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**Working Paper**

## Endogenous institution formation in public good games: The effect of economic education

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# Discussion Papers

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## Endogenous Institution Formation in Public Good Games: The Effect of Economic Education

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# Endogenous Institution Formation in Public Good Games: The Effect of Economic Education\*

## Abstract

In a public good experiment, the paper analyses to which extent individuals with economic education behave differently in a second-order dilemma. Second-order dilemmas may arise, when individuals endogenously build up costly institutions that help to overcome a public good problem (first-order dilemma). The specific institution used in the experiment is a communication platform allowing for group communication before the first-order public good game takes place. The experimental results confirm the finding of the literature that economists tend to free ride more intensively in public good games than non-economists. The difference is the strongest in the end-game phase, yielding in the conclusion that the magnitude of the end-game effect depends on the share of economists in the pool of participants. When it comes to the building-up of institutions, the individual efficiency gain of the institution and its inherent cost function constitute the driving forces for the contribution behaviour. Providing an investment friendly environment yields in economists contributing more to the institution than non-economists. Therefore, we make clear that first-order results of a simple public good game cannot be simply applied for second-order incentive problems.

*Keywords: voluntary contribution mechanism, endogenous formation of institutions, second-order incentive problem, economic education*

*JEL Classification: C91, C92, H41*

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## 1. Introduction

Decentral provision of public goods typically causes a conflict of interest between individual rational behavior of market participants and socially desired outcomes. Therefore, markets usually fail in the absence of strong institutions that coordinate and enforce individual contributions to a public good. In our experiment we want to analyze the effect of economic education on the contributions of both, a public good and an efficiency providing institution. This question is important for two reasons. Firstly, a large number of individuals registered in the subject pools of laboratories of economic research are students in management or economics. Previous research (e.g. Kirchgässner 2005) presents evidence that economists act differently in experiments. Using a public goods experiment we shed some light on the exact occasions in which these differences occur. Secondly, based on previous research there is a demotic conclusion that economists in general display more selfish behavior. We question this idea by giving the participants in our experiment the option to pay for an institution that solves the standard dilemma in a public good experiment.

The literature on voluntary public good provision points out several types of institutions that overcome the free-rider problem either by sanctioning free-riding behavior or by rewarding cooperative behavior. Basically, the underlying mechanism may entail either monetary incentives (taxes, subsidies) or implicit behavioral rules (norms) that enforce an individual contribution to the public good by social recognition or rejection. Parts of the literature focus on how varying exogenous institutions may be able to sustain cooperation in social dilemmas. Others treat these institutions *endogenously*. That is, they analyze how agents themselves may contribute to the formation of institutions that, in turn, lead to higher contributions to a public good. One particular problem in these situations is that if institutions can be formed endogenously, a second-order incentive problem can arise. This is especially true if the formation of an institution entails significant costs for its founding members. If agreements on cost-sharing fail, the typical free-rider incentive problem remains unresolved as it simply shifts to a second-order level (Yamagishi 1986).

Recent literature examines the second-order incentive problem that arises when institutions are build up endogenously. The most commonly applied tools are based on voting procedures (e.g. Kosfeld et al. 2009). However, the main influencing factors in an institution formation process are still largely unexplored. The question arises whether there are certain abilities and skills which enable subjects to build up an institution on the meta-level. It could be assumed that various factors such as certain attitudes towards institutional solutions or a certain educational background have an influence on the investments. In this paper, we focus on the role of economic education as one such explanatory factor. As several researchers (e.g. Kirchgässner 2005) have shown, economists have a lower willingness-to-cooperate in public good environment. In our research, we analyze whether these results also hold with respect to the formation of endogenous institutions, or whether economists are better able to understand the efficiency-enhancing effects of institutions and thus are willing to contribute to their establishment to a greater extent.

Using a laboratory experiment we test the individuals' investments in the establishment of the institution. The pool of test persons consists of both individuals with and without economic

education. In order to achieve an optimal experimental control, it should be ensured that all stakeholders gather similar experiences about the benefits of an institution. This is why the experiment contains an *experience stage* and an *investment stage*. In the experience stage players find out how effectively the institution can overcome the underlying free-rider problem. Based on this experience we subsequently test the players' investments in a specific institutional setting. In the experiment, we consider an institutional design that allows for oral and visual communication before a public good game is played, similar to the studies by Cason and Khan (1999), Brosig et al. (2003), and Bochet et al. (2006).

We enhance our analysis by investigating different types of deviating behavior (e.g. first round, last round, first time individuals deviate from full contributions). If the typical lower contributions in the voluntary contribution mechanism (VCM) arise from better dilemma solving abilities it should be possible to observe changes in strategies via these proxies. In our analysis, we distinguish between two groups: economists (E) and non-economists (NE). This distinction is based on the participants' responses in a post-experimental questionnaire in which all individuals had to report their major field of study. This setup enables us to focus on the questions (i) how do the strategies of economists and non-economists differ concerning contributions to a public good (first-order dilemma) and (ii) what differences arise when these individuals can contribute to the establishment of a beneficial institution (second-order dilemma).

The paper outline is as follows. After providing a brief review of literature in section 2 the paper proceeds by describing the experimental setup in section 3. Further, in section 4 we display the structure of the data. Subsequently we display and discuss our main results in section 5. Section 6 concludes and points out related further-reaching issues for future research.

## 2. Literature

The standard result in the literature on public good experiments, where individuals are subject to a dilemma between an individual and social optimum, is a too low provision of the public good. This has already been shown in an early in-depth literature review by Ledyard (1995) and more recently verified by Chaudhuri (2011). The literature further shows that there is a variety of mechanisms to induce socially optimal behavior. Falkinger (1996) and Falkinger et al. (2000) introduce a tax-subsidy procedure, which can negatively impact free-riding and induce a higher than average willingness to cooperate. This approach is similar to different other mechanisms in terms of providing significantly higher contribution rates (e.g. Gürer et al. 2006, Cason and Khan 1999).

Whereas the early literature focused on efficiency consequences of different exogenous institutional backgrounds, some recent studies investigate the *endogenous* formation of such institutions. Gürer et al. (2006) allowed the subjects to choose between two scenarios in which they could choose between the two institutional environments, firstly a simple VCM that does not foresee any other regulation and a VCM that includes sanction measures giving subjects the mean to respond to co-players' free-riding behavior. The authors show that the environment that allows for sanctioning prevails relatively quickly as the overriding institution. Besides the contribution rate in the sanctioning institution achieves up to 91

percent. Ertan et al. (2009) allowed players to vote on whether and who should be punished. The authors showed that only the low contributors were chosen to be punished and groups that in general allowed punishment achieved very high levels of contribution. In the experiment of Kosfeld et al. (2009) the subjects could vote on whether their group should be allowed to implement sanctions. Sutter et al. (2010) points out that the option to endogenously implement institutions has a positive effect on contributions as compared to exogenous alternatives. Further the subjects preferred the reward option instead of the sanctioning option although the latter was more effective. In two different approaches literature discusses the choices of subjects between formal and informal sanction schemes with (Kamei et al. 2015) and without (Markussen et al. 2014) endogenizing formal sanction schemes. Ramalingam et al. (2016) revealed the influence of the cost of an endogenously created institution on its effectiveness.

