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Topics

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A Cross-Cultural Real-Effort Experiment on Wage-Inequality Information and Performance

Abstract: We conduct a real-effort laboratory experiment to examine how disclosure of information about the pay received by co-workers affects work performance in Germany and China. We employ an individual piece-rate setting in which a piece rate is received for each unit of output successfully produced. We find that receiving information that one's co-workers are all receiving the same piece rate as oneself has no significant effect on performance compared to non-disclosure. In contrast, learning that one co-worker is receiving a higher piece rate than oneself does significantly affect performance. In particular, receiving such information initially results in a larger performance increase than receiving information that others are all receiving the same piece rate as oneself. However, this performance gap decreases toward the end of the experiment.

Keywords: inequity aversion, experiment, inequality, wage information, real effort, cross-cultural comparison
JEL Classification: C91, D63, J31, J33

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1 Introduction

The effect of information about the wages of co-workers on work performance is a matter of considerable interest, debate, and practical importance (e.g. Akerlof and Yellen 1990; Card et al. 2012; Clark and Oswald 1996; Milgrom and Roberts 1992). Some research supports the active promotion of salary transparency (Angelova, Güth, and Kocher 2012; Bierman and Gely 2004; Day 2007; Edwards 2005; Gely and Bierman 2003; Lawler 1967). For example, Lawler (1967) argues that pay secrecy can result in misperceptions of salary levels, which may increase pay dissatisfaction. He, therefore, suggests that organizations may be able to improve employee pay satisfaction by increasing pay transparency.

Other studies point to potential negative effects of wage transparency on work motivation and employee satisfaction (e.g. Bartol and Martin 1988; Burroughs 1982; Futrell and Jenkins 1978; Lawler 1967; Leventhal, Karuza, and Fry 1980; Lind and van den Bos 2002; Nosenzo 2013). If wages are unequal within one company or industry, revealing this information could induce horizontal social comparison, making some workers feel disadvantaged. Such a perception may result in stress, envy, and resentment. For example, Card et al. (2012) report the results of a survey concerning job satisfaction and job-search intentions for a randomly chosen subset of employees at the University of California (UC), some of whom were told how to access a new website listing the pay of UC and other public employees, while others were not informed about the availability of such pay information. They found that employees with salaries below the median for their occupation and job unit reported lower pay satisfaction and were more likely to be searching for a new job compared to similarly placed employees in the control group who did not receive instructions on accessing information about the pay of their co-workers. In contrast, those earning above the median exhibited no differences in pay satisfaction or in the likelihood that they were searching for a new job relative to similarly situated control-group employees.

The Card et al. (2012) study does not reveal whether income disclosure affected work performance. The primary purpose of our study is to examine the effect of disclosure on performance. Specifically, we use a real-effort laboratory experiment to study the effect on work performance of learning that a co-worker is receiving a substantially higher piece rate than oneself for the successful completion of an identical task. A growing experimental literature has examined the effects of disclosing information concerning differing rates of pay in the contexts of fixed salaries (Abeler et al. 2010; Clark, Masclet, and Villeval 2010; Cohn et al. 2011; Charness and Kuhn 2007; Gächter and Thöni 2010; Greiner, Ockenfels, and Werner 2011), a salary having both a fixed component and a component proportional to output (Güth et al. 2001), piece rates intertwined with team production (Bartling and von Siemens 2011), piece rates based on the number of attempts whether successful or not (Greiner, Ockenfels, and Werner 2011), and the assignment of fixed salaries for some and piece rates for others (Burchett and Willoughby 2004). In contrast, we focus on a very simple pay-for-performance compensation scheme: individual piece rates paid to each individual based on the number of correctly completed tasks. We contrast the effects of disclosure when all of one's co-workers are revealed to be receiving the same piece rate as oneself to the effects when one learns that one out of three co-workers is receiving a higher piece rate.

A secondary purpose of this study is to provide data on how disclosure affects work performance in two different countries: Germany and China. Cultural values and the socio-economic environment from which they stem may influence people's emotional and behavioral responses to wage-inequality information. In today's global environment, understanding the effect of culture and environment on reactions to the disclosure of inequality is especially important to understand and facilitate incentive-mechanism design within organizations located in different parts of the world. Indeed, a number of recent theory papers have emphasized the possibility that different culture-based attitudes toward inequality and fairness may be responsible for the prevalence of different compensation systems in different parts of the world (e.g. Bartling 2011, 184; Demougin, Fluet, and Helm 2006, 400). The socio-economic environment differs substantially between China and Germany. While China is a rapidly growing developing country, Germany is a mature industrialized country. Obvious and pervasive inequality has long been a fact of life in China. A recent study by the Survey and Research Center for China Household Finance Survey (2012) estimates a Gini coefficient of 0.61 for China using household survey data from 2010. This represents a very high degree of household income inequality. In contrast, according to the Eurostat Statistics on Income and Living Conditions (2012), the Gini coefficient for Germany was a much lower 0.29 in 2011, representing substantially less inequality than in China. People living in such different environments might well have differing reactions when they receive information indicating that they are receiving lower piece rates than their co-workers for identical work.

Most experimental research on the reactions of workers to disadvantageous wage inequality has used data from Europe or North America.[1] We know of no such studies comparing such reactions in Germany versus China. However, there are three experimental studies that compare aspects of economic behavior in Germany and China. While Herrmann, Thöni, and Gächter (2008) find very similar behavior among German and Chinese subjects playing a public goods game with individual punishment, Hennig-Schmidt and Li (2006) find that in the

1 Burchett and Willoughby (2004) is an exception. Their experiment was conducted in the United Arab Emirates.

context of asymmetric bargaining power, the more powerful player is able to dictate significantly higher payoffs in China than in Germany. Geng (2010) presents three experimental studies comparing the behavior of German versus Chinese subjects. She finds that in an incomplete contracting game, Chinese rely more on relational contracting than Germans. Moreover, she finds that in a bribery game, German behavior in a treatment using neutral, context-free instructions is identical to behavior in a treatment using contextual instructions that refer directly to bribery. However, Chinese exhibit bribery behavior less often when instructions are contextual than when instructions are context-free. In contrast, in a voting dictator game, voting for a dictator versus having the dictator randomly chosen makes no difference to behavior in either country. The presence or absence of a cultural impact on behavior thus appears to depend on the particular context under study. It is, thus, uncertain *a priori* and important to examine empirically whether or not reactions to the disclosure that one is receiving a lower piece rate than a co-worker are similar or different in a mature, more equal European country like Germany compared to a rapidly developing more unequal country like China.

This article proceeds as follows. Section 2 provides a review of the most closely related literature in order to provide context for our study and underscore its novel contribution. Section 3 presents the experimental design. Section 4 develops a theoretical framework based on Fehr and Schmidt's (1999) model of inequity aversion and uses that model to highlight the hypotheses being tested. The results are presented and discussed in Section 5. Section 6 concludes the article.

