Fairness and Learning in Multi-Employee Gift-Exchange Games: An Experimental Analysis

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Abstract

We compare Abeler et al.'s (2010) multi-employee gift-exchange game to a single-employee environment and find a twofold effect. Under flexible wages, workers learn that higher effort pays off and exert more effort than in the single worker case. Without wage discrimination, effort is crowded-out: it is substantially smaller than in the single-employee treatment.

JEL Classification numbers: C91, C92, J41.

Keywords: Learning Behavior, Gift Exchange, Multi-Employees, Reciprocity.

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1 Introduction

A typical finding in gift-exchange games is that workers behave reciprocally exerting higher effort than predicted by theory (e.g., Fehr et al., 1993; 1998). Although, most of the literature considers games with one worker per employer, the case where one employer hires multiple workers is presumably more frequent in the field. Hence, gift-exchange games with multiple workers resemble a more realistic framework. These games may lead to negative or positive externalities, influencing reciprocity in a negative or positive way. Vertical fairness concerns may matter because firm profits are higher when generated by two workers. When employees are inequity averse they should exert lower efforts than in the one-worker game. Maximiano and Sonnemans (2007) compare a gift-exchange game with four workers to a setup with one worker. Workers moderately lower their effort when having co-workers, i.e., reciprocity is even stable in a four-worker treatment.

Abeler et al. (2010) study horizontal fairness concerns in a reversed gift-exchange game with two workers. The workers simultaneously decide on efforts before the employer chooses wages. The authors argue that wage regimes play a key role. In their individual wage treatment (IWT) wages are flexible, whereas under the equal-wage treatment (EWT) employers are bound to pay the same wage to both workers. In both treatments, workers may be susceptible to norm violations. An advantageous (disadvantageous) norm violation is defined as a situation where a worker has chosen a lower (higher) effort level than the co-worker but does not receive a lower (higher) wage. The paper nicely shows that this may impair reciprocity. In EWT, norm violations occur whenever the workers choose different effort levels. This induces significantly lower efforts as compared to the individual-wages treatment. However, in multi-employee environments, workers may also be affected by learning which may enhance effort levels. When a low-performing worker is matched with a high performing employee, she may realize that reciprocity "works" when her co-worker receives higher wages.[1] Low-performing employees may therefore increase the effort in subsequent periods.

The goal of our study is to disentangle the positive and negative externalities of co-workers from working alone. We extend Abeler et al.'s (2010) setup to a reversed gift-exchange game with a single-employee treatment (SET) which enables us to

[1] Gächter et al. (2010) report that second movers in a sequential one-shot multi-employee gift exchange game learn from first movers' actions.

isolate the impacts of co-workers on employees' effort choices. The data shows that working with a co-worker has a twofold effect, i.e., effort in the individual-wage treatment is never lower and sometimes even higher than in the single-employee treatment. Crucially, employers reward higher performing workers by paying higher wages and co-workers learn that it pays off to increase the effort. By contrast, working alone is superior to *EWT* where norm violations disrupt reciprocity.

2 Experimental Design

Our design is based on the reversed multi-employee gift-exchange game by Abeler et al. (2010). In the two-stage game two workers simultaneously choose an effort level between 1 and 10. Subsequently, one employer sets the wages. Workers' effort choices are costly (see Table 1).

Effort Level e	1	2	3	4	5	6	7	8	9	10
Costs $c(e)$	0	1	2	4	6	8	10	13	16	20

Table 1: Effort - Cost-of-effort relation

Each unit of effort exerted increases the principals' payoffs by 10 units. Employers decide on the wage payments to both workers after they have chosen their efforts. In *IWT* employers can pay different wages, whereas in *EWT* they are forced to pay equal wages to both workers. Our Single-Employee-Treatment (*SET*) is identical to *IWT* except only *one* worker is matched to an employer. To exclude wealth effects and to ensure comparability, we double employers' payoffs in SET (see Table 2). A random-matching routine is applied for 12 periods.

