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The Impact of Burden Sharing Rules on the Voluntary Provision of Public Goods

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Abstract: We investigate how burden sharing rules may impact the voluntary provision of a public good which generates heterogeneous benefits to agents. We study different rule-based contribution schemes that are based on the principle of the smallest common denominator: all agents can suggest a minimum provision level of the public good that is allocated across agents according to some predetermined rule. We find that rule-based contribution schemes significantly increase payoff levels relative to the VCM. Importantly, the equal-payoff rule Pareto-dominates all other rules. This holds in particular relative to a scheme where different types of players separately can determine their minimum contribution levels. Our results lend insights not only into efficient institutional design for voluntary private provision of public goods, but may also inform the recent climate policy debate on whether to have small agreements among more homogeneous players instead of having one comprehensive Kyoto style agreement that creates complicated burden sharing issues.

Keywords: public goods, institutions, minimum contribution, cooperation, heterogeneity

JEL: C72, C92, H41

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1. Introduction

The provision of public goods often faces the problem that agents need to voluntarily decide on their own contributions or – alternatively – have to agree upon some desired provision level of the public good in combination with a specific burden sharing rule. This challenge is particularly demanding, when, in addition to enforcement problems, interests differ among players due to heterogeneous preferences. International climate policy is an important example. While strong free-riding incentives prevent a pure voluntary and uncoordinated solution, international negotiations are loaded with debates on equity issues, i.e. on what constitutes a fair distribution of a global reduction target for greenhouse gas emissions.

In this paper, we investigate how burden sharing rules may impact the provision level of a public good that all agents voluntarily accept. We focus on different rule-based contribution mechanisms that are based on the principle of the smallest common denominator: all agents can suggest a minimum provision level of the public good that is allocated across agents according to some predetermined rule. The minimum of all proposals, i.e. the lowest common denominator, then takes effect and creates a "lower bound" for the individual contribution levels.

This approach reflects many real world institutional arrangements that either involve a simultaneous choice of provision goal and burden sharing, or sequentially try to first determine the burden sharing rule before then deciding upon the provision goal. A pre-negotiated rule, e.g. using uniform obligations among countries (Barrett 2003), may particularly be beneficial in reducing negotiation costs when the total target changes over time. Since each participating country needs to sign and ratify the agreement, the player with the smallest proposal is pivotal. Countries can, however, voluntarily go beyond their obligations. We experimentally compare the ability of different rule based contribution schemes to overcome the inefficiency in public good provision.

Our paper relates to the vibrant literature on the voluntary provision of public goods. Orzen (2008) and Dannenberg et al. (2010) have already shown the benefits from such a least common denominator rule when agents are homogeneous. It may not be surprising that these authors find that often this mechanism allows groups to coordinate on large provision levels, thereby generating substantial welfare gains relative to the voluntary contribution mechanism, as the only fair burden sharing rule allocates the same burden to all players. However, cooperation in many settings faces the challenge of substantially differing interests, for example due to different wealth or costs and benefits from the public good. International negotiations on climate change pose a prominent example for such heterogeneity (e.g., Nordhaus 2010). Our paper explores the performance of rule-based contribution schemes for heterogeneous agents. We thereby focus on differences in the agents' benefits from the public good.

There is a significant literature on voluntary public good provision when players are heterogeneous. Many papers concentrate on endowment heterogeneity. Ledyard (1995) and Zelmer (2003) each review several experimental studies and find a negative impact of endowment heterogeneity on contributions.[1] Spraggon and Oxoby (2009) show endowment effects to be sensitive to the endowments' origin. In our experiment we keep the endowment identical across agents, and rather concentrate on heterogeneous public good benefits.

In their literature reviews, both Ledyard (1995) and Zelmer (2003) expose higher marginal per capita returns (MPCR) to enhance cooperation in public goods experiments. However, this effect does not necessarily remain robust if group members differ in their MPCRs. Fisher et al. (1995), for example, report only small tendencies low-type players (MPCR = 0.3) contributing more and high-type players (MPCR = 0.7) contributing less in heterogeneous settings in contrast to homogeneous groups. Tan (2008) shows that heterogeneity with respect to contributing costs lowers cooperation. Reuben and Riedl (2009) find that heterogeneity in endowments or benefits do not alter decision behavior if no punishment options exists. With punishment they investigate contribution norms based on different fairness principles. For instance, with unequal endowments or heterogeneous benefits, contributions are proportional to endowments or to the ratio of marginal benefits. Fellner et al. (2011) investigate the impact of productivity isolated from the costs of contribution. They report that information about heterogeneity increases cooperation but alters contribution norms. While less information leads to more equal contributions, in case of full information subjects focus on group efficiency. Focusing on endogenous coalition formation to provide public goods, McGinty et al. (forthcoming) focus on different distribution rules for coalition payoffs among heterogeneous players and find that efficiency substantially depends on the rule for division of coalitions' benefits.

