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

Jordi Brandts* José M. Ortiz** and Carles Solà Belda***

* IAE (CSIC) and Barcelona GSE

**Department of Economics, Middlesex University

***City University of New York, College of Staten Island

April 2019

Abstract

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, as well as their relations to various equity principles. We are also interested in how owner-managers decisions' are affected by pay secrecy. We use a game in which workers first exert effort and owner-managers then decide on bonuses for themselves and workers. 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. The equity principles we focus on are 'production-equity', higher production leads to higher wage, and 'effort-cost equity', higher effort-cost leads to higher wage. Across all treatments about 50% of all manager choices are compatible both with 'production equity' and with 'effort- cost equity', about 20% only with production equity and about 15% only with effort-cost equity. Overall, the effect of effort-cost equity is significantly stronger than that of production-equity. Pay secrecy does not significantly affect compensation differences among workers.

Keywords: equity, gift exchange, experiment, effort, productivity, pay secrecy.

JEL-codes: C91, D63, D 90

Contact Information and Acknowledgements: Brandts: Jordi.brandts@iae.csic.es, Ortiz Gomez: n.ortizgomez@mdx.ac.uk, Solà: carles.solabelda@uab.es. We thank Ramon Cobo-Reyes, Francis Lagos and Ismael Rodríguez-Lara for very helpful suggestions. We also thank participants in the SEET Meeting in Sesimbra and the ESA European Meetings in Prague for their comments. The authors gratefully acknowledge financial support from the Spanish Ministry of Economy and Competitiveness (Grant: ECO2017-88130), the Severo Ochoa Program for Centers of Excellence in R&D (SEV2015-0563) the *Generalitat de Catalunya* (Grant: 2017 SGR 1136).and the Antoni Serra Ramoneda (UAB – Catalunya Caixa) Research Chair.

1. Introduction

Distributional concerns are a central issue in structuring compensation systems in companies as well as in other organizations.[1] Both the stakeholders of organizations and society as a whole are sensitive to how the production of firms is distributed among their stakeholders. In this paper we present the results of a lab experiment which we conducted to shed light on how managers decide how to compensate their workers. More specifically, 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, that is, a wage for each worker. Our design is influenced by the one in Abeler, Altmann, Kube and Wibral (2010). We also use a reverse gift-exchange game with two workers and one manager. However, in our case workers are heterogeneous, since our focus is precisely on how workers with different characteristics are compensated.

The two workers first independently make effort decisions, which jointly determine the production that can be distributed between the manager and the three workers. 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.

Managers observe both 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

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

horizontal ones, the criteria that drive the relative earnings of the two workers as decided by managers.[2]

We vary workers' characteristics separately along two dimensions. First, we study the case where workers have different productivities. The fact that workers differ in their ability to contribute to total production is a central determinant of earnings differences in a market economy. We model productivities as exogenously given personal characteristics. A worker's productivity parameter together with his effort level determines his contribution to production. In our setting, the value of the productivity parameters are common information for the three players. Total production is additive so that the contributions of different workers can be clearly attributed to each of them.[3] Second, we study cost of effort differences. In this setting, workers have the same productivity but the cost of effort is doubled for one worker. Cost of effort increases with the level of effort chosen by the worker.

The two sources of heterogeneity have different effects. Productivity differences will imply different production levels for the same employee effort cost, whereas cost of effort differences imply that the same production level has different impacts on the net income of employees with different effort costs.

In addition to worker heterogeneity we also study the effect of another factor. Managers' distributional decisions may be affected by whether workers know how other workers are compensated. We study two polar cases. In one case both workers are informed about both wages and in the other case they both are only informed about their own wage. In many organizations

[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).

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. Paying heterogeneous workers differently implies discrimination and managers may differ with respect to their willingness to discriminate depending on observability. Pay secrecy can affect workers' job satisfaction and productive effort. Several papers that will be mentioned in the literature section study workers' reactions to pay secrecy. In this paper we focus on managers' reactions to pay secrecy when deciding on compensation policies. Specifically, for both types of worker heterogeneity we analyze whether managers' compensation policies are affected by whether workers are informed about both wages. In the absence of pay secrecy managers may follow certain distributive principles when paying heterogeneous workers. By contrast, under pay secrecy they may – in comparative terms – tend to deviate more from moral considerations and pay more to the worker who has produced more output, motivated by the feeling of having more moral wiggle room as in Dana et al. (2007).

We find that on average managers pay more to the more productive workers in both cases (different productivity and different cost of effort), but the proportional difference in wages between workers is lower than the proportional difference in production. We also find that secrecy has only a limited effect on managers' distributional decisions. Looking at managers' individual decisions we find that over 50% of decisions are compatible with both production-equity and effort-cost equity, about 20% only with the former notion and about 15% only with the latter notion.

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 some studies using the traditional gift-exchange structure to study how workers' productivity affects the 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 and effort is 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 workers' decisions.

The work of Güth et al. (2001) is in the same line. They compare 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 which they can accept or not. If either of them does not accept the contract, 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.

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.[5]

[4] The notions of 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 whereas homo oeconomicus model states that they should give zero to others.

[5] See Karni and Safra (2002a, b), Karni, Salmon and Sopher (2008) and Karagözoğlu and Riedl (2014) for more literature on fairness studies with uncertain information.

Unlike the previous papers, we use a reverse gift-exchange game where the workers first independently choose the effort levels of effort and, knowing both levels of effort, the manager decides on a wage for each worker.

Abeler et al (2010) use a reverse gift-exchange game with one manager and two workers to compare the behavior of workers when the manager has to pay the same wage to each worker and when the manager may choose a different wage for each worker. The two workers are of equal productivity. Workers move first and then the manager pays them, like in our experiments. Their results show that workers exert more effort when the manager can choose a different wage for each worker. In the context of that paper pay equality is not a good way to incentivize workers.[6]

Schneider and Kube (2006) use a similar design to Abeler et al. (2010) to analyze if personal relationships, as studied in Brandts and Solà (2010), produce wage differences between workers. In each firm, the manager and one of the workers are friends in 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.

It is also worth noticing 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). Our design represents organizational situations where the manager just decides how much to pay to each worker without participating in the production process. Our setting is especially related to a discretionary bonus payment situation, where a manager decides the amount of the bonus he/she is going to pay to a given worker without

[6] Lazear (1989) also demonstrates that pay equality leads to a lower efficiency than others pay schemes.

any contract obligation involved.[7] This situation may be found in many companies in Japan, where workers receive a bonus at the end of the year but they do not know the amount until they receive the payment.[8]

With respect to secrecy Nosenzo (2013) reports on experiments in which he finds that pay secrecy can be advantageous for a firm due to higher effort provision when workers are in the dark about the fact that workers are treated unequally results. With respect to the effects of pay secrey on managers' behavior, Colella et al., (2007) propose that managers are more egalitarian when secrecy is involved. However, there is, to the best of our knowledge, no experimental evidence on the effect of pay secrecy on managers.

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

3. Experimental design

3.1 Treatments

We use a 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

[7] In natural environaments, a bonus typically has an incentive effect, since the owner-worker relation is an ongoing repeated one. Our focus is on the purely distributive concerns of managers when making decisions and for this reason we use a strangers protocol.

[8] Equity concerns have also been studied in other settings as for example using trust games (Rigdon & Cassar, 2011), team production (Meidinger, Rullière & Villeval, 2003; Corgnet, Sutan, & Veszteg, 2011), and ultimatum games (Rodriguez-Lara, 2016). See also Cappelen, Sorensen & Tungodden (2010) or Eisenkopf, Fischbacher & Föllmi-Heusi (2013) for more experimental papers studying equity.

