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PAY SECRECY AND EFFORT PROVISION

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Abstract:

Pay secrecy is often justified on the ground of concerns about the detrimental consequences of intra-firm pay comparisons for work morale and performance. Surprisingly, however, there is only limited empirical evidence that the availability of pay comparison information is detrimental for effort provision. In this paper we study pay comparison effects in a gift-exchange game laboratory experiment where an employer is matched with two symmetric employees. We compare effort choices made by employees in a 'pay secrecy' treatment and in two 'public wages' treatments where employees are informed of the wage paid to the co-worker. In one 'public wages' treatments the employer can choose both wages she pays to the employees, while in the other treatment the wage paid to one employee is regulated exogenously. We show that pay disclosure can be detrimental for effort provision if employees are treated unequally.

Keywords: pay secrecy; pay comparisons; wage inequality; gift-exchange; experiment.

JEL: A13, C92, J31.

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I. INTRODUCTION

Pay secrecy norms are widespread in many organizations. A survey of 2700 US employees conducted in autumn 2010 found that almost 1 out of 2 employees face limitations to the extent to which they can access information about other employees' compensation.[1] Similarly, a recent survey of US employers found that over one third of private sector organizations have in place formal rules prohibiting employees to discuss their pay with co-workers (reported in Gely and Bierman, 2003). A common argument used to justify the adoption of pay secrecy is that it helps minimize the negative effects arising when employees compare their pay with the pay of their co-workers (Colella et al., 2007).[2] Pay comparisons are in fact thought to be a key factor in employees' judgments of the fairness of their pay (e.g., Akerlof and Yellen, 1990). Discovering the existence of pay differentials between oneself and co-workers who are in comparable positions within the firm may spur perceptions of unfairness and reduce job satisfaction (Card et al., *forthcoming*). This may ultimately lead to reduced work morale and lower effort. Whereas this conjecture finds considerable support among managers and compensation executives (e.g., Agell and Lundborg, 1995; Campbell III and Kamlani, 1997; Bewley, 1999), there is limited direct evidence that the availability of pay comparison information has detrimental effects on effort behavior.[3] In this paper we use laboratory experiments to provide a controlled test of this proposition.

The experiments reported in this paper are based on a multilateral version of the gift-exchange game (Fehr et al., 1993). In the standard bilateral gift-exchange game a first-mover (the 'employer') decides on the size of the gift ('wage') she sends to a second-mover (the 'employee'), who can in turn reciprocate by choosing costly actions ('effort') that reward the first-mover. A typical result of bilateral gift-exchange game experiments is that employees are often willing to incur costs in order to reward employers who have treated them favorably (for reviews of the experimental literature see Fehr et al., 2009 and Charness and Kuhn, 2011). In the multilateral version of the game used in this study, described in detail in Section II, the employer interacts with two employees at the same time, and pays a wage to each of them. Employees receive their wage and then independently choose an effort level. We observe effort choices in three different conditions. In a first condition employees only learn

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[1] Source: Survey of Economic Security (2010) conducted by the Institute for Women's Policy Research (http://www.iwpr.org/press-room/press-releases/pay-secrecy-and-paycheck-fairness-new-data-shows-pay-transparency-needed).

[2] Danziger and Katz (1997) discuss an alternative reason why firms may benefit from discouraging employees to discuss their salaries. In their model, pay secrecy reduces the ability of employees to locate other higher-wage firms in the market, thus reducing labor mobility and making risk-shifting contracts feasible.

[3] In fact, some studies argue that the *lack* of pay comparison information may be detrimental: pay secrecy may actually lead employees to suspect that they are treated unfairly and thus damage morale (e.g., Lawler, 1967).

their own wage while co-workers' wages remain undisclosed. We use this benchmark condition to assess how employees respond to given levels of the own wage under a wage secrecy regime. In two other conditions we remove any limitation on the availability of information about other workers' wages: in these treatments employees are fully informed of the wage paid to co-workers when they choose effort. By comparing these 'public wages' treatments with the 'wage secrecy' treatment we can test whether the availability of pay comparison information is detrimental for effort provision.

The two 'public wages' treatments differ in how wages are determined. In one treatment the employer can choose the two wages she pays to the employees, while in the other treatment the wage paid to one employee is mandated exogenously by the experimenter. This allows to study the effect of pay comparisons in settings where the employer has full discretion on the firm's wage structure, as well as in settings where an employer's wage policy is partly constrained by exogenous labor market regulations. Such exogenous constraints to firms' wage policies are commonplace in natural workplaces (e.g., minimum wage laws, centralized pay regulations, etc.), and previous experiments have shown that they can affect pay fairness considerations and effort behavior in important ways.[4] Differently from previous studies, which either focused on bilateral labor relations or studied multilateral relations where workers received no information about the treatment of co-workers, in our experiment we study how employees' effort is influenced by labor market regulations that affect the wage of their co-workers. Thus, we can study how these regulations affect pay fairness considerations through horizontal pay comparisons.

In Section III we discuss behavioral considerations about potential treatment effects, and report the results of the experiment in Section IV. As in many other related gift-exchange game experiments, we observe a strong positive own wage-effort relation: employees reciprocate high wages with higher effort. Most importantly, our data support the proposition that the availability of pay comparison information can be detrimental for effort provision. Employees in the public wages treatments who are underpaid relative to the co-worker expend significantly less effort than employees in the wage secrecy treatment. In the treatment where one of the two wages is fixed exogenously, employees also react negatively to overpayment and expend lower effort even when wage inequality is to their advantage.

[4] For example, Falk et al. (2006) show that introducing a nonbinding wage guideline in a previously unregulated experimental labor market shifts employees' perceptions of what constitutes a fair wage and increases their reservation wages considerably. The effect is even stronger if the same wage level chosen for the wage guideline is set as a (binding) 'minimum wage'. On the impact of minimum wages on effort in gift-exchange games see also Brandts and Charness (2004) and Owens and Kagel (2010).

We discuss these results and the related literatures in Section V. Our study contributes to a small but growing literature that uses multi-worker gift-exchange game experiments to examine pay comparison effects (Güth et al., 2001; Charness and Kuhn, 2007; Gächter and Thöni, 2010; Bartling and von Siemens, 2011; Cohn et al., 2011; Angelova et al., 2012; Gächter et al., *forthcoming*).[5] Only few of these studies, however, have compared regimes with secret and public wages, and the results are mixed: in some cases the availability of information about co-workers' wages has been found to systematically affect effort (Angelova et al., 2012), whereas in other cases such effects are weak or absent (Güth et al, 2001; Charness and Kuhn, 2007). Differently from these studies, where employees either differed in their productivity or in the duration of their employment contract, employees in our experiment are *ex-ante* symmetric, and unequal pay may be perceived as decidedly unfair. Our findings show that when pay inequalities have clear-cut implications for pay fairness judgments, pay disclosure can have detrimental effects on effort provision.

II. EXPERIMENTAL DESIGN & PROCEDURES

A. The experimental game

The experiment is based on the following three-player game. At the outset of the game an Employer is endowed with £22 from which she pays a wage to two Employees, labeled RED and BLUE. The wages w_{RED} and w_{BLUE} can take three values: £1, £4 or £7. Employees are paid their wage and then select simultaneously an effort level $e_{i\in\{RED,BLUE\}}$ among three possible levels: low (-1), medium (0) or high (+1). Low effort costs an employee £1 and reduces the Employer's earnings by £4. Medium effort is costless and does not affect the Employer's earnings. High effort costs an employee £1 and increases the Employer's earnings by £4. Note that this effort technology, which is also used by Charness and Levine (2007), allows both rewarding (when employees choose high effort) and punishment (when employees choose low effort) of fair/unfair wage offers. This is different from the effort technology usually adopted in gift-exchange games where employees can only decide whether or not to reward the Employer, and allows fairness considerations to affect behavior through both positive and negative reciprocity. Also note that employees are *ex ante* symmetric as they do not differ in their productivity when the Employer sets the wages. After

[5] Maximiano et al. (2007) also study a multi-worker gift-exchange game. However, in their experiment all employees are paid the same wage by design.

employees have chosen their efforts the game ends and earnings (in UK Pounds) are computed as:

$$\pi_{ER} = 22 + 4 \cdot (e_{RED} + e_{BLUE}) - w_{RED} - w_{BLUE} \quad \text{and} \quad \pi_i = w_i - (e_i)^2$$

for the Employer and for Employee $i \in \{RED, BLUE\}$, respectively.

In the experiment subjects played a one-shot version of the game. The game was described using a labor market framing, and was implemented using the strategy method (Selten, 1967), i.e. subjects had to specify complete strategies in the game-theoretic sense.

B. The treatments

The experimental game was implemented in three different treatments which vary along two dimensions. The first dimension is whether wages are public (both employees learn both wages before making an effort choice) or secret (each employee learns only her own wage). The second dimension is whether the Employer can choose *both* wages she pays to the employees, or whether she can instead choose only *one* wage, while the other wage is fixed exogenously. In the experiment subjects were assigned to treatments randomly in a between-subjects design. Table 1 provides an overview of the treatments used in the experiment.

TABLE 1. Overview of treatments

Wages	both determined by the Employer	one determined exogenously
public	*PUBLIC*	*PUBLIC / EXO* £1 *PUBLIC / EXO* £7
private	*SECRET*	-

In the SECRET treatment the Employer chooses a wage for the RED Employee and a wage for the BLUE Employee. Each employee learns her own wage but is not informed of the wage that the Employer chooses for the co-worker: thus, co-workers' wages are *secret*.

In the PUBLIC treatment wages are also determined by the Employer, but they are *public* information and employees are informed of both wages before they choose effort.

