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ABSTRACT

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Non-monotone contracts, which can well represent the theoretically optimal choice of a contracting problem, are often deemed as non-plausible labor contracts and attention is (therefore) confined to monotone if not linear contracts. In this paper we test the incentive effects of non-monotone contracts in a simple principal-agent setting. Principals select either a monotone or a non-monotone contract, both are incentive compatible, and agents then decide which effort level to choose. The results show that principals do select the non-monotone contract, agents virtually never reject the non-monotone contract and they expend that effort level which is desired by principals.

Keywords:experimental agency, non-monotone contracts, epeated decision making

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Experimental evidence on the appropriateness of non-monotone incentive contracts*

Jeannette Brosig† and Christian Lukas‡

Abstract

Non-monotone contracts, which can well represent the theoretically optimal choice of a contracting problem, are often deemed as non-plausible labor contracts and attention is (therefore) confined to monotone if not linear contracts. In this paper we test the incentive effects of non-monotone contracts in a simple principal-agent setting. Principals select either a monotone or a non-monotone contract, both are incentive compatible, and agents then decide which effort level to choose. The results show that principals do select the non-monotone contract, agents virtually never reject the non-monotone contract and they expend that effort level which is desired by principals.
Keywords: experimental agency, non-monotone contracts, repeated decision making

1 Introduction

The research on contract theory has shown that for various contractual relationships, monotone or even linear contracts are seldomly the optimal choice[1]. The widespread use of such contracts in practice has lead many to confine attention to monotone or linear contracts. Non-monotone contracts, which can well represent the theoretically optimal choice are therefore often deemed non-plausible labor contracts.

Incentive effects of linear or, at least, monotone contracts have been analyzed in various empirical studies, both field and experimental studies. A review is beyond the scope of this paper but many studies have shown positive incentive effects of monetary rewards, i.e. higher incentives lead to higher effort (Bailey et al. (1998), Sprinkle (2000), whereas others could not find significant positive effects of monetary incentives on performance (Bonner et al. (2000), Jenkins et al. (1998)). A still growing literature deals with fairness (in different notions, e.g. higher effort should lead to higher compensation; equal distribution of compensation among group members; compensation should not be lower than a certain reference point etc.) and reciprocity in repeated contractual relationships. The evidence is overwhelming that both fairness and reciprocity do matter[2].

While the design of quite a number of experimental studies makes compensation contingent on (effort) inputs (e.g., Fehr et al. (2004), Falk/Gächter (2002), Huck et al. (2004)), a fundamental feature of agency-models is the unobservability of the agent's effort. As a consequence, output is relevant for compensation while input has an indirect effect on it. The papers by Güth et al. (1998) and Anderhub et al.

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1 See, for example, Grossman/Hart (1983) on conditions for monotonicity. A discussion about (the optimality of) linear contracts can be found in Christensen/Feltham (2005), ch. 19, Hart/Holmström (1987), or Holmström/Milgrom (1987).

2 See, for example, Fehr et al. (1997), Fehr/Schmidt (2001), Gneezy (2003), or Rabin (1998).

(2002), which dealt with incentive effects of output contingent pay, assumed that contracts have to be monotone, i.e. higher outcomes lead to higher compensation. Keser/Willinger (2000) allowed contracts to be non-monotone but these contracts were not (incentive-)compatible offers. A study carried out by Lukas (2006a) tests for the incentive effects of incentive compatible non-monotone contracts in repeated decision-making. He finds that agents act as income-maximizers and chose high effort instead of low effort despite the non-monotonicity of the contracts. This behaviour was statistically significant. Framing and even the presence of a principal who selected the contract (the majority of principals selected the non-monotone contract) did not have any statistically significant impact either. However, the study could not shed light on some aspects that are relevant for a judgment on the appropriateness of non-monotone incentive schemes: First, the non-monotonicity was not explicitly mentioned in the contract (or in the instructions); second, agents did not know the set of possible contracts and were not allowed to reject contract offers; and third, repeated interaction between principal and agent did not play a role as principal-agent pairs were formed only once.

The present paper extends the analysis in Lukas (2006a) therefore along these lines. Specifically, we consider three different treatments. In the first treatment (FS - framing with selected contract information), agents received information only on the contract selected by the principal. That information explicitly included a statement whether the selected contract was monotone or non-monotone in the performance measure. The second treatment (FC - framing with complete contract information), provided agents with information on the entire set of possible contracts and their respective properties. And in the third treatment (FCR - framing with complete contract information and repeated interaction), pairs of principal and agent were randomly formed anew at the beginning of each decision round and agents could reject contract offers. The experimental results confirm our hypotheses with respect to the agents' decisions but do not support those with regard to principals' decisions. Specifically, we find that agents act as income maximizers - they virtually never reject (non-monotone) contract offers and select high effort as intended by the principals. Principals, however, do not select the optimal non-monotone contract in a statistically significant way. On average, 45% of principals in each of the treatments prefer to offer the monotone contract although their expected payoff, given income maximizing decisions by the agents, was lower under the monotone contract than under the non-monotone contract. This result is in stark contrast to the finding by Lukas (2006a) who reports that principals do select the non-monotone contract in a statistically significant way; it is due to differing information structures in the experiments. Given our experimental design, principals apparently presumed contract rejection if the non-monotone contract is selected or deviation from the income-maximizing effort level by the agents. That presumption is based on the information structure because agents received explicit information on the non-monotonicity of the contract or on the set of possible contracts - information that was not made available to agents in Lukas' study. The paper's contribution to the research in experimental agency theory and experimental labor markets is thus to test a notion of fairness, compensation monotonicity in outcomes, that has not been tested so far. It is the objective of this paper to help fill this gap. It shows that non-monotone contracts are accepted by agents and they respond to such offers with the desired level of effort. As such non-monotone labor contracts may not be as implausible as they are often seen. Principal's, however, expect agents to deviate from income-maximizing effort levels if faced with a non-monotone contract. That may help explain why these contracts are not often used in the labor market.

The paper is structured as follows. Section 2 contains the model description. In section 3 the experimental design is described and we derive testable hypotheses. The following section presents the results of the experiments and statistical tests. The final section concludes.

2 Outline of the model

The model underlying our experimental design is taken from Lukas (2006b). We scetch its idea and will then derive testable hypotheses from it[3]. We consider a two-period agency model with risk-neutral contracting parties. The agent performs similar tasks in each period and her actions $e_t \in \{0,1\}, t = 1,2$, which are unobservable to the principal, cause monetory costs of $C(e) = ce, c > 0$. The agent's first-period action affects the outcome in both period 1 and period 2. It can therefore be considered "strategic effort". Effort in period 2 affects only the current period and is considered "operational effort". We assume a binary output distribution in each period, $x_t \in \{x^L, x^H\}, t = 1,2$, so that four different output sequences, characterised by a first-period outcome and a second-period outcome are possible. Higher probabilities for high outcomes are associated with high(er) effort. Given the strategic complements property (Bulow et al., (1985)) of strategic and operational effort in Lukas' (2006b) model setup, low strategic effort in period 1 cannot be made up by (excessive) operational effort in period 2. As the principals desires high effort in both periods, he has to rely on incentive-compatible output contingent payments. Let $s^{ij}, i,j \in \{L,H\}$ denote the state contingent payment on which the agent has a legal claim if she achieves outcome i in period 1 and outcome j in period 2. The strategic complements property drives the pay structure. We are interested in the following two different, incentive-compatible, pay structures that can be derived from Lukas' model:

$$s^{LL} < s^{HL} < \mathbf{s}^{LH} < \mathbf{s}^{HH}, \tag{1}$$

$$s^{LL} < s^{HL} < \mathbf{s}^{HH} < \mathbf{s}^{LH}. \tag{2}$$

It is apparent, that these pay structures are non-monotone in the number of successes. (2) is especially interesting because a higher payment is given to an agent who succeeds only once in period 2 than to an agent who succeeds in both periods. In light of the model's the rationality assumption and given the incentive compatibility of the pay structure (2) any agent is expected to accept such a contract and subsequently expend high effort in both periods. We will subsequently speak of "effort" or "no effort" instead of "high effort" or "low effort" because the former terms were also used in the experiments.

