# Social Comparison and Effort Provision: Evidence from a Field Experiment

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**Abstract:** Social comparison processes have potentially far reaching consequences for many economic domains. We conducted a randomized field experiment to examine how social comparison affects workers' effort provision if their own wage or the wage of a co-worker is cut. Workers were assigned to groups of two, performed identical individual tasks, and received the same performance-independent hourly wage. Cutting both group members' wages caused a decrease in performance. But when only one group member's wage was cut, the affected workers decreased their performance more than twice as much as when both workers' wages were cut. This finding indicates that social comparison processes among workers affect effort provision because the only difference between the two wage-cut treatments is the *other* group member's wage level. In contrast, workers whose wage was not cut but who witnessed their group member's pay being cut displayed no change in performance relative to the baseline treatment in which both workers' wages remained unchanged. This indicates that social comparison exerts asymmetric effects on effort.

**JEL classification:** C93, J33, M53

**Keywords:** Compensation, Field Experiment, Social Comparison

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# 1. INTRODUCTION

The hypothesis that individuals' welfare and behaviour are affected by relative income has a long history in economics (Veblen 1899, Duesenberry 1949). More recently, several studies have indicated that happiness, job satisfaction and other reward experiences are affected by relative income comparisons (e.g. Clark and Oswald 1996, Luttmer 2005, Fliessbach, et al. 2007, Brown, et al. 2008, Clark, Kristensen and Westergard-Nielsen 2009, Card, et al. forthcoming). Evidence for the behavioural effects of social comparison is, however, still very scarce although they have received attention throughout the history of economics.

Social comparison processes among workers may, for example, play an important role both within firms and in the labor market. They may affect firms' internal pay structure, employee morale and thus firms' labor demand, firm boundaries, wage changes over time, and even the rate of unemployment.[1] The hypothesis that social comparison processes and associated fairness concerns affect the labor market dates back at least to Marshall (1890), Slichter (1920), and Hicks (1932). Practitioners have also observed that unjust inequalities in wages within a firm "break down morale, create individual dissatisfaction, encourage absenteeism, increase labor turnover and hamper production" (in Kochan and Barocci 1985, p.249).

We conducted a randomized field experiment in a firm by forming groups of two employees for a *one-time* sales promotion. The workers' task was to sell promotional cards that permitted entrance to specific nightclubs and bars on specific dates, yielding a clean measure of each worker's individual performance in terms of the number of cards sold. To handle the workers more efficiently, the firm formed groups of two workers, but both workers in each group were to perform the same individual tasks. The individual workers were also paid the same hourly wage during the first phase of the experiment. The formation of groups of two with identical tasks and identical pay made it very plausible that

[1] Several authors have pointed out these implications of social comparison effects. Among them are Akerlof and Yellen (1990); Babcock and Loewenstein (1997); Baron and Kreps (1999); Bewley (1999); Krueger and Mas (2004); Greenberg, Ashton-James and Ashkanasy (2007); Camerer and Malmendier (2007).

the two group members became natural comparison agents for each other, which set the stage for the second phase of the experiment.

The firm implemented three treatments in the second phase of the experiment. In the baseline treatment, the hourly wage was not changed relative to the first phase; in the general wage-cut treatment, the firm cut both group members' hourly wage by 25 percent; and in the unilateral wage-cut treatment, the firm cut only one group member's hourly wage by 25 percent. This design enables us to study social comparison effects by comparing the unilateral wage-cut treatment with the general wage-cut treatment and the baseline treatment. In particular, if workers who received a wage cut behave differently in the unilateral wage-cut treatment compared to the general wage-cut treatment, social comparison processes play a role in the disadvantaged workers' behaviour because the only difference between those two treatments is the *other* group member's wage. The same is true for the comparison between the workers in the unilateral wage-cut treatment whose wage was not cut and the workers in the baseline treatment: If the former behave differently than the latter, social comparison processes play a role in the advantaged workers' behaviour. Finally, our design also allows us to examine the impact of general wage cuts by comparing effort provision in the general wage-cut treatment and in the baseline treatment.

We observed that workers reduced their performance by 15 percent in the general wage-cut treatment relative to the baseline treatment, while those workers whose wages were lowered in the unilateral wage-cut treatment reduced their performance by 34 percent, i.e., by more than twice as much. This result suggests that social comparison can have a powerful and large effect on individual behaviour – although all workers who suffered a wage cut earned exactly the same wage, their performance was very different. Interestingly, workers whose wages were not cut in the unilateral wage-cut treatment neither reduced nor increased their performance relative to the baseline treatment.

In view of the one-time nature of the firm's promotion and the clear communication to the workers that they were only being hired for this campaign and that no future employment at the firm was possible, reputation effects or repeated game effects are unlikely to explain our results. It is thus plausible that the large performance reduction in the unilateral wage-cut treatment was driven by social comparison effects. The workers whose wage was cut in this treatment may have perceived their cut as much more unkind than a general wage cut. This interpretation is consistent with theories of intention-based reciprocity (Rabin 1993, Dufwenberg and Kirchsteiger 2004, Falk and Fischbacher 2006) if the notion of kindness – which is key in these models – includes payoff comparisons across different workers. In addition, we show in this paper that the theory of inequity aversion (Fehr and Schmidt 1999), which assumes that payoff comparisons between agents enter their utility functions, predicts all three empirical regularities: the reduction of performance in the general wage-cut treatment, the stronger reduction of performance in the unilateral wage-cut treatment for the workers whose wage was cut, and the absence of any change in performance for the workers whose wage was not cut in the unilateral wage-cut treatment. Thus, inequity aversion may also have played a role in workers' behaviour.

Our paper is related to observational studies that report a negative correlation between wage inequality within firms and workers' self-reported performance measures (Levine 1993, Pfeffer and Langton 1993). However, it is difficult to derive unambiguous causal conclusions from these data because the direction of causality could be the reverse – it is possible that performance differences caused wage differences. The results of a recent study based on a survey of university employees' self-reported job satisfaction is nicely related to our findings (Card, et al. forthcoming). That study found the employees' job satisfaction to be asymmetrically related to information about their colleagues' wages. Employees whose wage was below the median reported a decrease in pay and job satisfaction and a higher willingness to search for a new job, while satisfaction and the willingness to search remained unchanged for those whose wage was above the median. This observation is in line with our asymmetric findings from the unilateral wage-cut treatment – while the workers whose wage was cut responded with a strong decrease in performance, the workers whose wage was not cut did not respond at all.

Our paper is also related to the literature on gift exchange, social preferences and social connections in the labor market (Bandiera, Barankay and Rasul 2005, Gneezy and List 2006, Bellemare and Shearer 2009, Bandiera, Barankay and Rasul 2010, Kube, Maréchal and Puppe 2012a). These studies, however, do not examine the effect of wage comparisons among workers on effort because the studies either focus on *bilateral* gift exchanges between workers and firms in the absence of *horizontal* social comparisons between workers or they study the impact of social preferences and social connections on the effectiveness of financial incentives.

A small number of recent laboratory studies have studied the role of social comparison information in effort provision. For example, Charness and Kuhn (2007) conducted a laboratory gift exchange experiment with one principal and two agents who differed in their effort productivity. They report that information about the other worker's wage did not influence effort. Thöni and Gächter (forthcoming) implemented a similar treatment in which the laboratory workers did not differ in productivity. They find that wage comparison information reduces a subject's effort somewhat if the other worker earns considerably more (i.e., twice as much). Finally, Clark, Masclet and Villeval (2010) report results from a bilateral gift exchange experiment (with identical effort productivity across different firm-worker pairs) indicating that workers' ordinal wage rank in an experimentally constructed reference group has a positive impact on their effort. Causal evidence on this topic in field settings and when subjects are unaware of being observed is very scarce, however. In the field, perhaps the most difficult problem is finding *exogenous* sources of wage variations that trigger social comparison processes. In view of the fact that some economists have raised skepticism regarding the generalizability of results from the laboratory to the field (for a discussion, see List 2008, Falk and Heckman 2009), the demonstration of social comparison effects in the field seems important.

