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Honesty and Relational Contracts

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Honesty and Relational Contracts

Holger Herz, Armin Schmutzler and André Volk*

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Abstract

We study the economic consequences of opportunities for dishonesty in an environment where efficiency relevant behaviour is not contractible, but rather incentivized by informal agreements in an ongoing relationship. We document the repeated interaction between a principal and an agent who, within our main treatment, was privately informed about the costs of effort provision being either high or low. At the beginning of the interaction, an agent could either truthfully report the cost type to the principal or choose to lie about it. We find that a substantial fraction of low cost agents decided to signal high costs. Dishonest low cost and honest high cost agents pool on the complete information outcome with high costs, as measured in our control treatment. The outcome of such pooling is less efficient than for honest low cost agents. Moreover, principals who face dishonest agents earn substantially less profits than those facing honest agents. Our evidence therefore suggests that informal agreements in a repeated interaction generate less efficient outcomes if dishonesty is possible but, at the same time, are robust to substantial degrees of deception. We furthermore show that our experimental findings can be organized using the logic of repeated games.

Keywords: Relational contracts, private information, dishonesty, deception.

JEL Classification: C73, D23, D82.

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1 Introduction

Opportunities to tell the truth or lie pervade social and economic life. We study the economic consequences of such opportunities in an environment where efficient transactions rely on informal agreements developed in the course of an ongoing relationship. Keeping up such relational or implicit “contracts” typically demands a willingness to forego short term profits in exchange for the benefits of a prosperous ongoing interaction.¹ Threats to worsen the relationship in response to breaches to the agreement serve as a powerful instrument to incentivize such informal understandings. If dishonesty comes with payoff reductions for the other party, this party may doubt whether good relations are truly honoured by a given behaviour. It is not obvious how individuals react to such doubts. One possibility is that they turn a blind eye on dishonesty to keep the relationship on an even keel. By contract, suspicions about deceit may breed conflict within the relationship and lead to economically inferior outcomes. Finally, if a party has evidence that the other has been honest, and thus refrained from deception, this may nourish beliefs that good relations are intended. Thus honesty may help to enhance the outcomes within the interaction.

To address these hypotheses, we designed and conducted an experiment which allows for the identification of the causal effect of opportunities for dishonesty on relational contracts and, in particular, on the efficiency generated within the relationship. We document the behaviour of a principal and an agent involved in repeated interaction. In each round, the principal firstly offers a wage to the agent who secondly chooses effort which comes at a cost for the agent but is valued by the principal. As effort is not contractible, the parties must rely on an informal understanding about wages and efforts to benefit from the ongoing interaction. An agent is either assigned to low or high costs of effort provision. The possibility to be (dis-)honest relates to the type of costs. Within our main treatment, an agent holds private information about the assigned costs and, at the beginning of the interaction, has the choice to either truthfully report the cost type to the principal or to be dishonest about it. By contrast, an agent does not have such a choice in the context of our control treatment but instead costs are truthfully communicated to the principal by design.

We find that only about one third of all low cost agents and almost all high cost agents truthfully reported their costs if they had the choice between honesty and lying. Elicited beliefs suggest that such behaviour was common knowledge among parties. Our evidence indicates that honesty among low cost agents leads to no different outcomes than under low costs in the context of our control treatment. Hence, the explicit choice to refrain from dishonesty does not enhance the outcome of parties’ relationship relative to a case where costs are publicly known without an explicit choice of the agent. Moreover, we find pooling in terms of efficiency among cases of dishonest low cost and honest high cost agents. The outcome is no different from efficiency in case of high costs within our control treatment. In other words, high cost signals lead to the same outcome as high costs under complete information, despite the fact that parties were aware of the extent of dishonesty. However, the outcome of pooling among cases with high cost signals is substantially inferior to the outcome in case of low costs. Overall, we therefore document that

¹See MacLeod (2007) and Malcomson (2012b) for reviews of the literature on relational contracts.

the possibility to choose between honesty and dishonesty significantly reduces efficiency in case of low costs.

We furthermore find a strong and positive correlation between wage and effort across all treatments, signals and cost types. The intensity of this dependency is contingent on the indicated cost type: wages for a given effort level are higher if high signals are reported. Our data reveals a slight discounting of high cost signals relative to reports of high costs under complete information. Quantitatively, this effect seems negligible to the extent that honest high cost agents do not suffer, with regard to their profits, from being suspected of dishonesty. Moreover, we find that dishonest low cost agents do not profit from lying as they earn no different amounts than honest low cost agents. By contrast, lying substantially harms the principals: those matched with dishonest low cost agents earn about 15CHF (17\$) less than those paired with honest low cost agents. In light of this substantial profit reduction for the principal, it is remarkable that the relational contracts nevertheless function as well as for high cost agents under complete information.

Our research is related to previous studies of relational contracts with private information (see e.g. Levin (2003), Halac (2012), Li and Matouschek (2014), Englmaier and Segal (2012), Yang (2013), Malcomson (2012a)). We contribute to this literature, which has primarily focussed on theory, by providing clean empirical evidence. Our design is closely related to the one employed by Brown et al. (2004) who show that relational contracts emerge endogenously if third party enforcement is infeasible. Our paper is also related to the literature on honesty and deception (see e.g. Fischbacher and Foellmi-Heusi (2013), Mazar et al. (2008), Pruckner and Sausgruber (2013), Gibson et al. (2013), Gneezy (2005), Brandts and Charness (2003), Hurkens and Kartik (2009), Sanchez-Pages and Vorsatz (2007)). In contrast to most research in this literature, we explore the economic consequences of (dis-)honesty. In this regard, our study is related to the research by Ederer and Fehr (2009).

The remainder of the paper is organized as follows. We present the design of our experimental study in section 2. We report the empirical results of our study in section 3. We then address theoretical considerations with regard to our findings in section 4.