In the PUBLIC/EXO treatment wages are also *public* information, but the Employer chooses only one of the two wages she pays to the employees, namely the wage for the BLUE Employee. The wage for the RED Employee is instead determined *exogenously* by the experimenter. We conducted two versions of the PUBLIC/EXO treatment where the RED Employee's wage was either fixed equal to £1 (PUBLIC/EXO £1 sessions) or equal to £7 (PUBLIC/EXO £7 sessions). The level of the RED wage was mandated using a neutral

language: in the instructions (reproduced in Appendix A) subjects were simply told that "*the Employer **must** pay a £1* [£7 in PUBLIC/EXO £7] *wage to the Red Employee, while he/she can decide on what wage (£1, £4 or £7) to pay to the Blue Employee.*" (emphasis in original).

C. Discussion of the design

In our experiment we study how the availability of information about co-workers' wages affects effort behavior in a setting where employees are *ex ante* symmetric in that they do not differ in their productivity. The advantage of this setup is that pay differentials between employees have a more straightforward interpretation in terms of pay fairness than in previous studies with asymmetric employees (Charness and Kuhn, 2007; Angelova et al., 2012). One may argue that the absence of productivity differences between employees might limit the potential for observing pay differentials in the experiment. While productivity differences constitute an important rationale for paying unequal wages, there are other reasons why employers may want to introduce pay differentials between employees. For example, employers may speculate that employees will only work harder if paid more than a co-worker. Moreover, we also note that unequal wages have been chosen relatively frequently in previous gift-exchange game experiments with symmetric employees (see, e.g., Gächter and Thöni, 2010; Gächter et al, *forthcoming*).

In the PUBLIC/EXO treatment employers can only choose the wage for one employee, whereas the other wage is mandated exogenously. We use this treatment to study reactions to pay comparisons in environments where the wage of a portion of the workforce is regulated by external labor market institutions. Note that, because employees are *ex ante* symmetric in our experiment, in PUBLIC/EXO we study a setting where the portion of the workforce whose wage is not exogenously regulated has similar characteristics to the portion of the workforce whose wage is regulated. This may, for example, be the case when a firm's workforce is composed of a mixture of public and private sector employees, the former being paid a centrally regulated wage and the latter being employed at the market wage.[6]

Pay comparison effects in PUBLIC/EXO are studied focusing on two 'extreme' levels of the co-worker's wage, £1 and £7. These seem the most attractive cases to isolate pay

[6] For example, Van Reenen and Propper (2010) discuss the case of the UK National Health Service, relying both on 'permanent' public sector nurses, whose wages are regulated at the national level, and 'agency' nurses with non-regulated wages. The existence of separate pay negotiations for employees working at similar jobs across different civil service departments may also give rise to situations of 'exogenous' pay comparisons: for example, in 2005 employees at the UK Department for Environment, Food and Rural Affairs (DEFRA) took industrial action over pay gaps resulting from separate pay negotiations for DEFRA employees and employees at its associated agencies (see, e.g., http://news.bbc.co.uk/1/hi/uk/4363684.stm).

comparison effects: it appears in fact unlikely that we would observe any effect of moderate amounts of wage inequality had we failed to observe reactions to larger amounts.

We are interested in observing how employees choose effort across situations that differ in the wage they receive and, in PUBLIC and PUBLIC/EXO, in the wage paid to the co-worker. In order to study how an employee behaves in different situations one could have subjects play repeatedly the experimental game using the direct response method. However, repeated play of the experimental game may introduce strategic confounds as well as confounds related to learning effects as behavior in different situations is necessarily observed at different times during the experiment. Moreover, repetition of the task does not guarantee the collection of a sufficient number of observations for all information sets in the game. To avoid these drawbacks, we use the strategy method to identify pay comparison effects. In principle, eliciting choices using the strategy method may produce different results than using the direct response method. In fact, most of the experimental literature directly comparing choices elicited with the strategy method and the direct response method find that the two elicitation methods do not lead to qualitatively different results (Brandts and Charness, 2011). Gächter and Thöni (2010) and Gächter et al. (2012) investigate this issue specifically in the context of trilateral gift-exchange game experiments and show that the two elicitation methods produce consistent results.

Note that the number of effort decisions that employees have to submit with the strategy method depends on the treatment they are playing, as they control a different number of information sets in different treatments. In PUBLIC employees control nine information sets, one for each wage combination that may be chosen by the Employer: thus, we collect nine effort choices from RED and BLUE Employees in the PUBLIC treatment. In PUBLIC/EXO the RED Employee's wage is exogenously fixed at either £1 or £7 depending on which version of the treatment is implemented. Thus, only three wage combinations are actually feasible, and vary in the wage the Employer chooses for the BLUE Employee. Thus, we collect three effort choices from BLUE and RED Employees in our two versions of the PUBLIC/EXO treatment. Lastly, because in SECRET employees only learn their own wage and not the co-worker's wage, they control three information sets corresponding to the three wage levels that could possibly be paid to them by the Employer. Thus, we collect three effort choices from employees in the SECRET treatment.

In the instructions the trilateral gift-exchange game was described to subjects using a labor market framing. The most common instruction framings used in laboratory gift-exchange game experiments are the labor market framing used here and the 'buyer-seller'

framing (e.g., Fehr et al., 1993), whereby buyers (employers) first choose product prices and sellers (workers) then choose product quality. Both frames are 'non-neutral', although the 'buyer-seller' frame is conceivably more 'neutral' relative to our research question. On the other hand, the labor market framing is more 'natural' as it matches more closely the environment under study. Although it is ultimately an empirical question whether or not instruction framing matters in the gift-exchange game, it should be noted that previous studies have documented pay comparison effects using both the 'buyer-seller' frame (e.g., Gächter and Thöni, 2010) and the labor market frame (e.g., Angelova et al., 2012). Moreover, Abbink and Hennig-Schmidt (2006) compare the effects of 'neutral' and 'loaded' instructions in a related 'reciprocity game' (the bribery game), and find that instruction framing has little impact on choice behavior.

D. Experimental procedures

The experiment was conducted at the University of Nottingham using the software z-Tree (Fischbacher, 2007). Subjects were students from a range of disciplines recruited through the online recruitment system ORSEE (Greiner, 2004). Twelve sessions with a total of 180 participants were conducted: we had 30 subjects participate in two sessions of the PUBLIC treatment, 30 subjects participate in two sessions of the SECRET treatment, and 120 subjects participate in eight sessions of the PUBLIC/EXO treatment, equally divided between its two versions, PUBLIC/EXO £1 and PUBLIC/EXO £7. No subject took part in more than one session. The average age of participants was 20.7 years, and 52% of them were male.

All sessions used an identical protocol. Upon arrival, subjects were randomly seated at visually separated computer terminals and given a written set of instructions that the experimenter read aloud. Subjects were also given a set of Earnings Distributions tables (reproduced in Appendix B for the PUBLIC treatment) showing the Employer's and Employees' earnings for all possible combinations of efforts and wages. Subjects were then randomly assigned to a group and a role (Employer, RED Employee or BLUE Employee), and had to solve a set of control questions to corroborate their understanding of the experimental game. Subjects had to answer all questions correctly before the experiment could continue. The decision-making phase of the session consisted of a one-shot play of the relevant experimental game. All decisions were made anonymously as subjects could not learn the identity of the other people in the room they were matched with.

At the end of the experiment subjects completed a post-experimental questionnaire. Subjects were then privately paid a £3 show-up fee plus their earnings from the experimental

game. Subject earnings, inclusive of the show-up fee, ranged from £3 to £27, with an average of £10.12 and a standard deviation of £6.95. Sessions lasted about 50 minutes on average.

III. BEHAVIORAL PREDICTIONS

In the one-shot gift-exchange game used in the experiment a rational Employee who only cares about maximizing her own material payoff will choose medium effort, which minimizes effort costs, regardless of the wages paid by the Employer. Anticipating this, a rational and selfish Employer will offer employees the lowest possible wage in order to minimize wage costs. Thus, both in SECRET and PUBLIC low wages and medium efforts emerge in the subgame perfect equilibrium. In PUBLIC/EXO the Employer must pay an exogenously determined wage (either low or high) to the RED Employee, but she will always choose a low wage for the BLUE Employee. Both employees will choose medium wage in the subgame perfect equilibrium. Note that, according to standard predictions, pay comparison information has no effect on effort choices. Employees choose the effort level that minimizes effort costs regardless of the wage paid to the co-worker and regardless of whether this information is available (PUBLIC and PUBLIC/EXO treatments) or not (SECRET treatment).

Previous experiments with the gift-exchange game have found that, contrary to standard predictions, wages and efforts typically exceed the cost-minimizing levels. In particular, the experimental evidence points to the existence of a positive own wage-effort relation: the more generous the wage offered by the employer, the higher the effort employees are willing to expend, even in one-shot interactions where there are no future gains associated with reciprocal behavior (see, e.g., Fehr et al., 2009). These findings are typically interpreted as supportive of Akerlof and Yellen's (1990) fair wage-effort hypothesis whereby employees' effort depends positively on the perceived fairness of their pay. The existence of fairness concerns introduces the potential for treatment differences in effort provision because what constitutes a 'fair pay' may not only depend on considerations about the absolute level of the own wage, but also on *relative* pay considerations. In particular, to determine how fairly they are being treated by the employer, employees may compare their pay with the pay of their co-workers, when this information is available. Observing salary differences between oneself and other employees who perform comparable work in the firm may lead employees to

believe that wages have been set unfairly by the employer, and this will reduce their willingness to expend costly effort, ceteris paribus.[7]

In our SECRET treatment employees are not informed about the wage that the employer pays to the co-worker. Thus, pay fairness judgments in this treatment cannot be directly based on relative pay comparisons, and must instead rely on considerations about the absolute level of the wage offered by the employer, as in standard bilateral gift-exchange games.[8] Thus, based on the evidence from previous gift-exchange game experiments, we expect to observe a positive own-wage effort relation in SECRET, whereby higher (fairer) wages are associated with higher effort (more rewarding and less punishment), whereas low (unfair) wages are reciprocated with low effort (less rewarding and more punishment).

