

# Adding a Stick to the Carrot?

## The Interaction of Bonuses and Fines

BY ERNST FEHR AND KLAUS M. SCHMIDT\*

Interaction in small groups is often affected by concerns 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 the current 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. However, our previous experiments (FKS 2007, Fehr and Schmidt 2004) show that many principals make substantial voluntary bonus payments, even if the interaction with the

---

\* Fehr: Institute for Empirical Research in Economics, University of Zurich, Bluemlisalpstrasse 10, CH-8006 Zurich, Switzerland ([efehr@iew.unizh.ch](mailto:efehr@iew.unizh.ch)); Schmidt: Department of Economics, University of Munich, Ludwigstrasse 28, D-80539 Muenchen, Germany ([klaus.schmidt@Lrz.uni-muenchen.de](mailto:klaus.schmidt@Lrz.uni-muenchen.de)). Financial support by Deutsche Forschungsgemeinschaft through SFB-TR 15 and the RTN network ENABLE is gratefully acknowledged. Ernst Fehr also gratefully acknowledges support from the Swiss National Science Foundation (project number 101312-103898/1) and the Research Priority Program on the “Foundations of Human Social Behavior” at the University of Zurich.

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. With an incentive contract the principal could impose a fine on the agent for spending too little effort. However, the fine was bounded, so the incentive contract could not be used to implement the first best efficient effort level. More than 80 percent of the principals preferred the bonus contract, which also was significantly more profitable and efficient.

In this paper we report on an experiment in which the principal could combine the two instruments. At first glance it seems that a combined contract that uses both, a voluntary bonus payment and a fine, should always dominate. First of all, it is more general and gives more options to the principal than the pure bonus and the pure incentive contracts. Second, adding a stick (the explicit incentive) to the carrot (the voluntary bonus) should improve incentives in particular for those agents who worked too little with a pure bonus contract. However, in our experiment the combined contracts did not induce the agents to work harder, and two thirds of the principals preferred a pure bonus over a combined contract. Our experiment suggests that principals who are less fair are more likely to choose a combined contract and less likely to actually pay the announced bonus. This offers a new explanation for why explicit and implicit incentives are substitutes rather than complements.

## I. The Principal-Agent Experiment

We use exactly the same framework as in FKS but 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  $10 \cdot e$  for the principal. Effort is costly to the agent with

effort costs given by Table I. Note that the efficient effort level is  $e=10$  which generates a net surplus of 80.

TABLE I: 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

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 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  $(w, e^*, b^*)$  that 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  $b^*$ . However, neither the agent's effort nor the principal's bonus payment is enforceable. 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.

<sup>1</sup> A self-interested agent prefers to work  $e=4$  at an effort cost of 4 rather than to shirk ( $e=1$ ), 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 to incur the effort cost  $c(5)=6$ .

- *Combined Contract (CC)*: The principal invests in the verification technology at cost  $k = 10$  and offers a contract  $(w, e^*, f, b^*)$  that 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

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

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 10 for the verification technology. This cost is a plausible feature of real world contracts that rely on third party verification and enforcement. Note further that from the perspective of traditional contract theory the announcement of a voluntary bonus payment should not affect the agent's effort choice. In a one-shot relationship a rational and self-interested principal will never pay a bonus which should be anticipated by a rational agent. However, FKS (2007) have shown that some principals make substantial bonus payments which induces the agents to work significantly more than if a pure incentive contract is offered (that relies only on the fine).

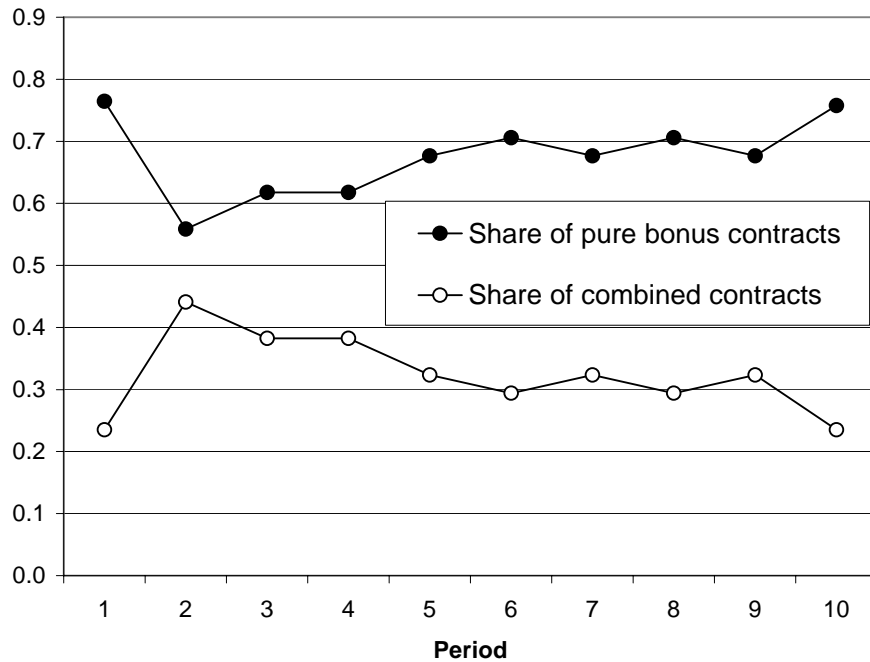
The experimental subjects were students of the University of Munich and the Technical University of Munich. We had three sessions with 22-24 subjects in each session, half of them randomly assigned to the role of the principal and half to that of the agent. Each session had ten periods. The agents were randomly matched with a different principal in each period so that no

