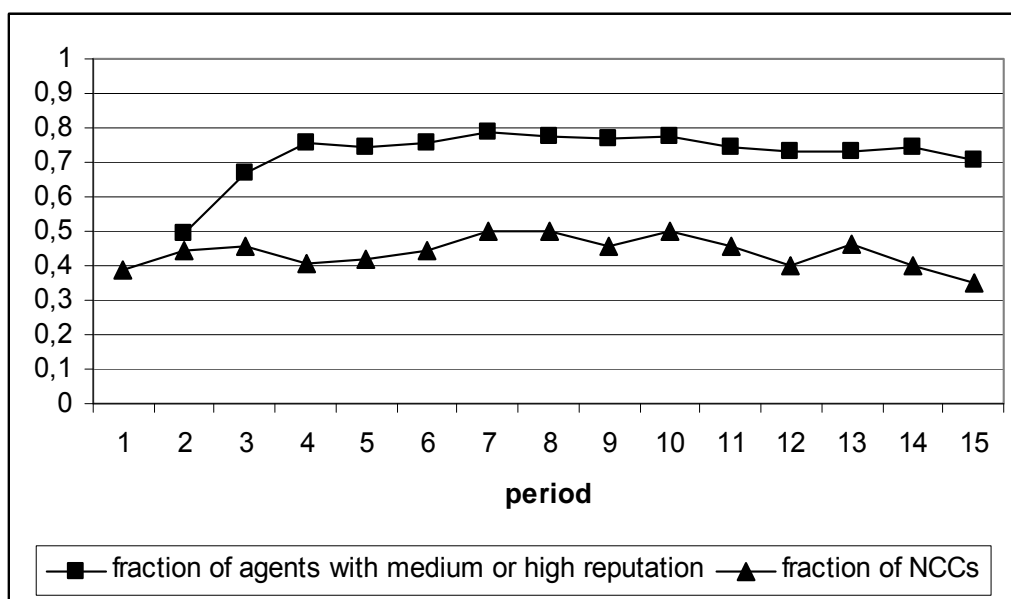


FIGURE 7: Fraction of medium- and high reputation agents and fraction of TCs.

Result 7 (Control-loving principals): *A sizable fraction of principals does not respond to the information about the agents' past behavior: 19 percent of principals (21 out of 108) always chose the CC in the reputation treatment. Another 7 percent (8 out of 108) chooses the TC only once.*

A closer look at the data shows that all of these non-responsive principals faced an agent with a reputation index of 8 or higher at least once, and 12 out of the 21 principals even faced an

agent with the maximum reputation index of 10. Furthermore, the principals that always chose the CC had agents with an average reputation index of 5.19 while the overall average of the reputation index was 5.02. Hence, the non-responsive principals faced the same distribution of agents as the principals that conditioned their contract choices on agents' track records.

Why are TCs more profitable than CCs for medium and high-reputation agents. There are two possible explanations. First, it could be the case that control contracts crowd out voluntary effort provision and that agents work harder if they are offered a trust contract (hidden cost of control). Second, it could be the case that the trust contract does not elicit more effort than the control contract but that it is still more profitable because of the agent's higher productivity.

Result 8 (No Hidden Costs of Control): *For almost all wage levels agents work more under a CC than under a TC. Thus, there are no hidden costs of control in the reputation treatment either and the higher profitability of TCs is exclusively due to higher productivity.*

Evidence for Result 8 is provided by Figure 8 which displays the average effort chosen by the agents for different wage intervals. It shows that average effort increases with wages for both, CCs and TCs. However, for almost all wage levels agents work more under a CC than under a TC. Only for wages between 25 and 30, the TC induces slightly higher effort levels. However, there are only 5 observations for CC in this wage interval (and 222 for TC) and the difference in effort levels is not significant.¹²

¹² A Wilcoxon-Mann-Whitney rank-sum test shows that the hypothesis that both means are identical could only be rejected at a 56% significance level.