Our paper utilizes communication as an efficiency providing mechanism. From the early literature onwards (Dawes et al. 1977, Isaac and Walker 1988) it was shown that communication increases the cooperation in experiments. Several studies (Cason and Khan 1999, Brosig et al. 2003, Bochet et al. 2006) show that the introduction of a video-conference for all players before VCM has a significant positive effect on individuals' contribution rates. The authors distinguished between different types of communication and found the high relevance of face-to-face communication, yielding in cooperation rates of more than 90%. Instead of investigating the welfare-enhancing effects of an exogenously given communication platform like the aforementioned papers do, we analyze the endogenous formation of an institution that allows for pre-play communication.

Furthermore, the paper is reminiscent to a literature concerning the role and performance of economists in public good experiments. Kirchgässner (2005) demonstrated that economists and non-economists behave differently in the VCM. Laboratory experiments have shown that subjects with economic education already have a much lower voluntary willingness to cooperate at the beginning of the experiment. Marwell and Ames (1981) show that American high school majors contribute twice as much in a VCM as students in the first year of their university education. In an ultimatum game by Carter and Irons (1991), economists do not behave completely selfishly, but their bids are significantly lower, and thus closer to Nash equilibrium than those of non-economists. Selten and Ockenfels (1998) exposed that economists have a much lower a priori willingness to commit themselves to compensation payments to players with a low payoff. A similar discrepancy is revealed by Frank and Schulze (2000) who displayed that economists have a much higher propensity for corruption than non-economists. However, gender effects could also be responsible for the results, since low cooperation is mainly due to the behavior of male economists (Ockenfels and Weimann 1999). In other cultural contexts, such as Japan, differences between economists and non-economists could only be partially replicated (see Iida and Sobei 2011).

The recent literature on the voluntary contributions of economists to public goods focuses mainly on the first-order problem. Here, various studies (Brosig et al., 2010 and Hellmich 2012) provide evidence that the economists' below-average contribution rates in a VCM are mainly due to a selection bias rather a training effect. Emphasizing the relevance of the research focus of this paper, it was shown how non-cooperators negatively influence the total

contribution behavior in the group (de Oliveira et al., 2015). However, the results from the laboratory contrast some related field studies. For example, Laband and Beil (1999) show that economists are significantly more likely to make honest (i.e. correct) information on their income when compared to political students and sociologists. It was exposed that economists have a higher willingness to contribute to the provision of public goods of professional associations. Similar conclusions can be drawn from the interviews of Gandal et al. (2005). In contrast, in a field experiment Frey and Meier (2003) have some more differentiated results. They point out that business students were less willing to donate as part of a charity campaign at the University of Zurich than fellows from other disciplines, although this does not hold for students in economics.

### 3. Experimental Design

We conduct a large-scale laboratory public good experiment consisting out of three game blocks that are consecutively executed. During the experiment participants are stepwise informed about the experimental design by the organizers' reading-aloud of an instruction manual, see Appendix 1. Hence, participants learn the institutional details of a game block immediately before its starting. In addition, we ask questions of understanding related to the experimental design. Only after all players have given the right answer to these questions the experiment starts. Individuals play the public good game in a group of four. The pay-off function of individual  $j$  in period  $k$  is:

$$\pi_{jk}(g_{jk}) = z - g_{jk} + \frac{\alpha}{n} \sum_{j=1}^n g_{jk}, \quad j=1, \dots, 4$$

with  $z$  (initial endowment per round) = 20 Laboratory Dollar (LD),  $\alpha$  (efficiency multiplier) = 2 and  $g_{jk}$  representing tokens invested by subject  $j$  in period  $k$ ). After every period the subjects receive anonymous information on the payoff in their group. At the end of each block, the subjects are informed about their cumulative payoff that stems from the subsequent ten rounds. By using randomization measures between blocks, we rule out a repeated encounter of subjects in the same group in subsequent blocks. Therefore, every block constitutes an independent set of observations. To avoid income accumulation among the blocks subjects are informed that only one block is randomly selected as cash-effective after the end of the last block.

In the first block, the participants play a typical VCM for ten rounds. In the beginning of the second block, each group of four individuals attends a video conference for up to three minutes. During the conference, individuals can have an open discussion but do not have the power to make binding commitments. Accordingly, their conversation constitutes cheap talk. After the video conference ends, participants play the same VCM as in the first block. Subsequently, participants are randomly assigned to a group anew before they decide on their investments into a communication platform that can be used in block III. The communication platform is successfully installed if the cumulative group investment volume attains a threshold level of 32 LD<sup>1</sup>. The group in block III receives information about how much their group must pay in total for communication and can invest a share of their income into the

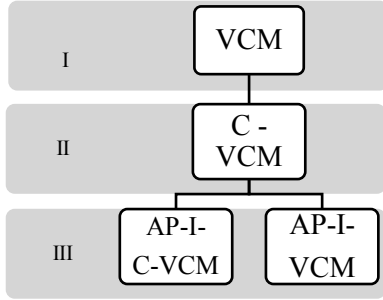
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<sup>1</sup> This threshold level was calibrated during a pilot experiment prior to the main experiment. Hereby we randomized the threshold values for the participants and evaluated the corresponding investments in the institution.

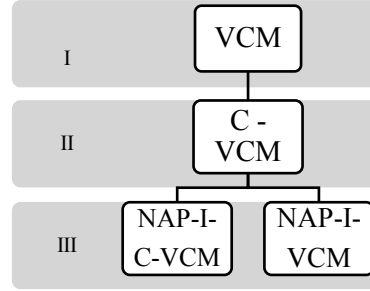


communication platform. If the cumulative investment of the group is at least as high as the threshold value, block III includes pre-play communication. Otherwise, a simple VCM is played, see figure 1.

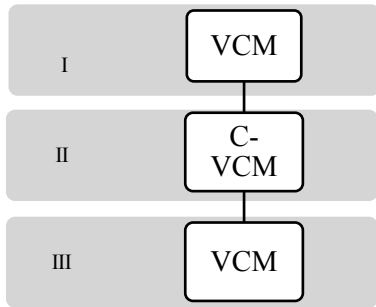
a) Treatment Group 1 (All-Pay)



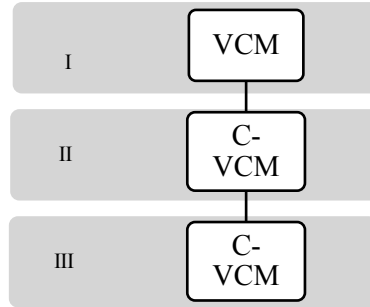
b) Treatment Group 2 (No-All-Pay)



c) Control Group 1 (VCM)



d) Control Group 2 (C-VCM)



**Fig. 1** Experimental Design

**Note:** VCM: simple voluntary contribution mechanism; C-VCM: voluntary contribution mechanism with pre-play communication; I-C-VCM: cumulative investment in block III meets the threshold value, so that pre-play communication is introduced; I-VCM: cumulative investment in block III does not meet the threshold value, so that the simple VCM is played; AP: individuals pay their investment independent of whether the threshold was met; NAP: individuals pay their investment only if threshold was met.