2 Related literature

Most of the experimental research on how knowledge of wage differentials affects work performance has involved fixed salaries or hourly wages in a gift-exchange framework. Charness and Kuhn (2007) conducted such an experiment with one principal and two agents who were endowed by the experimenter with different levels of productivity. Each principal chooses a fixed wage for each of the two agents. Agents choose costly effort from a menu, which indicates how much different levels of effort cost to the agent and how much revenue each effort level provides to the principal. Charness and Kuhn find that while agents' effort choices are highly sensitive to their own wages, they are not affected by whether or not they receive information about the other agent's wages. This is perhaps because different productivity levels are perceived as a justification for the principal to offer different wages to the two agents. Using a similar experimental design, Gächter and Thöni (2010) examine a case where the two agents are equally productive. They find that while disadvantageous wage discrimination leads to lower effort, advantageous wage discrimination fails to raise average effort levels.

Abeler et al. (2010) also match a principal with two agents. As in Gächter and Thöni (2010), agents face identical menus indicating the cost of effort and the resulting revenue for the principal. In contrast to Gächter and Thöni, the agents select their effort levels prior to the choice of a fixed wage by the principal. In one treatment, the principal must choose one identical wage for both agents. In the other, the wages are allowed to differ. The latter treatment results in significantly more effort. The authors see this as reflecting a greater concern for equity than for equality where equity requires that agents selecting higher effort levels be rewarded with correspondingly higher wage rates.

Clark, Masclet, and Villeval (2010) use a variant of the gift-exchange fixed-wage framework in which each principal is matched with a single agent. In a control treatment agents observe only the wage offer made by the principal with whom they are matched prior to selecting costly effort from a menu, while in an information treatment they are also informed of the wage offers made to four other agents by different principals. In the information treatment, there is a positive correlation between income rank and effort level with income rank being a better predictor of effort than distance of the agent's wage from the average wage of the four-person reference group.

Cohn et al. (2011) conduct a field experiment, collaborating with a firm that temporarily hired workers for a sales promotion. The promotion involved real effort, specifically selling promotional cards or exchanging them for personal contact information. Workers were assigned to teams of two and received a fixed hourly wage independent of their performance. When just one team member's wage was cut, the performance decrease for those who received the cut was more than twice as large as the performance decrease by each individual when both workers' wages were cut. This result is consistent with inequity aversion.

Some studies have also examined how knowledge of pay differentials affects the work performance in a pay-for-performance setting. An early article by Güth et al. (2001) introduces the matching of one principal with two agents who are endowed with different levels of productivity. Principals offer a contract to each of the two agents involving a fixed component that could be positive or negative and a variable component proportional to effort. Agents then select costly effort from a menu. A private treatment in which agents could observe only their own contract is compared to an information treatment in which they could also observe the contract offered to the other agent matched with the same principal. The authors point out that their sample sizes were small and that most agents chose the optimal, profit-maximizing level of effort regardless of treatment. However, there is some suggestive evidence that deviations from the profit-maximizing choice reflect horizontal fairness considerations in the information treatment. In particular, there is a tendency toward less (more) effort by agents offered a relatively less (more) favorable contract. Principals offered less asymmetric contracts in the information treatment.

Bartling and von Siemens (2011) examine the impact of wage inequality on participation and effort choices in team production, where each team member's income is positively related to both his/her own effort and the effort contribution of the other team member. Costly effort is selected from a menu. In contrast to some other studies, there is no third participant to act as a principal, focusing attention on a horizontal comparison between the two team members rather than a vertical comparison between agent and principal. The piece rate for each team member is randomly determined to be either high (0.5) or low (0.2) after selection of an effort level by each team member. There are two treatments. In the equal-wage treatment, the randomly determined piece rates are the same for each team member, while in the unequal-wage treatment, they always differ. The results show no significant treatment effects on either willingness to participate or effort choices in this team-production setting. The authors point out that in their design team members in the unequal-wage treatment are *ex-ante* identical in the sense that each of them has an equal chance of receiving the high or low piece rate. If subjects care only about *ex-ante* rather than *ex-post* piece-rate inequality, we should not expect any reaction to the treatment manipulation.

Burchett and Willoughby (2004) use a 5-minute real-effort task involving collation of stacks of paper and compensate their subjects using one of three possible payment systems: a low piece rate (1 United Arab Emirates Dirham per stack), a high piece rate (3 Dirhams per stack), and a fixed salary unrelated to performance (30 Dirhams). On average, subjects produce 3.46 stacks. Thus, the fixed salary of 30 Dirhams represents a considerably higher income than is possible under either piece rate. In the uninformed treatment, subjects know only about their own compensation system, while in the informed treatment they know about all three. Moreover, in the informed treatment, each subject is seated at a table with two other subjects, each of whom is being compensated by means of one of the alternative payment schemes. In the uninformed treatment, there are no significant differences in performance related to payment scheme. However, in the informed treatment, the high-piece-rate subjects produce significantly more while the fixed-salary subjects produce significantly less than in the uninformed treatment.

In Greiner, Ockenfels, and Werner (2011), identical wages are paid for the first part of an experimental real-effort data-entry task lasting 20 minutes. Agents are paired in the sense that each is informed that another agent is working on exactly the same data. In an otherwise identical second part, wage differentials are introduced by increasing the wage of one agent and reducing the wage of the other by the same amount. The authors employ a 2-by-2 factorial design. The first factor is whether one knows the wage of the person with whom one is paired, that is, private versus public information. The second is piece rate versus fixed salary. It is important to note that the piece rate depends only on the quantity of data entered, and not on its quality or accuracy. In the private information treatment, there are no significant differences in performance between the low and high wage earners under either the piece rate or the fixed salary. However, in the public-information case, agents offered the lower piece rate increase the quantity of data entered by significantly more than agents offered the higher piece rates, while simultaneously falling significantly behind in terms of quality. Being informed that another person doing exactly the same work is receiving a higher piece rate induces many disadvantaged subjects to retaliate by sacrificing quality to focus on income-increasing quantity. The analogous effects under the fixed-salary treatment are in the same direction but not significant.

Like the articles discussed above, we also investigate the effects of wage-inequality information on work performance. Specifically, we focus on whether agents adapt their effort levels in response to learning that another agent is earning a higher piece rate for the same work. Under piece rates, earnings depend directly on performance. Therefore, showing one's frustration at being unfairly treated by reducing effort as occurs in some fixed-salary (Gächter and Thöni 2010; Clark, Masclet, and Villeval 2010) or hourly-wage studies (Cohn et al. 2011) reduces one's own monetary income. Moreover, one can pursue a financial outcome closer to one's advantaged fellow workers by increasing effort. Indeed, we show in a simple theoretical framework based on Fehr and Schmidt (1999) that if inequity aversion focuses on differences in monetary incomes, knowledge that one is receiving a lower piece rate than another person in one's reference group will lead to an increase in effort and performance. Therefore, one might expect the receipt of wage-inequality information to have quite different effects on effort under a piece-rate than under a fixed-wage compensation scheme.