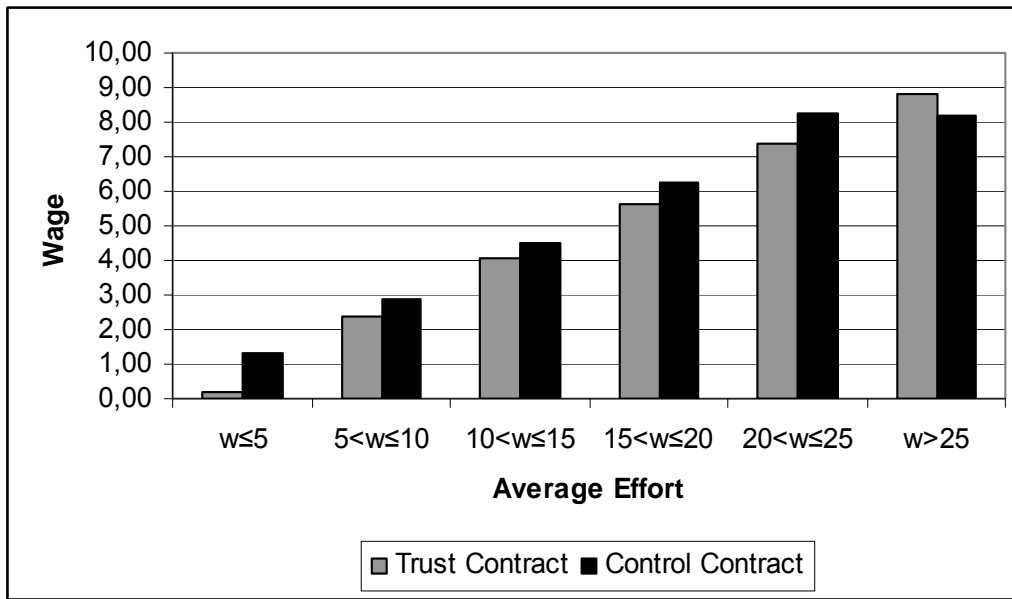


FIGURE 8: Average effort choices in the reputation treatment under TCs and CCs

This is confirmed by the OLS regressions of effort reported in Table 4. Increasing the wage by one unit increases average effort by 0.19 with a TC and by 0.13 with a CC. However, offering a CC increases the intercept by 1.85. This is very similar to the effort regression in the base treatment (Table 2).

independent variables \ dependent variable	OLS (robust)	OLS (robust)	OLS (robust)	OLS (robust)	OLS (robust)	OLS (robust)
	effort	effort	effort	effort	effort	profit
wage	0.19***	0.18***	0.18***	0.17***	0.17***	0.05
control*wage	-0.06***	-0.06***	-0.10***	-0.10***	-0.10***	-0.35***
control	1.85***	1.78***	1.91***	1.95***	1.96***	4.19***
high-reputation*wage	0.11***	0.12***	0.13***	0.13***	0.13***	0.48***
medium-reputation*wage	0.08***	0.10***	0.10***	0.10***	0.10***	0.36***
last period dummy	-1.88***	-1.88***	-1.89***	-1.88***	-1.75***	-7.48***
constant	0.49	0.71*	0.85**	0.79**	0.65	1.38
medium-reputation	—	-0.30	-0.41	-0.42	-0.42	—
high-reputation	—	-0.19	-0.56	-0.59	-0.61	—
med-rep*control*wage	—	—	0.02	0.02	0.02	—
high-rep*control*wage	—	—	0.04*	0.04*	0.04*	—
desired effort	—	—	—	0.02	0.02	—
other period dummies	—	—	—	—	not sig. ¹³	—
# of obs.	1290*	1290*	1290*	1290*	1290*	1478
R ²	0.62	0.62	0.62	0.62	0.62	0.28

TABLE 4: Determinants of effort and principal's profit in the reputation treatment¹⁴

The dummy variables for medium and high reputation are not significant in the OLS regressions on effort, but they are highly significant when they are interacted with wage. Thus, medium and high reputation agents do not work harder per se, but they are prepared to spend more effort if they are offered higher wages. We also interacted the reputation dummies with wage and control. If agents with medium or high reputation would feel offended by a control contract the slope of their effort-wage relation should be smaller and the coefficients should be negative. However, both coefficients are positive (the coefficient for medium reputation is not significant, the coefficient for high reputation is significant only at the 10

¹³ Only period 5 is significant at the 10 percent level.