Since workers in *SET* work alone, norm violations can be ruled out. Thus, average effort levels in *SET* should be at least as high as in *IWT* and *EWT*.

Treatment	Payoff Employer	Payoff Worker
SET	$2(10e - w)$	$w - c(e)$
IWT	$10(e_1 + e_2) - (w_1 + w_2)$	$w_i - c(e)$
EWT	$10(e_1 + e_2) - 2w$	$w - c(e)$

Table 2: Payoffs

Our experiment was conducted in November 2010 at the University of Heidelberg

using z-Tree (Fischbacher, 2007) and ORSEE (Greiner, 2004). Our data involves four independent observations of *IWT* and nine of *SET*. We had 36 subjects in IWT and 54 in *SET*. Subjects' endowment was 400 points which served as a show-up fee. The profits were converted at an exchange rate of 0.01€/point. On average, subjects earned 10.33€. Abeler et al.'s (2010) *IWT* and *EWT* data (eight observations in each case) was generated in April 2005 at the University of Bonn.

3 Results

We test treatment effects with two-sided Mann-Whitney tests. Afterwards, we infer learning behavior with regressions.

3.1 Treatment differences

The data shows that the average effort level of *IWT* (8.09) is not significantly different as in Abeler et al. (2010) (8.21) ($p = 1.000$). We merge the *IWT* data for the subsequent analysis.[2] Figure 1 depicts the effort development over time.

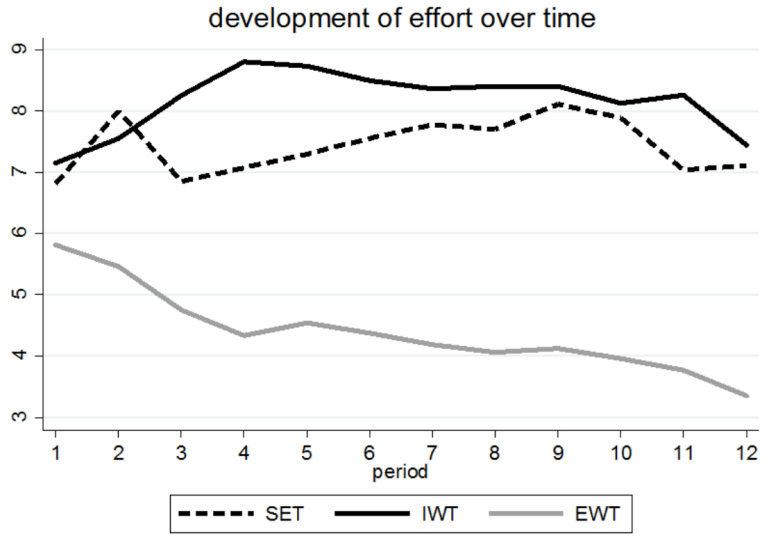

Figure 1: Development of effort over time in the three treatments

The highest average effort level (8.17) can be found in the multi-employee treatment with wage discrimination. In *SET* average effort (7.44) is moderately lower.

[2]Table 5 in the appendix presents a detailed periodical analysis.

We observe the lowest average effort level (4.39) in the absence of flexible-wage payments. Comparing the impacts of co-workers to *SET*, we find a converse effect: Performance is initially higher in *IWT*, whereas it is always smaller in *EWT*. The finding that effort in *IWT* is mostly higher than in *SET* is remarkable, as norm violations here are not possible.

A conspicuous finding is the pronounced effort increase (19%) in periods 1–4 of *IWT*. Whereas, in *SET* employees moderately increase effort (4%). In *EWT* performance substantially decreases by 25%. Table 3 summarizes workers' average effort levels.

Treatment	Periods 1-4	Periods 5-8	Periods 9-12	Overall
SET	7.19 (2.79)	7.58 (2.69)	7.54 (2.75)	7.44 (2.74)
IWT	7.94 (2.24)	8.50 (2.39)	8.06 (2.87)	8.17 (2.52)
EWT	5.09 (2.77)	4.29 (3.01)	3.80 (2.90)	4.39 (2.94)

Table 3: Average effort levels. Standard deviations in parentheses.