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] 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 and keeps the rest for herself, where a compensation scheme consists of a wage for each of the workers, w_A and w_B.

We define a compensation scheme as the vector composed by the wages that a manager sets for his/her workers.

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:

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).

Variations in the productivity parameters, the effort cost functions of the two workers and the information conditions determine our treatment variations. The fundamental idea behind the variations in the parameters is to have two treatments in which worker A is favored with respect to B in different ways to study to which extent managers treat these different cases differently.

Table 2 shows an overview of our four treatments together with the names we will be using for each of them.

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

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

Table 2: Treatments.

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

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.[10]

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 a 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.

The *Secrecy* treatment uses the same parameters as the Baseline treatment but differs 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.

[10] We induce a convex effort cost relation. In doing this we follow previous experimental work by Fehr, Kirchsteiger and Riedl (1993) and Abeler et al. (2010). In addition, there is now evidence Gill and Prowse (2019) that effort costs are effectively convex in effort.

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.

The fourth treatment, *Different Effort Costs with Secrecy* (DECS), uses the same parameters as DEC together with the same information condition as Secrecy.[11]

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.[12] 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.[13] After the last round, subjects answered a short post-experimental questionnaire. The experiment was conducted with a labor market framing, i.e.,

[11] 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.
[12] We use a strangers matching protocol to abstract from confounding reputation effects.
[13] Every matching group has seven type A agents and seven type B agents. In two sessions the matching group consists of 6 players of every role due to a problem with the recruitment schedule.

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 (63 subjects per treatment, except DECS 69 subjects). 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.

3.3 Theoretical considerations and research questions

In this section we introduce the equity principles that we will use.[14] In principle, we have to distinguish between equity principles pertaining to vertical equity and those to horizontal equity. However, in terms of vertical equity the only issue is how much the manager keeps for herself and how much she distributes to the workers. Any distribution between a pure egalitarian one and one where the manager keeps everything can be easily rationalized, for example, in terms of a simple inequality aversion model with more or less weight on the inequality component.

[14] Following the homo economicus assumption, 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 such as reciprocity (Charness, 2004). In this sense, we expect managers to reciprocate workers' effort with wages..

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.[15] 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.

The second principle is the *libertarian* principle, which, in general terms, proposes to give each person what he produces. Applied to the two workers in our environment this principle implies that from what the manager does not keep for herself 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 liberal egalitarian 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.

All three equity principles propose very stringent conditions on managers' compensation schemes. However, the libertarian and the liberal egalitarian principle can also be applied in a less strict

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

sense, which preserves the basic intuition behind them. The notions we will be using are *production equity* and *effort-cost equity*. As will be explained the prescriptions of these concepts will in some cases overlap and in some others be in conflict with each other.

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.

Next we discuss the application of, egalitarianism, 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. Given the difference in the magnitudes of the productivity parameters, 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 workers will exert more effort and incur a higher effort cost. If worker A incurs a higher effort cost than B 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 will the introduction of secrecy 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 DEC treatment the two workers are equally productive but, for each effort level, worker B incurs a higher effort cost. If both workers choose the same effort level, then both will produce the same. 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 Baseline and Secrecy treatments we expect the introduction of secrecy to lead to a higher incidence of the use of the production equity principle.

We formulate our research questions as follows:

1. *How do managers remunerate heterogeneous workers, and how does this depend on the type of heterogeneity?*
2. *Do managers behave differently under secrecy?*
3. *What is the link between managers' behavior and 'production equity, 'effort-cost equity' and egalitarianism?*

4. Experimental results and discussion.

In section 4.1 we present results pertaining to aggregate behavior, moving from comparisons of averages to regression analysis to answer research questions 1 and 2. In section 4.2 we study the data at the disaggregated level and relate them to our equity principles to respond to research question 3.

4.1. Aggregated behavior

4. 1. 1. Descriptive statistics.

Table 5 shows descriptive statistics of the most important variables by treatment.[16] The patterns that can be seen in Table 5 give a first impression of the distributive principles used by managers when deciding on compensation schemes. We first look at the average data within treatments and then make some comparisons across treatments.[17]

In the first two treatments, workers A and B incur the same effort levels and, hence, the same effort costs. Signed-rank tests comparing the effort levels of workers A and B within the two 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). Given the productivity differences A produces more than B and A's wage is significantly higher than that of B (signed-rank tests: $p < 0.001$ and $p < 0.001$, respectively). This overall patterns is consistent with production equity and not with effort-cost equity or egalitarianism.

[16] All statistical tests are at the individual level unless otherwise stated in the text.

[17] In Appendix B one can find figures showing the evolution over time of effort levels, wages, manager profits and worker incomes and production levels over time, separately for all treatments. Overall, behavior is stable over time. One does observe some decline in wages towards the end of the experiments. In our experiments we used a random rematching protocol to exclude reputation effects. However, there could be some group reputation at work, which would mean that we were not completely successful in isolating managers' distributive concerns from the effects of repeated interaction. Note, however, that wages are quite stable over for many periods and are still rather high in period 12 when the manager has no incentive to pay her workers anything. We have added a footnote about this issue.

In the third and fourth treatments B incurs a higher effort cost than A (p=0.000 with and without secrecy), but A produces more than B. In this case production equity calls for paying A a higher wage than B, whereas effort-cost equity calls for the opposite: the two principles point in different direction. There is no significant difference between the average wages of the two workers in the first case and a marginally significant effect in the second case (signed-rank test: p = 0.316 and p = 0.067, respectively). This equality seems to be an artifact of the particular parameter values we chose. However, it is consistent with managers considering both principles in their decisions.[18]

Comparing effort levels of A and B separately across 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). Note that worker A 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 worker is not affected by differences in the treatment conditions for the B workers.

[18] A's income is higher in all four treatments showing that managers' decisions in no case compensate for the unequal starting points of A and 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].

By, contrast, the between treatment comparisons of the effort level of the B workers 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 reward them less under secrecy, since Bs 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.

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 Baseline and Secrecy treatments (rank-sum test: $p = 0.514$) whereas there is a significant difference between the DEC and DECS treatments (rank-sum test: $p = 0.048$), albeit a small one in magnitude. The above analysis suggests that income levels are not affected by secrecy.

Table 6 presents some of the information shown in table 5 in relative terms. For the Baseline and Secrecy treatments we can see that worker A produces a little more than twice the amount that worker B produces (and incurs a little lower cost of effort) and receives only between 36% and 41% higher wage. For the DEC and DECS treatments 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.[19]In our data about 1/3 of additional production translates into additional production.

	Baseline	Secrecy	DEC	DECS
Ratio of effort A/B	1.01	1.05	1.14	1.20
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 effort costs	1.05	1.08	0.63	0.66
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	123.55	118.66	154.39	147.10
% A	19%	19%	15%	16%
% B	12%	12%	10%	10%
% M	69%	69%	75%	74%

Table 6: Ratios of production, wage and income.

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 Baseline and Secrecy treatments (24%, 17% and 59% for worker A, worker B and

[19] 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.

the manager, respectively in both Baseline and Secrecy treatments), on one hand, and for the DEC and DECS 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 DEC and DECS treatments (76% and 75% in DEC and DECS, respectively) than in the Baseline and Secrecy treatments (73% and 70% in Baseline and Secrecy, respectively).