In the PUBLIC treatment employees receive information about the wage paid to the co-worker before making an effort decision. Thus, relative pay considerations can influence pay fairness judgments (and effort) in this treatment. In particular, if employees care about 'horizontal' (i.e. employee-employee) pay equality and perceive as unfair wage configurations that entail disadvantageous or advantageous pay inequalities, we may expect to observe, ceteris paribus, lower effort (less rewarding, more punishment) when an employee is underpaid or overpaid relative to the co-worker than in the absence of relative pay information. Moreover, if employees are more sensitive to disadvantageous than advantageous inequalities (Loewenstein et al., 1989), we may expect to observe stronger reactions when employees are underpaid than overpaid relative to the co-worker.

In PUBLIC/EXO employees also receive information about co-worker's wages, but these are mandated exogenously. It is not clear a priori how this may affect effort choices. On the one hand, the fact that co-workers' wages are not determined by the employer in PUBLIC/EXO may reduce the scope for relative pay comparisons, as only wages actively chosen by employers may be considered as relevant for pay fairness attributions. Indeed, Gächter and Thöni (2010) find reduced pay comparison effects in their '*Non-intentional*' treatment where a random device chooses employees' wages on behalf of the employer. Nevertheless, note that, differently from Gächter and Thöni, employers in our PUBLIC/EXO treatment do have some discretion over wages as they can set the level of the BLUE wage: hence in our game the Employer *is responsible for any wage inequality within the firm*, as she

[7] Note that here we are focusing on pay equality as a criterion to assess pay fairness. However, in some circumstances employees may perceive equal pay as unfair (see, e.g., Abeler et al., 2010). We return to this point later in Section V.

[8] However, differently from standard bilateral gift-exchange games, fairness considerations in SECRET may also depend on employees' beliefs about the (unobservable) wages paid to the co-worker.

can always treat employees symmetrically if she wishes to do so. Moreover, the RED wages in PUBLIC/EXO are *not* determined by a random mechanism: they are fixed exogenously by the rules of the experiment, and employees may view the realization of a random process differently from an exogenous wage mandated by the experimenter.[9] In fact, similarly to how the introduction of an exogenous minimum wage shifted workers' perceptions of what is a fair wage in previous experimental studies (e.g., Falk et al., 2006), our exogenous intervention on RED wages may increase the prominence of co-workers' wages as a reference point for what constitute a fair wage in an experimental firm, and thus promote relative pay considerations.[10]

IV. RESULTS

A large fraction of Employers in our experiment chose to pay the lowest possible wages to the employees: 60% of the Employers in SECRET and 50% of the Employers in PUBLIC paid two £1 wages to their employees, while in PUBLIC/EXO 47% of the Employers chose to pay a £1 wage to the BLUE Employee. The Employers who were in SECRET and PUBLIC and chose at least one non-minimal wage, paid either one low wage and one medium wage (20% in each treatment), or two medium wages (20% in each treatment), or two high wages (only one Employer in PUBLIC). In the sessions of PUBLIC/EXO where the RED wage was fixed at £1 (£7), 55% (30%) of the Employers chose a £4 wage for BLUE, while 5% (15%) paid BLUE a £7 wage.

In the remainder of the section we examine employees' behavior in these wage combinations. In particular, we will compare the effort chosen by employees in the wage secrecy regime with effort in the public wages regimes. We start by comparing effort behavior across our SECRET and PUBLIC treatments. We then turn to a comparison of effort choices made in SECRET and PUBLIC/EXO. Because the focus of the study is on the impact of pay comparisons on own wage-effort reciprocal relations, only the effort decisions made by BLUE Employees are relevant to the analysis of effort in PUBLIC/EXO: since RED Employees' wage was set exogenously by the experimenter their effort responses cannot be interpreted as a form of reciprocation towards the employer, and we will therefore not use

[9] However, Charness (2004) find little difference between a treatment where wages are mandated by the experimenter and a treatment where wages are selected by a random device.

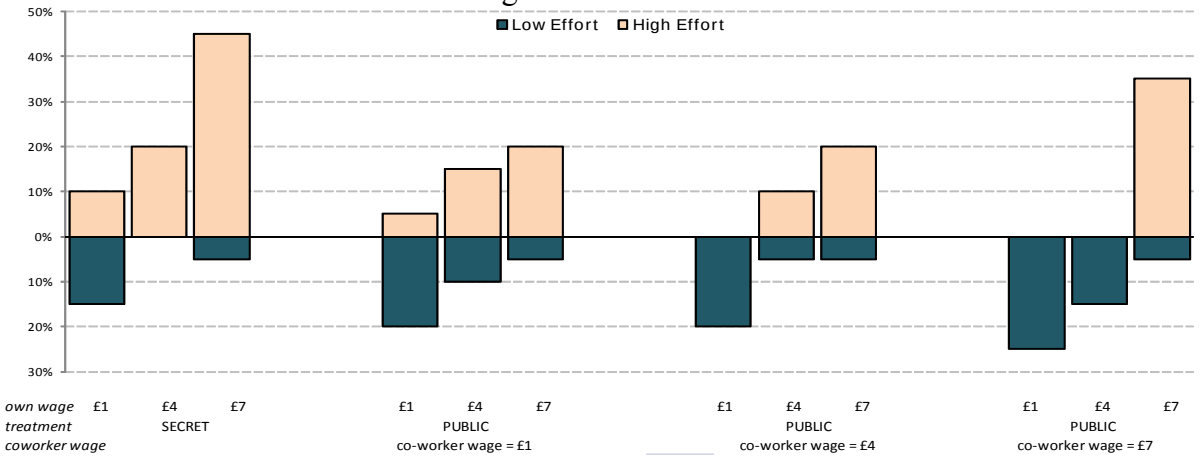
[10] This may be particularly true for settings where the exogenous constraints contain value-laden elements that may speak to workers' entitlements, as in the case of minimum wages or union-negotiated wage rates (see Gächter and Riedl, 2005 on the importance of entitlements for economic outcomes). On this respect, note that we opted for a conservative approach to mandate the RED wage levels in PUBLIC/EXO rather than for more value-laden interventions.

their responses in the following data analysis (RED Employees' effort in PUBLIC/EXO is analyzed in Appendix C).

A. SECRET vs. PUBLIC

Figure 1 reports the proportions of low effort choices (punishments) and high effort choices (rewards) made by employees in SECRET and PUBLIC for different levels of the own wage. In PUBLIC we also differentiate effort choices made when the co-worker's wage was low (£1), medium (£4) or high (£7). Effort rates for SECRET are not disaggregated according to the co-worker's wage as employees could not condition their choices on this information in the experiment.

FIGURE 1. Low and high effort rates: SECRET vs. PUBLIC*



* The Figure omits the category 'medium effort', thus % low effort + % high effort = 100% - % medium effort. Bars are based on choices made by 20 employees in each treatment.

A first evident feature of Figure 1 is that in both treatments employees expend higher effort when they are paid a higher wage. Employees rarely reward the employer with high effort when the own wage is £1, but the proportion of high effort choices when the own wage is £7 varies from 20% to 45% depending on treatment and relative pay conditions. Conversely, there are virtually no low effort choices when the own wage is £7, while a £1 wage triggers punishment between 15% and 25% of the times. Thus, in these treatments, as in many other gift-exchange game experiments, a positive own wage-effort relation emerges.[11]

A second noticeable feature of Figure 1 is that, in general, employees expend more effort under the wage secrecy regime than when the co-workers' wages are public. In particular, note that, when employees in the PUBLIC treatment are *underpaid* relative to the

[11] Using Wilcoxon signed-ranks tests we find statistically significant differences in effort across contingencies where the own wage is £1 or £7, both in SECRET ($p = 0.030$) and PUBLIC for any level of the co-worker's effort (all $p \leq 0.034$). We further analyze this own wage-effort relation in the regression analysis of Table 2.

co-worker (i.e. when the employee's own wage is £1 and the co-worker's wage is £4 or £7, and when the employee's own wage is £4 and the co-worker's wage is £7), employees never reward the employer with high effort, whereas punishment rates are between 15% and 25%. In contrast, in SECRET reward rates are between 10% and 20% for comparable own wage levels (i.e., when the employee's wage is £1 and £4), and punishment rates are not higher than 15%.[12] Employees seem also to expend less effort in PUBLIC than in SECRET when they are *overpaid* relative to the co-worker (i.e. when the employee's own wage is £4 and the co-worker's wage is £1, and when the own wage is £7 and the co-worker's wage is £1 or £4). Reward rates in PUBLIC are between 15% and 20% for the wage combinations where an employee is overpaid relative to the co-worker, whereas they vary from 20% to 45% in SECRET for comparable own wage levels. Punishment rates do not seem to vary markedly between treatments when employees in PUBLIC are overpaid.[13] Finally, there seem to be smaller differences in reward and punishment rates between SECRET and PUBLIC when employees in PUBLIC are paid the same wage as the co-worker.[14]

We further examine these effects by performing a regression analysis of effort behavior in the two treatments. In a first model (Model I) we regress effort on three dummy variables that assume value 1 for effort choices made in the PUBLIC treatment in wage combinations where an employee receives respectively the same wage as the co-worker (*PUBLIC EQUAL PAY*), a lower wage than the co-worker (*PUBLIC UNDERPAID*), or a higher wage than the co-worker (*PUBLIC OVERPAID*). Note that the baseline category is represented by effort choices made in the SECRET treatment. The model also includes two dummy variables for different levels of the own wage ('*Own wage £1*' and '*Own wage £7*', with the intermediate case where the own wage is £4 as benchmark category), and dummy variables controlling for individual characteristics (gender and field of study). In a second model (Model II) we investigate pay comparison effects separately for the cases where an employee is paid a £1, £4 and £7 wage. In Model II we measure pay comparison effects using dummy variables that

[12] Treating each subject as an independent observation and using tests of equality of proportions (Glasnapp and Poggio, 1985), we find that reward (punishment) rates are significantly higher (lower) in SECRET when the own wage is £4 than in PUBLIC when the own wage is £4 and the co-worker's wage is £7 ($p = 0.035$ for rewards; $p = 0.072$ for punishments). We do not detect significant differences in reward and punishment rates of SECRET and PUBLIC for the other cases of underpayment ($p > 0.146$).