Our results may help to explain several important economic phenomena. Akerlof and Yellen (1990) have shown that social comparison processes may lead to involuntary unemployment. Furthermore, such processes may be a reason for the absence of two-tier labor markets. In principle, two-tier labor markets could be a method for lowering labor costs by paying lower wages to new hires who perform the same tasks as the incumbent workers. Airlines such as American Airlines, Delta, or Northwest introduced two-tier wage systems in the 1980s. These wage systems were, however, abolished in the 1990s because they appeared to have led to worker resentment and high turnover (Card 1997).[2] Social comparison effects could also be a reason for inefficient outsourcing decisions. Outsourcing part of the work force is likely to reduce social comparison between the incumbent and outsourced workers, which may make lowering wages easier. Due to savings in wage costs, outsourcing certain firm activities may be profitable, even if it causes an increase in other cost components. As a final example, social comparison effects may also cause a reduction in pay inequalities within the firm, which may be associated with smaller pecuniary performance incentives. Frank (1984), for instance, shows that automobile and real estate salespeople were paid less than their marginal product, that is, their commission schemes were flatter than they should have been in the absence of social comparison effects. Taken together, these examples suggest that social comparison among workers may have important implications for labor markets.

Finally, our evidence also provides insights into the effects of general wage cuts on performance. There is interesting previous evidence on this issue from interview and survey studies that are based on employers' counterfactual beliefs about the potential effects of wage cuts (Blinder and Choi 1990, Agell and Lundborg 1995, Campbell and Kamlani 1997, Bewley 1998). Direct behavioural evidence on this topic is, however, very scarce because it is very difficult to find non-experimental exogenous wage variations involving nominal pay cuts. In addition, because employers often fear that wage cuts will have detrimental effects on employee morale, they typically do not allow the implementation of wage-cut experiments. Fortunately, we were able to convince "our" employer to do so, enabling us to show that a general cut in the hourly wage reduces workers' performance. This evidence is related to the findings of Kube, Maréchal and Puppe (2012b), who show that workers' performance is lower when they are hired for a projected hourly wage of €15 but only receive €10 as compared to when they receive the projected €15. Among other aspects, the Kube, Maréchal and Puppe study differs from ours in that they did not implement work teams and could thus not study wage comparison effects, and, in addition, they did not cut wages in the course of an employment relation.

[2] Salpukas (1987) reports circumstantial evidence that two-tier wage systems in the airline industry "produced a resentful class of workers who in some cases are taking their hostility out on customers".

The remainder of this paper is organized as follows. The next section describes the economic environment in which the experiment took place. Section 3 presents our experimental design and Section 4 discusses various theories that predict social comparison effects. Section 5 describes our estimation strategy and presents the empirical results. Section 6 concludes the paper.

## 2. EXPERIMENT ENVIRONMENT

We collaborated with a small German firm that operates a nightlife web portal and sells a membership card permitting entrance to specific bars and nightclubs. Our field experiment is based on a short-term sales promotion aimed to make the firm's membership card more popular. Because the firm has a relatively small budget and was not able to finance a large-scale promotion campaign from internal or external funds, it was willing to let us conduct the experiment if we financed the larger part of the campaign in exchange. We seized this opportunity and enabled the firm to run a short-term promotion campaign in two big cities and to hire almost a hundred workers exclusively for this campaign.[3] The firm's willingness to conduct an experiment involving wage cuts was also due to the fact that the promotion workers did not belong to the firm's permanent staff and that the firm had no intention to hire any of the promotion workers after the campaign. The firm thus had no reason to fear effects on the morale of its own employees.

In each city, the sales promotion took place on two consecutive weekends. The promotion workers were hired to work two shifts on each of the two weekends – the first two shifts took place on Friday and Saturday evening of the first weekend, the third and fourth shift on Friday and Saturday evening of the next weekend. The workers were explicitly told that the promotion campaign would only take place on two consecutive weekends and that the firm was not seeking permanent employees. Thus, the promotion workers knew that none of them had a chance to become a permanent employee of the firm and that the campaign was strictly short-term. The workers' task was to sell

[3] To rule out potential influences of job applicants' past interactions with the firm's permanent staff, those applicants who knew a permanent employee were not hired.

promotional cards at a price of €5 or in exchange for a customer's personal information that enabled the firm to contact him or her afterwards. The personal information was recorded in a database and used to invite the customer to join the firm's nightlife web portal. By contacting the customers the firm could thus verify ex post whether the customer information the workers provided was correct. The workers were, however, not informed that the validity of the customer information would be checked.

Before the first shift, the workers were invited to a training session during which they were made familiar with the objective and procedures of the promotion campaign, trained on how to approach potential customers, and provided with equipment and clothing. In this training session, the workers were *randomly* allocated to groups of two and *randomly* assigned to be either "Worker 1" or "Worker 2" in a group.[4] Group members had identical tasks and responsibilities and they stayed together for the entire employment period, making the coworker in a group a natural reference agent.

Each group was assigned to a fixed location, which was either a shopping avenue or a large nightclub.[5] Because there is typically a large number of people (i.e., potential customers) at these locations, one worker alone would not nearly have been able to fully exploit the available opportunities of approaching people. In fact, not even two workers were able to do this. This feature of the task provided a natural reason to form groups while at the same time the two workers were assigned to different areas of the location in order to best "harvest" the potential customer pool. In this way we could form groups but still collect a meaningful performance measure – the number of sold cards – for each individual worker.

The workers were managed by group leaders who were permanent employees of the firm. A group leader was responsible for two to three groups during a shift. Before the work shifts, they supplied the workers with promotional cards and other equipment. During the shifts, they visited the locations in an unobtrusive way to check whether everything was going well and to assess various characteristics of the locations, such as the number of club

[4] During the training phase, each worker filled out a form for accounting purposes. These forms were marked "Worker 1" or "Worker 2" and randomly distributed to the group members.
[5] Working hours for shopping avenues were from 5 pm to 8 pm and for nightclubs from 11 pm to 2 am.

visitors (i.e., potential customers).[6] They had a comprehensive set of instructions on how to communicate with the workers. In particular, they were instructed to treat all workers in the same manner and they were not allowed to motivate or rebuke particular workers. After the shifts, the group leaders collected the revenues, the customer information collected by the workers, and the unsold cards.

## 3. EXPERIMENT DESIGN

We implemented a difference-in-difference setup. The first week – which we call the pre-intervention phase – allows us to capture the workers' baseline performance and therefore to control for individual heterogeneity. This is important because many field experiments report substantial heterogeneity in workers' abilities and emphasize the importance of controlling for it (Shearer 2004, Fehr and Goette 2007). During the first week, all workers were paid €12 per hour.

In the second week – which we call the post-intervention phase – we randomly assigned groups to one of three treatments. In the unilateral wage-cut treatment, denoted by HL, Worker 2's hourly wage was cut by €3, while Worker 1 continued to earn the previous hourly wage of €12. Treatment HL thus consists of two groups, that of low-wage workers (HL2) and that of high-wage workers (HL1). In the general wage-cut treatment, denoted by LL, both Worker 1 and Worker 2 in a group suffered a wage cut of €3. In the baseline treatment, denoted by HH, both Worker 1 and Worker 2 continued to earn the previous hourly wage of €12 (see Table [1] for a treatment overview).