Result 1: *(How do managers remunerate heterogeneous workers, and how does this depend on the type of heterogeneity?)*

i) *A's average wage level is significantly higher than B's in the Baseline and Secrecy treatments. The wage ratio is between the effort-cost ratio and the production ratio.*
ii) *A's average wage levels is not statistically different from B's in the DEC treatment and only marginally higher in the DECS treatment. The wage ratio is between the effort-cost ratio and the production ratio.*

4. 1. 2. Regression analysis

Table 7 shows the results of four GLS regressions of wages on various variables; in this and all subsequent regression tables we show robust standard errors clustered by matching group. Models 1 and 2 pertain to the Baseline and the Secrecy treatments, whereas models 3 and 4 pertain to the DEC and DECS treatments. We regress worker i's wage (w_i), on his effort level ($Effort_i$). We also

control for the coworker's effort ($Effort_j$).[20] To control for differences between treatments (Baseline vs Secrecy and DEC vs DECS), we include a treatment dummy (Secrecy).

Model	1	2	3	4
Dependent variable	W_A	W_B	W_A	W_B
EffortA	4.656***	.301*	5.466***	.206
	(.415)	(.168)	(.483)	(.204)
EffortB	-.663***	3.343***	-.392	5.853***
	(.254)	(.328)	(.247)	(.509)
Secrecy	-.524	-.248	.079	1.470
	(3.822)	(3.995)	(4.830)	(4.390)
Period	-.674**	-1.094***	-.658***	-.607***
	(.280)	(.185)	(.237)	(.215)
Constant	11.103***	7.435**	3.140	-.350
	(4.111)	(2.943)	(3.139)	(3.958)
Obs.	684	684	708	708
R^2	0.299	0.256	0.331	0.379

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

The results of model 1 show that worker A's wage positively depends on his own effort level. An additional unit of effort increases the high productivity worker's wage by 4.595 points. This coefficient is significant ($p < 0.01$). Also, worker B's effort has a negative effect on worker A's wage, an additional unit of effort of worker B makes worker A's wage go down by 1.139 points ($p < 0.001$).

[20] In Appendix B one can find regression tables parallel to Tables 7-10 in which effort levels have been replaced by costs of effort. The basic results do not change.

As we can see in model 2 the effort effects are not symmetric to those shown in model 1. The effect of B's effort on his own wage is significantly positive, but, in contrast to the results in model 1, worker A's effort does not create a positive pecuniary externality on worker B's wage. Observe also that the magnitude of the own-effort effect is larger in model 1 than in model 2. This is consistent with the fact that A's productivity is considerably higher than B's, that an increase in A's effort increases production more than one in B's effort and that the manager takes this into account when setting wages.

For a possible explanation of the asymmetric other-effort effects consider that higher effort by B does not generate much more production. Given this, if the manager wants to reward B for his higher effort she has to reduce the wage of A so as not to hurt her income. By contrast, the fact that higher effort by A does not affect the wage B is consistent with the fact that, given A's high productivity, the manager can reward the higher effort of A without having to change the wage of B.

Note that the results in models 3 and 4 are similar to those in models 1 and 2. The effort-wage pattern is the same. Own-effort effects have the same sign as in models 1 and 2, but observe that, in contrast to models 1 and 2, the magnitudes of the own-effort effects are the same. Since now productivities are the same, it seems natural that the manager reacts to effort of the two workers in the same way. The other-effort effects are asymmetric as in models 1 and 2. This is consistent with the manager taking into account the different effort-cost functions of the two workers. Specifically, if A increases his effort the manager does not react by decreasing B's wage, since B's situation is worse due to the higher effort-cost.

Observe also that the secrecy dummy is not significant in any of the regressions and that the period dummy is negative and significant in all of them.

In Table 8 we can see how the results from table 7 translate into workers' income levels. Observe first that the pattern of significances is the same as in table 7. The main difference with respect to the results in Table 7 is that the own-effort effects for A are larger than the ones for B. In models 1 and 2 the own-effort effect of A is almost three times the one for B, reflecting the fact the difference in productivities. In models 3 and 4 the own-effort effect of A is now more than twice the one for B, when in table 7 they were of similar magnitudes. This reflects that fact that although higher effort by B leads to a higher wage, the effect on income is mitigated by the fact that for B higher effort is very costly and this moderates the effect on income.

Model	1	2	3	4
Dependent variable	π_A	π_B	π_A	π_B
EffortA	2.364***	.305*	3.151***	.258
	(.410)	(.165)	(.480)	(.214)
EffortB	-.658***	1.030***	-.411*	1.438***
	(.251)	(.326)	(.242)	(.500)
Secrecy	-.540	-.594	-.066	.946
	(3.832)	(3.006)	(4.838)	(4.410)
Period	-.685**	-1.112***	-.721***	-.703***
	(.282)	(.184)	(.235)	(.210)
Constant	15.868***	12.856***	8.434**	8.723**
	(4.074)	(2.956)	(4.169)	(3.909)
Obs.	684	684	708	708
R^2	0.117	0.088	0.157	0.064

Table 8: 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.

In Table 9 we have added interaction terms between secrecy and effort levels to the regressions of Table 7. The only difference with respect to the results of Table 7 is that in model 2 there is now a significantly negative interaction between secrecy and the effort of A. Under secrecy the manager translates an increase in the effort of A less into a higher wage for B than in the absence of secrecy. This is the only indication of the manager using secrecy to behave in a less distributive way. In models 3 and 4 the introduction of the interaction effects does not alter the pattern of effects.

Model	1	2	3	4
Dependent variable	W_A	W_B	W_A	W_B
EffortA	4.995***	.650***	4.990***	-.069
	(.617)	(.248)	(.757)	(.307)
EffortB	-.971**	3.070***	-.715*	5.467***
	(.485)	(.491)	(.423)	(.776)
Secrecy	-.399	1.175	-8.789	-5.560
	(6.821)	(5.035)	(5.531)	(4.854)
Secrecy*EffortA	-.643	-.660**	.862	.462
	(.830)	(.329)	(.979)	(.404)
Secrecy*EffortB	.519	.461	.483	.642
	(.587)	(.650)	(.530)	(1.024)
Period	-1.079***	-1.080***	.652***	-.611***

	(.179)	(.179)	(.238)	(.210)
Constant	10.766*	6.800	8.422*	3.972
	(6.210)	(4.369)	(5.047)	(4.160)
Obs.	684	684	708	708
R^2	0.303	0.263	0.329	0.378

Table 9: Wage regressions. GLS regressions with robust standard errors, clustered by matching group. Significance at the 10%, 5% and 1% level is denoted by *, **, and ***, respectively.

In Table 10 we add interaction effects to the income regressions of Table 8. In model 2 we see the same significant interaction effect between secrecy and the effort of A than in Table 9. In model 4 we also see that now the pure effect of the effort of B on B's income is not significant anymore, i.e. when there is no secrecy the manager's remuneration of B's effort is not enough to make B's higher effort translate into higher income.

