Economics Letters 124 (2014) 304–307

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

# Compensation and performance: An experimental study

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## HIGHLIGHTS

- How monetary incentives affect performance in a simple but effort-consuming task?
- Per-unit compensation function has a positive non-linear effect.
- Option-based compensation results in better performance.

## ARTICLE INFO

*Article history:*
Received 24 January 2014
Received in revised form
27 May 2014
Accepted 6 June 2014
Available online 13 June 2014

*JEL classification:*
C9
G3
J3

*Keywords:*
Compensation contract
Incentive contract
Experimental study

## ABSTRACT

This paper investigates how compensation structure affects performance in a simple but effort-consuming task. In this experimental study, the subjects were asked to multiply two-digit numbers for 40 min and were paid using either a linear (with different pay for performance sensitivities) or a convex (option-based) compensation mechanism. We found that per-unit wage has a non-linear positive effect on performance: whereas increasing per-unit compensation from \$0 to \$0.02 or from \$0.05 to \$0.15 has virtually no effect on performance, an increase from \$0.02 to \$0.05 results in higher productivity. We also found that option-based compensation results in better performance.



## 1. Introduction

This paper reports the results of an experimental study that tests the effectiveness of stock-based (linear) and option-based (convex) compensation contracts. Performance-based compensation contracts are one of the main mechanisms employed to incent employees to exert effort, and, for top management, they usually consist of bonuses, restricted stocks and stock option grants. The latter two are the main components of any executive compensation contract (Murphy, 1999, 2004). Whereas most researchers agree that restricted stocks and stock option grants incent managers to work harder, there is still an ongoing debate regarding which method provides greater incentives.

The study of performance-based compensation contracts dates back to the seminal work of Fama (1980), Holmstrom (1982), and Holmstrom and Milgrom (1987). While restricted stock and stock option grants have their own specific characteristics, one of the fundamental differences between them is the shape of the payoff structure: linear (in the case of restricted stocks) vs. convex (in the case of stock option grants). The choice between the optimal mix of stock-based and option-based contracts may depend on many factors, such as managerial risk aversion (Hall and Murphy, 2002), the manager's expected compensation and limited liability constraints (Lambert and Larcker, 2004; Kadan and Yang, 2005), or behavioral biases that affect the manager's utility function (Dodonova and Khoroshilov, 2006).

In this paper, we analyze how the pay-to-performance sensitivity of a linear contract and the choice between linear and convex (option-based) compensation contracts affect people's performance in a simple but effort consuming task. The existing evidence of the effect of financial incentives in experimental settings is mixed. Camerer and Hogarth (1999), that reviews 74 experimental studies with varying degree of performance pay, shows that providing such incentives (or increasing their magnitude) may improve, reduce, or have no effect on the subjects' performance depending on the nature of the task performed. In particular, financial incentives may hurt performance when such

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http://dx.doi.org/10.1016/j.econlet.2014.06.004
0165-1765/

**Table 1**
Performance: a descriptive statistics.

| Treatment | Compensation | | #of subjects | Performance min | max | mean | st. dev. |
|---|---|---|---|---|---|---|---|
| 1: "Flat" | $20 flat wage | | 26 | 4 | 175 | 73.8 | 43.4 |
| 2: "$0.02" | Linear with low p-t-p: $18 + $0.02 per question | | 30 | 3 | 144 | 88.8 | 38.2 |
| 3: "$0.05" | Linear with medium p-t-p: $15 + $0.05 per question | | 31 | 62 | 205 | 112.9 | 33.0 |
| 4: "$0.15" | Linear with high p-t-p: $5 + $0.05 per question | | 56 | 60 | 196 | 110.3 | 33.5 |
| 5: "options" | Option-based: $5 + $0.60 per question in excess of 90 | | 34 | 61 | 208 | 122.4 | 34.6 |
| 6: "choice" | Choice between "linear with high p-t-p" or "option-based" | Total | 54 | 40 | 201 | 112.4 | 36.4 |
| | | When subjects have chosen linear | 42 | 40 | 185 | 105.8 | 32.2 |
| | | When subjects have chosen option-based | 12 | 77 | 201 | 135.8 | 42.7 |

incentives make people self-conscious and afraid to make mistakes while incentive pay has no effect when the magnitude of such incentives are low, when an increase in performance requires disproportionally higher effort of when the subjects are sufficiently self-motivated to performed well without additional financial incentives. In addition to studying the direct pay-to-performance sensitivity effect, there are experimental studies that deal with analyzing different types of tournament-based compensations (Hannan et al., 2008; Newman and Tafkov, 2011), studying the effect of positive vs. negative contract framing (Hannan et al., 2005; Church et al., 2008), and comparing direct and relative performance mechanisms (Bonner et al., 2000; Agranov et al., 2013). Finally, some studies document that people are more likely to honor their contracts if they were involved in their design (Eigen, 2012) and that workers' performance may be positively affected by their ability to affect the choice of their own incentive compensation scheme (Charness et al., 2012, 2013).