Workers exert in periods 1-4 of *IWT* a significantly higher effort level (7.94) than in *SET* (7.19) ($p = 0.050$) and *EWT* (5.09) ($p < 0.001$). *IWT* always leads to higher effort than in *SET* and *EWT*.[3] In *EWT* effort is significantly smaller in periods 5-8 and 9-12 than in *IWT* and *SET*.[4] Contrary to the expectation that the absence of norm violations leads to higher efforts in *SET*, we find that employees' performance is smaller than in *IWT*, but significantly higher than in *EWT* ($p = 0.001$). Average effort in *SET* is moderately lower (7.44) than in *IWT* (8.17).[5] The performance in *IWT* is significantly higher in *SET* (7.44) than in *EWT* ($p < 0.001$).

Result 1:

The impact of the second employee is twofold:

a) Effort in IWT is initially higher and never lower than in SET.

b) Effort in EWT is significantly smaller than in SET.

[3]The differences between *IWT* and *SET* are insignificant in the course of the game.

[4]A Mann-Whitney test yields for periods 5-8: $p < 0.001$ (IWT); $p = 0.003$ (SET) and for periods 9-12: $p < 0.001$ (IWT; SET)

[5]The difference is not significant ($p = 0.255$).

3.2 Regression analysis: Learning Behavior

We investigate the twofold effects by running separate GLLAM-OLS regressions (sub samples of the treatments are used) focusing on the time dynamics of effort.[6] Standard errors are adjusted by clustering at the match-group and subject level.

	average effort		
	SET	IWT	EWT
	(1)	(2)	(3)
lagged wage	0.050***	0.035***	0.072***
	(0.007)	(0.004)	(0.007)
period	0.136	0.341***	-0.117
	(0.183)	(0.114)	(0.136)
period squared	-0.010	-0.026***	0.002
	(0.128)	(0.008)	(0.010)
own data	-	-0.038	-
	-	(0.364)	-
constant	5.981***	6.365***	3.668***
	(0.602)	(0.413)	(0.473)
observations	297	792	528
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Table 4: OLS-GLLAM regressions on average effort.

The independent variables are: *lagged wage* (previous period's wage payment), *period*, *period squared* (variables controlling for the time dynamics), *own data* (a dummy controlling for differences in our and Abeler et al.'s *IWT* data).

Lagged wage is always highly significant and positive. Thus, effort levels in all treatments are triggered by wages of previous periods. Regression 1 highlights that effort does not significantly increase over time when working alone. Whereas, in *IWT period* is highly significant and positive, documenting that employees learn to exert higher efforts over time. The time coefficient is not significant for *EWT*, even though Figure 1 reports a pronounced negative time trend. Regression 3 shows that this phenomenon appears to be entirely captured by *lagged wage*.

To understand the role of co-workers, we investigate the learning dynamics of two workers in more detail. Figure 2 depicts whether workers' effort in the multi-worker

[6]The results hold for random and fixed effects panel regressions.

treatments has increased, is unchanged, or has decreased in the subsequent period. We condition on two cases comparing workers payoff to their co-workers: workers have a lower payoff, workers have an equal/higher payoff.