[13] A series of tests of equality of proportions detect marginally significant differences in reward rates between SECRET when the own wage is £7 and PUBLIC when the own wage is £7 and the co-worker's wage is £1 or £4 ($p = 0.091$ in both comparisons). We do not find significant differences between treatments for reward rates when the own wage is £4 and the co-worker's wage is £1, or punishment rates in any comparison ($p > 0.146$).

[14] Using tests of equality of proportions, we cannot detect any significant difference in punishment or reward rates between SECRET when the own wage is £1, £4 or £7 and PUBLIC when the own wage and the co-worker's wage are respectively £1, £4 or £7 ($p > 0.311$).

distinguish among effort choices made in the PUBLIC treatment when the co-worker earns respectively £1 (*PUBLIC £1*), £4 (*PUBLIC £4*) or £7 (*PUBLIC £7*). As before, the regressions also include controls for gender and field of study. Ordered logit estimations of the two regression models are reported in Table 2.

TABLE 2. Effort behavior in SECRET and PUBLIC

	Model I	Model II		
		own wage = £1	own wage = £4	own wage = £7
Own wage £1	- 0.63** *(0.511)*	-	-	-
Own wage £7	1.94*** *(0.392)*	-	-	-
PUBLIC EQUAL PAY	- 0.28 *(0.525)*	-	-	-
PUBLIC UNDERPAID	- 0.66** *(0.481)*	-	-	-
PUBLIC OVERPAID	- 0.52 *(0. 615)*	-	-	-
PUBLIC £1	-	- 0.15 *(0.980)*	- 0.51 *(0.937)*	- 0.56 *(0.752)*
PUBLIC £4	-	- 0.35 *(0.908)*	- 0.52 *(0.784)*	- 0.56 *(0.737)*
PUBLIC £7	-	- 0.50 *(0.911)*	- 0.88*** *(0.643)*	- 0.15 *(0.728)*
1 if Male	- 0.73** *(0.532)*	- 0.86** *(0.806)*	- 0.75** *(0.703)*	- 0.62 *(0.689)*
1 if studies Social Sciences (incl. Economics)	0.15 *(0.511)*	0.34 *(0.889)*	- 0.19 *(0.740)*	0.30 *(0.569)*
N.	*240*	*80*	*80*	*80*
Pseudo R^2:	*0.155*	*0.121*	*0.121*	*0.059*
Wald tests:				
PUBLIC EQUAL PAY = PUBLIC UNDERPAID	*p = 0.022*	-	-	-
PUBLIC EQUAL PAY = PUBLIC OVERPAID	*p = 0.119*			
PUBLIC OVERPAID = PUBLIC UNDERPAID	*p = 0.440*			

Ordered logit regressions. The dependent variable is effort. Robust standard errors in parentheses, adjusted for intragroup correlation (individuals are used as independent clustering units). The results are displayed as percentage changes in the odds of expending higher effort. In Model I the reference subject type is: in the SECRET treatment, receiving a medium wage of £4, female and studying in a field other than Social Sciences. In Model II the reference subject type is: in the SECRET treatment, female and studying in a field other than Social Sciences. Significance levels: * 10% ; ** 5%; *** 1%.

Starting with Model I, we confirm the existence of a positive own wage-effort relation in our experiment: receiving a £7 wage rather than a £4 wage increases the odds of expending higher effort by almost 200%, *ceteris paribus*. The effect is significant at the 1% level. In contrast, receiving a £1 wage reduces the odds of expending higher effort by about 63%, and the effect is significant at the 5% level. Thus, own wages are a powerful determinant of effort in the experiment.

The regression also shows that being in the PUBLIC treatment generally reduces effort provision. The effect is statistically significant only for the case where employees in PUBLIC

are underpaid relative to the co-worker: the odds of expending higher effort are 66% lower for an underpaid employee in PUBLIC than for an employee in SECRET, and the effect is significant at the 5% level.[15] Being overpaid relative to the co-worker also reduces the odds of expending higher effort (by 52%), but the effect falls short of conventional significance levels ($p = 0.237$).[16] Receiving the same wage as the co-worker has instead a smaller effect on the odds of expending effort (the percentage change in the odds is -28%) and the effect is not statistically significant ($p = 0.535$).[17, 18]

Model II shows that the negative impact of pay comparisons on effort is driven by the case where an employee is paid a £4 wage and is paired with a co-worker paid a £7 wage: the effect is strong (the odds of expending higher effort in this wage combination are 88% lower than in SECRET) and highly significant ($p = 0.001$). These results compare with those reported by Gächter and Thöni (2010), who also find stronger pay comparison effects when employees receive a medium wage and are paired with a highly-paid co-worker. In both experiments, this is the only case where reactions to underpayment can be detected because in the other wage combinations where employees are underpaid they receive the lowest wage, and this already induces low effort.

Among the controls for individual characteristics included in the regressions, the gender dummy enters significantly in Model I and in two regressions of Model II: men expend lower effort than women, and the difference is significant at the 5% level. This result compares with findings on second-mover's behavior in related trust and sequential prisoner's dilemma games, where men are sometimes found to act more selfishly than women (e.g., Croson and Buchan, 1999), although the effect is not always significant (e.g., Cox and Deck, 2006)

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[15] Moreover, according to a Wald test, underpayment has a significant negative effect on effort in PUBLIC relative to the case where employees receive the same wage as the co-worker ($p = 0.022$).

[16] Comparing the effects of pay comparison information within PUBLIC, we find that overpayment does not reduce effort significantly relative to equal payment according to a Wald test ($p = 0.119$).

[17] The fact that all three PUBLIC treatment dummies enter the regression with a negative sign raises the question whether disclosing co-workers' wages has a generally negative effect on effort provision regardless of relative pay conditions. To examine this, we ran an additional regression where we replaced the three PUBLIC treatment dummies in Model I with one dummy variable assuming value 1 for observations from the PUBLIC treatment. The coefficient of the dummy variable is negative but statistically insignificant ($p = 0.173$) suggesting that we do not observe a general 'public information effect' in PUBLIC.

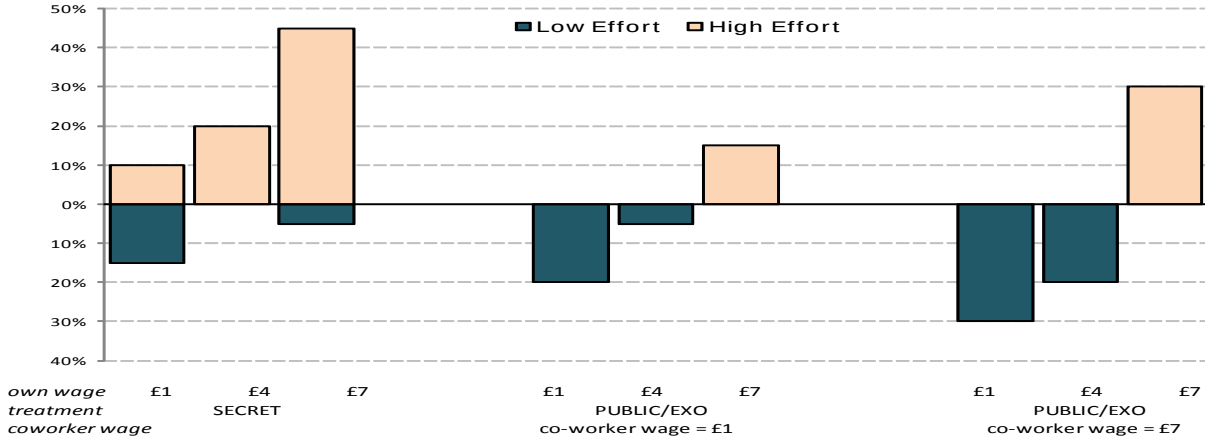
[18] An interesting question is whether the negative effects of pay comparisons are driven by changes in rewarding or punishing behavior. To address this question we perform separate logit regressions for the cases where an employee punishes or rewards the employer using a slightly modified version of Model I. In the modified specification we replace the dummy variables *PUBLIC OVERPAID* and *PUBLIC UNDERPAID* with one variable which assumes value 1 when the employee is paid a different wage than the co-worker, and value 0 otherwise. This modification is necessary because we never observe rewards when an employee is underpaid in PUBLIC (see Figure 1). The regressions show that being paid differently than the co-worker significantly reduces rewarding ($p = 0.042$), but does not increase the propensity to punish ($p = 0.655$). The complete regression results are available upon request.

