

## Adding a Stick to the Carrot? The Interaction of Bonuses and Fines

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Interaction in small groups is often affected by the concern for fairness and reciprocity. These effects have to be taken into account in the design of optimal incentive schemes. In Fehr and Schmidt (2004) and Fehr, Alexander Klein, and Schmidt (2007, henceforth FKS), we have shown experimentally that “bonus contracts” that rely on fairness and trust as an enforcement device can be more efficient and more profitable than “incentive contracts” that are enforced by the courts. In this paper, we consider contracts that combine a voluntary bonus with enforceable incentive payments. The question is whether the combination of these two instruments improves efficiency or whether the use of explicit incentives undermines the functioning of implicit incentives such as voluntary bonus payments.

Voluntary bonus payments are frequently used in situations where the principal and the agent both observe some aspects of the agent’s performance, but where it is impossible to contract explicitly on this information because it is not verifiable to the courts. In a one-shot relationship, a purely self-interested principal would never pay the bonus and thus the agent would have no incentive to work. Our previous experi-

ments (FKS; Fehr and Schmidt 2004) show that many principals make substantial voluntary bonus payments, even if the interaction with the agent is one-shot and completely anonymous. The agents anticipate this, and many of them choose high levels of effort.

In our previous experiments, the principals were restricted to use either a bonus contract or an incentive contract, where the incentive contract used a fine that was enforced by a third party. More than 80 percent of the principals preferred the bonus contract. At first glance it seems that a combined contract that uses both a voluntary bonus payment and a fine should always dominate. It is more general, and it gives additional incentives, in particular to those agents who worked too little with a pure bonus contract. In our experiment, however, the combined contracts do not induce the agents to work harder, and two-thirds of the principals prefer a pure bonus over a combined contract.

### I. The Principal-Agent Experiment

The experimental framework is the same as in FKS, but we allow for different contracts. There is a principal who hires an agent to carry out production. The agent has to choose an effort level  $e \in \{1, \dots, 10\}$ , which induces gross profit,  $v = 10 \cdot e$  for the principal. Effort is costly to the agent with effort costs given in Table 1.

Gross profits and effort costs cannot be contracted upon. Both parties observe the agent’s effort level, but in order to contract on effort, it has to be verified by the courts. At date 0, before the agent chooses  $e$ , the principal can invest in a verification technology at a fixed cost,  $k = 10$ , that permits partial verification of effort. If the principal invested  $k$  and required the agent to work at least  $e^*$ , then, with probability  $p = 1/3$ , the courts observe whether  $e \geq e^*$  or  $e < e^*$ . The principal can impose a fine on the agent if

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TABLE 1—THE AGENT’S EFFORT COST FUNCTION

$e$	1	2	3	4	5	6	7	8	9	10
$c(e)$	0	1	2	4	6	8	10	13	16	20

shirking ( $e \leq e^*$ ) has been verified, but the fine is bounded by  $f \leq 13$ . Thus, if the agent is not too risk averse,  $e^* = 4$  is the highest incentive compatible effort level.<sup>1</sup>

In this contractual environment, we consider two types of contracts:

- *Pure Bonus Contract (BC)*: The principal offers a contract  $(w, e^*, b^*)$  which stipulates an unconditional base wage  $w$  and asks the agent to expend effort  $e^* > 1$ . Furthermore, the principal announces that she may pay a bonus  $b^*$ . Neither the agent’s effort nor the principal’s bonus payment is enforceable, however. After observing the agent’s effort the principal chooses the actual bonus  $b \geq 0$ . Thus, monetary payoffs are  $M^A = w - c(e) + b$  for the agent and  $M^P = 10e - w - b$  for the principal.
- *Combined Contract (CC)*: The principal invests in the verification technology at cost  $k = 10$  and offers a contract  $(w, e^*, f, b^*)$ , which stipulates a wage  $w$ , a demanded effort level  $e^*$ , and a fine  $f$  to be paid in case shirking ( $e < e^*$ ) is verified. Furthermore, the principal announces a possible bonus payment  $b^*$ . Again, the bonus is voluntary, and the principal can choose any  $b \geq 0$ . Expected payoffs are

$$M^A = \begin{cases} w - c(e) + b & \text{if } e \geq e^* \\ w - c(e) + b - \frac{1}{3}f & \text{if } e < e^* \end{cases}$$

and

$$M^P = \begin{cases} 10e - w - b - k & \text{if } e \geq e^* \\ 10e - w - b + \frac{1}{3}f - k & \text{if } e < e^* \end{cases}$$

<sup>1</sup> A self-interested agent prefers to work  $e = 4$  at an effort cost of 4 rather than to shirk ( $e = 1$ ), and incur an effort cost of 0 and an expected fine of 4.3. If the principal requires the agent to choose  $e^* = 5$ , however, the agent prefers to incur the expected fine of 4.3 rather than incur the effort cost  $c(5) = 6$ .