[Table 1 here]

We stratified treatment assignment by city, location type, and gender to maximize the statistical power of the experimental design.[7] To avoid contamination between

[6] Team leaders had to ensure, for example, that the workers did not run out of cards to sell.

[7] We also stratified treatments across locations to control for random differences in time trends across locations. Therefore, we conducted the experiment at each location twice in two separate months, each month with 48 workers. At locations at which we had previously run Treatments HH or LL, we subsequently ran Treatment HL, and vice versa.

treatments, we arranged the work schedule so that workers from different treatments did not meet; furthermore, a few workers who knew each other were assigned to the same treatment but to different groups within the treatment. We also exclusively formed same-gender groups to avoid gender-related confounds. Importantly, the workers were unaware that they were participating in an experiment to rule out experimenter demand effects.

## 4. HYPOTHESES

How do workers respond to wage cuts? And how does their response depend on the wages paid to their coworkers? We have designed our experiment such that under the standard assumption that workers have exclusively self-regarding preferences they will not respond to a change in the hourly wage. In particular, the wage cut is implemented in such a way that we can rule out that it is perceived as a signal for the low-paid workers that they have a lower re-employment probability due to lower past performance or other personal characteristics. As already mentioned above, it was made transparent at the beginning that there was no prospect of employment at the firm beyond the promotion campaign. In addition, the workers had been randomly allocated to the position of Worker 1 and Worker 2 in the group upon entering the employment relationship. Thus, the workers perceived their allocation to the position of Worker 1 and Worker 2 as unrelated to any personal characteristics. The exogenous allocation to the position of Worker 1 or Worker 2 in combination with the announcement at the beginning of the post-intervention phase that *all* Workers 2 would receive a wage cut made it clear that the wage cut was unrelated to the previous performance of the workers. Therefore, effort variations in response to the wage cut cannot be interpreted as a response to a change in pecuniary incentives.

These features of the experiment also imply that efficiency wage incentives in the spirit of Shapiro and Stiglitz (1984) cannot play a role. According to this model, workers may respond to a wage cut with an effort reduction because workers lose less rent at the lower wage if they are fired. This model does not predict, however, that wage cuts reduce effort by more in Treatment HL than in Treatment LL because the model does not rely on any sort of social comparison or interdependence between workers. Moreover, because the employment contract lasted for exactly two weekends, there was no threat of firing.

The independence of current wages, future wages and future employment prospects from the workers' effort level thus implies that self-regarding workers have no reason to respond to the wage cut with a change in the effort level. If we assume, however, that workers are also motivated by fairness or reciprocity concerns, the predictions are different. Many social preference theories assume that workers compare their outcomes to fair reference outcomes in order to define measures of fairness or reciprocity (e.g. Rabin 1993, Fehr and Schmidt 1999, Dufwenberg and Kirchsteiger 2004, Falk and Fischbacher 2006). In other words, these theories typically rely in some form on assumptions about social comparison. According to intention-based reciprocity approaches, for example, workers may view a wage cut as a hostile act by the firm, and may consequently reduce their effort. The workers may view cutting only one worker's wage in a group as even more hostile, and this may further amplify the effort reduction.

Likewise, outcome-based considerations of fairness that are based on the comparison between the actual wage and a fair reference wage may also affect workers' fairness assessments and, therefore, their response to a wage cut. We show in the appendix, for example, that the Fehr and Schmidt model of inequity aversion makes specific, testable, predictions in our setting. However, we would like to mention that other social preferences approaches may make similar predictions. Thus, we do not view evidence that is consistent with these predictions as evidence in favor of a particular social preference model.

The Fehr-Schmidt model assumes that, in addition to their own material payoff, workers also want to avoid payoff inequalities between themselves and other workers, and the aversion against disadvantageous inequality ("envy") is stronger than the aversion against advantageous inequality ("compassion"). The model (see appendix) generates the following hypotheses about performance changes from the pre- to post-intervention phase if workers are sufficiently inequity averse:

(H1) Workers in Treatment Group HL2 decrease their performance after the wage cut more than those in Treatment LL.

(H2) Workers in Treatment Group HL1 do not change their performance relative to Treatment HH after their coworkers suffer the wage cut.

(H3) Workers in Treatment LL decrease their performance after the wage cut relative to workers in Treatment HH.

The intuition for these hypotheses is best developed if we start explaining (H3) first. Payoff equality between the two group members exists if both workers put forward the same effort and receive the same wage. Payoff equality between the firm and a worker exists if the workers' material payoff (measured by wage minus effort cost) is equal to the firm's profit from that worker (measured by revenue minus wage). In the equilibrium of Treatment HH, both group members choose an identical effort level that equalizes the payoffs across all three parties. Since the wage is lower in Treatment LL than in HH, the firm would have a payoff advantage if workers put forward the same effort in LL as in HH. After the wage cut, the two group members will therefore re-establish equality between themselves and the firm by reducing effort in Treatment LL.

Next, let us explain (H1). Why does the Worker 2 with low pay in HL provide even less effort than workers in LL? Suppose that Worker HL1 – whose wage is not cut – provides the same effort as in HH, and Worker HL2 puts forward the same effort as in LL. Recall that the same effort as in LL renders Worker HL2's material payoff equal to the firm's profit from this worker, but Worker HL2 now suffers from envy with respect to Worker HL1. By further reducing the effort (cost) below the level of Treatment LL, Worker HL2 can reduce the payoff disadvantage relative to Worker HL1, but this also generates a payoff advantage relative to the firm. However, because envy looms larger than compassion, it is better for Worker HL2 to reduce envy with regard to Worker HL1 and accept the small compassion cost with regard to the firm. Worker 2's effort in Treatment HL will thus be lower than in LL.

Why does Worker HL1 provide the same effort as workers in HH? The intuition for (H2) goes as follows. By increasing the effort above the HH level (i.e., by reducing her own material payoff), Worker HL1 would reduce the payoff advantage with regard to Worker HL2, but this would also cause a payoff disadvantage with regard to the firm. Because envy looms larger than compassion, a higher effort than in HH would therefore imply a large envy cost with regard to the firm and a small compassion gain with regard to the worker. As a consequence, Worker HL1 prefers providing the same effort as workers in Treatment HH.

Taken together, concerns for reciprocity or inequity aversion predict that (i) workers will respond to the general wage cut with an effort reduction and (ii) that the effort reduction will be even stronger in the event of a unilateral wage cut. Considerations of fairness and reciprocity are, of course, also one possible reason why workers provide positive effort in the absence of pecuniary performance incentives. However, this is not the only possible reason why workers may provide positive effort despite the absence of pecuniary incentives. They may perceive the task itself as interesting, i.e., they may have some intrinsic motivation to perform the task. In fact, *some* intrinsic performance motivation is perhaps the rule rather than the exception for tasks like ours that involve communicative skills and interactions with potential customers.[8]

## 5. ESTIMATION STRATEGY AND RESULTS

Our sample consists of 96 workers in 48 groups. None of the workers quit after the wage cut.[9] Table [2] shows that about three quarters of the workers were women and that the age ranged from 18 to 28 years. All but one were German citizens. On average, the workers exchanged 22.3 cards per shift and in 97.9 percent of these exchanges the customers provided personal information instead of paying €5 for the card. Since the firm verified the correctness of the customer information, we know that this information was wrong only in 2.2 percent of the cases. Because almost all customer information the workers provided was correct, a separate analysis of the quality dimension of effort is not informative. We therefore use the total number of "correct" exchanges as a measure of performance, i.e.,

[8] The presence and the economic implications of intrinsic task motivation are increasingly recognized in economics. See, for example, Ariely, Bracha and Meier (2009), Frey and Oberholzer-Gee (1997), Kreps (1997), Prendergast (2008) and Meier and Stutzer (2008).