[1] Van Dijk et al. (2002) and Cherry et al. (2005) as well as Anderson et al. (2008) also confirm the negative endowment effect. In contrast, Chan et al. (1996, 1999) and Buckley and Croson (2006) show potential positive effects. Recent studies on this topic include Sadrieh and Verbon (2006) Koukoumelis et al. (2010) and Georgantzis and Proestakis (2011).

In this paper, we experimentally test and compare several rule-based contribution schemes that are based on the lowest common denominator rule. We consider a linear repeated four-person public good game with players that differ in their benefits from the joint project. Each group consists of two high-type players (MPCR = 0.7) and two low-type players (MPCR = 0.3). We compare the traditional *VCM* with four other treatments that differ in the implemented burden-sharing rule: (i) two variants of equal minimum contribution requirements for all players, (ii) separated minimum levels for low- and high-type players, and (iii) a burden-sharing rule aiming at equalizing payoffs of all players. The first rule thereby equally distributes the contribution obligation on all players and thereby extends the smallest common denominator rule (Orzen 2008, Dannenberg et al. 2010) to a heterogeneous player setting. The second rule allows both types of players to separately coordinate on minimum contributions that are only binding for players of their own type. This treatment is inspired by proposals in international climate policy negotiations to have small agreements among more homogeneous players rather than creating the problem of complicated discussion on burden sharing rules when all countries try to agree on a comprehensive treaty as in the Kyoto process (Olmstead and Stavins 2006). The third rule exogenously determines a differentiated burden regime that is inspired by calls for reducing payoff inequalities.

Our results indicate that all rule-based contribution schemes significantly increase both payoff levels relative to the *VCM*. Interestingly, the equal-payoff rule Pareto-dominates all other rules. This finding is particularly surprising since all rules are predicted to generate coordination on efficient, but differing allocations. Explicitly addressing redistribution among heterogeneous players by equalizing payoffs performs best due to substantially higher contributions from high-type players. This holds in particular relative to the scheme where high- and low-type players separately can determine their minimum contribution: here, low-type agents end up contributing at the same rate as in the equal-payoff treatment while high-type agents fail to efficiently coordinate. This result thereby indicates an important caveat of the smallest common denominator rule: differently from Orzen (2008) and Dannenberg et al. (2010), homogeneous agents may fail to coordinate among themselves in presence of players with other characteristics. We therefore find a superiority of appropriately designed rule-based contribution schemes that involve all players rather than having separate schemes for players of the same type.

The remainder of the paper is organized as follows. Section 2 provides a short theoretical framework in order to derive the predictions for our experiment. The experimental design is described in section 3. We discuss our results in section 4, before concluding in section 5.

2. Theoretical Predictions

In our experiment, we consider different institutions by which agents may decide upon the provision of a public good. They include a standard voluntary provision mechanism as well as different rule-based contribution schemes. In these, players first are requested to suggest a desired total provision level, whose costs are then allocated across the agents according to differing burden sharing rules.

The payoff structure in all treatments is given by a linear public good game. That is, the payoff to player *i* is given by

$$\pi_i = e - q_i + b_i Q$$

where e denotes the initial endowment, q_i the individual contribution, b_i the marginal benefit from the public good to player i, and $Q = \sum_{j=1}^{n} q_j$ the total provision level of the public good. Players differ with respect to their marginal benefits from the public good only. As standard, we assume that $b_i < 1$ and $\sum_{j=1}^{n} b_j > 1$. In our experiment, we consider groups of four players ($n = 4$) that consist of two low-type players ($b_{low} = 0.3$) and two high-type players ($b_{high} = 0.7$). The endowment is given by $e = 20$ such that $q_i \in [0,20]$.

Voluntary contribution mechanism (VCM)

In the traditional *VCM*, individuals simultaneously choose their contribution level q_i. Since $b_i < 1$ for all agents, individual utility maximization yields the Nash equilibrium of zero contributions to the public good both for low- and high-type players with individual earnings $\pi_i = e$.