agent interacted more than once with the same principal. Thus, we had ten contracts with ten different contracting partners for each subject in each experimental session.<sup>2</sup>

## II. Experimental Results

About two thirds of all contract offers (229 of 339, 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.

FIGURE 1: SHARE OF PURE BONUS AND COMBINED CONTRACTS



<sup>2</sup> A more detailed description of the experimental procedures, a complete set of the instructions and the data can be found at [http://www.vwl.uni-muenchen.de/ls\\_schmidt/experiments/stick-and-carrot/index.htm](http://www.vwl.uni-muenchen.de/ls_schmidt/experiments/stick-and-carrot/index.htm).

The combined contracts did not induce significantly higher effort levels. The average effort is 5.4 in the combined contracts and 5.1 in the pure bonus contracts, but this difference is statistically not 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 vs. 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.

Why is the additional incentive instrument of the fine ineffective? Figure 2 shows that the average bonus that the principals paid for any given level of effort is much lower for the combined contracts than for the pure bonus contracts. The dark dots show the average bonus that is paid under a pure bonus contract for any given level of effort. The figure shows that the bonus is strongly increasing with effort. In fact this relationship is very similar to the bonus-effort relationship observed for pure bonus contracts in FKS (2007). The light dots show the average bonus that is paid under a combined contract for any given effort level.

---

<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.

FIGURE 2: AVERAGE BONUS PAYMENTS CONDITIONAL ON EFFORT

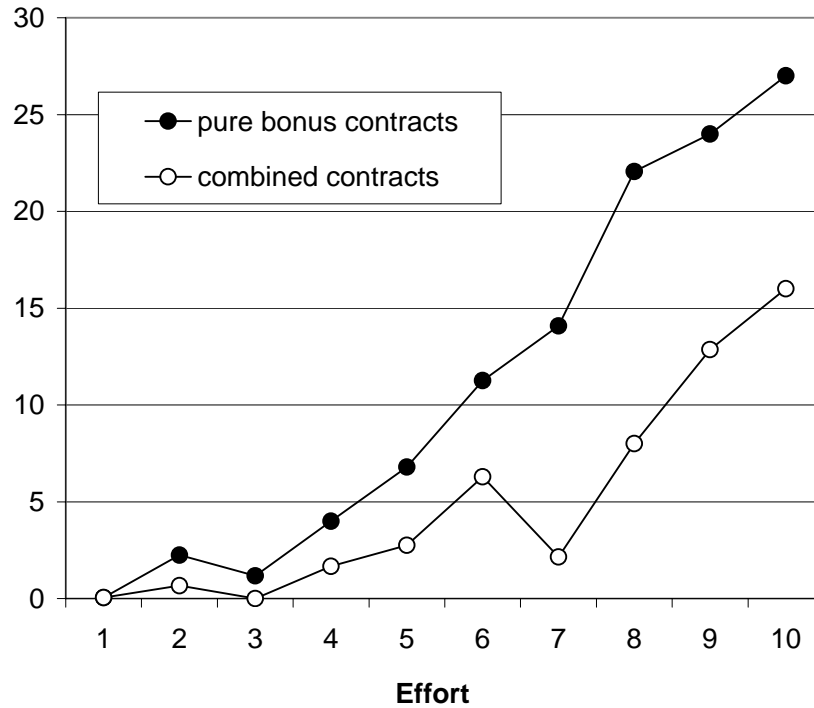


Table 2 reports multivariate regressions to better understand what determines the actual bonus payments. Regressions (1) and (2) look at the data of pure bonus contracts and combined contracts separately. In both regressions the agent's effort is highly significant. However, the coefficient of effort in the pure bonus contracts is twice as high as the coefficient of effort in the combined contracts. 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 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 individual principals offered over the 10 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 10 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. 56 percent of the principals (19 of 34) chose the bonus contract in at least eight out of ten periods. 15 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 choose the combined contract pay eight tokens less than those who predominantly choose the pure bonus contract.<sup>5</sup>

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			-0.98*** (0.23)	
Dummy for BC-principals				3.52*** (1.00)
Dummy for CC-principals				-4.21*** (1.39)
No. of observations	224	102	326	326
R <sup>2</sup>	0.64	0.35	0.58	0.56

Table reports the coefficients from OLS regressions. Robust standard errors are in parentheses. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. BC-

<sup>5</sup> We also conducted Tobit regressions. Relative to the OLS regressions the same variables remain (and no other variables become) significant in the Tobit regressions, but the absolute values of the significant coefficients are larger.



principals (CC-principals) chose the bonus contract (combined contract) at least eight times. In all regressions we clustered on individual principals.