[9] Three workers fell ill before any wage cut was announced and missed both post-intervention shifts. These workers were replaced by spare workers who were treated in exactly the same way as the replaced workers would have been treated. We exclude spare workers from the analysis, however.

we exclude those sales that are associated with wrong customer information from our performance measure.[10]

[Table 2 here]

We balanced the treatments over cities, location types (i.e., street versus nightclub), and gender. The pre-intervention phase enables us to control for worker heterogeneity by including individual fixed effects into our regression. Because workers were always assigned to the same location, individual fixed effects not only capture time-invariant differences across workers but also location-specific factors. In addition, we are able to include a proxy for the demand potential for cards as a control variable. Recall that the group leaders visited "their" groups several times during a shift. These visits allowed them to assess the number of potential customers for each group and shift on a 5-point scale (-2 = very low, 1 = moderately low, 0 = normal, 1 = moderately high, 2 = very high). We use this assessment to control for potential variations in demand across groups, shifts, and treatments. Therefore, we also report a specification in which we control for demand potential.[11]

Using the balanced panel data structure, we estimate the following difference-in-difference regression model with each worker as a panel unit and each group as an independent observation:

$$\log(y_{ikt}) = \alpha + \phi_i + \delta D_{kt} + \beta_1 t + \beta_2 (LL_i \times t) + \beta_3 (HL1_i \times t) + \beta_4 (HL2_i \times t) + \epsilon_{ikt}.$$

$\log(\mathrm{y}_{\mathrm{ikt}})$ denotes the logarithm of the average performance of worker *i* in group *k* and weekend *t*. The constant $\alpha$ captures average pre-intervention performance, $\phi_{\mathrm{i}}$ represents individual fixed effects, $D_{kt}$ controls for differences in demand potential, and *t* is a dummy variable that equals 1 if the observation is from the post-intervention phase and zero otherwise. The coefficient of the variable *t* thus measures the change in performance in the post-intervention phase relative to the average pre-intervention performance. The coefficients of the three interaction terms $LL_i \times t$, $HL1_i \times t$, and $HL2_i \times t$ are our

[10] The empirical results do not change if we analyze quantity without adjusting for quality.
[11] Note that we cannot reject the null hypothesis that demand was equally distributed across treatments (p = 0.23, Kruskal-Wallis test). However, controlling for demand potential enables a more precise estimate of the treatment effects. All p-values reported in this paper are two-sided.

difference-in-difference estimators of interest, as they capture the differences across treatments (relative to Control Treatment HH) in the performance change between pre- and post-intervention phase. Finally, $\epsilon_{\mathrm{ikt}}$ is the idiosyncratic error term, which we allow to be clustered over groups. As expected, the individual fixed effects are significant ($p < 0.01$, F-test).

Based on the estimation strategy described above, we can report the following result with regard to Hypothesis (H1), which involves a comparison between the unilateral and the general wage-cut treatment:

**Result 1:** A *unilateral* wage cut causes a much stronger decrease in performance than a general wage cut.

We illustrate this result in Figure 1, which presents the performance changes from pre- to post-intervention phase by treatment in percent of the pre-intervention average. Panel (H1) shows that there is a performance decrease of 5 percent between the two phases in Treatment LL while in Treatment HL2 workers' performance decreased by 16 percent. Thus, although workers in Treatment HL2 suffered the same monetary loss as workers in Treatment LL, their drop in performance was more than three times larger. This difference is already significant in the absence of further controls ($p < 0.05$, Mann-Whitney test). In addition, workers in HL2 also reduced their performance compared to their coworkers in HL1 who did not suffer the pay cut ($p < 0.01$, Wilcoxon signed rank test). Finally, the regressions in Table [3] further corroborate this finding. The first column in Table [3] represents the model above without controlling for demand potential, whereas we control for demand in the second column.[12] Regardless of whether we control for demand potential, the coefficients of "HL2 x Post-intervention" in the two regressions are highly significant; they indicate that the unilateral wage cut reduced HL2 workers' performance by 31 to 34 percent compared to Control Treatment HH ($p < 0.01$, t-test). Moreover, a

[12] When demand potential is included in the regression, the number of observations decreases by 10 because the demand measure is missing for some shifts. The team leaders forgot to collect this information in these cases.

comparison between the coefficient of “LL x Post-intervention”, which measures the impact of the wage cut in LL, and the coefficient of “HL2 x Post-intervention”, which measures the impact of the wage cut in HL2, shows that the reduction in HL2 is about 20 percentage points larger than that in Treatment LL – a difference that is significant ($p < 0.01$, Wald test).

Workers were assigned the role of Worker 1 and Worker 2 at the very beginning. However, some workers in Treatment HL may have erroneously thought that the wage cut was a consequence of their low previous performance relative to that of their coworker. If this were the case, workers should have reacted differently to the unilateral wage cut depending on whether they had performed better or worse than their coworker before the intervention. To test this, we divide workers in Treatment Group HL2 into those whose pre-intervention performance was higher than or equal to their coworker’s performance and those whose performance was lower. We find that both groups significantly reduce their performance in the post-intervention phase ($p = 0.04$ and 0.02, respectively, Wilcoxon signed rank test). In addition, the performance reduction in the two groups is not significantly different ($p = 0.49$, Mann-Whitney U).

Next we turn to the test of Hypothesis (H2), which involves a comparison between the workers whose wage is not cut in the unilateral wage-cut treatment and the workers in the baseline treatment:

**Result 2:** A *unilateral* wage cut has no effect on the group members whose wage is not cut.

First support for Result 2 comes from Panel (H2) in Figure 1. The panel shows that workers in Treatment HH display a performance increase between the pre- and the post-intervention phase, possibly due to learning effects. Interestingly, the workers in Treatment HL1 show almost the same performance increase as workers in Treatment HH ($p = 0.37$, Mann-Whitney U). In addition, both regression estimates of “HL1 x Post-intervention” in Table [3] confirm the finding that workers in Treatment HL1 did not perform differently than those in Treatment HH (p = 0.72 and p = 0.87, t-test). Thus, performing the same task but earning more than one's coworker is not associated with higher effort.

Finally, we turn to Hypothesis (H3), which involves a comparison between the general wage cut and the baseline treatment:

**Result 3:** A *general* wage cut causes a decrease in performance.

We illustrate this result again in Figure 1. Panel (H3) shows that performance in Control Treatment HH *increased* by 8 percent relative to the pre-intervention average. In contrast, performance in Treatment LL *decreased* by 5 percent after the wage cut, but without further controls, this difference is not significant (p = 0.37, Mann-Whitney U). We therefore turn to the regression in Table [3] which controls for demand potential. The coefficient of demand is highly significant (p < 0.01, t-test) and has the expected sign: The more potential customers present at a location, the more cards the workers were able to sell. Moreover, the adjusted $R^2$ increases substantially if we include the demand variable in the regression. Overall, these facts indicate that the number of potential customers is an important control variable that needs to be included in the regression.

The coefficient on "LL x Post-intervention" has a negative sign in both specifications reported in Table [3]. If we control for demand potential, performance drops by roughly 15 percent compared to Control Treatment HH. This constitutes a substantial and significant performance decrease (p = 0.07, t-Test).[13]

[Table 3 here]

[Figure 1 here]

[13] As mentioned earlier, we routinely report two-sided p-values in this paper. However, Hypotheses H1 and H3 are directional hypotheses, justifying the use of one-sided tests.