Common individual minimum contribution mechanism (min-I-q)

We next consider a setting in which all subjects first simultaneously suggest a common individual minimum contribution level. After these minimum proposals $q_i^{\min}$ are received from all agents, this rule requires all four players to provide at least the smallest suggested level, i.e. $q_i \geq q^{\min} = \min_{j \epsilon S} q_j^{\min}$. Under these conditions, each agent has a weakly dominant strategy to suggest $q_i^{\min} = e$: in the second stage, no payoff maximizing player would contribute more than required ($q_i = q^{\min}$). When making their minimum proposal $q_i^{\min}$ in the first stage, agents therefore need to recognize their potential impact on the provision levels of all other players such by suggesting a higher minimum they can only increase their own payoff ($\pi_i = e - q^{\min} + b_i n q^{\min}$) since $nb_i > 1$. We therefore predict $q_i^{\min} = e$ such that an efficient outcome results ($\pi_i = b_i ne$).

Separate individual minimum contribution mechanism (min-II-q)

In the next treatment, we consider a modification to *min-I-q* in which the high- and low-type players may suggest an individual minimum contribution level that applies only to their own type. This treatment incorporates the idea that a forced equal contribution obligation that is implicitly present in *min-I-q* may not be acceptable. Rather, differentiated obligations for the respecteive player types are possible. That is, low-type players agree on their own binding minimum level q_{low}^{min} and high-type players choose q_{high}^{min}. Again, the smallest suggested level is binding for the respective type. Theory predicts full contribution if $1 < (\frac{n}{2}) b_i$ which holds only for the high-type players. Low-type players have a dominant strategy of suggesting $q_i^{\min} = 0$. The payoffs are therefore predicted as $\pi_{i,high} = b_{high}(\frac{n}{2})e$ and $\pi_{i,low} = e(1 + (\frac{n}{2}) b_{low})$. Note that this allocation is efficient: since we assumed that no direct transfers are possible, no other allocation exists that treats agents of the same type identically and generates a larger payoff to all players.

Rule-based contribution schemes

The two treatments above implicitly lead to predictions that can be incorporated in rule-based contribution schemes in which a total provision level Q is distributed across agents to a specific rule such that $q_i \geq \alpha_i Q$ where $\sum_i \alpha_i = 1$. We define such schemes as follows: In a first step, each agent can suggest a total provision level Q_i. The minimum of the suggested levels is then decisive for contributions in the second stage: $Q^{\min} = \min_j Q_j$ such that $q_i \geq \alpha_i Q^{\min}$. In the second stage, players again have no incentive to contribute more than required, i.e. $q_i = \alpha_i Q^{\min}$. The payoff is therefore given by $\pi_i = e - \alpha_i Q^{\min} + b_i Q^{\min}$ such that agents have a weakly dominant strategy to suggest the maximal possible Q_i if $\alpha_i \leq b_i$, while suggesting $Q_i = 0$ is dominant if $\alpha_i > b_i$.

The strategic features of *min-I-q* coincide with a setting in which $\alpha_i = 1/n$, that is an egalitarian burden sharing rule. The predictions in *min-II-q* coincide with a setting in which $\alpha_{low} = 0$ and $\alpha_{high} = \frac{2}{n} = \frac{1}{2}$, that is a rule that allocates the burden only to high-type players.

Equal contribution treatment (min-I-Q)

In our experiment, we introduce a treatment *min-I-Q* with $\alpha_i = 1/n$ in order to control for framing effects. As in *min-I-q*, the predictions are $Q^{min} = ne$, with $\pi_i = b_i ne$.

Equal payoff treatment (min-I-Q-eq)

We further consider a burden sharing rule that is motivated by reaching equal payoff. That is, the α_i values are determined such that the predicted payoff:

$$\pi_i = e + (b_i - \alpha_i)Q$$

is identical for all players i. In general, this implies that

$$\alpha_i = b_i - \frac{1}{n}\left(\sum_j b_j - 1\right)$$

which in our experiment would require $\alpha_{low} = 0.05 = 0.3 - (2-1)/4$ and $\alpha_{high} = 0.45 = 0.7 - (2-1)/4$. Note, however, payoff equality can only be reached if $\alpha_{high} Q^{min} \leq e$, or $Q^{min} \leq 20/0.45 = 44.4$. In our experiment, we therefore distribute the burden for $Q^{min} > 20/0.45$ such that the high-type players contribute all their endowment, while allocating a minimum contribution of $(Q^{min} - 40)/2$ to low-type players.