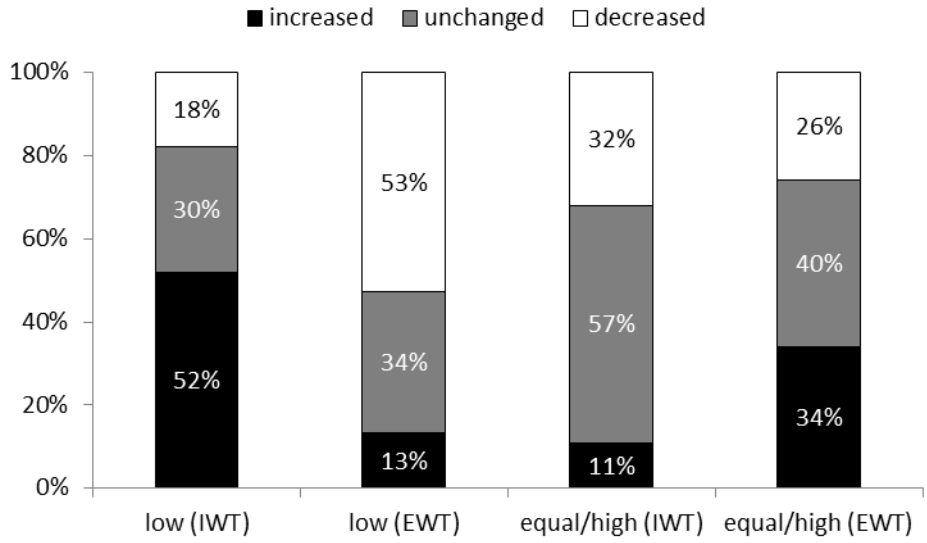

Figure 2: Employees' reactions to co-workers' effort choices

In *IWT* the majority of low-profit employees (52%) increases the effort in the subsequent period. Workers seem to learn from co-workers, i.e., 30% imitate their co-worker's effort.[7] Employers in *IWT* trigger effort comparisons between workers, i.e., they pay in 84% of the cases higher wages to the better performing employee. In *EWT* only 13% of low-profit employees increase their effort, whereas the majority (53%) decreases it. The latter findings explain the twofold effect of working with co-workers under flexible and non-flexible wage payments. Focusing on high-profit employees in the two treatments, we find a similar pattern, i.e., 68% choose equal/higher efforts in *IWT*, whereas 74% do it in *EWT*.

Result 2:

Learning behavior drives the twofold effect:

a) In IWT (EWT) effort levels increase (decrease) over time.

b) No conspicuous effort development can be observed in SET.

[7]Imitation is a common finding in experiments (Offerman and Sonnemans, 1998; Huck et al., 1999).

4 Conclusion

We compared the effects of multi-employee with single-employee workplaces. Our results adequately replicate Abeler et al.'s (2010) data. Working with co-workers is twofold as compared to the single-worker case. In *IWT*, effort is sometimes even higher, i.e, low-performing employees learn that it pays off to exert effort, thus effort increases over time. Learning behavior seems to overpower the negative effects of norm violations. Whereas, in *EWT* many norm violations occur, i.e., high-performing workers learn that higher efforts are not rewarded. The finding is of importance as most workplaces are organized with more than worker.

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Appendix

	Data Source		MWU-test
Period	Benndorf & Rau	Abeler et al.	$p-value$
1	7.67 (2.22)	6.90 (2.35)	0.146
2	7.67 (2.10)	7.50 (2.33)	0.798
3	7.92 (2.60)	8.42 (2.00)	1.000
4	8.75 (2.05)	8.83 (1.72)	0.932
5	8.13 (2.56)	9.04 (1.53)	0.544
6	8.25 (2.56)	8.63 (2.06)	0.733
7	8.17 (2.62)	8.46 (2.72)	0.603
8	8.33 (2.51)	8.44 (2.75)	0.798
9	8.08 (2.36)	8.56 (2.40)	0.609
10	8.04 (2.94)	8.17 (3.03)	0.670
11	8.04 (2.79)	8.38 (2.88)	0.607
12	8.00 (2.87)	7.17 (3.34)	0.306

Table 5: Average effort levels in IWT: Data of Benndorf and Rau (2014), and Abeler et al. (2010). Standard deviations in parentheses.

Appendix: Instructions (MET)

Welcome to this experiment on decision making.

Please read these instructions carefully. At the end of these instructions you will be asked to answer several control questions. The experiment will begin as soon as each participant answered the control questions correctly. The experiment is anonymous, i.e., you will not get to know with which other participants you are interacting.

