Universitat Autònoma de Barcelona

COMPENSATION SCHEMES WHEN WORKERS HAVE DIFFERENT CHARACTERISTICS: THREE EXPERIMENTAL ESSAYS

José M. Ortiz Gómez

Universitat Autònoma de Barcelona

DOCTORAL DISSERTATION

COMPENSATION SCHEMES WHEN WORKERS HAVE DIFFERENT CHARACTERISTICS: THREE EXPERIMENTAL ESSAYS.

Author

José M. Ortiz Gómez

Advisors

Jordi Brandts Bernad
Carles Solà Belda

Department of Business

Barcelona, Spain

2017

Universitat Autònoma de Barcelona

DOCTORAL DISSERTATION

COMPENSATION SCHEMES WHEN WORKERS HAVE DIFFERENT CHARACTERISTICS: THREE EXPERIMENTAL ESSAYS.

Author

José M. Ortiz-Gomez

Advisors

Jordi Brandts
Carles Solà-Belda

Department of Business

Barcelona, Spain

2017

ABSTRACT

Motivating workers in the workplace is one of the cornerstone issues that managers face in their daily business life. However, this is not an easy task to implement since not all workers react in the same way to a same incentive. A growing literature studies how workers reacts to different incentives. However, there are few studies that look at how workers with different characteristics respond to the same incentive scheme. My dissertation contributes to this body of the literature by investigating several situations where managers have to motivate workers with different characteristics to exert the higher possible effort.

In the first chapter of the thesis we present results from three-player experiments aimed at studying distributional concerns in how owner-managers compensate themselves and workers of different productivities and effort costs. We use a game in which workers first exert effort and owner-managers then decide on bonuses for themselves and workers. Our motivation is to contribute to understanding both the vertical and the horizontal dimensions of the distributional concerns of owner-managers. We are also interested in how owner-managers decisions' are affected by pay secrecy. Our design includes four treatments: 1) different productivities of workers with complete information; 2) different productivities of workers with pay secrecy among workers; 3) different effort cost of workers with complete information; and 4) different effort cost of workers with pay secrecy among workers. We find that, on average, managers do not pay relative wages in accordance to relative production levels. In our data about 1/3 of additional production translates into additional compensation. The equalizing tendency of managers' compensation policies together with the fact that high-productivity workers exert more effort in all cases leads to ex post

similar income levels among workers. We also find that pay secrecy does not affect wage differences among workers. Across all treatments about 50% of all manager choices are compatible both with 'production equity' and with effort- cost equity.

In the second chapter, we present an experimental analysis that investigates compensation policies and its effects when workers differ in its distribution impact on profits. Specifically, we set three types of workers according to their impact in profits. We introduce one standard worker (routinely used in gift-exchange experiments); a star worker who outperforms the standard worker by doubling its productivity for every level of effort; and a guardian worker who generates losses unless he/she exerts high effort. Managers will face combinations of these workers and set compensations. Our objective, hence, it is to analyze the determinants of different types of workers on wage setting decisions. We observe that guardians get more compensation in relation to the soldier than stars do since managers seek to avoid negative production. Moreover these differences change the effort decisions by the negatively discriminated worker when a guardian and a star are paired together, but it does not change the effort decision of the positively discriminated worker in any situation. We interpret this as evidence of unacceptable unfair wage distributions and give a reason for its cause and prevalence.

In the third chapter, we study the incentive effect of firing threats when bosses have limited information about workers. We show that, regardless of the amount of information possessed by the boss, firing threats substantially boost workers' production and reduce on-the-job leisure. Even when the boss has no individual information about workers' effort and production levels, firing threats have strong incentive effects. Any minimal amount of individual information about workers individual effort such as the time they spend at their work station is sufficient to ensure strong incentive effects. Our findings thus support the use of firing threats based on rudimentary yet uncontroversial measures of work performance such as absenteeism, in organizational settings in which limited information about workers is available.

ACKNOWLEDGEMENTS

I am finishing what I could define as the most enriching period of my life. You all know I am not a very talkative person, so you should know I am already writing too much. ;-)

I would like to thank each person and animal I have met during these years for their support and patience, from the first person I saw when I arrived in Barcelona to the last platypus I saw in Australia.

Lastly, special thanks go to Jordi Brandts and Carles Solà. I am glad that they decided to supervise my doctoral thesis and appreciate their constant support in the good and bad moments of the Ph.D. process.

TABLE OF CONTENTS

Introduction

Motivating workers is one of the most important (if not the most important) tasks that managers have to perform to generate successful organizations. To make this task even more difficult, not all workers respond to incentives in the same way. Most people think that money is the only incentive that works. However, sometimes, people react in a higher extent to non-monetary incentives than to monetary ones or people do not work harder when they are paid more (Gneezy and Rustichini, 2000). This is the reason why managers need to find different incentives to motivate their workers because workers may have different characteristics or goals.

There is a growing literature in behavioral economics studying how workers react to different incentives (Charness and Kuhn, 2011). However, the vast majority of the papers are focused in studying workers who have the same characteristics. My dissertation contributes to this literature by analyzing the behavior of managers and workers in environments where workers have different characteristics.

The doctoral dissertation is composed by three essays, each of which is presented in a separate chapter. In each essay, we use experiments to analyze how subjects interact with each other and respond to different incentives. Laboratory experiments have the advantage of a controlled environment where you can isolate the variables you want to study (Falk and Heckman, 2009). Here subjects take their decisions anonymously. They are motivated to respond to incentives in experiments since they get paid for the decisions they take.

In the first chapter of this dissertation, we study how managers distribute total production generated by two workers with different characteristics. In one hand, we study the case where workers have different productivity levels. In this setting one worker is twice as productive as the other worker. In the other hand, we study the case where workers have different cost of effort. Here the cost of effort of one worker doubles the cost of the other worker. The aim of this experiment is to disentangle the weight that managers give to production, effort and cost of effort when they decide how to pay to different workers. We find that managers pay more to the workers whose production is higher. Managers do not take into account other workers' characteristics like higher effort levels or higher cost of effort. We also find that pay secrecy does not change managers' behavior.

In the second chapter, we study how different job characteristics affect wage distribution. Our experiment consists of three treatments in which we have a manager who is paired with two workers who have different characteristics. We have three types of workers: a soldier who can positively contribute to the company's profit but to a certain level, a star who can contribute twice as much as the soldier to the company's profit, and a guardian whose contribution may be negative if the level of effort spent is low. This experiment helps us to better understand why some jobs like stevedores or truck drivers are better paid than others when workers do not need to have a special ability to perform them. We find that the wage gap between the guardian and the soldier is higher than the wage gap between the star and the soldier. We attribute this result to loss aversion. Managers prefer to avoid loses than to account for potential gains. We also find that workers do not react to positive wage discrimination. However, guardians and stars react to negative wage discrimination when they are paired together. Finally, we find that soldiers and stars receive higher wages when they are paired with guardians.

In the third chapter, we study how different levels of information for the boss about workers' activities in the workplace, affects workers' performance in the presence of firing threats. In our experiment we have three different sets of information (treatments). Depending on the treatment the boss may have access to workers' total production, individual working time and individual production. In the treatment with no individual information the boss only knows the group total production. In the partial information treatment, the boss may know the total production of the group and the individual working time. Finally, in the complete information treatment, the boss may have all the information available (total production, individual working time and individual production). In this experiment the boss may fire one worker at the end of each production period. We have a control treatment where it is not possible to fire any worker. This setting allow us to study if just the threat of being fired is powerful enough to motivate workers or it also needs a certain level of information to be effective. We find that just the threat of being fired is effective to motivate workers. When we add information about the individual working time, the threat of being fired becomes a stronger motivational incentive. However, adding the individual production into the picture does not seem to increase workers' production. This is driven by low ability workers who are not motivated who know that they will be fired when information is complete.

References

Charness, G., and Kuhn, P. (2011). Lab labor: What can labor economists learn from the lab?. Handbook of labor economics, 4, 229-330.

Gneezy, U., and Rustichini, A. (2000). Pay enough or don't pay at all. The Quarterly Journal of Economics, 115(3), 791-810.

Falk, A., and Heckman, J. J. (2009). Lab experiments are a major source of knowledge in the social sciences. Science, 326(5952), 535-538.

Chapter I: Distributional Concerns in Managers' Compensation Schemes for Heterogeneous Workers: Experimental Evidence

1. Introduction

Distributional concerns are a central issue in structuring compensation systems in companies as well as in other organizations.[1] Workers and society as a whole are sensitive to how the production of firms is distributed among their stakeholders. In this chapter we present the results of a lab experiment which we conducted to shed light on how managers decide how to compensate their workers. We define a compensation scheme as the vector composed by the wages that a manager sets for his/her workers.

We are interested in identifying the distributional principles consistent with the compensation schemes applied by managers and, to better discern them, abstract from possible incentive effects of different compensation schemes. We do this by studying behavior in an environment where workers first produce and the manager then decides on a compensation scheme. Our design is influenced by those of Croson and Konow (2009), Rigdon and Cassar (2011) and Abeler, Altmann, Kube and Wibral (2010).

In our set-up we have three players on two hierarchical layers: a manager and two workers. The two workers first independently make effort decisions, which jointly determine the production that can be distributed between the three workers involved. Total production is the sum of the productions of the two workers. Managers are owner-managers in the sense that they do not contribute directly to production, but have the right to make distributional decisions.

[1] See Milkovich, Newman and Gerhard (2011).

Managers observe workers' effort levels and contributions to total production and then decide how much of the total production to distribute to each of the two workers and how much to keep. Hence, managers make decisions that will give us information on vertical distributional concerns, pertaining to the division of the value of production between herself and workers, as well as on horizontal ones, the criteria that drive the relative earnings of the two workers as decided by managers.[2] Observe that in our set-up the distributional decision is not made by an uninvolved third party as considered by Konow (2009) or by one of the parties who creates the surplus as in Cappelen, Hole, Sørensen and Tungodden (2007).

We study managers' behavior in two different settings by varying workers' characteristics (productivity and cost of effort). The first characteristic we study is workers' productivity. The fact that workers differ in their ability to contribute to total production is a central determinant of differences in earnings in a market economy. Here we want to study how managers decide how much to allocate to workers of different productivities.

We model productivities as exogenously given personal characteristics. A worker's productivity parameter together with his effort level determines his contribution. The value of the productivity parameters are common information for the three players. In our set-up total production is additive so that the contributions of different workers can be clearly attributed to each of them.[3]

The second characteristic we study is cost of effort. Professional projects may differ in complexity and require more personal implication to get the same quantifiable performance than others. An example of this is that for sales personnel it is easier to sell a certain product in some geographical

---

[2] For other experimental studies on vertical vs. horizontal fairness in an organizational context see Güth, Königstein, Kovács and Zala-Mezõ (2001).

[3] This set-up resembles the one used in optimal income tax theory (see Mirrlees 1972).

areas or neighborhoods than in others. Hence, for the same result different effort levels are required.

The two sources of heterogeneity have different effects. Productivity differences will imply different production levels for the same employee effort cost, while cost of effort differences are irrelevant to production and only have a personal impact on the employee. Here we want to find out how this difference in the impact of heterogeneity on production affects the distributive decisions of the manager.

Moreover, distributional decisions may be affected by the information that those involved in the situation have available. In many organizations there exists some form of pay secrecy practice, which can take different shapes. In some cases pay secrecy can just be the result of informal group norms, while in other cases workers are explicitly instructed not to talk about salaries with others workers. From the point of view of management of firms or organizations pay secrecy can have advantages and disadvantages (see Colella et al., 2007). We study two polar cases. In one case both workers know both wages and in the other case they both only know their own wage. Our focus is on whether for given conditions and effort levels the manager behaves differently under pay secrecy than in the absence of it, perhaps using moral wiggle room to create a larger pay difference. We will also be able to study whether workers exert different effort levels with and without pay secrecy.

2. Literature Review

To center our discussion, we focus on the experimental literature that analyzes fairness questions in labor environments, where production is involved. [4] There are previous studies using the traditional gift-exchange structure to study how workers' productivity affects wage distribution. For example, Charness and Kuhn (2007) design a gift exchange game where a manager is matched with two workers with different productivity levels. Effort and wages are not contractible. In their experiment the manager chooses the wages and then the workers choose the level of effort, without information on the other worker's characteristics. They analyze workers' behavior in situations with or without secrecy, finding that coworkers' wages do not affect the workers' decisions.

The work of Güth et al. (2001) also goes in the same line. They analyze managers' behavior when effort is observable and when effort is not observable. In their design a manager is matched for the whole experiment with the same two workers who differ in productivities. First, the manager offers a contract to each worker that they can accept or not. If either of them does not accept, both the worker and the manager receive zero. They find that the manager offers more asymmetric contracts when contracts are not observable than when contracts are observable.

Equity has been also studied from the point of view of workers' equity concerns. In this line, Abeler et al (2010) use a reverse gift-exchange game to analyze the behavior of workers when the manager has to pay the same to each worker and when the manager may choose a different wage for each worker. Here one manager is matched with two workers with equal abilities. Workers move first and then the manager pays them. Results show that workers exert more effort when the

[4] Equity (Adams, 1965), inequality aversion (Fehr and Schmidt, 1999 and Bolton and Ockenfels, 2000), fairness (Fehr, Klein and Schmidt, 2007), or reciprocity (Rabin, 1993; Charness and Rabin, 2002; Konow, 2003) have generated a vast literature, both in the theoretical area as well as in the experimental literature. Dictator games (Cappelen, et al. 2007), ultimatum games (Kagel and Wolfe, 2001), and public good games (Fehr and Gächter, 2000) among others, have been used to study fairness preferences. All these studies find that most people do not behave completely selfishly, and they share gains with other individuals when homo economicus model states that they should give zero to others.

manager can choose a different wage for each worker. They demonstrate that pay equality is not a good way to incentivize workers.[5]

Following the line of workers' equity concerns, Schneider and Kube (2006) use a similar design to Abeler et al. (2010) to analyze if personal relationships produce wage differences between workers. In their design, one manager is matched with two workers. In each firm, the manager and one worker are friends in the real life while the other worker is an unknown individual who is matched anonymously to the manager. They compare wage secrecy with public wages as we do in our experiment. They find that personal relationships do not create wage differences between workers in any of the treatments.

In the same vein, Gross, Guo and Charness (2015) study how managers set wages in a multi-worker gift-exchange experiment where workers have different productivities and the manager has imperfect information about workers' productivities. They find that managers compress wages when this information is more uncertain.[6]

Equity is also studied in team experiments.[7] In their work, Meidinger, Rullière and Villeval (2001), design an experiment analyzing workers' decisions when teams are homogeneous and when teams are heterogeneous.[8] Workers' payoff depends on both own performance and the team performance. They find that when the teams are heterogeneous much free-riding occurs. When the teams are homogenous there is much more coordination and they achieve more efficient payoff.

Equity concerns have also been studied using trust games. Rigdon and Cassar (2011) develop a trust game design with two senders and one receiver and find that the amounts that the receiver

[5] Lazear (1989) also demonstrates that pay equality leads to a lower efficient result than others pay schemes.
[6] See Karni and Safra (2002a, b), Karni, Salmon and Sopher (2008) and Karagözoğlu and Riedl (2014) for more literature in fairness studies with uncertain information.
[7] In team experiments the final income of every player depends, completely or partially, on the performance of the whole group. See, for example, Corgnet, Sutan, and Veszteg (2011).
[8] When teams are homogeneous all the agents have the same productivity and when teams are heterogeneous the agents have different productivities.

returns depends on the amounts sent by both senders. In their game the two senders are identical so that they can not study how different productivities of effort costs affect behavior.

The rest of the chapter is structured as follows. In the next section we describe the experimental design and discuss theoretical predictions. In section 3 we present and discuss our results. Finally, conclusions are drawn in section 4.

3. Design and hypotheses

3.1 Treatments

Our design is based on the reverse-order gift-exchange game with two workers, A and B, and a manager. Together the three players constitute a firm. The game has two stages. In the first stage, workers simultaneously choose effort levels. The firm's production depends on the level of effort exerted by the workers A and B, denoted by e_A and e_B, and the productivity levels of the two workers denoted by P_A and P_B. Workers know their own productivity when they choose the level of effort but they don't know the wage they will receive.[9] A worker's production is the product of his productivity and the effort he chooses. In our setting neither effort nor wage levels are contractible, but effort is pre-spent.

In the second stage, after observing the level of effort, the production and the cost of effort of both workers, the manager chooses a compensation scheme for the two workers, w_A and w_B, and keeps the rest for herself.

The payoffs are determined as follows, where $C_i(e_i)$ denotes that the cost of effort of worker i depends both on the effort exerted by him and on his effort cost function:

[9] For convenience, we will consider the manager as female and the workers as males.

Income Manager	$\pi_P = P_A(e_A) + P_B(e_B) - (w_A + w_B)$
Income Worker *i*	$\pi_i = w_i - C_i(e_i)$, i=A,B.

Table 1: Payoffs of players (all treatments).

Differences in productivities and the effort cost functions of the two workers, as well as different information conditions determine our treatment variations. We have a total of four treatments. We design two treatments to study a situation where workers differ in productivity levels and another two treatments to study a situation where workers differ in cost of effort levels. Table 2 shows an overview of our four treatments.

	Different productivities, equal costs	Equal productivities, different costs
Full information	*Baseline*	*Different Effort Costs (DEC)*
Secrecy	*Secrecy*	*Different Effot Costs Secrecy (DECS)*

Table 2: Treatments.

In all treatments the productivity parameters and the effort cost functions of the two workers are commonly known for all players at the beginning of the game as well as the payoff functions.

In the Baseline treatment there is full information and cost equality. Workers have different productivities, P_A =14, P_B = 7, and identical effort cost functions, and all three workers have full information about these parameters as well as about workers' effort choices and the manager's wage choices. The effort cost function common to both workers is shown in table 3.

Effort level e_i	1	2	3	4	5	6	7	8	9	10
Cost of effort $C(e_i)$	0	1	2	4	6	8	10	13	16	20

Table 3: Cost of effort (Baseline and Secrecy treatments).

Note that since workers have different productivity factors effort choices have different impact on the organization's production.

In our experiment there will be several rounds and the differences between our two information conditions pertain to what information workers receive at the end of the round. In the Baseline treatment, the manager and the two workers are - at the end of every round - informed about effort and wage levels of the two workers and the payoffs of each player in this round for all three players. Our second treatment (Secrecy) uses the same parameters as the Baseline treatment but differ in the information feedback. After the workers and the manager have made their decisions, workers receive information only about their own level of effort, production and payoff; as in the Baseline treatment the manager observes the effort and production levels of both workers.

Our third treatment is the Different Effort Costs (DEC) treatment. It differs from the Baseline in two respects. First, workers have different costs of effort. As in the Baseline treatment, the range of effort choices is from 1 to 10 and is associated with a convex cost function but now $C(e_B) = 2* C(e_A)$, the cost of effort for the worker B is twice that of the cost of effort for the worker A. Table 4 shows the cost of effort associated to every level of effort in this treatment.

Effort level e_i	1	2	3	4	5	6	7	8	9	10
Cost of effort $C(e_A)$	0	1	2	4	6	8	10	13	16	20
Cost of effort $C(e_B)$	0	2	4	8	12	16	20	26	32	40

Table 4: Cost of effort (DEC and DECS treatments)

Second, workers are now equally productive with $P_A = 14$, $P_B = 14$. Hence, in this case effort choices of both workers have the same impact on the production of the firm, but the costs borne by workers differ. In this case, managers face a decision which is cognitively similar to the case of the Baseline, but instead of having the tradeoff effort-impact on the firm, now the tradeoff is effort-cost to the worker.

The fourth treatment, Different Effort Costs Secrecy (DECS), uses the same parameters as the third treatment together with the same information condition as the second treatment.[10]

3.2. Experimental procedures

In our experiment subjects play the same game for twelve rounds. We used a strangers matching protocol and fixed role assignments.[11] At the beginning of each round, managers and workers were re-matched anonymously and randomly within a matching group. A matching group consists of seven managers and fourteen workers.[12] After the last round, subjects answered a short post-experimental questionnaire. The experiment was conducted with a labor market framing, i.e., workers were called "workers" and managers were called "employers" (Charness and Kuhn, 2007; Abeler et al., 2010). All of this was common information for all the subjects. The instructions for the experiment can be found in Appendix A.

The experiment was conducted at the Universitat Autònoma of Barcelona with 258 subjects, who were recruited using the online recruitment system ORSEE (Greiner, 2004). All sessions were conducted using the Z-Tree software (Fischbacher, 2007). No one participated in more than one treatment or session. We ran three sessions for each treatment (21 groups per treatment except treatment Different Effort Costs Secrecy with 23 groups). Points earned were converted at an exchange rate of 0.01 Euro/point. Subjects also received a show-up fee of 5 Euro. Every session lasted approximately 80 minutes. On average, subjects earned 10 Euro.

[10] We chose not to study the case of productivities and effort cost functions both being equal between workers and the case of both being distinct between workers.
[11] We use a strangers matching protocol to abstract from confounding reputation effects.
[12] Every matching group has seven type A agents and seven type B agents. In two sessions the matching group consists in 6 players of every role due to a problem with the recruitment schedule.

3.3 Theoretical considerations

If players are rational and selfish, the manager will not pay anything to the workers because wages reduce her monetary payoff. Anticipating this, both workers will exert the minimum level of effort. The finite repetition of this game in randomly re-matched groups does not change this prediction. The equilibrium prediction is the same for all four treatments: $w_a = w_b = 0$ and $\pi_P = (P_A e_A + P_B e_B)$, $e_A = e_B = 1$.

However, this prediction is at this point not a very relevant one, since, as we mentioned before, much previous research has shown that in different scenarios the standard homo economicus prediction fails and people's behavior is driven by other forces as reciprocity (Charness, 2004).

With respect to equity principles that could influence managers' distributional decisions we have to distinguish between those pertaining to vertical equity and to horizontal equity. In terms of vertical equity the only issue is how much the manager keeps for himself and how much he distributes to the workers. Any distribution between a pure egalitarian one and one where the manager keeps everything can be easily rationalized in terms of a simple inequality aversion model with more or less weight on the inequality component.

In terms of the notions of horizontal equity that may influence the manager's compensation scheme for the two workers our approach is to start with the specific principles of Cappelen et al. (2007) and to adapt them to our environment. These principles are central in the history of equity analysis.[13] The first principle is egalitarianism, which simply prescribes $w_A=w_B$. According to this principle, neither decisions (effort with the corresponding cost of effort) nor characteristics (productivity) should influence the share an individual obtains.

[13] See also Rodríguez-Lara and Moreno-Garrido (2012).

The second principle is the libertarian principle, which, in general terms, proposes to give each person what she produces. Applied to the two workers in our environment this principle implies that from what the manager does not keep for himself the two workers obtain a fraction that is proportional to what each of them produced.

Finally, the liberal egalitarian principle, also called equal opportunity principle, posits that people should only be held responsible for their choices. It calls for taking into account factors under the control of the subjects when deciding on a distribution. In our setting productivity factors are randomly assigned and the only choice variable is effort. However, effort cost parameters are also randomly assigned, hence an individual should, from the point of view of the liberal egalitarian principle, not receive a wage such that the person is penalized for having a high effort cost. Applied to our context the principle implies that from what the manager does not keep for himself each worker receives a fraction that is proportional to the effort cost incurred in production.

The libertarian and liberal egalitarian principles propose very stringent conditions on managers' compensation schemes. However, they can also be applied in a less strict, more qualitative sense. In what follows we explain how we do this.

Adams (1965) defines equity as equity in terms of output: the worker who produces more should receive a higher wage. We will refer to this as production equity and we consider that it is satisfied when higher production implies higher wages and equal production implies equal wages. The notion of production equity corresponds to a qualitative version of the libertarian principle. We do not ask for relative wages to be proportional but only for the difference in wages to go in the right direction with respect to the difference of production levels.

Similarly, one can also define a qualitative version of the liberal egalitarian principle to which we will refer as effort cost equity. It proposes that a higher effort cost corresponds to a higher wage and equal effort cost translates into equal wages.

Before moving to the data analysis we briefly discuss the application of production equity and effort cost equity in our four treatments. In our Baseline treatment the productivity of A is twice that of B, whereas the effort cost functions of the two workers are the same. We can reasonably expect the production level of A to be larger than that of B, but it is not clear which of the two players will exert more effort and incur in a higher effort cost. If player A incurs in a higher effort cost than both principles will call for a higher wage for A. If B incurs a higher effort cost, then production equity and effort cost equity will be in conflict. In this second case, some managers will follow one of the principles and some other managers the other principle.

How can the introduction of secrecy in our second treatment be expected to affect managers' decisions? Our conjecture is that managers will, for the case of conflict between the two principles have a stronger tendency towards rewarding higher production, since higher productivity allows the manager - ceteris paribus – to keep a larger amount for himself. If managers' wage decisions in the Baseline treatment were driven by social pressure considerations, these should be now lower as the available information on the managerial decision is missing.

In our third treatment the two workers are equally productive but, for each effort level, worker B incurs a higher effort cost. We expect the typical outcome to be higher production by A than by B and higher effort cost by B than by A. Hence, in this case there will typically be a conflict between the two principles. Some managers will follow one while others will follow the other. However, we may expect a higher proportion of managers following production equity in this setting since their payoffs are not directly affected by this effort cost difference.

Just like for the comparison between the first two treatments we expect the introduction of secrecy to lead to a higher incidence of the use of the production equity principle.

We derive the following hypotheses from our theoretical framework:

Hypothesis 1 (*Wage distribution*)

We expect wage differences will depend more on production levels than on cost of effort levels.

Hypothesis 2 (*Secrecy*)

According to previous literature, we expect managers will apply production equity more often in the presence of secrecy.

4. Experimental results and discussion.

We first present results pertaining to aggregate behavior and then look into disaggregated data. This is followed by some regression analysis and finally with a section in which we relate the results to the equity concepts introduced above.

4.1. Aggregated behavior

Table 5 shows descriptive statistics of the most important variables aggregated by treatment.[14]

We will look at effort and wage levels as well as income levels. We start with statistical tests for effort comparisons within and across treatments.[15] Signed-rank tests comparing the effort levels of A and B within treatments find that differences in productivities do not lead to differences in average effort levels (p=0.413 in the Baseline and p=0.137 in the Secrecy treatments, respectively). By contrast, as suggested by the average values in table 5, differences in effort costs do lead to higher effort levels by worker A, the worker with lower effort cost (p=0.000 for both treatments).

[14] All statistical tests are at individual level unless other method is stated in the text.

[15] It is noteworthy that effort levels are quite high due to the order of play and workers looking for high wages.

Comparing effort levels of A and B separately across the relevant treatments, rank-sum tests find no differences for the effort levels of A (Baseline vs. Secrecy: p=0.273; DEC vs. DECS: p=0.456). Worker A player has the same productivity parameter and effort cost function across all treatments. The absence of differences across treatments show that the behavior of the A player is not affected by differences in the treatment conditions for the B players.

By, contrast, the between treatment comparisons of the effort level of the B players do reveal significant differences. Effort in the Baseline treatment is significantly higher than in the Secrecy treatment (p=0.017), and effort in the DEC treatment is significantly larger than in the DECS treatment, in this case only at the 10% level (p=0.060). In both cases, secrecy leads to lower effort of B, perhaps as the result of Bs expecting that the manager will pay them less since they can not compare their salaries to those of the As. Also, higher effort costs lead to lower effort levels than being endowed with a lower productivity.[16]

[16] Differences in production levels just mimic the differences in effort levels, except for the fact that in the first two treatments, production levels of A are much larger than those of B.

	Baseline	Secrecy	DEC	DECS
Worker A effort	6.94 (7) [2.55]	6.73 (7) [2.63]	7.02 (8) [2.67]	6.82 (7) [2.84]
Worker B effort	6.88 (7) [2.06]	6.43 (7) [2.54]	6.13 (6) [2.51]	5.69 (6) [2.87]
Worker A production	97.17 (98) [35.75]	94.26 (98) [36.80]	98.29 (112) [37.45]	95.44 (98) [39.77]
Worker B production	48.17 (49) [14.46]	45.04 (49) [17.76]	85.83 (84) [35.17]	79.63 (84) [40.22]
Worker A wage	34.47 (30) [24.12]	33.28 (30) [23.60]	34.83 (30) [28.01]	33.97 (30) [27.75]
Worker B wage	25.42 (23) [17.05]	23.62 (20) [19.12]	33.03 (30) [26.40]	31.87 (25) [28.25]
Worker A effort cost	11.18 (10) [6.01]	10.72 (10) [6.17]	11.49 (13) [6.24]	11.15 (10) [6.70]
Worker B effort cost	10.60 (10) [4.92]	9.91 (10) [6.03]	18.24 (16) [11.22]	16.82 (16) [12.83]
Worker A income	23.29 (20) [21.26]	22.56 (19) [21.34]	23.34 (20) [25.37]	22.82 (20) [24.28]
Worker B income	14.82 (12) [15.98]	13.70 (10) [16.86]	14.79 (15) [22.40]	15.04 (11.5) [22.23]
Manager profit	85.44 (80) [39.48]	82.40 (81.5) [41.54]	116.26 (109) [52.02]	109.24 (100) [54.62]

Table 5: Descriptive statistics. Average, (Median) and [standard deviation].

Result 1: *(Comparison of A's and B's effort levels within and between treatments)*

i) There are no significant differences in A's and B's average effort levels in the two treatments with productivity differences.

ii) A's average effort level is higher than that of B in the two treatments with effort cost differences.

Next we study managers' choices of wages for A and B. First, wages in the Baseline and the Secrecy are significantly higher for the more productive A workers than for the B workers, despite similar effort levels (signed-rank tests: $p < 0.001$ and $p < 0.001$, respectively). On the other hand, wages between workers are not significantly different in the DEC treatment and significant but only at the 10% level in the DECS treatment (signed-rank test: p = 0.316 and p = 0.067, respectively).[17] These results go in line with our hypothesis 1 which states that differences in workers' production create differences in wages.

Result 2: *(Comparison of A's and B's wages within and between treatments)*

i) *A's average wage level is significantly higher than B's in the two treatments with productivity differences.*

ii) *A's average wage levels is not statistically different from B's in the DEC treatment and only marginally so in the DECS treatment.*

Workers' effort choices and managers' wage decisions jointly determine workers' average income levels as well as manager's profits levels. The average income level of the As is significantly higher than that of the Bs (signed-rank tests, $p < 0.001$ for all four treatments). At the same time, none of the three treatment comparisons between A income levels yield significance (rank-sum test with p-values ranging from p=0.401 to p=0.941). The same is true for three comparisons of B income levels (rank-sum test with p-values ranging from p = 0.126 to p = 0.968). Perhaps surprisingly, whether B is handicapped in terms of productivities or in terms of effort costs leads to similar income differences with respect to the A workers and pay secrecy has no effect on relative income levels.

One can see directly from the table that there is no difference in manager profit between the first two treatments (rank-sum test: p = 0.514) whereas there is a significant difference between the last two treatments (rank-sum test: p = 0.048), albeit a small one in magnitude.

[17] We do not observe strong changes over time. In the appendix one can find figures showing the evolution of the different variables over time.

Result 3: *(Income levels within an between treatments and profit levels)*

i) A's average income is higher than that of B in all four treatments.

ii) A's average income levels are the same in all treatments.

iii) B's average income levels are the same in all treatments.

iv) There is no significant difference in profit levels in the first two treatments, but there is between the last two treatments.