2 An Experimental Study of Honesty, Relational Contracts and Efficiency

2.1 Experimental Design

In order to identify the causal effect of opportunities for dishonesty on relational contracts and efficiency, we designed an experiment which features exogenous ceteris paribus variation in the possibility to be dishonest. We designed two experimental conditions, C and I , which are equivalent except for the possibility of being dishonest. Subjects within condition I were given the choice to either report the truth or to be dishonest. In condition C , the truth was revealed by design. Hence, subjects within this condition did not have the possibility to be dishonest.

Within both conditions, we study the repeated interaction between a principal and an agent. The parties interacted for 15 periods during which the roles as well as the matching persisted. In each of the 15 rounds, the principal firstly chose a wage w and indicated a desired effort level

\tilde{e} . The principal’s choice of w was binding. An agent secondly observed his principal’s choice (w, \tilde{e}) and selected an effort level e . Importantly, an agent was free to choose his effort and did not have to follow the desired effort level indicated by his principal. In other words, effort could not be enforced within the environment the parties operated in. They were then thirdly informed about their payoffs. We chose the parameters, as outlined below, such that efficiency strictly increases in effort.

In both experimental conditions C and I and before the interaction took place, every agent was assigned, with equal probability, to either low costs of providing effort $c(e, L)$ or high costs $c(e, H)$ and then privately informed about the assignment. The exogenous variation, key to our design in identifying the effect of the opportunity for dishonesty on relational contracts and efficiency, relates to an agent’s possibilities to inform his principal about his assigned costs. Within condition I , an agent could either send a message to his principal that he was assigned to low costs or a message indicating that he had high costs, independent of his truly assigned costs. Within condition C , the agent did not have a choice but, instead, the principal received a message containing truthful information about his agent’s costs. In other words, the key difference between condition I and condition C is that the message received by the principal in the former case could contain either honest or dishonest information while the message contained truthful information by construction in the latter case.

2.2 Parameters, Information Conditions, Procedures, and Subject Pool

In every round of interaction, a principal chose a wage between 0 and 100. The set of feasible efforts was given by $\{1, 2, \dots, 9, 10\}$ from which the principal selected \tilde{e} and the agent chose e . Given choices w and e , a principal’s material payoff $\Pi_P(w, e)$ and an agent’s material payoff $\Pi_A(w, e, \theta)$ were given by

$$\Pi_P(w, e) = 10 \cdot e - w \text{ and } \Pi_A(w, e, \theta) = w - c(e, \theta)$$

where $c(e, \theta)$ indicates the cost of effort e given cost type $\theta \in \{L, H\}$ as summarized in Table 1 below. Costs are strictly increasing and marginal costs are weakly increasing in effort, irrespective of the agent’s cost type. For any given e , low costs $c(e, L)$ are strictly lower than high costs $c(e, H)$. The difference between low and high costs is increasing in e . Yet, since the marginal benefit of effort to a principal always strictly exceeds the marginal cost of effort to his agent, the efficient effort level equals the highest feasible effort under both cost regimes.

Table 1: Cost of Effort

e	1	2	3	4	5	6	7	8	9	10
$c(e, L)$	0	0.5	1	2	4	6	8	10	13	16
$c(e, H)$	0	3	6	10	15	20	25	30	36	42

At the end of each period, both principal and agent received a summary of the choices in the current round including the wage, desired effort as well as the chosen effort. Every player was additionally informed about his own material payoff in the current round which was noted in terms of the experimental currency “Points” and converted into real money by the end of

the experiment (10 Points=1 CHF(\$1.1)). The summary of results provided in condition C contained the same elements as the summary given in condition I .

The experiment was framed in the neutral language of a goods exchange where a principal was referred to as a “buyer” and the agent as a “seller”.² Assignment into the roles as well as to cost types was random. Agents within condition I could choose between message “I have low costs.” and message “I have high costs.”. A message was only chosen at the beginning of the experiment and could not be reversed in the course of it. A principal received the selected message and was informed that, within the experiment, he would not receive information about his agent’s true costs. Within condition C , a principal received either message “Your seller has high costs.” or message “Your seller has low costs.” depending on the true costs of his agent.

After the interaction had taken place, subjects answered a brief questionnaire.³ Within condition I , we additionally elicited principals’ first-order beliefs about the (dis-)honesty of agents.⁴ We furthermore elicited agents’ second order beliefs about their principals’ first order beliefs. Beliefs were incentivized.⁵

The experiment was computerized using the software z-tree (Fischbacher, 2007). For organizing and recruitment, we used the software hroot (Bock et al., 2012). Our subject pool consisted primarily of students at the University of Zurich and the Swiss Federal Institute of Technology in Zurich. In total, 184 subjects participated in the experiment. We conducted 2 sessions (28 subjects each) under condition C and 4 sessions (32 subjects each) under condition I in August, October and November of 2013. No subject participated in more than one session. On average, a session lasted 95 minutes with an average payment of 47 CHF (\$52).

3 Experimental Results

We firstly address the consequences of our treatments with regard to efficiency. We measure the degree of “efficiency” achieved by choice of e under cost regime $\theta \in \{L, H\}$ as the percentage of the Pareto efficient surplus i.e. $(10e - c(e, \theta))/(100 - c(10, \theta))$.⁶ In order to further understand our findings with regard to efficiency, we secondly report on the relationship between wages and efforts as well as subjects’ profits.

3.1 Honesty, Lying and Efficiency

For a start, we consider the causal effect of the different cost regimes on efficiency in isolation. We are not aware of any previous experimental evidence in this regard. Documenting such an

²Instructions are available on request.

³We elicited subjects’ preferences concerning positive and negative reciprocity, trust as well as altruism using questions employed by e.g. Dohmen et al. (2009) and Becker et al. (2012).

⁴We elicited beliefs about all other agents’ message choices, rather than the belief about a principal’s actual agent. For instance, in a session with 16 agents where 8 were assigned to low costs, we asked the following question: “8 out of 16 sellers were assigned to low costs. How many of these sellers with true low costs sent the message “I have low costs.” to their buyers?”.

⁵Subjects earned, on average, 18 additional Points for indicating their beliefs.