Bartling and von Siemens (2011), Burchett and Willoughby (2004), and Greiner, Ockenfels, and Werner (2011) all deal with piece rates. However, our article differs in important ways from these studies. Unlike Bartling and von Siemens (2011), there is no payoff interdependence in our experimental design. Thus, a reduction in effort cannot reduce another agent's income as in Bartling and von Siemens. Moreover, in our unequal-wage treatment, low-wage participants learn that they will face disadvantageous inequality prior to making their effort decisions and thus face *ex-ante* inequality in contrast to the *ex-ante* equality in Bartling and von Siemens. Finally, our subjects are given a real-effort task rather than being asked to select a level of costly effort from a menu.

In contrast to Burchett and Willoughby (2004), all of our participants receive one of two possible piece rates linked to performance. Thus, nobody is placed in the position of having to react to another participant receiving a completely different kind of compensation. In addition, we use a no-information treatment along with two different information treatments: one in which piece rates are equal and another in which they are unequal. Thus, we are able to separate any potential effects of receiving wage information that piece rates are equal from the effects of learning that another participant is receiving a higher piece rate. This is impossible in the Burchett and Willoughby framework. Finally, our experiment is divided into two parts with five work periods in each part. This allows us to examine the interaction of experience and repetition with reactions to different kinds of wage information about other participants. Burchett and Willoughby employ just one work period.

There are two important points of contrast with the Greiner, Ockenfels, and Werner (2011) piece-rate experiments. First, our piece rates are paid only for correctly produced output. Thus, it is not possible as in Greiner et al. to increase one's income by trading off quality to produce a higher quantity. While this feature of Greiner et al.'s design provides an obvious outlet for participants who feel unfairly treated, it is not realistic in many work situations where quality control is exercised. Second, Greiner et al. increase the piece rate by 60% for some subjects and decrease it by 60% for others in the second part of their experiment. Such wage changes are revealed to all subjects in their public-information treatment. Thus, it is unclear how much of the treatment effect on performance is due to the change in each participant's own piece rate and how much is due to the opposite change in the piece rate of the participant with whom one is paired. In contrast, in our study, the level of the piece rate is held constant for each subject throughout the experiment. Since our differing treatments only involve giving (or not) of information to participants about the equal or unequal piece rates being paid to their co-workers, we are able to isolate the effect of inequality information without the potential confound of a simultaneous change in a participant's own piece rate.

3 Experimental design

The experiment was run at Zhejiang University in Hangzhou, China and at Clausthal University of Technology in Clausthal, Germany. In both countries, participants were recruited by posting an announcement on an electronic university bulletin board and by announcements in large classes. A total of 316 undergraduate and graduate students (168 Chinese and 148 German) from various majors participated. The experiment was programmed and conducted using z-Tree software (Fischbacher 2007). Controlling stakes is one of the most challenging methodological issues in cross-country comparisons. We used the average wage for a part-time job on campus in each country to determine the payment levels for our experiment. The average hourly wage is about 10–15 RMB at Zhejiang University and 10–13 Euros at Clausthal University of Technology.[2] The exchange rate between experimental and real currency was set, so that 1 experimental cent equaled 0.01 RMB in China and 0.01 Euros in Germany. This resulted in average earnings of 17.20 RMB in China and 16.94 Euros in Germany. The experimental session lasted about 1 hour in both countries.

In the experiment, subjects were required to perform two kinds of tasks, labeled as task A and task B. Task A was to find the missing number in a series of numbers by discovering the pattern followed by the numbers in each series. Task B was to arrange a group of letters in alphabetical order.[3] In the experimental instructions, subjects were given detailed examples on how to perform these tasks.[4] In fact, neither task proved especially difficult for the subjects. Nonetheless, to perform the tasks successfully required the subjects to exert real effort. However, there were some differences in the educational background of the subjects in these two countries. Generally, Chinese participants can do especially well in task A, because Chinese education emphasizes mathematical skills from early childhood. German subjects are more familiar with the alphabet, because it is used to write German but not Chinese. Thus, they are good at

2 The exchange rate between Yuan RMB and Euro was around 9–10 at the time when the experiment was conducted.

3 For example, in task A the computer screen presented a series of numbers: "12, 10, 18, 54, 52, 60, 180, ___". Subjects were required to calculate the number after "180" according to the pattern revealed by the previous numbers. The relationship between the consecutive numbers is as follows: $12-2 = 10$, $10+8 = 18$, $18 \times 3 = 54$, $54-2 = 52$, $52+8 = 60$, $60 \times 3 = 180$. The algorithm repeated here is subtracting 2, adding 8, and multiplying by 3. Therefore, the right answer is 178 ($180-2 = 178$). In task B, the computer screen presented a series of letters, such as "H C D E K Q", and subjects were required to arrange these letters in alphabetical order. Thus, the correct answer is "C D E H K Q".

4 Instructions are available from the authors upon request.

task B. The purpose of using these two kinds of tasks was to ensure that for a given amount of effort the average performance summed over both tasks and hence the average experimental earnings would be similar between the two countries. Thus, we use the sum of task-A performance and task-B performance as our performance measure.

An experimental session lasted for 10 periods, and each period included two stages. In the first stage participants performed task A, while in the second stage they performed task B. Each stage lasted 120 seconds. When both tasks were finished, the computer screen would show each participant the number of attempts and the number of correct answers s/he had produced. The screen also indicated his/her earnings, which were determined by the number of correct answers for both tasks in the period and that participant's piece-rate wage. Thus, the more correct answers a subject provided, the higher would be his/her earnings.

Each subject participated in one of three treatments. In all treatments, subjects were informed that they were working on the same tasks. It was also explained that they had been randomly divided into groups of four, but that each participant would be compensated for their work through an individual piece rate for each unit of correctly produced output as explained above. Although different participants were paid different piece rates as outlined below, for each participant, the piece rate remained the same throughout all ten periods of the experiment. In both the No-Information (NO) control treatment and the Equal Piece-Rate Information (EPRI) treatment, all participants received a piece rate of six cents. In the Unequal Piece-Rate Information (UPRI) treatment, one member of each four-person group was randomly chosen to receive a piece rate of 24 cents, while the remaining three members received a piece rate of six cents. From periods 1 to 5, all subjects were informed only about their own piece rate and received no information about the piece rates paid to others. From period 6 onward, the treatments diverged in terms of information provision. In the NO treatment, periods 6–10 were conducted in the same manner as periods 1–5 with no information revealed about the piece rates of other participants. In contrast, in both the EPRI and UPRI treatments, the distribution of piece rates within each group was revealed to the whole group as public information at the beginning of period 6. While in the EPRI treatment, subjects learned that everyone else in their group was receiving a piece rate of six cents, in the UPRI treatment it was revealed that one group member had been randomly selected to receive a piece rate of 24 cents from the beginning of the experiment, while the other three were receiving the six-cent piece rate. The identity of each group member remained anonymous. The function of the groups was similar to that of the two-person teams in Cohn et al. (2011), the three differently-compensated persons sitting at the same table in Burchett and

Willoughby (2004), or the two agents informed that they are working on the same data in Greiner, Ockenfels, and Werner (2011), namely to establish a salient and concrete reference group for fairness comparisons. Subjects were also informed that every other group in their session faced the same distribution of piece rates.

