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A carrot, a stick, or a relative piece-rate: an experimental study

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Abstract

Using an experimental setting, this paper investigates people's preferences over, and performance of, three compensation contracts: relative bonus-based, relative penalty-based, and relative piece-rate (RPR) contracts. It finds that, given the same expected payoff, most subjects prefer a bonus-based contract, followed by RPR, with the penalty-based being the least preferred choice. While evaluating efficiency, we find that bonus-based compensation results in the worst performance, while the performance levels under penalty-based and RPR contracts are virtually identical.

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1. Introduction

The expected utility maximization principle is a fundamental assumption in economics and finance. This assumption implies the need for compensation contracts that incentivize employees to put in the desired amount of effort. Although excessive or insufficient incentives may reduce effort level, even below that which people are willing to exert given a fixed payoff (Gneezy and Rustichini, 2000; Ariely *et al*., 2009; Dodonova and Khoroshilov, 2014), it is generally true that people are willing to put in more effort when such effort is more likely to result in a higher payoff. Not only the shape, but also the perception of the compensation contract matters. Loosely speaking, most incentive contracts can be divided into three categories: bonus-based contracts (e.g., extra pay for achieving the set goal or a promotion in tournament-pay structures), penalty-based contracts (e.g., a fine for not meeting the target or a layoff of the worst performing employees), or piece-rate payment structures (e.g., sale commissions).

The experimental study presented in this paper investigates the preferences of people for specific incentive payment structures (bonus, penalty, or piece-rate) in a relative performance compensation setting, as well as the effects of these compensation structures on performance. Existing experimental research (Luft, 1994; Hannan et al., 2005; Christ et al., 2012) that compares bonus-based and penalty-based compensations usually focuses on differences in contract framing, where the same payment structure can be presented as a bonus for achieving a specific goal or a penalty for not achieving it. These studies find that framing a payoff as a penalty increases productivity, which can be attributed to loss-aversion (Kahneman and Tversky, 1979). In this paper, we adopt the approach that any deviation from fixed payoff in a tournament setting, be it a bonus or a penalty, is a low-probability event, so, when a given group of employees competes against each other, only a small number of people will receive a bonus or will have to pay a penalty.

Our study is most closely related to Agranov and Tergiman's (2013) study that investigates the performance of absolute piece-rate, relative bonus-based (tournament), and relative piece-rate (RPR) compensation structures. In our study, we similarly look at RPR and relative bonus-based contracts, but we also consider relative penalty-based compensation where the worst performer in the group must pay a penalty, and we drop non-relative piece-rate compensation from consideration. In addition, while Agranov and Tergiman (2013) consider compensation structures that generate the same expected utility for employees, we consider contracts with the same expected payoffs (i.e., the same expected costs for the employer), allowing us to study the preferences of employees over the proposed contracts. Similar to Agranov and Tergiman (2013), we find that RPR outperforms the bonus-based tournament compensation structure. While we also find that penalty-based compensation outperforms bonus-based compensation, we find no difference between subjects' performance under penalty-based and RPR contracts. When it comes to subjects' preferences, bonus-based compensation was the most preferred, followed by RPR, with penalty-based compensation being the least desired option.

2. Experiment set-up

In total, 96 subjects, recruited from the pool of undergraduate students, participated in eight identical sessions with 12 subjects per session. Subjects were paid a $5 participation fee plus the incentive compensation payment as described below.

The subjects were presented with two 468-digit numbers, each of which took six full lines on the printed paper, and tasked with determining how many of each of the digits 0, 1, 2, …, 9 were found in each number. They were allowed 20 minutes to work on the task.

The subjects' scores were computed as the total number of correctly identified digits with no penalty for incorrect answers, so an individual's score could be any integer number between 0 and 20 inclusive. The subjects were divided into three groups of four based on the payment structure. In group 1, bonus-based compensation was used: Everybody received a $20 incentive compensation payment, and the person who correctly identified the greatest number of digits received an extra bonus of $20. Group 2 was the penalty-based group, where each subject received $30, but the subject with the worst performance had to pay a $20 penalty. Group 3 was the RPR group, where the total prize pool of $100 was divided among subjects proportionally to the ratio of their performance to the total number of correct answers in the group, i.e., the incentive payment of subject i was set to $\frac{\$100 n_i}{\sum_{j=1}^{4} n_j}$, where n_j is the number of correct answers given by subject j. If there was a tie in groups 1 or 2, the respective bonus or penalty was shared equally among the tied subjects. In all groups, the average incentive compensation payment was $25 per person. While $25 was the average incentive compensation payment paid per subject and the unconditional expected incentive compensation payment received by any subject in any payment group, the conditional expected compensation, based on a subject's relative ability, depended on both said subject's relative ability and the payment group they were assigned to. Furthermore, since subjects were not aware of their true relative ability, they made their decisions based on their perceived relative ability.