¹⁴ In the effort regressions we consider accepted contracts only as no effort is chosen in rejected contracts. We also consider only observations for which a reputation index is available, i.e. observations with at least one previous effort choice. 'Medium-reputation' and 'high-reputation' are dummy variables that take on value 1 if the reputation index is in (3,6] or (6,10], respectively. 'Control' is a dummy variable that takes on value 1 if the CC is offered. Of the other period dummies only the period-5 dummy is significant at the 10 percent level.

percent level and very small). Thus, we conclude that there are no hidden costs of control in the reputation treatment either.

The OLS regressions of Table 4 also show that the agent's reputation is an informative signal about his future behavior. It does not pay to offer a TC with high wages to an agent with a low reputation, but it is profitable to do so for a medium or high reputation agent, except for the last period:

- If the agent's reputation is low, a wage increase by one unit increases effort by about 0.18 under a TC and by about 0.12 under a CC. Thus, with an efficiency factor of $b=5$ ($b=4$, respectively), paying high wages does not pay off. Furthermore, introducing control increases the agents' effort by about 1.8 units, very similar to what we observed in the base treatment.¹⁵ Thus, CC and a low wage of about 9 that is likely to be accepted by the agent is optimal and yields an expected profit of about 6.
- If the agent's reputation is high (medium, respectively), increasing the wage by one unit increases effort by 0.3 (0.27) under a TC and by 0.24 (0.21) under a CC. Thus, the principal should always offer a high wage. The profit regression shows that offering a high wage of 30 with a TC yields an expected profit of 17.3 (13.7) while the same wage with a CC yields only 11.0 (7.4). Thus, a TC with a high wage is indeed optimal.¹⁶ However, in the last period effort drops by 1.88. This renders trust contracts with high wages unprofitable for all three types of agents.

The experimental results clearly reject the prediction of the self-interest model that all principals should offer CCs with low wages (Hypothesis 1). There is a large fraction of

¹⁵ As in the base treatment, we conducted separate Tobit regressions for TCs and CCs. While the wage-effort relation is flatter for CCs for agents with low reputation also in the Tobit regressions, this does not hold for agents with medium or high reputation. The details of the regressions are reported in the appendix.

¹⁶ As in the base treatment, in the regression we analyze the pooled data from the sessions in which the reputation treatment was played first and the sessions in which it was played second. In the appendix we report separate effort regressions, and we find differences: When the reputation treatment comes second (i) the wage-effort relation is slightly flatter for agents with medium and high reputation, and (ii) neither the control dummy nor its interaction wage is significant. However, the conclusions with regard to optimal contract choices remain valid in both data sets separately. Therefore, as in the base treatment, we analyze only the pooled data.

principals who offer TCs with high wages. This is indeed the optimal contract choice with agents of medium and high reputation. The experimental results also reject the predictions of the notion of ‘strong reciprocity’ (Hypothesis 3). We do not find that agents work less under CCs. For almost all wage intervals, the average effort under CCs exceeds the average effort under TCs.

The predictions of models of fairness (Hypothesis 2) are, however, confirmed by the experimental results. These models correctly predict contract choices both in the base and the reputation treatment. While the share of reciprocal agents is not sufficient to render generous wage offers profitable in the base treatment, it is optimal to offer TCs with high wages to agents with a medium or good reputation in the reputation treatment. Some agents work more because they are concerned about their reputation. This is confirmed by the observation that there is a large and highly significant drop of effort in the last period in the reputation treatment — but not in the base treatment (see Tables 2 and 4).

5. Incentive and Sorting Effects of Reputation

If we compare the reputation treatment to the base treatment we find

Result 9: *Agents work harder in the reputation treatment than in the base treatment for all wage intervals both with trust and with control contracts. On average effort is 60 percent higher in the reputation treatment than in the base treatment.*

Evidence for Result 9 is provided by Figure 9. The figure shows that agents work harder in the reputation treatment no matter what wages they were offered. This effect is stronger for TCs than for CCs.