An intuitive interpretation of the model setup should be given. Consider an agent who is new in a firm or a certain position. Then one could think of the strategic effort in period 1 as an agent's learning-on-the-job - the agent gets acquainted with the work environment and tasks and learns about other specific requirements of the job. In period 2, the acquired skills are applied. In case the agent did not qualify properly in period 1 ($e_1 = 0$), she cannot compensate it by spending comparably higher operating effort. As such qualification effort and operating effort are strategic complements. Now, a low performance x^L in period 1 it indicates that low effort might have been chosen and that a high outcome x^H in period 2 is rather unlikely. If the principal intends to induce high effort in period 2 (because the agent's effort is nevertheless sufficiently profitable) it takes comparably higher incentives than in a situation with x^L being first-period outcome. If the agent then does accomplish x^H in period 2, she acquires a claim on a state contingent payment that is higher than the one had she achieved successes in both periods. A specific example would be marketing manager who learns about consumer tastes in period 1 while already being in charge of the company's key accounts. The more she learns in period 1 the more likely are high sales (x^H) in period 1 and period 2. In case she does not meet the sales target in period 1, the marketing manager appears poorly informed about consumer tastes. High sales in period 2 are then rather uncertain. Therefore it takes high incentives to induce high effort in period 2, and the state contingent payment s^{LH} will be higher than s^{HH}.

3 For a detailed presentation and interpretation of the model, see the corresponding sections in Lukas (2006b).

3 Design of the experiments and derivation of hypotheses

The experiments were carried out at the Magdeburger Experimentallabor (MaxLab) in June 2006. A total of 116 graduate students, who were recruited from several courses, took part. Each of the six sessions lasted about one hour; there were no time-constraints imposed on participants' decision making. Before the experiments, participants were given a presentation by one of the experimentators. The presentation included a detailed explanation of the decision context and how the individual's decisions influence outcome probabilities and eventually his/her profits. The same game-tree visualization that was used in the presentation appeared in the written instructions participants found at their randomly assigned seats[4]. After reading theses instructions - as well as during the experiments -, participants had the chance to privately ask clarifying questions; no questions in public were allowed. Communication between participants was disallowed, too.

We tested three different treatments with 10 decision rounds each. The set of contracts available did not vary among treatments. Basically, the setup was as follows: A principal (first mover) could choose between two similar, incentive compatible contracts X and Y. Contract X was characterised by the pay structure given in (2), whereas (1) characterised Y's pay structure. So contract X awarded the highest payoff to the output sequence $\{low, high\}$ and contract Y to sequence $\{high, high\}$. The contract choice determined the payoffs for both principal and agent (second mover) for every possible output sequence. The agent's decision influenced the probabilities of output sequences. The treatments differed in the amount of information that was given to the agent.

The first treatment was labeled "framing with selected contract information" (FS). Here agents received information only on the contract chosen by the principal. This information included a statement that made the pay structure explicit and a game-tree visualization of that contract containing probabilities of success and respective payoffs for both players (see figures 1 and 2).

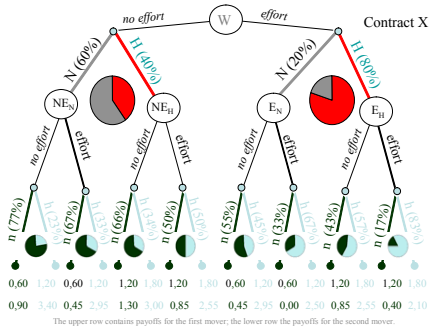

Figure 1: Game tree, contract X

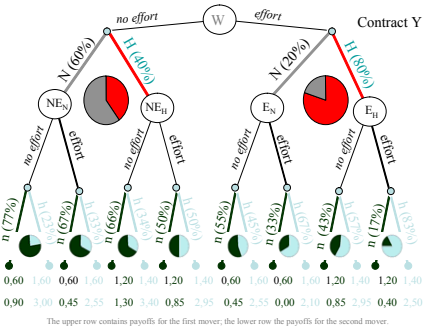

Figure 2: Game tree, contract Y

In the second treatment "framing with complete information" (FC), agents received information as described above for contract X *and* for contract Y. And in the third treatment "framing with complete information, repeated interaction" (FCR), agents received the same information as in treatment FC but pairs of principal and agent were randomly formed anew before each decision round and agents had an option to reject contract offers. In treatment FC (and treatment FS), matched pairs remained together for 10 decision rounds and a principal decided on a contract only once that the agent could not reject.

Testing the model in these three treatments was intended to serve the following purposes: In treatment FS we test if the different pay structures given contract X and contract Y, respectively, have any impact on the agents' decisions. Note that in this treatment, agents did not have information on the other contract,

4 Complete instructions can be found in the appendix.

i.e. the one that was not selected by the principal. Treatment FC then tests for the impact of complete information on the set of possible contracts on the agents' and the principals' decision. In other words, do principals select the monotone contract Y more often if agents know about its properties compared to the non-monotone contract X? And how do agents react? Finally, in treatment FCR, the option to reject a contract offer was introduced to test whether agents reject non-monotone contract offers.

The probabilities to achieve an output sequence $x_1, x_2 \in \{x^L, x^H\}$, given an effort strategy $e_1, e_2 \in \{no\ effort, effort\}$, were identical in each treatment. The same holds for net payoffs under contract X and Y, respectively. Principals could choose between the non-monotone contract, labeled X, and the monotone contract, labeled Y. The pay structure of each contract as used in the experiments is shown in table 1.

payment \ contract	X	Y	X	Y
	second mover (agent)		*first mover (principal)*	
s^{LL}	$0,90$	$0,90$	$0,60$	$0,60$
s^{HL}	$1,30$	$1,30$	$1,20$	$1,20$
s^{LH}	$3,40$	$3,00$	$1,20$	$1,60$
s^{HH}	$3,00$	$3,40$	$1,80$	$1,40$

Table 1: State contingent payoffs (in €) under different contracts

Since the production environment does not depend on the particular contract chosen, we chose to transform the non-monotone contract X into the monotone contract Y by shifting surplus from the principal to the agent for the output sequence {*high, high*} and in the opposite direction for the output sequence {*low, high*}[5]. The impact of that on expected payoffs given different decisions by agents will be made clear now. The cost of selecting effort in any period (or decision knot) was set € 0,45. If a contract offer was rejected int treatment FCR, both principal and agent had to settle with a fixed payment of € 0,50 each and the decision round ended with the agent's rejection.