While there is a significant body of empirical research that studies the pay-to-performance sensitivity of the incentive contracts (including seminal work of Jensen and Murphy, 1990 and Hall and Liebman, 1998) and provides an empirical analysis of the pros and cons of linear and option-based (convex) compensation contracts (Certo et al., 2003; Hanlon et al., 2003; Kato et al., 2005), to the best of our knowledge, this paper is the first attempt to directly compare stock-based and option-based compensation contracts in an experimental setting. The experimental settings allows us to separate the contract effect from any additional factors that may affect the people's effort decision and our ability to measure it.

## 2. The design of the experiment

In this experimental study, the subjects, recruited from a pool of undergraduate students, were asked to multiply two-digit numbers for 40 min without the use of a calculator. In total, 231 subjects, recruited using online Brown University Social Science Experimental Laboratory recruitment system, participated in six different treatments. The first four treatments were design to examine the effect of the pay-to-performance sensitivity of linear incentive contracts. In the first treatment, subjects were paid a flat wage of $20 ("flat"). In treatments two to four, subjects' payments depended linearly on the number of correctly computed multiplications. In the second treatment, subjects were paid a show-up fee of $18 plus $0.02 for each correctly computed multiplication ("$0.02"). In the third treatment, they were paid $15 and $0.05 per multiplication ("$0.05"). In the fourth treatment, the payments were $5 and $0.15 ("$0.15"). In the fifth treatment, designed to test the effect of convex, option-based compensation mechanism, subjects were paid a $5 show-up fee plus $0.60 for each correct multiplication in excess of 90 ("options"). In the final treatment, before starting the task, the subjects were able to choose between the option-based and linear ($0.15 per multiplication) payment structures ("choice"). The latter treatment was conducted to test the hypothesis that people are more likely to exert greater effort if they were able to chose their own compensation scheme.

The parameters of the model were chosen such that the average compensation was approximately $20 and in the option-based treatment, both the average and the median expected payments were $20 (the parameters of the option-based treatment were chosen after the fixed-wage and linear compensation treatments had been concluded). There was no penalty for incorrect multiplications, but the subjects were required to provide the correct answer to the current problem before moving on to the next one. Before the start of any experimental session, subjects were asked to complete a four-minute trial round. The experiment was programmed and conducted using the *z*-Tree software (Fischbacher, 2007).

## 3. The results

Table 1 presents the descriptive statistics of the subjects' performance in different treatments. Table 2a reports the p-values for the two-sample t-tests used to compare the average performances in different treatments. As these tables show, the higher pay-to-performance sensitivity (p-t-p) of a linear contract has a non-linear positive effect on performance. Such an effect is similar to the step function, where the subjects have a pay-to-performance threshold that triggers a genuine effort level, whereas a change in the p-t-p without going through the threshold has little effect on performance. Indeed, while increasing per-unit compensation from $0 to $0.02, or from $0.05 to $0.15, has virtually no effect on performance, the increase from $0.02 to $0.05 leads to a jump in productivity. The option-based compensation results in better performance than any of the linear contracts; however, the difference between the average performance in the treatments with option-based ("options") and high p-t-p ("$0.15") linear contracts is significant only at the 10% level.

As Table 1 shows, the minimum performance scores in the "flat" and "$0.02" treatments are 4 and 3 respectively, while the minimum performance in all other treatments is at least 40. The only plausible explanation for this effect is that some of the subjects in the treatments with flat wage and low pay-to-performance sensitivity contracts were not incentivized sufficiently to put any serious effort into the task and simply sat out the experiment awaiting their basic compensation. To separate this "non-participation" effect from the effect that the pay-to-performance sensitivity might have on the level of effort of those who were actually trying to perform the task, we eliminated the