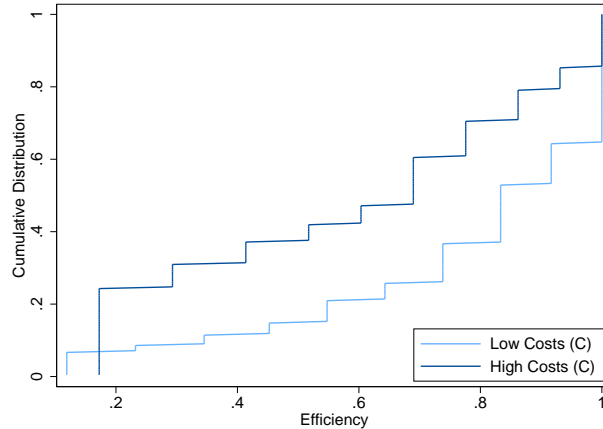
⁶We could, alternatively, use e as our measure of “efficiency”. Under both cost regimes, the percentage of the Pareto efficient surplus increases in e and a one unit increase in e has about the same marginal effect on this measure. We nevertheless prefer the above defined measure to e since it allows us to better compare the degree of efficiency provided under the differing cost structures. However, none of the results below would change qualitatively if we would use e as a measure of efficiency instead.

effect thus closes a gap concerning the empirical understanding of relational contracts. It also lays the ground for understanding the effect of the possibility to be dishonest on efficiency, as being (un-)truthful directly relates to the cost of effort provision.

Result 1. *Within condition C, efficiency in case of low costs is higher compared to high costs.*

In condition C, average efficiency with low costs equals 0.78. By contrast, average efficiency with high costs amounts to 0.59. The 19%-point difference in average efficiency is significant (p-value 0.03, t-test⁷). As Figure 1 suggests, the distributions of efficiency under the different cost regimes also differ (p-value 0.001, Kolmogorov-Smirnov test⁸). As we report in section A.2.1, these empirical findings can be organized theoretically by comparing the equilibrium sets with high and low costs in infinite-horizon versions of the game.

Figure 1: Cost Types and Efficiency within Condition C



We next report on agents' signal choices in the context of condition I. Thereafter, we will compare efficiency in cases where low signals were selected under condition I to the above reported outcomes in the context of low costs within condition C. We analogously relate cases of high cost signals under condition I to cases of high costs in condition C. These comparisons will help to analyse the efficiency effect of the possibility to be dishonest, which we report thereafter.

Result 2. *Within condition I, about two thirds of all low cost agents untruthfully reported high costs, and only one high cost agent untruthfully reported low costs. Elicited beliefs suggest that principals were aware of the extent of (dis-)honesty and that their agents suspected so.*

We find that about 66% of all low cost agents participating in condition I over reported their costs. True high cost agents, by contrast, refrained from being dishonest: all high cost agents - with the exception of one agent - reported truthfully. Principals' first-order beliefs indicate that such behaviour was roughly expected. On average, they believed about 6% of high cost and about 72% of low cost agents to be dishonest. Principals thus even slightly overestimated dishonest behaviour. Agents' second-order beliefs about their principals' first-order beliefs suggest that agents were well aware of their partners' suspicions concerning dishonesty. On average, agents

⁷In the following, all t-tests concerning efficiency are two-sided and feature clustering by the individual.

⁸In the following, all Kolmogorov-Smirnov tests with regard to efficiency are performed on averages, taken over all periods and for each individual.

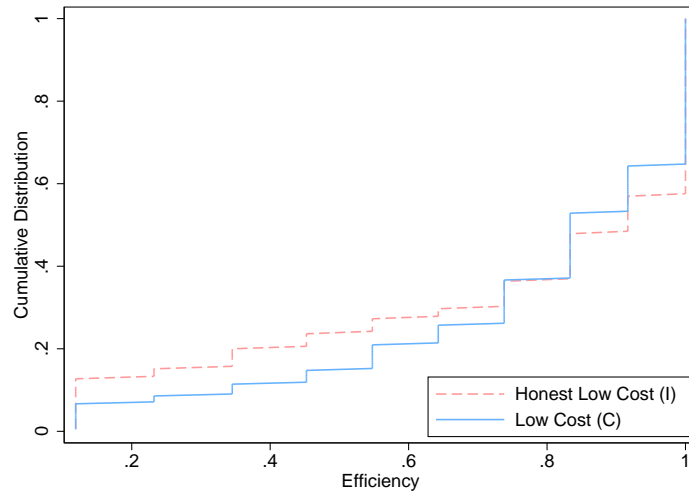
believed that their principals believed that about 9% of high cost and 64% of low cost agents reported untruthfully.

There are two conceivable hypotheses about the evolution of the relationship after a low cost signal. To see this, recall that principals believed low cost signals to be truthful with high probability. Thus, agents who sent the low signal essentially resolved the informational incompleteness in condition I . A natural first hypothesis would therefore be that the relationship emerges in the same way as with low costs and complete information. An alternative hypothesis can be based on the idea that principals who observed low signals under condition I might feel gratitude towards the agents for their honest behaviour. This would suggest that the relationship evolves better than under complete information with low costs, with principals paying higher wages and agents responding with higher efforts. However, as the following result shows, this last hypothesis is not confirmed.

Result 3. *The efficiency levels of low cost agents in condition C do not differ from those of honest low cost agents in condition I .*

On average, efficiency among truthful low cost cases within condition I equals 0.75 and is not significantly different from average efficiency provided by low cost agents in condition C (p-value 0.73, t-test). The distributions are not significantly different (p-value 0.71, Kolmogorov-Smirnov test). A plot of the empirical distributions is presented in Figure 2 below.