Overall, these findings show that employees expend more effort under a wage secrecy regime than under a regime where information about co-workers' wages is public and they are underpaid relative to the co-worker. Being overpaid or being paid the same wage as the co-worker does not affect effort decisions relative to the case where wages are secret.[19]

B. SECRET vs. PUBLIC/EXO

We now turn to effort in PUBLIC/EXO. Figure 2 reports the proportions of low and high effort choices made by BLUE Employees in PUBLIC/EXO for different levels of the own wage. We distinguish between effort chosen in sessions where the co-worker's wage was low or high. For comparison, we also include effort choices made in SECRET. As in Figure 1, we do not disaggregate effort in SECRET according to the co-worker's wage.

FIGURE 2. Low and high effort rates: SECRET vs. PUBLIC/EXO*



* The Figure omits the category 'medium effort', thus % low effort + % high effort = 100% - % medium effort. Bars are based on choices made by 20 employees in SECRET and by 20 BLUE Employees in each version of the PUBLIC/EXO treatment.

As in PUBLIC and SECRET, also in PUBLIC/EXO we observe a positive own wage-effort relation: irrespectively of the wage paid to the co-worker, higher own wage levels decrease the frequency of low effort and increase the frequency of high effort (in fact, high effort is only chosen when the own wage is £7).[20]

A second important feature of Figure 2 is that also in PUBLIC/EXO the availability of pay comparison information appears to have a negative impact on effort choices relative to SECRET. In particular, note how employees who are in PUBLIC/EXO and are underpaid

[19] The negative effects of pay comparisons reflect on realized total earnings per firm. The 10 firms in SECRET earned on average £22.4 from the experiment, whereas the average earnings of the 10 firms in PUBLIC were £20.9. The difference is just insignificant according to a Mann-Whitney rank-sum test ($p = 0.134$).

[20] Using Wilcoxon signed-ranks tests we find statistically significant differences in employees' effort across wage combinations where the own-wage is £1 or £7 for both possible levels of the co-worker's wage ($p \leq 0.026$).

relative to the co-worker (i.e. in the wage combinations where the co-worker's wage is £7 and the employee's own wage is £1 or £4) never choose high effort and choose instead low effort between 20% and 30% of the times. In contrast, in SECRET employees who receive a low or medium wage reward employers between 10% and 20% of the times. Low effort is never chosen in SECRET when employees are paid a medium wage, and is chosen 15% of the times in response to a low own wage.[21] Overpayment has also a negative impact on effort choices in PUBLIC/EXO. When employees in PUBLIC/EXO receive a £4 wage and the co-worker's wage is £1, they never expend high effort and choose low effort 5% of the times. In SECRET the reward rate is instead 20% when employees receive a £4 wage. Similarly, when employees in PUBLIC/EXO receive a £7 wage and the co-worker's wage is £1, the reward rate is 15%, whereas in SECRET 45% of the employees reward the employers when they receive a £7 wage.[22] Finally, being paid the same wage as the co-worker does not affect effort choices much relative to SECRET.[23]

Table 3 reports a regression analysis of effort behavior in PUBLIC/EXO and SECRET. Similarly to the analysis performed in the previous sub-section, in a first model (Model I) we regress effort on a set of dummy variables measuring whether an employee in PUBLIC/EXO is paid the same wage (*PUBLIC/EXO EQUAL PAY*), a lower wage (*PUBLIC/EXO UNDERPAID*), or a higher wage than the co-worker (*PUBLIC/EXO OVERPAID*). The model also includes two dummies for different levels of the own wage ('*Own wage £1*' and '*Own wage £7*') and the usual controls for individual characteristics. Model II analyzes pay comparison effects separately for each possible level of the own wage. The regressions contain

[21] Using tests of equality of proportions, we find that reward (punishment) rates are higher (lower) in SECRET when the own wage is £4 than in PUBLIC/EXO when the own wage is £4 and the co-worker's wage is £7 ($p = 0.035$ in both comparisons). We do not find significant differences in reward or punishment rates across the two treatments when the own wage is £1 and, in PUBLIC/EXO, the co-worker's wage is £7 ($p > 0.146$). We also note that underpayment leads to similar effort choices in PUBLIC/EXO and PUBLIC (see Figure 1). In fact, we do not find any significant difference in reward or punishment rates between the two 'public wages' treatments in any possible comparison (all $p > 0.677$).

[22] Reward rates in SECRET when the own wage is £4 or £7 are higher than reward rates in PUBLIC/EXO when the own wage is £4 or £7 and the co-worker's wage is £1 (tests of equality of proportions, $p = 0.035$ and $p = 0.038$, respectively). We do not find significant differences in punishment rates ($p > 0.311$). Reward rates are generally lower in PUBLIC/EXO than in PUBLIC for overpaid employees. In fact, we find a significant difference in reward rates between the two 'public wages' treatments when the own wage is £4 and the co-worker's wage is £1 ($p = 0.072$), suggesting that overpayment may result in higher effort when employers control both employees' wages. We do not find, however, significant differences between PUBLIC and PUBLIC/EXO in reward rates when the own wage is £7 and the co-worker's wage is £1 ($p = 0.677$), or in punishment rates ($p > 0.311$).

[23] There are no significant differences in reward or punishment rates between SECRET when the own wage is £1 or £7 and PUBLIC/EXO when both the own wage and the co-worker's wage are £1 or £7 (tests of equality of proportions, $p > 0.146$). We also do not find any difference in reward or punishment rates between PUBLIC/EXO and PUBLIC ($p > 0.311$).

two dummy variables measuring the different levels of the co-worker's wage (*PUBLIC/EXO £1* and *PUBLIC/EXO £7*), and dummy variables controlling for gender and field of study.

TABLE 3. Effort behavior in SECRET and PUBLIC/EXO

	Model I	Model II		
		own wage = £1	own wage = £4	own wage = £7
Own wage £1	-0 .70*** *(0.407)*	-	-	-
Own wage £7	3.67*** *(0.546)*	-	-	-
PUBLIC/EXO EQUAL PAY	- 0.57 *(0.554)*	-	-	-
PUBLIC/EXO UNDERPAID	- 0.86*** *(0.657)*	-	-	-
PUBLIC/EXO OVERPAID	- 0.74*** *(0.485)*	-	-	-
PUBLIC/EXO £1	-	- 0.55 *(0.906)*	- 1.00*** *(0.605)*	- 0.71 *(0.829)*
PUBLIC/EXO £7	-	- 0.73 *(0.916)*	- 1.00*** *(1.028)*	- 0.39 *(0.728)*
1 if Male	0.28 *(0.398)*	0.32 *(0.639)*	0.69 *(0.755)*	0.01 *(0.557)*
1 if studies Social Sciences (incl. Economics)	0.35 *(0.391)*	0.14 *(0.689)*	1.63 *(0.900)*	0.08 *(0.622)*
N.	*180*	*60*	*60*	*60*
Pseudo R^2:	*0.185*	*0.038*	*0.269*	*0.039*
Wald tests:				
PUB/EXO EQ. PAY = PUB/EXO UNDERP.	*p = 0.116*			
PUB/EXO EQ. PAY = PUB/EXO OVERP.	*p = 0.397*			
PUB/EXO OVERP. = PUB/EXO UNDERP.	*p = 0.345*			

Ordered logit regressions. The dependent variable is effort. Robust standard errors in parentheses adjusted for intragroup correlation (individuals are used as independent clustering units). In PUBLIC/EXO only data from BLUE Employees is used in the regressions. Results are displayed as percentage changes in the odds of expending higher effort. In Model I the reference subject type is: in the SECRET treatment, receiving a medium wage of £4, female and studying in a field other than Social Sciences. In Model II the reference subject type is: in the SECRET treatment, female and studying in a field other than Social Sciences. Significance levels: * 10% ; ** 5%; *** 1%.

Model I confirms the existence of a positive own wage-effort relation in the experiment: increasing (decreasing) an employee's wage from £4 to £7 (£1) increases (reduces) the odds of expending higher effort, and the effects are highly significant. Turning to pay comparison effects, the dummies controlling for the cases where employees in PUBLIC/EXO are underpaid or overpaid are both highly significant in Model I. Being underpaid relative to the co-worker reduces the odds of exerting higher effort by 86% and the effect is significant at the 1% level. Overpayment has a smaller negative impact on the odds of choosing higher effort (the percentage change in the odds is -74%), and the effect is also significant at the 1% level.[24] Being in the PUBLIC/EXO treatment has no significant effect on effort when there is

[24] Note, however, that effort choices under underpayment or overpayment do not differ significantly from effort expended in PUBLIC/EXO under pay equality according to the Wald tests reported in Table 3.

no wage inequality.[25] Model II shows that, as in the PUBLIC treatment, also in PUBLIC/EXO the negative effects of pay comparisons are driven by employees receiving a medium wage. Underpayment and overpayment do not have instead a significant impact on effort when the own wage is £1 or £7. Contrary to the results reported in Table 2, the gender dummy is insignificant in all regressions reported in Table 3, showing that overall we do not observe a clear gender effect in our experiment.