4 Theoretical framework and behavioral predictions

Our experimental design was developed in order to focus on the low-piece-rate workers. In order to develop predictions about their behavior under the three treatments, we put forward a simple framework based on Fehr and Schmidt's (1999) influential inequity-aversion model and focusing on a piece-rate setting.

We start with a purely self-interested piece-rate worker. Such a worker would choose a level of effort, $e^* \geq 0$ to maximize the utility function:

$$U(e) = pv(e) - c(e), \tag{1}$$

where $v(e)$ is a production function linking output to effort with $v'(e) > 0; v''(e) \leq 0$, $c(e)$ is the cost of effort with $c'(e) > 0$, $c''(e) > 0$, and p is a piece rate paid per unit of output.

Taking the first-order condition and setting it equal to zero yields the maximizing level of effort, e^*, such that the marginal revenue product from effort is equal to its marginal cost:

$$U'(e^*) = pv'(e^*) - c'(e^*) = 0. \tag{2}$$

The assumptions on the functional forms $v(e)$ and $c(e)$ imply that e^* is a global maximum. Applying the implicit function theorem:

$$\frac{de^*}{dp} = -\frac{v'(e^*)}{U''(e^*)} > 0, \tag{3}$$

because $v'(e) > 0$ and $U''(e) < 0 \forall e$. We assume that if a participant in our experiment is unaware of the piece rates paid to other workers as in all ten periods of the NO treatment and the first five periods of both the EPRI and UPRI treatments, s/he chooses effort in such a self-interested manner.

Now suppose that a piece-rate worker, l, observes the piece rates of his co-workers. If all of his co-workers are being paid the same piece rate as s/he is receiving as in the EPRI treatment, we hypothesize that s/he experiences no inequity issues and thus continues to behave identically to a purely self-interested worker. In the context of our experimental design, this hypothesis implies that participants in the EPRI treatment will behave identically to those in the NO control treatment. However, suppose that as in treatment UPRI, s/he learns that while two other workers in his reference group are earning the same piece rate as s/he is being paid, p_l, one other worker, h, is being paid a higher piece rate, p_h. Defining:

$$S_l(e_l) \equiv p_l v(e_l) - c(e_l) \text{ and } S_h(e_h) \equiv p_h v(e_h) - c(e_h), \qquad [4]$$

we can apply Fehr and Schmidt's (1999) inequity-aversion utility function for l:

$$U_l(e_l, e_h) = S_l(e_l) - \alpha_l[S_h(e_h) - S_l(e_l)], \qquad [5]$$

where $\alpha_l \geq 0$ is the sensitivity of l to disadvantageous inequity with respect to the h player.

Since l cannot observe h's production function, $v(e_h)$, or his/her cost of effort function, $c(e_h)$, we assume that s/he acts as if they were identical to his/her own production and cost of effort functions and as if h were maximizing his/her own self-interested utility. In other words, l's initial point of comparison is based on what his/her own maximized self-interested utility would be if s/he were being paid a piece rate of p_h versus his/her maximized self-interested utility based on his/her actual piece rate, p_l. Starting at that point, we can then ask whether s/he can increase his/her utility by changing his/her effort.

Since $S_l(e_l^*) = p_l v(e_l^*) - c(e_l^*) < p_h v(e_l^*) - c(e_l^*)$ when $p_h > p_l$, and furthermore since $S_h(e_h^*) = p_h v(e_h^*) - c(e_h^*) > p_h v(e_l^*) - c(e_l^*)$ because e_h^* is the global maximizing level of effort for a piece rate of p_h, it follows that $S_h(e_h^*) > S_l(e_l^*)$, i.e. l experiences disadvantageous inequality when maximizing his/her purely self-interested utility function. Taking inequity aversion into account, s/he must maximize eq. [5], which can be rewritten as:

$$U_l(e_l, e_h) = [p_l v(e_l) - c(e_l)][1 + \alpha_l] - \alpha_l\left[p_h v(e_h^*) - c(e_h^*)\right]. \qquad [6]$$

Calculating the first-order condition with respect to $e_l$and setting it equal to zero, we find that l's welfare is maximized when

$$[pv'(\tilde{e}_l) - c'(\tilde{e}_l)][1 + \alpha_l] = 0 = [pv'(\tilde{e}_l) - c'(\tilde{e}_l)], \qquad [7]$$

i.e. his/her optimal effort is $\tilde{e}_l = e_l^*$, the same as in the self-interested case. Although his/her utility is reduced when s/he learns that another worker is receiving a higher piece rate, s/he can do nothing to ameliorate his/her situation. This is because the observation that another worker is being paid a higher piece rate does nothing to change either the marginal revenue product or the marginal cost of effort at e_l^*.

While this is a plausible outcome, it relies on the assumption embodied in eq. [5] that the quantity $S_l(e_l)$, the self-interested component of l's utility function, is also the relevant quantity for the equity comparison in the other-regarding component of the utility function. This need not be the case. In particular, suppose $S_l(e_l) \equiv p_l v(e_l) - c(e_l)$ as before, but

$$U_l(e_l, e_h) = S_l(e_l) - \alpha_l[p_h v(e_h) - p_l v(e_l)] = p_l v(e_l) - c(e_l) - \alpha_l[p_h v(e_h) - p_l v(e_l)]. \tag{8}$$

In this case, l compares the self-interested monetary earnings s/he would have received had his or her piece rate been p_h (or equivalently, h's self-interested earnings if h faced the same production and cost of effort functions as l) with his/her actual self-interested earnings at p_l. Since $p_h > p_l$, eq. [3] implies that $e_h^* > e_l^*$. Furthermore, since $p_h > p_l$ and $e_h^* > e_l^*, p_h v\left(e_h^*\right) > p_l v\left(e_l^*\right)$, and thus at the maximizing self-interested level of effort, e_l^*, l experiences disadvantageous inequality. At $e_l^*, p_i v'\left(e_l^*\right) - c'\left(e_l^*\right) = 0$. However, differentiating eq. [8] yields

$$\frac{dU_l}{de_l} = p_l v'(e_l) - c'(e_l) + \alpha_l p_l v'(e_l). \tag{9}$$

Thus, $\frac{dU}{de_l}\big|_{e_l^*} = \alpha_l p_l v'\left(e_l^*\right) > 0$. To maximize utility, e_l must increase so that

$$p_l v'(\tilde{e}_l)(1 + \alpha_l) - c'(\tilde{e}_l) = 0, \textit{ where } \tilde{e}_l > e_l^*. \tag{10}$$