Result 3 implies that income levels are not affected by secrecy. Table 6 presents some of the information shown in table 5 in relative terms. For the two treatments with unequal productivities we can see that worker A produces a little more than twice the amount that worker B produces (and incurs a little higher cost of effort) and receives only between 36% and 41% higher wage. For the two treatments with unequal effort costs one can see that worker A produces 14% - 20% more than worker B (incurring only about two thirds the effort cost) and receives a 5 - 6% higher wage. In both cases, the manager does not pay relative wages in accordance to relative production levels. Interestingly, in our data about 1/3 of additional production translates into additional wage.

	Baseline	Secrecy	DEC	DECS
Ratio of production A/B	2.02	2.09	1.14	1.20
Ratio of wage A/B	1.36	1.41	1.05	1.06
Ratio of income A/B	1.57	1.65	1.58	1.52
Total production	145.34	139.3	184.12	175.07
% A	24%	24%	19%	19%
% B	17%	17%	18%	18%
% M	59%	59%	63%	63%
Total income	123.37	116.62	149.34	144.67
% A	16%	18%	15%	15%
% B	11%	12%	9%	10%
% M	73%	70%	76%	75%

Table 6: Ratios of production, wage and income.

If one looks at relative income it is striking that the ratios are not too different for the four treatments. It turns out that the equalizing tendency of managers' compensation policies together with the fact that worker A exerts more effort in all cases leads to ex post similar income levels.

Table 6 also shows the distribution of total production and total income between the manager and the two workers. With respect to the first of these distributions, note that the percentages are the same for the first two treatments (24%, 17% and 59% for worker A, worker B and the manager, respectively in both Baseline and Secrecy treatments), on one hand, and for the other two treatments (19%, 18% and 63% for worker A, worker B and the manager, respectively in both DEC and DECS treatments) on the other hand. Again, wage secrecy does not appear to affect the distribution of wages. In the distribution of income the relative weight of manager income is higher than in the distribution of total production, with overall higher percentages in the two latter treatments (76% and 75% in DEC and DECS, respectively) than in the two first (73% and 70% in Baseline and Secrecy, respectively).

Result 4: *(Relative production levels, relative wages, and relative income levels)*

- *i) About 1/3 of additional production translates into additional wage.*
- *ii) Relative income levels of A and B are similar across treatments.*

Model	1	2	3	4
Dependent variable	π_A	π_B	π_A	π_B
EffortA	2.655***	.591**	2.592***	-.146
	(.600)	(.245)	(.749)	(.310)
EffortB	-1.154**	.465	-.792*	.987
	(.489)	(.548)	(.450)	(.791)
Secrecy	-.559	-.344	-8.786	-6.592
	(6.693)	(5.066)	(5.801)	(5.021)
Secrecy*EffortA	-.667	-.729**	.938	.628
	(.807)	(.304)	(.971)	(.420)
Secrecy*EffortB	.675	.694	.359	.523
	(.582)	(.686)	(.542)	(1.020)
Constant	12.804**	7.519*	10.006**	9.754**
	(5.645)	(4.006)	(4.953)	(4.063)
Obs.	684	684	708	708
R^2	0.110	0.043	0.144	0.048

Table 7: Income regressions. GLS regressions with robust standard errors, clustered by matching group. Significance at the 10%, 5% and 1% level is denoted by *, **, and ***, respectively.

Table 7 shows the results of four GLS regressions, with robust standard errors clustered by matching group. We run these regressions to test whether secrecy has any impact in workers' income. Here we compare independently worker A's income levels and worker B's income levels between Baseline and Secrecy treatments (models 1 and 2 for worker A's income and worker B's income. respectively) and between DEC and DECS treatments (models 3 and 4 for worker A's income and worker B's income. respectively). According to homo economicus standard prediction there should not be any differences between treatments. In our model, we regress worker i's income (π_i), on his effort level (Efforti). We also control for the coworkers' effort (Effortj). To control for differences between treatments (Baseline vs Secrecy and DEC vs DECS), we include a treatment dummy (Secrecy) and two interaction terms, one of the treatment dummy and worker i's effort (Secrecy*Efforti) and another one of the treatment dummy and the coworker j's effort (Secrecy*Effortj).

We can observe in model 1 that worker A's income positively depends on his own effort level. An additional unit of effort increases the high productivity worker's income by 2.655 points. This coefficient is significant ($p < 0.001$). Also, worker B's effort creates a negative externality in worker A's income, an additional unit of effort of worker B makes worker A's income decrease by 1.154 points ($p < 0.05$). However, the difference between treatments is not significant ($p > 0.1$). As we can see in model 2, worker A's effort creates a positive externality in worker B's income, a worker A's effort increase of 1 leads to an increase of 0.591 in worker B's income. This coefficient is significant ($p < 0.05$). Surprisingly, worker B's effort does not affect his own income. Again, we do not find treatment differences ($p > 0.1$) Hence secrecy seems to have no impact at all in wage distribution when workers differ in productivity levels.

We run our model in the case of workers with different cost of effort (models 3 and 4). In model 3 we find that worker A's income positively depends on his own effort. An additional unit of effort provides a wage increase of 2.592 points ($p < 0.001$). Besides of this, worker B creates a negative externality in worker A's income, an effort increase of one unit of worker B leads to a decrease of worker A's income of 0.792 points ($p < 0.1$). We do not find treatment differences in this case ($p > 0.1$).

With respect to worker B's income, we can see in model 4 that nothing affects worker B's income. Thus, we do not find treatment differences in this case neither. We can state that secrecy does not have an impact in wage distribution when workers have different effort cost levels.

Result 5: *(Secrecy and workers' income)*

i) Secrecy does not affect workers' income levels when they differ in productivity level.

ii) Secrecy does not affect workers' income levels when they differ in cost of effort level.

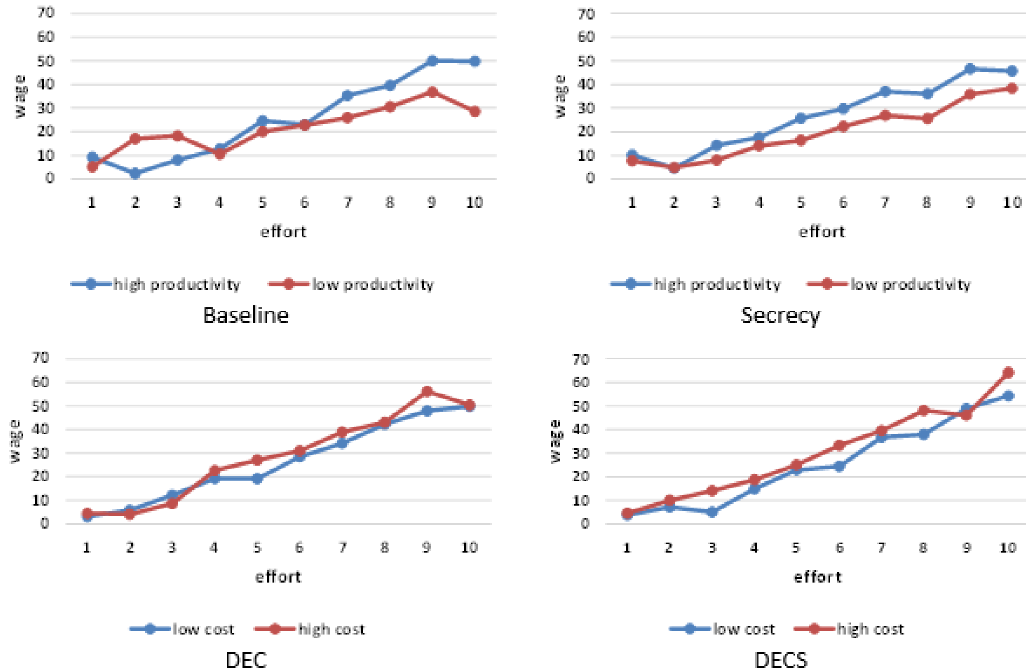


Figure 1: Average wages by level of effort

We close this section with figure 1 which shows the relationships between effort levels and wages for all four treatments separately for A and B workers. As can be observed the relationships are increasing in all cases (Spearman rank test: $p < 0.001$ in all situations), as it is the case in the experimental studies in which wages are set before effort.[18] Notice again the difference between high productivity and low productivity wages in treatments Baseline and Secrecy. Managers compensate slightly more high cost effort workers in the DEC and DECS treatments for the same effort but the difference is insignificant. Secrecy does not have any significant impact in this respect.

[18] See, for example, Maximiano, Sloof, and Sonnemans (2007) or Charness (2004).

4.2. Disaggregated behavior

Figure 2 shows the data for the distribution of total production between the manager and the two workers, disaggregated by manager.[19] The triangles are the projection of the simplex onto the plane. The straight line that bisects the angle denoted as M measures the participation of the manager, with points closer to M representing a higher participation of the manager. Points below (above) that line represent a relatively higher participation of A than B (B than A) in the total production distribution. The other straight line intersects the angle bisector at 50% of the value of M. The intersection point corresponds to equality in the total production distribution between M, A and B.

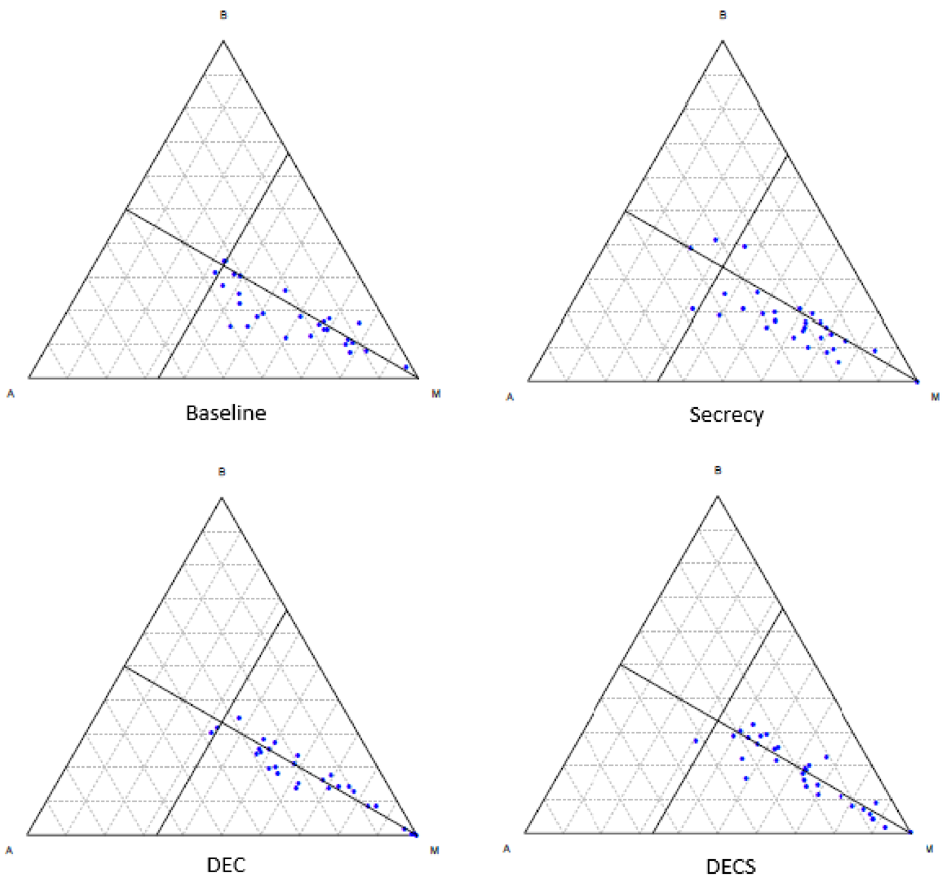


Figure 2: Distribution of total production between the manager, worker A and worker B.

[19] For each manager we show the average distribution, aggregated over time.

Figure 3 shows analogous triangles for the distribution of income. Here some points are outside the triangles, since the manager may not compensate workers enough for the effort costs they incur. For the first two treatments, the figure simply confirms what could be seen in the previous one: Player A has higher income than B, since wage levels are different but effort levels are similar. In table 5 we saw that Bs exert somewhat lower effort and, therefore, inequality is somewhat higher.

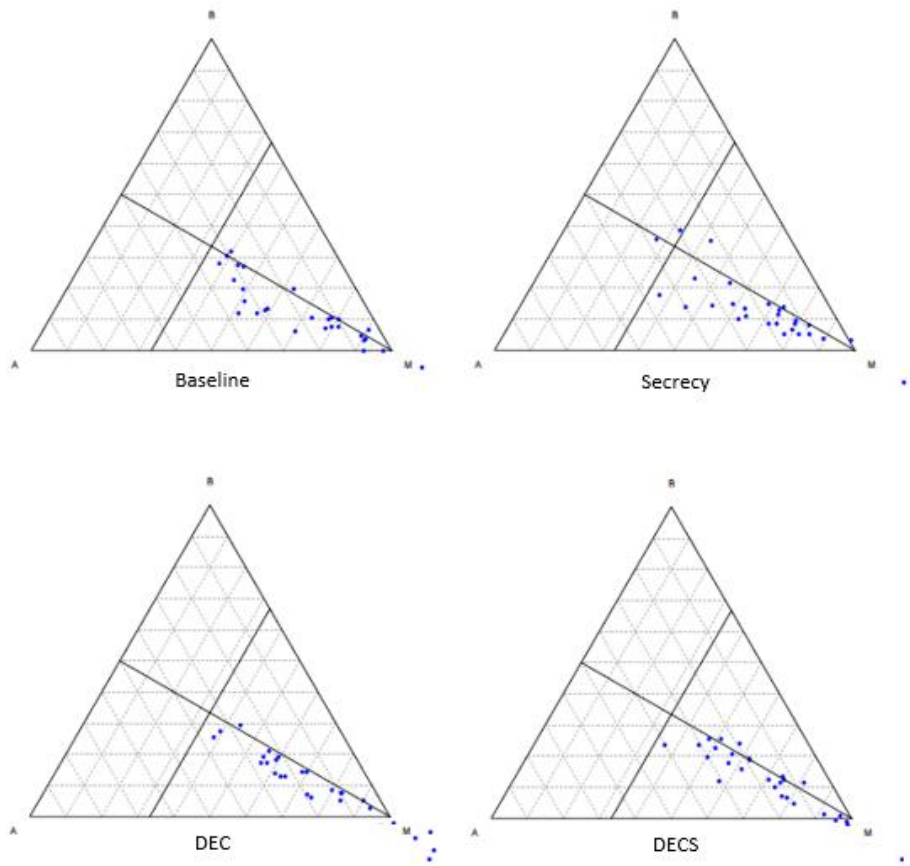


Figure 3: Distribution of income between the manager, worker A and worker B.

The information shown in figures 1, 2 and 3 can be summarized in the following results.

Result 6: *(Overall distributions of total production and income)*

i) *In all treatments managers' behavior is quite heterogeneous with respect to how much they keep for themselves, ranging from complete selfishness to complete equality.*

ii) *The relative wage of A and B does not seem to depend on the selfishness of the manager. In other words, vertical and horizontal distribution seem to be independent.*[20]

4.3 Effort cost equity versus production equity

Table 8 shows how differences in production and effort cost levels between A and B relate to wage differences between A and B. The disaggregated information contained in the table allows us to compare the incidence of production equity and effort cost equity across treatments. It is important to recall that particular compensation schemes can be compatible with both equity principles with only one of them or with neither of them. To find the total number for the different cases we have to aggregate across the three subtables.

The total number of cases compatible with both production and effort cost equity for each treatment can be found by aggregating the number in the first column from the first subtable, with the one from the fifth column in the second subtable and the last column in the third subtable where the two wages are equal. We find that the four total percentages for the four treatments are: 50%, 49.42%, 51.75% and 51.49%. The very small differences between the first and second figure, on one hand, and the third and fourth figure, on the other hand, confirm that secrecy of pay has almost no effect on behavior. Observe also that all four figures are quite similar. This is remarkable since the first two figures and the last two figures are the result of quite different aggregation. In the first two treatments, the largest component of the sums (40.77% and 41.09%) is the one corresponding

[20] As already revealed in the overall averages shown in tables 5 and 7 in the first two treatments As receive a considerably higher wage than Bs, while the difference is small in treatments 3 and 4.

to the high productivity A workers exerting more effort (and hence incurring a higher effort cost) than the low productivity B workers and being rewarded for it with a higher wage. By contrast in the last two treatments the case where low effort-cost A workers incur more effort than the high effort-cost B workers and produce more and the case where the Bs incur higher effort costs and produce carry similar weights (24.07% and 26.49% in the third treatment and 27.01% and 21.51% in the fourth treatment).

Wage A > Wage B (726/1392) 52.16%

Treatment	$P_Ae_A>P_Be_B$ Ca>Cb	$P_Ae_A > P_Be_B$ Ca<Cb	$P_Ae_A > P_Be_B$ Ca=Cb	$P_Ae_A < P_Be_B$ Ca>Cb	$P_Ae_A < P_Be_B$ Ca<Cb	$P_Ae_A < P_Be_B$ Ca=Cb	$P_Ae_A = P_Be_B$ Ca>Cb	$P_Ae_A = P_Be_B$ Ca<Cb	$P_Ae_A = P_Be_B$ Ca=Cb
Baseline (210/336) 62.5%	137/336 40.77%	26/336 7.74%	45/336 13.39%	0	2/336 0.6%	0	0	0	0
Secrecy (214/348) 61.49%	143/348 41.09%	39/348 11.21%	28/348 8.05	0	3/348 0.86%	0	0	1/348 0.29%	0
DEC (143/336) 42.56%	83/336 24.7%	44/336 13.1%	13/336 3.87%	0	1/336 0.3%	0	0	2/336 0.6%	0
DECS (159/372) 42.74%	101/372 27.15%	25/372 6.72%	21/372 5.65%	0	3/372 0.81%	0	0	9/372 2.42%	0

Wage A < Wage B (432/1392) 31.03%

Treatment	$P_Ae_A > P_Be_B$ Ca>Cb	$P_Ae_A > P_Be_B$ Ca<Cb	$P_Ae_A > P_Be_B$ Ca=Cb	$P_Ae_A < P_Be_B$ Ca>Cb	$P_Ae_A < P_Be_B$ Ca<Cb	$P_Ae_A < P_Be_B$ Ca=Cb	$P_Ae_A = P_Be_B$ Ca>Cb	$P_Ae_A = P_Be_B$ Ca<Cb	$P_Ae_A = P_Be_B$ Ca=Cb
Baseline (92/336) 27.38%	10/336 2.98%	44/336 13.1%	0	0	31/336 9.23	0	0	7/336 2.08%	0
Secrecy (84/348) 24.14%	5/348 1.44%	46/348 13.22	0	0	29/348 8.33	0	0	4/348 1.15%	0
DEC (127/336) 37.8%	3/336 0.89%	17/336 5.06%	1/336 0.3%	0	89/336 26.49%	0	0	17(336 5.06%	0
DECS (129/372) 34.68%	0	16/372 4.3%	0	0	80/372 21.51%	0	0	31/372 8.33%	2/372 0.54%

Table 8: Decisions compatible with production equity and effort cost equity

Wage A = Wage B (234/1392) 16.81%

Treatment	P_Ae_A > P_Be_B Ca>Cb	P_Ae_A > P_Be_B Ca<Cb	P_Ae_A > P_Be_B Ca=Cb	P_Ae_A < P_Be_B Ca>Cb	P_Ae_A < P_Be_B Ca<Cb	P_Ae_A < P_Be_B Ca=Cb	P_Ae_A = P_Be_B Ca>Cb	P_Ae_A = P_Be_B Ca<Cb	P_Ae_A = P_Be_B Ca=Cb
Baseline (34/336) 10.12%	8/336 2.38%	14/336 4.17%	7/336 2.08%	0	4/336 1.19%	0	0	1/336 0.3%	0
Secrecy (50/348) 14.37%	18/348 5.17%	18/348 5.17%	9/348 2.59%	0	5/348 1.44%	0	0	0	0
DEC (66/336) 19.64%	17/336 5.06%	12/336 3.57%	5/336 1.49%	0	18/336 5.36%	0	0	10/336 2.98%	4/336 1.19%
DECS (84/372) 22.58	14/372 3.76%	13/372 3.49%	9/372 2.42%	0	19/372 5.11%	0	0	18/372 4.84%	11/372 2.96%

Table 8 (continuation): Decisions compatible with production equity and effort cost equity

To find the total percentage compatible with production equity and not effort cost equity we have to aggregate the entries in the second and third column of the first sub-table, the fourth and the sixth in the second sub-table and the seventh and eighth columns in the last sub-table. The resulting percentages are: 21.43%, 19.26%, 19.95% and 16.65%

Similarly we can find that the percentages of cases compatible with effort cost equity but not with production equity are 17.17%, 16.96%, 12.8% and 18.01%, with the rest not being compatible with either principle. Looking at these results we have to reject our hypothesis 2 which states that secrecy affects managers' distributional decisions.

We can summarize the above discussion in the following result:

Result 7: *(Managers' use of the equity principles)*

i) Overall, production equity and effort cost equity have the same importance in all treatments.

ii) In all treatments the largest fraction of decisions is compatible with both production equity and effort cost equity.

5. Summary and Conclusions

In this chapter, we study the interaction between a manager and two workers when the workers have different productivities or different effort cost. We analyze manager's behavior when they have to choose workers' wages. In our experiment, one manager is matched with two workers. Firstly, workers choose their effort level and then the manager pays them a wage knowing their effort levels. In the Baseline treatment, workers know their coworkers' wages and they have different productivities. In the Secrecy treatment, workers only know their own wage and they also have different productivities. In the DEC treatment, workers know their coworkers' wage but one of them has a higher effort cost. The DECS treatment is the same as the DEC but workers do not receive any information about the others participants efforts, wages, and payoffs.

Our aim is to characterize managers' compensation policies in the different treatments and to relate them to several equity principles: egalitarianism, production equity and effort cost equity.

We find that managers do not pay relative wages in accordance to relative production levels. In our data about 1/3 of additional production translates into additional wage. Managers' compensation policies together with worker decisions lead to the income levels of the different types of workers not being different across treatments. In particular, whether a worker knows the other worker's wage has no effect on his income level.

In all treatments managers' behavior is quite heterogeneous with respect to how much they keep for themselves, ranging from complete selfishness to complete equality. The relative wage of A and B does not seem to depend on the selfishness of the manager. In other words, vertical and horizontal distribution seem to be independent.

With respect to the equity principles we find that the fraction of the decisions compatible and incompatible with production equity and effort cost equity is similar across treatments, with egalitarianism playing only a minor.

Overall, production equity and effort cost equity have the same importance in all treatments. In all treatments over 50% of all decisions are compatible with both production equity and effort cost equity. In all treatments the fractions of decisions compatible with production equity and not effort cost equity and those compatible with effort cost equity but not production equity are similar. Overall, the influence of production equity and effort cost equity is similar across treatments.

6. References

Abeler, J., Altmann, S., Kube, S., and Wibral, M. (2010). Gift exchange and workers' fairness concerns: When equality is unfair. Journal of the European Economic Association, 8(6): 1299-1324.

Adams, J. S. (1965). Inequity in social exchange. In L. Berkowitz (Ed.), Advances in experimental social psychology, vol. 2: 267-299. New York: Academic Press.

Akerlof, G. A., and Yellen, J. L. (1990). The fair wage-effort hypothesis and unemployment. The Quarterly Journal of Economics, 105(2): 255-283.

Andrews, I. R. (1967). Wage inequity and job performance: An experimental study. Journal of Applied Psychology, 51: 39-45.

Bolton, G. E., and Ockenfels, A. (2000). ERC: A theory of equity, reciprocity, and competition. American Economic Review, 90(1): 166-193.

Bolton, G. E., and Zwick, R. (1995). Anonymity versus punishment in ultimatum bargaining. Games and Economic Behavior, 10(1): 95-121.

Cappelen, A. W., Hole, A. D., Sørensen, E., and Tungodden, B. (2007). The pluralism of fairness ideals: An experimental approach. American Economic Review, 97(3): 818-827.

Cassar, A., and Rigdon, M. (2011). Trust and trustworthiness in networked exchange. Games and Economic Behavior, 71: 282-303.

Charness, G. (2004). Attribution and reciprocity in an experimental labor market. Journal of labor Economics, 22(3), 665-688.

Charness, G., and Kuhn, P. (2007). Does pay inequality affect worker effort? Experimental evidence. Journal of Labor Economics, 25(4): 693-723.

Charness, G., and Rabin, M. (2002). Understanding social preferences with simple tests. The Quarterly Journal of Economics, 117(3), 817-869.

Colella, A., Paetzold, R. L., Zardkoohi, A. and Wesson, M. J. (2007). Exposing pay secrecy. Academy of Management Review, 32(1): 55-71.

Corgnet, B., Sutan, A., and Veszteg, R. F. (2011). My teammate, myself and I: Experimental evidence on equity and equality norms. The Journal of Socio-Economics, 40(4), 347-355.

Croson, R., and Konow, J. (2009). Social preferences and moral biases. Journal of Economic Behavior & Organization, 69(3), 201-212.

Dana, Jason, Daylian M. Cain, and Robyn M. Dawes. (2006). What you don't know won't hurt me: Costly (but quiet) exit in dictator games. Organizational Behavior and Human Decision Processes 100 (2): 193–201.

Fehr, E., and Gachter, S. (2000). Cooperation and punishment in public goods experiments. The American Economic Review, 90(4): 980-994.

Fehr, E., Kirchsteiger, G., and Riedl, A. (1993). Does fairness prevent market clearing? An experimental investigation. The Quarterly Journal of Economics, 108(2): 437-459.

Fehr, E., Klein, A., and Schmidt, K. M. (2007). Fairness and contract design. Econometrica, 75(1): 121-154.

Fehr, E., and Schmidt, K. M. (1999). A theory of fairness, competition, and cooperation. The Quarterly Journal of Economics, 114(3): 817-868.

Fischbacher, U. (2007). Z-Tree: Zurich toolbox for ready-made economic experiments. Experimental Economics, 10: 171-178.

Greiner, B. (2004). The online recruitment system ORSEE 2.0 – A guide for the organization of experiments in economics. Working paper, Cologne University.

Gross, T., Guo, C., and Charness, G. (2015). Merit pay and wage compression with productivity differences and uncertainty. Journal of Economic Behavior & Organization, 117, 233-247.

Güth, W., Königstein, M., Kovács, J., and Zala-Mezõ, E. (2001). Fairness within firms: The case of one manager and multiple workers. Schmalenbach Business Review, 53(2): 82-101.

Homans, G. C. (1961). Social behavior: its elementary forms. London: Routledge & Kegan Paul.

Kagel, J. H., and Wolfe K. W. (2001). Tests of fairness models based on equity considerations in a three-person ultimatum game. Experimental Economics, 4(3): 203.

Karagözoğlu, E., and Riedl, A. (2014). Performance information, production uncertainty, and subjective entitlements in bargaining. Management Science, 61(11), 2611-2626.

Karni, E., & Safra, Z. (2002a). Individual sense of justice: a utility representation. Econometrica, 70, 263–284.

Karni, E., & Safra, Z. (2002b). Intensity of the sense of fairness: measurement and behavioral characterization. Journal of Economic Theory, 105, 318–337.

Karni, E., Salmon, T., and Sopher, B. (2008). Individual sense of fairness: an experimental study. Experimental Economics, 11(2), 174-189.

Konow, J. (2003). Which is the fairest one of all? A positive analysis of justice theories. Journal of Economic Literature, 41: 1188-1239.

Lazear, E. P. (1989). Pay equality and industrial politics. Journal of Political Economy, 97(3): 561-580.

Maximiano, S., Sloof, R., and Sonnemans, J. (2007). Gift exchange in a multi-worker firm. The Economic Journal, 117(522), 1025-1050.

Meidinger, C., Rullière, J. L., and Villeval, M. C. (2003). Does team-based compensation give rise to problems when workers vary in their ability? Experimental Economics, 6(3): 253-272.

Rodríguez-Lara, I., and Moreno-Garrido, L. (2012). Self-interest and fairness: self-serving choices of justice. Experimental Economics, 6(3): 253-272.

Schneider, S., and Kube, S. (2006). Personal relations and implicit contracts – An experimental study. Mimeo.

Selten, R. (1978). The equity principle in economic behavior. In Gottinger, H., & Leinfellner, W. (Ed.), Decision theory and social ethics; issues in social choice: 289-301. Dordrecht: Reifel Pub.

Slonim, R., and Roth, A. E. (1998). Learning in high stakes ultimatum games: An experiment in the Slovak Republic. Econometrica, 66(3): 569-596.

Suvorov, A. and van de Ven, J. (2006). Discretionary rewards as a feedback mechanism. Games and Economic Behavior, 67(2): 665-681.

Appendix A

ALL TEXT IN CAPITAL LETTERS (LIKE THIS ONE) IS ADDED FOR READERS AND DOES NOT BELONG TO THE ORIGINAL INSTRUCTIONS[21]

I N S T R U C T I O N S [BASELINE AND SECRECY]

First at all, thank you for participating in this experimental study. The instructions are simple and if you follow them carefully you will be privately paid in cash, since nobody will know the payments received by the other participants. In this experiment there are neither correct nor incorrect answers. Do not think that we expect a specific behavior from you. On the other hand, you have to take into consideration that your decisions will affect the amount of money you will earn in the experiment. If you have any doubt, you can raise your hand and ask any of the experimenters. Out of these questions, any kind of communication is forbidden.

There are three types of participants: **manager, worker A** and **worker B**. In each round, each manager will be randomly paired with one worker A and one worker B. This pairing will change each round. The difference between the two types of workers will be explained in advance.

The experiment lasts 12 rounds.

You will know your role (manager, worker A or worker B) at the beginning of the experiment. It will be randomly assigned by the computer. You will keep the same role throughout the 12 rounds of the experiment.

In each round, participants will be paired with different people to the ones they were paired in the previous round, meaning that you will interact with different people in each round. Those people will be randomly chosen among the participants in this experiment by an algorithm. Furthermore, the identities of the participants will always be hidden.

Each round consists of two stages.

Stage 1:

a) Each worker chooses his/her *level of effort*. The level of effort have to be an integer number between 1 and 10.
b) The higher the level of effort chosen by the worker, the higher the cost of effort of the worker. The cost of effort associated with each level of effort is shown in the following table:

[21] The same rule applies to the instructions in chapter II.

Level of effort	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cost of effort	0	1	2	4	6	8	10	13	16	20

c) The difference between worker A and worker B is that worker A is more productive than worker B, meaning that his/her level of effort contributes more to the profit of the manager than the level of effort of worker B does.

Stage 2:

a) The manager will know the level of effort of each worker, the cost of effort and the profit that each worker contributes to the manager.
b) After knowing all the information explained above, the manager will set a *compensation* for each worker. The compensation must be an integer number between 0 and 100. The manager may choose a different compensation for each worker.

The profit of the manager in each round is calculated as follows:

Profit of the manager = 14*level of effort of worker A + 7* level of effort of worker B – compensations paid to both workers

That is, the level of effort of worker A multiplied by 14 plus the level of effort of worker B multiplied by 7 minus the sum of the compensations paid to each worker.

Hence, the profit of the manager is higher the higher is the level of effort chosen by the workers and the lower is the compensation paid to the workers.

The profit for each worker in each round is calculated as follows:

Profit of the worker = compensation – cost of effort

That is, the profit of each worker is composed by the compensation received from the manager minus the cost of effort associated to the level of effort chosen by the worker.

Hence, the profit of the worker is higher the higher is the compensation and the lower is the level of effort chosen by the worker.

For example, if the level of effort of worker A is 7 and his/her compensation is 35, the level of effort of worker B is 5 y his/her compensation is 50, then the profit of each participant in this round will be:

Profit of the manager = 14*7 + 7*5 – (35 + 50) = 48 points
Profit of worker A = 35 – 10 = 25 points
Profit of worker B = 50 – 6 = 44 points

At the end of each round, a screen will inform to all participants about compensations, levels of effort chosen and profit of all participants.