### **III. Interpretation of the Results**

The interaction of explicit and implicit incentives has received a lot of attention in recent years. Several 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, and Frey and Reto Jegen, 2001, surveys). Several theoretical arguments have been suggested to explain this phenomenon. However, most of these arguments do not apply to our experiments. First, 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 in itself 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, Uri Gneezy and Aldo Rusticini, 2000a and 2000b, or Roland Bénabou and Jean Tirole, 2006). Third, the task is very simple and the fine is tailored to performance, so explicit incentives do not distort the agents effort (as in Bengt Holmström and Paul Milgrom, 1989, and David M. Kreps, 1997). Forth, 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 Bénabou and Tirole, 2003) or the social norm (as in Dirk Sliwka, 2006) to the agent. Finally, the interaction is one-shot, so the principal has no incentive to signal to agent that he trusts him in order to induce the agent to work harder in a second relationship (as in Florian Herold, 2004).

Our experiments are similar to the recent experiments by Fehr and Bettina Rockenbach (2003) and Fehr and John List (2004) who considered trust games in which the principal could

commit ex ante to punish the agent if the agent chooses to return less than the desired amount. Similarly, Armin Falk and Michael Kosfeld (2006) consider a gift exchange game in which the principal can restrict the action set of the agent and thus force the agent to choose at least an effort level  $\underline{e} > 0$ . These papers show that controlling the agent by threatening to impose a fine or by restricting his action space reduces the agent's effort. This is similar to what we observe in our experiment. Fehr and List (2004) argue that 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.

However, there is one important difference in our experiment that gives rise to a different interpretation. In our experiment the principal has to move 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. Recall that the principals who predominantly offer the complete contract make significantly lower bonus payments than the principals who predominantly use the bonus contract. If the agents understand this, they should expect lower bonus payments if a complete contract is offered and therefore work less. The principal's monetary payoff is the same under a pure bonus and a combined contract. Thus, a selfish principal has no incentive to mimic the behavior of a fair principal.

The use of a fine has the direct effect to induce the agent to work more, but it also signals that the principal is more selfish and less likely to make a generous bonus payment. On balance, these two effects seem to just cancel out. This is a new interpretation for why the additional explicit incentive of a fine is ineffective.

## REFERENCES

- Benabou, Roland and Jean Tirole (2003). "Intrinsic and Extrinsic Motivation." *Review of Economic Studies* 70: 489-520.
- Benabou, Roland and Jean Tirole (2006), "Incentives and Prosocial Behavior." *American Economic Review* 96(5): 1652-1678.
- Falk, Armin and Michael Kosfeld (2006). "The Hidden Cost of Control." *American Economic Review* 96(5): 1611-1630.
- Fehr, Ernst and Bettina Rockenbach (2003). "Detrimental Effects of Sanctions on Human Altruism." *Nature* 422 (March): 137-140.
- Fehr, Ernst, Alexander Klein and Klaus M. Schmidt (2007). „Fairness and Contract Design“, *Econometrica* 75(1), 121-154.
- Fehr, Ernst and John A. List (2004). "The Hidden Costs and Returns of Incentives – Trust and Trustworthiness among CEOs." *Journal of the European Economic Association* 2(5): 743-771.
- Fehr, Ernst and Klaus M. Schmidt (2004). „Fairness and Incentives in a Multi-Task Principal-Agent Model.“ *Scandinavian Journal of Economics* 106 (3): 453-474.
- Frey, Bruno S. (1997), *Not just for the Money*. Cheltenham: Edward Elgar
- Frey, Bruno S. and Reto Jegen (2001). "Motivation Crowding Theory." *Journal of Economic Surveys* 15: 589-611.
- Gneezy, Uri and Aldo Rusticini (2000a). "A Fine Is a Price." *Journal of Legal Studies* 29(1): 1-17.
- Gneezy, Uri and Aldo Rusticini (2000b). "Pay Enough or Don't Pay at All." *Quarterly Journal of Economics* 115(2): 791-810.

Herold, Florian (2004). "Incomplete Contracts as a Signal of Trust." University of Munich:  
*mimeo.*

Holmström, Bengt, and Paul Milgrom (1991). "Multi-task Principal-Agent Analyses." *Journal of Law, Economics and Organization* 7 (Sp.): 24-52.

Kreps, David M. (1997). "Intrinsic Motivation and Extrinsic Incentives." *American Economic Review* 87(2): 359-364.

Sliwka, Dirk (2007). "Trust as a Signal of a Social Norm and the Hidden Costs of Incentive Schemes." *American Economic Review*, forthcoming.