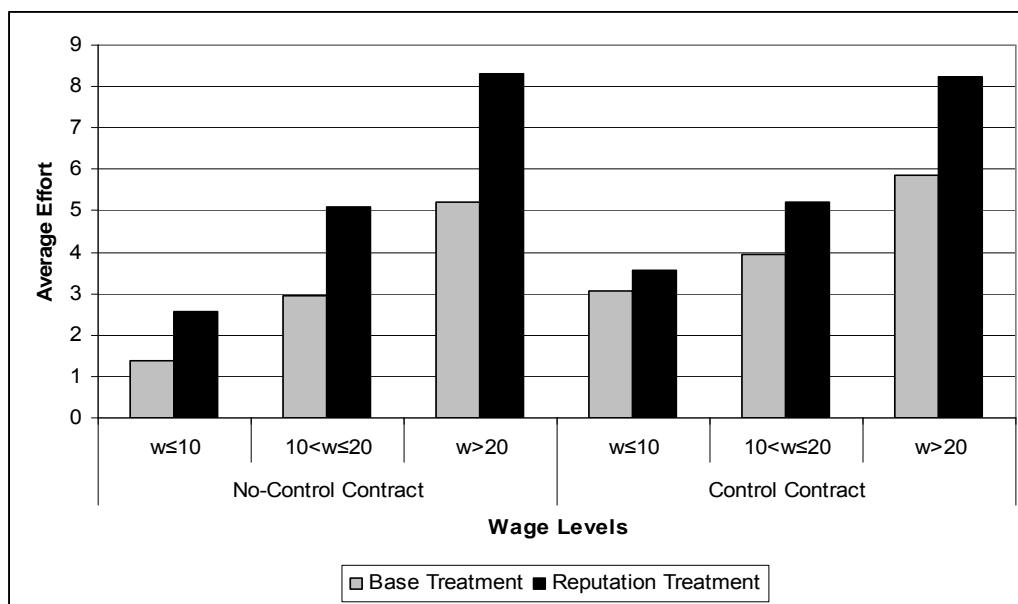


FIGURE 9: Average effort choices in base and reputation treatments

The average effort in the reputation treatment is 4.7 as compared to 2.9 in the base treatment.

There are two possible effects that may explain this increase in effort of 60 percent:

1. *Incentive Effect:* If agents know that principals observe their past record and that a good reputation will be rewarded with more generous wages (and less control), they have an additional incentive to provide more effort in order to improve their reputation.
2. *Sorting (or composition) effect:* If the principal observes the agent's record he can use this information for sorting, that is, for offering different contracts to different types of agents. By offering a TC with high wages to agents with a good reputation and CCs with low wages to agents with a poor reputation, principals can induce high effort from the trustworthy agents with limited risk of being exploited by an agent who is not trustworthy.

In this section we analyze how much of the total effort difference of 1.8 can be attributed to each of the two effects in isolation.

Pure incentive effect: Suppose agents believe that principals observe their reputation but in fact they do not. In this case the incentive effect is present, but principals cannot use the agents' records for sorting. By how much would the average effort increase in this case?

We could address this question with a corresponding control experiment, but this would require misleading the participants. A more elegant way is to use our existing data and conduct a thought experiment. We consider the reputation treatment and estimate how the agents react to different contracts. However, the contracts that were offered in the reputation treatment are affected by the sorting effect. Therefore, we use the contracts that have been offered in the base treatment and compute how the agents would have reacted had they been randomly offered these contracts in the reputation treatment. This gives us an estimate for the pure incentive effect.¹⁷

Proposition 1 (Pure Incentive Effect): *If there is no sorting effect, the pure incentive effect is positive but small. The hypothetical average effort if principals offered the type independent contracts of the base treatment to the agents in the reputation treatment is 3.66 (incentive but no sorting effect) as compared to the actual average effort of 2.89 in the base treatment (no incentive and no sorting effect).*

Does this imply that the sorting effect is much more important than the incentive effect? The pure sorting effect answers the following hypothetical question:

Pure sorting effect: Suppose principals can observe the agents' reputation and can offer different contracts to agents with different records, but agents do not

¹⁷ The details of this calculation can be found in the appendix.

know this. Therefore, they do not consider the impact of a higher reputation on future income. How large is the remaining pure sorting effect?

Again, we answer this question through a thought experiment. Considering the data of the reputation treatment we estimate what contract the principals offer for any given reputation index. Then we consider the data of the base treatment and ask what effort an agent with a given reputation index would have chosen if he was offered the contract that principals offered to this type of agent in the reputation treatment. This can be done by estimating effort as a function of wage, contract type and reputation index. Finally we compute the average effort that would result in the base treatment had the principals offered the type contingent contracts. The difference between this hypothetical average effort and the actual average effort is the pure sorting effect.