[IN SECRECY TREATMENT]

[At the end of each round, a screen will inform to each worker about his/her own compensation, level of effort chosen and profit. That is, he/she will not know the level of effort, compensation or profit of the other worker. He/she will not know the profit of the manager. The manager will know the compensations, levels of effort chosen and profit of all participants including him/herself.]

At the end of the experiment we will privately pay you. You earnings will be a show up fee of 5 euros plus the equivalence in euros of the SUM of the points you have won in each of the 12 rounds. The points will be converted to euros in a rate of: 10 points = 10 cents.

SUMMARY

- If you are WORKER:

  You have to choose your level of effort between 1 and 10 knowing the costs of effort associated to each level of effort.

- If you are MANAGER:
  You have to set a compensation to each worker (between 0 and 100) knowing the level of effort chosen by each worker, the cost of effort associated to each level of effort chosen and the profit that each worker contributes to you.

QUESTIONNAIRE

To be sure that you have understood the instructions, before starting the experiment you are going to answer a simple questionnaire, just when you answer it correctly you will start your participation in this experiment.

If the level of effort of worker A is 8 and his/her compensation is 80, the level of effort of worker B is 6 and his/her compensation is 50, then the profit for each participant in this round will be:

Profit of the manager = 14*___ + 7*___ - (___ + ___) = ___ + ___ - ___ = ___ points
Profit of worker A = ___ – ___ = ___ points
Profit of worker B = ___ – ___ = ___ points

If the level of effort of worker A is 10 and his/her compensation is 30, the level of effort of worker B is 1 and his/her compensation is 70, then the profit for each participant in this round will be:

Profit of the manager = 14*___ + 7*___ - (___ + ___) = ___ + ___ - ___ = ___ points
Profit of worker A = ___ – ___ = ___ points
Profit of worker B = ___ – ___ = ___ points

I N S T R U C T I O N S [DEC AND DECS]

First at all, thank you for participating in this experimental study. The instructions are simple and if you follow them carefully you will be privately paid in cash, since nobody will know the payments received by the other participants. In this experiment there are neither correct nor incorrect answers. Do not think that we expect a specific behavior from you. On the other hand, you have to take into consideration that your decisions will affect the amount of money you will earn in the experiment. If you have any doubt, you can raise your hand and ask any of the experimenters. Out of these questions, any kind of communication is forbidden.

There are three types of participants: **manager, worker A** and **worker B**. In each round, each manager will be randomly paired with one worker A and one worker B. This pairing will change each round. The difference between the two types of workers will be explained in advance.

The experiment lasts 12 rounds.

You will know your role (manager, worker A or worker B) at the beginning of the experiment. It will be randomly assigned by the computer. You will keep the same role throughout the 12 rounds of the experiment.

In each round, participants will be paired with different people to the ones they were paired in the previous round, meaning that you will interact with different people in each round. Those people will be randomly chosen among the participants in this experiment by an algorithm. Furthermore, the identities of the participants will always be hidden.

Each round consists of two stages.

Stage 1:

a) Each worker chooses his/her *level of effort*. The level of effort have to be an integer number between 1 and 10.
b) The higher the level of effort chosen by the worker, the higher the cost of effort of the worker. The cost of effort associated with each level of effort is shown in the following table:

Level of effort	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cost of effort worker A	0	1	2	4	6	8	10	13	16	20
Cost of effort worker B	0	2	4	8	12	16	20	26	32	40

c) The difference between worker A and worker B is that the cost of effort of worker B is higher than the cost of effort of worker A.

Stage 2:

a) The manager will know the level of effort of each worker, the cost of effort and the profit that each worker contributes to the manager.

b) After knowing all the information explained above, the manager will set a *compensation* for each worker. The compensation must be an integer number between 0 and 100. The manager may choose a different compensation for each worker.

The profit of the manager in each round is calculated as follows:

Profit of the manager = 14*level of effort of worker A + 14* level of effort of worker B – compensations paid to both workers

That is, the level of effort of worker A multiplied by 14 plus the level of effort of worker B multiplied by 14 minus the sum of the compensations paid to each worker.

Hence, the profit of the manager is higher the higher is the level of effort chosen by the workers and the lower is the compensation paid to the workers.

The profit for each worker in each round is calculated as follows:

Profit of the worker = compensation – cost of effort

That is, the profit of each worker is composed by the compensation received from the manager minus the cost of effort associated to the level of effort chosen by the worker.

Hence, the profit of the worker is higher the higher is the compensation and the lower is the level of effort chosen by the worker.

For example, if the level of effort of worker A is 7 and his/her compensation is 35, the level of effort of worker B is 5 y his/her compensation is 50, then the profit of each participant in this round will be:

Profit of the manager = 14*7 + 14*5 – (35 + 50) = 83 points
Profit of worker A = 35 – 10 = 25 points
Profit of worker B = 50 – 12 = 38 points

At the end of each round, a screen will inform to all participants about compensations, levels of effort chosen and profit of all participants.

[IN DECS TREATMENT]

[At the end of each round, a screen will inform to each worker about his/her own compensation, level of effort chosen and profit. That is, he/she will not know the level of effort, compensation or profit of the other worker. He/she will not know the profit of the manager. The manager will know the compensations, levels of effort chosen and profit of all participants including him/herself.]

At the end of the experiment we will privately pay you. You earnings will be a show up fee of 5 euros plus the equivalence in euros of the SUM of the points you have won in each of the 12 rounds. The points will be converted to euros in a rate of: 10 points = 10 cents.

SUMMARY

- If you are WORKER:

  You have to choose your level of effort between 1 and 10 knowing the costs of effort associated to each level of effort.

- If you are MANAGER:

  You have to set a compensation to each worker (between 0 and 100) knowing the level of effort chosen by each worker, the cost of effort associated to each level of effort chosen and the profit that each worker contributes to you.

QUESTIONNAIRE

To be sure that you have understood the instructions, before starting the experiment you are going to answer a simple questionnaire, just when you answer it correctly you will start your participation in this experiment.

If the level of effort of worker A is 8 and his/her compensation is 80, the level of effort of worker B is 6 and his/her compensation is 50, then the profit for each participant in this round will be:

Profit of the manager = 14*___ + 14*___ - (___ + ___) = ___ + ___ - ___ = ___ points
Profit of worker A = ___ – ___ = ___ points
Profit of worker B = ___ – ___ = ___ points

If the level of effort of worker A is 10 and his/her compensation is 30, the level of effort of worker B is 1 and his/her compensation is 70, then the profit for each participant in this round will be:

Profit of the manager = 14*___ + 14*___ - (___ + ___) = ___ + ___ - ___ = ___ points
Profit of worker A = ___ – ___ = ___ points
Profit of worker B = ___ – ___ = ___ points

Appendix B

Baseline:

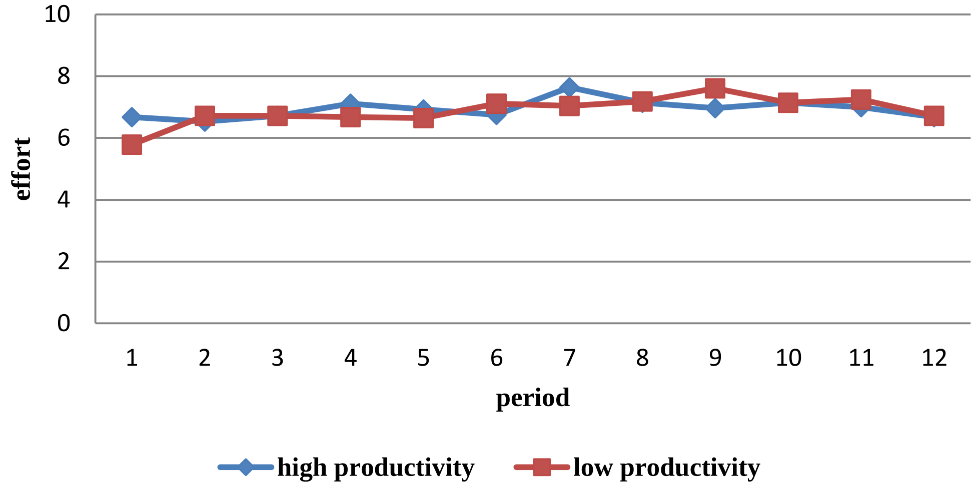


Table B.1: average effort by period (Baseline).

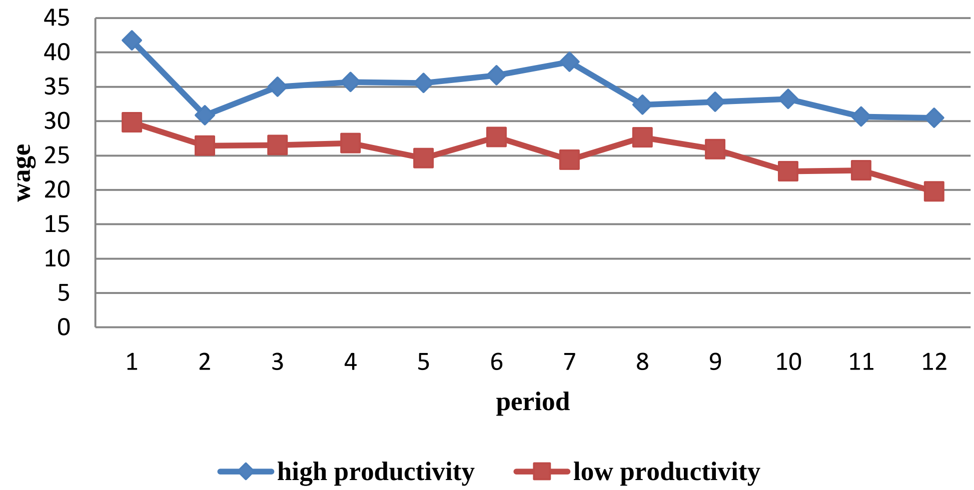


Table B.2: average wage by period (Baseline).

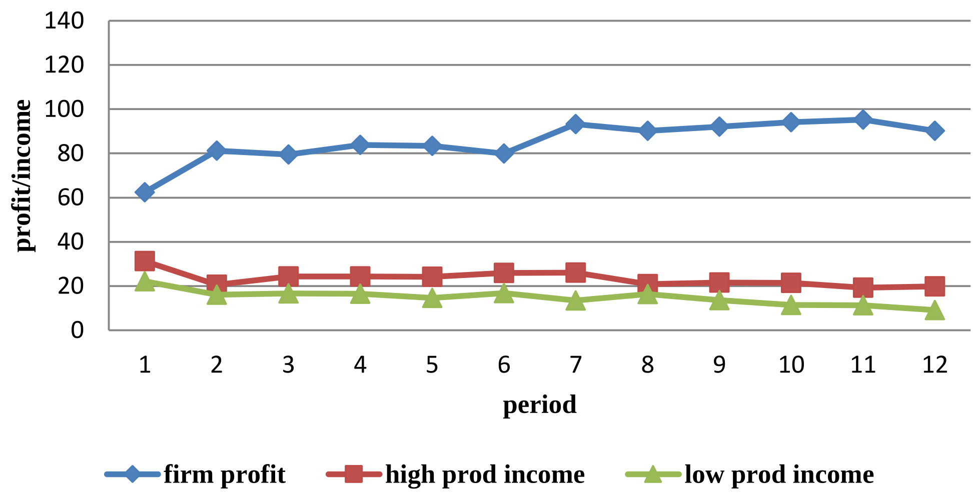


Table B.3: average firm's profit and workers' income by period (Baseline).

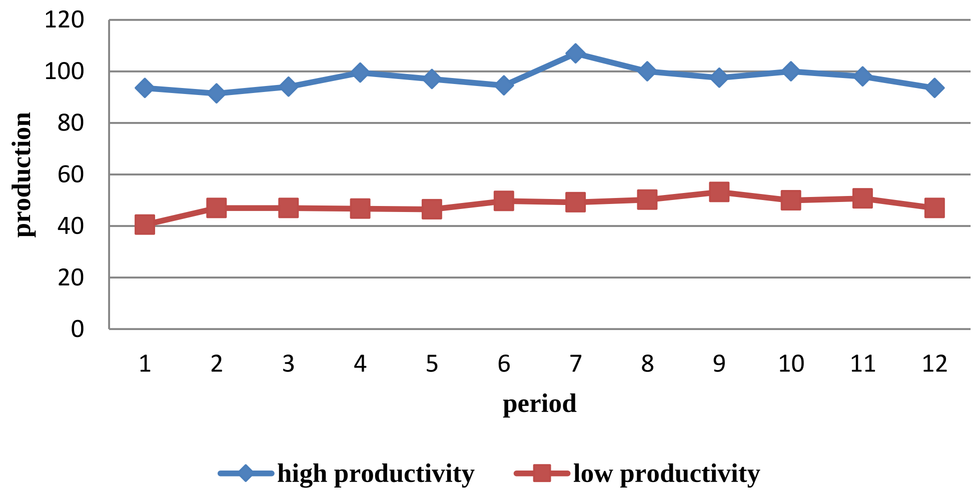


Table B.4: average production by period (Baseline).

Secrecy:

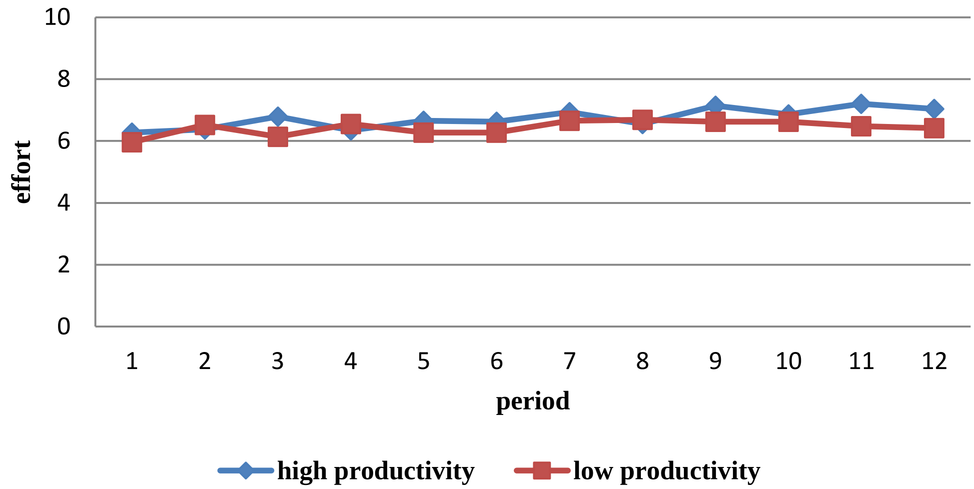


Table B.5: average effort by period (Secrecy).

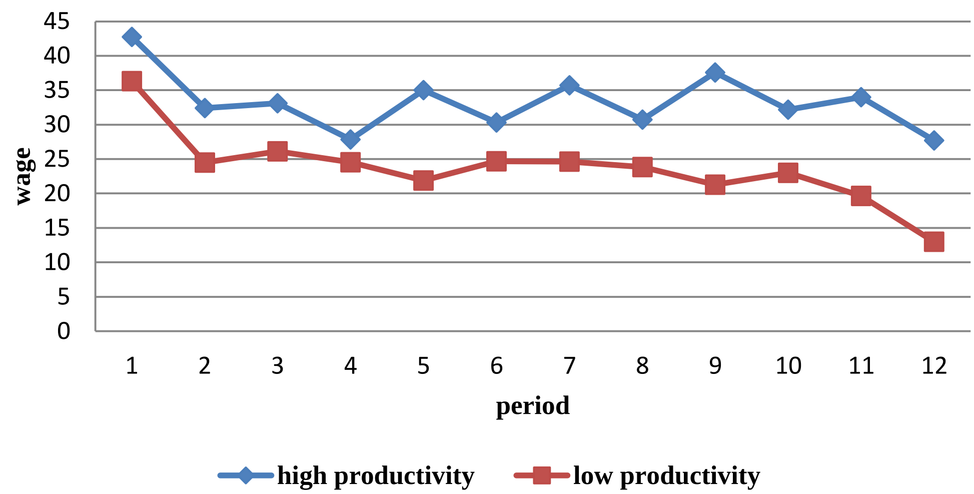


Table B.6: average wage by period (Secrecy).

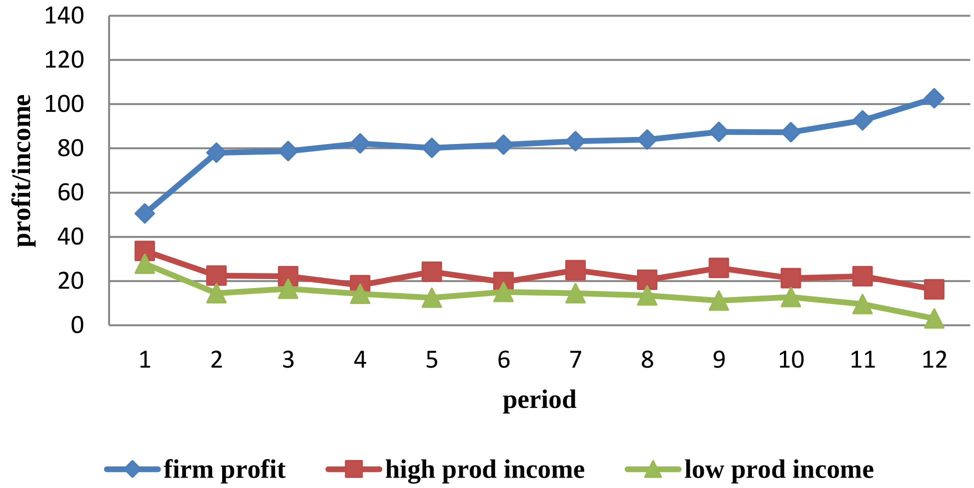


Table B.7: average firm's profit and workers' income by period (Secrecy).

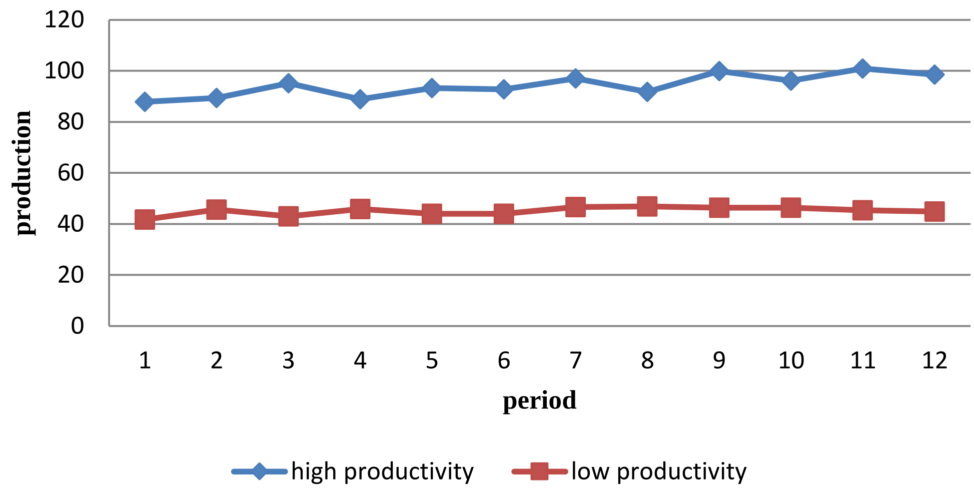


Table B.8: average production by period (Secrecy).

DEC:

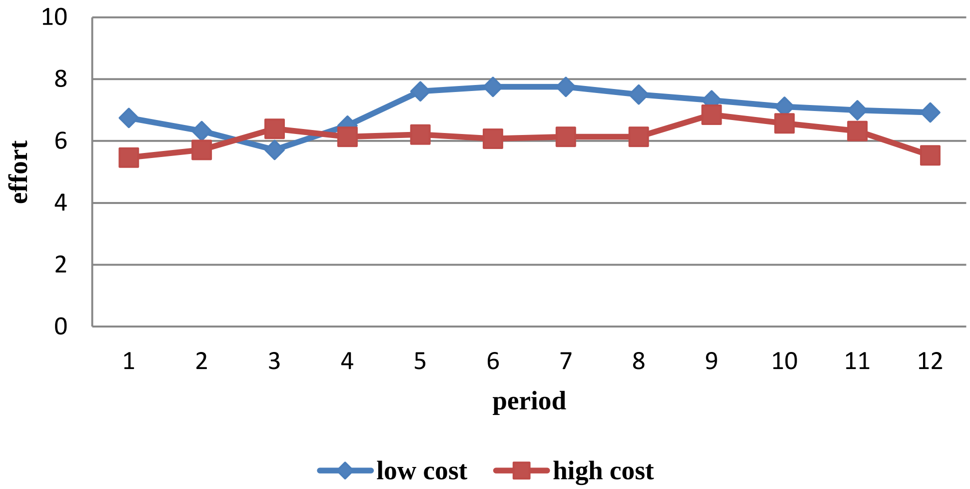


Table B.9: average effort by period (DEC).

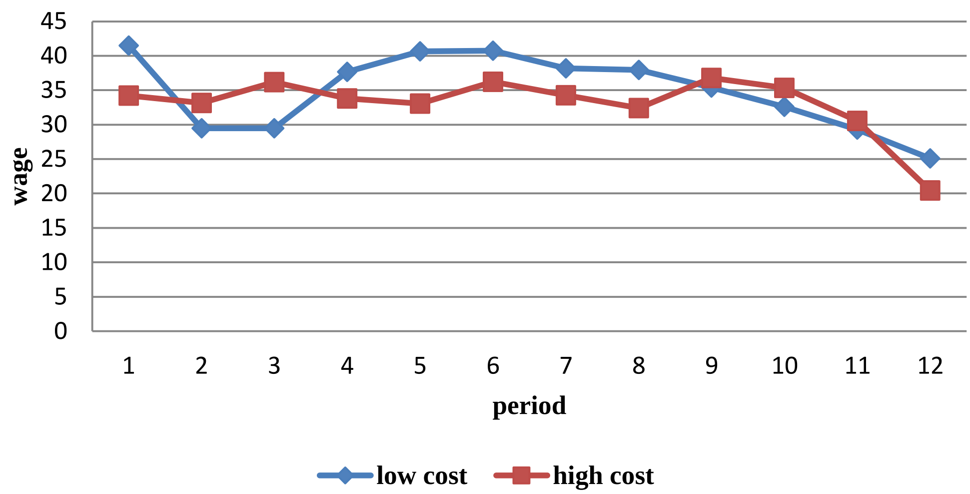


Table B.10: average wage by period (DEC).

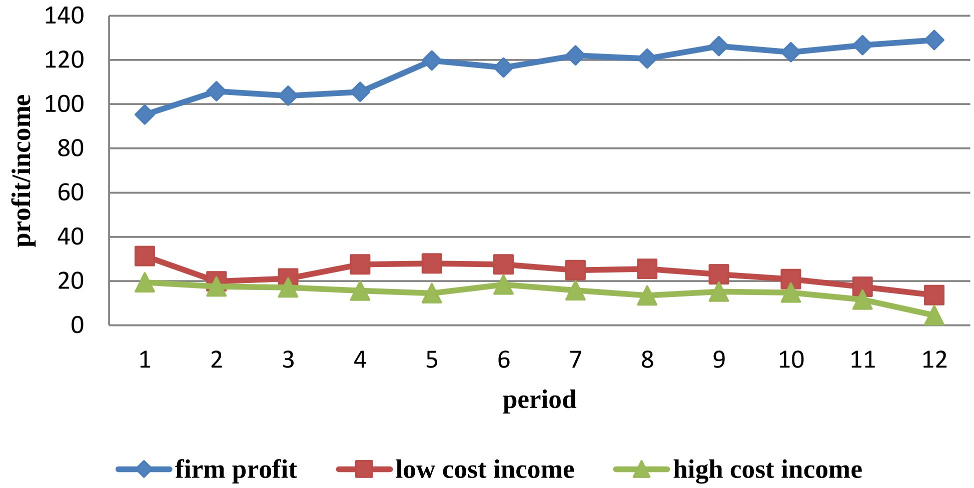


Table B.11: average firm's profit and workers' income by period (DEC).

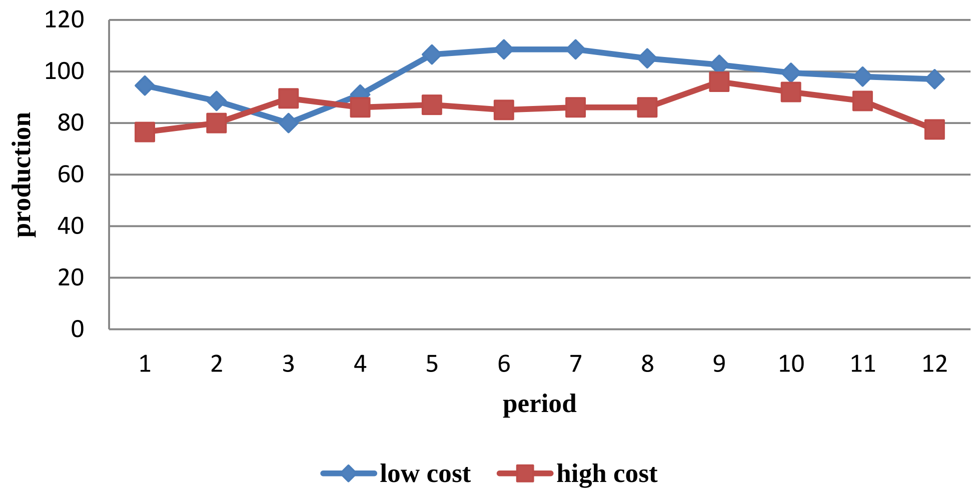


Table B.12: average production by period (DEC).

DECS:

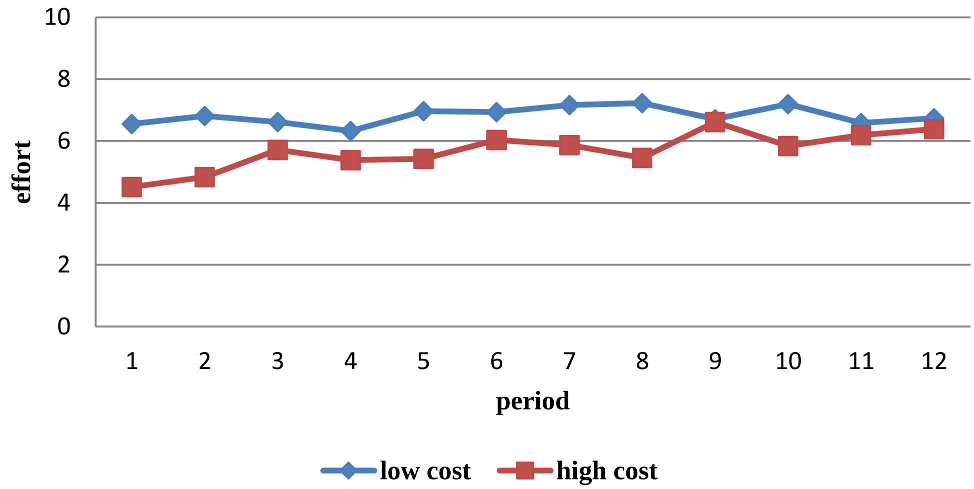


Table B.13: average effort by period (DECS).

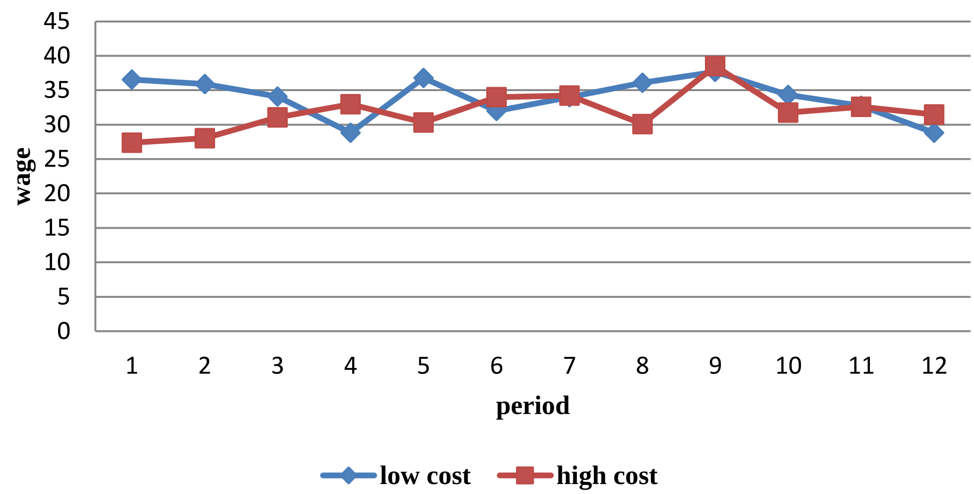


Table B.14: average wage by period (DECS).

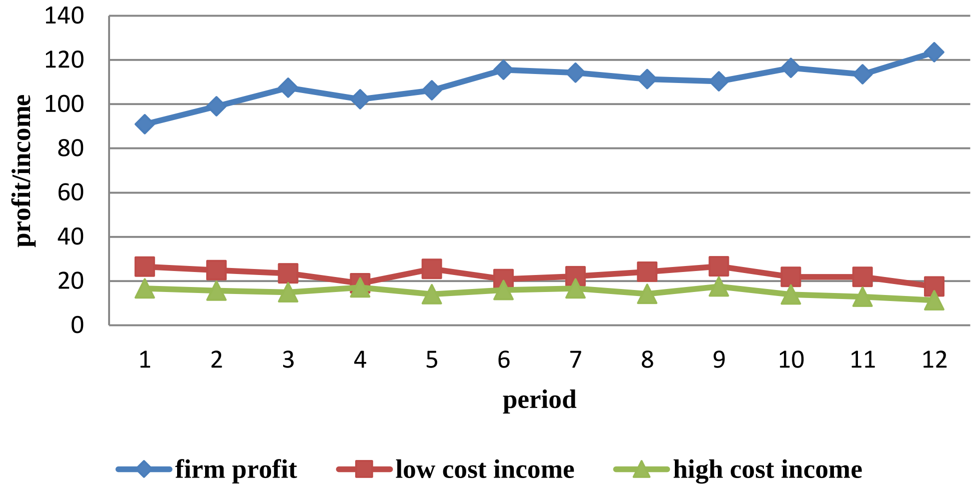


Table B.15: average firm's profit and workers' income by period (DECS).

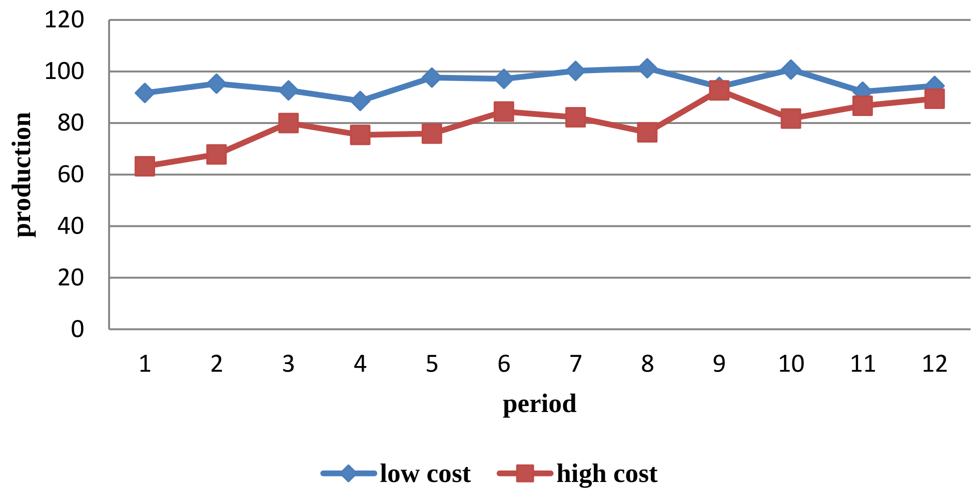


Table B.16: average production by period (DECS).