Model	1	2	3	4
Dependent variable	π_A	π_B	π_A	π_B
EffortA	2.688***	.643***	2.693***	-.046
	(.608)	(.246)	(.749)	(.319)
EffortB	-.983**	.742	-.735*	1.044
	(.468)	(.496)	(.419)	(.781)
Secrecy	-.001	.542	-8.713	-6.519
	(6.664)	(5.037)	(5.566)	(4.946)
Secrecy*EffortA	-.614	-.640**	.827	.518
	(.820)	(.323)	(.970)	(.422)
Secrecy*EffortB	.547	.484	.488	.650
	(.576)	(.652)	(.523)	(1.012)
Period	-.670**	-1.098***	-.716***	-.706***
	(.283)	(.178)	(.236)	(.207)
Constant	15.754***	12.386***	13.594***	13.298***
	(6.055)	(4.380)	(5.116)	(4.297)
Obs.	684	684	708	708
R^2	0.122	0.095	0.155	0.061

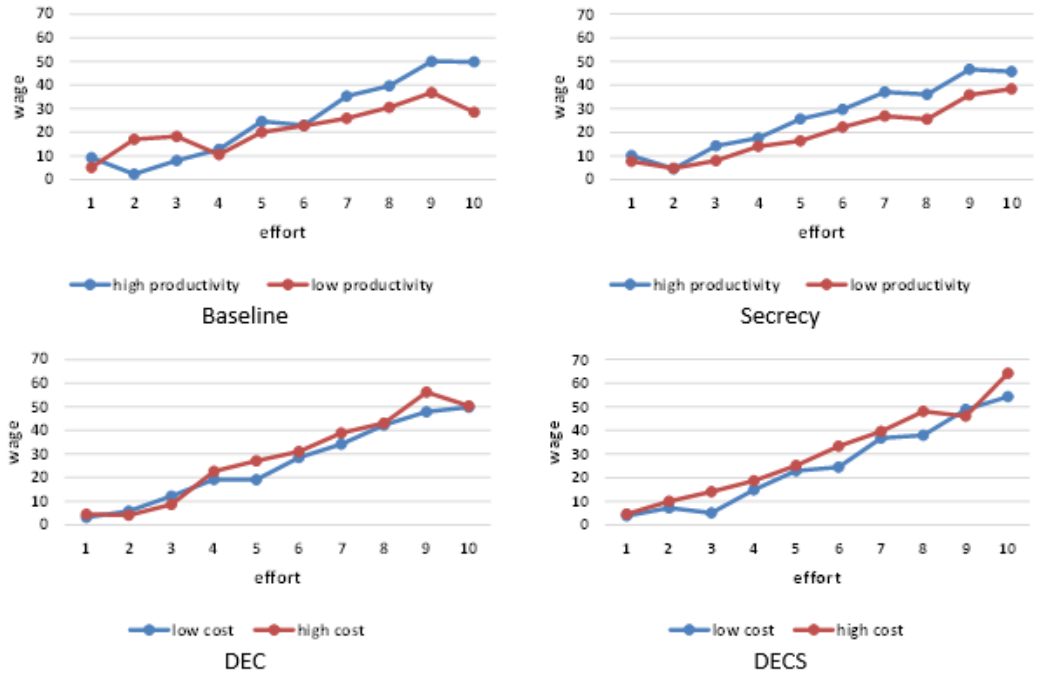
Table 10: Income regressions. GLS regressions with robust standard errors, clustered by matching group. Significance at the 10%, 5% and 1% level is denoted by *, **, and ***, respectively.

Result 2: *(Do managers behave differently under secrecy?)*

In the Secrecy treatment the manager translates an increase in A's effort (and, hence, production) less strongly into a higher wage for B than in the Baseline.

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.[21] Notice again the difference between high productivity and low productivity wages in Baseline and Secrecy treatments. 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.



4.2 Egalitarianism, effort cost equity versus production equity: disaggregated data.

In this section we first present a descriptive analysis about which equity principles are compatible with managers' decisions in the different treatments: egalitarianism, effort cost equity or production equity). Second, we show regression results which speak to the relative importance of the two equity principles in the different treatments.

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

Table 11 shows how differences in production and effort cost levels between A and B relate to wage differences between A and B. The three subtables correspond to whether the wage of A is larger than, smaller than or equal to that of B, with overall frequencies of 52.16 %, 31.03 % and 16.81 %. In the very first column we can see the frequency of the different wage régimes across treatments, where the percentages have to be added up for each treatment over the three subtables.[22] Similarly, the percentages in the body of the table add up across all three subtables.

The disaggregated information contained in the table helps us to see 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.

[22] For example, for the Baseline treatment, we add up 62.5%, 27.38% and 10.12%.

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%

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 11: 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.

Model	1	2	3	4	5	6
Dependent variable	Wage A - Wage B	Wage A – Wage B	Wage A - Wage B	Wage A- Wage B	Wage A – Wage B	Wage A - Wage B
Prod_diff	.355***	.408***	-	-	.86	.272***
	(.029)	(.038)			(.054)	(.049)
Cost_diff	-	-	1.802***	1.533***	1.415***	.569***
			(.134)	(.127)	(.271)	(.111)
Secrecy	.532	-1.061	.196	-1.362	.266	-1.224
	(2.544)	(1.777)	(2.527)	(1.812)	(2.524)	(1.754)
Period	.298	-.122	.455	.123	.418	-.022***
	(.288)	(.194)	(.291)	(.199)	(.298)	(.186)
Constant	10.276***	-2.485	5.056***	11.362***	1.314***	2.404
	(2.440)	(1.516)	(2.548)	(1.677)	(2.835)	(1.806)
Obs.	684	708	684	708	684	708
R^2	0.402	0.596	0.432	0.568	0.437	0.608

Table 12: Wage differences. GLS regressions with robust standard errors, clustered by matching group. Significance at the 10%, 5% and 1% level is denoted by *, **, and ***, respectively.

Table 12 shows regressions of wage differences on production differences and effort-cost differences. Models (1), (3) and (5) pertain to the data of the Baseline and Secrecy treatments, whereas models (2), (4) and (6) pertain to the data from the other two treatments. In models (1) and (2) ((3) and (4)) one can see the separate incidence of production equity (effort-cost equity) and in models (5) and (6) we look at the joint incidence of both equity principles.

In the first four models one can see that separately the equity principles have highly significant positive effects. The effect of production equity is numerically slightly higher in the DEC and DECS treatments, whereas that of cost-effort equity is numerically slightly higher in the Baseline and Secrecy treatments. In models (5) and (6) the coefficients are larger than the ones for production cost equity. Indeed the results of Wald tests allow us to reject equality of the coefficients for both (5) and (6), with p-values of .000.[23]

We can summarize the above discussion in the following result:

Result 3: *(What is the link between managers' behavior and 'production equity, 'effort-cost equity' and egalitarianism?)*

i) Overall, production equity and effort cost equity are used to the same extent in all treatments.

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

iii) The effects of effort-cost equity is somewhat stronger than that of production-equity.

5. Summary and Conclusions

In this paper, we study the interaction between a manager and two workers when the workers have different productivities or cost of effort. 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.

[23] Note that the ratios of the coefficients amount to 38% and 32% respectively, close to the 1/3 of additional preoduction translating into additional compensation that we found in the inspection of Table 6.

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. We only find a small effect of information about others' behavior. In the case where the two workers have the same productivities, managers translate higher effort and production by A less strongly into a higher wage by B under secrecy than in the absence of it, but these effects are not significant.

In all treatments managers' behavior is quite heterogeneous with respect to how much they keep for themselves, ranging from complete selfishness (when the manager keeps all the money produced by the workers) to complete equality. The relative wage of A and B does not seem to depend on the amount of money the manager keeps for herself. In other words, vertical and horizontal distributions 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 role.

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.

This paper helps to better understand how managers take wage allocation decisions when they have complete information about workers with different characteristics. This is the case of discretionary bonuses, where the managers decide how much to pay to a given worker after knowing the total production of the worker.

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.

Dana, J., Weber, R.A. and Kuang, J.X. (2007). Exploiting moral wiggle room: experiments demonstrating and illusory preference for fairness. Economic Theory, 33: 67-80.

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.

Gill, D. and Prowse, V. (2019). Measuring costly effort using the slider task. Journal of Behavioral and Experimental Finance, 21: 1-9.

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.

Milkovich, T., Newman M., and Gerhart B. (2011). Compensation; revision 10.