Prior to performing the task, subjects were given one 468-digit number with correct answers to practice for 10 minutes. After practicing, subjects were asked to rank their preferences over the three payment groups. Two randomly chosen subjects were assigned to their most preferred group, one more randomly chosen subject was assigned to their second-best group, and all remaining subjects were assigned into groups randomly. This assignment procedure made it optimal for subjects to reveal their preferences truthfully, and subjects were informed both of this procedure and that it was in their best interests to truthfully report their preferences.

3. Data and results

Table I presents the ranking of the three different compensation structures (bonus, penalty, and RPR) and the p-values for paired sign tests, where the most preferred option corresponds to rank 1 and the least preferred to rank 3. This table shows that bonus-based compensation was the most preferred option and that penalty-based compensation was the least preferred (all differences are significant at the 1% level). If subjects believed that their ability was at the average level, and their

absolute risk averseness decreased with income (as in the case of the Constant Relative Risk Aversion utility function), their preference for bonus-based over penalty-based compensation can be easily explained their risk-averseness. The pairwise rankings of RPR with bonus-based and penalty-based compensation, however, do not follow directly from risk or loss-averseness.

Table I: Payment structure preferences

Compensation contract type	**The number of subjects who ranked the specified compensation structure as:**			**Average rank**	**p-values for paired sign tests**		
	Best (rank=1)	2nd best (rank=2)	Worst (rank=3)		Bonus	Penalty	PTP
Bonus	56	30	10	1.52	n/a	0.000	0.000
Penalty	17	18	61	2.46	0.000	n/a	0.001
RPR	23	48	25	2.02	0.000	0.001	n/a

Table II presents the average performance (number of correct answers, with standard deviations given in brackets) of each contract type and the p-values for two-sample t-tests. It shows that bonus-based compensation results in the worst performance, while performance levels under penalty-based and RPR compensations are virtually identical. Since subjects may self-select into payment groups, to further confirm our results, Table III presents the average performance of each contract type for the subsample of subjects who were randomly assigned into the groups. The qualitative results of the randomly-assigned subsample are the same as those of those of the entire sample. They remain significant at the 5% significance level, although the associated p-values are higher than for the entire sample due to smaller sample size. It is worth noting that the average performances reported in Tables II and III are very similar, which implies that a subject's performance depends on their ability and payment group and not on whether they were assigned to their most preferred group. Unfortunately, since most subjects ranked the bonus-based compensation structure first, there is not enough data to directly test whether subjects allocated to their most preferred groups performed significantly different from subjects in the same payment group but who ranked a different group first.

Table II:
The effect of compensation structure on performance (number of correct answers): full sample

Contract type	**Number of subjects**	**Average performance**	**p-values for two-sample t-tests**		
			Bonus	Penalty	RPR
Bonus	32	2.88 (2.01)	n/a	0.013	0.006
Penalty	32	4.50 (2.96)	0.013	n/a	0.999
RPR	32	4.50 (2.51)	0.006	0.999	n/a

Table III:
The effect of compensation structure on performance (number of correct answers): subsample of subjects randomly allocated into payment groups

Contract type	Number of subjects	Average performance	p-values for two-sample t-tests		
			Bonus	Penalty	RPR
Bonus	21	2.72 (2.22)	n/a	0.049	0.021
Penalty	29	4.31 (2.93)	0.049	n/a	0.586
RPR	22	4.68 (2.92)	0.021	0.586	n/a

The better performance of RPR compensation relative to bonus-based compensation is consistent with the findings of Agranov and Tergiman (2013), even though in our study the expected wage was kept the same, while Agranov and Tergiman (2013) used contracts that deliver the same expected utility. The superior performance of penalty-based compensation relative to the bonus-based compensation is consistent with prior studies of contract framing. However, unlike those prior studies where only the framing varied, and so penalty was a small probability event while bonus was a large probability event, we kept the bonus and penalty probabilities equal at 25%, making them both small probability events.

On the other hand, the indistinguishable performance of penalty-based compensation from RPR compensation sheds some doubts on the prevailing beliefs that penalty-based contracts are the most efficient way to elicit the highest effort: A simple RPR contract is just as effective. Combined with the fact that RPR is preferred to penalty-based compensation by most subjects, if one was to adjust the fixed portion of compensation to make people indifferent between penalty-based and RPR contracts, RPR contracts would elicit the same effort level but offer lower expected payoffs (i.e., be cheaper to implement).

4. Conclusion

This paper presents the results of an experimental study investigating the performance of bonus-based, penalty-based, and RPR compensation structures in a tournament setting. In this study, subjects were faced with a non-trivial counting task, and, after some practice, were asked to rank the proposed compensation contracts. Then, the subjects were assigned into different payment groups either based on their ranking or randomly. We found that subjects preferred the bonus-based contract the most, and preferred the penalty-based contract the least. When it comes to effectiveness, subjects who were offered bonus-based compensation performed the worst, while subjects who had penalty-based or RPR contracts performed identically. The latter result, together with the subjects' revealed preferences towards RPR over penalty-based contracts and the fact that all contracts had the same average payoffs, allows us to conclude that RPR compensation is a better choice for incentivizing people to put in the desired level of effort.

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