# 6. CONCLUSIONS

This paper reports evidence from a randomized field experiment on the behavioural effects of wage cuts and whether these effects depend on the wages paid to coworkers. We collaborated with a firm that hired workers for a one-time sales promotion. The firm formed groups of two, and the workers in a group had identical individual tasks. Group members were paid the same hourly wage in the first phase of the experiment. We subsequently implemented three treatments that enabled us to examine social comparison effects and the effects of wage cuts on performance. We find that cutting both group members' wages by 25 percent caused a decrease in performance by 15 percent relative to the baseline treatment. In contrast, cutting only one group member's wage by 25 percent caused a decrease in the performance of the affected workers by 34 percent, i.e., by more than twice as much as in the general wage-cut treatment, even though pay levels and the size of the pay cuts were identical in both treatments. The unilateral wage cut had an asymmetric effect on group members, that is, those workers whose wage was not cut neither decreased nor increased their performance relative to the baseline treatment.

Our results provide causal evidence for the role of social comparison processes among workers in effort provision. Such social comparison effects may have important consequences for a wide range of economic issues. They may induce employers to compress the wage distribution across workers, and, as demonstrated in Akerlof and Yellen (1990), they may even lead to involuntary unemployment. The key assumption in this model is that workers withdraw effort when their wage falls short of a "fair" wage, which depends on coworkers' wages because of social comparison processes. These processes thus provide a rationale for firms to pay efficiency wages to low-wage workers.

Social comparison processes may also be an important reason for firms' reluctance to implement two-tier wage systems. Two-tier wages systems seem to trigger considerable opposition from workers and rarely persist once introduced (Card 1997, Krueger and Mas 2004). Our results indicate that these phenomena may be due to social comparison processes that are caused by unequal pay for equally skilled workers who perform the same tasks.

Furthermore, social comparison may affect firm boundaries. For example, the success of a merger of different firms may strongly depend on whether workers compare their wages to those of the coworkers in the newly merged firm (Nickerson and Zenger 2008, Bartling and Von Siemens 2009). This is because a merger may change the set of reference agents, implying that after the merger some of the incumbent workers may earn less than their new colleagues and thus reduce effort accordingly. Kole and Lehn (2000) report circumstantial evidence from the airline industry. For example, U.S. Airways encountered unexpectedly high labor costs after taking over Piedmont Aviation because the former Piedmont workers threatened to strike if they did not receive the same generous wages as the U.S. Airways workers did. Our findings thus support the view that the boundaries of firms may not be driven by transaction costs or property rights concerns alone (Holmström and Roberts 1998), but that social comparison processes may also shape them.

In view of the potentially important role of social comparison processes in many economic phenomena, we believe that it is worthwhile to study them in more depth. Many exciting questions still remain to be answered. What are the determinants of individuals' comparison agents? How do various network structures (e.g., structures of friendship networks) determine individuals' comparison agents? How do organizational structures and social connections within and between firms affect the structure of comparison agents? To what extent can firms affect (e.g., through job design) an employee's comparison agents and what are the consequences for employee behaviour? Along which dimensions (wages, fringe benefits, promotions opportunities, etc.) do employees compare themselves and what is the relevance of the various dimensions? Thus, there is no scarcity of exciting research questions in this domain of research.

## I. Appendix: Prediction of workers' effort responses to wage changes

To analyze how workers respond to wage cuts and how their response depends on the wages paid to their coworkers, we present a simple framework that mirrors the experiment environment. Consider a firm that hires a group of two identical workers who have to perform identical individual tasks. Assume first that each worker *i* can generate a revenue for the firm by exerting costly effort $e_i$. The firm's payoff $\pi_i$ from worker *i* is the worker's revenue $ve_i$ less her wage costs $w_i$:

$$\pi_i = ve_i - w_i,$$

with $i \in \{1,2\}, v > 0$, $w_i \geq 0$ and effort $e_i$. For simplicity, we assume that minimal effort is given by $e_i = 0$. Now assume that worker *i*'s payoff is her wage less her effort costs $ce_i$ (measured below in money equivalent terms):

$$x_i = w_i - ce_i,$$

where the constant $c$ obeys $0 < c < v$. In our setup, wages are set independently of workers' effort and each worker knows her own wage and that of her coworker in the same group. In addition, workers have no prospect of future employment at the firm, implying that reputation or repeated game incentives cannot play a role.

With the standard assumption that only their own payoff enters workers' utility function, i.e. $U_i = x_i$, the analysis of their effort behaviour is straightforward: Because both explicit performance and reputation incentives are absent, a worker exerts the minimal effort, no matter what wage is offered to the worker and to the coworker in the group. The self-interest model thus predicts that neither wage cuts nor changes in coworkers' wages affect effort.

For tractability reasons, we use the model of inequity aversion developed by Fehr and Schmidt (1999) to study how social comparison processes and associated fairness concerns determine effort. In their model, inequity-averse workers dislike unequal payoffs. Thus, the utility function of worker *i* is given by

$$U_i = x_i - \frac{\alpha}{2}\max\{\pi_i - x_i, 0\} - \frac{\beta}{2}\max\{x_i - \pi_i, 0\} - \frac{\alpha}{2}\max\{x_j - x_i, 0\} - \frac{\beta}{2}\max\{x_i - x_j, 0\},$$

with $i \neq j$ and the assumptions $\beta \leq \alpha$ and $0 \leq \beta < 1$. Worker *i*'s utility is therefore the sum of her payoff and her disutility from both payoff differences between her and the firm, and her and her coworker *j*. The parameter $\alpha$ measures the extent to which workers suffer from receiving *less* than the firm or the coworker ("envy"), while $\beta$ measures the extent to which they suffer from receiving *more* than someone else ("compassion"). Hence, if both $\alpha$ and $\beta$ equal zero, workers only care about their own payoff and the model reduces to the standard economic model.

Because both explicit performance and reputation incentives are absent, the only incentive for inequity-averse workers to exert more than minimal effort is to reduce payoff differences. Consider first payoff inequality between worker *i* and the firm: [14]

$$|x_i - \pi_i| = |2w_i - (c+v)e_i|.$$

If worker *i* provides the minimal effort (i.e., $e_i = 0$), she creates a payoff advantage relative to the firm of $2w_i$. Conversely, if she exerts more than minimal effort, she reduces this inequality by simultaneously increasing the firm's payoff and decreasing her own payoff; one unit of effort reduces the firm-worker inequality by $c + v$ units. Thus, worker *i*'s effort that equalizes her and the firm's payoff is:

$$e_i^{x_i=\pi_i}(w_i) = \frac{2}{c+v} w_i \equiv e_i^F,$$

where $e_i^F$ denotes the effort level that equalizes $x_i$ and $\pi_i$ for a given $w_i$. Consider now payoff inequality between worker *i* and her coworker *j*:

$$|x_i - x_j| = |w_i - w_j - c(e_i - e_j)|.^{15}$$

[14] We assume that workers exhibit narrow bracketing, i.e., they evaluate the fairness of their transaction with the firm in isolation from other determinants of the firm's profit. Rabin and Weizsäcker (2009) find that about 90 percent of subjects in their sample bracket narrowly and there is also field evidence suggesting that this feature of decision making has important consequences for investment decisions (Barberis, Huang and Thaler 2006) and labor supply (Fehr and Goette 2007).

[15] Without loss of generality, let $w_i \geq w_j$.