We employ two different variants of the investment decision regarding pre-play communication in block III. In the less investment-friendly setup (“all-pay”), individuals must pay their investment independent of whether the institution is sufficiently funded in the end. In the more investment-friendly setup (“no-all-pay”) participants only need to pay when the group was able to finance communication. In both variants subjects are informed about the cumulative costs of the institution, i.e. the threshold investment value that must be commonly reached by the group of players to undertake communication in block III. Since the investment choice exhibits a simultaneous-move game, no subject knows *a priori* whether his or her contribution will suffice for the formation of the institution. After their investment choice, there is a three-minute video conference for those groups that invested at least 32 LD in total, before all participants enter 10 rounds of the VCM. Finally, individuals filled in a questionnaire consisting of several questions e.g. on demographics and their major. The

duration of experiments in total is between 70 and 90 minutes. Finally, the payoff of one of the blocks was converted to euro (1 Laboratory Dollar = 4.5 Cents). The experimental design was executed in z-Tree (Fischbacher 2007). The experiment was organized and recruited with the software hroot (Bock, Nicklisch, Baetge 2012).

#### 4. Data sample

**Table 1** Subjects pool statistics

Block	Treatment 1 VCM/C- VCM/AP-I	Treatment 2 VCM/C- VCM/NAP-I	Control 1 VCM/C- VCM/VCM	Control 2 VCM/C- VCM/C-VCM
Session	8	8	4	4
Subjects	128	128	64	64
E	65	57	29	31
NE	63	71	35	33
Male	66	78	36	32
Females	62	50	28	32
Average age	23.96	24.10	23.28	22.92

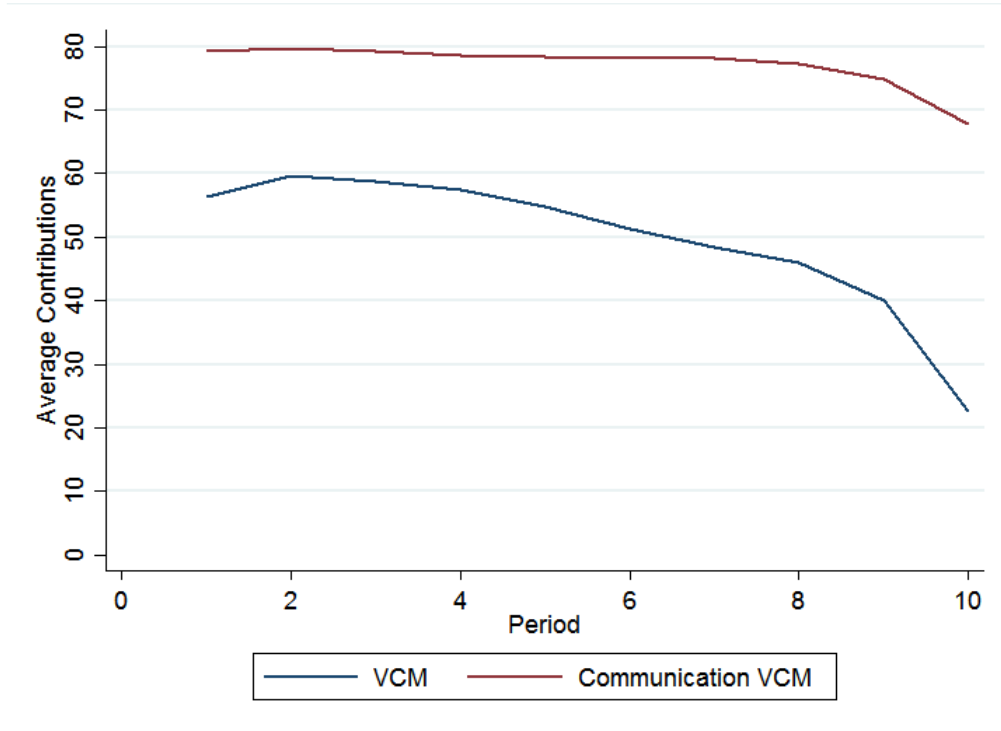
The total sample consists of 384 subjects (see Table 1) that are distributed among the two treatment groups (128 subjects each) and two control groups (64 subjects each). Due to the aforementioned randomization scheme, it was necessary to obtain exactly 16 subjects per session. To investigate the effects of economic education we assured that there is always a sufficient proportion of students with economic background. We hereby distinguish two different types of economic education. Individuals who study economics or business majors as well as students from majors with a high share of lectures in management or economics in the curriculum (e.g. industrial engineering, information management) as economists (E) and the remaining students as non-economists (NE). We classify each participant based on the data provided in the questionnaire where the subjects had indicated their study program.

#### 5. Results

Our analysis focuses on two kinds of decisions: Firstly, the individual contributions of subjects in the VCM and C-VCM, secondly their contributions to the financing of the communication platform. Presenting the results we distinguish between results on group level, which ensures higher independence of observations, and individual level which enables a clearer attribution of economic education to the respective individual. We first discuss the contributions to the public good (first order dilemma) on the group-level and later turn to the individual-level. Eventually, we discuss the results obtained for the second order dilemma.

##### 5.1. Voluntary Contributions to the Public Good: Group Level Analysis

Prior to discussing the group-level contributions we first investigate the effect of the provided institution. Hereby we analyze contributions of 96 groups over 10 periods. The average contributions in the VCM and C-VCM are 49.54 and 77.16 LD respectively. This difference is significant ( $p=0.0000$ ) and is further visualized in figure 2. We support the evidence from previous research that pre-play communication leads to higher and more stable contributions in a VCM.



**Fig. 2** Effect of pre-play communication (N=384)

For the group level analysis, we pursue two different approaches: We first investigate whether groups containing economists show different levels of contributions using the Mann-Whitney test. We further provide the results of the two-sided t-test for robustness and for providing intuition for the direction of the differences between groups with different shares of economists<sup>2</sup>. Hereby we create dummy variables indicating groups with at least 50% economists<sup>3</sup> and test the group level contributions (see Table 2)<sup>4</sup>. We find ambiguous results. In the first block, as predicted by previous research, groups with economists have lower contributions. However, in the second block we observe higher contributions in groups with at least 50% economists.

In the second approach, we utilize a simple regression model (1). We apply this approach for two reasons. Firstly, it enables us to include control variables. Secondly, we can distinguish different compositions with respect to the number of economists in the group (2) and (3)<sup>5</sup>. Since we have panel data that is censored from both sides (between 0 and 80 LD) we chose a panel Tobit regression.<sup>6</sup> In the results (see table 3) we can observe that the share of economists is a relevant factor concerning group contribution<sup>7</sup>. However, the results show a level of ambiguity which implies that not all economists are the same. This stresses the importance of further investigation on individual level.

<sup>2</sup> The results are robust with respect to the application of the Mann-Whitney test

<sup>3</sup> Robustness checks are possible at (25%/75%/100%). However, thresholds other than 50% result in more unbalanced groups as a group of e.g. three or more economists is less likely to occur.