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

Mirrlees, J. A. (1972). On producer taxation. The Review of Economic Studies, 39(1): 105-111.

Nosenzo, D. (2013). Pay secrecy and effort provision. Economic Inquiry, 51(3): 1779-1794.

Rabin M. (1993). Incorporating fairness into game theory and economics. The American economic review, 1281-1302.

Rodriguez-Lara, I. (2016). Equity and bargaining power in ultimatum games. Journal of Economic Behavior & Organization, 130: 144-165.

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

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:

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

In the first two treatments, the largest component of the sums (40.77% and 41.09%) is the one corresponding 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).

Baseline:

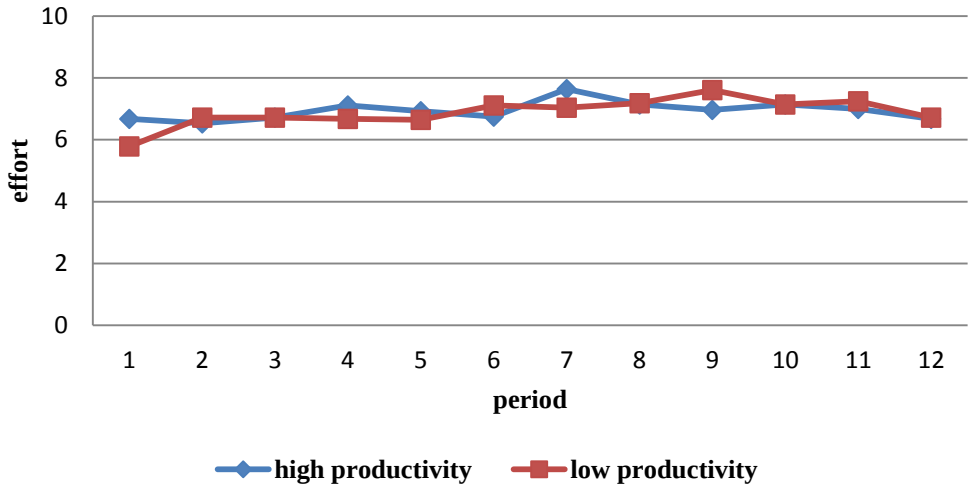


Figure B.1: average effort by period (Baseline).

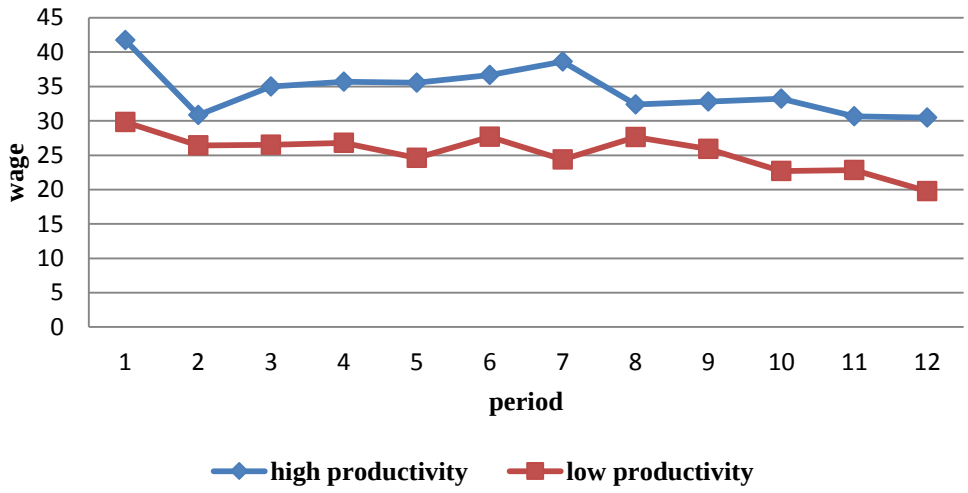


Figure B.2: average wage by period (Baseline).

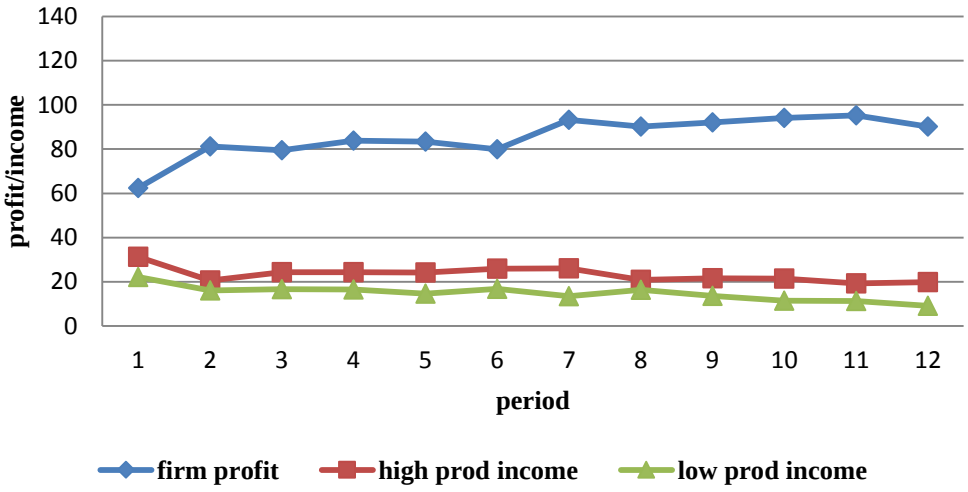


Figure B.3: average firm's profit and workers' income by period (Baseline).

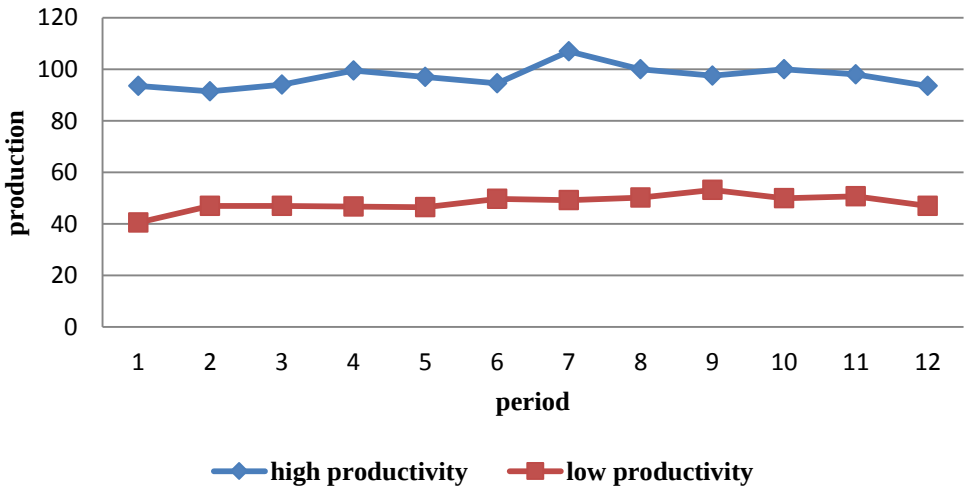


Figure B.4: average production by period (Baseline).