Contract X. Starting in period-two decision knots, agents faced the following decision under contract X :

Point	expected payoff: no effort	expected payoff: effort	income-maximizing strategy
NE_N	1,48	1,28	no effort
NE_H	1,88	1,70	no effort
E_N	1,58	1,68	effort
E_H	1,82	1,81	effort (indifference)

Table 2: Contract X - Expected net payoffs in period 2 given period 1 decision

Expected net payoffs as given in table 2 could then be used to determine the income-maximizing strategy in period 1. Relevant payoffs are listed in table 3.

Point	expected payoff: no effort	expected payoff: effort	income-maximizing strategy
W	1,64	**1,78**	effort

Table 3: Contract X - Expected net payoffs in period 1 given income-maximizing period 2 decisions

Income maximizing agents would choose "effort" in period 1, and "effort" in period 2[6]. If an agent instead selects "no effort" in period 1, it is efficient to select "no effort" in period 2 as well.

5 It should be noted that contract Y is still not strictly monotone in the number of high outcomes but at least the sequence {*high, high*} leads to a higher payoff than {*low, high*}.

6 This expected net payoff for each of the 10 decision rounds corresponds to the agents' assumed reservation wage. Due to reputational concerns of MaxLab, an average overall payoff of € 15 per participant is aspired.

Contract Y. Again, starting in period-two decision knots, agents faced the following decision under contract Y :

Point	expected payoff: no effort	expected payoff: effort	income-maximizing strategy
NE_N	1,38	1,14	no effort
NE_H	2,01	1,90	no effort
E_N	1,40	1,41	effort (indifference)
E_H	2,05	2,14	effort

Table 4: Contract Y - Expected net payoffs in period 2 given period 1 decision

Expected net payoffs as calculated in table 2 could then be used to determine the income-maximizing strategy in period 1. Relevant payoffs are listed in table 5.

Point	expected payoff: no effort	expected payoff: effort	income-maximizing strategy
W	1,64	**2,00**	effort

Table 5: Contract Y - Expected net payoffs in period 1 given income-maximizing period 2 decisions

Income maximizing agents under contract Y would again choose "effort" in period 1, and "effort" in period 2. And again, if an agent instead selects "no effort" in period 1, it is efficient to select "no effort" in period 2 as well.

Principals' payoffs. To predict principals' choices, one can easily check that no contract dominates the other in terms of first-order stochastic dominance or second-order stochastic dominance for *any* effort strategy selected by agents. However, the principal is never worth off under contract X than under contract Y in terms of expected payoff for any effort strategy selected by an agent. This shows that it is costly to principals to offer a monotone contract if a non-monotone contract is optimal. Knowing the optimal decisions of income maximizing agents under either contract, the expected payoffs for principals given exactly these decisions can be calculated. Table 6 presents the calculations.

Contract	X	Y
expected payoff	1,56	1,35

Table 6: Expected payoffs for principals

The decrease in expected surplus of € 0,20 associated with chosing Y instead of X is exactly what the agent gains. The relevant numbers from table 3 and 5 are highlighted in bold face. Income maximizing principals would then pick contract X in one-shot relationships.

The hypotheses we test can now be summarized from the above analysis.

Hypothesis 1 *Income maximizing agents select effort in period 1.*

Hypothesis 2 *Income maximizing agents select effort in period 2, if they selected effort in period 1; they select no effort if they selected no effort in period 1.*

Hypothesis 3 *Income maximizing agents will never reject a contract offer by principals.*

Hypothesis 4 *In a one-shot relationship, income maximizing principals will always select the non-monotone contract.*

The experiments were all carried out on computers using the zTree-software (Fischbacher (1999)). Participants could see their own decision(s), random draws by the computer and their payoffs on the computer screen (see figure 3). Agents could, of course, see the principals' decisions but principals were not allowed to see the agents' decisions. This accords with the fundamental assumption of unobservable effort in agency models.

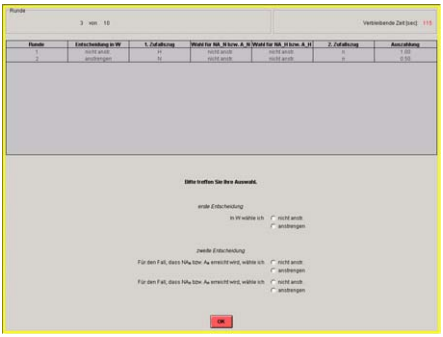

Figure 3: Screenshot on input stage

Participants received their payoffs immediately after the experiment in cash. Each particpant earned € 13,62 on average.

4 Results of the experiments

In the following section we present first the analysis of the principals' decisions and then the analysis of the agents' decisions. In each case, this includes some stylized facts, a statistical analysis and interpretation for the observed behavior. To test hypotheses, we used nonparametric tests following the description of test procedures in Siegel/Castellan (1988). A 5% level of significance in one-sided tests was required.

4.1 Principals' decisions

The sample size amounted to 19 pairs in treatments FS and FC each, and to 20 in treatment FCR where principals repeatedly decided on the contract. Overall, a majority of principals selected the non-monotone contract X. For each treatment we obtained the following numbers (see table 7).

	FS	FC	FCR
(i) Number of X-choices	11	9	114
(ii) Total number of choices	19	19	200
Percentage (i) / (ii)	57,9	47,3	56,5

Table 7: Descriptive data on principals' choices

Although the non-monotone contract X yields a higher expected payoff then the monotone contract Y, principals did not choose contract X as often as expected. Applying the binomial test to principals' choices in treatment FS and FC shows no statistical signifance in the data, i.e. principals do not select contract X in a statistically significant way. In treatment FCR, principals alltogether had to choose a contract a total two-hundred times. Due to repeated contract choice, the decisions cannot be treated as independent samples. To circumvent that problem, an individual probability of selecting contract X was

computed for each principal. To do that, we simply divided the number of X-choice by the number of decision rounds, which amounted to 10. Figure 4 graphically shows the distribution of these individual probabilities.

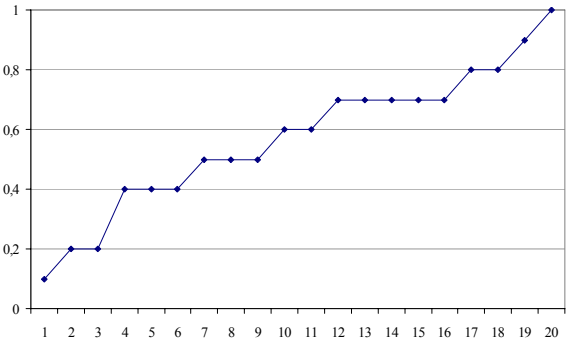

Figure 4: Treatment FCR - Distribution of individual probabilities to select contract X

There were 6 principals who selected contract X with a probability of less than 50%, and therefore 14 with a probability of at least 50%. This probability of 50% was used as the threshold level to test hypothesis 4 in the FCR-treatment In other words, an individual probability to select contract X of at least 50% was considered income-maximizing behavior. The contract choice X is thus not statistically significant (in the binomial test) which leads to conclusion 1.

Conclusion 1 *In all treatments, principals do not select the non-monotone contract X in a statistically significant way (binomial test).*

The rejection of hypothesis 4 should be compared to the finding in Lukas (2006a), where he reports a statistically significant choice of contract X by principals, i.e. 15 out of 18 principals selected contract X. The experimental design is comparable to ours with the important difference that instructions for participants did not include the explicit statement on contract (non-)monotonicity. Comparing the treatment FP (framing principal) from that study with the data from treatments FS and FC yields the following $p-$value (for the same or a stronger association) in the Fisher exact test:

	FS	FP	FC	FP
Number of X-choices	11	15	9	15
Number of Y choices	9	3	11	3
$p-$value (FS vs. FP)	0,0506*			
$p-$value (FC vs. FP)	0,0163**			

* significant at 10%-level

**significant at 5%-level

Table 8: Contingency tables and p-values for Fisher exact test

The Null-hypothesis, that the probability of selecting contract X is identical in treatments FS and FP, and FC and FP, respectively, must be rejected based on the Fisher exact test. This conclusion is significant at the 10%-level for treatments FS and FP, and significant at the 5%-level for treatments FC and FP.