During the experiment you can earn „Experimental Currency Units" (ECU). Your earnings depend on your decisions and on the other participants' decisions as well. After the experiment the ECUs will be **converted into Euros** at the following **exchange-rate**:

1 ECU = 1 Cent

Please wait at your desk until we ask you to come to receive your payment. After the experiment, please bring all the documents we handed out to the place where you will receive your payment.

You begin with a starting capital of **400 ECUs (€4,-)**. It increases if you make profits and it decreases if you experience losses during the experiment. Note, that you can always rule out the possibility of making losses by your own decisions.

Please also note that you must not talk to the other participants during the experiment. In this case we need to abort the experiment immediately. **If you have any questions please raise your hand and we will answer them personally.**

Appendix: Instructions (MET)

In this experiment participants either act as an **employer** or as an **employee**. At the beginning of the experiment, you will be randomly assigned one of these roles. Your role does not change during the experiment.

The experiment will be repeated for **12 periods**. In each period participants are randomly divided into groups of three people. Each group consists of one **employer** and of two **employees** called employee 1 and employee 2. Your decisions are only reported to the other two members of your current group. The other participants are not informed about your decisions.

Each period comprises two stages. In the **first stage employee 1 and employee 2 each choose an effort level**. Their decision is independent of the other employee's decision. There are ten different effort levels the employees may choose. **The lowest possible effort level is 1 and the highest one is 10**. Each unit of effort exerted by an employee produces 10 ECUs for the **employer**. For instance if the effort level is 1 the employer will receive 10 ECUs, if the effort level is 2 the employer will receive 20 ECUs, etc. If the effort level is 10 the employer receives 100 ECUs.

Choosing an effort level is costly for the employees. The higher the effort level, the higher the corresponding costs. However, the costs only depend on the effort level an employee chooses for himself. The effort level chosen by the other employee does not affect the costs. For an employee, the costs of choosing an effort are as follows:

Effort level:	1	2	3	4	5	6	7	8	9	10	
costs:	0	1	2	4	6	8	10	13	16	20	ECUs

Thus, choosing an effort level of 1 does not provoke any cost for the employee. Choosing a level of two costs 1 ECU, etc.; choosing a level of 10 costs 20 ECUs. All employees have the same cost table and it is the same for all periods.

Appendix: Instructions (MET)

In the **second stage** the employer is informed about the effort choices of employee 1 and employee 2. After that the employer chooses wage payments w1 and w2 for employee1 and employee2, respectively. The wage payments for the employees may either be equal or different. A wage payment for an employee must not be lower than 0 ECUs and it must not exceed 100 ECUs.

At the end of a period both employees and the employer are informed about the effort levels, about the wage payments and about the resulting profits.

Thus, in each period, a participant's profit in ECUs is as follows:

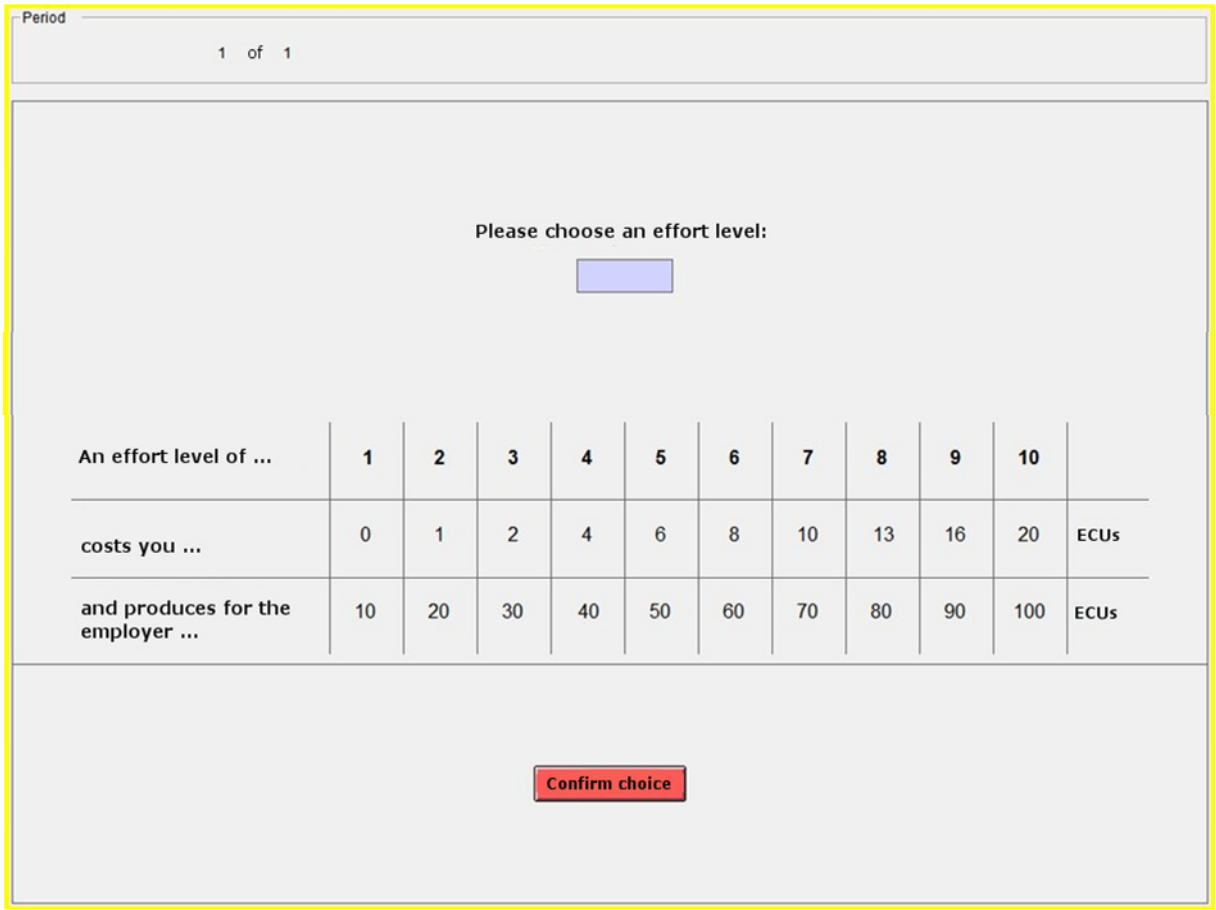
Employer's profits	=	10 x effort level chosen by employee 1 + 10 x effort level chosen by employee 2 – wage payment for employee 1 (w1) – wage payment for employee 2 (w2)
Employee 1's profits	=	wage payment for employee 1 (w1) – cost of effort chosen by employee 1
Employee 2's profits	=	wage payment for employee 2 (w2) – cost of effort chosen by employee 2

At the end of the experiment, you will receive your total profits. They consist of the starting capital and the sum of the profits earned in each period of the experiment. 1 ECU corresponds to €0.01.

Appendix: Instructions (MET)

Effort screen

Below, you can see a screenshot of the input screen an employee is faced with when choosing his effort level. The effort–cost-of-effort relation and the amount of profits generated for the employer are reported in the lower area of the screen. The employees choose their effort levels in the upper part of the screen and confirm their choice by clicking the red button. This screen is only visible for employees.