Proposition 2 (Pure Sorting Effect): *If there is no incentive effect, the pure sorting effect is positive but small. The average effort if principals offer the type dependent contracts in the last period of the reputation treatment (sorting but no incentive effect) is 3.03 as compared to 2.81 in the last period of the base treatment (no sorting and no incentive effect).*

The sum of the pure incentive and the pure sorting effect ($0.77 + 0.22 = 0.99$) cannot explain the much larger effort difference between the base treatment and the reputation treatment (1.80).

The explanation for the difference must be that the two effects are not additive but strong complements. If there is no incentive effect, it is optimal to offer control contracts with low wages to everybody. Therefore, all agents will spend little effort. Hence, the reputation index contains little information about the agents and the principals cannot sort the agents. On

the other hand, if there is no sorting effect, all principals offer control contracts with low wages to the agents. Thus, agents do not benefit in the future from working harder. Therefore, without sorting the incentive effect is small. However, if both effects are present, they support each other: Some agents work hard because they hope

The analysis shows that incentive and sorting effects are strong complements: only if both effects are present, agents work hard.

7. Conclusions

In this paper we have shown how optimal contract design depends on the information the principal has about the agents' record. If the principal cannot observe past behavior, it is optimal to control the agent and to pay low wages. If the principal can observe past behavior and if the agent's record is moderate or good, it is optimal to offer trust contracts and to pay generous wages. However, if the agent has a poor track record, it is again optimal to control and pay low wages.

We find that most principals understand this. In the base treatment, the fraction of trust contracts falls to about 10 percent in the last periods, and wages are on average so low that they just ensure the acceptance of contract offers by the agents. In contrast, in the reputation treatment, there is a constant fraction of more than 40 percent of trust contracts. Moreover, wages are more than twice as high in trust contracts than in control contracts. As a result, the average effort is more than 60 percent higher in the reputation treatment than in the base treatment.

Models of fairness are largely consistent with our experimental findings, while the predictions of the classic self-interest model and the notion of strong reciprocity go astray.

We show that this huge treatment effect is driven by the interaction of a sorting and an incentive effect. Some agents work harder in the reputation treatment because they expect that

a better reputation yields higher future wages. Principals condition their contract offers on agents' past behavior: only if an agent has proven to be trustworthy in the past, it is optimal not to control and to pay a high wage. The incentive and the sorting effect are strong complements: If there is no incentive effect, all agents work very little and sorting is not possible. If there is no sorting effect, agents do not benefit in the future from working harder and the incentive effect is small. The possibility to build a reputation leads to high effort choices only if both effects are present.

One might have suspected that principals would prefer to observe the agents' past behavior without the agents knowing that they are observed. After all, in this case agents' do not try to mimic trustworthy behavior but rather reveal their "true" types. Our results show that this is not the case. If agents don't know that they are observed all of them expect to be offered control contracts with low wages, so none of them has an incentive to show that he would work hard if he could expect higher wages in the future. Therefore, principals are strictly better off if agents know that they are observed.¹⁸

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¹⁸ Milinski and Rockenbach (2007) discuss the question whether an observer would want to see 'unobserved' behavior (the observed person does not know that she is observed). While this permits observing a person's 'true' behavior, more altruistic or reciprocal behavior might be triggered if the person knows that she is observed. Interestingly, humans differ from most animals in that we have a large white sclera of either side of the iris that openly signals where one watches. Milinski and Rockenbach argue that this shows that there has been a net selective advantage of signalling the directions of our gazes. This is consistent with the results of our experiments showing that principals would—if they had the choice—prefer the agents to know that their track record is observed.