Apparently, an explicit statement on the non-monotonicity of the contract already leads principals to believe that agents could deviate from income-maximizing behavior, and they select contract Y more often (treatment FS vs. FP). Complete information on the set of possible contracts, one monotone contract and one non-monotone contract, makes this effect even stronger (treatment FC vs. FP).

As principals could only see the random draws by the computer, i.e. outcomes, and their corresponding payment, they did not know the agents' effort choices. Inference from outcomes to action choices was limited to knowing that high payoffs were more likely to be the result of high effort instead of low effort. Therefore, it is conclusive to investigate principals' behavior in treatment FCR, where they repeatedly decided on a contract. Table 9 lists the number of selection changes contingent on principals' payoffs.

switch from \ after round	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*Total*
X to Y, payoff short of maximum	6	3	1	2	4	4	4	2	1	*25*
X to Y, with maximum payoff	2	1	0	0	1	0	0	0	1	*5*
Y to X, payoff short of maximum	2	5	4	1	2	4	2	4	1	*25*
Y to X, with maximum payoff	0	0	0	2	0	0	0	0	0	*2*

Table 9: Changes in principals' contract selection

As table 9 shows, if principals change their decision which contract to offer, they do so after the maximum payoff possible was missed. This accords with learning direction theory (Selten/Stöcker (1986)). Based on this theory one could argue, if the maximum payoff achievable with the selected contract is not realized, principals believe that they have selected the "wrong" contract and they select the other contract in the following round. The agency-theoretic explanation with regard to switches from X to Y emphasises the likelihoods of outcomes, i.e. if the principal realizes less than maximum payoff it is indication for low effort by the agent in period 1. As income-maximizing principals want the agents to choose high effort in period 1, they attempt to induce that effort with contract Y in the next round. Concerning switches from Y to X, the agency-theoretic explanation is more subtle. At first, principals receive the highest payoff not from the highest gross outcome, i.e. from the outcome sequence $\{x^H, x^H\}$. If they do receive the highest payoff it points to low effort by agents in period 1, so the switch to contract X is intended to induce high effort in period 1 (point W). The total of 25 decisions to switch from Y to X following a less than maximum payoff can be subdivided in 10 decisions following the highest possible outcome and 15 decisions following less than maximum outcome. In accordance with the agency-theoretic explanation from above are the latter 15 decisions whereas the former 10 decisions are at odds with it. For them, learning direction theory seems to fit better to observations.

4.2 Agents' decisions

In treatment FS, there were 11 agents "working" under contract X (X-agents), and 8 under contract Y (Y-agents); in treatment FC, the respective numbers were 9 X-agents and 11 Y-agents. In treatment FCR, each agent faced contract X on average 5,65 times and contract Y thus 4,35 times. The analysis that follows distinguishes between X-agents and Y-agents.

The first interesting observation is related to agents' contract acceptance decisions in treatment FCR. Of the 114 times that principals offered contract X, only one offer was rejected; contract Y was never rejected by agents. Apparently, the expected payoff was high enough under either contract given the intended effort strategy to dominate the certain payoff of € 0,50 following contract rejection. Conclusion 2 follows immediately.

Conclusion 2 *In treatment FR, agent do not reject contract offers.*

Before we analyse agents' decisions, it is conclusive to take a look at the time agents needed to reach their decisions in each round.

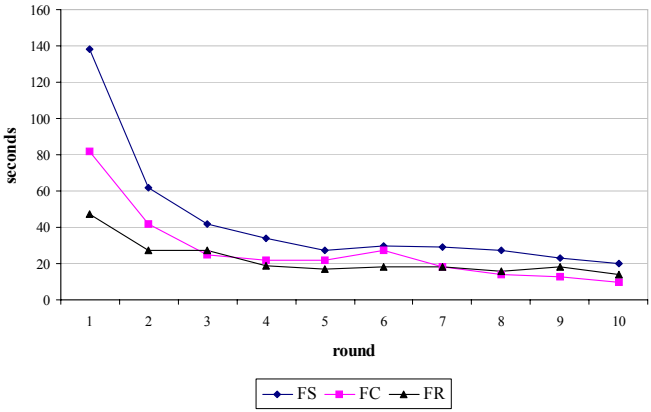

Figure 5: Average time needed for agents' decision making

Figure 5 shows that it took agents comparably longer to make decisions in the first two rounds than in the following eight rounds. As the variances of the average time figures decrease with the same pattern, we conclude that agents had a sound understanding of the task. This is also supported by the fact that agents (at their seats) did not raise any questions with regard to the game-tree visualization of the contract.

To analyze decisions within and between treatments and contracts, we have determined individual probabilities for income-maximizing behavior or decisions, respectively, for each agent. That probability was calculated as the number of rounds in which income-maximizing behavior was observed divided by the number of rounds. The latter number amounted to 10 in treatments FS and FC (recall that agents "worked" under the same contract for 10 decision rounds), whereas in treatment FCR it was dependent on principals' choices, i.e. how often each agent faced contract X or contract Y, respectively. Two additional remarks should precede the analysis. First, in decision knot E_N under contract X, and decision knot E_H under contract Y any decision by the agent was consistent with income-maximizing behavior as the difference in expected payoffs between chosing effort or no effort amounted to € 0,012 in E_N under contract X, and € 0,008 in E_H under contract Y. Second, to test hypothesis 2, income maximizing behavior required the choice of "no effort" in period 2 decision knots NE_L and NE_H, and "effort" in E_L and E_H under either contract.

Depending on the treatment, the following data was obtained for contract X:

Period	*Individual probability*	*Treatment FS*	*Treatment FC*	*Treatment FCR*
1	$< 50\%$	**0**	3	**1**
	$\geq 50\%$	**11**	6	**19**
2	$< 50\%$	5	3	6
	$\geq 50\%$	6	6	14
$1+2$	$< 50\%$	8	6	10
	$\geq 50\%$	3	3	10

Table 10: Individual probabilities for income-maximizing behavior under contract X

(Numbers in bold are significant in binomial test)

Table 10 shows that statistically significant results were observed in treatments FS and FCR for period 1 decisions only. Considering decisions in period 2 only, or decisions in both periods (i.e. all three decision knots), income maximizing behavior was not observed in a statistically significant way.

For contract Y, observed behavior lead to the following numbers (see table 11).

Period	*Individual probability*	*Treatment FS*	*Treatment FC*	*Treatment FCR*
1	$< 50\%$	**1**	2	**2**
	$\geq 50\%$	**7**	8	**18**
2	$< 50\%$	**1**	**1**	**1**
	$\geq 50\%$	**7**	**9**	**19**
$1+2$	$< 50\%$	3	2	**5**
	$\geq 50\%$	5	8	**15**

Table 11: Individual probabilities for income-maximizing behavior under contract Y

(Numbers in bold are significant in binomial test)

Agents "working" under contract Y showed income maximizing behavior in all decision knots (periods) in treatment FCR, in period 1 and period 2 in treatment FS, and in period 2 only in treatment FC.