Figure 2: Honesty and Efficiency in Case of Low Costs

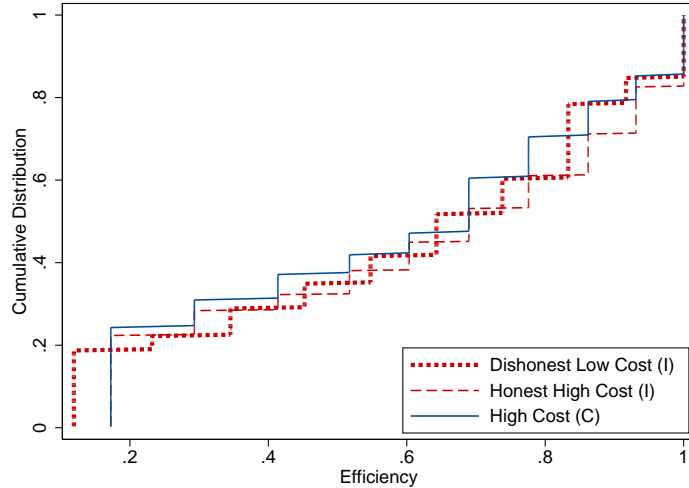


Since principals believed that a substantial fraction of low cost agents reported high costs, they must have been aware that either a truthful high cost or a dishonest low cost agent would be hiding behind a high cost signal. It is not obvious how principals should behave in such a situation. One might expect that principals who faced the possibility of deception might react to high cost signals with suspicion. Such suspicion could destabilize relationships to the extent that efficiency under high signals is lower than under high costs in the context of condition C . Alternatively, one might expect principals to ignore their doubts about others' honesty, thereby implicitly accepting the possible costs of deception. This view predicts no difference in outcomes between high signals in I and high costs in C . It turns out that the latter rather than the former hypothesis is consistent with the facts.

Result 4. *Dishonest low cost and honest high cost cases pool within condition I. Efficiency under such pooling is no different from efficiency under high costs in condition C.*

We find that there is pooling in efficiency among dishonest low cost and honest high cost cases. In condition *I*, the average efficiency of dishonest low cost agents equals 0.61 and does not significantly differ from the average efficiency of truthful high cost agents, which equals 0.63 (p-value 0.73, t-test). Moreover, the distributions are not significantly different (p-value 0.94, Kolmogorov-Smirnov test). Figure 3 illustrates such pooling. Interestingly, we find that efficiency under pooling is no different from efficiency under high costs in the context of condition *C*, both with regard to means (p-value 0.69, t-test) and distributions (p-value 0.94, Kolmogorov-Smirnov test). As we note in section A.2.2, this finding can very well be organized by theory. Taken together, a high cost signal under condition *I* has no different consequences for efficiency than high costs in condition *C*, despite the fact that parties were suspecting a substantial degree of dishonesty.

Figure 3: Efficiency in Cases of High Cost Information



Overall, when low cost types have the option to be either truthful or dishonest, this has detrimental consequences for efficiency. On the one hand, the explicit choice to be honest does not further efficiency. On the other hand, dishonesty reduces efficiency since the outcome of pooling, in which dishonest low cost and honest high cost agents participate, is no different from the high cost outcome under condition *C* which, in turn is substantially inferior to efficiency if low cost agents do not have the possibility to be dishonest. Given that a substantial fraction of low cost agents chose dishonesty, the possibility for (dis-)honesty reduces efficiency: average efficiency among low cost agents in condition *I* equals 0.65 and is therefore 12%-points lower than average efficiency provided by cases with low costs in the context of condition *C* (p-value 0.06, t-test).

Result 5. *The possibility to be (dis-)honest reduces efficiency in case of low costs.*

To understand the reasons behind the observed efficiency levels, it is crucial to investigate the relation between wages and efficiency levels. We will, in particular, consider if and to what extent principals' suspicions about dishonesty affect the relation between wages and efforts.

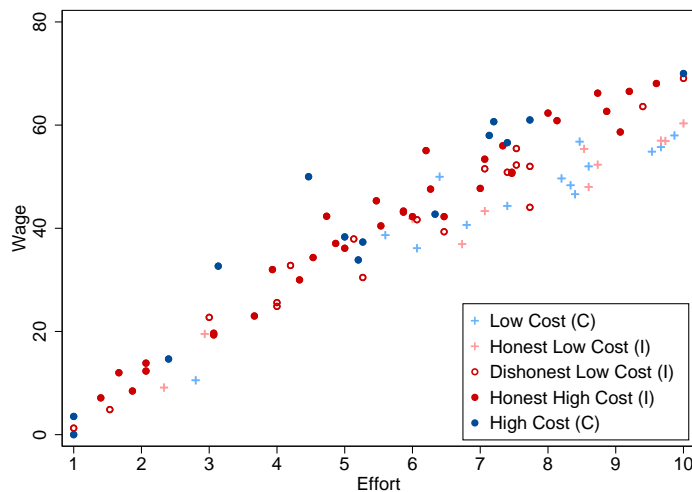
Thereafter, we will discuss subjects' profits earned in the course of their interaction. We will focus on whether dishonesty pays for low cost agents as well as to what extent it harms their principals and honest high cost agents. These insights with regard to wages, efforts and prices will reveal further details with regard to our finding that the outcome of pooling is no less efficient, despite the potential for additional conflict as a consequence of dishonesty.

3.2 Wages, Efforts and Profits

Result 6. *Wage and effort are positively related. The degree of correlation depends positively on the indicated costs. High cost signals under condition I are slightly discounted compared to information about high costs under condition C.*

We find that wage and effort are strongly positively related across all treatments, cost types and signals. The correlation is graphically illustrated in Figure 4 and shown to be significant by the regression results reported in Table 2. Our findings in this regard are in line with evidence of such dependency in the related experiments by Brown et al. (2004). Moreover, we find that, for a given effort level, wages are higher if costs are reported to be high. This hypothesis is suggested by Figure 4, where points corresponding to low costs (marked with a plus) lie below the remaining points. The regression results provided in Table 2 column (2) lend further support to this intuition.

Figure 4: Wage and Effort



Note: One data point marked in the above plot represents the vector of average wage and average effort chosen in one relationship between a principal and an agent, where averages are taken over all periods.