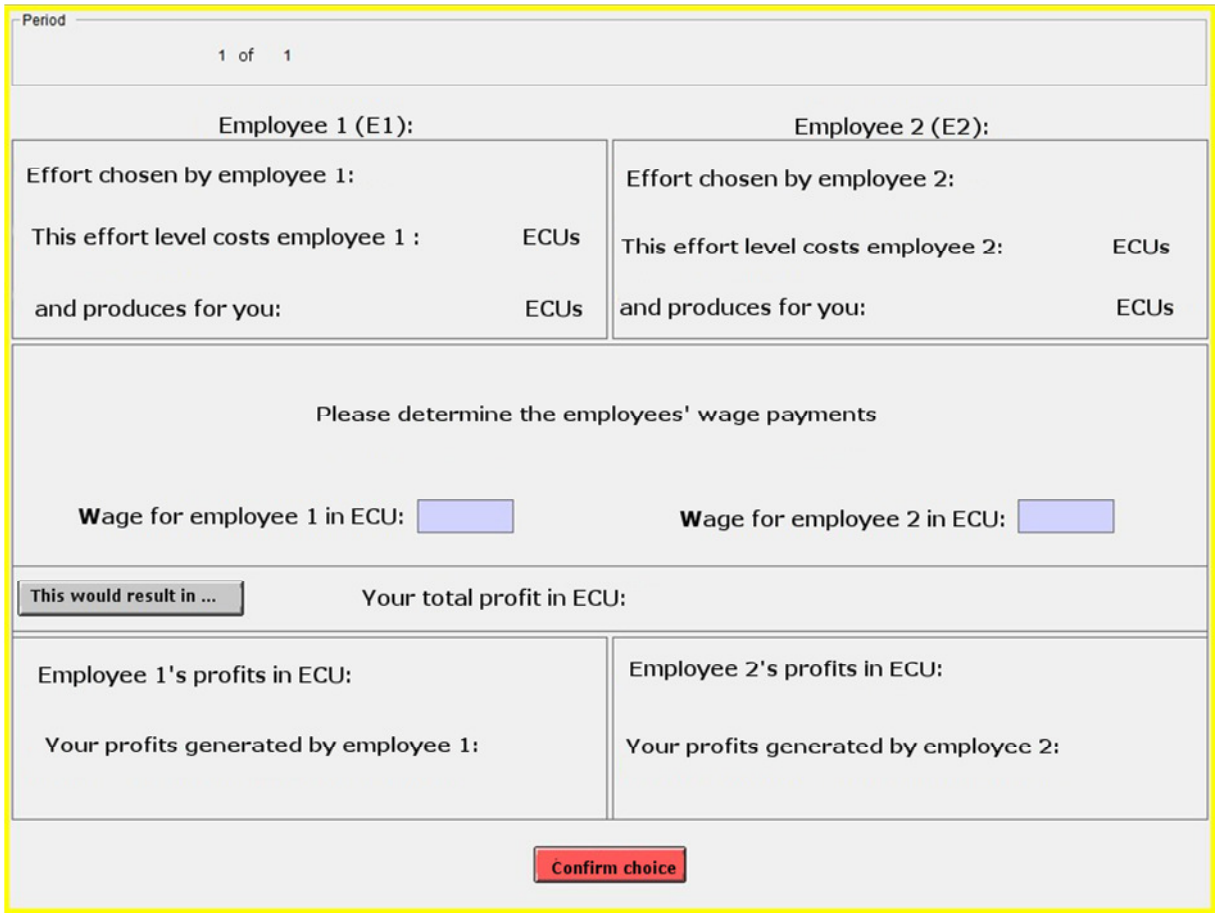


An effort level of ...	1	2	3	4	5	6	7	8	9	10	
costs you ...	0	1	2	4	6	8	10	13	16	20	ECUs
and produces for the employer ...	10	20	30	40	50	60	70	80	90	100	ECUs

Appendix: Instructions (MET)