Thus, by exerting effort, worker *i* can also influence the payoff inequality relative to her coworker. In contrast to firm-worker inequality, however, one unit of effort reduces worker-worker inequality by only $c$ units because a worker's effort affects the firm's payoff but not the coworker's payoff. Consequently, worker *i*'s effort that equalizes her and her coworker's payoff is:

$$e_i^{x_i=x_j}(w_i, w_j, e_j) = e_j + \frac{w_i - w_j}{c} \equiv e_i^C(w_i, w_j, e_j),$$

where $e_i^C$ denotes the effort level that equalizes $x_i$ and $x_j$ for a given level of $w_i, w_j$ and $e_j$. Before we proceed, it is useful to derive the non-pecuniary utility changes that are associated with changes in $e_i$. For example, if worker *i* is better off than the firm ($x_i \geq \pi_i$) and the coworker ($x_i \geq x_j$), then the non-pecuniary utility gain that arises from an effort increase by one unit is given by

$$\frac{\beta}{2}(c+v) + \frac{\beta}{2}c,$$

where the first term measures the non-pecuniary utility gain that arises from a reduction of the firm-worker inequality, while the second term measures the non-pecuniary utility gain associated with a reduction in worker-worker inequality. Likewise, if worker *i* is better off than the firm ($x_i \geq \pi_i$) but worse off than the coworker ($x_i < x_j$), then the non-pecuniary utility change that arises from worker *i*'s effort increase is given by

$$\frac{\beta}{2}(c+v) - \frac{\alpha}{2}c,$$

where the first term measures the non-pecuniary utility gain that arises from a reduction of the firm-worker inequality, while the second term measures the non-pecuniary utility loss associated with a further increase in worker-worker inequality. Thus, the amount of effort that inequity-averse workers provide depends strongly on the extent to which they care about payoff differences (i.e., on $\alpha$ and $\beta$). In view of this fact, the following statements will prove useful:

First, if worker *i* does not suffer much from advantageous inequity (i.e., $\beta$ is below a certain threshold $\underline{\beta}$), she will never exert more than minimal effort even if both the firm and the coworker are worse off (i.e., even if $x_i \geq \pi_i$ and $x_i \geq x_j$). In this case, the non-pecuniary utility gain from reducing a payoff advantage relative to both the firm and the coworker, $\frac{\beta}{2}(c+v)+\frac{\beta}{2}c$, never outweighs the associated cost of effort *c*:

$$\frac{\beta}{2}(c+v)+\frac{\beta}{2}c<c \quad \Leftrightarrow \quad \beta<\frac{2c}{2c+v}\equiv \underline{\beta}.$$

Second, we can derive a threshold value for $\alpha$, which we denote by $\overline{\alpha}$, such that if $\alpha$ is below the threshold $\overline{\alpha}$, the worker will always provide more than minimal effort, no matter how little effort the coworker exerts. In other words, if the worker does not suffer too much from disadvantageous inequity, she will always provide more than the minimal effort when she has a payoff advantage relative to the firm. To see this in more detail, assume that $x_i > \pi_i$ and $x_i \leq x_j$. The non-pecuniary utility increase associated with an effort increase in this case is given by $\frac{\beta}{2}(c+v)-\frac{\alpha}{2}c$. If this utility gain exceeds the marginal cost of effort, we have:

$$\frac{\beta}{2}(c+v)-\frac{\alpha}{2}c>c \quad \Leftrightarrow \quad \alpha<\beta\frac{c+v}{c}-2\equiv \overline{\alpha}.$$

In this case, worker *i* will increase effort as long as her payoff is higher than the firm's payoff, i.e., she will set $e_i = e_i^F$, but she will not exert effort above $e_i^F$. In fact, worker *i* will *never* increase her effort above $e_i^F$ (which would imply $x_i < \pi_i$) even if this would allow her to reduce a payoff advantage relative to her coworker. This is because the non-pecuniary utility change from a marginal increase in effort when $x_i < \pi_i$ and $x_i > x_j$ is given by

$$-\frac{\alpha}{2}(c+v)+\frac{\beta}{2}c,$$

which is always negative because envy looms larger than compassion ($\alpha \geq \beta$) and establishing payoff equality relative to the firm can be achieved more efficiently than relative to the coworker ($c+v>c$).

A third type of situation arises if workers suffer greatly from both advantageous and disadvantageous inequity, i.e., if both $\alpha$ and $\beta$ are above their threshold levels. Then both workers will try to equalize worker-worker payoffs. To see this, assume that $e_i^C \leq e_i^F$ and

$e_j^C \leq e_j^F$.[16] Suppose further that both provide effort levels $e_i^C \in [0, e_i^F]$ and $e_j^C \in [0, e_j^F]$, implying that both workers have equal payoffs. Because $\beta \geq \underline{\beta}$, neither worker is willing to individually *decrease* her effort because she would suffer too much from advantageous inequality relative to both the coworker and the firm. Similarly, because $\alpha < \overline{\alpha}$, neither worker is willing to individually *raise* her effort level because she would suffer too much from disadvantageous inequality with respect to her coworker, even if she can decrease advantageous inequality towards the firm. Thus, each pair of effort levels that equalizes worker-worker payoff is a Nash equilibrium. As shown above, the difference between effort levels that equalize the workers' payoffs is determined by the wage differential: $e_i^C - e_j^C = \frac{w_i - w_j}{c}$, implying that worker *i*, also provides more effort if she earns a higher wage than worker *j*. The boundaries of the continuum of Nash equilibria are given by worker *j*'s minimum effort level $e_j^{min} = 0$ and worker *i*'s maximum effort level $e_i^F = \frac{2}{c+v} w_i$.

**Description of Workers' Nash Equilibrium Strategies**

We are now able to characterize the three sets of Nash equilibrium strategies for worker *i* and her coworker *j* as a function of $\alpha$ and $\beta$:

(i) $\beta < \underline{\beta}$: $e_i^* = e_j^* = 0$

(ii) $\alpha < \overline{\alpha}, \beta \geq \underline{\beta}$: $e_k^* = e_k^F, k \in \{i,j\}$

(iii) $\alpha \geq \overline{\alpha}, \beta \geq \underline{\beta}$: $e_i^* \in \left[\frac{w_i - w_j}{c}, \frac{2}{c+v} w_i\right], e_j^* = e_i^* - \frac{w_i - w_j}{c}$

The effort implications of case (i) simply follow from the first statement above. If both workers have a low enough $(\beta < \underline{\beta})$, they will never increase their effort above the minimal level. The implications of case (ii) follow from the first and the second statement above: If $\beta$ exceeds the threshold value $\underline{\beta}$, each workers' motive to avoid advantageous

[16] This assumption means that the difference in wages is not too big such that workers can equalize their payoffs within the boundaries of $[0, e_i^F]$ and $[0, e_j^F]$. Note that the effort levels that equalize workers' payoffs is given by $e_i^C - e_j^C = \frac{w_i - w_j}{c}$. Because workers cannot provide negative effort and because they never provide more than $e_k^F$, $k \in \{i,j\}$, it is in principle possible they cannot achieve equality between their payoffs with their effort choices. We deal with this case below (see next footnote).

firm-worker inequality is sufficiently strong that each of them equalizes $x_i$ and $\pi_i$; this holds even if the provision of $e_k^F$ would imply disadvantageous inequality relative to the coworker as long as $\alpha$ is lower than the threshold $\overline{\alpha}$. In case (iii), effort levels are chosen in such a way that both workers' payoffs are equal. Thus, any common effort level between 0 and $e^F$ is a Nash equilibrium if wages are equal, while workers generally provide different effort levels in order to equalize their payoffs if wages are unequal. As a selection criterion in the case of a continuum of Nash equilibria, we make use of the concept of the coalition-proof Nash equilibrium (Bernheim, Peleg and Whinston 1987). The Nash Equilibrium concept rules out individual deviations that are unprofitable. The coalition-proof Nash equilibrium is more selective because it also rules out that subgroups coordinate and *jointly* deviate from equilibrium.