Secrecy:

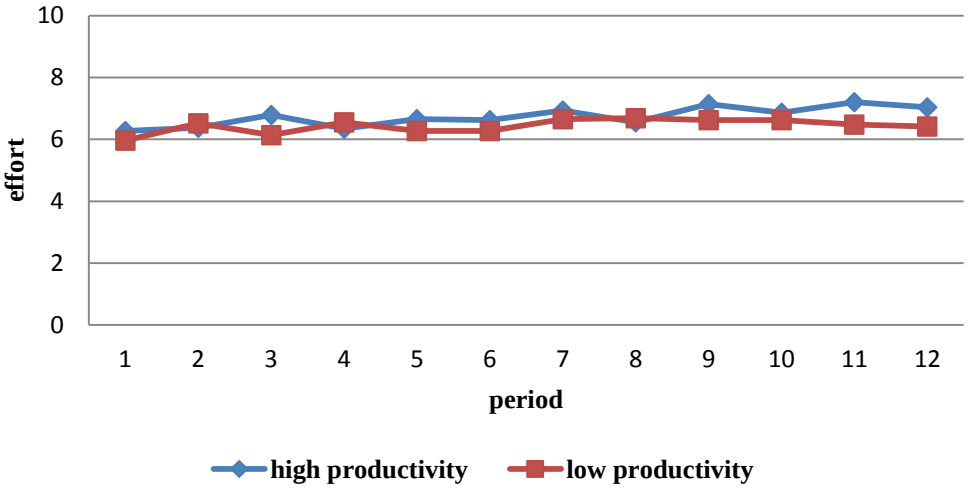


Figure B.5: average effort by period (Secrecy).

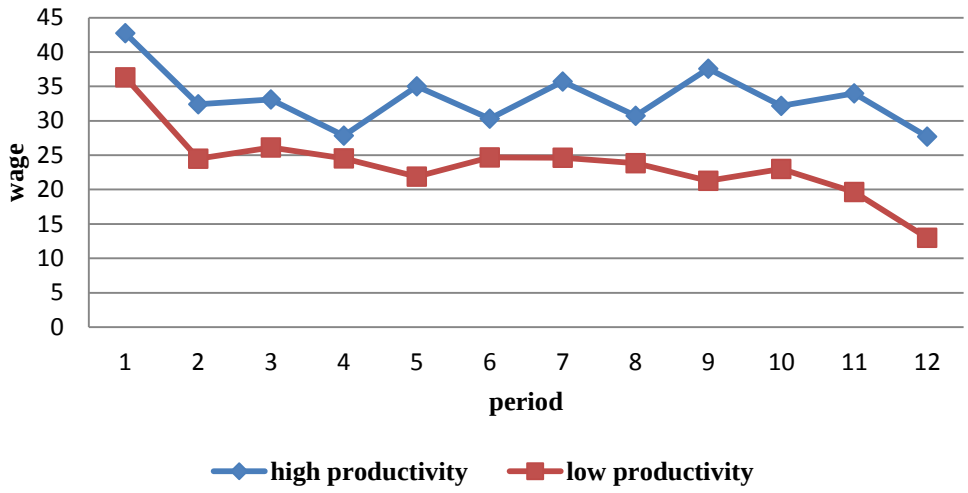


Figure B.6: average wage by period (Secrecy).

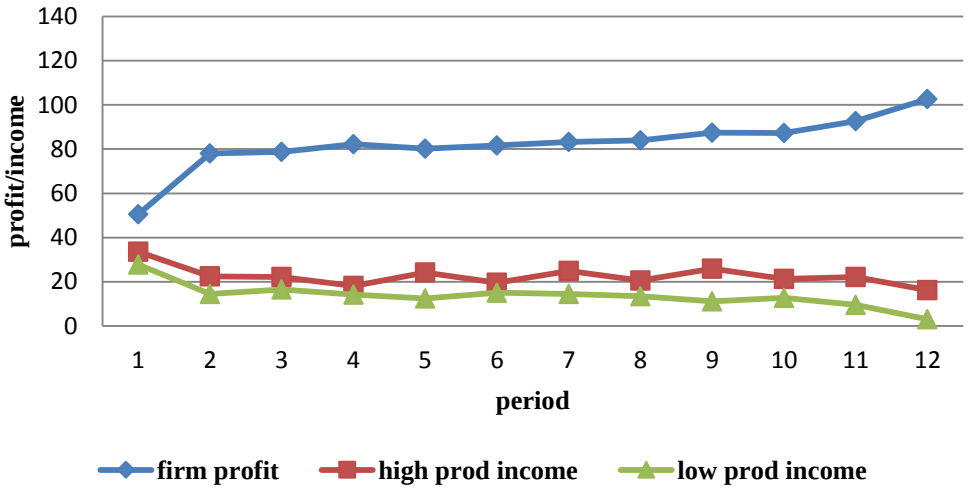


Figure B.7: average firm's profit and workers' income by period (Secrecy).

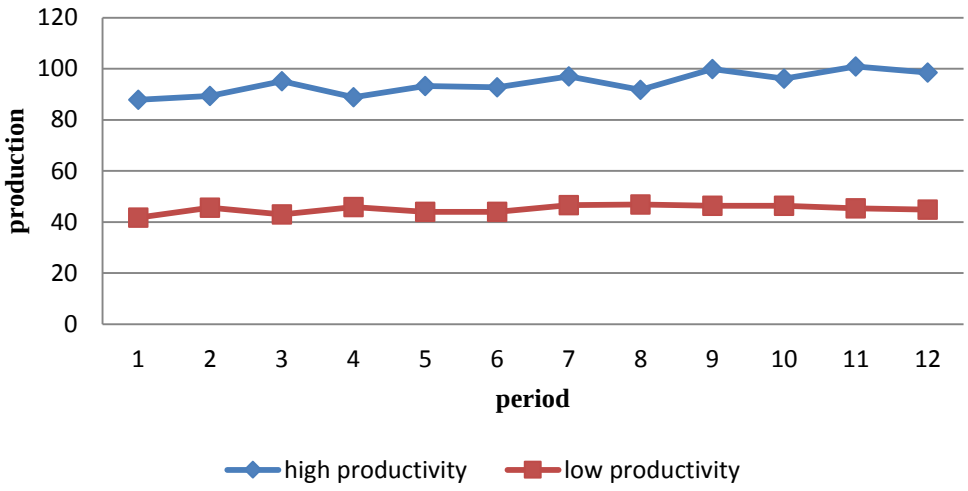


Figure B.8: average production by period (Secrecy).

DEC:

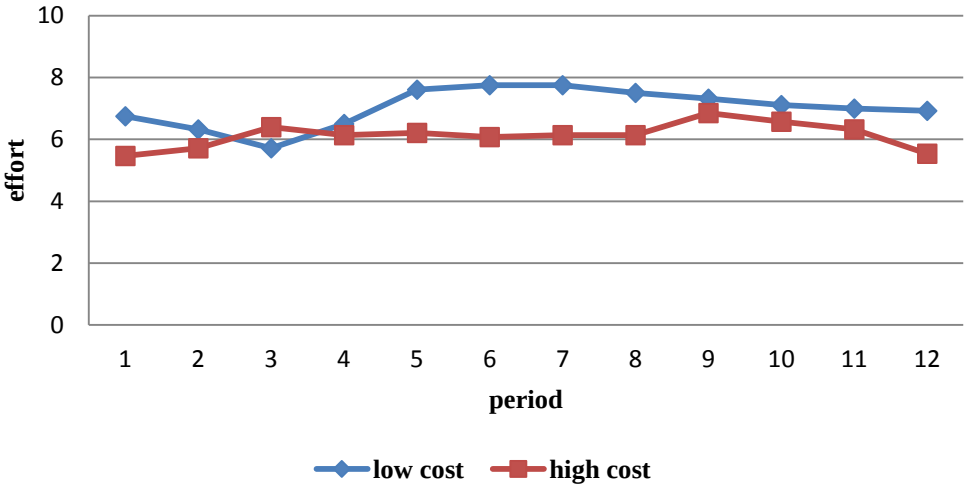


Figure B.9: average effort by period (DEC).