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Appendix

I. Tobit Regressions

dependent variable independent variables	Tobit Estimations in the Base Treatment					
	Trust Contract			Control Contract		
	effort	effort	effort	effort	effort	effort
wage	0.42***	0.38***	0.40***	0.49***	0.44***	0.45***
constant	-7.00***	-7.47***	-8.97***	-5.78***	-6.12***	-5.84***
desired effort	—	0.17	0.19	—	0.16	0.15
period dummies	—	—	none sig.	—	—	none sig.
pseudo R ²	0.05	0.05	0.05	0.18	0.18	0.19
# of obs.	309			1044		
left censored	135 (at effort ≤ 1)			919 (at effort ≤ 3)		
uncensored	125			119		
right censored	49 (at effort ≥ 10)			6 (at effort ≥ 10)		

Table A1: Tobit regressions in the base treatment.

dependent variable independent variables	Tobit Estimations in the Reputation Treatment							
	Trust Contract				Control Contract			
	effort	effort	effort	effort	effort	effort	effort	effort
wage	0.27***	0.33***	0.34***	0.34***	0.21***	0.21***	0.16**	0.16***
medium-rep*wage	0.11***	0.01	0.01	0.00	0.22***	0.25***	0.26***	0.25***
high-rep*wage	0.15***	0.13**	0.13**	0.12**	0.27***	0.25***	0.26***	0.26***
last period dummy	-5.52***	-5.53***	-5.53***	-4.82***	-0.36***	-3.62***	-3.60***	-4.15***
constant	-1.45***	-2.72***	-2.71***	-3.33***	-1.65***	-1.62**	-1.80**	-1.18
medium-reputation	—	2.17**	2.18*	2.21*	—	-0.36	-0.44	-0.30
high-reputation	—	0.36	0.38	0.40	—	0.32	0.12	0.23
desired effort	—	—	-0.01	-0.02	—	—	0.12	0.18
other period dummies	—	—	—	included	—	—	—	included
pseudo R ²	0.20	0.21	0.21	0.21	0.20	0.20	0.20	0.20
# of obs.	638				652			
left censored	65 (at effort ≤ 1)				374 (at effort ≤ 3)			
uncensored	401				243			
right censored	172 (at effort ≥ 10)				35 (at effort ≥ 10)			

Table A2: Tobit regressions in the reputation treatment.

II. Order Effects

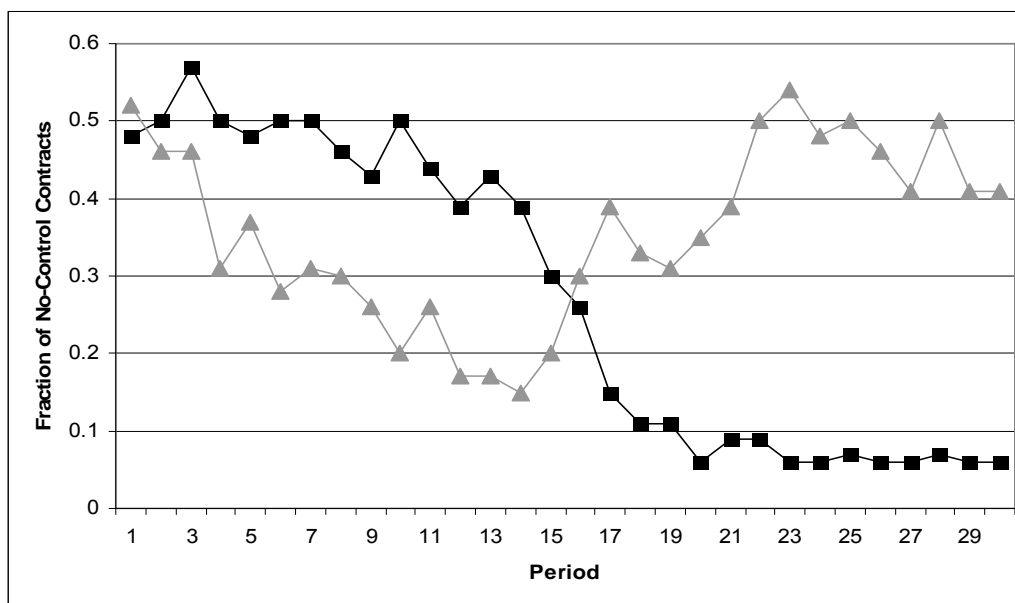


Figure A1: Order effects in principals' contract choices. The black squares show the fraction of TCs in sessions in which first the reputation and then the base treatment was played. The grey triangles show this fraction in the sessions with the reversed order. There is no order effect for the fraction of TCs in the reputation treatment (first 15 black squares vs. last 15 grey triangles; Wilcoxon-Mann-Whitney test, $p < 0.17$). There is an order effect for the fraction of TCs in the base treatment (first 15 grey triangles vs. last 15 black squares; Wilcoxon-Mann-Whitney test, $p < 0.001$). However, the time trend is identical irrespective of the treatment order: the fraction of TCs significantly decreases over time.