Conclusions 3 and 4 result from the numbers in table 10 and 11.

Conclusion 3 *Agents act as income maximizer in period 1 in treatments FS and FR; in treatment FC they do not.*

Conclusion 4 *Agents act as income maximizer in period 2 in all three treatments.*

The significance of choosing "effort", i.e. to act as income maximizer, is notable as it suggests that contract acceptance is *not* based on the maximin-criterion. To see this, note that contract rejection yields € 0,50 and contract acceptance - based on the maximin criterion - a payoff of at least € 0,90. To ensure a minimum payoff of € 0,90, however, agents must choose "no effort" in period 1 (and period 2). Observed behavior contradicts the presumption of acceptance guided by the maximin criterion.

In period 2, contract Y induces income maximizing behavior in a statistically significant way in all three treatments. This is, at first sight, in stark contrast to the finding for contract X. A possible interpretation is a change from (expected) income maximization to the maximin criterion in knot E_N under contract X. Although "effort" yields a higher expected payoff than "no effort", agents select "no effort" to avoid a possible zero payoff and to increase the minimal payoff to € 0,45. Under contract Y, the equally possible change does not show up in the numbers of table 11 since "no effort" and "effort" are associated with identical expected payoffs and are counted as income maximizing behavior.

Finally, considering decisions in both periods, contract Y provides incentives for the majority of agents to select "effort" in both periods; in treatment FCR this is statistically significant. From a principal's point of view, contract Y seems to be preferable then as this contract induces "effort" more often than contract X does. This conclusion follows from an inspection of table 9 and table 10. Interestingly, principals do select contract Y more often then expected. As argued above, principals apparently believed that the mere statement of non-monotonicity would induce non-income maximizing behavior on the agents' side. Principals consequently selected contract Y, and the data to be found in table 10 and 11 "justifies" their beliefs.

To test whether there are any significant differences between distributions of individual probabilities, we applied the Mann-Whitney-U-Test. Table 11 first represents the means of these individual probabilities for each treatment, contract, and period and in table 12 then the values for the test statistic are presented:

Contract	*Treatment*	*Period 1*	*Period 2*	*Period 1+2*
X	FS	68%	46%	27%
X	FC	58%	58%	28%
X	FCR	79%	65%	49%
Y	FS	66%	70%	48%
Y	FC	73%	75%	69%
Y	FCR	80%	86%	71%

Table 11: Mean value of individual probability for income maximizing behavior

Contract	*Treatments*	*Period 1*	*Period 2*	*Period 1+2*	*critical U-value*
X	FS vs. FC	38	35	45,5	27
X	FS vs. FCR	**69**	**66**	76	69
X	FC vs. FCR	**50**	73,5	65,5	54
Y	FS vs. FC	30	35	58	20
Y	FS vs. FCR	**44,5**	**33***	**41,5**	47
Y	FC vs. FCR	83,5	64,5	89,5	62

Table 12: Value of test statistic and critical U-value

*(Numbers in bold are significant; *significant at 1%-level)*

Table 12 shows that significant differences in the distributions of agents' individual probabilities to act as income maximizers can only be found between treatments FS and FCR, and here under either contract. Stated differently, information structures matter more than specific contract features. With selective contract information, agents more often deviate from income maximizing behavior. For practical purposes then, contracts would ceteris paribus perform better the more agents (employees) know about the set of possible contracts.

5 Conclusion

In this paper we tested incentive effects of non-monotone compensation contracts Pairs of principal and agents were formed and principals decided first on a two-period contract, choosing between a non-monotone and a monotone contract, and agents then decided on their effort levels. The experimental results confirm our hypotheses with respect to the agents' decisions but do not support those with regard to principals' decisions. Specifically, we find that agents act as income maximizers - they virtually never reject (non-monotone) contract offers and select high effort as intended by the principals. Principals, however, do not select the optimal non-monotone contract in a statistically significant way. On average, 45% of principals in each of the treatments prefer to offer the monotone contract although their expected payoff, given income maximizing decisions by the agents, was lower under the monotone contract than under the non-monotone contract. This result is in stark contrast to the finding by Lukas (2006a) who reports that principals do select the non-monotone contract in a statistically significant way; it is due to differing information structures in the experiments. Given our experimental design, principals apparently presumed contract rejection if the non-monotone contract is selected or deviation from the income-maximizing effort level by the agents. That presumption is based on the information structure because agents received explicit information on the non-monotonicity of the contract or on the set of possible contracts - information that was not available to agents in Lukas' study. The paper's contribution to the research in experimental agency theory and experimental labor markets is thus twofold: It shows that non-monotone contracts are accepted by agents and they respond to such offers with the desired level of effort. As such non-monotone labor contracts may not be as implausible as they are often seen. Principals', however, expect agents to deviate from income-maximizing effort levels if faced with a non-monotone contract. That may help explain why these contracts are not often used in the labor market.

References

Anderhub, V., S. Gächter and M. Königstein (2002). Efficient Contracting and Fair Play in a Simple Principal-Agent Experiment. Experimental Economics 5, 5-27.

Bailey, C.D., L.D. Brown and A.F. Cocco (1998). The effects of Monetary Incentives on Worker Learning and Performance in an Assembly Task. Journal of Management Accounting Research 10, 119-131.

Bonner, S., R. Hastie, G.B. Sprinkle and S.M. Young (2000). A Review of the Effects of Financial Incentives on Performance in Laboratory Tasks: Implications for Management Accounting. Journal of Management Accounting Research 12, 19-64.

Christensen, P.O. and G.A. Feltham (2005). Economics of Accounting - Volume II, Performance Evaluation. Springer Series in Accounting Scholarship, J.S. Demski, ed., Springer.

Falk, A., Gächter, S. (2002). Reputation and Reciprocity - Consequences for the Labour Relation. Scandinavian Journal of Economics 104, 1-26.

Fehr, E., S. Gächter, and G. Kirchsteiger (1997). Reciprocity as a contract enforcement device: experimental evidence. Econometrica, 65: p. 833 - 860.

Fehr, E. and K. Schmidt (2001). Theories of Fairness and Reciprocity - Evidence and Economic Applications. Institute for Empirical Research in Economics, Mimeo, University of Zurich.

Fehr, E. and K.M. Schmidt (2004). Fairness and Incentives in a Multi-task Principal- Agent Model. Scandinavian Journal of Economics, 106(3): p. 453-474.

Fehr, E., A. Klein and K.M. Schmidt (2004). Contracts, Fairness, and Incentives. CESifo Working Paper No. 1215.

Fischbacher, U. (1999). z-Tree: A Toolbox for Readymade Economic Experiments, Working Paper No. 21, University of Zurich.

Gneezy, U. (2003) Do high wages lead to high profits? An experimental study of reciprocity using real effort. Working paper, The University of Chicago GSB.

Grossman, S.J. and O.D. Hart (1983). An Analysis of the Principal-Agent Problem. Econometrica, 51(1): p. 7-45.

Güth, W., W. Klose, M. Königstein and J. Schwalbach, 1998. An experimental study of a dynamic principal-agent relationship. Managerial and Decision Economics 19, 327-341.

Hart, O. and B. Holmström (1995) The Theory of Contracts, in Advances in EconomicTheory, Fifth World Congress, Econometric Society Monographs, T. Bewley, ed., Cambridge University Press: Cambridge. p. 71-155.