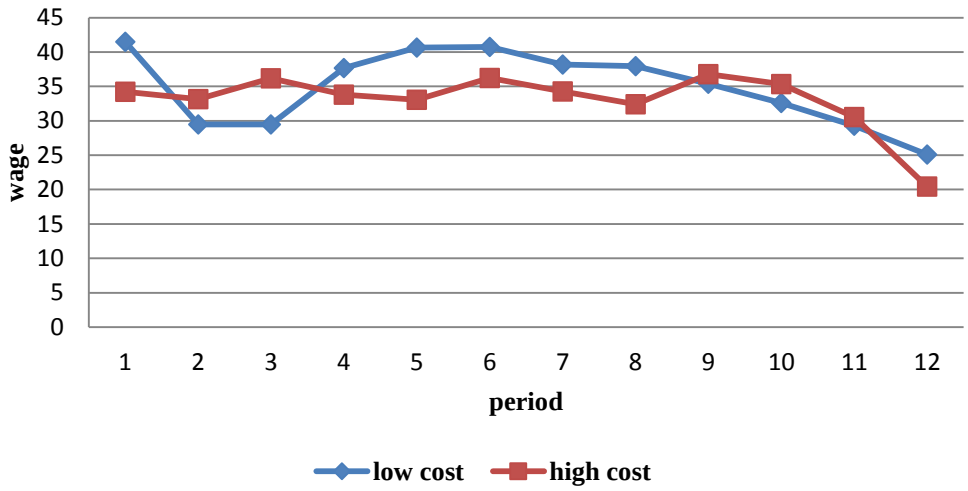


Figure B.10: average wage by period (DEC).

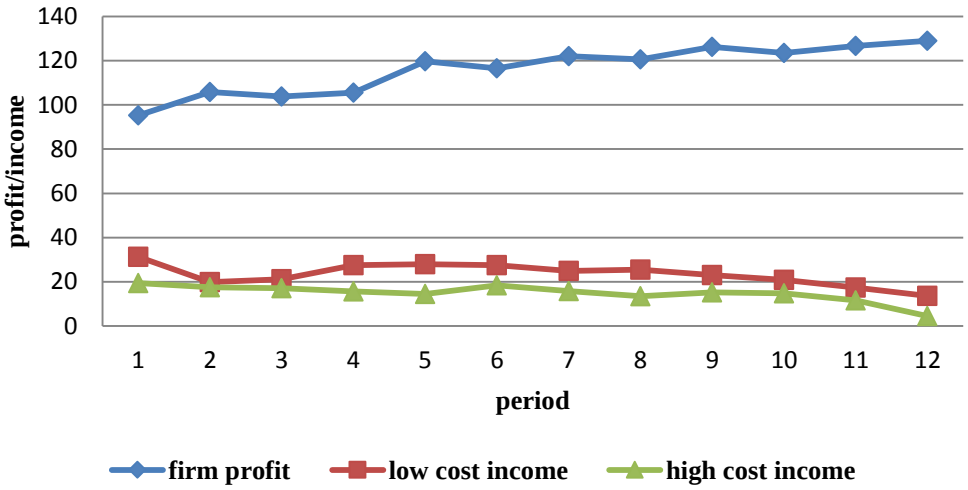


Figure B.11: average firm's profit and workers' income by period (DEC).

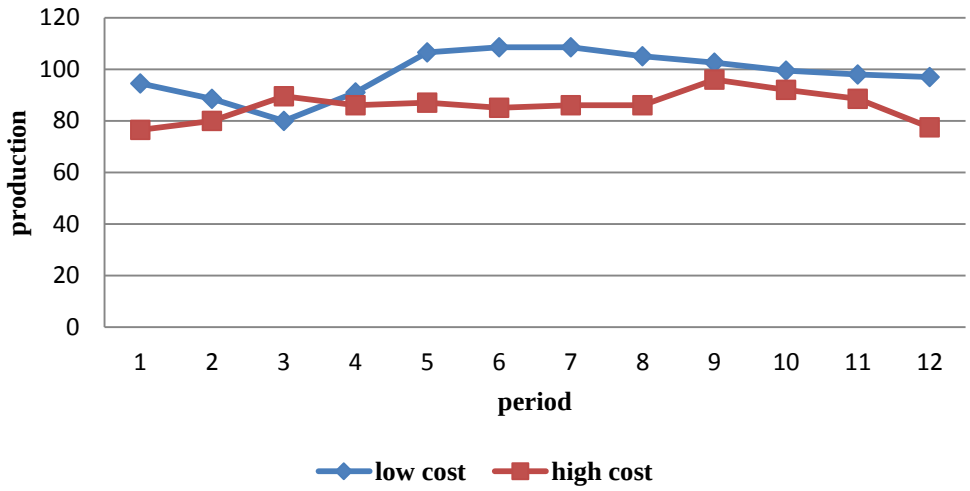


Figure B.12: average production by period (DEC).

DECS:

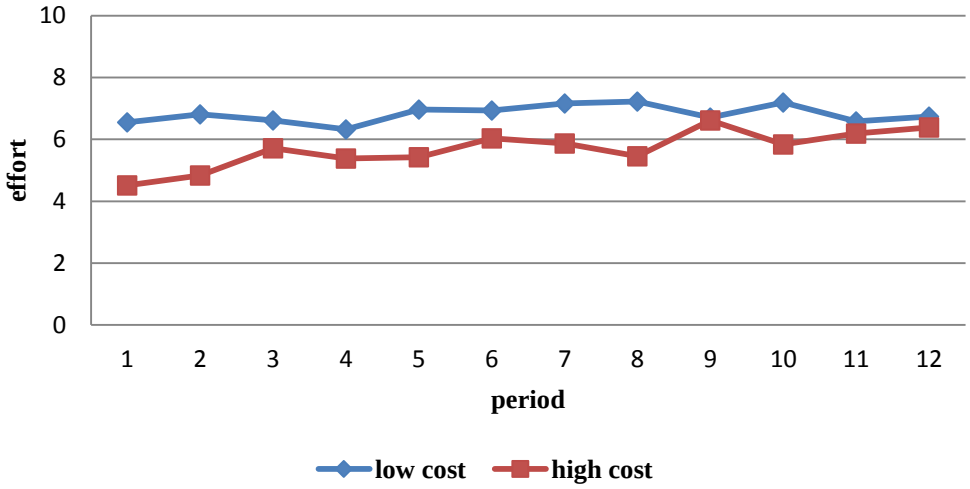


Figure B.13: average effort by period (DECS).

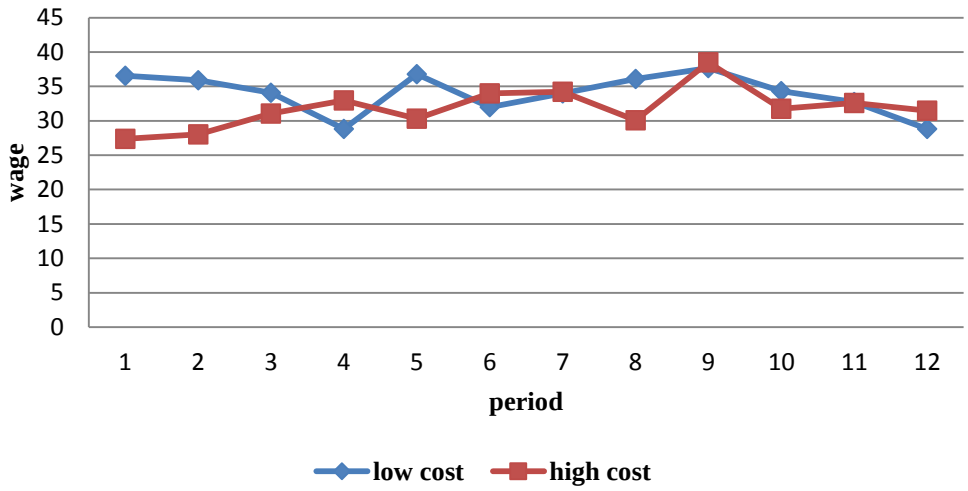


Figure B.14: average wage by period (DECS).