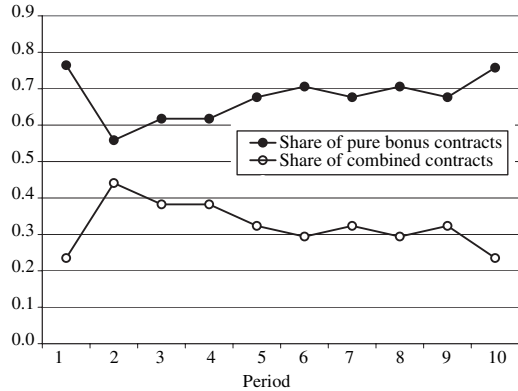


FIGURE 1. SHARE OF PURE BONUS AND COMBINED CONTRACTS

Note that the combined contract is more general than the pure bonus contract because it adds the additional instrument of imposing a fine if the agent shirks. On the other hand, it requires a cost of ten for the verification technology. This cost is a plausible feature of real world contracts that rely on third-party verification and enforcement.

We conducted the experiments in Munich in three sessions, each with 22 to 24 subjects randomly assigned to the roles of the principal and the agent. Each session had ten periods. Each agent was matched with a different anonymous principal in each period so that no agent interacted more than once with the same principal.<sup>2</sup>

## II. Experimental Results

Slightly more than two-thirds of all contract offers (229 out of 339, or 67.6 percent) are pure bonus contracts, and less than one-third are combined contracts. Figure 1 shows that there is a slowly increasing trend in favor of the pure bonus contract that peaks in period 10 at a share of roughly 75 percent. Thus, the clear majority of principals voluntarily forgo the opportunity to use the fine.

The combined contracts did not induce effort levels significantly higher. The average effort is 5.4 in the combined contracts and 5.1 in the pure

<sup>2</sup> A more detailed description of the experimental procedures, the instructions, and the data can be found at [www.e-aer.org/data/may07/P07040\\_data.zip](http://www.e-aer.org/data/may07/P07040_data.zip).

TABLE 2—DETERMINANTS OF BONUS PAYMENTS

Dependent variable:	(1)	(2)	(3)	(4)
Bonus payments	Pure bonus contracts	Combined contracts	All contracts	All contracts
Constant	-3.21 (2.43)	-9.56 (4.46)	0.45** (2.39)	-4.59** (1.95)
Effort	3.03*** (0.25)	1.59*** (0.37)	2.52*** (0.24)	2.53*** (0.14)
Demanded effort	0.19 (0.38)	0.96 (0.80)	0.46 (0.33)	0.51 (0.33)
Wage	-0.18** (0.07)	-0.27* (0.17)	-0.27*** (0.06)	-0.26*** (0.07)
Announced bonus	-0.01 (0.04)	0.03 (0.10)	-0.02 (0.03)	-0.02 (0.04)
Fine		0.30 (0.26)		
Number of CCs by principal BC-principals			-0.98*** (0.23)	3.52*** (1.00)
CC-principals				-4.21*** (1.39)
No. of observ.	224	102	326	326
R <sup>2</sup>	0.64	0.35	0.58	0.56

Notes: Reports the coefficients from OLS regressions. Robust standard errors are in parentheses.

\*\*\* Significant at the 1 percent level.

\*\* Significant at the 5 percent level.

\* Significant at the 10 percent level.

bonus contracts, but this difference is not statistically significant ( $p > 0.45$ , Mann Whitney test), and not sufficient to outweigh the verification cost for the explicit incentive. In fact, the principal's average payoff from offering a pure bonus contract is 24.7, while her payoff is 24.0 if she offered a combined contract. Again, this difference is not statistically significant ( $p > 0.99$  Mann Whitney test).<sup>3</sup> The agents' payoffs are significantly higher if a pure bonus contract is offered. On average, their income is 19.2 in the pure bonus contracts and 12.5 in the combined contracts.<sup>4</sup> Furthermore, the bonus contracts are rejected less often than combined contracts (2.2 percent versus 7.3 percent), and they do not require the costly verification technology. For these reasons, bonus contracts are more efficient. If a bonus contract is offered, the

average surplus is 43.9 tokens, which is significantly higher ( $p = 0.0012$ , Mann Whitney test) than the surplus of 36.5 tokens generated if a combined contract is offered.