There is a further constraint. For disadvantageous inequity aversion to exist, $p_l v(e_l) \le p_h v(e_h^*)$ If $\tilde{e}_l$ were to rise so high as to make this a binding constraint, the maximizing level of utility would be at $\bar{e}_l$ such that $p_l v(\bar{e}_l) = p_h v(e_h^*)$.[5]

It is possible that l would take account of the possibility that h may have an aversion to advantageous equity and accordingly adjust his/her effort downward. Even if l takes this into account, it would not affect the value of $\tilde{e}_l$. This is due to Fehr and Schmidt's (1999) simplifying assumption that α_l is a constant that does not depend on the difference between $p_h v(e_h)$ and $p_l v(e_l)$ as long as that difference is positive. However, taking account of h's possible aversion to advantageous inequity would reduce the level of e_l where the constraint

5 In an appendix, available from the authors upon request, we analyze this model more formally in a game-theoretic framework. We show there that when a Nash equilibrium such that $e_h = e_h^*$ and $e_l = \tilde{e}_l$ exists, that equilibrium is unique. However, if there is a Nash equilibrium such that $e_h = e_h^*$ and $e_l = \bar{e}_l$, other Nash equilibria may also exist for some parameter values. In those Nash equilibria, $e_h = e'_h > e_h^*$ and $e_l = \breve{e}_l$ such that $p_l v\left(\breve{e}_l\right) = p_h v(e'_h)$. Note that in any such equilibrium $\breve{e}_l > \breve{e}_l > e_l^*$. In the appendix, we also show that any such equilibrium is Pareto inferior to the equilibrium where $e_h = e_h^*$ and $e_l = \bar{e}_l$.

$p_l v(e_l) \leq p_h v(e_h)$ would be binding, and could lead to the possibility of multiple Nash equilibria, in each of which $p_l v(e_l) = p_h v(e_h)$.[6]

Is the variant of inequity-averse preferences in eq. [8] plausible and, therefore, worthy of study? We believe so. In eq. [8], a player uses $S_l(e_l)$ when assessing the own-benefit component of his/her payoff, taking account of his/her own costly effort. However, in the other-regarding component, s/he focuses only on the contrast between his/her own monetary income and the monetary income of his/her advantaged co-worker. This is consistent with many discussions of inequality, which frequently consider only the monetary incomes of others, without netting out the costly effort involved in obtaining those incomes. It is such gross monetary incomes for example that underlie the computation of Gini coefficients that economists themselves use to measure income inequality.

Whether or not people use only monetary incomes to make fairness comparisons or also take relative effort levels into account has been discussed in a number of recent theory papers on optimal contracts and inequity aversion (e.g. Bartling 2011; Englmaier and Wambach 2010; Itoh 2004; Rey-Biel 2008). Itoh (2004) analyzes both cases in a comparison of team versus relative performance

6 In an appendix, available from the authors upon request, we analyze more formally a game-theoretic model with both disadvantageous and advantageous inequities in the utility functions of both the h and the l players. We show there that if, for a set of parameter values, a Nash equilibrium in which l's monetary income is below h's monetary income exists, that equilibrium is unique with $e_l = \tilde{e}_l > e_l^*$. However, if, for a set of parameter values, a Nash equilibrium in which l's monetary income equals h's monetary income exists, there will in general be multiple equilibria. In all of those equilibria, l's monetary income will equal h's monetary income. Thus, in such equilibria, neither player is receiving disutility from any form of inequity. Any such equilibria for which the incomes of l and h are between l's self-interested maximum level of income, $p_l v(e_l^*)$, and h's self-interested maximum level of income, $p_h v(e_h^*)$, are not Pareto-rankable. This is because being closer to $p_l v(e_l^*)$ is better for l, while being closer to $p_h v(e_h^*)$ is better for h. In all such equilibria, $e_l \geq e_l^*$, qualitatively the same prediction as is given by the equilibrium where $e_l = \tilde{e}_l > e_l^*$. However, it is also possible that equilibria for which the incomes of l and h are equal exist outside of this range. We show in the appendix that any equilibrium in which the equal income levels of l and h are below $p_l v(e_l^*)$ will be Pareto-dominated by an equilibrium where the incomes of both l and h are equal to $p_l v(e_l^*)$. This is because there are no inequity considerations in either equilibrium since incomes are equal in both cases. However, at $p_l v(e_l^*)$, both l and h are closer to their self-interested maxima. Analogously, any equilibrium at an income level above $p_h v(e_h^*)$ will be Pareto-dominated by an equilibrium where the incomes of both l and h are equal to $p_h v(e_h^*)$. We thank an anonymous referee for suggesting we analyze the multiple equilibria that can arise in the case of both disadvantageous and advantageous inequities.

contracts and shows that which type of contract is more attractive to the principal depends in part on whether effort or only monetary income is considered in fairness comparisons. Bartling (2011) defines a parameter specifying the extent to which effort is incorporated into fairness comparisons. He argues that the extent to which effort is considered in such comparisons has an important impact on how social comparisons affect effort incentives under various types of compensation contracts. In particular, he shows that the less agents account for the disutility of effort in such comparisons, the greater is their incentive to exert effort under a variety of contracts including piece-rate contracts. Rey-Biel (2008) stresses that while theorists have modeled fairness comparisons both with and without effort, how agents actually behave is ultimately an empirical matter.

Our experiment directly addresses this empirical issue. In particular, we test whether low-piece-rate participants observing a high-piece-rate co-worker maintain the same effort levels as uninformed participants or increase their effort levels relative to those of uninformed participants. The former observation would be consistent with fully accounting for the cost of effort in making a social comparison, while the latter is consistent with focusing solely on monetary income when comparing oneself with others.[7]

In summary, we use our experimental design to test the following two null hypotheses:

Hypothesis 1: The change in the performance of subjects from the first to the last five periods of the EPRI treatment will be identical to the analogous change in the NO treatment.

Hypothesis 2: The change in the performance of low-piece-rate subjects from the first to the last five periods of the UPRI treatment will be identical to the analogous change in the EPRI treatment, consistent with utility function [6]. The alternative to this null hypothesis is that UPRI participants increase effort and performance relative to those in the EPRI treatment from the first to the last five periods, consistent with utility function [8]. Notice that both the null and the alternative hypotheses imply that UPRI participants do not decrease effort and performance relative to those in the EPRI treatment.

7 As in Bartling (2011), if the cost of effort is partially but not completely accounted for in assessing disadvantageous inequity, low-piece-rate participants would increase their effort levels relative to uninformed participants but not by as much as if the sole concern was a monetary-income comparison.