Since principals suspected dishonest low cost agents to hide behind a high cost signal in condition *I*, one might conjecture that they have discounted such signal relative to principals in condition *C* who could be sure that high cost signals reflect truthful information. The regression results presented in Table 2 column (3) confirm this hypothesis as the correlation between wage and effort is less intense if high costs are reported in condition *I* compared to high costs in condition *C*. Hence, principals do not seem to fully ignore the possibility of deception. However, the discounting is quantitatively small. Dishonest low cost agents are still rewarded with higher wages for effort than honest low cost agents. At the same time, honest high cost agents in

condition I do not suffer much from the wage reductions resulting from principals' suspicions about dishonesty. Overall, the evidence suggests that the provision of effort as well as the indicated costs impact prices far more than the credibility of the signal.

Table 2: Wage-Effort Regressions

	(1)	(2)	(3)
Constant	7.84*** (1.34)	6.24*** (1.10)	6.19*** (1.08)
Effort	6.57*** (0.25)	6.00*** (0.17)	6.01*** (0.17)
Effort $\cdot \mathbf{1}_{[H]}$		1.36*** (0.15)	1.92*** (0.33)
Effort $\cdot \mathbf{1}_{[H]} \cdot \mathbf{1}_{[I]}$			-0.68** (0.34)
N	92	92	92
Adj. R^2	0.88	0.93	0.93

Notes: The dependent variable in all of the above regressions is wage. The analysis is performed on average wages and average efforts (recorded s.t. $e \in \{0, 1, \dots, 9\}$, where the averages are taken over time for every pair of principal and agent. $\mathbf{1}_{[H]}$ represents a dummy which equals one if costs are reported to be high in condition I or costs are truly high in the context of condition C and zero otherwise. $\mathbf{1}_{[I]}$ symbolizes a dummy which equals one if the data were observed under condition I and zero otherwise. All reported standard errors are robust. ***(**) denotes significance at the 1(5) percent level.

Result 7. *Dishonest low cost agents do not earn higher profits than honest low cost agents. By contrast, principals paired with dishonest low cost agents earn about 15CHF (17\$) less than those paired with honest low cost agents. Being suspected of dishonesty does not reduce honest high cost agents' payoffs.*

We find that low cost agents do not benefit from choosing dishonesty. On average, honest low cost agents earn 503 Points while profits of dishonest low cost agents amount to 478 Points.⁹ These means are not significantly different (p-value 0.74, Wilcoxon rank-sum test). This result seems surprising in light of the observation made in Result 6 that for a given effort level, dishonest low cost agents were rewarded with higher wages than honest ones. These benefits are offset, however, by the reduced provision of effort by dishonest low cost agents who seem to imitate the behavior of high cost agents.¹⁰

By contrast, we find that the principals' payoffs are substantially lower when agents are dishonest. Those matched with honest low cost agents earn, on average, 440 Points whereas average profits among those matched with dishonest low cost agents amount to 286 Points. The 154 Points average difference is significant (p-value 0.01, Wilcoxon rank-sum test) and quantitatively sizeable: by choice of dishonesty rather than being truthful, agents deprive their principals by about 15 CHF (17\$) which constitutes a 35% reduction of overall profit.

⁹Indicated Points exclude the show up fee as well as the Points earned for beliefs and thus exclusively reflect profits earned within the interaction.

¹⁰On average, dishonest low cost agents provide 5.78 and honest high cost agents offer 5.66 points of effort. There is no significant difference between the two means (p-value 0.86, t-test with cluster robust standard errors).

Finally, dishonesty does not reduce the profits of high cost agents. On average, these agents earn 317 points while profits of high cost agents in condition C amount to 329 Points where the means are not significantly different ($p=0.46$, Wilcoxon rank-sum test). These findings support the view that the discounting of the high cost signal under condition C has quantitatively little impact. If, hypothetically, honest agents had suffered as a consequence of the suspicions about dishonesty, then this could have led to an additional conflict within the relationship. Along this line of argument, we would therefore underestimate the detrimental effect of dishonesty on efficiency in our setting.

4 Theoretical Considerations

In the following, we investigate whether our empirical findings can be organized within the established theoretical framework for relational contracts. In particular, we suppose that the game played in every period of the experiment is infinitely repeated, where the discount factor is $\delta \in (0, 1)$.¹¹ We firstly analyse the game under complete information about the costs. We then secondly turn to the case of incomplete information to investigate the theoretical properties of pooling. In the main text, we provide an intuitive presentation of the arguments. Technical definitions and details are supplied in Appendix A.2.

4.1 Complete Information

We follow the convention in the theoretical literature on relational contracts and analyse equilibria in trigger-strategy profiles (TSP) in which a principal chooses w^* and agent chooses e^* as long as no deviation from (w^*, e^*) has taken place; after a deviation, principals (agents) choose minimal wages (efforts) forever. We additionally address three classes of strategy profiles which capture important features of behaviour observed within our data.¹² First, we consider a forgiving strategy profile (FSP) such that the principal (agent) sticks to $w^*(e^*)$ unless the other player has initiated a deviation from the prescription without returning to it again.¹³ Second, we allow for cut-off trigger strategy profiles (CTSP) such that minimal efforts (wages) are only triggered after *downward* deviations from (w^*, e^*) . Finally, we combine the two preceding concepts by considering a forgiving cut-off strategy profile (FCSP) such that the principal (agent) sticks to $w^*(e^*)$ unless the other player has initiated a downward deviation from the prescription from which she has not returned.

As the following proposition shows, the conditions required to sustain any given wage-effort vector (w^*, e^*) under complete information are identical for each of the above introduced strategy profiles. In this condition $S(e^*) = 10e^* - 10$ is the additional benefit for the principal from effort e^* rather than the minimal effort 1, for which we obtain $S(1) = 0$.

¹¹For reasons of tractability, our experiment was set up as a finite rather than an infinitely repeated game. As can be inferred from Figure 6 in Appendix A.1, end of game effects are exclusively confined to the last period of interaction. Omitting the data of the last round would not qualitatively change the empirical results presented above. Hence, we believe that theoretical insight gained within an infinitely repeated game framework can help us organize our data.