What bonuses did the principals pay? If a pure bonus contract was offered, the average bonus is strongly increasing with effort. In fact, the relation between average bonus and effort is very similar to what we observed in FKS. There is also a clear positive relation between effort and average bonus for the combined contracts, but bonus payments are much lower. This is confirmed by the multivariate bonus regressions reported in Table 2. Regressions 1 and 2 look at the data of pure bonus contracts and combined contracts separately. In both regressions, the agent's effort is highly significant. The coefficient of effort in the pure bonus contracts is twice as high as the coefficient of effort in the combined contracts, however. The demanded effort  $e^*$  and the announced bonus  $b^*$  have no significant effect and seem to be cheap talk. The wage  $w$  has a small, negative effect suggesting that the bonus payment is smaller the larger the wage that has been paid upfront. The effect of

<sup>3</sup> Principals' profits from combined contracts exhibit considerably higher volatility. The standard deviation of the principals' payoffs in the combined contract is 26.8, while in the pure bonus contract it is only 23.7.

<sup>4</sup> This difference is significant ( $p < 0.001$ ) according to a Mann Whitney test.

the fine used in the combined contract is not significant. Regression 3 pools the data and adds an additional variable, namely the total number of combined contracts that the principal under consideration offered over the ten periods of the experiment. This variable is highly significant. It suggests that a principal who always used a pure bonus contract pays an average bonus that is ten tokens higher than a principal who always used a combined contract. A closer look at the data reveals that there are, in fact, different types of principals. Fifty-six percent of the principals (19 of 34) chose the bonus contract in at least eight out of ten periods. Fifteen percent of the principals (5 of 34) chose the combined contract in at least eight periods. Regression 4 adds dummy variables for these two types of principals that are highly significant. On average, the principals who predominantly chose the combined contract paid eight tokens less than those who predominantly chose the pure bonus contract.

### III. Interpretation of the Results

One might have expected that the additional instrument of a fine induces the agent to spend more effort, but this is not the case in our experiments. Several other experimental and field studies have shown that the use of explicit incentives, in particular the use of punishments and fines, may crowd out intrinsic motivation (see Bruno S. Frey 1997, Frey and Reto Jegen 2001), and several theoretical arguments have been suggested to explain this phenomenon. Most of these arguments do not apply to our experiments however. First, in our experiments the agent's task is just to pick a number at a monetary cost, so it is hard to argue that this task is so interesting that the agent wants to choose a positive effort level without explicit incentives (as argued by Frey and Jegen 2001). Second, the pure bonus contract and the combined contract both use monetary incentives, so the agents' behavior cannot be explained as a reaction to the introduction of money (as in Frey 1997; and Uri Gneezy and Aldo Rusticini 2000). Third, the task is very simple, and the fine is tailored to performance, so explicit incentives do not distort the agent's effort (as in Bengt Holmström and Paul Milgrom 1991). Fourth, the principal and the agent are symmetrically informed in

the experiment. Thus, the principal's contract choice cannot signal the difficulty of the task (as in Roland Bénabou and Jean Tirole 2003) or the social norm (as in Dirk Sliwka forthcoming) to the agent. Finally, the interaction is one-shot, so the principal has no incentive to signal to the agent that he trusts him in order to induce the agent to work harder in a second relationship (as in Florian Herold 2004).

There are two other explanations that may apply to our experiments, however. First, the explicit threat of using a sanction may be seen as a hostile act to which the agent reciprocates by choosing a lower level of effort. This argument of "strong reciprocity" has been used by Fehr and Bettina Rockenbach (2003) and Fehr and John A. List (2004), who consider trust games in which the principal can commit *ex ante* to punish the agent if the agent chooses to return less than the desired amount. They observed that the agents worked less if the punishment option was used. Similarly, in Armin Falk and Michael Kosfeld (2006), the principal could restrict the action set of the agent and thus force the agent to choose at least an effort level  $e > 0$ . Again, controlling the agent by restricting his action space had an adverse effect on the agent's action, which may be due to strong reciprocity.

Second, in our experiments the contract offer may have been a signal about the principal's trustworthiness. Recall that the principal moves twice. He offers a contract to the agent at date 0, and he decides on his bonus payment at date 2. If the agent does not know whether the principal is a fair or selfish type, he will try to infer from the contract offer how much bonus the principal is going to pay. The principals who predominantly offered the complete contract made significantly lower bonus payments than the principals who predominantly used the bonus contract. If the agents understand this, they expect that a lower bonus will be paid if a complete contract has been offered and therefore work less. The principal's monetary payoff is the same under a pure bonus and a combined contract, so a selfish principal has no incentive to mimic the behavior of a fair principal.

Adding a stick (the fine) to a carrot (the bonus) has adverse incentive effects that may render a pure bonus contract more efficient than a combined contract. However, we are just beginning to understand the interaction of explicit and

implicit incentives, which is a fascinating field for future research.

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