5 Experimental results

Table 1 presents the number of participants by country and treatment. Table 2 summarizes the performance results, also by country and treatment. In Table 2, we show the average performance levels in the first five periods separately from those in the last five periods, because in both the EPRI and UPRI treatments, participants began receiving information on the wages of others during the last five periods. The experiment was designed to focus on the performance of participants receiving the low piece rate under the three information treatments. Thus, there are relatively few high-piece-rate recipients, and they participate only in the UPRI treatment. However, in passing, we note that Mann–Whitney tests using one average performance number for each participant indicate no significant differences in average performance between the high-piece-rate recipients and the low-piece-rate recipients in the UPRI treatment for Germany during either the first ($p = 0.89$) or the last ($p = 0.88$) five periods of the experiment. For China, there is a marginally significant difference in the first five periods ($p = 0.08$) and a significant one in the last five periods ($p = 0.04$) with

Table 1: Session summary: number of subjects by country and treatment

	China	Germany
UPRI – high piece rate	20	18
UPRI – low piece rate	60	54
EPRI	60	44
NO	28	32

Table 2: Performance level by country and treatment: means with standard deviations in parentheses

	China		Germany	
	First five rounds	Last five rounds	First five rounds	Last five rounds
UPRI – high piece rate	11.96	15.92	12.73	16.96
	(3.52)	(3.74)	(4.22)	(6.63)
UPRI – low piece rate	13.89	18.79	12.68	16.95
	(4.69)	(5.76)	(3.84)	(5.96)
EPRI	12.82	16.94	12.1	15.71
	(5.01)	(6.06)	(4.60)	(5.74)
NO	13.03	17.56	11.74	15.43
	(2.78)	(4.07)	(5.23)	(5.79)

the low-piece-rate recipients exhibiting higher levels of performance in each case.[8] Thus, while for Germany the substitution and income effects of a higher piece rate seem to offset each other, for China income effects seem to dominate substitution effects. By comparing substitution and income effects, we do not mean to suggest that high-piece-rate recipients could leave the experiment early in order to experience more leisure. Rather the idea is that participants earning higher piece rates are able to slow down and work at a more comfortable, leisurely pace exerting less effort while still earning a reasonable amount of money. The data do not allow us to distinguish between this explanation and one based on a target-income model (e.g. Camerer et al. 1997; Crawford and Meng 2011; Farber 2008; Koszegi and Rabin 2006).[9]

To examine treatment effects for the low-piece-rate workers, we must account for the panel nature of the data. The dependent variable is the performance of each of the low-piece-rate participants in each of the ten periods. We cluster the errors by participant to account for the lack of data independence across periods.[10] We do a separate regression for each country. The independent variables are defined as follows.

Period is a simple time trend to account for learning. *Infotrmt* is a dummy variable that is zero for the NO treatment and one for the two treatments in which information is revealed about co-worker piece rates, EPRI and UPRI. *Upri* is a dummy variable that is one for the UPRI treatment and zero otherwise. The coefficients on *Infotrmt* and any interactions involving this dummy reflect differences between the EPRI and NO treatments, while the coefficients on *Upri* and

8 We also examine differences in average performance between high-piece-rate and low-piece-rate participants in a panel-data regression framework with clustered errors for each participant, analogous to the framework introduced below for comparing the performance of low-piece-rate participants among the different treatments. Despite a lack of statistical power owing to the small number of high-piece-rate participants, the results are consistent with the Mann–Whitney results. For Germany, they indicate no performance differences between high- and low-piece-rate participants. For China, they show a significantly lower increase in performance over time for the high- than for the low-piece-rate participants. These results are not reported here to save space, but are available from the authors upon request.

9 We thank two anonymous referees for this observation.

10 As a robustness check, we also ran the same regressions using two slightly different methods to account for the lack of independence across periods for each participant: in one, we used random effects for each participant and in the other we used a combination of both random effects and error clustering by participant. The coefficients are identical for each method, while the standard errors differ slightly. There are no qualitative differences in any of the statistical inferences obtained by any of the three methods.

any of its interactions reflect differences between the UPRI and EPRI treatments. *Lasthalf* is a dummy variable that is zero for the first five periods and one for the last five periods. Notice that in contrast to *Period*, which permits a linear time trend, *Lasthalf* allows for a discontinuity at the beginning of the sixth period when information about co-worker piece rates becomes available in the EPRI and UPRI treatments. The regressions also allow for a number of possible interactions.

The regression results are reported in Table 3, Panel A separately for Germany and China. Some F tests related to Hypotheses 1 and 2 are reported for each country in Table 3, Panel B. Table 4 reports F tests for both countries combined. Hypothesis 1 concerns a comparison of the improvement in

Table 3: Regression results on low-piece-rate subjects' performance

	Panel A: regression coefficients	Panel B: Joint F tests for hypothesis tests
1. German data		**1. German data**
Infotrmt	0.20 (1.06)	Preliminary Test 1: performance in the first five periods between the NO and EPRI treatments.
Upri	−0.11 (0.81)	
Lasthalf	2.05** (1.02)	*Infotrmt* = *Infotrmt* × *Period* = 0, $F(2,129) = 0.08$, $p = 0.92$.
Period	0.92*** (0.12)	Hypothesis 1 test: performance changes from the first to the second five periods between the NO and EPRI treatments.
Infotrmt × *Lasthalf*	−1.24 (1.41)	
Infotrmt × *Period*	0.06 (0.17)	*Infotrmt* × *Lasthalf* = *Infotrmt* × *Lasthalf* × *Period* = 0, $F(2,129) = 0.83$, $p = 0.44$.
Upri × *Lasthalf*	3.41** (1.43)	Preliminary Test 2: performance in the first five periods between the EPRI and UPRI treatments.
Upri × *Period*	0.23 (0.17)	
Lasthalf × *Period*	−0.37** (0.18)	*Upri* = *Upri* × *Period* = 0, $F(2,129) = 0.97$, $p = 0.38$.
Infotrmt × *Lasthalf* × *Period*	0.11 (0.23)	Hypothesis 2 test: performance changes from the first to the second five periods between the EPRI and UPRI treatments.
Upri × *Lasthalf* × Period	−0.49** (0.22)	*Upri* × *Lasthalf* = *Upri* × *Lasthalf* × *Period* = 0, $F(2,129) = 2.83$, $p = 0.06$.
Constant	8.98*** (0.86)	

(*continued*)

Table 3: (*Continued*)