Holmstrom, B. and P. Milgrom (1987). Aggregation and Linearity in the Provision of Intertemporal Incentives. Econometrica, 55(2): p. 303-328.

Huck, S., A.J. Seltzer, and B. Wallace (2004). Deferred Compensation and Gift Exchange: An Experimental Investigation into Multi- Period Labor Markets. IZA Discussion Paper, No. 1193.

Jenkins, G.D., Jr., A. Mitra, N. Gupta and J.D. Shaw (1998). Are financial incentives related to performance? A meta-analytic review of empirical research. Journal of Applied Psychology 83, 777-787.

Keser, C., Willinger, M. (2000). Principals' principles when agents' action are hidden. International Journal of Industrial Organization 18, 163-185.

Lukas, C. (2006a). Get more for less? Experimental evidence on repeated decision making under non-monotone incentives. Zeitschrift für Betriebswirtschaft, forthcoming.

Lukas, C. (2006b). Managerial Expertise, Learning Potential, and Dynamic Incentives: Get More for Less? Managerial and Decision Economics, forthcoming.

Rabin, M. (1998) Psychology and Economics. Journal of Economic Literature, 36(1): p. 11-46.

Selten, R. and R. Stoecker (1986). End behavior in sequences of finite prisoner's dilemma supergames: A learning theory approach. Journal of Economic Behavior and Organization, 7: p. 47-70.

Siegel, S. and N.J. Castellan, Jr. (1988). Nonparametric statistics for the behavioral sciences, 2nd ed., McGraw-Hill.

Sprinkle, G. B. (2000). The Effect of Incentive Contracts on Learning and Performance. The Accounting Review 75, 299-326.

6 Appendix: Instructions

6.1 Treatment FS

6.1.1 First-mover instructions

Welcome to the experiment!

Introduction: You are about to take part in a laboratory experiment to investigate individual behavior in decision making. During the experiment you participate in 10 repetitions (decision rounds). You can earn money. How much money you will earn depends on your decisions. After the experiment you will receive your entire payoff in cash.

Please read the following instructions carefully. Approximately five minutes after handing out the instructions we will come to your seat to answer any questions you may have. If you have questions during the experiment, please give us a sign and we will come to your seat.

No participants will receive any information on the identity and decisions of other participants during the experiment.

Situation and decisions: You face the same situation in each of the 10 decision rounds.

You are part of a labor relation that lasts for 2 periods. You are the employer (first-mover). A participant who will be randomly assigned to you is the employee (second-mover). You choose between two similar contracts X and Y that will be effective in all 10 decision rounds. Your choice determines the conditions for output-contingent pay that the second-mover receives and at the same time on the conditions for your own payoff.

The second-mover will only be informed about your contract choice (i.e. he will not receive any information on the contract that was not chosen) and then decides whether he expends "effort" or "no effort" in each of the two periods. The probability of achieving a high output will be influenced by the second-mover's effort choice. A higher probability of the high outcome is associated with "effort" than with "no effort". If the second-mover selects "effort" in any period he incurs personal effort costs of 0,45 €; "no effort" does not lead to effort costs.

The second-mover's first decision in point A determines whether he expends "effort" or "no effort". In case he chooses "no effort" the low outcome and the decision knot NE_N will be achieved with a probability of 60%. The high outcome and the decision knot NE_H will be reached with a probability of 40%.

In case the second-mover selects "effort", the low outcome and the decision knot E_N will be achieved with a probability of 20%. The high outcome and the decision knot E_H will be reached with a probability of 80%.

The second-mover's first-period decision also affects the outcome probabilities in period 2.

The second-mover's second decision determines whether he expends "effort" of "no effort" if he had achieved the low outcome or the high outcome in period 1. The relevant probabilities and the corresponding net payoffs (personal costs are already deducted) are given in the two decision trees for contract X and contract Y, respectively.

Both participants make their decision sequentially. You decide once on the contract, the second mover decides on his effort twice in each of 10 decision rounds given the contract you selected.

Contract X is characterized by the fact that the output-contingent pay of the second mover does not rise monotonously in the output-level, i.e. the outcome sequence {low; high} leads to a higher payment than the output sequence {high; high} for every possible combination of effort levels. Contract Y, on the other hand, is characterized by the fact that the outcome sequence {low; high} leads to a lower payment than the output sequence {high; high} for every possible combination of effort levels.

The following examples will clarify this:

Effort *Yes/no*	*Outcome sequence*	*Net-payment for second Mover with contract X*	*Net-payment for second Mover with contract Y*
{yes, yes}	{low; high}	2,5	2,1
{yes; yes}	{high; high}	2,1	2,5
{no; no}	{low; high}	3,4	3
{no; no}	{high; high}	3	3,4

The experiment is carried out on the computer. The computer will determine the results in each period by a random draw with the probabilities as they are given in the decision tree.

Information:

After each round the first-mover will be informed about his current round payoff.

After each round the second-mover will be informed about current round outcomes and his own payoff.

Payoff

With the completion of the 10 decision rounds you will receive the sum of your payments of every round in cash.

6.1.2 Second-mover instructions

Welcome to the experiment!

Introduction:

You are about to take part in a laboratory experiment to investigate individual behavior in decision making. During the experiment you participate in 10 repetitions (decision rounds). You can earn money. How much money you will earn depends on your decisions. After the experiment you will receive your entire payoff in cash.

Please read the following instructions carefully. Approximately five minutes after handing out the instructions we will come to your seat to answer any questions you may have. If you have questions during the experiment, please give us a sign and we will come to your seat.

No participants will receive any information on the identity and decisions of other participants during the experiment.

Situation and decisions: You face the same situation in each of the 10 decision rounds.

You are part of a labor relation that lasts for 2 periods. A participant who will be randomly assigned to you is the employer (first-mover). You are the employee (second-mover). The first-mover selects one out of two similar contracts X and Y that will be effective in all 10 decision rounds. By making his contract choice he decides on the conditions for your output-contingent pay and at the same time on the conditions of his own payoff.

You will only be informed about the chosen contract (i.e. you will not receive any information on the contract that was not chosen) and then you decide whether you expend "effort" or "no effort" in each of the two periods. The probability of achieving a high output will be influenced by your effort choice. A higher probability of the high outcome is associated with "effort" than with "no effort". If you select "effort" in any period you incur personal effort costs of 0,45 €; "no effort" does not lead to effort costs.

Your first decision in point A determines whether you expend "effort" or "no effort". In case you choose "no effort" the low outcome and the decision knot NE_N will be achieved with a probability of 60%. The

high outcome and the decision knot NE_H will be reached with a probability of 40%. In case you select "effort", the low outcome and the decision knot E_N will be achieved with a probability of 20%. The high outcome and the decision knot E_H will be reached with a probability of 80%.

Your first-period decision also affects the outcome probabilities in period 2.

Your second decision determines whether you expend "effort" or "no effort" if you had achieved the low outcome or the high outcome in period 1. The relevant probabilities and the corresponding net payoffs (personal costs are already deducted) are given in the decision tree.

Both participants make their decision sequentially. The first-mover decides once on the contract, you decide on your effort twice in each of 10 decision rounds given the contract selected by the first-mover.

The experiment is carried out on the computer. The computer will determine the results in each period by a random draw with the probabilities as they are given in the decision tree.

Information

After each round the first-mover will be informed about his current round payoff.

After each round the second-mover will be informed about current round outcomes and his own payoff.

Payoff

With the completion of the 10 decision rounds you will receive the sum of your payments of every round in cash.