Overall, the results from the PUBLIC/EXO treatment confirm that the availability of pay comparison information can be detrimental for effort provision. Relative to the treatment where wages are secret, employees expend lower effort when wages are public if there is wage inequality in their experimental firm, even if co-workers' wages are not chosen by the employer but are mandated exogenously. In PUBLIC/EXO negative pay comparison effects are observed both when an employee is underpaid and overpaid relative to the co-worker. If employees are paid the same wage as their co-workers, there is instead no systematic difference between the wage secrecy and public wages regimes.[26]

V. DISCUSSION & CONCLUSIONS

Pay secrecy is often justified on the ground that letting employees engage in pay comparisons might have detrimental consequences for effort provision: pay satisfaction and work morale may be damaged if employees discover (apparently arbitrary) differences between their own pay and the pay of co-workers who are in comparable positions within the firm. This might in turn lead employees to reduce their effort at work. This study reports an experiment that examines whether the availability of pay comparison information has in fact a negative impact on effort behavior. Using a multilateral version of the gift-exchange game, we compare effort choices made by employees in a 'pay secrecy' treatment and in treatments where co-workers' wages are instead public information. The two 'public wages' treatments vary in how the wages paid to the employees are determined: in one treatment both wages are chosen by the

[25] As with the PUBLIC treatment (see footnote 17), we ran an alternative specification of Model I where we replaced the three PUBLIC/EXO dummies with one dummy variable assuming value 1 for observations from the PUBLIC/EXO treatment, regardless of relative pay conditions. The coefficient of the dummy variable is negative and significant at the 1% level, suggesting that disclosing information about co-workers' wages has a generally detrimental effect on effort provision in PUBLIC/EXO. We also performed separate logit regressions with dummy dependent variables for punishment and reward using the modified version of Model I discussed in footnote 18 (replacing the two dummy variables PUBLIC/EXO OVERPAID and PUBLIC/EXO UNDERPAID with one variable taking value 1 when the employee's wage is different from the co-worker's). The propensity to reward is significantly reduced when employees are paid a different wage than the co-worker ($p = 0.002$), whereas the propensity to punish does not increase significantly ($p = 0.167$). The complete regression results are available upon request.

[26] Realized earnings per firm in PUBLIC/EXO are lower than SECRET (£21.2 vs. £22.4), but the difference is statistically insignificant according to a Mann-Whitney rank-sum test ($p = 0.429$).

employer, while in another treatment one of the two wages is chosen by the experimenter. This latter treatment is a stylized representation of workplaces where employers are partially constrained in their wage policy by external labor market regulations.

In all treatments we observe a strong positive own wage-effort relationship: employees reciprocate high wages with high effort, as it has also been found in many previous gift-exchange game experiments (e.g., Fehr et al., 1993; Fehr et al., 1997; Gächter and Falk, 2002; Charness, 2004). Most importantly, we find that the availability of pay comparison information damages effort provision. Employees in the 'public wages' treatments who learn that they are underpaid relative to an ex-ante symmetric co-worker expend significantly less effort than employees in the pay secrecy treatment. In the treatment where the employer is forced to pay an exogenously fixed wage to one of the two employees, we observe negative reactions to pay comparisons also in the case where an employee is overpaid relative to the co-worker. In both 'public wages' treatments we do not find significant pay comparison effects when employees are paid equal wages.

These findings contribute to a recent experimental literature on the effects of pay comparisons on effort behavior. Most of the previous studies have investigated pay comparison effects by examining how employees' effort decisions change across situations that differ in the wages paid to their co-workers. Results from these experiments are mixed: some studies find that co-workers' wages have weak or no impact on effort behavior (Bartling and von Siemens, 2011; Gächter et al., *forthcoming*), whereas other studies document the existence of systematic pay comparison effects (Abeler et al., 2010; Gächter and Thöni, 2010; Cohn et al., 2011). Importantly, these studies only include treatments where co-workers' wages are public. It is unclear that observing reactions to co-workers' wages in 'public wages' settings implies that effort will be higher under wage secrecy. For example, under wage secrecy employees may suspect unfair treatment and reduce their effort as a consequence (e.g., Lawler, 1967). Our study shows that this is not actually the case. The availability of pay comparison information and the discovery of arbitrary pay differentials lead to significantly lower effort relative to a setting where co-workers' wages are kept secret. Effort under pay secrecy is instead not significantly different from the effort expended in a 'public wages' setting if employers treat employees equally.

Three studies have previously examined settings where co-workers' wages are public or secret. Güth et al. (2001) study a setting where a principal has to design separate contracts for two agents who differ in productivity. They compare a treatment where agents only learn their own contract with a treatment where agents also learn the contract offered to the other

agent. While principals in their experiment anticipate the existence of pay comparison effects and offer less asymmetric contracts in the treatment where contracts are public information, there is only weak evidence that pay comparisons actually affect agents' behavior. Charness and Kuhn (2007) use a multilateral version of the gift-exchange game where one employer interacts with two differently productive employees, and find that pay comparisons have negligible effects on effort behavior. Angelova et al. (2012) study a three-person game where a principal is matched with a permanent agent, who is in a long-term relationship with the principal, and a temporary agent, who is matched with a different principal in each period. They find that when agents are only informed of their own contracts principals discriminate against temporary agents by offering them less favorable contracts. Discrimination is reduced when contracts are public as temporary agents reduce their effort when they are discriminated against.[27] An important difference between these studies and our study is that in our experiment employees do not differ in their productivity or in the duration of their employment contract. The existence of asymmetries between employees may justify pay differentials and attenuate perceptions of unfairness. In contrast, in our study it is straightforward to associate unequal pay with unfair treatment. Under such circumstances we find that pay disclosure can be detrimental for effort provision.

Our study also suggests that labor market policies and institutions can play an important role in shaping pay fairness perceptions and work behavior. Previous studies have documented the effects of these regulations on vertical fairness considerations (i.e. fairness between an employer and the employees). For example, Falk et al. (2006) show that introducing external regulations on the lower bound of the possible wage offers made by an employer influences what workers perceive to be a fair wage and affect their behavior. Our findings suggest that labor market policies and institutions can affect pay fairness perceptions also through considerations of horizontal fairness (i.e. fairness among co-workers). We show that regulating the wage that employers pay to a portion of the workforce significantly affects the behavior of the portion of the workforce which is not directly affected by these regulations. Indeed, the fact that we observe negative pay comparison effects for both underpayment and overpayment in the treatment where one of the wages is exogenously regulated by the experimenter suggests

[27] No pay comparison effects are instead found in the real effort experiment by Hennig-Schmidt et al. (2010). However, employees in their experiment are also unwilling to provide high effort in return for high own wages. Subsequent laboratory experiments (where no pay comparisons were possible) revealed that this was due to the lack of surplus information, which limited the scope for employees to develop adequate fairness attributions. Clark et al. (2010) use bilateral gift-exchange games that vary in whether employees receive information about the wages offered in four other firms in the market (i.e. they study inter-firm pay comparisons). They find that effort is significantly affected by how the own wage is ranked relative to others' wages.

that horizontal fairness concerns may be even stronger in the presence of external regulations, possibly because they increase the prominence of co-workers' wages as a reference standard for what constitutes a fair wage in a given environment.

Overall, our findings show that the disclosure of pay information can have detrimental effects on effort provision. Relative to the pay secrecy setting employees' efforts are significantly lower when employees observe disadvantageous pay inequalities, can be lower in the presence of advantageous pay inequalities, and are not higher when employees learn that they receive the same wage as their co-worker. These results may be viewed as lending support to the use of pay confidentiality rules in workplaces. Employers should prefer to adopt pay secrecy rules whenever there are salary differences between employees that may be perceived as unfair. In the absence of such salary differences employers may be indifferent to the use of pay secrecy clauses as disclosing payments has little effect on effort provision when employees are paid equal wages.

On this respect, it should be noted that whether or not pay inequalities will be actually seen as unfair is likely to depend on the details of the work environment. In the stylized setting studied in this paper pay differentials have rather clear-cut implications for pay fairness judgments. In the absence of observable asymmetries between workers, paying different upfront wages to different employees is unfair. However, in other settings pay inequalities may actually be perceived as *fair* and may thus be effort-enhancing. For example, Abeler et al. (2010) study a multi-worker gift-exchange game where employers choose wages *after* having observed employees' effort decisions. In one treatment employers have to pay equal wages to the employees by design. In a second treatment employers can pay different wages to different employees. They find that employees who are paid equal wages expend significantly lower effort than employees in the treatment where employers can pay individualized wages. The reason for this effect is that in the latter treatment employers use wage differentials to compensate for observed differences in performance, for example by offering higher wages to the harder-working employees. Thus, unequal wages can actually be used to enforce equity and fairness, whereas equal wages may engender unfairness. An implication of these considerations is that, in settings where employer-employees interactions are not one-shot (as in our experiment) but are repeated, pay inequalities that are based on past performance differentials (when these are observable) may actually promote fairness and effort provision.

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APPENDICES

Appendix A – Instructions

In the following we report the instructions used in the PUBLIC/EXO £7 sessions. Instructions used in the PUBLIC/EXO £1 sessions are identical with the exception that RED Employees' wage was fixed at £1. Any differences between the instructions used in the PUBLIC/EXO sessions and those used in the SECRET and PUBLIC sessions are italicized and reported in square brackets.

Instructions

Welcome!

You are about to take part in an experiment in the economics of decision making. This experiment is run by the "Centre for Decision Research and Experimental Economics" and has been financed by various foundations for research promotion.

There are other people in this room, who are also participating in this experiment. All participants are reading the same instructions as you are and have been recruited in the same fashion. Likewise, all participants are participating in this experiment for the first time, as you are.

It is important that you do not talk, or in any way try to communicate with the other participants during the experiment. If you have a question, raise your hand and a monitor will come over to where you are sitting and answer your question in private.

The experiment will take no more than 60 minutes, and at the end you will be paid in private and in cash. You will be paid a £3 show-up fee, plus an additional amount that will depend on the decisions that you and the other participants make. It is therefore very important to read these instructions with care.

1. Introduction

In this experiment you will be randomly paired with two other participants to form a group of three people. We will refer to each group as a "**firm"**, and to the three group members as "**the Employer**", "**the Blue Employee**" and "**the Red Employee**".