independent variables \ dependent variable	OLS (robust)	OLS (robust)	OLS (robust)	OLS (robust)
	base pooled	base first	base second	base pooled
	effort	effort	effort	effort
wage	0.20***	0.20***	0.20***	0.20***
control*wage	-0.07***	-0.06**	-0.10**	-0.06**
control	2.62***	2.39***	3.45***	2.39***
constant	-0.42	-0.28	-1.03	-0.28
wage*base-second	—	—	—	-0.01
control*wage*base-second	—	—	—	-0.03
control*base-second	—	—	—	1.06
base-second	—	—	—	-0.75
# of obs.	1353	658	695	1353
R ²	0.26	0.29	0.17	0.27

Table A3: Order effects in effort choices in the base treatment.

independent variables \ dependent variable	OLS (robust)	OLS (robust)	OLS (robust)	OLS (robust)
	rep pooled	rep first	rep second	rep pooled
	effort	effort	effort	effort
wage	0.19***	0.20***	0.20***	0.20***
medium-reputation*wage	0.08***	0.10***	0.04**	0.10***
high-reputation*wage	0.11***	0.13***	0.07***	0.13***
control*wage	-0.06***	-0.13***	-0.00	-0.13***
control	1.85***	2.80***	0.76	2.82***
last period dummy	-1.88***	-1.83***	-1.97***	-1.90***
wage*rep-second	—	—	—	-0.00
med-rep*wage*rep-s~nd	—	—	—	-0.06**
high-rep*wage*rep-s~nd	—	—	—	-0.06**
control*wage*rep-second	—	—	—	0.12***
control*rep-second	—	—	—	-2.06***
rep-second	—	—	—	1.56***
constant	0.49	-0.19	1.38***	-0.19
# of obs.	1290	655	635	1290
R ²	0.62	0.63	0.62	0.63

Table A4: Order effects in effort choices in the reputation treatment.

III. Calculation of the Pure Incentive Effect

To calculate the pure incentive effect, we estimate how the agents react on average to different contracts in the reputation treatment. The regression results are shown in Table A5.

independent variables \ dependent variable	OLS (robust)
	effort
wage	0.29***
control*wage	-0.05**
control	1.51***
constant	0.22
# of obs.	1405
R ²	0.52

Table A5: Effort choices in the reputation treatment.

The regression is conducted for accepted contracts only. We must however take into account that contracts got rejected at low wages. Since there are almost no rejections for wages exceeding 10 (less than 1 percent), we explicitly consider rejections only for wages of 10 or less. For these wages we estimate the rejection probability as a function of wages and type of contract. The regression results are shown in Table A6.

independent variables \ dependent variable	OLS (robust)
	acceptance
wage	0.09***
control*wage	0.02
constant	0.04
# of obs.	697
R ²	0.17

Table A6: Rejection probabilities for wages of 10 or less.

To isolate the incentive effect, we have to abstract from the sorting effect. We thus take the contracts that had been offered in the base treatment (no sorting possible) and ‘offer’ these contracts to the agents in the reputation treatment (incentive effect is present). Table A7

shows the contract offers in the base treatment. There were no observations for wages larger than 32.

	number of observations	
wage	TC	CC
1	2	—
2	0	—
3	4	48
4	6	138
5	10	442
6	6	596
7	10	546
8	4	182
9	6	54
10	30	204
11	2	52
12	20	98
13	6	0
14	10	18
15	44	116
16	6	6
17	4	6
18	12	6
19	0	2
20	88	58
21	8	2
22	20	0
23	10	0
24	0	0
25	38	32
26	6	0
27	16	0
28	0	0
29	0	0
30	238	10
31	14	0
32	4	0

Table A7: Contract offers in the base treatment.

Using Table A5, we can now compute the hypothetical average effort level that would have been observed had the agents in the reputation treatments received the contracts that were offered in the base treatment. For wages of 10 or less we take into account the rejection probabilities as estimated in Table A6. The calculation is now straightforward and yields 3.66.