¹²Detailed descriptions of our data are available on request.

¹³Suppose $w', w'' \neq w^*$ and $e' \neq e^*$. Under an FSP, for instance, an agent will deviate after a history w^*, e^*, w' or w^*, e^*, w', e', w'' , but not after a history w^*, e', w' or w^*, e^*, w', e', w^* .

Proposition 1. Consider the game with complete information under cost regime $\theta \in \{L, H\}$. Then, a wage-effort vector (w^*, e^*) can be sustained as subgame-perfect equilibrium by a TSP (FSP, CTSP, FCSP) if and only if

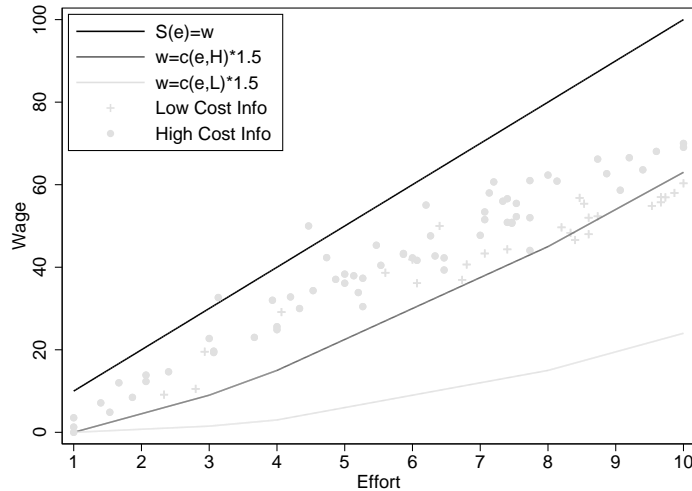
$$S(e^*) \geq w^*, \quad (1)$$

$$w^* \geq \frac{c(e^*, \theta)}{\delta}. \quad (2)$$

The intuition for the result is similar for all four strategy profiles. Condition (1) guarantees that the principal is willing to pay the wage w^* rather than choosing zero wages if she expects an effort e^* generating benefits $S(e^*)$ that are high enough to compensate for the wages w^* . Condition (2) guarantees that the agent who is expecting a discounted future payment of δw^* is willing to incur the equilibrium effort costs of $c(e^*, \theta)$ rather than exerting no effort at all.

The result has several implications that are useful to interpret our empirical observations. We shall say that a wage-effort vector (w^*, e^*) is sustainable (for given δ and θ) if $(\delta, \theta, w^*, e^*)$ satisfy conditions (1) and (2); similarly, we say that an effort e^* is sustainable given (δ, θ, w^*) in this case. The set of sustainable wage-effort vectors for high and low costs for a given parameter choice of δ is graphically illustrated in Figure 5. The following corollary is immediately intuitive from the figure.

Figure 5: Sustainable Wages and Efforts for $\delta = \frac{2}{3}$



Note: One data point marked in the above plot represents the vector of average wage and average effort chosen in one relationship between a principal and an agent, where averages are taken over all periods. “Low Cost Info” data points subsume cases of low costs in C and honest low costs in I . “High Cost Info” data points represent cases of high costs in C , honesty and high costs and dishonesty and low costs in I .

Corollary 1. (i) For fixed discount factor δ and type θ , the set of sustainable e^* is increasing in w^* .¹⁴

(ii) For given δ and w^* , the maximal sustainable e^* given (δ, θ, w^*) is decreasing in the type θ .

(iii) For given δ and e^* , the minimal w^* for which e^* is sustainable given (δ, θ, w^*) is increasing in the type θ .

¹⁴The formulation that a set is increasing in some parameter refers to the strong set order; that is, it means that both the minimum and the maximum of the set increase.

Statement (i) is consistent with the empirical observation that high efforts and high wages go hand in hand (Result 6). Statements (ii) and (iii) reflect comparative statics with respect to the cost parameter: First, if costs increase, higher efforts are generally harder to sustain with a given wage, as the right boundary of the region described by (1) and (2) shifts to the left. This statement provides a rationalization of Result 1. Similarly, for a given effort to be sustained, higher wages are required: the lower bound of the region described by (1) and (2) shifts up. This statement is in line with the observation that wages conditional on efforts are higher for high costs (Result 6).

4.1.1 Incomplete Information

We now proceed to the incomplete information case. Specifically, we want to improve our understanding of the behaviour in situations in which a high cost signal is observed. As reported in Result 4, the behaviour of high and low types who sent the high signal under incomplete information is similar. We therefore first search for conditions under which simple pooling equilibria exist. Thereafter, we ask whether the observed pooling arises even though separating equilibria also exist.

Pooling Equilibria We consider pooling strategy profiles that correspond to those used in the complete information case. For instance, a pooling trigger-strategy (PTSP) profile sustaining (w^*, e^*) is defined by the requirements that the principal and both types of agents play the trigger-strategy defined by (w^*, e^*) ; and beliefs about agents cost types are unchanged by observed behaviour and therefore correspond to initial beliefs. Definitions of pooling forgiving strategy profiles (PFSP), pooling cut-off trigger strategy profiles (PCTSP) and pooling forgiving cut-off strategy profiles (PFCSP) are analogous.

Proposition 2. *Consider the game with incomplete information. Then, the wage-effort vector (w^*, e^*) can be sustained as perfect Bayesian equilibrium by a PTSP (PFSP, PCTSP, PFCSP) if and only if*

$$S(e^*) \geq w^* \tag{3}$$

$$w^* \geq \frac{c(e^*, H)}{\delta} \tag{4}$$

Thus, the condition for sustainability exactly corresponds to the condition for sustainability under high costs with complete information. Intuitively, in the pooling equilibria the binding incentive constraint is that the high-cost types remain onboard and are willing to exert effort. The proposition is consistent with our observation made in Result 4: behaviour in the incomplete information treatment without information revelation is very similar to behaviour in the complete information condition with high costs. This matches nicely with our theoretical result that the conditions for a trigger pooling equilibrium are the same in both cases. Moreover, the proposition obviously implies the first statement of Corollary 1: for fixed discount factor δ and type θ , the set of sustainable $w^*(e^*)$ is increasing in $e^*(w^*)$. Thus, we should expect to see a positive relation

between wages and efforts in the incomplete information treatment as well which is consistent with Result 6.