Chapter II: It Is Not What You Do, It Is What You Do Not

1. Introduction

Compensating workers who perform different duties within the same company or industry is a fundamental issue for managers and policy makers. Jobs which require a higher ability to be performed tend to be better compensated than the rest of jobs (CEOs, physicians, etc.). However, there are some jobs where workers do not need to have high ability to receive a higher compensation than most of workers in others jobs (stevedores, truck drivers). In this chapter we present the results of a laboratory experiment we conducted to disentangle the reasons that make managers to set different compensations to workers in different job positions. It is important to highlight that we are analyzing different jobs in this paper not workers with different abilities. In the case the manager could fire a worker he would have to hire another one to perform the same duties of the job.

The aim of this chapter is to test how different characteristics between jobs affect compensation decisions of managers. We study this situation by setting an environment where the manager has to decide how to compensate two workers with different characteristics. After the manager's decision is implemented, the two workers have to decide on a level of effort knowing both his/her own wage and his/her coworker wage. Our design is based on a multi-worker setting as those of Maximiano, Sloof, and Sonnemans (2007) or Charness, Cobo-Reyes, Lacomba, Lagos, and Pérez (2016).

In our setting we have a manager and two workers. The manager first decides a different (or equal) wage for each worker. Knowing both wages, each worker independently choose an effort level which jointly determine the total production of the group. Profits depend on the wages and effort levels of each worker. Manager's profits increase with effort levels and decrease with wages. Contrary to the manager's profits, workers' profits increase with wages and decrease with effort levels.

This environment allows us to study how managers take decisions on wages depending on workers' characteristics and how workers react to wage differences (equality) between him(her)self and his/her coworker. It is worth noting that in our design we use workers with different characteristics not two equal workers as they do in Maximiano et al. (2007) or Charness et al. (2016).

In our experiment we study the effects of workers' different productivity levels in wage decisions. The novelty in our design is that one of the workers may decrease the manager's profits by exerting low effort levels. By introducing this feature we can analyze the power of loss aversion in workers' compensation.

Productivities in our setting are exogenously given to each worker. Workers' potential production is determined by a productivity parameter together with his/her effort level. The value of the productivity parameters of each worker are common information for the three players. Thus the manager have all the information available to decide on workers' compensation.

Compensation involves a wide set of considerations that complicate its analysis. We will abstract from some of the previous considerations to concentrate on how the presence of different workers (defined by its impact on profits) influences the compensation distribution. Our objective is then to analyze how managers decide on a compensation distribution given the characteristics of the workers and the effect that this distribution will have on the effort the different workers exert.

In particular, we include three types of workers we want to use as reference categories, and we call them, following the terminology by Baron and Kreps (1999), soldiers, stars and guardians. Stars have received much attention in organizational research (Aguinis and O'Boyle (2014), Borman and Motowidlo (1997)). This kind of worker has the potential to impact positively in a significant way in profits and examples can be found in science, sales, technology and white-collar sectors. Organizations put much effort to recruit the right candidate and compensation could be substantial with variable pay, bonuses or stock plans playing a large role. Moreover, the difference in terms of value added with respect to other positions (Lepak and Snell, 2002; Oldroyd and Morris, 2012) will contribute to large differences in compensation.

Guardians are in those jobs, needed in the organization, who do not contribute decisively in increasing profits whatever they do, but, on the other hand, can substantially decrease profits if performance is low. Examples of these workers could be lab technicians, stevedores, pilots, truck drivers or soccer goalkeepers. A lab technician will follow the instructions by specialists, scientists or researchers and hence allow them to perform but will not generally enhance the result. On the other hand, mistakes may have a large negative impact. We believe that the presence of these jobs in a organization introduces an interesting trade-off to the managers. We want to study this trade-off between increasing wages to stars in order to obtain positive returns or increasing wages to guardians to avoid negative returns. In this sense, in this chapter we use the idea of loss aversion (Kahneman and Tverski, 1991) and applies it to a situation where it may affect income distribution. Nevertheless, little attention has been posed on workers' behaviors that may be harmful for the company.[22] A small number of harmful behaviors such as sabotage (Harbring and Irlenbusch, 2005, and Carpenter, Matthews, and Schirm, 2010), absenteeism (Riphahn, 2004) or impression management (Corgnet, Hernán-Gonzalez, and Rassenti, 2015) have been previously studied. We

[22] See Rotundo and Sackett (2002), Griffin, O'Leary-Kelly, and Collins (1998), and Koopmans, Bernaards, Hildebrandt, Schaufeli, de Vet Henrica, and van der Beek, (2011).

contribute to this literature by analyzing the effects that the presence of guardians have in compensation policies.

Soldiers are those workers needed to do certain operations who do not contribute individually much to the profits of the firm, either positively or negatively. Effectively, one could think of soldiers as the vast majority of workers. For example, cleaning staff or receptionists. Given these types, the question we ask is whether managers will take into account these specific differences in deciding how to compensate simultaneously two different types in a gift exchange setting.

Previous studies find different results using natural data regarding the effect of pay dispersion on employee's performance. Some studies find that internal pay dispersion is detrimental for work morale and job performance (e.g., Grund and Westergaard-Nielsen, 2008), others fail to find that pay dispersion has any effect on employees' behavior (e.g., Leonard, 1990), and some studies even find that large pay differentials may have beneficial effects on firm performance (e.g., Winter-Ebmer and Zweimüller, 1999). These differences in compensation may appear because of unobserved variables, and we hypothesize that the specific job assignment that workers have (stars, soldiers or guardians) is one of the factor explaining these divergences.

We take these typologies and combine them in pairs to analyze the effect that the comparison between typologies has on the managerial decision to set wages. Our main hypothesis has to do with effect of introducing guardians into the picture. We posit that managers will be affected by a loss aversion effect and this will distort the distribution of compensation towards guardians.

2. Literature review

We present first the existing literature focused in different types of workers' compensations. Following this line, Aguinis and O'Boyle Jr (2014) discuss how stars performers emerge and how the presence of stars affects all management practices concerning individual performance. They also develop a set of propositions to guide future research on star workers.

Lepak and Snell (2002) theorize that stars are more likely to be sought out by employers. They argue that stars have an information advantage due to their higher social capital. However, all information is not beneficial for them, and human resource management is a key element to minimize information this potentially detrimental information overload.

Regarding to dysfunctional or harmful workers' behavior, the work of Collin and Griffin (1998) defines a list of dysfunctional behaviors that may negatively affect companies' profits. For example: sabotage, impression management, absenteeism or unsafe work practices.

Carpenter et al. (2010) run a real effort experiment to test how sabotage affects effort provision under tournament and piece-rate payment schemes. The task consists of preparing envelops and they also have to evaluate the quality of their coworkers' envelops. They find that the possibility of sabotage decreases effort in tournaments. This result is due to the fact that workers expect to be sabotaged by their coworkers.

The experimental literature related to social comparisons among workers is also related to our work. Gächter and Thoni (2010) present the results of three experiments using a three-person gift-exchange game. They find that workers react in a higher magnitude to disadvantageous wage discrimination by decreasing their effort level more than they do when they face advantageous wage discrimination. They attribute this result to pure discrimination.

In the same line, Cohn, Fehr, Herrmann, and Schneider, (2014) analyze how wage differences affect workers' effort in a field experiment. In the experiment two workers have to perform the same task and they are paid equally. They find that when both wages decrease workers decrease their effort. However when just one worker's wage is decreased, this worker's effort drop is more than twice as much as when both wages were decreased at the same time.

Previous studies analyze how loss aversion affects workers' behavior.[23] For example, Fehr and Goette (2007) run a field experiment where workers may choose their working time and effort per hour. They show that loss averse workers respond negatively to a wage increase. To the best of our knowledge, ours is the first experimental study that analyzes how loss aversion affects managerial decision making.

The rest of the chapter is structured as follows. In the next section we describe the experimental design. In section 3 we discuss theoretical predictions. In section 4 we present and discuss our results. Finally, conclusions are drawn in section 5.

3. Design

Our design uses the standard gift-exchange setting (Fehr, Kirchsteiger and Riedl, 1993). In our setting, however, three players allow us to represent our object of interest, how managers are affected in their distributional decisions by the presence of different types, especially the guardian. Hence we have the manager, and a pair of two different workers composed by two of the following types: Soldier, Star and Guardian (so,st and gu, hereafter). The manager in our design is the first to move by selecting a pair of wages (w_i, wj), where w_i, wj $\in$ [0,100]. Both wages are public information once the manager sets them. Once workers know the vector of wages, they decide simultaneously the level of costly effort $e_i \in \{0, 1\dots 10\}$. The key feature in our design is that we incorporate two workers that differ in their performance function of effort, Y_i (e_i). The table below shows the different impacts these workers have in the manager's profit.[24]

[23] See, for exemple, Goette, Huffman, and Fehr (2004) or Fryer Jr, Levitt, List, and Sadoff (2012).

[24] See also figure 1for a more visual explanation.

Effort Level	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
$\mathbf{Y_{St}}$	**0**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**
$\mathbf{Y_S}$	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
$\mathbf{Y_G}$	**-100**	**-80**	**-60**	**-40**	**-20**	**0**	**20**	**40**	**60**	**80**	**100**

Table 1: Production by effort level for each type of worker.

The reference worker is what we call the soldier. This type could be assimilated to the standard worker in gift-exchange games. It is important to notice that impact in profit from this worker is always in the positive side, from 0 to 100 points in increments of 10 units as effort increases. Stars can be identified by comparison to the standard workers, as Aguinis and O'Boyle (2014) point out. So, to incorporate a star in our design, it is the relative difference in impact with respect to what standard workers produce what defines a star job. In our design a star is a type of worker that, again, has always a non-negative impact, from 0 to 200 points in increments of 20 points per unit of effort. Hence, for any given strictly positive effort the star doubles the impact of the soldier. The last type of worker we introduce is the one we predict will have more pervasive effects on the compensation decisions. The guardian's impact on profit ranges from -100 to 100 points in increments of 20 points per unit of effort. The objective of this difference is to study how the pair of wages decided by the manager changes as we pair the different types of workers. Hence we have in our design three treatments: so/st, so/gu and st/gu. The profits to the manager are defined by: [25]

$$\Pi\ (e_{i,\ ej}) = 100 + Y_i\ (e_i) + Y_j\ (e_j) - (w_i + w_j)$$

$$Y_i\ (e_i) = a_i + b_i\ e_i;$$

[25] Where $a_{so}=a_{st}=0$ in the case of the soldier and star, $a_{gu}<0$ in the case of the guardian and $b_{st} = b_{gu} > b_{so} > 0$. The workers' payoff is given by Πi (wi, ei) = wi – C (ei), where the values C (ei) can be found in the table given in Appendix A.

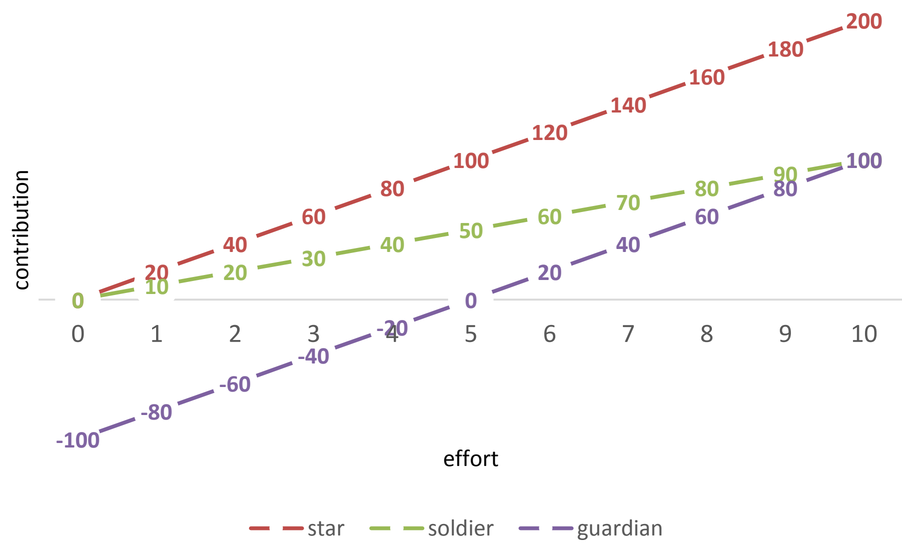


Figure 1: Production by effort level for each type of worker.

3.1 Experimental procedures

Subjects play the same game for twelve rounds. First, they play two (no paid) practice rounds to get familiar with the software. The data from the practice rounds are not included in the data analysis. We use a strangers matching protocol in our design.[26] Roles are fixed throughout the whole experiment. Subjects are re-matched after each period with a different group of subjects. After the last round, subjects answered a short post-experimental questionnaire including questions about gender, studies and age.

The experiment was conducted at the Universitat Autònoma of Barcelona with 264 subjects (90 in the so-st treatment and 87 in each of the so-gu and st-gu treatments), who were recruited using the online recruitment system ORSEE (Greiner, 2004). All sessions were conducted in the lab between June 2014 and December 2015, using Z-Tree software (Fischbacher, 2007). No one participated in more than one treatment or session. We ran four sessions for each treatment. Points earned were

[26] We use a strangers matching protocol to abstract from confounding reputation effects.

converted at an exchange rate of 0.01 Euro/point. Subjects also received a show-up fee of 5 Euro. Every session lasted approximately 80 minutes. On average, every subject earned 12 Euro. The instructions for the experiment can be found in Appendix A.

4. Research questions

In this section we outline the hypotheses that inspire our design. The standard prediction assuming fully rational, payoff maximizing-agents in the one shot game is that workers will select effort 0 and managers will accordingly set a pair of wages (0, 0). Since we use a strangers matching design, no reputation building strategies should play a role. Previous accumulated evidence and models lead us to propose a different set of hypotheses for our design. Hence, based on previous experimental results, we focus on inequality aversion (Bolton and Ockenfels, 2000) and reciprocity (Falk and Fischbacher, 2006) considerations. Furthermore, we include an additional hypothesis that includes loss aversion considerations.

In our setting managers move first and compensations will be public to both workers before they decide on effort. Managers' decisions may influence the motivation of workers to exert effort, but the manager may also want to implement a certain distribution of wages according to personal criteria. We will observe just their decisions and hence will hypothesize what is behind these decisions and the reactions of workers.

The trade-off that managers face is how to motivate workers to exert maximum effort only with the wage instrument while having in mind that extreme inequalities may generate low effort if workers are inequality averse (Bolton and Ockenfels, 2000).

If the manager believes inequality considerations matter, compensations should be similar. And the higher the compensation, the higher the effort managers will expect. So, under this scheme we expect $w_{gu} = w_{so} = w_{st}$ and our treatments would reveal no significant differences between compensations. Since managers pay positive and relatively high wages, we correspondingly expect efforts by workers to be similar and positive in our several treatments, $e_{gu}(w_g) = e_{so}(w_{so}) = e_{st}(w_{st}) > 0$.

If inequality aversion is not strong enough, we posit that since workers differ, some inequality may be worth to the manager if this generates higher effort by the most productive worker. For example, let's consider the case where we pair the star and the soldier. If we suppose an initial situation in which the manager considers equality of wages and expects certain efforts, then by increasing inequality with a symmetric deviation in compensation in favor of the star, the manager may expect changes in effort. In any case, the variation in profits would be $20 \cdot \Delta e_{st} - 10 \nabla e_{so}$ and profits by managers would increase as long as $(\nabla e_{so})/2) < \Delta e_{st}$, turning increases in inequality profitable in this case. Increases in effort by the star generate a positive overall production increase with the same wage cost. This could be consistent with the existing literature on star compensation, with striking differences in compensation.

This same argument could be translated to the situation where the manager faces a soldier and a guardian. From a hypothetical initial situation of equal wages, managerial profits increase by increasing the wage to the guardian to generate more effort from her, assuming this implies an equal reduction in effort in the soldier type.

On the other hand, if we compare a star and a guardian, this reasoning leads to no changes because there is not profit in increasing inequality, so in this context, equality between them could be sustained. Therefore, we expect would expect: $w_{st} - w_{so} = w_{gu} - w_{so} > w_{st} - w_{gu} = 0$.

In our experiment managers face a loss factor we introduce by using guardians in certain treatments and our expectation is that this factor will distort the wage distribution. In the presence of a guardian, low levels of effort by this worker can have a negative impact in the managers' profit function. Following Tversky and Kahneman (1991), since losses loom larger than wins, we predict than the manager will try to avoid these losses by setting a higher wage to induce the guardian to exert a sufficiently high effort. If a guardian and a star are paired together, then we expect higher wages than in previous cases to induce the guardian increase effort above the losses threshold and from there, deviations from equal wages in favor or the guardian. Any positive deviation with respect to equal wages could induce an increase in income of $20 \cdot \Delta e$ with a possible decrease in effort by the other agent. However decreases in effort by the guardian may generate negative income to the manager (and decreases in effort by the manager will still generate positive income). Hence, if any difference, this should be in favor of the guardian. If we pair the guardian with a soldier, these differences should be more important, since increases in effort by the soldier just increase income by a factor of 10. So, we expect the guardian to profit from her production function with higher wages with respect to the soldier and equal or higher wages than the star.

We derive the following hypotheses from our theoretical framework:

Hypothesis 1: *(Loss aversion)*

Managers' loss aversion will lead to higher wages for guardians.

Hypothesis 2: *(Social comparison)*

Workers will react to a higher extent to negative wage discrimination than to positive wage discrimination.

5. Results

In this section we will present results concerning allocation decisions of wages by managers when they face different pairs of workers. Also, we will analyze effort decisions and how these individual effort decisions are affected by individual wages and wage allocations. In section 4.1 we check for wage differences among the different pairs in our experiment. In section 4.2 we present the results on the wage-effort relationship. Finally, in section 4.3 we show how workers react to wage differences.

5.1 Wage distribution

We study here how managers distribute wages among the different pairs of workers. We want to test whether differences in job typologies affect the way managers pay each type of worker. More specifically, we want to test whether loss aversion plays a role in wages distribution. We present evidences of managers' behavior by comparing wage distributions across the different situations they can face.

We show in table 2 the average (standard deviation) wage, effort and profits for each type of worker by treatment. We observe in figures 2 and 3 that soldiers receive a lower wage than stars and guardians ($p < 0.001$ Wilcoxon signed-rank test for both so-st and so-gu treatments). Soldier also receive lower profits than stars and guardians ($p < 0.001$ Wilcoxon signed-rank test for both so-st and so-gu treatments).

Treatment	so-st	so-gu	st-gu
Soldier wage	35.35 (31.50)	43.99 (36.52)	
Star wage	45.43 (36.44)		59.56 (33.34)
Guardian wage		61.27 (32.19)	63.82 (30.84)
Soldier effort	1.9 (2.6)	2.74 (3.43)	
Star effort	1.98 (2.85)		3.70 (3.38)
Guardian effort		4.19 (3.58)	4.32 (3.37)
Soldier profits	32.65 (29.63)	39.55 (32.29)	
Star profits	42.47 (33.86)		53.69 (29.23)
Guardian profits		54.36 (29.11)	56.86 (27.21)
Manager profits[27]	77.78 (55.42)	5.98 (63.88)	37.03 (73.72)

Table 2: Average wage and effort and manager profits by treatment

When stars and guardians are paired they receive, on average, the same wage and profits (p=0.469 and p=0.320, Wilcoxon signed-rank test, for wage and profits respectively). We can observe that wage differences are higher between the soldier and the guardian than between the soldier and the star. This result is statistically significant when we compare wage differences between so-st and so-gu treatments (figure 5) using the soldier as a reference point (p=0.002 rank-sum Mann-Whitney test).

We can also observe in table 2 that both soldier and star receive a higher wage when they are paired with the guardian (43.99 and 59.56 for soldier and star, respectively) than when they are paired together (35.35 and 45.43 for soldier and star, respectively). These differences are statistically significant in both cases ($p < 0.001$ rank-sum Mann-Whitney test, for both soldier and star).

[27] Due to the nature of our experimental design, managers may potentially get higher profits in the treatments where the star is present. Our results are in line with those expected from the design.

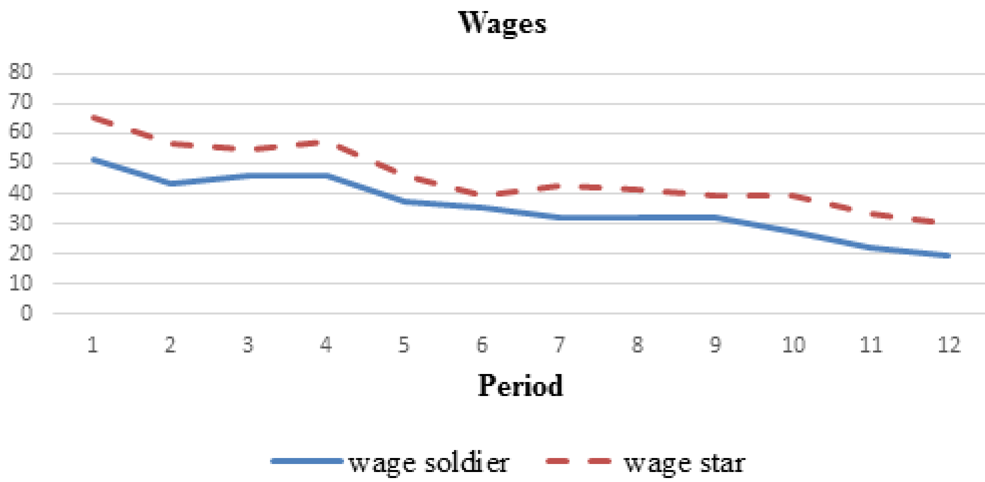


Figure 2: Average wages by period for treatment so-st.

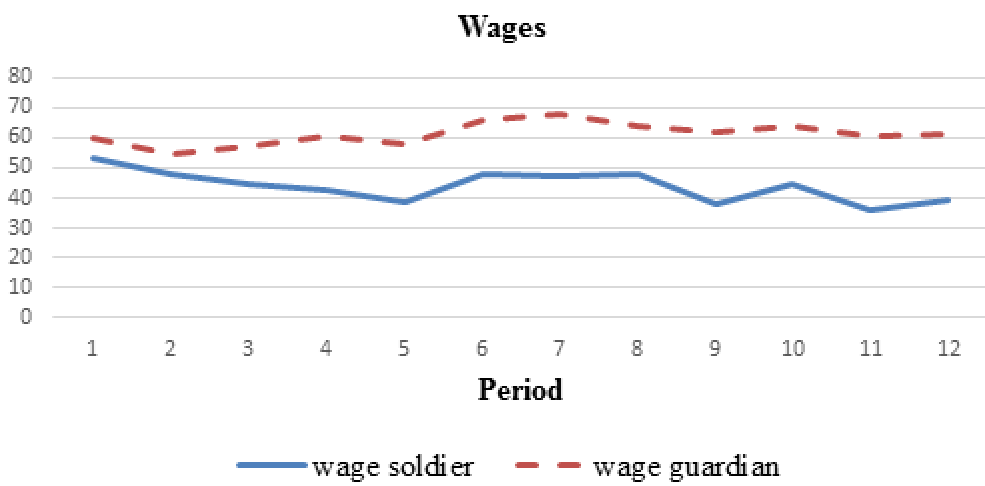


Figure 3: Average wages by period for treatment so-gu.

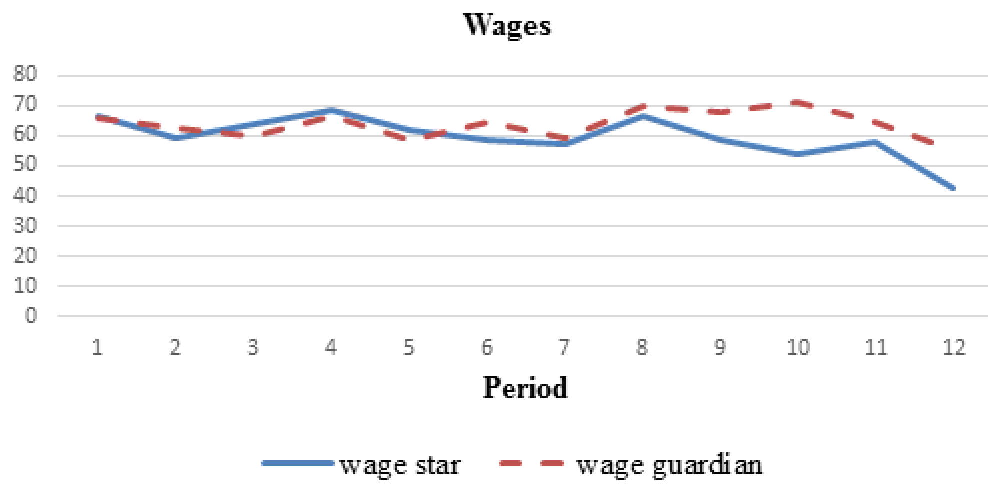


Figure 4: Average wages by period for treatment st-gu.

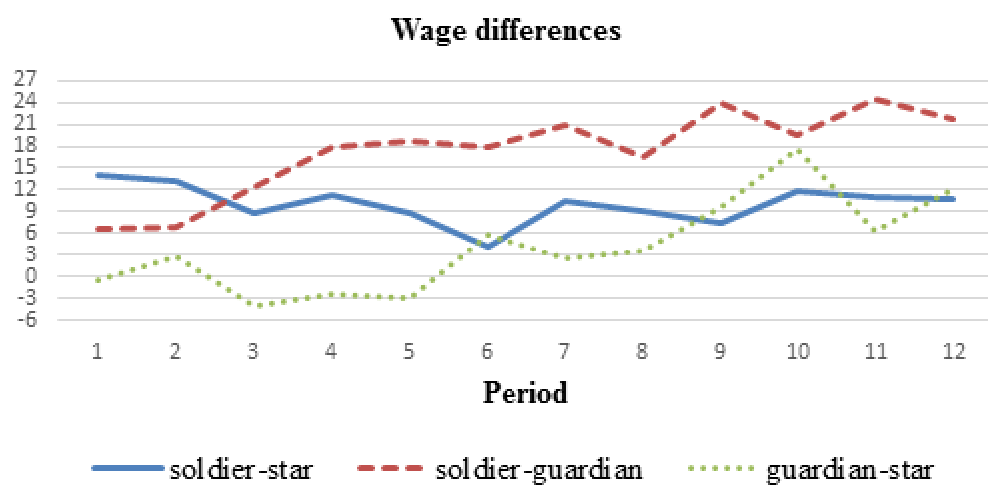


Figure 5: Average wage differences by period for all treatments.

We can state from our analysis that guardians are better paid than stars when we use the soldier as a reference point. However, loss aversion does not seem to appear when stars and guardians are paired together. We can also state that the presence of the guardian makes the manager to increase other workers' wages. This could happen because the guardian may act as a (dangerous) reference point for the manager when setting the wages. The manager set a high wage for the guardian and then set the wage for the other worker closer to the reference point than when the guardian is not a reference and loss aversion does not play any role (so-st treatment).[28] These results partially support our hypothesis 1 which states that loss aversion affects manager's wage decisions.

Result 1: *(Wage distribution)*

i) *Loss aversion leads to a higher wage for the guardian when he/she is paired with a soldier*.

ii) The guardian creates a positive externality in his/her coworkers' wage independently of their characteristics.

5.2 Wage-effort relationship

In this sub-section we want to test whether there is an increasing relation between wage and effort for each type of worker. We run a Spearman rank test for each possible situation in our experiment. Previous papers using gift-exchange with pairs of one manager and one worker find a positive correlation between wage and effort.[29] Our results are in line with these findings in the literature. This wage-effort relationship is strong in the case of soldiers (rho = 0.604, $p < 0.001$ and rho = 0.754, $p < 0.001$ Spearman rank test for so-st and so-gu, respectively), stars (rho = 0.588, $p < 0.001$ and rho = 0.769, $p < 0.001$ Spearman rank test for so-st and st-gu, respectively) and guardians (rho = 0.544, $p < 0.001$ and rho = 0.672, $p < 0.001$ Spearman rank test for so-gu and st-gu, respectively). Our results support the idea of an increasing relation between wage and effort for all types of workers independently of the type of their pair, see figures B.1 to B.3 in appendix B. This finding connects with those of previous studies and also demonstrate that the increasing relation wage-effort is robust for different types of workers.

[28] Deeper research needs to be done to test this explanation.

[29] See, for example, Charness (2004), Fehr and Gächter (2000), Gneezy and List (2006) and Fehr and Falk (1999).

Result 2: *(Wage-effort relationship)*

There is an increasing relationship between wage and effort for all types of workers.

5.3 Wage discrimination

In this sub-section we want to study how workers react to differences in wages. Previous studies find that workers with equal characteristics react to negative differences in wages to a higher extent than they do to positive differences in wages.[30] Here, we analyze how different types of workers react to wage discrimination. First, we present descriptive data (see table 3), and second we estimate GLS models to test our assumptions (see table 4).

Treatment	so-st	so-gu	st-gu
Advantage wage soldier	3.05 (2.92)	4.88 (2.87)	
Disadvantage wage soldier	2.24 (2.57)	1.59 (2.30)	
Advantage wage star	3.09 (3.04)		4.65 (2.87)
Disadvantage wage star	1.19 (1.63)		1.55 (2.30)
Advantage wage guardian		4.82 (3.05)	4.88 (3.05)
Disadvantage wage guardian		3.84 (2.96)	3.38 (2.96)
Equal wage soldier	1.27 (2.39)	3.82 (3.69)	
Equal wage star	1.08 (2.52)		4.52 (3.69)
Equal wage guardian		3.18 (3.73)	4.63 (3.73)

Table 3. Average workers' effort (standard deviation) by wage differences.

[30] See, for example, Akerlof and Yellen (1990), Gächter and Thoni (2010), Abeler, Altmann, Kube, and Wibral (2010), and Cohn et al. (2014).

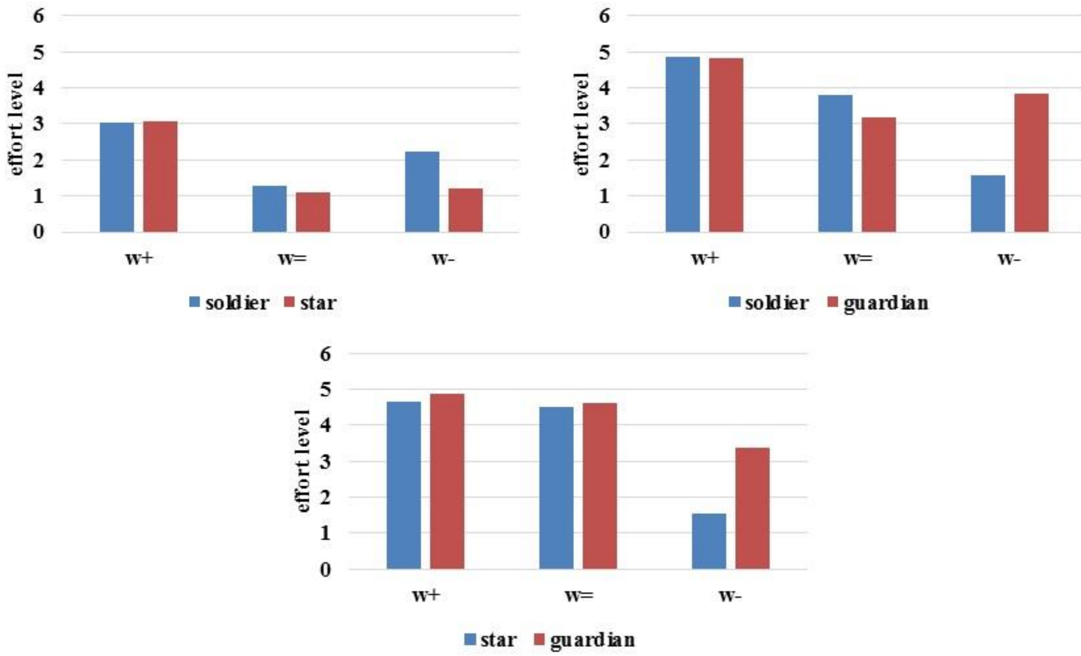


Figure 6: Wage discrimination and effort by treatment.