<sup>4</sup> Note that there are 96 groups with 10 observations per group. Alternatively, we present the results for the averages over ten periods which constitute the highest level of independence

<sup>5</sup> However, as groups with zero or four economists were extremely rare, the respective effect has to be dealt with caution. Further, this is the cause for taking groups with one economists as the base line regression model (1)

<sup>6</sup> The dependent variable is the sum of LD contributed as the group modeled as function of the number of economists in the group, the round and gender.

<sup>7</sup> We apply groups with one economists as the basis line since there were only very few groups without any economist. The same holds for groups consisting of four economists.

**Table 2** Results of two-sided t-test and Mann-Whitney test at 50% threshold of economists in a group

	t-test ≥50% Economists	<50% Economists	MW-test ≥50% Economists	<50% Economists
<b>Block I</b>				
Statistics (10 periods)	47.61	52.91		
p-value	0.0012		0.0036 (z=2.912)	
Observations	610	350	610	350
Statistics (average)	47.61	52.91		
p-value	0.1674		0.1694 (z=1.374)	
Observations	61	35	61	35
<b>Block II</b>				
Statistics (10 periods)	77.65	76.36		
p-value	0.0876		0.0008 (z=-3.360)	
Observations	600	360	600	360
Statistics (average)	77.65	76.36		
p-value	0.4427		0.8244 (z=-0.222)	
Observations	60	36	60	36

## 5.2. Voluntary Contributions to the Public Good: Individual Level Analysis

Analyzing the contribution behavior on the individual level, we consider three different moments. Firstly, we investigate the individual behavior in the first period play, which depicts the individuals' actions at a point of time, when they still have not received any information on the contributing behavior of the other group members. Secondly, we consider the individual contribution levels at the point of time when the subjects deviate from the full contribution level (20 LD) for the first time. As a proxy this identifies how long the individuals pursue the socially optimal strategy. Thirdly, we have a look at the final round that usually entails a lower contribution rate than the precedent rounds. Since at the end of game there is no direct response of co-players on free-riding, subjects' individual characteristics towards free-riding should gain on importance.

With respect to the first period play we find no significant differences between the two groups (average contributions of economists = 13.93 LD, average contributions of non-economists = 14.20 LD, p-value from t-test= 0.3504). Since we reshuffle the groups after every block, ceteris paribus the same analysis can be done for the second block. Here we find that economists (average contribution = 19.95 LD) contribute insignificantly more than non-economists (19.75 LD). The analysis of the first deviation time shows that economists deviate later (after 3.23 periods) than non-economists (after 2.43 periods) with a p value of 0.0042.<sup>8</sup> For the second block the results for economists and non-economists are 8.33 and 7.19 rounds respectively (p= 0.0714)<sup>9</sup>. We further repeat the analysis only for all the individuals that did

<sup>8</sup> This result remains significant after applying a simple Tobit regression controlling for gender and number of economists in the group

<sup>9</sup> This analysis considers only individuals that have deviated at least once. Since a large number of individuals played the socially optimal strategy over the entire 10 rounds, the sample size for the second block decreases as compared to the first block.

not deviate already in the first period. By excluding the individuals that initially deviated from the socially optimal behavior, we focus on those whose deviation was induced by either the contributions of the other players or the approaching end-game. In the first block we obtain for economists and non-economists 5.78 and 4.63 periods respectively ( $p=0.0092$ ). In the second block we obtain for these two groups 8.56 and 8.38 periods ( $p=0.3860$ ). Our explanation for this result is that economists to a larger share fully contribute to the public good in the beginning of the second block as we present below.

**Table 3** Panel regressions

Dep. Variable:	(1)	(2)	(3)
Group level contributions			
N	960	960	960
Constant	77.05321*** (3.87198)	71.49465*** (5.451089)	77.79323*** (9.647428)
Number of economists			
0	-24.85607 (15.42209)	-26.58201*** (15.30602)	-21.92364 (15.27039)
2	-8.916633* (5.057218)	-10.02692** (5.064)	-9.584847* (4.971686)
3	-11.32984* (6.12047)	-12.98615** (6.166066)	-14.48485** (6.098477)
4	7.86601 (11.24118)	6.141688*** (11.18769)	3.685461 (11.05362)
Gender	-	2.91267 (2.034211)	-
Number of males			
1	-	-	-10.14208 (10.2624)
2	-	-	4.757136 (9.917311)
3	-	-	2.100724 (10.04529)
4	-	-	2.779302 (11.04663)
Period	-3.581298*** (.201777)	-3.580784*** (.201769)	-3.579672*** (.2017534)
Wald chi2 (Prob > chi2)	322.48 (0.0000)	324.58 (0.0000)	329.48 (0.0000)
$\sigma_u$	20.44584*** (1.613293)	20.21243*** (1.597674)	19.69392*** (1.563087)
$\sigma_e$	17.38424*** (.4909651)	17.38417*** (.4909559)	17.38413*** (.4909466)
$\rho$	.5804035 (.040065)	.5748032 (.0402799)	.5620544 (.0407381)

Std. error in brackets; \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

The observations in the last period verify the standard observation of decreasing cooperation in the end-game. In contrast to the analysis of the first period, the contributions differ significantly among the two groups ( $p=0.0009$ ). Hereby the economists contribute 4.32 LD and non-economists 6.88 LD. In the last period of the second block economists contribute 9.21 LD and non-economists 10.83 LD ( $p=0.0532$ ). This hints that the economists might be more perceptive of the specific structure of the dilemma.

**Table 4** Analysis of different periods

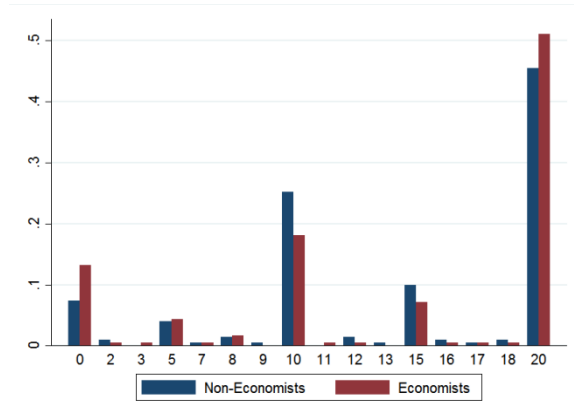
	First period (N=384)		Last period (N=384)		Joint block (N=3840)	
	Economists	Non-Ec.	Economists	Non-Ec.	Economists	Non-Ec.
<b>Block I</b>						
Extreme points	0.6429	0.5297 (0.0247)	0.8516	0.7426 (0.0082)	0.7286	0.6366 (0.0000)
Free-riding	0.1319	0.0743 (0.0623)	0.6978	0.5248 (0.0005)	0.2720	0.1980 (0.0000)
Full-contributions	0.5110	0.4554 (0.2779)	0.1538	0.2178 (0.1093)	0.4566	0.4386 (0.2633)
<b>Block II</b>						
Extreme points	0.9945	0.9802 (0.2179)	0.9890	0.9802 (0.4881)	0.9940	0.9832 (0.0019)
Free-riding	0.0000	0.0050 (0.3432)	0.1593	0.1287 (0.3936)	0.0341	0.0272 (0.2184)
Full-contributions	0.9945	0.9752 (0.1293)	0.8297	0.8515 (0.5605)	0.9599	0.9559 (0.5434)