	Panel A: regression	Panel B: Joint F tests for hypothesis tests
2. Chinese data		
Infotrmt	0.004	**2. Chinese data**
	(0.86)	Preliminary Test 1: performance in the first five periods between the NO and EPRI treatments.
Upri	0.27	
	(0.73)	
Lasthalf	2.71***	*Infotrmt* = *Infotrmt* × *Period* = 0, $F(2,147) = 0.09$, $p = 0.92$.
	(0.96)	
Period	1.31***	Hypothesis 1 test: performance changes from the first to the second five periods between the NO and EPRI treatments.
	(0.14)	
Infotrmt × *Lasthalf*	0.48	
	(1.26)	
Infotrmt × *Period*	0.07	*Infotrmt* × *Lasthalf* = *Infotrmt* × *Lasthalf* × *Period* = 0, $F(2,147) = 0.53$, $p = 0.59$.
	(0.18)	
Upri × *Lasthalf*	3.45**	Preliminary Test 2: performance in the first five periods between the EPRI and UPRI treatments.
	(1.40)	
Upri × *Period*	0.26	
	(0.17)	*Infotrmt* × *Lasthalf* = *Infotrmt* × *Lasthalf* × *Period* = 0, $F(2,147) = 1.40$, $p = 0.25$.
Lasthalf × *Period*	−0.59***	
	(0.17)	Hypothesis 2 test: performance changes from the first to the second five periods between the EPRI and UPRI treatments.
Infotrmt × *Lasthalf* × *Period*	−0.16	
	(0.21)	
Upri × *Lasthalf* × *Period*	−0.50**	
	(0.23)	*Upri* × *Lasthalf* = *Upri* × *Lasthalf* × *Period* = 0, $F(2,147) = 3.13$, $p = 0.04$.
Constant	8.67***	
	(0.77)	

Notes: Robust standard errors clustered by participant in parentheses. *, **, and ***: statistically significant at the 0.10, 0.05 and 0.01 levels, respectively.

performance from the first and to the last five periods in the EPRI versus the NO treatment. In the first five periods, these treatments are identical. Accordingly, random assignment of participants to treatments should ensure that there are no significant differences in performance or its evolution over time during the first half of the experiment. This implies that for each country both the coefficient on *Infotrmt* = 0 and the coefficient on the interaction *Infotrmt* × *Period* = 0. We begin by running some tests to verify that this is the case. An F test labeled Preliminary Test 1 in Panel B of Table 3 indicates that the joint null hypothesis cannot be rejected ($p = 0.92$) for Germany. This is also the case for

Table 4: Joint F tests for hypothesis tests on low-piece-rate subjects' performance

Preliminary Test 1: performance in the first five periods between the NO and EPRI treatments.
Both countries combined:

$Infotrmt = Infotrmt \times Period = 0$ (for Germany) AND $Infotrmt = Infotrmt \times Period = 0$ (for China), $F(4,277) = 0.09$, $p = 0.99$.

Hypothesis 1 test: performance changes from the first to the second five periods between the NO and EPRI treatments.
Both countries combined:

$Infotrmt \times Lasthalf = Infotrmt \times Lasthalf \times Period = 0$ (for Germany) AND
$Infotrmt \times Lasthalf = Infotrmt \times Lasthalf \times Period = 0$ (for China), $F(4,277) = 0.68$, $p = 0.61$.

Preliminary Test 2: performance in the first five periods between the EPRI and UPRI treatments.
Both countries combined:

$Upri = Upri \times Period = 0$ (for Germany) AND $Upri = Upri \times Period = 0$ (for China), $F(4,277) = 1.19$, $p = 0.32$.

Hypothesis 2 test: performance changes from the first to the second five periods between the EPRI and UPRI treatments.
Both countries combined:

$Upri \times Lasthalf = Upri \times Lasthalf \times Period = 0$ (for Germany) AND
$Upri \times Lasthalf = Upri \times Lasthalf \times Period = 0$ (for China), $F(4,277) = 2.98$, $p = 0.02$.

China ($p = 0.92$). A joint F test on these restrictions for both countries combined reported in Table 4 gives a consistent result ($p = 0.99$).[11]

We are now ready to examine Hypothesis 1 itself. We do so by utilizing a difference-in-difference approach. In particular, for each treatment, we need to determine how performance changes from the first to the second half of the experiment. If the changes in performance in the EPRI treatment are significantly different from those in the NO treatment, we can conclude that telling participants that their co-workers are all receiving the same piece rate as themselves affects effort and hence performance. In both the first and the last halves of each treatment, performance is modeled as a linear trend. There are, therefore, two dimensions in which performance can change. First, there can be a shift in the intercept. Second, there can be a change in the slope. The null hypothesis restricts both of these performance dimensions to be simultaneously

11 The tests on both countries combined reported in Table 4 are done by first running a regression for both countries combined, clustering the errors by participant. A dummy variable for country is used and interacted with each of the independent variables. To save space, the results of the regression itself are not reported here, because they are identical to the reported results of the regressions run separately for Germany and China. However, the hypothesis tests reported in Table 4 are based on this regression for both countries combined.

identical across treatments. It, thus, requires a joint F test. This null hypothesis implies that both the coefficient on *Infotrmt* $\times$ *Lasthalf* (the difference in the difference of the intercepts) $=$ 0 and the coefficient on *Infotrmt* $\times$ *Period* $\times$ *Lasthalf* (the difference in the difference of the slopes) $=$ 0. An F test for each country reported in Panel B of Table 3 reveals that Hypothesis 1 is not rejected for either Germany ($p = 0.44$) or China ($p = 0.59$). A further F test on these restrictions for both countries jointly reported in Table 4 yields a consistent result ($p = 0.61$). Thus, the disclosure of information that all of one's co-workers are receiving a piece rate equal to one's own does not affect the evolution of performance compared with non-disclosure.

Hypothesis 2 concerns a difference-in-difference comparison of performance from the first to the last five periods between the UPRI and the EPRI treatments. However, as with Hypothesis 1, we initially consider the first five periods. In the first five periods, no information about the piece rates paid to co-workers is disclosed, and, thus, random assignment should ensure that there are no treatment differences in performance or its evolution over time. This implies that both the coefficient on *Upri* $=$ 0 and the coefficient on the interaction *Upri* $\times$ *Period* $=$ 0. We run some tests to verify that this is the case. An F test for each country reported in Panel B of Table 3 indicates that the joint null hypothesis cannot be rejected for either Germany ($p = 0.38$) or China ($p = 0.25$). A further F test on these restrictions for both countries jointly reported in Table 4 gives a consistent result ($p = 0.32$).

We are now ready to focus on Hypothesis 2 itself. To do so, we compare the change in performance of the low-piece-rate recipients from the first to the last five periods in the UPRI versus the EPRI treatments. In the former, they learn that while two of the co-workers in their group are earning the same low six-cent piece rate as themselves, one is earning a higher 24-cent piece rate. In the latter, they learn that all of the co-workers in their group are earning the six-cent piece rate. As with Hypothesis 1, the null hypothesis is two-dimensional and thus requires a joint F test. The null hypothesis implies that both the coefficient on *Upri* $\times$ *Lasthalf* $=$ 0 and the coefficient on *Upri* $\times$ *Period* $\times$ *Lasthalf* $=$ 0. An F test reported in Panel B of Table 3 reveals that Hypothesis 2 is marginally rejected for Germany ($p = 0.06$) and rejected for China ($p = 0.04$). A further F test on these restrictions for both countries jointly reported in Table 4 also rejects the null hypothesis ($p = 0.02$). Thus, change in performance from the first to the last five periods differs between the UPRI and EPRI treatments.