In figure 6 (table 3) we can observe how the different types of workers react to wage discrimination. In the so-st treatment, both the soldier and the star have a stable effort level, but they spend a higher level of effort when they face an advantageous wage (3.05 and 3.09 for the soldier and the star, respectively). In the so-gu treatment, guardians (4.82) and soldiers (4.88) also spend more effort when they are positively discriminated but it seems that they (especially guardians) do not react to wage discrimination. In the st-gu treatment, both the star and the guardian spend much less effort when they are negatively discriminated (1.55 and 3.88 for the star and the guardian, respectively). In order to better analyze these effort differences we conduct an econometric analysis (see table 4).

Model Dependent variable	1 so-st effort	2 so-gu effort	3 st-gu effort
ownwage	.045*** (.005)	.065*** (.005)	.072*** (.004)
period	- .076*** (.025)	- .067** (.031)	- .067** (.029)
positivewage	- .226 (.252)	.092 (.242)	- .268 (.213)
negativewage	- .015 (.185)	- .189 (.223)	- .532*** (.208)
constant	.689*** (.244)	.524* (.345)	.257 (.359)
Observations	720	672	696
R^2	0.335	0.454	0.520

Table 4. GLS regression for individual effort decisions. Robust standard errors clustered by matching groups are given in brackets. Significance at the 10%, 5% and 1% level is denoted by *, **, and ***, respectively.

We estimate linear regression models (one per treatment) with robust standard errors clustered by matching group to analyze which factors affect individual effort decisions (see table 4). In our model, we include the subject's wage (ownwage), period number (period), a dummy which takes the value 1 if the subject has received more than his/her coworker and 0 otherwise (positivewage), and a dummy which takes the value 1 if the subject has received less than his/her coworker and 0 otherwise (negativewage). Worker's own wage has a positive and significant effect in worker's effort in all treatments as expected. In all models, the variable period has a negative and significant sign which implies that effort has a downward trend over time. We do not find significant effects when a worker receive a higher wage than his/her coworker in any treatment. However, we find a negative and significant effect of receiving a lower wage than his/her coworker on worker's effort in the st-gu treatment (model 3).[31]

[31] This effect is robust if we run the regression for the guardian and the star individually.

In the light of the results from our analysis, we can state that workers just react to negative differences in wages when they are in the st-gu treatment while positive differences do not affect workers' effort exertion at all. This results complement previous findings by demonstrating that positive wage discrimination does not affect positively effort exertion when workers have different characteristics. These results partially support our hypothesis 2 which states that workers react to a greater extent to negative wage discrimination than to positive wage discrimination.

Result 3: *(Wage comparison)*

Guardians and stars react negatively to disadvantageous wage discrimination when they are paired together. However, workers do not react to advantageous wage differences in any situation.

6. Conclusions

In this chapter we study how pairs of workers with different productivity levels affect wage allocation. We analyze manager's decisions when they have to allocate workers' wages. We also analyze workers' reaction to wage discrimination. In our experiment, one manager is matched with two different workers. The manager first decides on a different (or similar) pair of wages knowing workers' characteristics. Then workers have to decide an effort level after receiving information about both his/her wage and his/her coworker's wage. We design three treatments (so-st, so-gu, and st-gu) to study all possible combination of our three types of workers (soldier, guardian and star).

We want to shed light on which are the determinants of wage discrimination among different types of jobs, and how this discrimination affects workers' performance when they know they are paid differently.

We find that guardians and stars are better paid than soldiers in all situations. We also find that guardians and stars are equally paid when they are paired together. However, guardians are better paid than stars when their pair is a soldier.

Moreover, the presence of the guardian leads to an increase of the other workers' wage. We observe that both soldier and star workers receive a higher wage when they are paired with the guardian than when they are paired together.

With respect to workers' reaction to wage discrimination, we find that positive wage discrimination does not have any effect on workers' effort level. But, when managers negatively discriminate workers, they exert a significantly lower effort level in the case where a guardian and a star are paired together.

We can state that loss aversion has an impact in how managers allocate wage among workers. We can also argue that the presence of workers that may potentially damage the manager's profits makes all workers to be better off than when they are paired with another type of worker.

These results might help to better understand the determinants of wage differences across different job typologies in the real world even in the cases where a special ability is not needed to perform a certain job.

7. References

Abeler, J., Altmann, S., Kube, S., and Wibral, M. (2010). Gift Exchange and Workers' Fairness Concerns: When Equality is Unfair. Journal of the European Economic Association, 8(6), 1299-1324.

Aguinis, H. and O'boyle jr., E. (2014). Star performers in twenty-first century organizations. Personnel Psychology 2014, 67, 313–350.

Akerlof, G. A., and Yellen, J. L. (1990). The fair wage-effort hypothesis and unemployment. The Quarterly Journal of Economics, 105(2), 255-283.

Bolton, G. E., and Ockenfels, A. (2000). ERC: A theory of equity, reciprocity, and competition. American economic review, 166-193.

Borman, W. C., and Motowidlo, S. J. (1997). Task performance and contextual performance: The meaning for personnel selection research. Human performance, 10(2), 99-109.

Carpenter, J., Matthews, P. H., and Schirm, J. (2010). Tournaments and office politics: Evidence from a real effort experiment. The American economic review, 100(1), 504-517.

Charness, G. (2004). Attribution and reciprocity in an experimental labor market. Journal of labor Economics, 22(3), 665-688.

Charness, G., Cobo-Reyes, R., Lacomba, J. A., Lagos, F., and Pérez, J. M. (2016). Social comparisons in wage delegation: Experimental evidence. Experimental Economics, 19(2), 433-459.

Cohn, A., Fehr, E., Herrmann, B., and Schneider, F. (2014). Social comparison and effort provision: Evidence from a field experiment. Journal of the European Economic Association, 12(4), 877-898.

Corgnet, B., Hernán-Gonzalez, R., and Rassenti, S. (2015). Firing threats: Incentive effects and impression management. Games and Economic Behavior, 91, 97-113.

Falk, A., and Fischbacher, U. (2006). A theory of reciprocity. Games and economic behavior, 54(2), 293-315.

Fehr, E., and Falk, A. (1999). Wage rigidity in a competitive incomplete contract market. Journal of political Economy, 107(1), 106-134.

Fehr, E., and Gächter, S. (2000). Fairness and retaliation: The economics of reciprocity. The journal of economic perspectives, 14(3), 159-181.

Fehr, E., and Goette, L. (2007). Do workers work more if wages are high? Evidence from a randomized field experiment. The American Economic Review, 97(1), 298-317.

Fehr, Ernst, Georg Kirchsteiger, and Arno Riedl. (1993). "Does fairness prevent market clearing? An experimental investigation." The quarterly journal of economics 108.2 (1993): 437-459.

Fryer Jr, R. G., Levitt, S. D., List, J., and Sadoff, S. (2012). Enhancing the efficacy of teacher incentives through loss aversion: A field experiment (No. w18237). National Bureau of Economic Research.

Gächter, S. and Thoni, C. (2010). Social comparison and performance: Experimental evidence on the fair wage–effort hypothesis. Journal of Economic Behavior & Organization 76 (2010) 531–543.

Gneezy, Uri, and John List. (2006). Putting Behavioral Economics to Work: Testing for Gift Exchange in Labor Markets Using Field Experiments. Econometrica 74 ð5Þ: 1365–84.

Goette, L., Huffman, D., and Fehr, E. (2004). Loss aversion and labor supply. Journal of the European Economic Association, 2(2-3), 216-228.

Griffin, R. W., O'Leary-Kelly, A., and Collins, J. (1998). Dysfunctional work behaviors in organizations. Journal of Organizational Behavior (1986-1998), 65.

Grund, C., and Westergaard-Nielsen, N. (2008). The dispersion of employees' wage increases and firm performance. ILR Review, 61(4), 485-501.

Harbring, C., and Irlenbusch, B. (2005). Incentives in tournaments with endogenous prize selection. Journal of Institutional and Theoretical Economics JITE, 161(4), 636-663.

Koopmans, L., Bernaards, C. M., Hildebrandt, V. H., Schaufeli, W. B., de Vet Henrica, C. W., and van der Beek, A. J. (2011). Conceptual frameworks of individual work performance: a systematic review. Journal of Occupational and Environmental Medicine, 53(8), 856-866.

Leonard, Jonathan S. (1990). Executive pay and firm performance. ILR Review, 43.3: 13-S.

Lepak, D. P., and Snell, S. A. (2002). Examining the human resource architecture: The relationships among human capital, employment, and human resource configurations. Journal of management, 28(4), 517-543.

Malmendier U, and Tate G. (2009). Superstar CEOs. The quarterly journal of economics, 124, 1593–1638.

Maximiano, S., Sloof, R., and Sonnemans, J. (2007). Gift exchange in a multi-worker firm. The Economic Journal, 117(522), 1025-1050.

Oldroyd, J. B., and Morris, S. S. (2012). Catching falling stars: A human resource response to social capital's detrimental effect of information overload on star employees. Academy of Management Review, 37(3), 396-418.

Riphahn, R. T. (2004). Employment protection and effort among German employees. Economics Letters, 85(3), 353-357.

Rotundo, M., and Sackett, P. R. (2002). The relative importance of task, citizenship, and counterproductive performance to global ratings of job performance: a policy-capturing approach. Journal of applied psychology, 87(1), 66.

Tversky, A., and Kahneman, D. (1991). Loss aversion in riskless choice: A reference-dependent model. The quarterly journal of economics, 106(4), 1039-1061.

Winter-Ebmer, R., and Zweimüller, J. (1999). Firm-size wage differentials in Switzerland: Evidence from job-changers. The American Economic Review, 89(2), 89-93.

Appendix A

INSTRUCTIONS

First at all, thank you for participating in this experimental study. The instructions are simple and if you follow them carefully you will be privately paid in cash, since nobody will know the payments received by the other participants. In this experiment there are neither correct nor incorrect answers. Do not think that we expect a specific behavior from you. On the other hand, you have to take into consideration that your decisions will affect the amount of money you will earn in the experiment. If you have any doubt, you can raise your hand and ask any of the experimenters. Out of these questions, any kind of communication is forbidden.

There are three types of participants: **manager, worker A** and **worker B**. In each round, each manager will be randomly paired with one worker A and one worker B. This pairing will change each round. The difference between the two types of workers will be explained in advance.

The experiment lasts 12 rounds.

You will know your role (manager, worker A or worker B) at the beginning of the experiment. It will be randomly assigned by the computer. You will keep the same role throughout the 12 rounds of the experiment.

In each round, participants will be paired with different people to the ones they were paired in the previous round, meaning that you will interact with different people in each round. Those people will be randomly chosen among the participants in this experiment by an algorithm. Furthermore, the identities of the participants will always be hidden.

Each round consists of two stages.

Stage 1:

The manager will set a *wage* for each worker. The wage must be an integer number between 0 and 100. The manager may choose a different wage for each worker.

Stage 2:

a) The workers will know both his/her own wage and his/her coworker wage.
b) Each worker chooses his/her *level of effort*. The level of effort have to be an integer number between 1 and 10.
c) The higher the level of effort chosen by the worker, the higher the cost of effort of the worker. The cost of effort associated with each level of effort is shown in the following table:

Level of effort	0	1	2	3	4	5	6	7	8	9	10
Cost of effort	0	1	2	3	5	7	9	11	14	17	20

d) The difference between worker A and worker B is the amount of points, per each level of effort, each worker may contribute to the manager. It is shown in the following tables:

[SOLDIER-GUARDIAN TREATMENT]

Level of effort	0	1	2	3	4	5	6	7	8	9	10
Contribution of worker A	0	10	20	30	40	50	60	70	80	90	100

Level of effort	0	1	2	3	4	5	6	7	8	9	10
Contribution of worker B	-100	-80	-60	-40	-20	0	20	40	60	80	100

[SOLDIER-STAR TREATMENT]

Level of effort	0	1	2	3	4	5	6	7	8	9	10
Contribution of worker A	0	10	20	30	40	50	60	70	80	90	100

Level of effort	0	1	2	3	4	5	6	7	8	9	10
Contribution of worker B	0	20	40	60	80	100	120	140	160	180	120

[STAR-GUARDIAN TREATMENT]

Level of effort	0	1	2	3	4	5	6	7	8	9	10
Contribution of worker B	0	20	40	60	80	100	120	140	160	180	120

Level of effort	0	1	2	3	4	5	6	7	8	9	10
Contribution of worker B	-100	-80	-60	-40	-20	0	20	40	60	80	100

The profit of the manager in each round is calculated as follows:

Profit of the manager = 100 + Contribution of A + Contribution of B – (wage of A + wage of B)

That is, 100 plus the contribution of worker A, plus the contribution of worker B, minus the sum of wages.

Hence, the profit of the manager is higher the higher is the level of effort chosen by the workers and the lower is the wage paid to the workers.

The profit for each worker in each round is calculated as follows:

Profit of the worker = wage – cost of effort

That is, the profit of each worker is composed by the wage received from the manager minus the cost of effort associated to the level of effort chosen by the worker.

Hence, the profit of the worker is higher the higher is the wage and the lower is the level of effort chosen by the worker.

[SOLDIER-GUARDIAN TREATMENT]

[For example if the wage of worker A is 85 and his/her level of effort is 7, the wage of worker B is 70 and his/her level of effort is 8, then the profit of each participant in this round will be:

Profit of the manager = 100 + 70 + 60 – (80 + 75) = 75 points
Profit of worker A = 80 – 11 = 69 points
Profit of worker B = 75 – 14 = 61 points]

[SOLDIER-STAR TREATMENT]

[For example if the wage of worker A is 85 and his/her level of effort is 7, the wage of worker B is 70 and his/her level of effort is 8, then the profit of each participant in this round will be:

Profit of the manager = 100 + 70 + 160 – (80 + 75) = 175 points
Profit of worker A = 80 – 11 = 69 points
Profit of worker B = 75 – 14 = 61 points]

[STAR-GUARDIAN TREATMENT]

[For example if the wage of worker A is 85 and his/her level of effort is 7, the wage of worker B is 70 and his/her level of effort is 8, then the profit of each participant in this round will be:

Profit of the manager = 100 + 140 + 60 – (80 + 75) = 145 points
Profit of worker A = 80 – 11 = 69 points
Profit of worker B = 75 – 14 = 61 points]

At the end of each round, a screen will inform to all participants about compensations, levels of effort chosen and profit of all participants.
At the end of the experiment we will privately pay you. You earnings will be a show up fee of 5 euros plus the equivalence in euros of the SUM of the points you have won in each of the 12 rounds. The points will be converted to euros in a rate of: 10 points = 14 cents.
Before the experiment starts, you will play 2 practice rounds to get familiar with the software. These rounds will be exactly the same as the experiment rounds but without any payment involved.

SUMMARY

- If you are MANAGER:

  You have to set a wage for each worker (equal or different) between o and 100.

- If you are WORKER:

  You have to choose your level of effort between 1 and 10 knowing the costs of effort associated to each level of effort.

QUESTIONNAIRE

To be sure that you have understood the instructions, before starting the experiment you are going to answer a simple questionnaire, just when you answer it correctly you will start your participation in this experiment.

If the wage of worker A is 50 and his/her level of effort is 8, the wage of worker B is 70 and his/her level of effort is 7, then the profit for each participant in this round will be:

Profit of the manager = 100 + (____) + (____) - (____ + ____) = [____ - ____] = ____ points
Profit of worker A = ____ – ____ = ____ points
Profit of worker B = ____ – ____ = ____ points

If the wage of worker A is 90 and his/her level of effort is 10, the wage of worker B is 50 and his/her level of effort is 4, then the profit for each participant in this round will be:

Profit of the manager = 100 + (____) + (____) - (____ + ____)] = [____ - ____] = ____ points
Profit of worker A = ____ – ____ = ____ points
Profit of worker B = ____ – ____ = ____ points

Appendix B

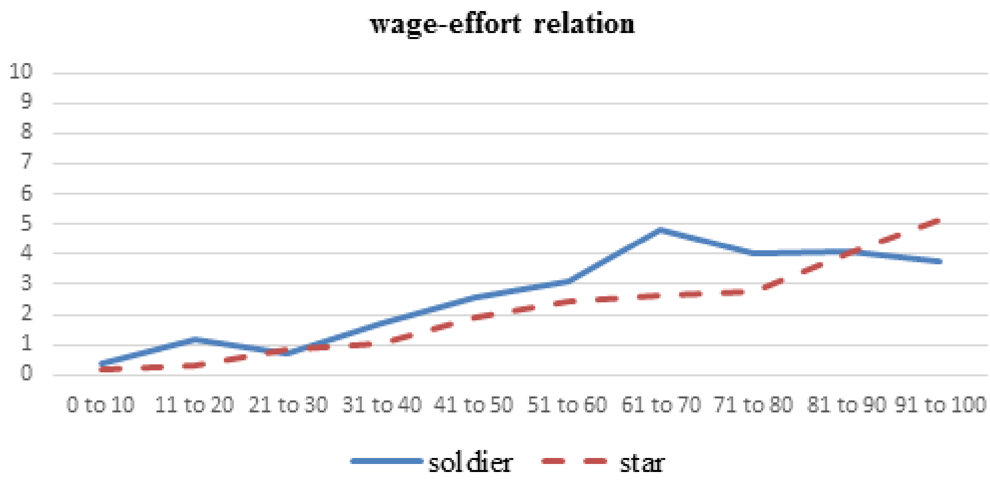


Figure B.1: Wage – effort relation by period for so-st treatment.

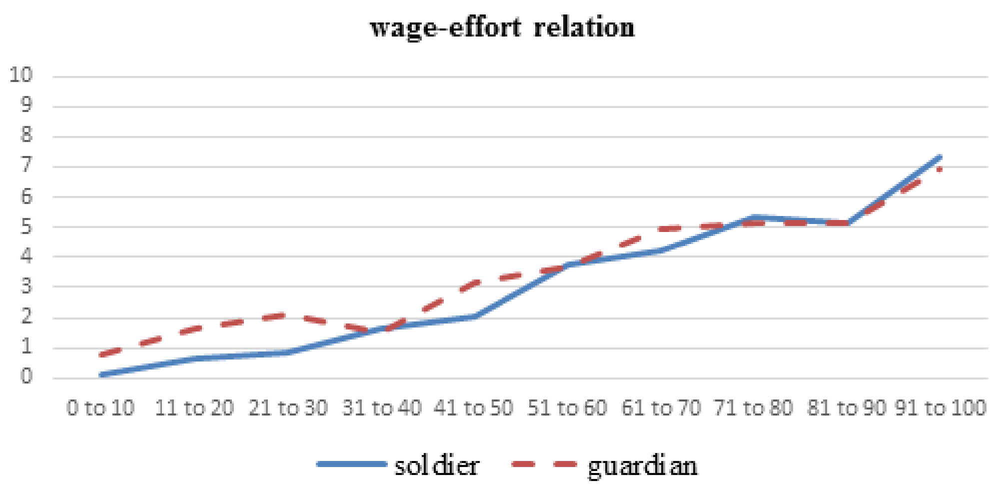


Figure B.2: Wage – effort relation by period for so-gu treatment.

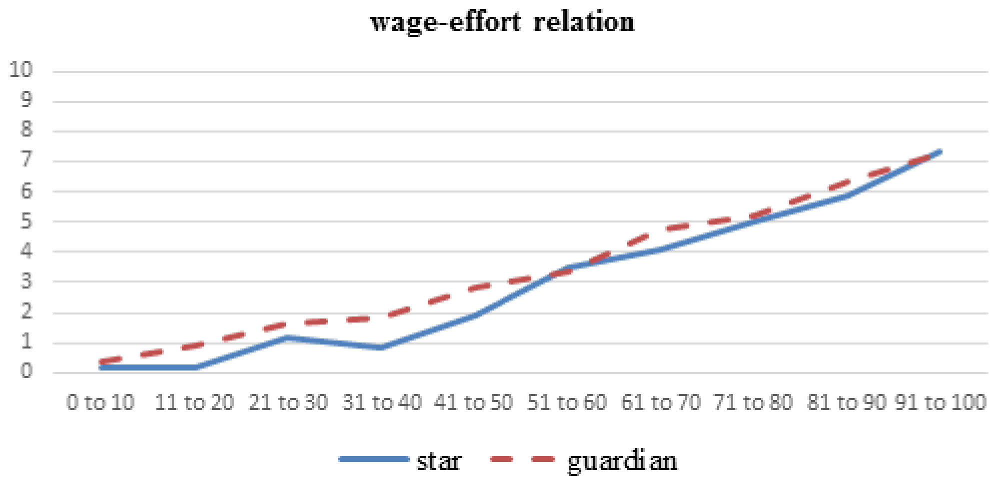


Figure B.3: Wage – effort relation by period for st-gu treatment.

Chapter III: Firing in the Dark: Minimal Information for Maximal Performance

1. Introduction

In the economic theory of incentives precise information about workers' individual effort is regarded as a key input for the design of efficient compensation contracts (e.g. Laffont and Martimort, 2002; Bolton and Dewatripont, 2004). All available information about workers' effort should be incorporated in the optimal incentives contract so that workers exert the efficient level of effort (Holmström, 1979). However, the complex nature of most jobs (Kirsh, 2000; Lumesse, 2013) challenges the precise evaluation of work effort as output measures are increasingly likely to be affected by random shocks (March and Simon, 1993). For example, Hanson and Spring (2016) vigorously argue that using student test scores to incentivize teachers is "no more reliable than a coin toss". There is thus a fundamental disconnect between workers' effort and performance making it difficult for employers to provide individual incentives to workers. In the absence of precise individual measures of output, firing threats have been proposed as an essential feature of the optimal employment contract (Becker and Stigler, 1974; Klein and Leffler, 1981; Shapiro and Stiglitz, 1984; MacLeod and Malcomson, 1989). Previous experimental studies using different labor contracts find that dismissal barriers lead to lower production levels (Falk, Huffman and MacLeod, 2015) and how introducing a long-term investment option outside the labor market increases workers' production levels even in the presence of dismissal barriers (Charness, Cobo-Reyes, Jimenez, Lacomba and Lagos, 2017). However, a crucial question is thus to assess the relative effectiveness of firing threats in environments in which the amount of information available about workers' effort is scarce. To that end, we use a virtual workplace environment which allows for the study of labor incentives in the lab (Corgnet, Hernán-González and Schniter, 2015; Corgnet Hernán-González and Rassenti, 2015a, 2015b) comparing three settings that differ in the amount of information available to bosses.

In this environment, experimental participants have the role of either the boss or a worker. Workers can choose between productive work and two unproductive activities: chatting with other workers and browsing the internet. In the *complete information* treatment, bosses had access to real-time production information about workers as well as real-time information about the current activity workers were undertaking (either working, chatting or browsing the internet). In the *partial information* treatment, bosses could not observe workers' production levels but could see the current activity they were undertaking. Finally, in the *no individual information* treatment, bosses could neither observe workers' production nor their current activity and were only informed about the production level of the organization as a whole.

We formulate hypotheses based on a two-period model of one boss and several workers, where workers vary both in productivity and intrinsic motivation to perform highly. Workers receive a fixed wage and the only decision the supervisor can make is to fire a worker after the first period. The first hypothesis suggested by this model is that more precise signals about agents' effort do not necessarily lead to higher production under firing threats incentive schemes. Our second hypothesis is that in the complete information case, high-ability non-intrinsically motivated workers are more likely to exert to mimic intrinsically-motivated workers than low-ability workers, while with partial information the reverse is true: low-ability non-intrinsically motivated workers are more likely to exert high effort to mimic intrinsically-motivated workers than high-ability workers.

Regardless of the information available to bosses, our results show that workers' dedication to the task (time spent at the work station instead of either chatting or browsing the web) and performance are significantly higher in all three firing treatments compared to a baseline in which firing workers is not possible. As expected, the firing treatment with *no individual information* underperform the *partial information* and *complete information* treatments. However, organizations under *partial information* do at least as well as organizations under *complete information* suggesting that very rudimentary information about workers' job attendance may suffice for firing threats to be effective. This apparently surprising finding is actually consistent with our model's prediction that non-optimal incentive schemes such as firing threats incentivizing properties are robust to cases in which information is scarce. This is the case because precise information about workers' output may discourage non-intrinsically motivated workers to signal themselves as intrinsically motivated which can ultimately affect organizational output negatively. In the presence of firing threats incentive schemes more information does not always reduce agency costs for the principal.

The incentive effects of firing threats are thus robust to environments in which information is scarce. It follows that firing threats are likely to provide adequate incentives in settings in which commonly-used high-powered incentive schemes such as piece rates cannot be implemented. However, it is important to stress that short-term productivity gains may not lead to long-term organizational performance.

2. Hypotheses

The effectiveness of firing threats hinges upon the precision of the signal obtained by supervisors regarding workers' effort. This follows from the informativeness principle (Holmström, 1979) which implies that more precise signals about workers' effort carry additional value that should be included in the compensation contract in order to reduce the agency costs associated to motivating workers. For example, the higher the precision of the supervisor's signal the more likely exerting low effort will trigger dismissal thus increasing the benefits of exerting high effort.

At the same time, the informativeness principle applies to case in which the optimal compensation scheme is in use which may not be the case for commonly-used incentive schemes such as firing threats. We illustrate this point in our two-period model in which one supervisor. Even though the supervisor cannot adjust wages across periods, (s)he can fire workers at the end of the first period (see Appendix B for details). We assume workers possess different levels of ability on the task and vary in their level of intrinsic motivation to complete the task. Agents' levels of ability and intrinsic motivation are private information. The principal can monitor workers and obtain signals regarding their level of production. The monitoring technology of the supervisor is such that (s)he can perfectly observe workers' levels of production or only coarse signals in which case the supervisor cannot distinguish between all levels of production above a certain threshold(ρ). We consider that intrinsically-motivated workers, regardless of their ability, always exert high effort. Non-intrinsically motivated workers are inclined to exert no effort except in the case in which they want to signal themselves as intrinsically motivated. We assume that workers cannot achieve the work output of those who have a higher level of ability even when exerting high effort as a result of a signaling strategy.

Now, consider that the supervision signal is perfect, the supervisor will be able to identify the workers who are producing as much as intrinsically-motivated high-ability workers and will be able to fire the remaining workers at the end of the first period.[32] In that case, non-intrinsically

[32] For the sake of the argument we are assuming that only the production output achieved by these high-ability workers is efficient for the supervisor in the second period. In that case, the supervisor will fire all other workers (if given the possibility to fire as many workers).

motivated low-ability workers who cannot produce as much as intrinsically-motivated workers will exert no effort as they know they will be fired anyway. By contrast, in a case in which the signal about workers' production levels is coarse, non-intrinsically motivated low-ability workers may find it optimal to mimic their intrinsically-motivated counterparts to reduce the probability of being fired. This is the case because coarse signals may not allow the supervisor to distinguish the output of a low-ability and a high-ability worker when both exert high effort.

It follows that coarser signals may lead to high levels of effort for low-ability workers who are not intrinsically motivated. In the case of high-ability workers, perfect signals provide powerful incentives as they allow non-intrinsically motivated workers to signal themselves as high-ability intrinsically-motivated workers thus reducing the probability of being fired. Our model thus shows that the relationship between organizational output and information precision is not as straightforward as in the case in which the informativeness principle applies. If follows that organizational output may not suffer from using coarse signals in the case of firing threats incentives. Furthermore, our model predicts that the use of coarse signals will have opposite effects on non-intrinsically motivated workers depending on their level of ability.

We detail the formal version of the model in Appendix B from which we derive the following hypotheses.

Hypothesis 1 (*Firing in the dark*)

More precise signals about agents' effort do not necessarily lead to higher production under firing threats incentive schemes.

Hypothesis 2 *(Intrinsic motivation and firing threats)*

i) Perfect signals. High-ability non-intrinsically motivated workers are more likely to exert high effort to mimic intrinsically-motivated workers than low-ability workers.

ii) Coarse signals. Low-ability non-intrinsically motivated workers are more likely to exert high effort to mimic intrinsically-motivated workers than high-ability workers.

Our aim is to test these hypotheses in a controlled setting which we describe below.

3. Design

3.1. Virtual organizations

Our experimental environment is meant to represent an organization or firm, compose by a boss or supervisor and several workers. Subjects interacted through a computer network. In our setting workers can work on a real-effort task while having access to Internet browsing and chatting activities at any point in time during the experiment. Each of the three activities was undertaken in a separate window so that the experimenter had a precise measurement of the time spent on each activity by each subject. Our virtual organizations are composed of ten subjects, nine of which had the role of B subjects (employees) while the remaining subject was had the role of the C subject (boss).[33] C subjects could monitor B subjects' activities in real time and track B subjects' experimental IDs across periods. A session consisted of 5 periods of 20 minutes each. The experimental environment is described in detail below.

[33] We chose to have ten workers in each organization so as to represent a small company, which both in the EU and the US consists of at least 10 people.

3.1.1. The work task

We introduced a particularly long and laborious task so as to ensure that completing the work task required a significant level of effort. All subjects, employees and boss, were asked to add up matrices of 36 numbers for 1 hour and 40 minutes.[34] In the *work task*, subjects were not allowed to use a pen, scratch paper or calculator. This rule amplified the level of effort subjects had to exert in order to complete tables correctly. Each table had 6 rows and 6 columns. The numbers in each table were generated randomly.

Each table completed correctly generated a 40-cent profit while a penalty of 20 cents was subtracted from individual production for each incorrect answer.[35] At the end of each period, and only then, the total amount of money generated by all 10 subjects during the period was displayed in the history panel located at the bottom of their screens.

3.1.2. Internet browsing

The Internet browser was embedded in the software so that the experimenter could keep a record of the switching times between activities as well as the exact amount of time subjects spent on each activity. Subjects were informed that their usage of the Internet was strictly confidential.[36]

The introduction of the possibility of using the Internet is motivated by the widespread use of Internet at the workplace (Malachowski, 2005). An appealing feature of Internet as an alternative to the work task is the wide range of activities that can be undertaken online. Many people are

[34] Different variations of this task have been used by Bartling et al. (2009), Dohmen and Falk (2010), and Abeler et al. (2011).

[35] Penalties did not apply when individual production was equal to zero so that individual production could not be negative.

[36] Subjects were expected to follow the norms set by the university regarding the use of Internet on campus.

likely to derive utility from Internet access as they will be able to browse Web pages that best fit their personal interests.[37]

3.1.3. Chatting activities

Subjects also had access to a chat room through which they could communicate with the other subjects during the experiment. A subject could send a message to all subjects at once or to any subset of them. If subjects received a message while not currently in the chat room, a pop-up window displaying the content of the message as well as the experiment *ID* of the sender would automatically appear on their screen. As a result, incoming chat could potentially distract subjects completing the *work task*.