**Note** First number is the respective share of individuals. Numbers in brackets represent p-values from two-sided t-test. The results are robust to the Mann-Whitney test

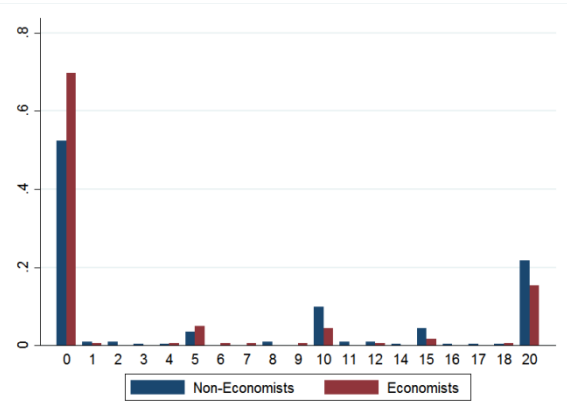
The observation that in a VCM economists contribute less on average but start deviating later yields the conjecture that there is certain heterogeneity between the groups. This conjecture is supported by the observation of the first period contributions (Figure 3). We clearly observe that economists have higher spikes at the two extreme points (0 and 20) whereas non-economists have an excess around the average value of 10 LD. We further test for differences generating dummy variables for free-riding contributions, full contributions (and combined extreme points) contributions. We observe significant differences between the two groups, which are mainly driven by differences in free-riding contributions. The full-contributing dummy variable does not provide such strong results (see table 4). The observation is further robust to the analysis of other periods as well as an analysis of 10 joint periods. Even though it is arguable whether rounds two to ten can be considered as independent observation on individual level it can be assumed that the binary decision whether to decrease the contributions steadily or quickly to zero is largely based on individual characteristics.

To further support the observation that there are differences in the perception and exploitation of the dilemma structure we present the quantile-plots for the first and last period as well as the contribution histogram from the last period (see Figures 3-6) and a regression model

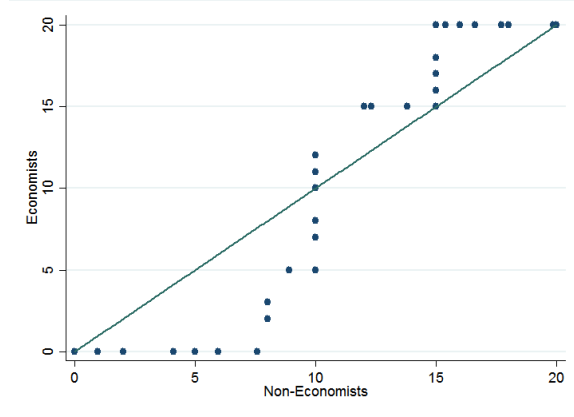
including interactions (see Table 5)<sup>10</sup>. Hereby the graphs provide visual evidence of how economists and non-economists differ at different stages of the VCM.



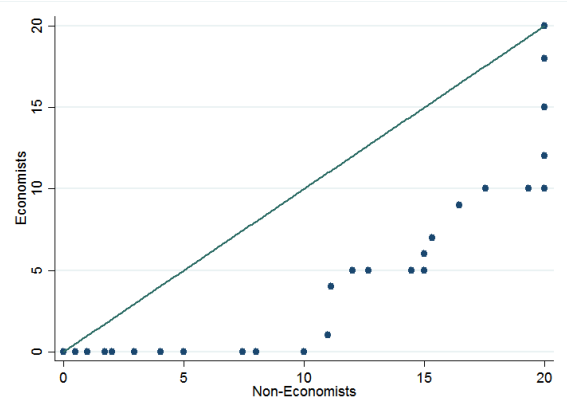
**Fig. 3** First period contributions



**Fig. 4** Last period contributions



**Fig. 5** Quantile-Quantile plot (first period)



**Fig. 6** Quantile-Quantile plot (last period)

This indication finds further support when we apply a panel Tobit regression model. Since we apply the model on the individual level we control for group contributions in the previous period<sup>11</sup>. We observe that the period and the lagging contribution of the three co-players have a strong and significant effect on the individual contributions. To test our previously made observation of economists changing their contribution pattern stronger towards the end of the game or adjusting it more with respect to the contribution behavior of the co-players we utilize interaction terms. The results (see Table 5) provide further evidence that economists decrease their contributions stronger than non-economists and react more positive to high contributions in their respective groups.

<sup>10</sup> For a comparable analysis on the group level see Appendix 3.

<sup>11</sup> We add the period as a further control variable. The lower and upper bounds are set at 0 and 20 respectively.

**Table 5** Panel regressions

Dep. Variable:	(1)	(2)	(3)	(4)	(5)
Individual contribution					
N	3456	3456	3456	3456	3456
Constant	-1.644554 (1.688368)	-4.262461** (1.808312)	.4006017 (1.902788)	-2.926572 (2.072836)	- 11.00006*** (3.505316)
Own contribution in previous period	.8066218*** (.0616739)	.7816197*** (.0614254)	.7995271*** (.0617814)	.7809382*** (.0615032)	.8006749*** (.0615047)
Period	-	-	-	-	.1212675 (.4285801)
Economics study	1.460714*** (.1292513)	.9732256*** (.1655891)	1.467593*** (.1292517)	1.013131*** (.1682872)	4.467853 (5.121319)
Economics x period	-	-	-	-	-1.405358** (.6616283)
Contribution of co-players in previous period (co-lag)	.428742*** (.0251386)	.4291776*** (.0252475)	.378706*** (.0324489)	.4006208*** (.0329959)	.6012793*** (.0784147)
period x co-lag	-	-	-	-	-
Economics x Co-lag	-	-	.1073431** (.0452764)	.0617179 (.0466325)	.0301088*** (.0105241)
Economics x period x co-lag	-	-	-	-	-.0131512 (.1180993)
Wald chi2 (Prob > chi2)	766.91 (0.0000)	767.45 (0.0000)	764.82 (0.0000)	765.50 (0.0000)	.0113651 (.015843)
$\sigma_u$	7.020808*** (.6432378)	7.250348*** (.6464244)	7.078226*** (.6457525)	7.240598*** (.6467468)	779.87 (0.000)
$\sigma_e$	14.80589*** (.3999994)	14.70133*** (.397131)	14.78623*** (.3995561)	14.70224*** (.3972183)	7.201117*** (.6404742)
$\rho$	.1835777 (.0286029)	.195639 (.0292395)	.1864346 (.0288331)	.1951964 (.0292476)	14.67279 (.3960325)

Std. error in brackets; \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

### 5.3 Endogenous institution formation

Analyzing the investments in an institution we firstly take a closer look on the outcome in the experience stage, i.e. block I and block II. This stage theoretically lays the foundation for the players' subsequent investment choice in block III. Before making their investment decisions, individuals can compute the additional pay-off that stems from the higher cooperation rates due to pre-play communication setting of block II.