In case (iii), there are multiple Nash equilibria if $\frac{w_j}{w_i} \geq \frac{v-c}{v+c}$.[17] In particular, there are many Nash equilibria in which the two workers could form a coalition and coordinate their effort provision so that both of them are better off. Two possible coalition-proof Nash equilibria remain. Suppose first that workers care relatively little about advantageous inequality (i.e., a relatively low $\beta$, but one above $\underline{\beta}$), and, for simplicity, that wages are equal. If both workers provide a common intermediate effort level between 0 and $e_k^F$, this constitutes a Nash equilibrium because an *individual* worker faces compassion costs with respect to both the firm and the coworker if she decreases her effort. Both workers can, however, improve their situation if they form a coalition and agree to provide zero effort. By *collectively* moving to a new common effort level, they avoid non-pecuniary utility losses arising from worker-worker inequality. This way they incur only compassion costs with

[17] The condition $\frac{w_j}{w_i} \geq \frac{v-c}{v+c}$ follows from the following considerations. Suppose that worker *i*'s wage is high enough to induce effort $e_i^F = \frac{2}{c+v} w_i$ and that worker *j* receives a lower wage. The effort $e_j$ that equalizes workers' payoffs is then given by $e_j^C = e_i - \frac{w_i - w_j}{c} = e_i^F - \frac{w_i - w_j}{c} = \frac{2}{c+v} w_i - \frac{w_i - w_j}{c}$. Thus, $e_j^C \geq 0$ iff $\frac{w_j}{w_i} \geq \frac{v-c}{v+c}$. Note that worker *j* cannot equalize payoffs if $\frac{w_j}{w_i} < \frac{v-c}{v+c}$ holds. The reason for this is that *j*'s wage is so small relative to *i*'s wage that even at effort 0 *j* will earn less than *i*. In this "degenerate" case, there is only one Nash equilibrium left in case (iii): $e_i^* = e_i^F = \frac{2}{c+v} w_i$ and $e_j^* = 0$. In the following, we always assume that $\frac{w_j}{w_i} \geq \frac{v-c}{v+c}$.

respect to the firm, while saving on effort costs. Since this is true for every positive effort level, the only remaining equilibrium comprises zero effort by both workers.

The situation is only slightly more complicated if worker *i* receives a higher wage than worker *j*. Then the payoff equalization between the workers implies that worker *j* will provide zero effort and worker *i* exerts effort $e_i = e_i^C = e_j + \frac{w_i - w_j}{c} = \frac{w_i - w_j}{c}$.

The other corner solution obtains for high values of $\beta$, i.e., high disutility from advantageous inequality. If wages are equal, an *individual* worker will not increase effort from a common intermediate effort level because she would suffer from disadvantageous inequality relative to her coworker who does not deviate (recall that $\alpha \geq \overline{\alpha}$ in case (iii)). By increasing their effort levels *jointly*, workers avoid this envy cost while reducing compassion costs relative to the firm. The only surviving equilibrium entails maximum effort $e^F$ for both workers. Again, the situation is slightly more complicated if wages are unequal because payoff equalization then implies that the worker with the lower wage provides a lower effort level than $e_j^F$. With unequal wages, the worker who receives the higher wage (worker *i*) will provide $e_i = e_i^F$, while the low-paid worker will provide $e_j = e_j^C = e_i - \frac{w_i - w_j}{c}$.

Which corner solution prevails depends on the value of $\beta$. Since now we are considering deviations where both workers coordinate on an effort level that equalizes their payoffs, non-pecuniary disutility from worker-worker inequality vanishes from the equation. Suppose both workers provide an intermediate amount of effort. For each worker, an increase in the effort level by one unit entails a cost increase by *c* units and an increase in non-pecuniary utility by $\frac{\beta}{2}(c + v)$. Therefore, if $\frac{\beta}{2}(c + v)$ exceeds *c*, both workers will coordinate on an effort increase. If, instead, *c* exceeds $\frac{\beta}{2}(c + v)$, they will coordinate on an effort reduction. Therefore, the threshold value for $\beta$ that divides the two cases is given by

$$\frac{2c}{c + v} \equiv \overline{\beta}$$

We can now describe the two coalition-proof Nash equilibria. In case (iii.a), workers care only to some degree about advantageous inequity (i.e., $\underline{\beta} \leq \beta < \overline{\beta}$); thus, they equalize payoffs with each other but they are not willing to reduce the payoff advantage relative to the firm. As a result, they jointly reduce effort until the low-paid worker provides the minimal effort. In case (iii.b), workers suffer strongly under advantageous inequity ($\beta \geq \overline{\beta}$); they therefore equalize payoffs with each other and jointly increase their effort until the high-paid worker chooses $e_i^F$.

(iii.a) $\alpha \geq \overline{\alpha}, \underline{\beta} \leq \beta < \overline{\beta}$: $\quad e_i^* = \frac{w_i - w_j}{c} \geq 0, e_j^* = 0$

(iii.b) $\alpha \geq \overline{\alpha}, \beta \geq \overline{\beta}$: $\quad e_i^* = e_i^F, e_j^* = e_i^* - \frac{w_i - w_j}{c} \leq e_j^F$

**The Response of Inequity-Averse Workers to Wage Cuts**

How do inequity-averse workers respond to wage cuts? And how does their response depend on the wages paid to their coworkers? Suppose that wages can take on two levels, either high ($w_i = H$) or low ($w_i = L$ with $H - L \equiv \Delta > 0$). Consider first the Baseline Treatment HH where both workers receive the high wage in the post-intervention phase. In cases (i) and (iii.a), they both provide the minimal effort (i.e., $e_i^* = e_j^* = 0$) while they both exert effort that removes inequality between the firm and the workers in cases (ii) and (iii.b): $e_i^* = e_j^* = e_H^F = \frac{2}{c+v} H$.

Consider now Control Treatment LL, in which both workers receive the low wage in the post-intervention phase. Because they both earn the same wage, this situation is analogous to the situation in which they both receive the high wage. Thus, in cases (i) and (iii.a), both workers provide the minimal effort (i.e., $e_i^* = e_j^* = 0$) and in cases (ii) and (iii.b), they both provide $e^F$. However, $e^F$ is proportional to the wage, meaning that a lower wage implies lower effort (i.e., $e_L^F = e_H^F - \frac{2\Delta}{c+v} < e_H^F$).

Finally, consider Main Treatment HL, in which worker *i* receives the high wage and worker *j* receives the low wage. In case (i), the workers do not suffer much from a payoff advantage relative to the firm; thus, they both provide the minimal effort (i.e., $e_i^* = e_j^* = 0$). In principle, the low-paid worker may suffer from receiving less than her coworker; however, since she already provides the minimal effort she cannot withdraw further effort in order to reduce the payoff disadvantage relative to her coworker. In case (ii), the workers suffer greatly from their payoff advantage relative to the firm, implying that they both exert $e_k^F$. Thus, the high-paid worker provides $e_H^F$ and the low-paid worker provides $e_L^F < e_H^F$. Although the low-paid worker receives a lower payoff than her coworker in this case, she is not willing to reduce this inequality because it would generate a large payoff advantage relative to the firm. The high-paid worker is also not willing to reduce the payoff advantage relative to her coworker because it is never optimal to exert more than $e^F$.