3.1.4. Monitoring activities

In all treatments but one (the firing with no individual information), the C subject could monitor the nine B subjects' activities at any time during the experiment. Monitoring activities had to be undertaken in a separate window so that bosses could not complete their own work task, chat or browse the Internet while monitoring their employees.[38] In the monitoring screen, bosses could decide whether to monitor all or a subset of the employees at the same time. Depending on the treatment, the monitor received information in real time about the activities undertaken by the selected subject, their current total production, and their contribution to the *work task* (in % terms). This virtual monitoring activity was designed to mimic current organizational technology (e.g.,

[37] Two related studies (Eriksson, Poulsen and Villeval, 2009, Charness, Masclet and Villeval, 2014) have also introduced on-the-job leisure activities in experimental environments by giving subjects access to magazines.

[38] One possible limitation of our study is that monitoring does not have an additional cost other than the opportunity cost of monitoring and it is equal among treatments. The opportunity cost in this study is the time that the boss is not producing while she/he is monitoring.

SpectorSoft 360, Virtual Monitoring™, Employee Monitoring) that allows for real-time monitoring of employees activities by tracking the time they spend on various applications. Whenever they were being watched B subjects were notified with a message stating "*The C subject is watching you*" jointly with an eye picture. At the end of each period, the C subject had access to a monitoring summary which, depending on the treatment, included information regarding B subjects' activities during the period, their production levels as well as their contribution to total production.

Firing Complete Info & Baseline	Firing Partial Info	Firing No Individual Info
Total production	Total production	Total production
Individual working time	Individual working time	
Individual production		

Figure 1: information the boss may watch by using monitoring per treatment.

In addition to the previously mentioned activities, each subject could click on a box moving slowly from left to right at the bottom of their screen. Each time subjects clicked on a box they earned 5 cents. The box appeared at the bottom of a subject's screen every 25 seconds whether the subject was currently *working on the work task, chatting, or browsing the Internet*. Given that the experiment consisted of 5 periods of 20 minutes each, subjects could earn a total of €12.00 just by clicking on all the 240 boxes that appeared on the screen during the experiment. This aimed at representing the pay that workers obtain just for being present at their workstation regardless of their commitment to the work task. The rationale for this task was to create an environment in which subjects perceive that showing up for work already pays off. The aim is to limit the experimenter effect that may induce zealous diligence from subjects (Corgnet et al. 2015a).

3.2. Survey data

We collected survey data on five characteristics of the subjects. This information was needed to be able to classify subjects with respect to their ability and their intrinsic motivation, as well as accounting for social preferences, cognitive skills and some socio-demographic characteristics.

Adding skills. Upon arrival at the lab and before receiving instructions for the corresponding treatment, subjects were asked to sum as many five one-digit numbers as they could during two minutes in the spirit of Dohmen and Falk (2011). Each correct answer was rewarded 10 cents. The number of correct answers is what we refer to as “ability”.

At the end of the experiment, subjects were asked to fill out a 10-minute survey including questions regarding demographics, cognitive skills and social preferences.

Demographics. We asked subjects about their name, age and gender. We also asked them how many hours a week they usually work for pay or volunteer. We also collected data regarding which degree they were currently studying. We finally asked subjects how many siblings they had and how many were older than them.

Cognitive skills. We measured cognitive reflection using the CRT developed by Frederick (2005). Our CRT measure sums the number of correct answers on the test.

Social preferences. We elicited social preferences following Bartling et al. (2009). We asked subjects to make six choices between two possible allocations of money between themselves and another anonymous and randomly assigned subject in the experiment. In each experimental session, two subjects and one of the six decisions were selected at random for payment. The choice of the first subject in the selected decision was used to allocate payoffs between the two subjects. All decisions were anonymous. The allocation decisions are described in table D.1 in Appendix D. Option A always yielded an even distribution of money (10€ for both the self and the other subject), whereas option B yielded uneven payoffs. The first three decisions refer to the advantageous domain while the last three decisions refer to the disadvantageous domain.

Intrinsic motivation. We measured subjects' intrinsic motivation at the end of organizational experiment by assessing whether subjects were willing to sum 5 one-digit numbers for two minutes in the absence of monetary rewards (Dohmen and Falk, 2011). We compared their performance on this task with their performance on the incentivized version of the same two-minute task completed when they entered the lab (and before they read instructions).

3.3. Treatments

We conducted four different treatments (see table 1). In all treatments, B subjects were rewarded a fixed payment of 200¢ each period while not receiving incentives based on their performance on the *work task*.[39] C subjects received the output produced by all subjects (including themselves) on the *work task* while not being paid any fixed wage. In all three firing treatments (*complete, partial and no individual info*), the C subject could fire one B subject at the end of each of periods 2, 3 and 4.[40] The C subject kept the fixed pay of dismissed B subjects in the following periods.

Dismissed B subjects could only browse the Internet. They were rewarded solely for their earnings on the clicking task which were reduced to 1¢ per box instead of 5¢ per box for the active B and

[39] The choice of 200¢ was made so that, at least some B subjects would not be able to produce that amount thus inducing C subjects to fire workers. This value was calibrated using previous related experiments (e.g. Corgnet et al. 2015a).

[40] We do not allow firing in period 1 because of the large learning effects observed in the great majority of real-effort experiments that makes the first period substantially differ from the rest of the experiment (e.g. see Charness and Campbell, 1988).

C subjects.[41] They were not able to chat with active B and C subjects, and they could not be rehired. In all treatments, subjects received their individual earnings on the clicking task.

3.4. Procedures

Our subject pool consisted of students from two major Spanish Universities.[42] The experiments took place between December 2014 and June 2016. In total, 240 subjects participated in the experiments, divided into 24 groups of 10 subjects each. We have data from six groups for each treatment. All of the interaction was anonymous. Subjects had 20 minutes to read the instructions on their screens. Three minutes before the end of the instructions period, a monitor announced the time remaining and handed out a printed copy of the summary of the instructions. None of the subjects asked for extra time to read the instructions. The interaction between the experimenter and the subjects was negligible.

At the end of the experiment, subjects were paid their earnings in cash, rounded up to the nearest quarter. Individual earnings at the end of the experiment were computed as the sum of all earnings in the 5 periods. Participants playing the role of a B (C) subject in the *complete, partial, no individual info* and *baseline* treatments earned €29.36 (€97.47), €28.06 (€95.58), €29.21 (€76.54), €29.09 (€54.26) on average, respectively. This includes a 5 euro show-up fee. Experimental sessions lasted on average two hours and thirty minutes.

---

[41] As a result, the maximum period earnings of dismissed subjects on the clicking task were equal to 48¢ instead of 240¢ for active B and C subjects.

[42] Three sessions were conducted at two major Spanish universities.

Treatment	Description	Number of sessions (subjects)
No Firing Complete Info (Baseline)	*B* subjects were paid a fixed wage of 200¢ per period. The *C* subject kept the value of all output produced by all *B* subjects in the organization. In addition, *C* subjects were paid the value of their own production. *C* subjects could monitor *B* subjects' activities and individual production but had no possible recourse.	6 (60)
Firing Complete Info	The *C* subject could monitor *B* subjects' activities and individual production, and could fire one *B* subject at the end of periods 2, 3 and 4. Payment as in in the baseline but the *C* subject also kept the fixed pay of dismissed *B* subjects.	6 (60)
Firing Partial Info	Same as Complete Info *except* that *C* subjects could *only* monitor *B* subjects' activities not accessing any information regarding their individual production.	6 (60)
Firing No Individual Info	Same as previous firing treatments *except* that *C* subjects could *not* monitor *B* subjects and thus only had access to the total production of the organization when deciding upon firing *B* subjects.	6 (60)

Table 1: summary of the treatments.

4. Results.

We analyze in Sections 4.1 to 4.3 the first four periods of our experiment which correspond to periods in which firing threats applied. In Section 4.4, we classify B subjects by ability and intrinsic motivation to analyze our data. We also report our results when pooling data for all five periods in Appendix A (see tables A.5 and A.6).

Given the nature of our data, we will use panel regressions to assess the statistical significance of our findings. We use robust standard errors clustered at the session level.[43] We use random effects

[43] Following Cameron and Miller (2011), we also estimated standard errors using the wild bootstrap procedure. Using this procedure, we obtained very similar p-values to the ones reported in the results section. In particular, the effects which are shown to be statistically significant using robust standard errors continue to be significant when using the wild bootstrap procedure.

as we can not reject in all the regressions reported in this manuscript because, using the Breusch-Pagan Lagrange Multiplier test, we cannot reject the random effects specification.

4.1. Production and Internet usage

We define individual production as the monetary amount generated by a given subject on the task divided by the reward of a correct answer (40 cents). At every step of the analysis, we only include subjects who belong to the organization excluding fired subjects. This means that in the three treatments where firing was possible, subjects who had been fired before an actual period were excluded from the analysis.

Figures 2 and 3 show average production and working time for the first four periods of our four treatments, respectively. Working time is defined as the percentage of their time B subjects spent on the task screen instead of browsing the web or chatting with other subjects. Working time is thus a measure of work dedication which negatively correlates with on-the-job leisure which can be measured as the time spent browsing and chatting.

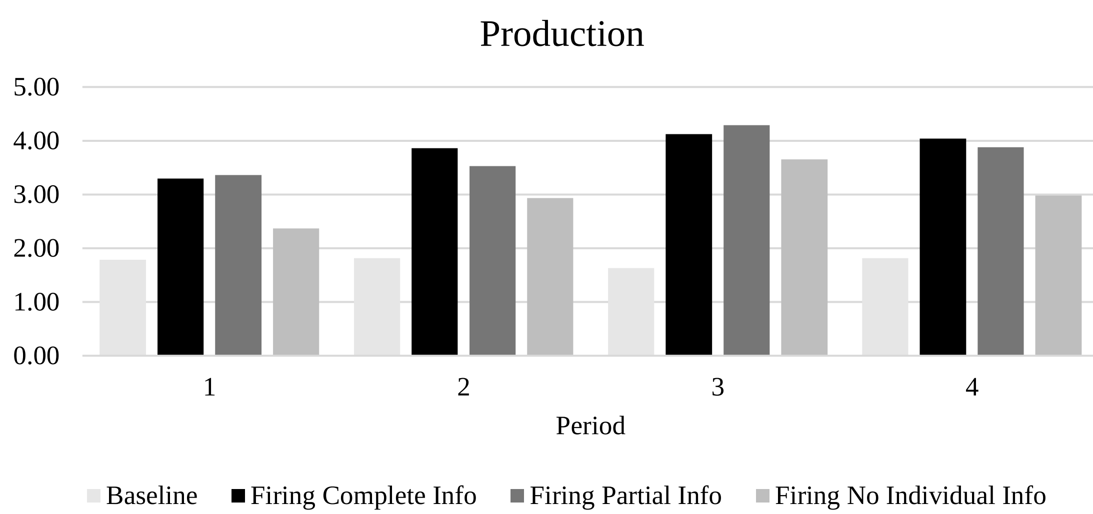


Figure 2: B subjects' average production across treatments for Periods 1 to 4. Subjects who have been fired before a current period are excluded.

We consider a GLS random-effects model (table A.1) to check for any statistically significant differences in B subjects' individual production across treatments. Individual production for B subjects is significantly higher in treatments where firing is available compare with the *baseline* without firing threats (see table A.5). The simple presence of the threat seems to be a sufficient condition to increase B subjects' average production (2.98 in the *no individual info* treatment vs 1.76 in the *baseline* treatment). Average production in the *firing complete info* (3.82) and *partial info* treatments (3.76) does not differ significantly (see table A.1). But, the average production of B subjects is about 30% higher in the firing treatments in which the boss has access to individual information (*firing complete info* and *partial info* treatments) compared to the *no individual info* treatment. These differences are statistically significant (see table A.1).

At the same time, B subjects spend significantly less time on the work task in the *baseline* (62.13%) than in the firing treatments (93.15%). In line with production results, we do not find any significant differences in the time spent on the task between the *firing complete* (92.51%) and *partial info* treatments (95.38%) (see Table A.2 in Appendix A).[44] Consistently with production findings, the time spent on the work task was increased in the *firing complete info* and *partial info* treatments compared to the *firing no individual* info treatment (91.25%). The difference in working time was, however, only significant when comparing *partial info* and *no individual info* firing treatments (see table A.2).

[44] We do not present treatment comparisons for C subjects because of their limited number per treatment. These results are shown in Appendix A.

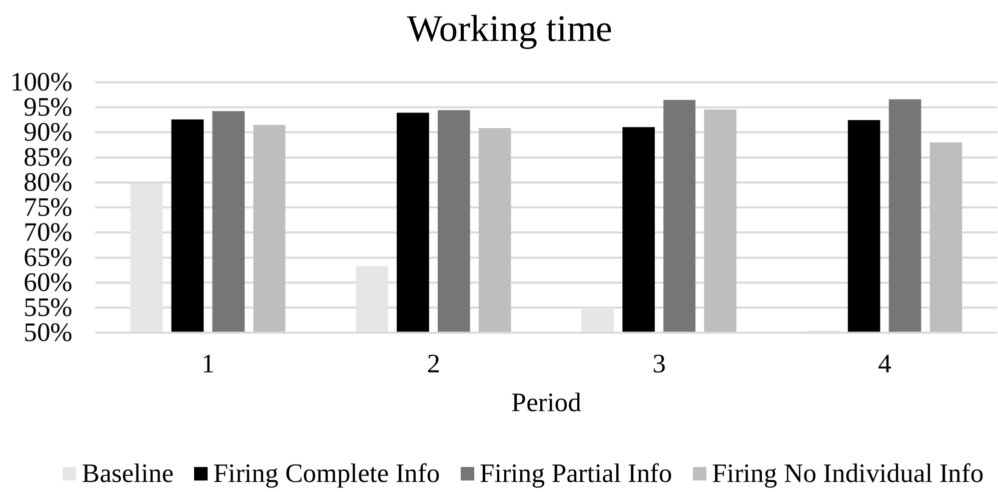


Figure 3: *B* subjects' average working time (%) across treatments for Periods 1 to 4. Subjects who have been fired before an actual period are excluded.

Our findings are in line with Hypothesis 1 according to which firing threats incentives do not become weaker when individual information about workers become coarse.

Result 1: *(Workers' production and Internet usage)*

a) Workers' production is higher in the presence of firing threats.

b) Firing threats incentives are strong even when information is coarse.

c) Internet usage is lower in the presence of firing threats.

Finally, subjects could also obtain earnings from clicking on yellow boxes appearing every 25 seconds at the bottom of their screen. No significant differences were observed across treatments regarding the clicking task. Subjects successfully clicked on the box in 96.46%, 93.77%, 92.59% and 94.25% of its appearances in treatments *firing complete info, firing partial info, firing no individual info* and *baseline*, respectively.

		Period 2	Period 3	Period 4	Total
Firing Complete Info					
	Total [maximum possible] number of fired subjects	2 [6]	2 [6]	3 [6]	7 [18]
	Average production of subjects before being fired*	0.5	1	1.67	6.79
	Average production of other *B* subjects	4.94	5.11	4.23	17.88
	p-value†	2.119 (**0.034**)	2.078 (**0.038**)	1.744 (**0.081**)	3.154 (**0.001**)
Firing Partial Info					
	Total [maximum possible] number of fired subjects	2 [6]	3 [6]	1 [6]	6 [18]
	Average production of subjects before being fired	0	2.5	0	3.92
	Average production of other *B* subjects	3.72	4.43	3.86	17.36
	p-value	2.12 (**0.034**)	1.17 (0.240)	1.537 (0.124)	2.058 (**0.040**)
Firing No Individual Info					
	Total [maximum possible] number of fired subjects	1 [6]	1 [6]	2 [6]	4 [18]
	Average production of subjects before being fired	2	3	4.25	9.12
	Average production of other *B* subjects	2.87	4	3.25	13.00
	p-value	0.394 (0.694)	0.659 (0.519)	-0.479 (0.632)	1.169 (0.242)

Table 2: firing decisions per period across treatments. *By multiplying these numbers by 40¢ one obtains the average monetary contribution of those subjects. It is evident that the average monetary contribution is well below the fixed wage of 200¢ received by *B* subjects at the beginning of each period.
†This p-value refers to the Wilcoxon rank-sum test that assesses whether average production is the same for subjects who were fired and for those who were not fired.

4.2. Firing decisions

In this section we analyze the firing decisions of the C subjects in the three firing treatments. In table 2 we show that the fired B subjects in a given period in the *complete* and *partial info* treatments were producing less than the rest of B subjects in the organization. Not surprisingly, the difference in production between fired and non-fired subjects was more pronounced for the *complete info* than for the *partial info* treatment (as indicated by the higher p-values reported in the last row of each panel). However, as expected, we do not observe production differences in the *no individual information* treatment when comparing fired B subjects with the rest of B subjects in the organization.

Result 2: *(Fired workers)*

a) *Under complete and partial information, bosses fire the workers who have the lowest production level.*
b) *Under no individual information, where firing is random, bosses rarely use firing threats.*

Also, there is anecdotal evidence that chatting activities may have affected the C subject's firing decisions. For example, in session 3 in the *no individual information* treatment, the C subject fired in period 2 the only B subject who sent some messages to C.[45]

4.3. Monitoring

The fact that C subjects fired B subjects according to their relative performance levels in the *complete* and *partial info* treatments suggests that C subjects were monitoring B subjects to gather information about their production and work dedication. In table A.7 (Appendix A), we show that C subjects did spend time monitoring B subjects. In table A.8, we show that subjects C spent the

[45] See Appendix C for a more detailed analysis of the chat.

same time (not statistically significant difference) monitoring in the *complete info* treatment (14.58%) than in the treatment with *partial info* (10.40%). We also observe substantial monitoring in the *baseline* (12.93%) which can be explained by the willingness of the boss to induce social pressure on workers as in Mas and Moretti (2009) and Corgnet et al. (2015b).

Result 3: *Bosses spend more time monitoring when information is complete.*

4.4. The effect of firing threats across ability and intrinsic motivation levels

We classify B subjects as either high or low ability subjects depending on whether their score on the adding task (used to measure their ability prior to starting the experiment) was either above or below the median performance of the subjects participating in the current study.[46]

Similarly, we classify B subjects as being (non-) intrinsically motivated if their intrinsic motivation score is above (below) the median of the subjects participating in the current study. We define our intrinsic motivation measures on subjects' performance on both the incentivized and the non-incentivized version of the 2-minute adding task. In particular, we compute the ratio of the number of correct answers in the non-incentivized task and in the incentivized task (Intrinsic motivation adding task).[47]

In this experiment 51.11% of subjects are classified as high-ability subjects and 48.75% are classified as intrinsically motivated. We do not find significant differences in the proportion of

[46] Our results are robust to categorize subjects' ability with respect to the median performance of a given experimental session instead of the pool of subjects recruited for the study.

[47] One should note that our intrinsic motivation measure could potentially be affected by the treatment as the non-incentivized adding task is completed at the end of the experiment. However, we do not report significant differences across firing treatments regarding our intrinsic motivation measure (Wilcoxon rank-sum test, p-values > 0.10 for all pairwise comparisons). We chose to have subjects complete the non-incentivized task at the end for two reasons. First, we wanted subjects to have experienced substantial fatigue so as to observe sufficient variance in our measure. Second, we did not want their performance on the incentivized task to serve as a benchmark thus again reducing the variance in our intrinsic motivation measure. Our own pretests have shown insufficient variance in the intrinsic motivation measure when collected right after the incentivized task.

high-ability subjects or in the proportion of intrinsically motivated subjects across treatments (p-values > 0.10 for all pairwise comparisons).

In table 3, we compare treatments with respect to intrinsic motivation as well as ability levels so as to test Hypothesis 2.

		Treatments		
Ability	Intrinsic motivation	Firing Complete Info	Firing Partial Info	Firing No Individual Info
Low	Low	73.60	92.80	92.27
	High	125.33	101.05	89.54
	P-value†	**0.044**	0.930	0.782
High	Low	181.88	135.00	107.24
	High	173.33	206.67	142.91
	P-value	0.927	**0.096**	0.292

Table 3: average period production across treatments, ability and intrinsic motivation levels. †This p-value refers to the Wilcoxon rank-sum test that assesses whether average production (for the whole experiment) for low and high intrinsic motivation workers given a level of ability.[48]

In line with Hypothesis 2ii, we show that in the presence of coarse information, non-intrinsically motivated low-ability workers produce as much as those low-ability workers who are intrinsically-motivated workers (see Firing Partial Info column, upper panel). By contrast, in the presence of perfect information, non-intrinsically motivated workers of low ability do not appear to mimic the work output of those who are intrinsically motivated (see Firing Complete Info column, upper panel). As predicted by Hypothesis 2i, the opposite occurs for high-ability workers as non-intrinsically motivated workers only mimic intrinsically-motivated workers in the case in which signals are perfect. In line with our predictions, we also observe that in the presence of perfect information, low-ability non-intrinsically motivated workers tend to exert very low effort as they know the boss could easily detect and fire them.

[48] We include fired B subjects in the analysis but similar results are obtained if we do not include them.

Result 4: *(Workers' production by ability and intrinsic motivation)*

a) *Under partial information, low-ability non-intrinsically motivated workers mimic low-ability intrinsically motivated workers to avoid firing.*
b) *Under complete information, high-ability non-intrinsically motivated workers mimic high-ability intrinsically motivated workers to avoid firing.*
c) *Under complete information, low-ability non-intrinsically motivated workers tend to exert none or very low effort because they know that the possibility of being fired is very high.*

5. Conclusions

Recent education reforms in the US have promoted the use of firing threats based on standardized tests to incentivize teachers. Given, the complex nature of a teacher's job, concerns have arisen regarding the accuracy of standardized tests as measures of teachers' performance. More generally, these reforms call for a study of the effectiveness of firing threats in the presence of limited information about workers' performance. Public servants could be another job where our study may be applied since their performance is also difficult to measure (Riphahn, 2004).

Our work proposes to study firing threats in a controlled virtual workplace so as to assess the behavioral underpinnings of their incentive effects as well as study their motivational implications. We find that the incentive effect of firing threats was robust to cases in which bosses did not have any individual information about workers' performance. Using a variety of measures, we also show that workers' intrinsic motivation was effectively sustained in the firing threats treatments whenever bosses had some minimal individual information about workers' dedication to the work task. In the firing treatment with no individual information, however, intrinsic motivation was significantly abated. These findings show that, even though no individual information ('firing in the dark') is sufficient to generate strong incentive effects, it is unlikely to be a viable solution for organizations as it fails to sustain workers' motivation. Our findings thus provide behavioral foundations for the use of firing mechanisms based on limited but uncontroversial and easily measured information about workers' dedication to their job such as absenteeism (Banerjee and Duflo, 2006; Duflo, Hanna and Ryan, 2012).

6. References

Abeler, J., A. Falk, L. Goette, and Huffman D. (2011). Reference points and effort provision. American Economic Review, 101 (2), 470–492.

Banerjee A. and Duflo E. (2006). Addressing absence. Journal of Economic Perspectives, 20, 117-132.

Bartling, B., E. Fehr, M. A. Maréchal, and Schunk D. (2009). Egalitarianism and Competitiveness. American Economic Review: Papers & Proceedings, 99(2), 93–98.

Becker, G. S., and Stigler G. J. (1974). Law Enforcement, Malfeasance, and Compensation of Enforcers. The Journal of Legal Studies, 3(1), 1-18.

Bolton, P. and Dewatripont M. (2005). Contract Theory. MIT Press, Cambridge, MA.

Cameron, A. C and Miller D. (2011). Robust Inference with Clustered Data. Handbook of Empirical Economics and Finance, ed. by A. Ullah and D. E. A. Giles. Boca Raton, CRC Press, 1-28.

Charness, N. and Campbell J. (1988). Acquiring skill at mental calculation in adulthood: a task decomposition. Journal of Experimental Psychology: General 117, 115-129.

Charness, G., Cobo-Reyes, R., Jimenez, N., Lacomba, J. A., and Lagos, F. (2017). Job security and long-term investment: An experimental analysis. European Economic Review.

Charness, G., D. Masclet, and Villeval M.C. (2014). The Dark Side of Competition for Status. Management Science, 60(1), 38-55.

Chetty, R., J. Friedman, and Rockoff J. (2014). Measuring the Impacts of Teachers I: Evaluating Bias in Teacher Value-Added Estimates. American Economic Review 104(9): 2593-2632.

Chetty, R., J. Friedman, and Rockoff J. (2014). Measuring the Impact of Teachers II: Teacher Value-Added and Student Outcomes in Adulthood. American Economic Review 104(9): 2633-2679.

Corgnet, B., J. Gómez-Miñambres, and Hernán-González R. (2105). Goal Setting and Monetary Incentives: When Large Stakes Are Not Enough. Management Science, 61(12), 2926-2944.

Corgnet, B., R. Hernán-González, and Rassenti S. (2015a). Firing Threats: Incentive Effects and Impression Management. Games and Economic Behavior, 91, 97-113.

Corgnet, B., R. Hernán-González, and Rassenti S. (2015b). Peer pressure and moral hazard in teams: Experimental evidence. Review of Behavioral Economics, 2(4), 375-403.

Corgnet, B., R. Hernán-González, and Schniter E. (2015). Why real leisure really matters: incentive effects on real effort in the laboratory. Experimental Economics, 18(2), 284-301.

Deci E. L., R. Koestner, and Ryan R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. Psychological Bulletin, 125, 627–668.

Deci, E. L. (1971). Effects of Externally Mediated Rewards on Intrinsic Motivation. Journal of Personality and Social Psychology, 18(1), 105-115.

Deci, E. L. (1975). Intrinsic Motivation. New-York: Plenum Press.

Deci, E. L., and Ryan R. M. (1985). Intrinsic Motivation and Self-Determination in Human Behavior. (1 ed.). Springer.

Deci, E. L., and Ryan R. M. (2014). The Importance of Universal Psychological Needs for Understanding Motivation in the Workplace. In M. Gagne (Ed.). Oxford University Press.

Deci, E. L., R. M. Ryan, M. M. Gagne, D. R. Leone, J. Usunov, and Kornazheva B. P. (2001). Need satisfaction, motivation, and well-being in the work organizations of a former eastern bloc country: A cross-cultural study of self-determination. Personality and Social Psychology Bulletin, 27(8), 930-942.

Dickinson, D. (1999). An experimental examination of labor supply and work intensities. Journal of Labor Economics, 17, 638–670.

Dohmen, T., and Falk A. (2010). You get what you pay for: incentives and selection in the education system. Economic Journal. 120 (546), 256–271.

Dohmen, T., and Falk A. (2011). Performance Pay and Multi-Dimensional Sorting: Productivity, Preferences and Gender. American Economic Review, 101 (2), 556-590.

Duflo E., R. Hanna, and Ryan S. (2012). Incentives work: getting teachers to come to school. American Economic Review, 102, 1241–1278

Eriksson, T., A. Poulsen, and Villeval M.C. (2009). Feedback and incentives: experimental evidence. Labour Economics, 16 (6), 679–688.

Falk, A., and Ichino A. (2006). Clean evidence on peer effects. Journal of Labor Economics. 24 (1), 39–58.

Falk, A., and Huffman D. (2007). Studying labor market institutions in the lab: minimum wages, employment protection, and workfare. Journal of Institutional and Theoretical Economics, 163 (1), 30–45.

Falk, A., Huffman, D. and Macleod, W.B. (2015). Institutions and contract enforcement. Journal of Labor Economics, 33(3), 571-590.

Gagne, M., and Deci E. L. (2005). Self-determination theory and work motivation. Journal of Organizational Behavior, 26(4), 331-362.

Gneezy, U., and List J.A. (2006). Putting behavioral economics to work: testing for gift exchange in labor markets using field experiments. Econometrica, 74 (5), 1365–1384.

Hanson, E., and Spring D. (2016). Using Student Test Scores to Fire Teachers Is No More Reliable Than a Coin Toss! https://coalitiontoprotectourpublicschools.org/trust-teachers/using-student-test-scores-to-fire-teachers-is-no-more-reliable-than-a-coin-toss

Holmström, B. (1979). Moral Hazard and Observability. Bell Journal of Economics, 10(1), 74-91.

Kirsh, D. (2000). A Few Thoughts on Cognitive Overload. Intellectia, 1(30): 19-51.

Klein, B., and Leffler K. B. (1981). The Role of Market Forces in Assuring Contractual Performance. Journal of Political Economy, University of Chicago Press, 89(4), 615-41.

Laffont, J. J. and Martimort D. (2002). The theory of incentives: The principal-agent model. Princeton University Press: Princeton, N.J.; Oxford.

Lumesse (2013). The Impact of Complexity. http://www.lumesse.com/

MacLeod, W. B., and Malcomson J. (1989). Implicit Contracts, Incentive Compatibility, and Involuntary Unemployment. Econometrica, 57(2), 447-80.

Malachowski, D. (2005). Wasted time at work costing companies billions. San Francisco Chronicle, July 11.
http://www.sfgate.com/cgi-bin/article.cgi?f=/g/a/2005/07/11/wastingtime.TMP.

March, J. and Simon H. (1993). Organizations. Second edition, Oxford University Press.

Mas, A., and Moretti E. (2009). Peers at Work. American Economic Review, 99(1), 112-145.

Riphahn, R. T. (2004). Employment protection and effort among German employees. Economics Letters, 85(3), 353-357.

Rothstein, J. (2010). Teacher Quality in Educational Production: Tracking, Decay, and Student Achievement. The Quarterly Journal of Economics 125(1): 175-214.

Rothstein, J. (2014). Revisiting the Impacts of Teachers. UC-Berkeley Working Paper.

Shapiro, C., and Stiglitz J. (1984). Equilibrium Unemployment as a Worker Discipline Device. American Economic Review 74(3), 433-44.