We classify investment levels as follows: zero investment level or value near to zero indicates that individuals either do not have preference for communication or intend to free-ride on the building of the communication platform (second-order incentive problem). Investment levels of individuals who intent to actively build up the institution crucially depend on their *a priori* expectations with respect to their co-players' willingness to invest. If they opt for a rule of thumb "fair-share" they would invest  $32/4$  LD=8 LD. If they however try to compensate possible zero-contributions of co-players they choose a so-called Level-k thinking. Thereby several options arise of which we briefly mention two. Firstly, the individual increases own contribution by 8 LD assuring the formation of the institution in the case of one free-rider. Secondly, if the individual expects other cooperation partner to provide similar line of thoughts the extra costs caused by a free-rider are also split. In this case, an individual that expects  $k$  free-riders in the group, contributes  $\frac{1}{4-k}$  of the threshold value.

**Table 6** Benefits of communication and investments in communication

Benefit criterion	Number of subjects	Average benefit in LD	Average investment in LD
Treatment 1	128	59.04	5.78
>0	119	64.83	5.97
>8	112	68.70	6.13
>32	82	86.45	6.65
Treatment 2	128	69.15	6.42
>0	112	84.53	7.16
>8	105	89.95	7.37
>32	93	98.66	7.71

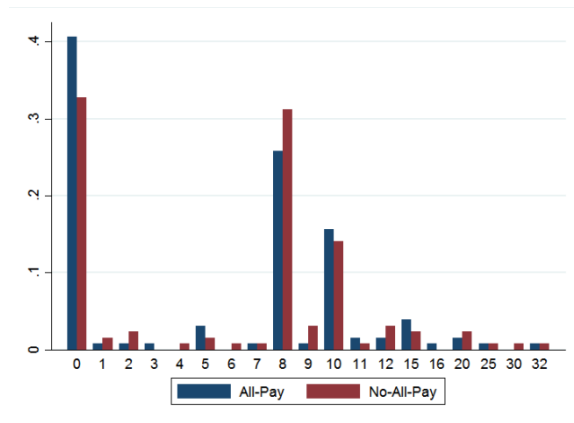
When it comes to the first treatment, the difference between block II and block I added up to an average of 59 LD per person. These 59 LD therefore constitute the average benefit of the institution for the individuals. We further provide different criterions which can be referred to different stages of Level-k thinking. These can be found in Table 6. Given the low financial threshold and the comparatively high gains from the institution, a high number of created institutions could be expected.

However, the observed investment decisions demonstrate the opposite. Only seven groups in treatment 1 and eight groups in the treatment 2 could attain the investment threshold to successfully build up the communication platform. For both treatments, we observe a large variety of values with different peaks. The mode is at zero indicating a large number of individuals without any willingness to contribute. Another frequent observation is the fair share value (8 LD). Furthermore, we observe a peak at 10, which could be attributed to the commonly observed behavior of choosing round figures. Figure 7 provides a histogram of the investments for both treatments. The lack of high value contributions results in an inefficient provision of the institution, independent of the treatment. The most notable difference between the treatments is a shift from zero-contributions to the fair share value. This can be attributed to decision structure, which includes more risk in the all-pay-treatment.

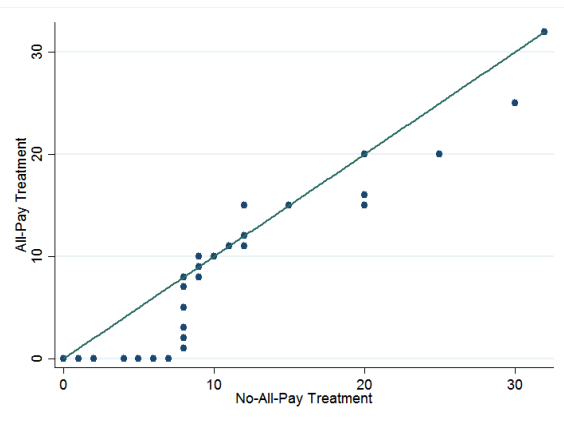
Pursuing the analysis of investments, we consider the actual investments as well as several dummy variables. The dummy variables represent discrete choices for freeriding (zero investment) and providing at least the fair share respectively. Comparing the average contributions to the institutions does not yield any significant results. However, as depicted in

figures 7 and 8 these contributions may be subject to different underlying distributions in the two treatments. The differences are most present concerning the number of individuals contributing the fair share and zero contributions. This implies that the change of the payment scheme has an influence on the contributions. Therefore, we focus on the effects of economic education within the respective treatment.

Applying a t-test on the investments yields in no significant results for the All-Pay Treatment, yet significant results for the No-All-Pay Treatment. As depicted in table 7, in the No All-Pay Treatment economists contribute significantly more to the institution than non-economists. Furthermore, we analyze several discrete choices via dummy variables. Hereby we focus on the shares of economists and non-economists that were free-riders, compensators or provided the fair share to the institution.<sup>12</sup> The biggest change for the non-economists is the tendency to contribute fair share values instead of compensating other players. For the economists two major observations can be done. Firstly, the number of free-riders strongly decreased in the No-All-Pay treatment (from 41.5% to 28.1%). Secondly, economists compensated more often for other players (24.61% to 36.8%).



**Fig. 7** Histogram of investments



**Fig. 8** Quantile-Quantile plot of investments

Using the difference-in-difference approach we further focus on the interaction between economic education and the treatment. Hereby, we observe significant interaction effects ( $p=0.045$ ). Therefore, economists reacted stronger to the change in the payment scheme that was constituted by the difference between the All-Pay and the No-All-Pay treatment. The removal of the enforced payment for the institution implied a loosening of the dilemma and a more investment-friendly environment. Since economists reacted stronger to this change, this provides further evidence that economists adapt to changes in the dilemma structure differently. The effect is robust to applying a censored regression model (see appendix 4).

<sup>12</sup> The free-riding variable is constructed using individuals who contributed zero LD to the institution. The min fair share variable composes the individuals who contributed at least eight LD. Fair share dummy variable includes only individuals with contributions of 8 LD and compensators are individuals with contributions higher than eight.

**Table 7** Analysis of investment

	All-Pay Treatment		No-All-Pay Treatment	
	Economists	Non-Economists	Economists	Non-Economists
Free riding	41.53%	39.68%	28.07%	36.62%
Min fair share	53.85%	52.38%	64.91%	54.93%
Fair share	29.23%	22.22%	28.07%	33.80%
Compensator	24.61%	30.16%	36.84%	21.13%
Average investment	5.3077	6.2698 (0.3592)	7.5614	5.5070 (0.0570)

**Note** Numbers in brackets represent p-values from a two-sided t-test.

Continuing the analysis of the investment to the institution we see that these contributions heavily depend on prior gains from communication. We therefore calculate the benefit of communication as the individual differences between the payoffs in block I (VCM) and block II (C-VCM). Hereby we apply a Tobit regression using the investment as the dependent variable and different sets of independent variables. The regressions provide further evidence that economists had significantly lower contributions in the first treatment as compared to the second treatment. For detailed results of the different regression models refer to appendix 4. Since the coefficients of the benefit of communication are low yet significant, the institution has to provide a better benefit-cost-ratio in order to be sufficiently funded.