The computer will randomly determine whether you are the Employer, the Blue Employee or the Red Employee just at the beginning of the experiment.

You will *not* be informed about who of the other participants are in your firm, either during or after the experiment. Therefore, all decisions are made anonymously.

In this experiment you will be asked to perform the following decision task and you will do it only once.

At the end of the experiment you will be paid a £3 show-up fee plus your earnings from this task.

2. The decision task

The structure of the decision-making within each firm is as follows.

- **The Employer** is initially endowed with £22 from which he/she pays a wage to the two employees with whom he/she is paired.

  Wages can take three values: £1, £4 or £7.

  The Employer **must** pay a £7 wage to the Red Employee, while he/she can decide on what wage (£1, £4 or £7) to pay to the Blue Employee. *[SECRET and PUBLIC: The Employer can decide on what wage (£1, £4 or £7) to pay to the Red Employee and on what wage (£1, £4 or £7) to pay to the Blue Employee.]*

  The wage the Employer chooses for the Blue Employee and the wage he/she must pay to the Red Employee will be subtracted from his/her £22 endowment. *[SECRET and PUBLIC: The*

wages the Employer chooses for the Blue Employee and the Red Employee will be subtracted from his/her £22 endowment.]

- Each **Employee** is then informed of the wages paid by the Employer, i.e. employees learn their own wage and the wage that the Employer pays to the other employee. *[SECRET: Each **Employee** is then informed of the wage the Employer pays to him/her, i.e. employees learn their own wage but not the wage that the Employer pays to the other employee.]*

  Each employee chooses then independently and in private an effort level: low, medium or high.

  Low effort costs the employee £1 and reduces the Employer's earnings by £4.
  Medium effort costs the employee nothing and leaves the Employer's earnings unchanged.
  High effort costs the employee £1 and increases the Employer's earnings by £4.

On the next pages you will find a couple of hypothetical examples which will illustrate how to calculate the earnings of each member in the firm.

HYPOTHETICAL EXAMPLE FOR DEMONSTRATION PURPOSES, #1

The Employer must pay the £7 wage to the Red Employee. Suppose the Employer chooses to pay a £4 wage to the Blue Employee. *[SECRET and PUBLIC: Suppose the Employer chooses to pay a £1 wage to the Red Employee and a £4 wage to the Blue Employee.]*

Suppose that the Red Employee chooses LOW effort and the Blue Employee chooses HIGH effort.

This situation results in the following earnings:

==> EMPLOYER'S EARNINGS:

The Employer pays a total of £11 *[SECRET and PUBLIC: £5]* to the employees: £7 *[SECRET and PUBLIC: £1]* to the Red Employee and £4 to the Blue Employee.

The Employer receives a £4 revenue from the HIGH effort of the Blue Employee, but the Red Employee's LOW effort choice decreases his/her earnings by £4.

Therefore the Employer's earnings are: £22 – £11 *[SECRET and PUBLIC: £5]* + £4 - £4 = **£11** *[SECRET and PUBLIC: £17]*.

==> RED EMPLOYEE'S EARNINGS:

The Red Employee is paid a £7 *[SECRET and PUBLIC: £1]* wage. LOW effort costs £1 to the employee.

Therefore the Red Employee's earnings are: £7 *[SECRET and PUBLIC: £1]* - £1 = **£6** *[SECRET and PUBLIC: £0]*.

==> BLUE EMPLOYEE'S EARNINGS:

The Blue Employee receives a £4 wage. HIGH effort costs £1 to the employee.

Therefore the Blue Employee's earnings are: £4 - £1 = **£3**.

HYPOTHETICAL EXAMPLE FOR DEMONSTRATION PURPOSES, #2

The Employer must pay the £7 wage to the Red Employee. Suppose the Employer chooses to pay a £1 wage to the Blue Employee. *[SECRET and PUBLIC: Suppose the Employer chooses to pay a £7 wage to the Red Employee and a £4 wage to the Blue Employee.]*

Suppose that the Red Employee chooses MEDIUM effort and the Blue Employee chooses MEDIUM effort.

This situation results in the following earnings:

==> EMPLOYER'S EARNINGS:

The Employer pays a total of £8 to the employees: £7 to the Red Employee and £1 to the Blue Employee.

Employees' effort choices do not produce any revenue for the Employer, as MEDIUM effort leaves the Employer's earnings unchanged.

Therefore the Employer's earnings are: £22 – £8 + £0 + £0 = **£14**.

==> RED EMPLOYEE'S EARNINGS:

The Red Employee is paid a £7 wage. MEDIUM effort costs nothing to the employee.

Therefore the Red Employee's earnings are: £7 - £0 = **£7**.

==> BLUE EMPLOYEE'S EARNINGS:

The Blue Employee receives a £1 wage. MEDIUM effort costs nothing to the employee.

Therefore the Blue Employee's earnings are: £1 - £0 = **£1**.

Although the structure of the decision-making within each firm is the one we have just described, in this experiment employees make their decisions **before** learning the wage that the Employer has actually chosen for the Blue Employee.

Employees know however that **the Employer must pay a £7 wage to the Red Employee.**

If you are an employee, you will then be asked to indicate what you would do in each of the following **THREE SITUATIONS**:

I. The Employer chooses to pay a **£1 wage** to the Blue Employee.
II. The Employer chooses to pay a **£4 wage** to the Blue Employee.
III. The Employer chooses to pay a **£7 wage** to the Blue Employee.

[SECRET: Although the structure of the decision-making within each firm is the one we have just described, in this experiment employees make their decisions before learning the wages that the Employer has actually chosen for them.

*If you are an employee, you will then be asked to indicate what you would do in each of the following **THREE SITUATIONS**:*

I. *The Employer chooses to pay a **£1 wage** to you.*
II. *The Employer chooses to pay a **£4 wage** to you*
III. *The Employer chooses to pay a **£7 wage** to you.]*

[PUBLIC: Although the structure of the decision-making within each firm is the one we have just described, in this experiment employees make their decisions before learning the wages that the Employer has actually chosen.

*If you are an employee, you will then be asked to indicate what you would do in each of the following **NINE SITUATIONS**:*

I. *The Employer chooses to pay a **£1 wage** to you and a **£1 wage** to the other Employee.*
II. *The Employer chooses to pay a **£1 wage** to you and a **£4 wage** to the other Employee.*
III. *The Employer chooses to pay a **£1 wage** to you and a **£7 wage** to the other Employee.*
IV. *The Employer chooses to pay a **£4 wage** to you and a **£1 wage** to the other Employee.*
V. *The Employer chooses to pay a **£4 wage** to you and a **£4 wage** to the other Employee.*
VI. *The Employer chooses to pay a **£4 wage** to you and a **£7 wage** to the other Employee.*
VII. *The Employer chooses to pay a **£7 wage** to you and a **£1 wage** to the other Employee.*
VIII. *The Employer chooses to pay a **£7 wage** to you and a **£4 wage** to the other Employee.*
IX. *The Employer chooses to pay a **£7 wage** to you and a **£7 wage** to the other Employee.]*

Please note that one of these situations will actually count for determining your and the other firm members' earnings, so make your choices carefully.

You will be informed of which situation is actually relevant at the end of the experiment, once everyone in the firm has taken his/her decision. The wage the Employer has actually chosen for the Blue Employee will determine which of the three situations above (I, II or III) counts for the computation of earnings. [*SECRET: The wages the Employer has actually chosen will determine, for each employee, which of the three situations above (I, II or III) counts for the computation of earnings.] [PUBLIC: The wages the Employer has actually chosen will determine, for each employee, which of the nine*

situations above (I to IX) counts for the computation of earnings.] Employees' choices in *that* situation will determine the final outcome for each firm member.

A complete list of all the possible earnings distributions resulting from the employees' effort choices in *each* of these three situations is provided in a separate sheet. *[SECRET and PUBLIC: A complete list of all the possible earnings distributions resulting from the employees' effort choices in each of these three [nine in PUBLIC] situations is provided separately. Two sets of Tables are provided. The two sets contain exactly the same information, just organised differently for your convenience. If you are a Red Employee you should refer to the set labelled "USE IF YOU ARE A RED EMPLOYEE". If you are a Blue Employee you should refer to the set labelled "USE IF YOU ARE A BLUE EMPLOYEE". If you are an Employer you can refer to either one.]*

3. What happens next?

- When the experiment starts, the computer will randomly assign you to a firm and randomly determine whether you are the Employer, the Blue Employee or the Red Employee.
- You will then access a couple of screens where you will be asked to answer a few questions. You will also have to calculate the earnings of all members of your firm for six hypothetical scenarios, with the help of the attached Tables. Press the "Check answers" button on the screen once you have answered all the questions. The computer will let you know whether your answers are correct.
- Once everyone has answered all the questions correctly, you will access the "Decision task" screen. Depending on whether you are an employer or an employee you will have to choose wage or effort levels, as described above in Section 2.

At the end of the experiment, you will be paid a £3 show-up fee plus your earnings from the decision task.
Please, raise your hand if you have any questions.

Appendix B – Earnings Distributions Tables

In the following we report the Earnings Distributions tables used by BLUE Employees in the PUBLIC sessions. In order to treat the two employee types symmetrically, columns and rows were inverted in the tables used by RED Employees and the order in which wage combinations were presented was modified accordingly. The tables used in the SECRET treatment were identical, but had different captions to account for the fact that only three 'situations' could occur in SECRET, depending on the level of the own wage. Tables with the same own wage and different levels of the co-worker's wage were referred to as different 'cases' of the same 'situation'. In the PUBLIC/EXO treatment only the tables where the co-worker's wage was equal to £1 (in PUBLIC/EXO £1) or £7 (in PUBLIC/EXO £7) were used.