Separating equilibria Our observations suggest that, after not revealing their types truthfully, the low types essentially behave as the high cost types. Thus, pooling equilibria seem to correspond to observed behaviour. Nevertheless, it appears important to understand whether separating equilibria also exist. If they do, then the observed behaviour should be interpreted as a statement about selection; if not, it would just confirm the theoretical prediction that separation does not occur. In an analysis that is currently being carried out, we focus on a particularly natural class of equilibria where full separation occurs in the first period and behaviour is static thereafter. In particular, in the context of a separating trigger-strategy equilibrium (STSE) agents respond to the initial wage offer in different ways to reveal their types; thereafter they interact with the principal on the basis of a relational contract that differs across types.

Our preliminary and incomplete analysis suggest that these simple trigger-strategy equilibria exist for the class of repeated principal-agent games we are considering. However, it appears that the required conditions are inconsistent with the specific parameter values used in the experiment. Intuitively, this result reflects the large efficiency gain that comes from exerting higher efforts. For any given effort of the low type, it is thus too costly for the principal to induce separation of types. Of course, the result does not rule out that other kinds of separation equilibria could exist. One could, in principal, imagine non stationary pure-strategy equilibria. One could also imagine mixed-strategy equilibria where types are revealed with some positive probability in each period until there is full separation.

5 Conclusion

In this paper, we have investigated the economic consequences of opportunities for dishonesty in an environment where relational contracts incentivize behaviour. If low cost agents choose to be honest, then we find that the efficiency generated within such relationships does not differ from the low cost outcome under complete information. If low cost agents decide to signal high costs, then we observe a less efficient outcome compared to cases where costs are truthfully reported. Given that a substantial percentage of low cost agents lie, our evidence therefore shows that the possibility to choose between honesty and dishonesty reduces efficiency.

At first glance, this finding might suggest that agents vary in their willingness to provide effort and that high performing agents report the truth more frequently than low performing agents. Yet, this kind of sorting hypothesis would imply that relationships with honest low cost agents generate more efficiency than those with low cost agents under complete information, where sorting of this kind is ruled out by design. As this prediction is inconsistent with our empirical findings, we therefore cannot readily interpret our evidence as consequence of such sorting. Rather, the observations lead to the conclusion that the agents who chose to be dishonest do not differ substantially in their willingness to provide effort from those who did not. However, the fact that they did not reveal their type truthfully appears to have led to an adverse effect on the outcome of the relationship, even though the agents in such relationships are not systematically less cooperative than others.

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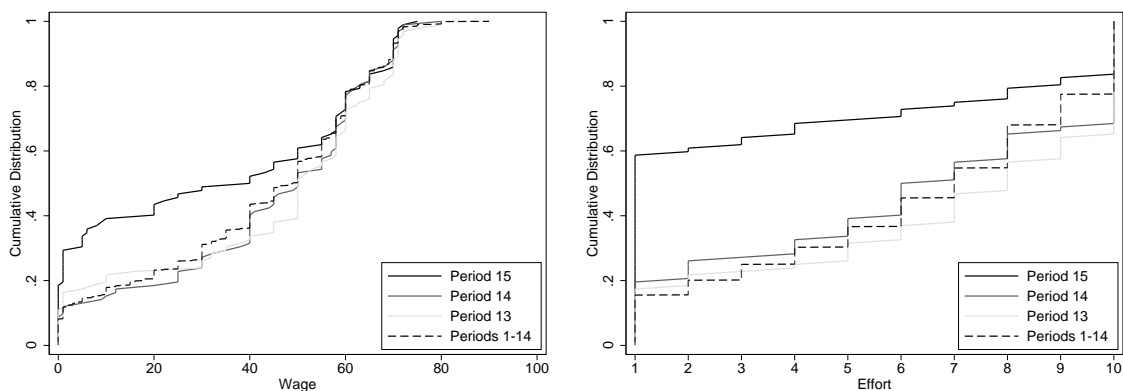
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A Appendix

A.1 Last Period Effects on Wages and Efforts

As the plots in Figure 6 suggest, wages and efforts in the second and third to last period are roughly indistinguishable from average behaviour in the first fourteen rounds. By contrast, there is a sharp decline in wages and efforts in the last round. We thus conclude that end of game effects are mostly confined to the last round.

Figure 6: Wage and Effort over Time



A.2 Formal Definitions and Proofs

A.2.1 Complete Information

Terminology We first formulate the definitions of the strategy profiles in the complete information game more precisely, taking into account that the stage games are extensive-form games, so that principals and agents act after different histories.

A strategy σ_P of the principal ($i = P$) maps every history of the form $h^t = \emptyset$ or $h^t = ((w_0, e_0), \dots, (w_{t-1}, e_{t-1}))$ into an action w_t . A strategy σ_θ of the agent of type θ ($i = \theta$) maps every history of the form $h^t = w_0$ or $h^t = ((w_0, e_0), \dots, (w_{t-1}, e_{t-1}), w_t)$ into an action e_t .