Wage-payments screen

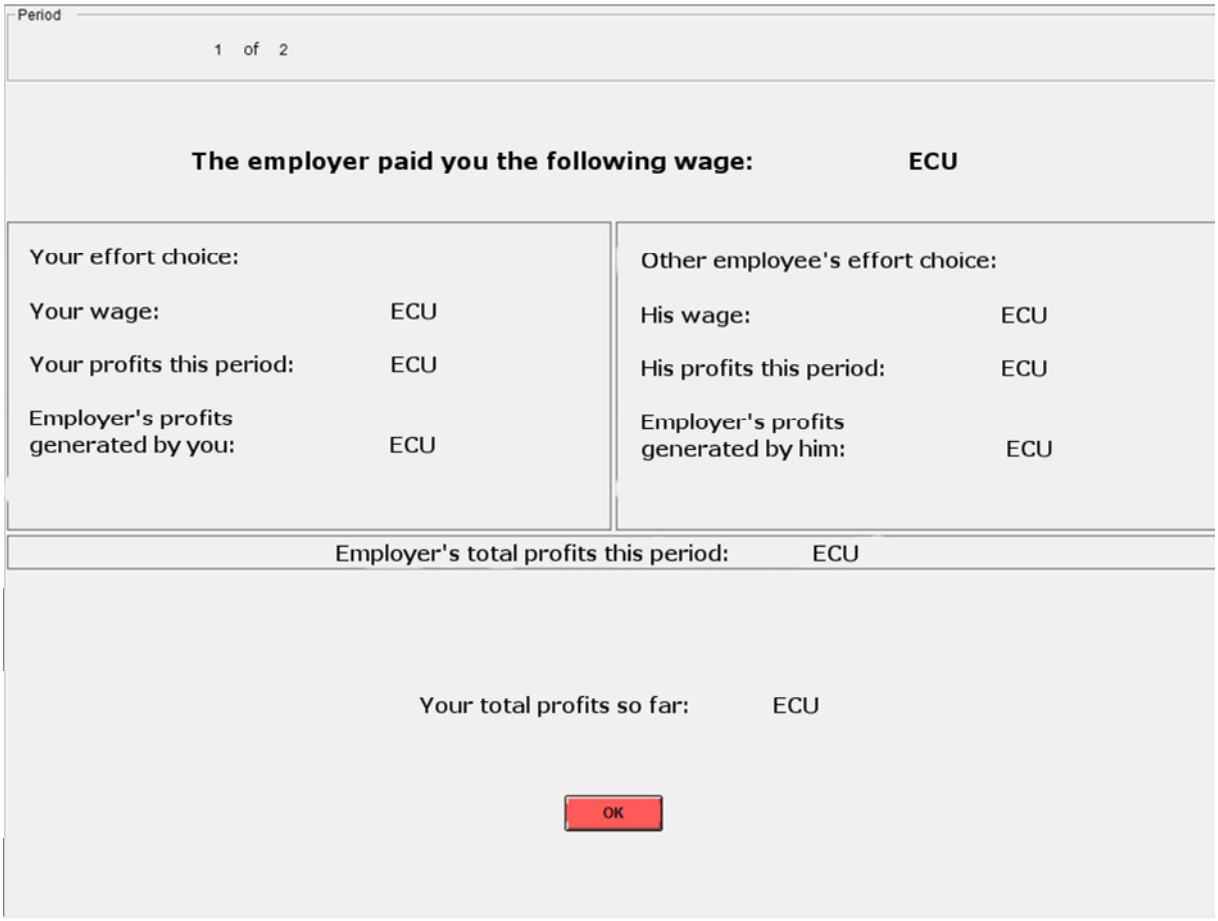
Below, you see the screen employers face when they determine the wage payments w1 and w2. It displays detailed information on the effort choices, the corresponding costs and the profits generated in the upper part of the screen. The employer can enter wage payments in the blue input boxes in the middle of the screen. By clicking on the „This would result in...“ button”, the employer may calculate the profits resulting for himself and for both employees. If desired, the employer may enter and try different wage payments by clicking the blue input boxes and the „this would result in ...“ button again. Finally, the employer confirms his final choice by clicking the red button. This screen is only visible for employers.



Appendix: Instructions (MET)

Feedback screen

At the end of each period, the employees are informed about their wage payment in the upper part of the feedback screen. In the middle of this screen a summary of choices and profits of the corresponding period is displayed. In the lower part, employees can track their total profits, i.e., their starting capital plus the sum of their earnings in previous periods. The screenshot below is an example screen for employees. The screen the employers face is similar but here, the upper part is empty.



Please raise your hand if you have any further questions.