In cases (iii.a) and (iii.b), workers generally equalize payoffs among themselves by choosing $e_k^C$. The workers in case (iii.a) suffer only to some extent from their payoff advantage relative to the firm ($\beta < \overline{\beta}$), implying that both of them would like to provide the lowest possible effort. However, only the low-paid worker actually provides the minimal effort because the high-paid worker would otherwise suffer from receiving more than both the firm and her coworker. Thus, the high-paid worker equalizes payoffs with her coworker by providing more than minimal effort $e_i^* = \frac{\Delta}{c}$, unless this effort level exceeds $\mathrm{e}_{\mathrm{H}}^{\mathrm{F}}$, in which case she chooses $e_H^F$. The workers in case (iii.b) suffer strongly under the payoff advantage relative to the firm ($\beta > \overline{\beta}$). The high-paid worker therefore provides $e_H^F$. Because workers also suffer greatly from payoff disadvantages (i.e., $\alpha \geq \overline{\alpha}$) in this case, the low-paid worker prefers equalizing payoffs with her coworker rather than with the firm in order to prevent her from receiving less than her coworker. Hence, the low-paid worker chooses $e_j^* = e_H^F - \frac{\Delta}{c}$ unless this value is negative, in which case she chooses the minimal effort (i.e., $e_j^* = 0$). Thus, the low-paid worker in case (iii.b) provides effort $e_H^F - \frac{\Delta}{c}$ in Treatment HL, whereas both low-paid workers provide effort $e_L^F = e_H^F - \frac{2\Delta}{c+v}$ in Treatment LL. This means that the low-paid workers in HL provide less effort than workers in LL because $\frac{\Delta}{c} > \frac{2\Delta}{c+v}$.

Now we can derive the hypotheses for the change in effort from pre- to post-intervention phase across treatments:

**Hypothesis (H1): Treatment LL**

(1a) If $\beta < \underline{\beta}$ or $\alpha \geq \overline{\alpha}, \beta < \overline{\beta}$: both workers' equilibrium effort remains the same.

(1b) Otherwise: both workers' equilibrium effort decreases.

**Hypothesis (H2): Group HL2**

(2a) If $\beta < \underline{\beta}$ or $\alpha \geq \overline{\alpha}, \beta < \overline{\beta}$: Worker 2's equilibrium effort remains the same.

(2b) Otherwise, Worker 2's equilibrium effort decreases.

(2b') If $\alpha < \overline{\alpha}, \beta \geq \underline{\beta}$: Worker 2's equilibrium effort is the same as in LL.

(2b'') If $\alpha \geq \overline{\alpha}, \beta \geq \overline{\beta}$: Worker 2's equilibrium effort is lower than in LL.

**Hypothesis (H3): Group HL1**

(3a) If $\alpha \geq \overline{\alpha}, \underline{\beta} \leq \beta < \overline{\beta}$ Worker 1's equilibrium effort increases.

(3b) Otherwise, Worker 1's equilibrium effort remains the same.

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## Tables and Figures

**Table [1]:** Hourly wages (in €)

| **Treatment** | **HH** | | **LL** | | **HL** | |
|---|---|---|---|---|---|---|
| **Group** | | | | | **HL1** | **HL2** |
| | Worker 1 | Worker 2 | Worker 1 | Worker 2 | Worker 1 | Worker 2 |
| Pre-intervention | 12 | 12 | 12 | 12 | 12 | 12 |
| Post-intervention | 12 | 12 | 9 | 9 | 12 | 9 |

**Table [2]:** Descriptive statistics

| **Treatment** | **HH** | **LL** | **HL** | | **Total** |
|---|---|---|---|---|---|
| **Group** | | | **HL1** | **HL2** | |
| Workers (#) | 24 | 24 | 24 | 24 | 96 |
| Female (#) | 18 | 18 | 19 | 19 | 74 |
| Age (mean) | 20.5 | 21.2 | 20.2 | 21.1 | 20.7 |
| Reported sick (#) | 1 | 1 | 0 | 1 | 3 |
| Cards sold (mean) | | | | | |
| Pre-intervention | 41.6 | 44.9 | 48.6 | 44.0 | 44.8 |
| Post-intervention | 45.5 | 42.7 | 53.1 | 36.8 | 44.6 |

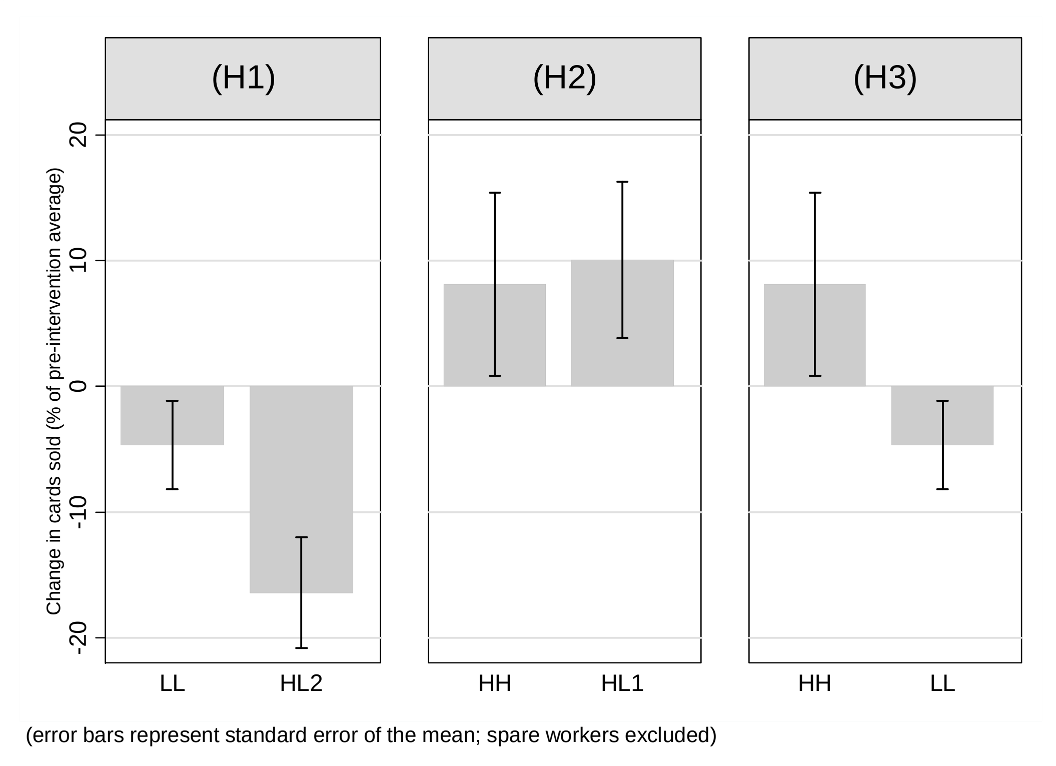
**Table [3]:** OLS regressions of treatment effects on individual work performance

| Dependent variable: log(cards sold) | (1) | (2) |
|---|---|---|
| Post-intervention | 0.058 | 0.090 |
| | (0.080) | (0.074) |
| LL x Post-intervention | -0.106 | -0.145* |
| | (0.090) | (0.079) |
| HL1 x Post-intervention | 0.034 | 0.015 |
| | (0.095) | (0.089) |
| HL2 x Post-intervention | -0.306*** | -0.342*** |
| | (0.103) | (0.101) |
| Demand potential | | 0.117*** |
| | | (0.034) |
| Constant[1] | 3.057*** | 3.048*** |
| | (0.015) | (0.015) |
| Individual Fixed Effects | Yes | Yes |
| *N* | 189 | 179 |
| Adj. $R^2$ | 0.202 | 0.312 |

Standard errors, clustered over groups, in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ according to two-sided t-tests

[1] The constant captures the logarithmic average performance in the pre-intervention phase.

**Figure [1]:** Average treatment effects on individual work performance




Panel (H1): Performance changes in Treatments LL (general wage cut) and HL2 (unilateral wage cut).

Panel (H2): Performance changes in Treatments HH (baseline) and HL1 (spared workers in the unilateral wage-cut treatment).

Panel (H3): Performance changes in Treatments HH (baseline) and LL (general wage cut).