EARNINGS DISTRIBUTIONS

TABLE I : Earnings distributions resulting from the employees' effort choices in **SITUATION I**, i.e. when the Employer chooses a **£1 wage** for the Blue Employee and a **£1 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£12	£0	£0	£16	£0	£1	£20	£0	£0
Blue Employee chooses **MEDIUM** effort	£16	£1	£0	£20	£1	£1	£24	£1	£0
Blue Employee chooses **HIGH** effort	£20	£0	£0	£24	£0	£1	£28	£0	£0

TABLE II : Earnings distributions resulting from the employees' effort choices in **SITUATION II**, i.e. when the Employer chooses a **£1 wage** for the Blue Employee and a **£4 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£9	£0	£3	£13	£0	£4	£17	£0	£3
Blue Employee chooses **MEDIUM** effort	£13	£1	£3	£17	£1	£4	£21	£1	£3
Blue Employee chooses **HIGH** effort	£17	£0	£3	£21	£0	£4	£25	£0	£3

TABLE III : Earnings distributions resulting from the employees' effort choices in **SITUATION III**, i.e. when the Employer chooses a **£1 wage** for the Blue Employee and a **£7 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£6	£0	£6	£10	£0	£7	£14	£0	£6
Blue Employee chooses **MEDIUM** effort	£10	£1	£6	£14	£1	£7	£18	£1	£6
Blue Employee chooses **HIGH** effort	£14	£0	£6	£18	£0	£7	£22	£0	£6

TABLE IV : Earnings distributions resulting from the employees' effort choices in **SITUATION IV**, i.e. when the Employer chooses a **£4 wage** for the Blue Employee and a **£1 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£9	£3	£0	£13	£3	£1	£17	£3	£0
Blue Employee chooses **MEDIUM** effort	£13	£4	£0	£17	£4	£1	£21	£4	£0
Blue Employee chooses **HIGH** effort	£17	£3	£0	£21	£3	£1	£25	£3	£0

TABLE V : Earnings distributions resulting from the employees' effort choices in **SITUATION V,** i.e. when the Employer chooses a **£4 wage** for the Blue Employee and a **£4 wage** for the Red Employee**.**

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£6	£3	£3	£10	£3	£4	£14	£3	£3
Blue Employee chooses **MEDIUM** effort	£10	£4	£3	£14	£4	£4	£18	£4	£3
Blue Employee chooses **HIGH** effort	£14	£3	£3	£18	£3	£4	£22	£3	£3

TABLE VI: Earnings distributions resulting from the employees' effort choices in **SITUATION VI**, i.e. when the Employer chooses a **£4 wage** for the Blue Employee and a **£7 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£3	£3	£6	£7	£3	£7	£11	£3	£6
Blue Employee chooses **MEDIUM** effort	£7	£4	£6	£11	£4	£7	£15	£4	£6
Blue Employee chooses **HIGH** effort	£11	£3	£6	£15	£3	£7	£19	£3	£6

TABLE VII : Earnings distributions resulting from the employees' effort choices in **SITUATION VII**, i.e. when the Employer chooses a **£7 wage** for the Blue Employee and a **£1 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£6	£6	£0	£10	£6	£1	£14	£6	£0
Blue Employee chooses **MEDIUM** effort	£10	£7	£0	£14	£7	£1	£18	£7	£0
Blue Employee chooses **HIGH** effort	£14	£6	£0	£18	£6	£1	£22	£6	£0

TABLE VIII : Earnings distributions resulting from the employees' effort choices in **SITUATION VIII**, i.e. when the Employer chooses a **£7 wage** for the Blue Employee and a **£4 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£3	£6	£3	£7	£6	£4	£11	£6	£3
Blue Employee chooses **MEDIUM** effort	£7	£7	£3	£11	£7	£4	£15	£7	£3
Blue Employee chooses **HIGH** effort	£11	£6	£3	£15	£6	£4	£19	£6	£3

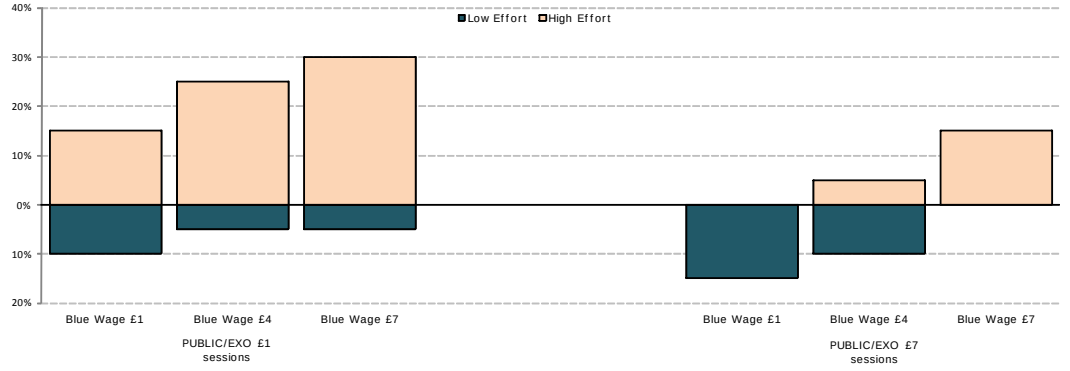
TABLE IX : Earnings distributions resulting from the employees' effort choices in **SITUATION IX**, i.e. when the Employer chooses a **£7 wage** for the Blue Employee and a **£7 wage** for the Red Employee.

	Red Employee chooses **LOW** effort			Red Employee chooses **MEDIUM** effort			Red Employee chooses **HIGH** effort		
	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee	Employer	Blue Employee	Red Employee
Blue Employee chooses **LOW** effort	£0	£6	£6	£4	£6	£7	£8	£6	£6
Blue Employee chooses **MEDIUM** effort	£4	£7	£6	£8	£7	£7	£12	£7	£6
Blue Employee chooses **HIGH** effort	£8	£6	£6	£12	£6	£7	£16	£6	£6

Appendix C – RED Employees' effort in PUBLIC/EXO

Though not the focus of the experiment, our design also delivers data on effort responses to fixed wages by RED Employees in PUBLIC/EXO. In this Appendix we briefly present these data for completeness. In PUBLIC/EXO, RED Employees knew that their wage had been fixed exogenously by the experimenter at either £1 (PUBLIC/EXO £1 sessions) or £7 (PUBLIC/EXO £7 sessions), and were asked to make an effort choice for each possible level of the BLUE wage. Figure A.1 shows the proportions of low and high effort choices made by RED Employees in the PUBLIC/EXO sessions for different levels of the BLUE wage.

Figure A.1. Low and high effort rates: RED Employees in PUBLIC/EXO*



The Figure omits the category 'medium effort', thus % low effort + % high effort = 100% - % medium effort. Bars are based on choices made by 20 RED Employees in each version of PUBLIC/EXO.

An interesting pattern emerging from Figure A.1 is that RED Employees' willingness to punish the Employer decreases and their willingness to reward the Employer increases as the Employer pays higher wages to the BLUE Employee. To explore whether these patterns are systematic we run an ordered logit regression of RED Employees' effort on a set of dummies for the different wage combinations faced by RED Employees in the PUBLIC/EXO treatment. The regression also includes controls for gender and field of study. Table A.1 reports the regression results. We find that RED Employees who were assigned a £1 wage by the experimenter expend significantly more effort when the Employer pays a £4 wage rather than a £1 wage to the BLUE Employee ($p = 0.078$). A Wald test also reveals that RED Employees who were assigned a £7 wage expend significantly more effort when the BLUE Employee receives a £7 wage than a £1 wage ($p = 0.004$). No other comparison between wage combinations where the RED Employee's wage is fixed and the BLUE Employee's wage changes is statistically significant. Overall, these findings suggest that RED Employees may respond to a form of *indirect reciprocity*, as they tend to act more favorably towards the Employer the more favorably she acted towards their co-worker.

Some of the free-form comments left by subjects in the post-experimental questionnaire are in line with this interpretation of RED Employees' effort decisions. For example, in PUBLIC/EXO £7 a RED Employee who chose to provide low effort when the Employer chose a low or medium wage to the BLUE Employee explained that "…*it seemed like the employer was being selfish and should not benefit from this attitude, if they had given £7 to both employees maybe they would be rewarded for those actions.*". Another RED Employee in PUBLIC/EXO wrote: "*Thought that the wage of £1 to blue employee represented greed by the employer and as such wanted to reduce their income*". Similarly, another person explained that he/she "… *wanted to punish the employer if they only paid the blue employee £1 by expending low effort*".

Table A.1. Effort behavior of RED Employees in PUBLIC/EXO

Wage combination: RED=£1; BLUE=£4	1.38* *(0.491)*
Wage combination: RED=£1; BLUE=£7	1.94 *(0.913)*
Wage combination: RED=£7; BLUE=£1	- 0.77 *(0.983)*
Wage combination: RED=£7; BLUE=£4	- 0.58 *(0.973)*
Wage combination: RED=£7; BLUE=£7	0.44 *(0.886)*
1 if Male	1.62* *(0.557)*
1 if studies Social Sciences (incl. Economics)	1.22 *(0.529)*
N.	*120*
Pseudo R^2:	*0.111*

Ordered logit regressions. The dependent variable is effort. Robust standard errors in parentheses adjusted for intragroup correlation (individuals are used as independent clustering units). The results are displayed as percentage changes in the odds of expending higher effort. The reference subject type is: in the wage combination where the RED wage is £1 and the BLUE wage is £1, female and studying in a field other than Social Sciences. Significance levels: * 10% ; ** 5%; *** 1%.