The following information was given to participants if the principal selected contract X or contract Y, respectively.

Contract X. Contract X, which is chosen by the first mover, is characterized by the fact that the output-contingent pay of the second mover does not rise monotonously in the output-level, i.e. the outcome sequence {low; high} leads to a higher payment than the output sequence {high; high} for every possible combination of effort levels.

The following examples will clarify this:

Effort ***Yes/no***	***Outcome sequence***	***Net-payment for second Mover with contract X***
{yes, yes}	{low; high}	2,5
{yes; yes}	{high; high}	2,1
{no; no}	{low; high}	3,4
{no; no}	{high; high}	3

Contract Y. Contract Y is characterized by the fact that the outcome sequence {low; high} leads to a lower payment than the output sequence {high; high} for every possible combination of effort levels.

The following examples will clarify this:

Effort ***Yes/no***	***Outcome sequence***	***Net-payment for second Mover with contract Y***
{yes, yes}	{low; high}	2,1
{yes; yes}	{high; high}	2,5
{no; no}	{low; high}	3
{no; no}	{high; high}	3,4

6.2 Treatment FC

6.2.1 First-mover instructions

Introduction: You are about to take part in a laboratory experiment to investigate individual behavior in decision making. During the experiment you participate in 10 repetitions (decision rounds). You can earn money. How much money you will earn depends on your decisions. After the experiment you will receive your entire payoff in cash.

Please read the following instructions carefully. Approximately five minutes after handing out the instructions we will come to your seat to answer any questions you may have. If you have questions during the experiment, please give us a sign and we will come to your seat.

No participants will receive any information on the identity and decisions of other participants during the experiment.

Situation and decisions: You face the same situation in each of the 10 decision rounds.

You are part of a labor relation that lasts for 2 periods. You are the employer (first-mover). A participant who will be randomly assigned to you is the employee (second-mover). You choose between two similar contracts X and Y that will be effective in all 10 decision rounds. Your choice determines the conditions for output-contingent pay that the second-mover receives and at the same time on the conditions for your own payoff.

The second-mover will be informed about your contract choice and about the contract you have not chosen (i.e. he will receive all information on each possible contracts) and then decides whether he expends "effort" or "no effort" in each of the two periods. The probability of achieving a high output will be influenced by the second-mover's effort choice. A higher probability of the high outcome is associated with "effort" than with "no effort". If the second-mover selects "effort" in any period he incurs personal effort costs of 0,45 €; "no effort" does not lead to effort costs.

The second-mover's first decision in point A determines whether he expends "effort" or "no effort". In case he chooses "no effort" the low outcome and the decision knot NE_N will be achieved with a probability of 60%. The high outcome and the decision knot NE_H will be reached with a probability of 40%.

In case the second-mover selects "effort", the low outcome and the decision knot E_N will be achieved with a probability of 20%. The high outcome and the decision knot E_H will be reached with a probability of 80%.

The second-mover's first-period decision also affects the outcome probabilities in period 2.

The second-mover's second decision determines whether he expends "effort" of "no effort" if he had achieved the low outcome or the high outcome in period 1. The relevant probabilities and the corresponding net payoffs (personal costs are already deducted) are given in the two decision trees for contract X and contract Y, respectively.

Both participants make their decision sequentially. You decide once on the contract, the second mover decides on his effort twice in each of 10 decision rounds given the information about both possible contracts.

Contract X is characterized by the fact that the output-contingent pay of the second mover does not rise monotonously in the output-level, i.e. the outcome sequence {low; high} leads to a higher payment than the output sequence {high; high} for every possible combination of effort levels. Contract Y, on the other hand, is characterized by the fact that the outcome sequence {low; high} leads to a lower payment than the output sequence {high; high} for every possible combination of effort levels.

The following examples will clarify this:

(Remark: The second-mover will get the same table of contract information)

Effort *Yes/no*	*Outcome sequence*	*Net-payment for second Mover with contract X*	*Net-payment for second Mover with contract Y*
{yes, yes}	{low; high}	2,5	2,1
{yes; yes}	{high; high}	2,1	2,5
{no; no}	{low; high}	3,4	3
{no; no}	{high; high}	3	3,4

The experiment is carried out on the computer. The computer will determine the results in each period by a random draw with the probabilities as they are given in the decision tree.

Information

After each round the first-mover will be informed about his current round payoff.

After each round the second-mover will be informed about current round outcomes and his own payoff.

Payoff

With the completion of the 10 decision rounds you will receive the sum of your payments of every round in cash.

6.2.2 Second-mover instructions

Welcome to the experiment!

Introduction:

You are about to take part in a laboratory experiment to investigate individual behavior in decision making. During the experiment you participate in 10 repetitions (decision rounds). You can earn money. How much money you will earn depends on your decisions. After the experiment you will receive your entire payoff in cash.

Please read the following instructions carefully. Approximately five minutes after handing out the instructions we will come to your seat to answer any questions you may have. If you have questions during the experiment, please give us a sign and we will come to your seat.

No participants will receive any information on the identity and decisions of other participants during the experiment.

Situation and decisions: You face the same situation in each of the 10 decision rounds.

You are part of a labor relation that lasts for 2 periods. A participant who will be randomly assigned to you is the employer (first-mover). You are the employee (second-mover). The first-mover selects one out of two similar contracts X and Y that will be effective in all 10 decision rounds. By making his contract choice he decides on the conditions for your output-contingent pay and at the same time on the conditions of his own payoff.

You will be informed about the chosen contract and about the contract that was not chosen (i.e. you will get all information about each possible contract). Then you decide whether you expend "effort" or "no effort" in each of the two periods. The probability of achieving a high output will be influenced by your effort choice. A higher probability of the high outcome is associated with "effort" than with "no effort". If you select "effort" in any period you incur personal effort costs of 0,45 €; "no effort" does not lead to effort costs.

Your first decision in point A determines whether you expend "effort" or "no effort". In case you choose "no effort" the low outcome and the decision knot NE_N will be achieved with a probability of 60%. The high outcome and the decision knot NE_H will be reached with a probability of 40%. In case you select

"effort", the low outcome and the decision knot E_N will be achieved with a probability of 20%. The high outcome and the decision knot E_H will be reached with a probability of 80%.

Your first-period decision also affects the outcome probabilities in period 2.

Your second decision determines whether you expend "effort" or "no effort" if you had achieved the low outcome or the high outcome in period 1. The relevant probabilities and the corresponding net payoffs (personal costs are already deducted) are given in the decision tree.

Both participants make their decision sequentially. The first-mover decides once on the contract, you decide on your effort twice in each of 10 decision rounds given the contract selected by the first-mover.

Contract X is characterized by the fact that the output-contingent pay of the second mover does not rise monotonously in the output-level, i.e. the outcome sequence {low; high} leads to a higher payment than the output sequence {high; high} for every possible combination of effort levels. Contract Y, on the other hand, is characterized by the fact that the outcome sequence {low; high} leads to a lower payment than the output sequence {high; high} for every possible combination of effort levels.

The following examples will clarify this:

Effort ***Yes/no***	***Outcome sequence***	***Net-payment for second Mover with contract X***	***Net-payment for second Mover with contract Y***
{yes, yes}	{low; high}	2,5	2,1
{yes; yes}	{high; high}	2,1	2,5
{no; no}	{low; high}	3,4	3
{no; no}	{high; high}	3	3,4

The experiment is carried out on the computer. The computer will determine the results in each period by a random draw with the probabilities as they are given in the decision tree.