Appendix A

Table A.1
GLS regression with random effects for individual production (periods 1–4) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	.63	1.34**	-.16	-.42	-.79	.10
	(.82)	(.64)	(.63)	(.74)	(.73)	(.57)
Treatment+	-.24	.84***	1.77***	1.04***	1.99***	1.02***
	(.38)	(.32)	(.36)	(.38)	(.37)	(.35)
Ability	.21***	.14***	.13***	.19***	.17***	.10***
	(.04)	(.03)	(.03)	(.04)	(.04)	(.03)
CRT	-.00	-.00	.19	-.00	.26	.22
	(.11)	(.10)	(.15)	(.12)	(.18)	(.16)
Gender	.33	-.55	.05	-.48	-.16	-.10
	(.40)	(.37)	(.38)	(.41)	(.42)	(.41)
Aheadness aversion	.25	-.28	.25	.07	.62	.22
	(.49)	(.47)	(.47)	(.49)	(.49)	(.43)
Behindness aversion	-.86**	-.46	-.73**	-.65	-.67*	-.46
	(.43)	(.42)	(.36)	(.43)	(.37)	(.35)
Number of observations	419	423	426	422	425	429
R^2	0.2170	0.1711	0.2893	0.1867	0.2925	0.1680

+Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.2
GLS regression with random effects for working time (in seconds) (periods 1–4) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	1130.78***	1147.48***	824.70***	1132.59***	809.31***	824.45***
	(32.70)	(36.78)	(88.85)	(36.51)	(94.31)	(97.59)
Treatment+	-29.01*	22.86	374.59***	46.36**	398.54***	341.63***
	(17.12)	(21.52)	(47.51)	(22.89)	(50.55)	(51.19)
Ability	-2.75	-4.28*	-1.77	-5.23*	-1.28	-2.35
	(1.87)	(2.19)	(3.78)	(2.76)	(4.13)	(4.34)
CRT	2.62	-2.97	-10.15	4.70	-4.25	-12.75
	(6.16)	(7.91)	(16.57)	(8.57)	(19.40)	(19.82)
Gender	32.26	-12.04	9.43	16.63	-1.80	21.26
	(20.91)	(21.26)	(50.53)	(27.27)	(54.63)	(54.12)
Aheadness aversion	19.49	36.00	-40.17	59.07**	-28.19	-12.41
	(19.85)	(24.78)	(59.30)	(29.02)	(58.30)	(67.87)
Behindness aversion	-33.73*	-44.60	-75.60	-40.34	-66.89	-74.01
	(19.84)	(29.50)	(53.12)	(30.26)	(50.30)	(59.36)

Number of observations	419	423	426	422	425	429
R^2	0.0584	0.0361	0.2740	0.0632	0.3093	0.2453

[+]Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.3
GLS regression with random effects for individual production (all periods) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	.82	1.18*	-.27	-.07	-.63	.03
	(.76)	(.61)	(.61)	(.70)	(.68)	(.53)
Treatment[+]	-.17	1.02***	1.70***	1.14***	1.87***	.79**
	(.36)	(.30)	(.34)	(.35)	(.34)	(.32)
Ability	.19***	.12***	.13***	.16***	.16***	.10***
	(.04)	(.03)	(.03)	(.04)	(.03)	(.03)
CRT	-.01	-.01	.18	-.00	.27	.22
	(.12)	(.10)	(.15)	(.11)	(.03)	(.16)
Gender	.25	-.41	.05	-.29	-.23	-.03
	(.38)	(.34)	(.37)	(.38)	(.18)	(.39)
Aheadness	.225	-.07	.39	.06	.54	.32
aversion	(.46)	(.45)	(.46)	(.44)	(.47)	(.42)
Behindness	-.78*	-.53	-.62*	-.62	-.56	-.45
aversion	(.40)	(.38)	(.34)	(.38)	(.34)	(.33)
Number of observations	514	520	527	520	527	533
R^2	0.1718	0.1435	0.2679	0.1490	0.2667	0.1349

[+]Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.4
GLS regression with random effects for working time (in seconds) (all periods) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	1171.74***	1089.99***	748.69***	1124.60***	788.04***	745.33***
	(36.22)	(45.58)	(87.63)	(43.20)	(94.04)	(93.64)
Treatment[+]	-22.87	74.54***	390.49***	92.67***	407.71***	304.85***
	(19.21)	(25.60)	(48.47)	(23.71)	(50.07)	(51.39)
Ability	-4.83**	-5.09*	-1.03	-7.41**	-2.29	-1.91
	(2.12)	(2.76)	(3.83)	(2.90)	(4.10)	(4.37)
CRT	-3.82	-8.05	-13.44	7.39	.87	-7.20
	(8.45)	(9.75)	(18.05)	(9.53)	(20.64)	(20.70)
Gender	8.31	21.56	30.64	-12.25	-15.13	47.00

	(21.85)	(25.62)	(52.02)	(25.76)	(54.42)	(55.07)
Aheadness aversion	10.70 (24.78)	60.28* (30.97)	-21.15 (64.94)	44.42 (31.53)	-49.26 (62.22)	2.13 (72.47)
Behindness aversion	-25.16 (23.85)	-51.97 (25.60)	-58.81 (55.75)	-40.17 (28.19)	-59.93 (51.37)	-77.29 (51.39)
Number of observations	514	520	527	520	527	533
R^2	0.0234	0.0418	0.2467	0.0578	0.2777	0.1619

+Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.5
Average (median) [standard deviation] individual production across treatments.

	Treatment	Period 1	Period 2	Period 3	Period 4	Subtotal Periods 1-4	Period 5	Total
B subjects only	Firing Complete Info (including fired subjects)	3.30 (3) [2.39]	3.86 (3.25) [2.69]	3.97 (4.25) [2.49]	3.74 (3.5) [2.55]	3.72 (3.5) [2.53]	2.72 (2) [2.81]	3.51 (3) [2.61]
	Excluding fired subjects	-	-	4.12 (4.5) [2.41]	4.04 (3.75) [2.41]	3.82 (3.5) [2.49]	3.13 (2) [2.79]	3.70 (3.5) [2.55]
	Firing Partial Info (including fired subjects)	3.36 (3) [3.01]	3.53 (2.5) [3.10]	4.13 (3.5) [2.98]	3.52 (3.5) [2.71]	3.63 (3) [2.95]	2.53 (2) [2.61]	3.41 (3) [2.92]
	Excluding fired subjects	-	-	4.29 (3.5) [2.93]	3.88 (4) [2.58]	3.76 (3) [2.92]	2.84 (2.5) [2.60]	3.59 (3) [2.88]
	Firing No Individual Info (including fired subjects)	2.37 (1.75) [2.02]	2.93 (2.5) [2.56]	3.58 (3.25) [2.42]	2.87 (3) [2.40]	2.94 (2.5) [2.38]	1.18 (0) [1.93]	2.59 (2) [2.40]
	Excluding fired subjects	-	-	3.65 (3.5) [2.39]	2.98 (3) [2.38]	2.98 (2.5) [2.37]	1.28 (0) [1.98]	2.66 (2) [2.39]
	Baseline	1.79 (1) [2.21]	1.81 (1) [2.58]	1.63 (1) [1.92]	1.81 (1) [2.56]	1.76 (1) [2.32]	1.39 (0.25) [2.12]	1.69 (1) [2.28]
C subjects only	Firing Complete Info	4.17 (4.5) [2.79]	4.92 (3.5) [4.13]	5.17 (4.75) [5.32]	4.08 (3.5) [1.98]	4.58 (4) [3.55]	4.25 (4.25) [2.58]	4.52 (4) [3.34]
	Firing Partial Info	2.58 (2.5) [2.40]	3.33 (2) [2.54]	2.67 (2.75) [1.33]	4.33 (3.25) [3.14]	3.23 (2.5) [2.39]	2.42 (.75) [3.18]	3.07 (2.25) [2.52]
	Firing No Individual Info	3.33 (3.25) [1.33]	3.42 (3.5) [1.46]	3.17 (2.25) [2.21]	3.08 (3.25) [1.46]	3.25 (3.25) [1.55]	3.25 (3.75) [2.16]	3.25 (3.5) [1.64]
	Baseline	1.67 (1.5) [1.86]	1.67 (1.5) [1.72]	3.17 (2.25) [3.33]	1.25 (1.25) [1.04]	1.94 (1.5) [2.14]	2.33 (2.25) [1.78]	2.02 (1.5) [2.05]

Table A.6
Average (median) [standard deviation] percentage of time subjects spent working across treatments.

	Treatment	Period 1	Period 2	Period 3	Period 4	Subtotal Periods 1-4	Period 5	Total
B subjects only	Firing Complete Info (including fired subjects)	92.58 (96.62) [9.60]	93.95 (97.19) [7.64]	87.66 (95.73 [21.77]	85.59 (96.17) [26.25]	89.94 (96.67) [18.32]	65.79 (85.60 [37.64]	85.11 (96.05) [25.32]
	Excluding fired subjects	-	-	91.03 (95.96) [13.41]	92.44 (96.81 [9.98]	92.51 (96.84) [10.32]	75.59 (89.26) [29.59]	89.42 (96.41) [16.95]
	Firing Partial Info (including fired subjects)	94.22 (96.83) [6.94]	94.41 (97.99) [13.88]	92.88 (98.21) [18.94]	87.66 (97.92) [28.59]	92.29 (97.68) [18.89]	68.58 (89.82) [38.23]	87.55 (97.49) [25.76]
	Excluding fired subjects	-	-	96.45 (98.25) [4.63]	96.61 (98.06) [4.52]	95.38 (97.82) [8.52]	77.15 (92.35) [31.19]	91.98 (97.61) [16.98]
	Firing No Individual Info (including fired subjects)	91.52 (96.36) [13]	90.83 (97.40) [15.03]	92.83 (98.07) [15.17]	84.75 (96.17) [23.60]	89.98 (97.03) [17.35]	49.29 (47.36) [37.79]	81.84 (96.11) [28.07]
	Excluding fired subjects	-	-	94.58 (98.08) [8.11]	88.01 (96.63) [16.91]	91.25 (97.18) [13.75]	53.23 (49.86) [36.48]	84.02 (96.35) [25.01]
	Baseline	79.78 (88.13) [22.59]	63.33 (72.72) [34.11]	55.01 (61.93) [38.51]	50.41 (54.41) [35.03]	62.13 (72.42) [34.74]	42.26 (32.27) [34.88]	58.16 (64.32) [35.60]
C subjects only	Firing Complete Info	79.70 (82.44) [15.53]	72.80 (70.38) [18.82]	67.87 (61.13) [21.24]	70.83 (72.88) [24.69]	72.80 (72.88) [19.49]	71.53 (69.62) [20.54]	72.55 (72.88) [19.35]
	Firing Partial Info	76.04 () [15.06]	77.18 () [16.22]	78.55 () [16.25]	88.18 () [6.04]	79.99 () [14.00]	82.83 () [10.74]	80.56 () [13.29]
	Firing No Individual Info	96.40 (98.04) [4.28]	96.50 (98.46) [3.34]	95.83 (97.91) [5.47]	89.33 (95.66) [13.09]	94.52 (97.99) [7.72]	77.13 (93.39) [38.31]	91.04 (97.72) [18.72]
	Baseline	67.47 (73.27) [25.59]	63.84 (73.33) [34.34]	69.44 (75.33) [26.40]	69.99 (73.26) [24.32]	67.69 (73.82) [26.17]	72.02 (80.44) [26.38]	68.55 (74.96) [25.81]

Table A.7

Period evolution of monitoring activities (% of total time).

Treatment	Proportion of total time (in %) *C* subjects spent monitoring	Period 1	Period 2	Period 3	Period 4
Firing Complete Info	14.58%	14.24%	15.68%	15.14%	13.25%
Firing Partial Info	10.40%	13.71%	9.93%	13.07%	4.88%
Baseline	12.93%	18.14%	12.47%	13.05%	8.06%

Table A.8

Tobit regression with random effects for monitoring time -in seconds- for periods 1 to 4.

	Firing Complete Info vs Partial Info	Firing Complete Info vs Baseline
Constant	117.94***	135.29***
	(46.02)	(46.78)
Treatment+	53.91	35.93
	(65.00)	(65.73)
Number of observations	*n* = 48 (3 left censored)	*n* = 48 (7 left censored)
Log likelihood (L)	L = -284.011	L = -270.659
	[Prob>χ2]=0.4069	[Prob>χ2]=0.5846

+Treatment F is a dummy variable that takes value 1 for Treatment Firing Complete Info and 0 otherwise.
*p-Value<.10, **p-value <.05, and ***p-value <.01. (Standard deviation in parentheses)

Table A.9

GLS regression with random effects for individual production for high ability workers (periods 1–4) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	1.49	3.59***	1.68**	1.69	2.30*	2.01***
	(1.66)	(.58)	(.65)	(1.49)	(1.30)	(.65)
Treatment+	.05	1.19***	1.98***	1.20**	2.09***	1.02*
	(.61)	(.42)	(.58)	(.61)	(.61)	(.60)
CRT	.33	.23	.47**	.10	.40	.28
	(.21)	(.14)	(.23)	(.20)	(.31)	(.24)
Gender	1.35*	-1.42**	-.08	1.01	-.45	-.01
	(.80)	(.56)	(.68)	(.68)	(.74)	(.63)
Aheadness	.90	.28	.98	.62	1.74	.59
aversion	(.83)	(.63)	(.80)	(.90)	(1.20)	(.91)
Behindness	-.47	-.73	-.91	-.86	-.70	-.86
aversion	(.86)	(.62)	(.64)	(.77)	(.73)	(.62)
Number of observations	219	227	222	226	221	229
R2	0.1104	0.1982	0.2906	0.0893	0.2036	0.1078

+Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.10
GLS regression with random effects for individual production for low ability workers (periods 1–4) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	3.58***	2.40***	1.29**	2.07***	.82	1.19*
	(.81)	(.54)	(.53)	(.66)	(.57)	(.65)
Treatment+	.04	.63	1.39***	.51	1.30***	1.08***
	(.44)	(.49)	(.47)	(.47)	(.38)	(.42)
CRT	-.04	-.07	.08	.04	.15	.16
	(.13)	(.13)	(.15)	(.14)	(.16)	(.19)
Gender	-.27	.24	.11	.20	.41	-.36
	(.42)	(.49)	(.44)	(.48)	(.43)	(.53)
Aheadness	-.21	-.46	-.01	.05	.34	.29
aversion	(.50)	(.50)	(.52)	(.39)	(.38)	(.42)
Behindness	-.76*	-.31	-.46	-.58	-.88**	-.14
aversion	(.44)	(.52)	(.41)	(.49)	(.38)	(.43)
Number of observations	200	196	204	196	204	200
R2	0.0539	0.0297	0.1694	0.0347	0.2374	0.1118

+Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.11
GLS regression with random effects for working time for high ability workers (in seconds) (periods 1–4) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	982.35***	1100.71***	918.74***	1025.60***	853.99***	928.46***
	(115.69)	(44.57)	(134.10)	(101.93)	(144.46)	(107.49)
Treatment+	-15.37	31.24	424.09***	56.59	449.23***	373.78***
	(28.78)	(30.58)	(63.89)	(38.84)	(73.81)	(68.24)
CRT	-4.79	-17.16	-23.08	1.75	-6.60	-15.30
	(11.42)	(10.80)	(20.36)	(14.34)	(27.41)	(23.04)
Gender	92.19**	-21.29	70.79	32.08	-54.72	89.35
	(45.71)	(34.08)	(84.80)	(50.74)	(88.51)	(73.73)
Aheadness	10.99	42.89	33.01	70.58*	54.96	120.98
aversion	(27.10)	(40.10)	(71.66)	(38.92)	(72.42)	(81.75)
Behindness	-28.26	-91.17**	-192.33**	-76.79*	-161.06**	-203.91***
aversion	(25.58)	(45.43)	(82.38)	(43.88)	(70.90)	(77.11)
Number of observations	219	227	222	226	221	229
R2	0.0922	0.0749	0.3413	0.0633	0.3515	0.3250

+Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.12
GLS regression with random effects for working time for low ability workers (in seconds) (periods 1–4) across treatments. Robust standard errors. Excluding fired workers.

	Firing Complete Info vs. Partial Info	Firing Complete Info vs. No Individual Info	Firing Complete Info vs. Baseline	Firing Partial Info vs. No Individual Info	Firing Partial Info vs. Baseline	Firing No Individual Info vs. Baseline
Constant	1163.57***	1098.4***	818.33***	1110.86***	796.63***	784.37***
	(20.54)	(47.82)	(81.03)	(38.62)	(113.12)	(137.18)
Treatment+	-52.79***	-10.82	320.74***	45.76**	374.39***	312.50***
	(16.17)	(26.18)	(68.97)	(20.06)	(63.46)	(70.18)
CRT	12.96**	14.67*	9.35	5.70	-.92	-11.47
	(5.34)	(7.67)	(25.39)	(6.61)	(29.70)	(36.87)
Gender	-18.03	-21.29	-19.75	-13.84	12.63	-33.29
	(15.64)	(34.08)	(62.99)	(19.90)	(74.68)	(85.75)
Aheadness	2.90	42.89	-136.97	7.43	-130.86	-138.52
aversion	(17.39)	(40.10)	(86.77)	(18.36)	(92.05)	(101.46)
Behindness	2.20	-91.17**	3.46	29.75**	15.39	-22.78
aversion	(15.90)	(45.43)	(75.41)	(15.09)	(82.46)	(85.81)
Number of observations	200	227	204	196	204	200
R2	0.1240	0.0749	0.2560	0.0587	0.3126	0.2301

+Treatment is a dummy variable that takes value 1 for the first treatment in the comparison and 0 otherwise. Excluding fired subjects.
*p-Value<0.1, **p-value<.0.05, and ***p-value<.0.01. (Standard deviation in parentheses)

Table A.13
Tobit regression with random effects for working time -in seconds- per period for B subjects.

	Firing Complete Info	Firing Partial Info	Firing No Individual Info	Baseline
Constant	1110.97***	1130.70***	1098.22***	957.42***
	(25.40)	(25.24)	(32.60)	(56.36)
Period 2	-16.38	1.62	-8.29	-197.46***
	(32.21)	(33.82)	(40.28)	(46.28)
Period 3	-18.03	24.02	32.73	-308.06***
	(32.57)	(34.21)	(40.52)	(46.55)
Period 4	-2.04	25.81	-45.82	-366.95***
	(32.95)	(34.78)	(40.75)	(46.64)
Period 5	-205.76***	-207.57***	-461.72***	-469.43***
	(33.55)	(34.98)	(41.21)	(46.79)
Number of observations	*n* = 257 (0 right censored)	*n* = 257 (0 right censored)	*n* = 263 (0 right censored)	*n* = 270 (11 right censored)
Log likelihood (L)	L = -1701.259 [Prob>χ2]<0.0001	L = -1700.363 [Prob>χ2]<0.0001	L = -1803.411 [Prob>χ2]<0.0001	L = -1858.559 [Prob>χ2]<0.0001

*p-Value<.10, **p-value <.05, and ***p-value <.01. (Standard deviation in parentheses)

Appendix B

We build on a two-period model of an organization composed of *n* workers and a supervisor. This model generates hypotheses about the relation between the effectiveness of firing threats and the quality of information available to the supervisor. In this model there is a fixed wage and the possibility of firing is the only instrument the supervisor has.

Workers

Workers vary in motivation and ability. In each period, a non-intrinsically motivated worker $i \in N = \{1, \dots, n\}$ of ability α_j selects a level of effort $e_{i,j} \in \{0,1\}$ where $j \in \{L, H\}$ and $\alpha_H > \alpha_L$ which determines the product of effort as follows: $q_{i,j}^t = P_t \alpha_j e_j^i$ where *t=1* (*t=2*) stands for the first (second) period. P_t captures what is specific in the product of effort in a given period. The cost of positive effort is denoted $c > 0$.

Intrinsically motivated workers always choose the maximal level of effort. We denote by *s* the proportion of intrinsically-motivated workers and we refer to π_j as the proportion of workers of ability *j* in the population. We focus on the interesting case in which fixed wages (*w*) paid by the supervisor are profitable only when the workers hired in the second period are of high ability, that is $P_2\alpha_L \leq w \leq P_2\alpha_H$.

Signals

The signals obtained by the supervisor (which we assume to be costless) are either perfect or coarse.

A perfect signal allows the supervisor to identify the level of production $q_{i,j}^t$ of each worker.

A coarse signal is such that the supervisor cannot distinguish between all levels of production above a certain threshold(ρ).

Perfect vs. coarse signals

In the case of perfect signals, non-intrinsically motivated low-ability workers have no incentives to mimic intrinsically motivated workers because they know they would be fired anyway, since their production in the second period can not compensate for the fixed wage. This is the case because low-ability workers would be identified by the supervisor. Given that $P_2\alpha_L \leq w$, it would be optimal for the supervisor to fire low-ability workers. If we assume that the supervisor can fire as much as $\pi_L \times n$ workers then low-ability workers would be fired for sure.

Non-intrinsically motivated high-ability workers would decide to exert high effort and mimic intrinsically-motivated high ability workers as this will prevent them from being fired. We consider that the supervisor can fire as much as $\pi_L \times n + (1-s)\pi_H \times n$ workers in which case non-intrinsically motivated high-ability workers exerting low effort in the first period would be fired with certainty. Evidently, this probability would be lower were the supervisor more limited in the number of workers (s)he can fire. The logic of the argument remains, however, unaffected. The non-intrinsically motivated high-ability workers will thus exert high effort whenever $c < w$ where w represents the gains obtained from not being fired at the end of the first period and thus being able to collect fixed wages despite exerting no effort in the second period. For these workers to be able to collect wages in the second period we also have to assume that the supervisor does not want to fire everybody at the end of the first period which would be the case if $w > s\pi_H P_2 \alpha_H$. It follows that under perfect signals, all workers exert effort but non-intrinsically motivated low-ability workers.

In the case of coarse signals, non-intrinsically motivated low-ability workers may be willing to exert effort and reduce their probability of firing. This is the case as long as coarse signals do not allow supervisors to distinguish the production of low- and high- ability workers, which occurs for

$\rho \leq P_1\alpha_L$. Assuming that $w < sP_2(\pi_H\alpha_H + \pi_H\alpha_H)$, the supervisor holding coarse signals would not fire any worker exerting effort in the first period.[49] In that case, it will be optimal for a non-intrinsically motivated low-ability worker to exert effort for any $c < w$. The same applies for non-intrinsically motivated low-ability workers.

Given this binary effort model, we are in a case in which equilibrium production is higher under coarse signals (in which case all workers exert high effort) than under perfect signals in the first period. In the second period, regardless of the signals of the supervisor, intrinsically-motivated workers exert effort whereas non-intrinsically motivated workers do not. If we consider a case with continuous effort or even with three levels of effort, coarse signals do not necessarily lead to higher production than perfect signals. This is the case because under coarse signals, non-intrinsically motivated high-ability workers will not exert maximal effort but simply the level of effort that ensures a level of production equal to ρ. This corresponds to a level of effort equal to $\frac{\alpha_L}{\alpha_H} < 1$. In that case, coarse signals lead to higher levels of first-period production than perfect signals only if: $\frac{\alpha_L}{\alpha_H} > \frac{\pi_H}{\pi_L+\pi_H}$.

Regarding supervisors' profits, the binary effort model implies high profits in the coarse signals case if: $P_1\alpha_L \geq w$.

[49] A similar argument holds if this assumption is relaxed.

Appendix C

Each chat message was assigned to one of thirty-three categories by two graduate students coding messages independently (see Table O.3). Then, we computed the Cohen's Kappa coefficient for each category to assess inter-rater agreement (see Table O.1).[50] We dropped category 18 and 19 from the analysis because they were empty and another five categories (categories 7, 20, 23, 24, and 33) because the corresponding Cohen Kappa test was not significant at a 5% significance level. These categories represented only 1.07% of the messages (see figure O.1). The most represented category (33.82%) corresponds to distracting messages (e.g. jokes and stories). General and nonstrategic messages constituted the great majority (67.75%) of chat messages. We consider as general and nonstrategic messages the ones that were assigned to categories related to either presentation (category 1), distraction (categories 2 and 3) or general observations about the experiment (categories 27, 28, 29 and 30). Most of the strategic messages consisted in subjects stating their own performance (category 13, 6.24% of all messages) and encouraging others to produce (category 4, 4.67% of all messages).

We present disaggregate data at treatment level of the percentage of messages of each category (see table O.2). We can observe that 44.31% of messages in the baseline treatment are related to category 2 (jokes and stories). This percentage is relatively high compared to firing complete info (19.61), firing partial info (15.83%), and firing no individual info (20.87%). In relation to strategic messages the highest differences we find are related to categories 4 (Encouraging others to produce) and 13 (State your own performance). We observe that the percentage of messages in these categories is much higher in the firing complete info treatment (10.65% for category 4, and

[50] According to Landis and Koch (1977), Cohen Kappa coefficients between 0.4 and 0.6 correspond to a moderate agreement level and coefficients greater than 0.6 correspond to full agreement.

11.95% for category 13) compare to the baseline, firing partial info and firing no individual info treatments (2.27%, 4.38% and 3.41% respectively for category 4, and 5.32%, 1.88%, and 6.41% respectively for category 13).

In summary, chatting activities were mostly leisure activities. Indeed, similarly to Internet browsing, the average amount of time *B* subjects dedicated to chatting was significantly greater in the baseline treatment (31.54%) than in firing complete info (4.71%), firing partial info (3.89%), and firing no individual info (10.08%).

TABLE O.1 Inter-rater analysis of chat messages categorization.

Category	Agreement	Expected Agreement	Kappa	Standard Error	Z	Prob> Z
1	98.97%	92.97%	0.80	0.016	51.18	0
2	77.21%	54.82%	0.50	0.015	32.51	0
3	87.01%	82.69%	0.25	0.015	16.38	0
4	97.89%	91.1%	0.76	0.016	49.01	0
5	99.54%	98.63%	0.66	0.015	43.50	0
6	99.66%	98.60%	0.76	0.015	49.37	0
7	99.52%	99.52%	0.001	0.0093	-0.09	0.5371
8	97.94%	95.38%	0.55	0.015	35.74	0
9	99.39%	99.01%	0.39	0.014	27.39	0
10	99.66%	98.75%	0.73	0.015	47.73	0
11	99.15%	97.25%	0.69	0.015	45.53	0
12	99.81%	99.76%	0.20	0.016	12.78	0
13	96.39%	88.28%	0.69	0.015	44.84	0
14	99.85%	99.66%	0.57	0.014	40.59	0
15	99.10%	98.91%	0.17	0.014	12.35	0
16	99.73%	99.06%	0.72	0.016	46.04	0
17	99.76%	99.52%	0.50	0.014	34.98	0
18	100%	100%	0	0	0	0.5
19	100%	100%	0	0	0	0.5
20	100%	100%	0	0	0	0.5
21	97.60%	94.09%	0.59	0.015	38.86	0
22	97.87%	96.14%	0.45	0.015	30.38	0
23	99.61%	99.61%	0.002	0.015	-0.12	0.5493
24	99.3%	99.3%	0.002	0.017	-0.17	0.5680
25	99.76%	99.66%	0.28	0.015	19.08	0
26	98.59%	95.45%	0.69	0.015	45.12	0
27	99.66%	99.61%	0.12	0.010	12.08	0
28	97.72%	96.1%	0.42	0.015	27.40	0
29	96.05%	91.28%	0.55	0.015	36.98	0
30	84.22%	75.25%	0.36	0.014	26.14	0
31	95.73%	91.68%	0.49	0.014	34.58	0
32	98.79%	98.74%	0.04	0.010	3.98	0
33	99.52%	99.52%	0.001	0.009	-0.09	0.5373

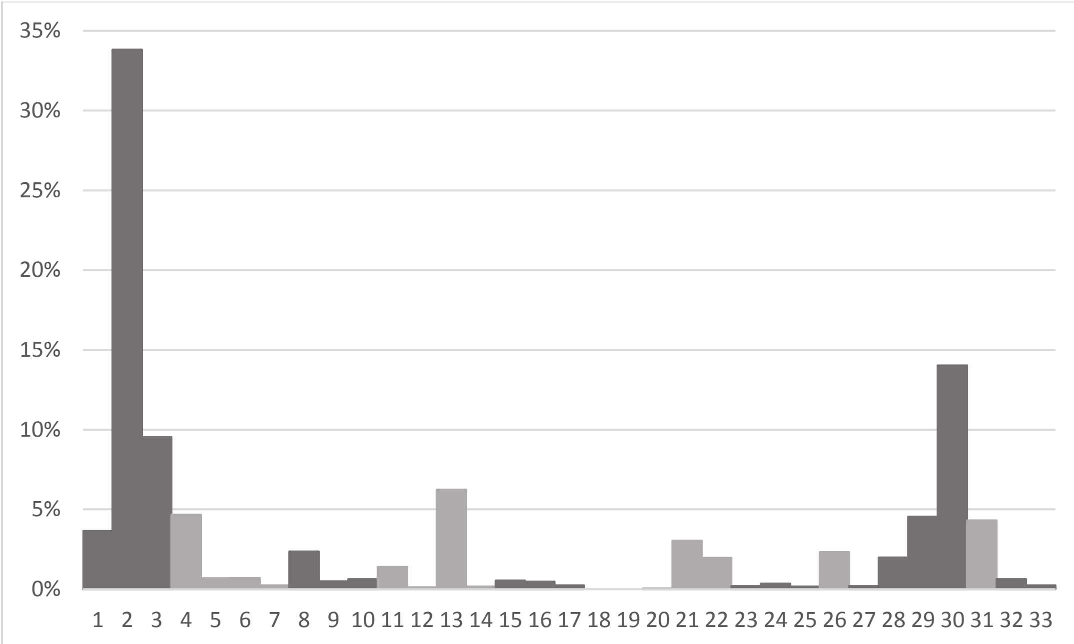


Figure O.1 Histogram of categorization of messages for all treatments.

TABLE O.2 Percentage of categories by treatment

Category	Baseline	FC	FP	FNoI	EndoC	EndoP	EndoNoI
1	3.53	2.34	4.38	3.83	1.16	6.20	4.83
2	44.31	19.61	15.83	20.87	30.06	15.26	13.60
3	8.47	3.64	9.79	14.26	24.86	8.91	9.65
4	2.27	10.65	4.38	3.41	12.72	11.03	10.09
5	0.61	0.52	1.46	0.73	0.00	1.21	0.88
6	0.21	4.42	0.84	0.00	0.00	0.76	2.20
7	0.07	0.91	0.21	0.31	0.58	0.61	0.00
8	1.50	3.51	6.46	5.89	0.00	1.21	0.00
9	0.42	1.04	0.83	0.93	0.00	0.00	0.00
10	0.15	2.60	0.84	0.83	0.00	0.45	4.39
11	0.92	1.04	0.21	3.72	0.87	2.27	3.51
12	0.04	0.13	0.00	0.11	0.00	0.60	0.88
13	5.32	11.95	1.88	6.41	3.47	9.22	10.53
14	0.17	0.00	0.00	0.62	0.00	0.00	0.00
15	0.57	0.13	0.83	0.73	0.00	0.91	0.00
16	0.00	2.73	2.09	0.73	0.00	0.15	0.00
17	0.00	0.00	0.00	0.00	1.73	0.46	4.83
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.11	0.00	0.30	0.00
21	3.97	2.86	1.88	1.35	0.58	1.66	1.76

22	1.02	1.69	2.92	3.41	0.58	4.23	10.09
23	0.02	0.00	1.46	0.83	0.00	0.00	0.00
24	0.09	0.13	0.00	0.11	4.05	1.36	0.00
25	0.00	0.00	0.00	1.45	0.00	0.00	0.00
26	2.38	3.51	6.46	1.76	0.00	0.00	1.32
27	0.09	0.00	0.00	0.00	3.18	0.15	0.00
28	1.96	3.51	2.92	1.76	0.00	0.61	3.51
29	4.28	3.51	9.79	4.44	2.89	3.78	7.90
30	13.51	15.59	14.79	14.26	12.43	17.98	7.90
31	3.30	3.64	7.29	6.31	0.87	10.28	1.32
32	0.79	0.39	1.04	0.52	0.00	0.00	0.44
33	0.11	0.00	1.46	0.42	0.00	0.46	0.44
Total messages	2398	385	240	484	173	331	114

Table O.3 Categories for chat messages.