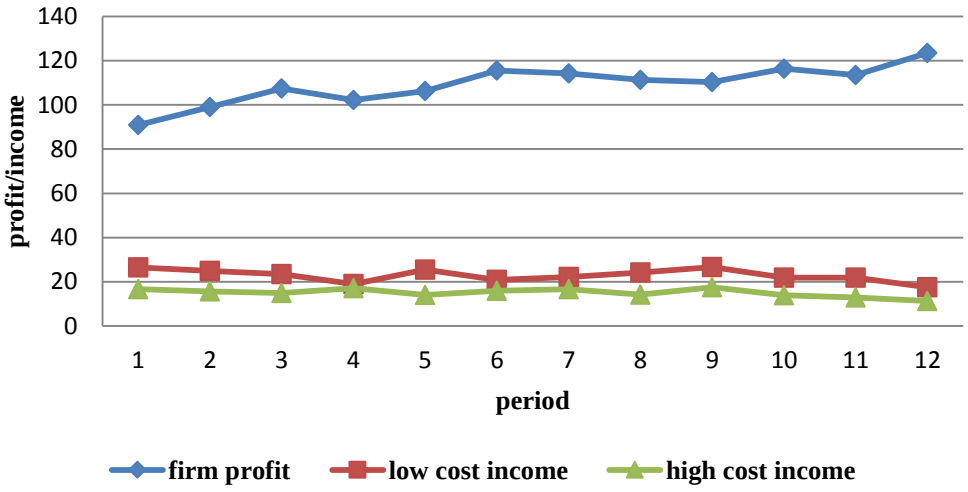


Figure B.15: average firm's profit and workers' income by period (DECS).

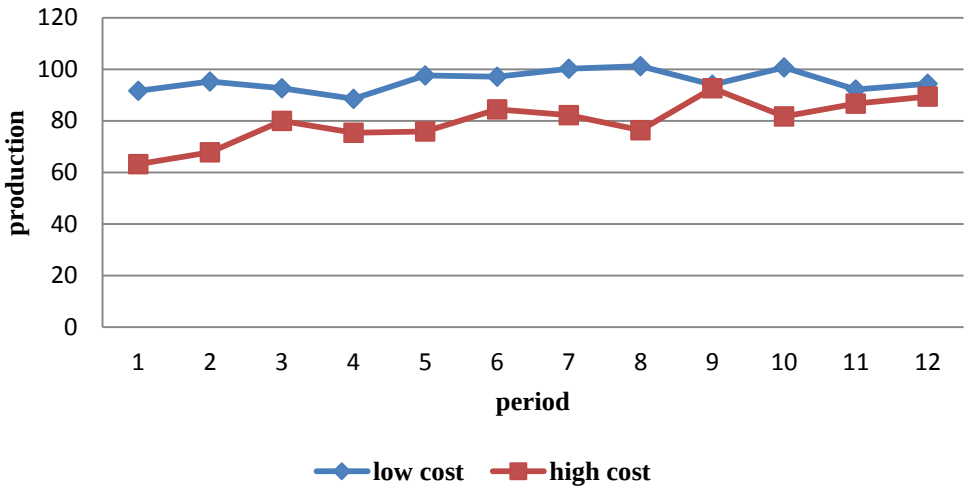


Figure B.16: average production by period (DECS).

Model	1	2	3	4
Dependent variable	W_A	W_B	W_A	W_B
CostEffortA	1.967***	.124*	2.311***	.119
	(.164)	(.070)	(.197)	(.092)
CostEffortB	-.321***	1.402***	-.090*	1.297***
	(.107)	(.138)	(.048)	(.109)
Secrecy	-.515	-.784	-.214	.720
	(3.854)	(3.016)	(4.848)	(4.427)
Period	-.677**	-1.114***	-.794***	-.728***
	(.284)	(.184)	(.233)	(.210)
Constant	20.286***	16.416***	15.084***	12.727***
	(3.397)	(2.456)	(3.746)	(3.453)
Obs.	684	684	708	708
R^2	0.289	0.248	0.327	0.374

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

Model	1	2	3	4
Dependent variable	π_A	π_B	π_A	π_B
CostEffortA	.967***	.124*	1.311***	.119
	(.164)	(.170)	(.197)	(.092)
CostEffortB	-.321***	.402***	-.090*	.297***
	(.107)	(.138)	(.048)	(.109)
Secrecy	-.551	-.784	-.214	.720
	(3.854)	(3.017)	(4.848)	(4.427)
Period	-.677**	-1.114***	-.794***	-.727***
	(.284)	(.184)	(.233)	(.210)
Constant	20.286***	16.416***	15.084***	12.727***
	(3.397)	(2.456)	(3.746)	(3.453)
Obs.	684	684	708	708
R^2	0.108	0.082	0.151	0.064

Table B.2: 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.

Model	1	2	3	4
Dependent variable	W_A	W_B	W_A	W_B
CostEffortA	2.119***	.280***	2.128***	-.038
	(.236)	(.097)	(.310)	(.138)
CostEffortB	-.470**	1.235***	-.162*	1.205***
	(.185)	(.198)	(.083)	(.168)
Secrecy	.067	-.426	-5.877	-4.992
	(4.550)	(3.478)	(4.105)	(3.631)
Secrecy*CostEffortA	-.289	-.297**	.324	.268
	(.239)	(.133)	(.402)	(.180)
Secrecy*CostEffortB	.251	.281	.112	.151
	(.285)	(.269)	(.104)	(.218)
Period	-.657**	-1.092***	-.788***	-.727***
	(.285)	(.178)	(.233)	(.208)
Constant	20.040***	16.304	18.464***	16.204
	(4.057)	(2.958)	(3.863)	(3.139)
Obs.	684	684	708	708
R^2	0.294	0.255	0.328	0.374

Table B.3: Wage regressions. GLS regressions with robust standard errors, clustered by matching group. Significance at the 10%, 5% and 1% level is denoted by *, **, and ***, respectively.

Model	1	2	3	4
Dependent variable	π_A	π_B	π_A	π_B
CostEffortA	1.119***	.280***	1.128***	-.038
	(.236)	(.097)	(.310)	(.138)
CostEffortB	-.470**	.235	-.162*	.205
	(.185)	(.198)	(.083)	(.168)
Secrecy	.067	-.426	-5.877	-4.992
	(4.550)	(3.478)	(4.105)	(3.631)
Secrecy*CostEffortA	-.289	-.297**	.324	.268
	(.325)	(.133)	(.402)	(.180)
Secrecy*CostEffortB	.251	.281	.112	.150
	(.239)	(.269)	(.104)	(.218)
Period	-.657**	-1.092***	-.788***	-.727***
	(.285)	(.178)	(.233)	(.208)
Constant	20.040***	16.304***	18.464***	16.204***
	(4.057)	(2.958)	(3.863)	(3.139)
Obs.	684	684	708	708
R^2	0.114	0.091	0.151	0.056

Table B.4: 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.