Information:

After each round the first-mover will be informed about his current round payoff.

After each round the second-mover will be informed about current round outcomes and his own payoff.

Payoff

With the completion of the 10 decision rounds you will receive the sum of your payments of every round in cash.

6.3 Treatment FCR

6.3.1 First-mover instructions

Welcome to the experiment!

Introduction:

You are about to take part in a laboratory experiment to investigate individual behavior in decision making. During the experiment you participate in 10 repetitions (decision rounds). You can earn money. How much money you will earn depends on your decisions. After the experiment you will receive your entire payoff in cash.

Please read the following instructions carefully. Approximately five minutes after handing out the instructions we will come to your seat to answer any questions you may have. If you have questions during the experiment, please give us a sign and we will come to your seat.

No participants will receive any information on the identity and decisions of other participants during the experiment.

Situation and decisions: You face the same situation in each of the 10 decision rounds.

You are part of a labor relation that lasts for 2 periods. You are the employer (first-mover). In each decision round a participant will be randomly assigned to you. He is the employee (second-mover). At the beginning of each decision round you choose between two similar contracts X and Y. Your choice determines the conditions for output-contingent pay that the second-mover receives and at the same time on the conditions for your own payoff.

The second-mover will be informed about your contract choice and about the contract you have not chosen (i.e. he will receive all information on each possible contracts) and then decides whether he accepts or rejects the chosen contract.

If he rejects, you and also the second-mover will receive a fixed payment of 0,50 € each and the decision round will be finished.

If he accepts, the second-mover will decides whether he expends "effort" or "no effort" in each of the two periods. The probability of achieving a high output will be influenced by the second-mover's effort choice. A higher probability of the high outcome is associated with "effort" than with "no effort". If the second-mover selects "effort" in any period he incurs personal effort costs of 0,45 €; "no effort" does not lead to effort costs.

The second-mover's first decision in point A determines whether he expends "effort" or "no effort". In case he chooses "no effort" the low outcome and the decision knot NE_N will be achieved with a probability of 60%. The high outcome and the decision knot NE_H will be reached with a probability of 40%.

In case the second-mover selects "effort", the low outcome and the decision knot E_N will be achieved with a probability of 20%. The high outcome and the decision knot E_H will be reached with a probability of 80%.

The second-mover's first-period decision also affects the outcome probabilities in period 2.

The second-mover's second decision determines whether he expends "effort" of "no effort" if he had achieved the low outcome or the high outcome in period 1. The relevant probabilities and the corresponding net payoffs (personal costs are already deducted) are given in the two decision trees for contract X and contract Y, respectively.

Both participants make their decision sequentially. First you decide on the contract, the second-mover decides about the acceptance or the rejection of the chosen contract given the information about both possible contracts and in case of acceptance he will decide on his effort twice. This sequence will be the same in each of the 10 decision rounds.

Contract X is characterized by the fact that the output-contingent pay of the second mover does not rise monotonously in the output-level, i.e. the outcome sequence {low; high} leads to a higher payment than the output sequence {high; high} for every possible combination of effort levels. Contract Y, on the other hand, is characterized by the fact that the outcome sequence {low; high} leads to a lower payment than the output sequence {high; high} for every possible combination of effort levels.

The following examples will clarify this:

Effort *Yes/no*	*Outcome sequence*	*Net-payment for second Mover with contract X*	*Net-payment for second Mover with contract Y*
{yes, yes}	{low; high}	2,5	2,1
{yes; yes}	{high; high}	2,1	2,5
{no; no}	{low; high}	3,4	3
{no; no}	{high; high}	3	3,4

The experiment is carried out on the computer. The computer will determine the results in each period by a random draw with the probabilities as they are given in the decision tree.

Information:

After each round the first-mover will be informed about his current round payoff.

After each round the second-mover will be informed about current round outcomes and his own payoff.

Payoff

With the completion of the 10 decision rounds you will receive the sum of your payments of every round in cash.

6.3.2 Second-mover instructions

Welcome to the experiment!

Introduction:

You are about to take part in a laboratory experiment to investigate individual behavior in decision making. During the experiment you participate in 10 repetitions (decision rounds). You can earn money. How much money you will earn depends on your decisions. After the experiment you will receive your entire payoff in cash.

Please read the following instructions carefully. Approximately five minutes after handing out the instructions we will come to your seat to answer any questions you may have. If you have questions during the experiment, please give us a sign and we will come to your seat.

No participants will receive any information on the identity and decisions of other participants during the experiment.

Situation and decisions: You face the same situation in each of the 10 decision rounds.

You are part of a labor relation that lasts for 2 periods. In each decision round a participant will be randomly assigned to you. He is the employer (first-mover) and you are the employee (second-mover). The first-mover selects one out of two similar contracts X and Y that will only be effective in this decision round. By making his contract choice he decides on the conditions for your output-contingent pay and at the same time on the conditions of his own payoff.

You will be informed about the chosen contract and about the contract that was not chosen (i.e. you will get all information about each possible contract). Then you decide whether you accept or reject the chosen contract.

If you reject, you and also the first-mover will receive a fixed payment of 0,50 € each and the decision round will be finished.

If you accept, then you have to decide whether you expend "effort" or "no effort" in each of the two periods. The probability of achieving a high output will be influenced by your effort choice. A higher probability of the high outcome is associated with "effort" than with "no effort". If the second-mover

selects "effort" in any period he incurs personal effort costs of 0,45 €; "no effort" does not lead to effort costs.

Your first decision in point A determines whether you expend "effort" or "no effort". In case you choose "no effort" the low outcome and the decision knot NE_N will be achieved with a probability of 60%. The high outcome and the decision knot NE_H will be reached with a probability of 40%. In case you select "effort", the low outcome and the decision knot E_N will be achieved with a probability of 20%. The high outcome and the decision knot E_H will be reached with a probability of 80%.

Your first-period decision also affects the outcome probabilities in period 2.

Your second decision determines whether you expend "effort" or "no effort" if you had achieved the low outcome or the high outcome in period 1. The relevant probabilities and the corresponding net payoffs (personal costs are already deducted) are given in the decision tree.

Both participants make their decision sequentially. The first-mover choose the contract, then you decide about the acceptance or the rejection of the chosen contract given the information about both possible contracts and in case of acceptance you will decide on his effort twice. This sequence will be the same in each of the 10 decision rounds.

Contract X is characterized by the fact that the output-contingent pay of the second mover does not rise monotonously in the output-level, i.e. the outcome sequence {low; high} leads to a higher payment than the output sequence {high; high} for every possible combination of effort levels. Contract Y, on the other hand, is characterized by the fact that the outcome sequence {low; high} leads to a lower payment than the output sequence {high; high} for every possible combination of effort levels.

The following examples will clarify this:

Effort ***Yes/no***	***Outcome sequence***	***Net-payment for second Mover with contract X***	***Net-payment for second Mover with contract Y***
{yes, yes}	{low; high}	2,5	2,1
{yes; yes}	{high; high}	2,1	2,5
{no; no}	{low; high}	3,4	3
{no; no}	{high; high}	3	3,4

The experiment is carried out on the computer. The computer will determine the results in each period by a random draw with the probabilities as they are given in the decision tree.

Information:

After each round the first-mover will be informed about his current round payoff.

After each round the second-mover will be informed about current round outcomes and his own payoff.

Payoff

With the completion of the 10 decision rounds you will receive the sum of your payments of every round in cash.

Already published

No.	Title	Authors
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