## 6. Conclusion

In the experiment, we analyzed whether the hypothesis that economists show less socially optimal contribution behavior in public good experiments can be supported. We enhance the standard research towards the contribution behavior in the second-order public good dilemma. Hereby the subjects were first presented an institution that was proven to effectively overcome the inefficiencies of the standard (first-order) public good game. Afterwards we tested how much the individuals would pay to obtain this institution – which composed the second-order dilemma. While both economists and non-economists mostly underfund the institution, we find evidence for the adjusting behavior of economists using one treatment in the experiment. Applying a small change in the payment scheme for the efficiency providing institution we can observe how economists and non-economists react to the more investment-friendly environment. This refers to the No-All-Pay treatment, where individuals only have to pay for the institution if it is sufficiently funded – on the contrary to the all-pay treatment. While non-economists do not show any significant reaction to the changes in the dilemma (and in fact slightly decrease their payments), economists strongly increase their contributions in the No-All-Pay treatment when they know they would retrieve their investment if no institution is formed. It is further notable that a larger number of economists increased their contributions to a level higher than the fair share value.

We further verify the observation that economists adapt more to a changing dilemma environment using results from the standard public good game. Concerning the question whether economists provide less socially optimal contributions we partially support the previous finding of lower contribution rates of economists (Marwell and Ames 1981). However, we introduce another measure – the first deviation time. We show that economists start defecting from the social optimum strategy significantly later than non-economists, yet converge faster to the Nash equilibrium strategy. Especially towards the end-game phase of the dilemma economists show significantly higher free-riding patterns than non-economists. Furthermore, the distributions of contributions of economists and non-economists differ

concerning the first and the last round. This yields in the conclusion that the magnitude of the end-game effect can depend on the share of economists in the entire population sample.

With respect to the initial questions two statements can be made. Firstly, economists remain longer at the socially benevolent contribution rate than non-economists. However, with an increasing threat of exploitation, e.g. towards the end-game, economists strongly decrease their contributions. Secondly, we find no support for the hypothesis of economists being generally more selfish. On the contrary, given a suitable payment scheme, economists contribute more to the funding of an efficiency providing institution.

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## Appendix 1 Instructions

### Instructions Experiment “Yellow“

Please read the instructions diligently. If questions arise, open the door to your cabin and remain seated. The experiment “Yellow” is carried out at the computer.

Your fellow participants will only play with you within the experiment “Yellow“.

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After reading the instructions you will receive four control questions. The control questions are not considered for your final payment. As soon as you have answered the control questions the part of the experiment relevant for your final payment will start. Please be aware that either experiment „Yellow“, „Blue“ or „Red“ will be paid out. Which experiment will be eventually relevant is decided by chance.

Within the experiment, we will use laboratory dollars as the used currency. The underlying exchange rate is the following: 100 laboratory dollars = 4.5 EUR.

---

You and three other participants receive each **20 laboratory dollars** per round of contribution. You can contribute these laboratory dollars either to a private or a group account.

**Private Account (P):** The deposited laboratory dollars are being kept.

**Group Account (G):** Each of the four players can deposit money in this account. The sum of the deposits is doubled by the experimenter and redistributed equally to the four players. Hence, each player receives 0,5 laboratory dollars per contributed laboratory dollar.

The laboratory dollars can be split up in between the two accounts. You take your decision anonymously. None of the other players will learn how you split your laboratory dollars up. Profit of player  $i$  is calculated accordingly:

$$\text{Profit} = (20 - G) + 0,5 \cdot \sum_{i=1}^4 G_i$$

**Please turn!**

## Instructions Experiment „Red"

Please read the instructions diligently. If questions arise, open the door to your cabin and remain seated. The experiment “Red” is carried out at the computer.

Your fellow participants will only play with you within the experiment „Red“.

---

After reading the instructions you will receive four control questions. The control questions are not considered for your final payment. As soon as you have answered the control questions the part of the experiment relevant for your final payment will start. Please be aware that either experiment „Yellow“, „Blue“ or „Red“ will be paid out. Which experiment will be eventually relevant is decided by chance.

Within the experiment, we will use laboratory dollars as the used currency. The underlying exchange rate is the following: 100 laboratory dollars = 4.5 EUR.

---

You and three other participants receive each **20 laboratory dollars** per round of contribution. You can contribute these laboratory dollars either to a private or a group account.

**Private Account (P):** The deposited laboratory dollars are being kept.

**Group Account (G):** Each of the four players can deposit money in this account. The sum of the deposits is doubled by the experimenter and redistributed equally to the four players. Hence, each player receives 0,5 laboratory dollars per contributed laboratory dollar.

The laboratory dollars can be split up in between the two accounts. You take your decision anonymously. None of the other players will learn how you split your laboratory dollars up.

Profit of player  $i$  is calculated accordingly:

$$\text{Profit} = (20 - G) + 0,5 \cdot \sum_1^4 G_i$$

---

**Video conference:** Before you take your decision on how to split the laboratory dollars you will be talking to the three other players in a video conference for three minutes. During this time, you can see and talk to each other. The duration of the call can neither be reduced nor prolonged.

Subsequently to the video conference, each player makes the above described decision.

**Please turn!**



## Instructions Experiment „Blue" (*All-Pay*)

Please read the instructions diligently. If questions arise, open the door to your cabin and remain seated. The experiment “Blue” is carried out at the computer.  
Your fellow participants will only play with you within the experiment „Blue“.

---

After reading the instructions you will receive six control questions. The control questions are not considered for your final payment. As soon as you have answered the control questions the part of the experiment relevant for your final payment will start. Please be aware that either experiment „Yellow“, „Blue“ or „Red“ will be paid out. Which experiment will be eventually relevant is decided by chance.

Within the experiment, we will use laboratory dollars as the used currency. The underlying exchange rate is the following: 100 laboratory dollars = 4.5 EUR.

---

You and three other participants receive each **20 laboratory dollars** per round of contribution. You can contribute these laboratory dollars either to a private or a group account.

**Private Account (P):** The deposited laboratory dollars are being kept.

**Group Account (G):** Each of the four players can deposit money in this account. The sum of the deposits is doubled by the experimenter and redistributed equally to the four players. Hence, each player receives 0,5 laboratory dollars per contributed laboratory dollar.

The laboratory dollars can be split up in between the two accounts. You take your decision anonymously. None of the other players will learn how you split your laboratory dollars up. Profit of player  $i$  is calculated accordingly:

$$\text{Profit} = (20 - G) + 0,5 \cdot \sum_1^4 G_i$$

---

**Set-up of the video conference:** At the beginning of the experiment you are asked whether you want to make the experiment this time with or without communication. Communication will be subject to a fee. To make the experiment with communication you must raise a required amount jointly as a group. This amount will pop up on your screen at the beginning of the experiment. The decision on how much you contribute will then be again taken anonymously. The deposited money for setting up communication is being deducted from your profit in the experiment „blue“ at the end of it – whether communication is successfully set up or not. If the group raises the required amount, a three-minute video conference is being set up, see previous round. Otherwise, all group members have to wait for three minutes until other groups have finished their communication period, respectively. Subsequently, the decision on how to split up the laboratory dollars between private and group account are being made.