Inspection of the relevant regression coefficients gives some insight into the magnitude of the change in performance for each treatment and indicates by how much these magnitudes differ from each other. In Germany, the intercept of the performance trend line shifts up by 4.22 in the UPRI treatment,[12] but only by 0.81 in the EPRI treatment.[13] Thus, the difference in difference for the intercept is 3.41 ($p = 0.02$), as indicated by the coefficient on *Upri* × *Lasthalf*. The slope of the performance trend line shifts down by 0.75 in the UPRI treatment[14] and by 0.26 in the EPRI treatment.[15] Thus, the difference in difference for the slope is −0.49 ($p = 0.03$) as indicated by the coefficient on *Upri* × *Lasthalf* × *Period*. In both treatments, the slope shifts downward. We conjecture that this occurs because there is presumably a limit on how well each person can perform within the prescribed time, represented by a very steep cost of effort at higher effort levels. When low-piece-rate workers find out that a co-worker is being paid a higher piece rate than themselves, they seem to put more effort into learning quickly to perform as well as possible, leaving less room for subsequent learning to improve their performance further. However, some learning continues to occur. In both treatments, the slope of the trend line remains positive. The results are similar in China. In the UPRI treatment, the intercept of the performance trend line shifts up by 6.64,[16] while in the EPRI treatment it

12 In the first five periods, the intercept for the UPRI treatment is *Constant* + *Infotrmt* + *Upri*. In the last five periods, the intercept for the UPRI treatment is *Constant* + *Infotrmt* + *Upri* + *Lasthalf* + *Infotrmt* × *Lasthalf* + *Upri* × *Lasthalf*. The difference between the intercept in the last versus the first five periods is *Lasthalf* + *Infotrmt* × *Lasthalf* + *Upri* × *Lasthalf* = 2.05 − 1.24 + 3.41 = 4.22.

13 In the first five periods, the intercept for the EPRI treatment is *Constant* + *Infotrmt*. In the last five periods, the intercept for the EPRI treatment is *Constant* + *Infotrmt* + *Lasthalf* + *Infotrmt* × *Lasthalf*. The difference between the intercept in the last versus the first five periods is *Lasthalf* + *Infotrmt* × *Lasthalf* = 2.05 − 1.24 = 0.81.

14 In the first five periods, the slope of the trend line for the UPRI treatment is equal to Period + *Infotrmt* × *Period* + *Upri* × *Period*. In the last five periods, the slope of the trend line for the UPRI treatment is equal to *Period* + *Infotrmt* × *Period* + *Upri* × *Period* + *Lasthalf* × *Period* + *Info* × *Lasthalf* × *Period* + *Upri* × *Lasthalf* × *Period*. The difference between the slope of the trend line in the last versus the first five periods is *Lasthalf* × *Period* + *Info* × *Lasthalf* × *Period* + *Upri* × *Lasthalf* × *Period* = −0.37 + 0.11 − 0.49 = −0.75.

15 In the first five periods, the slope of the trend line for the EPRI treatment is equal to *Period* + *Infotrmt* × *Period*. In the last five periods, the slope of the trend line for the UPRI treatment is equal to *Period* + *Infotrmt* × *Period* + *Lasthalf* × *Period* + *Info* × *Lasthalf* × *Period*. The difference between the slope of the trend line in the last versus the first five periods is *Lasthalf* × *Period* + *Info* × *Lasthalf* × *Period* = −0.37 + 0.11 = −0.26.

16 As in Footnote 12, the difference between the intercept in the last versus the first five periods for the UPRI treatment is *Lasthalf* + *Infotrmt* × *Lasthalf* + *Upri* × *Lasthalf*. For China, this equals 2.71 + 0.48 + 3.45 = 6.64.

shifts up by 3.19.[17] The difference in difference for the intercept is, thus, 3.45 ($p = 0.01$) as indicated by the coefficient on *Upri* × *Lasthalf*. The slope shifts down by 1.25 in the UPRI treatment[18] and by 0.75 in the EPRI treatment[19] for a difference in difference of −0.50 ($p = 0.03$) as indicated by the coefficient on *Upri* × *Lasthalf* × *Period*. Notice that the difference-in-difference values are virtually identical for Germany and China. Indeed, a joint F test of the difference in difference-in-difference values between the two countries cannot reject the null hypothesis that they are zero ($p = 0.99$).

6 Conclusions

In this article, we use a laboratory experiment to examine how disclosure of information about the pay being received by one's co-workers affects one's own effort and resultant performance. The study employs an individual piece-rate setting in which a preannounced piece rate is received for each unit of output successfully produced. We show that receiving information that one's co-workers are all receiving the same piece rate as oneself has no significant effect on performance compared to non-disclosure. Presumably, workers in the non-disclosure case assume that they are facing the same compensation system as their co-workers. Disclosing that this is indeed the case, therefore, does not affect their behavior.

In contrast, receiving information that while two of one's co-workers are receiving the same piece rate as oneself, one is receiving a piece rate that is four times higher does significantly affect performance. In particular, a difference-in-difference analysis reveals a larger performance increase early in the last half of the experiment when this information is received compared to the treatment in which the information reveals that piece rates are equal. This is coupled with a bigger drop in the rate of performance improvement from the first to the last half of the experiment in the unequal compared to the equal piece-rate treatment.

17 As in Footnote 13, the difference between the intercept in the last versus the first five periods for the EPRI treatment is *Lasthalf* + *Infotrmt* × *Lasthalf*. For China, this equals 2.71 + 0.48 = 3.19.

18 As in Footnote 14, the difference between the slope of the trend line in the last versus the first five periods for the UPRI treatment is *Lasthalf* × *Period* + *Info* × *Lasthalf* × *Period* + *Upri* × *Lasthalf* × *Period*. For China, this equals −0.59–0.16–0.50 = −1.25.

19 As in Footnote 15, the difference between the slope of the trend line in the last versus the first five periods for the EPRI treatment is *Lasthalf* × *Period* + *Info* × *Lasthalf* × *Period*. For China, this equals −0.59–0.16 = −0.75.

The extra effort to perform well that accompanies the disclosure that one is experiencing disadvantageous inequality thus seems to move one's best performance forward, leaving less scope for later improvement through experience.

In the context of our simple theoretical model based on Fehr and Schmidt's (1999) model of inequity aversion, these empirical results suggest that participants act as if they are comparing monetary incomes with their peers, neglecting or underweighting any potential comparison of the costs of effort. This empirical result, if supported in other contexts, has important implications for the design of optimal contracts that take into account equity considerations (e.g. Bartling 2011; Englmaier and Wambach 2010; Itoh 2004; Rey-Biel 2008).

This experiment was conducted in both Germany and China, because we conjectured that the kind of fairness comparisons made by participants and the resultant treatment effects on behavior might differ between a low-inequality country like Germany and a high-inequality country like China. This turned out not to be the case. In fact, the difference-in-difference results were almost identical for the two countries.

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