New Category	**Category Number**	**Category**
Social interaction	1	Greetings (Hello/Goodbye)
	2	Distracting others (jokes, stories)
	3	Personal chat (talking about likes and dislikes)
Positive feedback and help	4	Encouraging others to produce
	5	Thanking other for their cooperative behavior
	6	*C* give positive feedback about *B* contributions
	7	Help others complete the task
Discouragements	8	Discouraging others to produce
	9	Asking others what is the point of producing anything
	10	*C* give negative feedback about *B* contributions
Performance evaluation and comparison	11	Ask others' performance on the task
	12	*B* asks *C* about his/her own relative performance on the task
	13	State your own performance
	14	B talks to C about other B subjects' performance
Pay /firing threats	15	*B* threatening *C* not to produce anything
	16	*C* threatening others to fire them if they do not produce enough
	17	*C* telling *B* they will be paid based on their relative production
	18	*C* telling *B* they will be paid based on how much time they spent working instead of being online

	19	*C* telling all *Bs* they will all be paid the same if they achieve a certain level of total production
	20	*C* telling all *Bs* they will all be paid the same regardless of performance
Complaints about firing/supervision strategy/pay	21	Complaints about the supervision of the *C* subject
	22	Complaints about the firing/pay strategy of the *C* subject
Comments on firing/supervision/pay strategy	23	Suggesting/stating Firing strategy
	24	Suggesting/stating Supervising strategy
	25	Comments on effectiveness of firing policy
Envy	26	*B* envying the *C* subject
Non-strategic comments on the experiment	27	Ask others for help and hints to complete the task
	28	General comments about the experiment and its goals
	29	Specific comments on how earnings are calculated
	30	Other specific comments on the experiment
Influence and manipulation	31	Influencing *C* subject
Fairness	32	Negative comments on fairness of firing / pay policy
	33	Positive comments on fairness of firing / pay policy

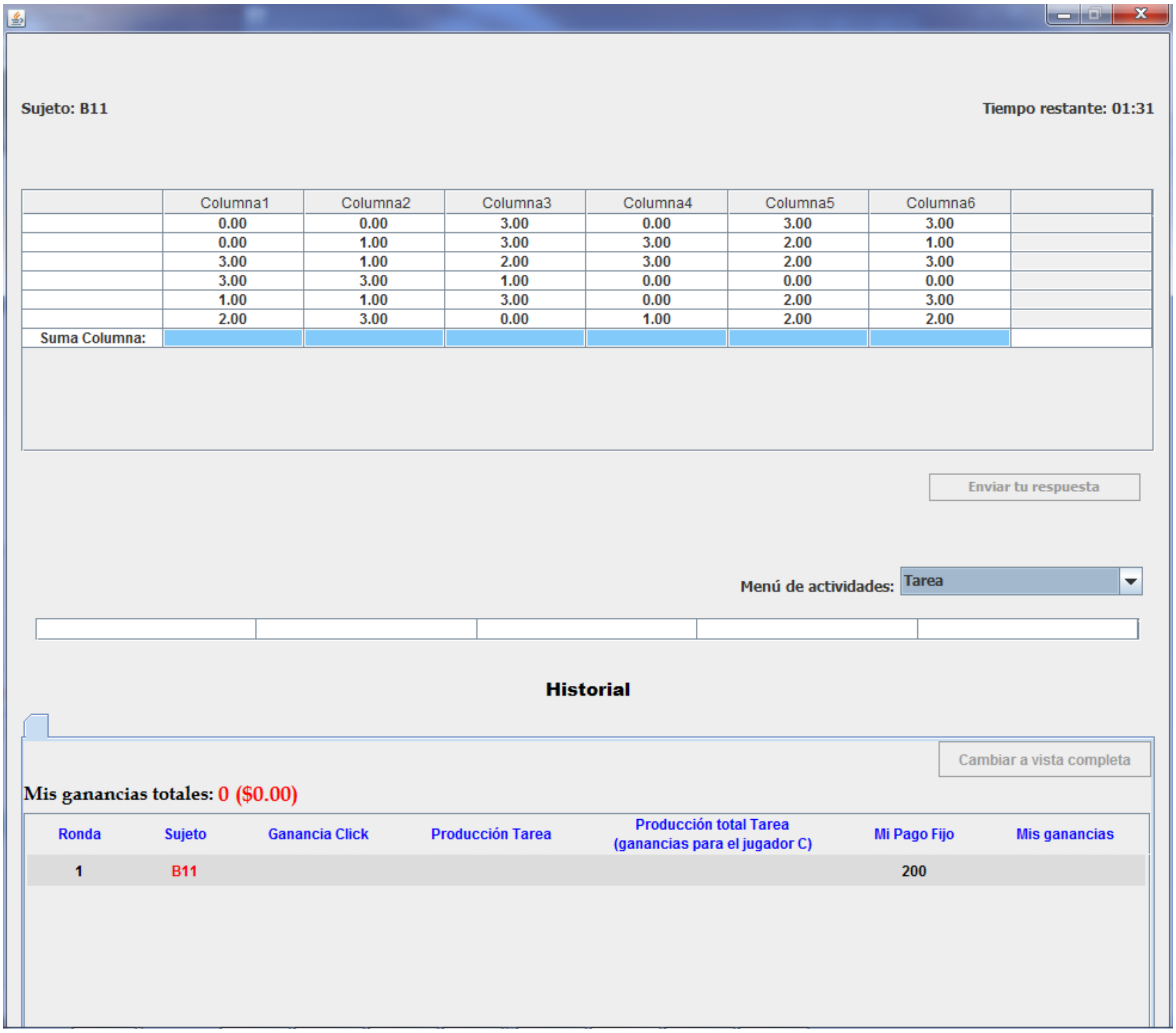
Appendix D

Table D.1. Decisions in the social preferences task.

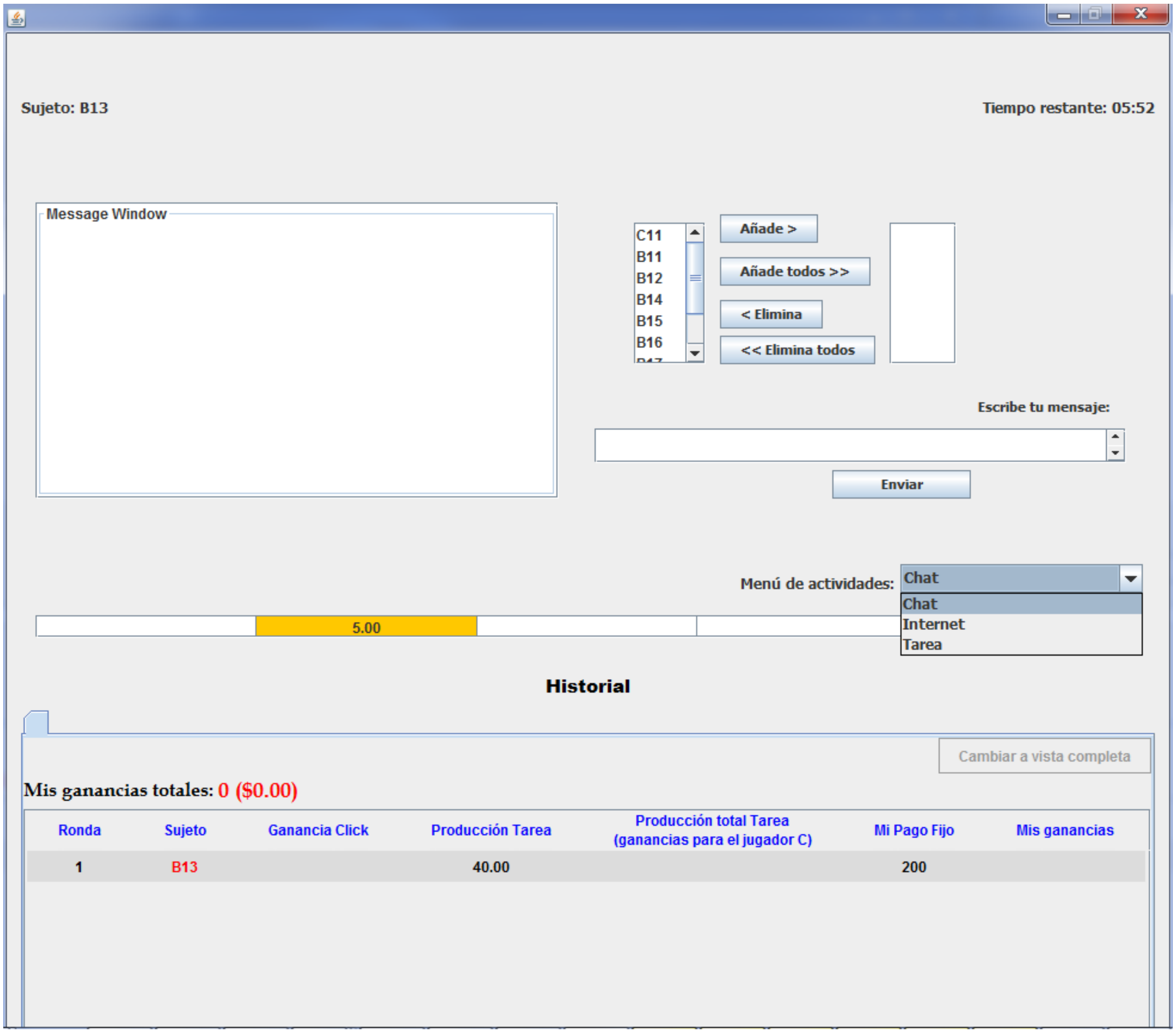
Decision	OPTION A self, other	OPTION B self, other
1	10€, 10€	10€, 6€
2	10€, 10€	16€,4€
3	10€, 10€	12€, 4€
4	10€, 10€	11€, 19€
5	10€, 10€	10€, 18€
6	10€, 10€	8€, 16€

Appendix E

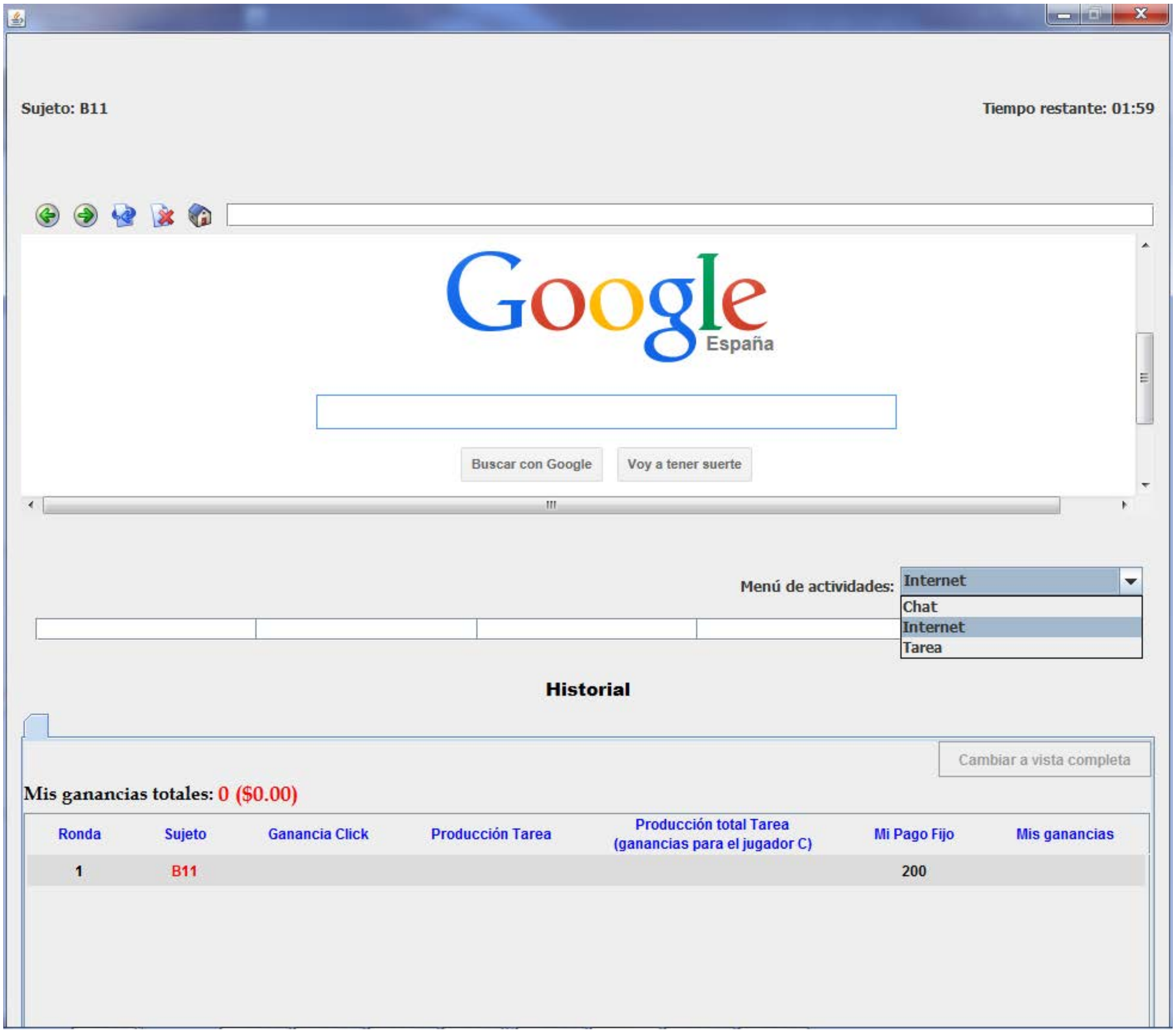
Task screen:



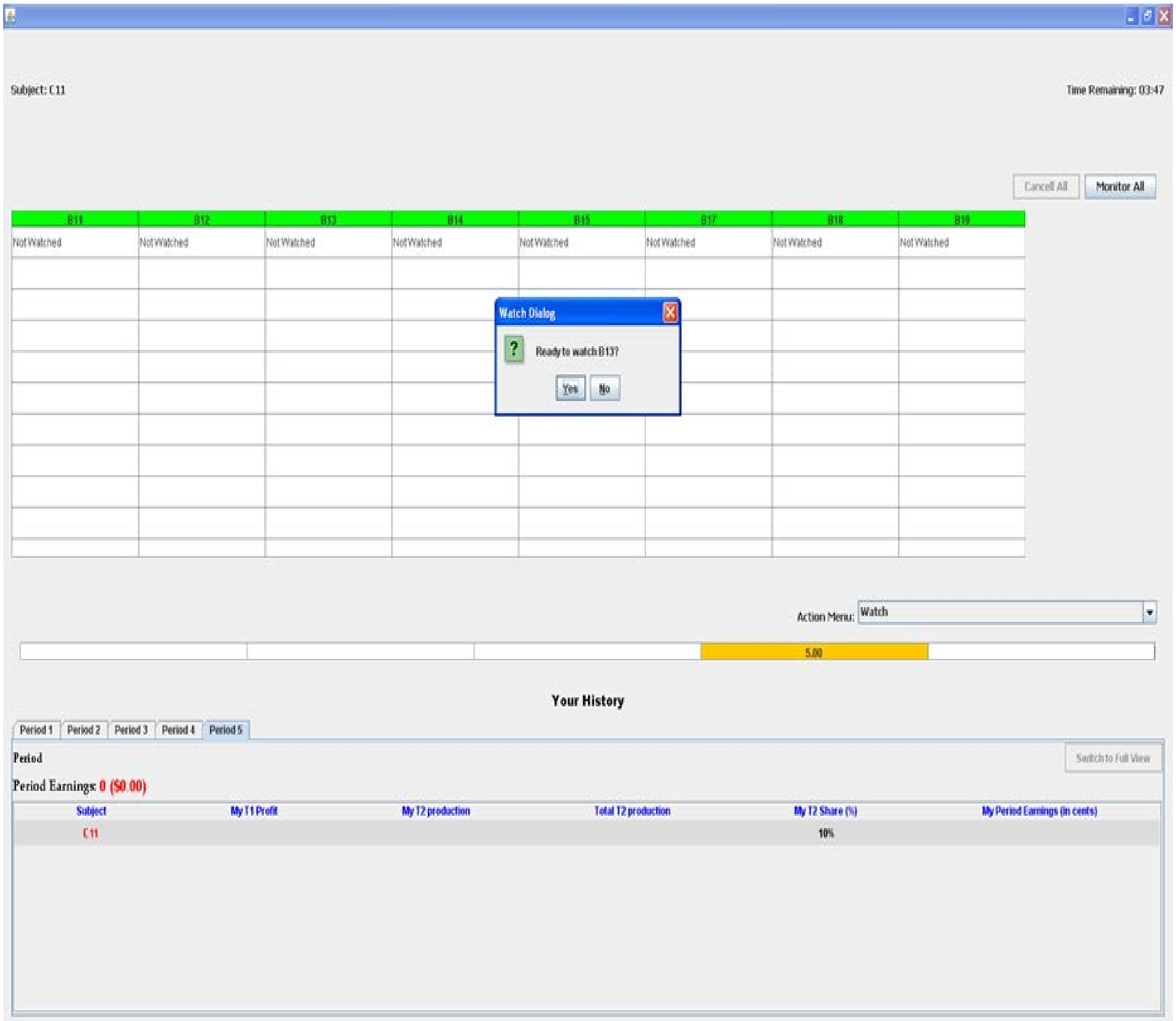
Chat screen:


Sujeto: B13
Tiempo restante: 05:52
Message Window
C11
B11
B12
B14
B15
B16
Añade >
Añade todos >>
< Elimina
<< Elimina todos
Escribe tu mensaje:
Enviar
Menú de actividades:
Chat
Chat
Internet
Tarea
5.00
Historial
Cambiar a vista completa
Mis ganancias totales: 0 ($0.00)
Ronda
Sujeto
Ganancia Click
Producción Tarea
Producción total Tarea (ganancias para el jugador C)
Mi Pago Fijo
Mis ganancias
1
B13
40.00
200

Internet screen:



Monitoring screen (baseline, firing complete info and firing partial info treatments):



Monitoring screen (what bosses can observe in real time):

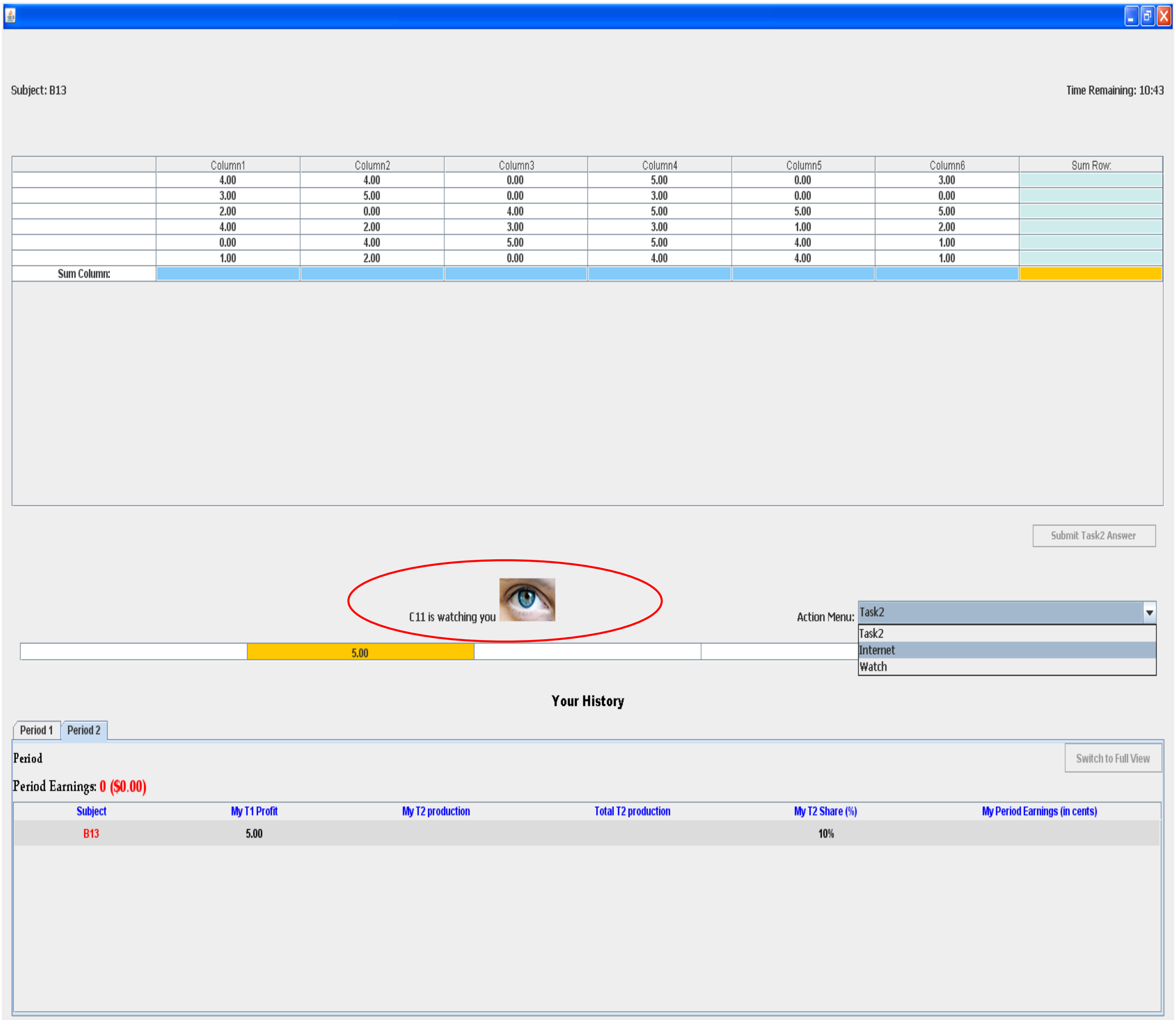
Baseline and firing complete info

B13 Activities
Switched to Internet Production(13:18): 40.00(**33%**)
Switched to Task2 Production(13:20): 40.00(**33%**)
Switched to Internet Production(13:21): 40.00(**33%**)
Answer Task2 Production(13:31): 40.00(**33%**)
Sum Column, #12 Production(13:35): 0.00(**0%**)
Answer Task2 Production(13:46): 0.00(**0%**)
Sum Column, #25 Production(13:55): 0.00(**0%**)
Switched to Task2 Production(15:30): 0.00(**0%**)
Switched to Internet Production(15:46): 0.00(**0%**)
Switched to Task2 Production(15:47): 0.00(**0%**)
Switched to Internet

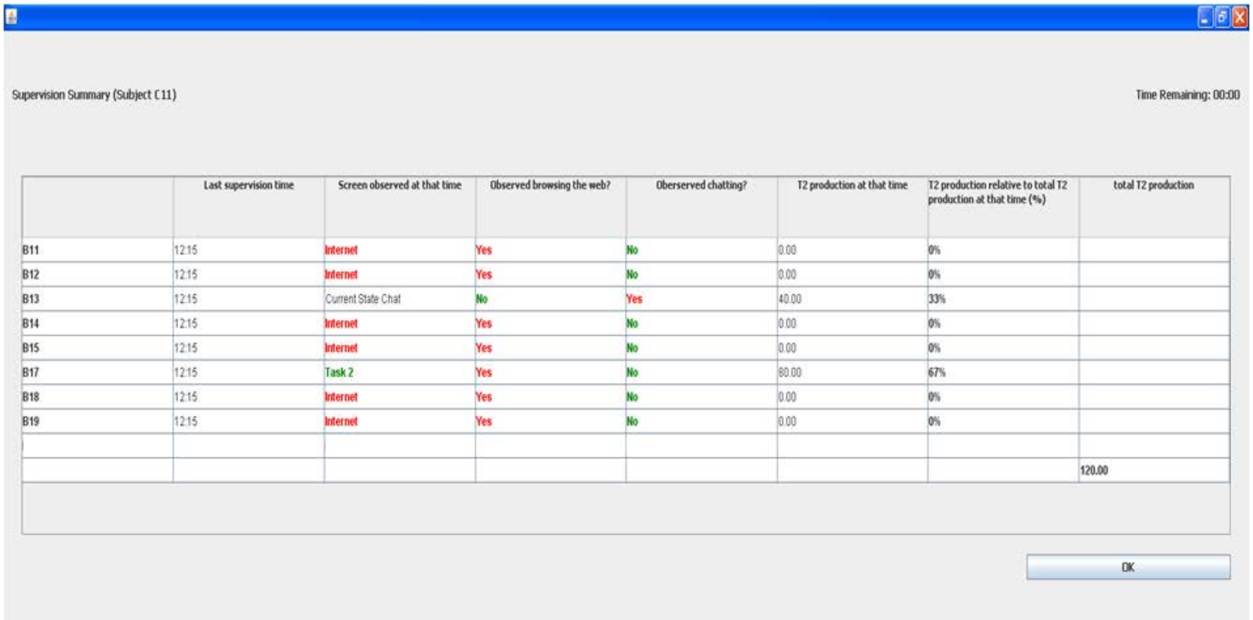
firing partial info

B13 Activities
Switched to Internet
Switched to Task2
Switched to Internet
Answer Task2
Sum Column, #12
Answer Task2
Sum Column, #25
Switched to Task2
Switched to Internet
Switched to Task2
Switched to Internet

Monitoring (worker's screen):



Monitoring summary (baseline and firing complete info treatments):



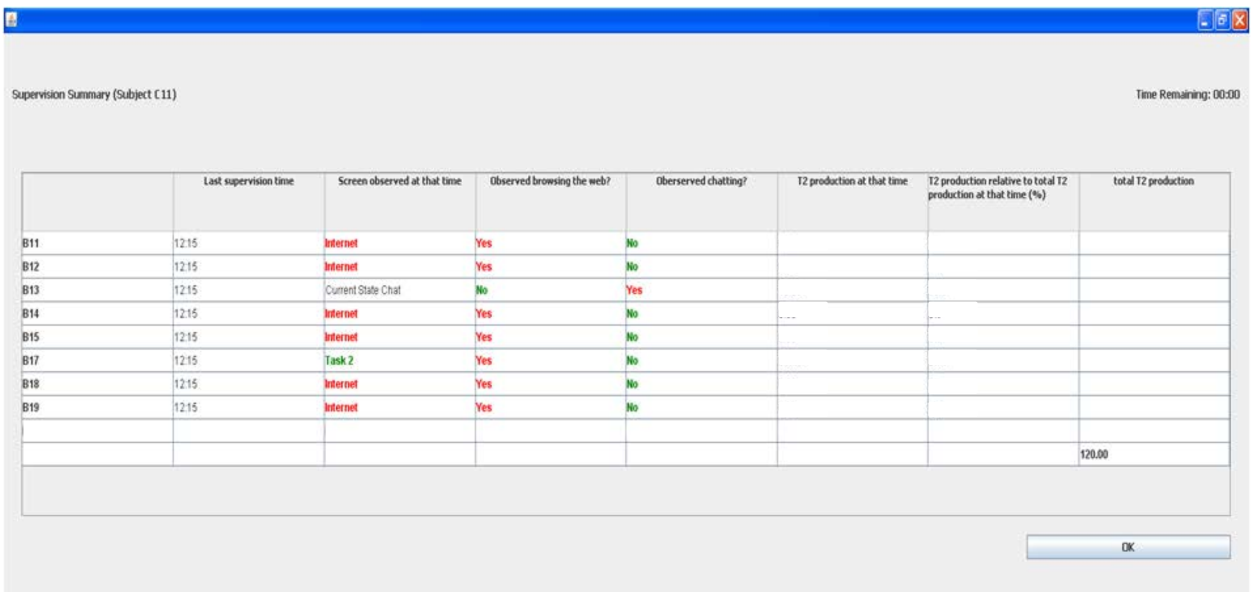
Supervision Summary (Subject C11)

Time Remaining: 00:00

	Last supervision time	Screen observed at that time	Observed browsing the web?	Oberserved chatting?	T2 production at that time	T2 production relative to total T2 production at that time (%)	total T2 production
B11	12:15	Internet	Yes	No	0.00	0%	
B12	12:15	Internet	Yes	No	0.00	0%	
B13	12:15	Current State Chat	No	Yes	40.00	33%	
B14	12:15	Internet	Yes	No	0.00	0%	
B15	12:15	Internet	Yes	No	0.00	0%	
B17	12:15	Task 2	Yes	No	80.00	67%	
B18	12:15	Internet	Yes	No	0.00	0%	
B19	12:15	Internet	Yes	No	0.00	0%	
							120.00

OK

Monitoring summary (firing partial info treatment):



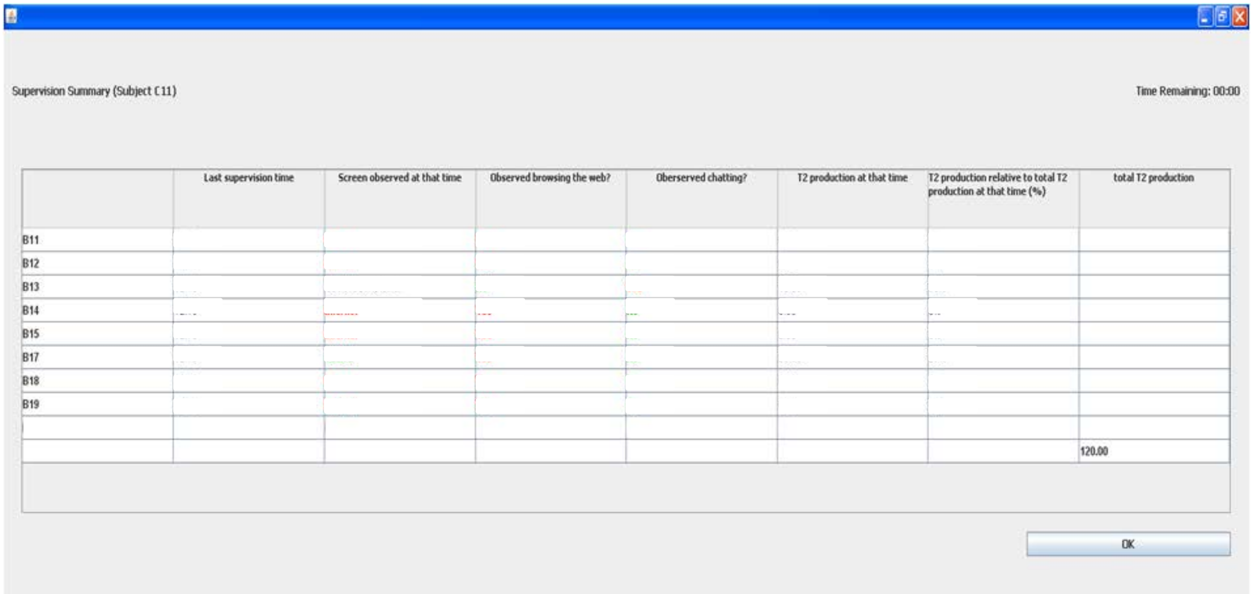
Supervision Summary (Subject C11)

Time Remaining: 00:00

	Last supervision time	Screen observed at that time	Observed browsing the web?	Oberserved chatting?	T2 production at that time	T2 production relative to total T2 production at that time (%)	total T2 production
B11	12:15	Internet	Yes	No			
B12	12:15	Internet	Yes	No			
B13	12:15	Current State Chat	No	Yes			
B14	12:15	Internet	Yes	No			
B15	12:15	Internet	Yes	No			
B17	12:15	Task 2	Yes	No			
B18	12:15	Internet	Yes	No			
B19	12:15	Internet	Yes	No			
							120.00

OK

Monitoring summary (firing no individual info):



Concluding remarks

An organization may have a strong leader, the latest technology or great business connections and it can still have losses if its workers are not motivated. Motivation is the engine of any organization in the world. People need to be motivated to perform any task within an organization, either extrinsically or intrinsically. Managers have to find the right incentive for each worker they have under their supervision. This is an arduous task most of the time.

Hence, it is not a surprise that a vast part of the literature in economics and psychology is focused in studying how people react to different monetary and non-monetary incentives. Furthermore, a growing literature on behavioral sciences is helping us to disentangle which kind of incentives fit better with different kind of people. This research might help people to create strong, healthy and better organizations with happy and productive workers.

All the research included in this dissertation was conducted using experimental methods in Barcelona, Castellón and Madrid using z-Tree and Virtual Organizations programs. Laboratory experiments allow us to study organizational and individual behavior that it is impossible to analyze otherwise.

In summary, my research has mainly found that: 1) found that managers mostly take into consideration production when they distribute the production generated by workers with different characteristics; 2) shown that pay secrecy does not change managers' distributional concerns; 3) found that loss aversion could explain why some jobs are better paid than others; 4) looked at how workers with different characteristics react to wage discrimination in different ways depending on the characteristics of her/his coworker; 5) shown that the threat of being fired is powerful when the boss does not have any information about workers' individual behavior, but little information about workers' working time helps to increase production; 6) found that complete information about workers is not needed to better motivate them in the presence of firing threats; 7) contributed to better understand how workers with different levels of motivation and ability behave in the presence of firing threats.