**Please turn!**

## Instructions Experiment „Blue" (No-All-Pay)

Please read the instructions diligently. If questions arise, open the door to your cabin and remain seated. The experiment “Blue” is carried out at the computer.

Your fellow participants will only play with you within the experiment „Blue“.

---

After reading the instructions you will receive six control questions. The control questions are not considered for your final payment. As soon as you have answered the control questions the part of the experiment relevant for your final payment will start. Please be aware that either experiment „Yellow“, „Blue“ or „Red“ will be paid out. Which experiment will be eventually relevant is decided by chance.

Within the experiment, we will use laboratory dollars as the used currency. The underlying exchange rate is the following: 100 laboratory dollars = 4.5 EUR.

---

You and three other participants receive each **20 laboratory dollars** per round of contribution. You can contribute these laboratory dollars either to a private or a group account.

**Private Account (P):** The deposited laboratory dollars are being kept.

**Group Account (G):** Each of the four players can deposit money in this account. The sum of the deposits is doubled by the experimenter and redistributed equally to the four players. Hence, each player receives 0,5 laboratory dollars per contributed laboratory dollar.

The laboratory dollars can be split up in between the two accounts. You take your decision anonymously. None of the other players will learn how you split your laboratory dollars up.

Profit of player  $i$  is calculated accordingly:

$$\text{Profit} = (20 - G) + 0,5 \cdot \sum_{i=1}^4 G_i$$

---

**Set-up of the video conference:** At the beginning of the experiment you are asked whether you want to make the experiment this time with or without communication. Communication will be subject to a fee. To make the experiment with communication you must raise a required amount jointly as a group. This amount will pop up on your screen at the beginning of the experiment. The decision on how much you contribute will then be again taken anonymously. The deposited money for setting up communication is being deducted from your profit in the experiment „blue“ at the end of it – only if communication is successfully set up. If the group raises the required amount, a three-minute video conference is being set up, see previous round. Otherwise, all group members have to wait for three minutes until other groups have finished their communication period, respectively. Subsequently, the decision on how to split up the laboratory dollars between private and group account are being made.

**Please turn!**

## Appendix 2

### Questionnaire

1. How many of the persons you communicated with in the second sub-experiment did you already know before (by first name)?  
0/1/2/3
2. How many of the persons you communicated with in the third sub-experiment did you already know before (by first name)?  
0/1/2/3/Communication did not take place.
3. A bat and a ball cost together 1.10 Dollar. The bat costs one dollar more than the ball. How much is the ball?
4. If 5 machines need 5 minutes to produce 5 devices, how much time need 100 machines to produce 100 devices?
5. On a lake, a field of water lilies starts to spread. Each day, the surface of the field is being doubled. If it takes 48 days to cover the whole lake, how long does it take to cover only half of the lake?
6. Did you already know one or several of the three previous questions?  
Yes/No
7. Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people? (Code one answer):  
1 Most people can be trusted. / 2 Need to be very careful.
8. Do you think most people would try to take advantage of you if they got a chance, or would they try to be fair? Please show your response on this card, where 1 means that "people would try to take advantage of you," and 10 means that "people would try to be fair" (code one number):

People would try to take advantage of you

People would try to be fair

1      2      3      4      5      6      7      8      9      10

9. I am going to name a number of organizations. For each one, could you tell me how much confidence you have in them: is it a great deal of confidence, quite a lot of

confidence, not very much confidence or none at all? (Read out and code one answer for each):

A great deal    Quite a lot    Not very much    None at all

The churches

Television

The Police

The courts

The government

Parliament

The Civil Service

Banks

Environmental Organisations

Humanitarian Organisations

10. Please tell me for each of the following actions whether you think it can always be justified, never be justified, or something in between, using this card. (Read out and code one answer for each statement):

Never justifiable

Always justifiable

1      2      3      4      5      6      7      8      9      10

Claiming government benefits to which you are not entitled

Avoiding a fare on public transport

Stealing property

Someone accepting a bribe in the course of their duties

11. What is your age?

12. Are you male or female?

13. Please indicate your highest educational level:

- No formal education
- Incomplete secondary school: technical/vocational type
- Complete secondary: university-preparatory type
- Bachelor Degree
- Master Degree
- PhD

14. In which major are you enrolled in?

### Appendix 3

Group level panel regression

Contribution on group level	Coef.	Std. Err	z	P>z
Number of Economists	3.399174	2.767627	1.23	0.219
Period	-2.441058	0.3277251	-7.45	0.000
Number of Economists x Period				
0	-0.3373681	1.244495	-0.27	0.786
2	-1.415291	0.4264092	-3.32	0.001
3	-2.872743	0.5445693	-5.28	0.000
4	-.2212763	0.9625393	-0.23	0.818
Constant	64.59884	5.792905	11.15	0.000
$\sigma_u$	20.69659	1.632813	12.68	0.000
$\sigma_e$	17.11746	0.4832869	35.42	0.000
$\rho$	0.5938104	0.0397096		

## Appendix 4

### Censored regression models

Dep. Variable: <b>investment</b>	Basis Line Multilinear <i>Regression</i>	<i>Tobit</i> (with lower bound)	<i>Tobit</i> (with lower and upper bound)	<i>Tobit</i> (with lower and upper bound) for Treatment 1	<i>Tobit</i> (with lower and upper bound) for Treatment 2	<i>Tobit</i> (with lower and upper bound) with Interaction
N	256	256	256	128	128	256
Constant	7.03264*** (1.661366)	4.691986* (2.562358)	4.732997* (2.598382)	-2.930375 (2.235198)	-1.951143 (1.67237)	-.2043457 (2.651278)
Treatment	-.762799 (1.032412)	-.6578195 (1.58671)	-.6971213 (1.609079)	-	-	-1.33767 (1.49324)
Decisiontime	-	-	-	.1874321*** (.064967)	.0186855 (.0483513)	.0943863** (.0398923)
Economics study	2.054361* (1.060812)	2.753633* (1.610487)	2.811942* (1.63344)	-.907088 (1.645435)	2.641305* (1.376684)	2.56588* (1.514169)
Difference between Block 1 and 2	-	-	-	.0376437** (.0160447)	.0715433*** (.012274)	.0572568*** (.0099225)
Treatment x Economics	-3.01651** (1.495812)	-3.964194* (2.291176)	-4.067995* (2.323877)	-	-	-3.713296* (2.150726)
Adj R-squared	0.0090	-	-	-	-	-
Chi2 (Prob > chi2)	-	4.55 (0.2077)	4.61 (0.2030)	15.92 (0.0012)	39.75 (0.0000)	48.56 (0.0000)
$\sigma$		8.662459 (.5295942)	8.779612 (.5428094)	8.629078 (.7840618)	7.281686 (.602642)	8.027398 (.4922758)

Std. error in brackets; \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$





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