Definition 1. (i) A trigger strategy profile (TSP) of the game with complete information and type $\theta \in \{L, H\}$ is given by a wage-effort vector (w^*, e^*) and pure strategies σ_i for $i \in \{P, \theta\}$ with

$$\begin{aligned}\sigma_P(h^t) &= \begin{cases} w^* & \text{if } h^t = \emptyset \text{ or } h^t = ((w^*, e^*), \dots, (w^*, e^*)) \\ 0 & \text{otherwise,} \end{cases} \\ \sigma_\theta(h^t) &= \begin{cases} e^* & \text{if } h^t = w^* \text{ or } h^t = ((w^*, e^*), \dots, (w^*, e^*), w^*) \\ 1 & \text{otherwise.} \end{cases}\end{aligned}$$

(ii) A forgiving strategy profile (FSP) of the game with complete information and type $\theta \in \{L, H\}$ is given by a wage-effort vector (w^*, e^*) and pure strategies σ_i for $i \in \{P, \theta\}$ with

$$\begin{aligned}\sigma_P(h^t) &= \begin{cases} 0 & \text{if } \exists t' < t \text{ such that } w^{t'} = w^* \text{ and } e^\tau \neq e^* \text{ for } \tau = t', \dots, t \\ w^* & \text{otherwise,} \end{cases} \\ \sigma_\theta(h^t) &= \begin{cases} 1 & \text{if } \exists t' \in \{1, \dots, t\} \text{ s.t. } w^\tau \neq w^* \text{ for } \tau = t', \dots, t \text{ and, for } t' \geq 2, e^{t'-1} = e^* \\ e^* & \text{otherwise.} \end{cases}\end{aligned}$$

(iii) A cut-off trigger strategy profile (CTSP) of the game with complete information and type $\theta \in \{L, H\}$ is given by a wage-effort vector (w^*, e^*) and pure strategies σ_i for $i \in \{P, \theta\}$ with

$$\begin{aligned}\sigma_P(h^t) &= \begin{cases} w^* & \text{if } h^t = \emptyset \text{ or } h^t \geq ((w^*, e^*), \dots, (w^*, e^*)) \\ 0 & \text{otherwise,} \end{cases} \\ \sigma_\theta(h^t) &= \begin{cases} e^* & \text{if } h^t \geq w^* \text{ or } h^t \geq ((w^*, e^*), \dots, (w^*, e^*), w^*) \\ 1 & \text{otherwise.} \end{cases}\end{aligned}$$

(iv) A cut-off forgiving strategy profile (CFSP) of the game with complete information and type $\theta \in \{L, H\}$ is given by a wage-effort vector (w^*, e^*) and pure strategies σ_i for $i \in \{P, \theta\}$ with

$$\begin{aligned}\sigma_P(h^t) &= \begin{cases} 0 & \text{if } \exists t' < t \text{ such that } w^{t'} < w^* \text{ and } e^\tau < e^* \text{ for } \tau = t', \dots, t \\ w^* & \text{otherwise,} \end{cases} \\ \sigma_\theta(h^t) &= \begin{cases} 1 & \text{if } \exists t' \in \{1, \dots, t\} \text{ s.t. } w^\tau < w^* \text{ for } \tau = t', \dots, t \text{ and, for } t' \geq 2, e^{t'-1} > e^* \\ e^* & \text{otherwise.} \end{cases}\end{aligned}$$

Proof of Proposition 1 We confine ourselves to the case of trigger-strategy profiles since the proofs for remaining candidate strategy profiles are analogous. Fix a TSP defined by (w^*, e^*) . Define the corresponding automaton as usual. There are two states D and E . The initial state is E . The transition function takes value E unless the previous state is D and the player who moves chooses the equilibrium action. The output function is given by $w^*(0)$ for a principal in state $E(D)$ and $e^*(1)$ for an agent in state $E(D)$.

The continuation payoffs in state E are given by $S(e^*) + S(1) - w^*$ for the principal. The optimal deviation in any period is to give a zero wage, yielding payoffs $S(1)$. Condition 1 of the proposition guarantees that this deviation is not profitable. For the agent, payoffs in state E

are given by $w^* - c(e^*, \theta)$. The optimal deviation is to choose zero efforts, resulting in average payoffs $(1 - \delta)w^*$. Condition 2 guarantees that the deviation is not profitable. In state D , both players earn zero payoffs. Neither player can prevent this, given the strategy of the other player. \square

A.2.2 Incomplete Information

The pooling strategy profiles described in section 4.1.1 are straightforward adaptations of the corresponding strategy profiles under incomplete information; we therefore confine ourselves to the exact definition of pooling trigger strategy profiles. The adaptation of the remaining three strategy profiles considered is analogous.

Definition 2. A pooling trigger strategy profile (PTSP) of the game with incomplete information is given by a wage-effort vector (w^*, e^*) and pure strategies σ_i for $i \in \{P, L, H\}$ with

$$\begin{aligned} \sigma_\theta(h^t) &= \begin{cases} e^* & \text{if } h^t = w^* \text{ or } h^t = ((w^*, e^*), \dots, (w^*, e^*), w^*) \\ 1 & \text{otherwise,} \end{cases} \quad \text{for } \theta \in \{L, H\} \\ \sigma_P(h^t, \mu^t) &= \begin{cases} w^* & \text{if } h^t = \emptyset \text{ or } h^t = ((w^*, e^*), \dots, (w^*, e^*)) \\ 0 & \text{otherwise.} \end{cases} \end{aligned}$$

Definition 3. A pooling trigger equilibrium (PTE) is a PTSP that, together with beliefs $\mu^t(h^t) \equiv \mu$ for all $t \in \{1, \dots, T\}$ and all h^t forms a weak Bayesian perfect equilibrium of the game with incomplete information

Proof of Proposition 2 We restrict attention to the case of PTSP since the proofs for all other strategy profiles are analogous. Fix a TPSP defined on (w^*, e^*) . Define an automaton as in the proof of Proposition 1. The payoffs in state E are given by $S(e^*) + S(1) - w^*$ for the principal. The optimal deviation in any period is to give a zero wage, yielding payoffs $S(0)$. Condition 3 guarantees that this deviation is not profitable. For the agent, payoffs in state E are given by $w^* - c(e^*, \theta)$. The optimal deviation is to choose zero efforts, resulting in average payoffs $(1 - \delta)w^*$. Condition 4 guarantees that the deviation is not profitable for agent H . As $c(e^*, H) > c(e^*, L)$, the corresponding condition for agent L is implied. In state D , the principal and both types of agents earn zero payoffs. Neither player can prevent this, given the strategy of the other player. \square