Given the parameters in our experiment, high-type players again have a weakly dominant strategy to suggest a group minimum contribution level of $Q_{high}^{min} = 80$ which would lead to unequal payoffs for both players. As low-type players only gain as long an increase in Q^{min} also lead to increased burden to high-type players, i.e. as long as $Q^{min} \leq 20/0.45 = 44.4$, they are predicted to suggest $Q_{low}^{min} = 44$.

Our predictions are summarized in Table 1. Figure 3 illustrates the predicted payoffs to low- and high-type players under *VCM* (point A), *min-I-Q* (Point B), *min-II-q* (point C), and *min-I-Q-eq* (Point D), as well as the line of all efficient allocations that give equal payoff to players of same type (line connecting B and C). Note that all rule-based contribution schemes that we consider lead to efficient outcomes (under the assumption that no direct transfers are feasible between agents).

For the sake of allowing the reader to better follow the remainder of the paper, we would like to explain the notation of our treatments: it indicates whether the treatment implements a minimum threshold ("*min*" in all treatments except *VCM*), whether there the individual contribution requirement is based on one or two separate minimum thresholds ("*I*" in *min-I-q*, *min-I-Q*, *min-I-Q-eq*, *"II"* in *min-II-q*), and whether subjects propose an individual contribution level $q_i^{\min}$ or a collective level $Q_i^{\min}$.

3. Experimental Design

The experiment was run in November 2011 at the MaXLab laboratory of the University of Magdeburg in Germany. We recruited 336 students from various disciplines. Each student took part in one of 14 sessions with 24 subjects each.[2] On average, a session lasted about 60 minutes. At the beginning of each session, subjects were seated at separated linked computer terminals. We used z-tree software (Fischbacher 2007) for programming and ORSEE (Greiner 2004) for recruiting. In each session, we randomly created six groups of four players with two high-type and two low-type players. Subjects were not aware of their exact partners. Each player remained the same type in the same group throughout the whole experiment (partner matching). All relevant information on players' type (high-type player or low-type player), contributions (*tokens)* and payoffs (in *Labdollars* LD) was transmitted via screen. No direct communication between participants was allowed, only the four players of one group received information on offers, decisions and payoffs on their screens. In a first step, subjects received a set of experimental instructions which included verbal descriptions, numerical examples and control

2 Due to a typing error in our z-tree program, we had to remove the results of one group of four players in the first session from our analysis.

questions to make sure that every participant understood the game.[3] In a second step, the experiment was started on the computer. A session consisted of 12 rounds, the first two being practice periods. At the end of each session, one non- practice round was randomly chosen to determine individual earnings for each player. The exchange rate between Euro and LabDollar (LD) was 1:2.5. On average, subjects earned about 11 Euro. No additional show-up fee was paid. The experimental design is summarized in Table 2.

4. Experimental Results

Our experimental design enables us, on the one hand, to test our theoretical predictions regarding public good contribution levels under heterogeneity across different mechanisms. On the other hand, we may observe "pattern" of individual behavior and, thus, develop a better understanding which mechanisms perform best when heterogeneous individuals have the option to contribute to a public good. We craft the results summary by both pooling the data across all periods and reporting treatment differences in the first and last five periods. We later explore the effects of time on contribution schedules in more detail.

Table 3 provides mean contribution levels for each of our treatments and Figure 1 provides a graphical depiction of the data. Averaged over all periods, contributions are lowest in *VCM* (5.5 tokens) and highest in the equal-payoff treatment *min-I-Q-eq* (9.4). These differences are even more pronounced when concentrating on the last five periods (*VCM* 3.9, *min-I-Q-eq* 9.9). While a comparison of contributions is indicative of the obtained efficiency, we first focus on the payoff comparisons across treatments. In our discussion, we hereby concentrate on the last five periods since the rule-based contribution schemes require some time for coordination for most groups. All results are, however, also reported for the first five and for all ten periods in Table 4.

We first establish the following result on the benefits of rule-based contribution schemes:

Result 1.

Rule-based contribution schemes lead to larger payoffs than VCM.

[3] We provide an example of instructions and screenshots in the Appendix.

Focusing on the last 5 periods, average profit over all players is minimal in *VCM* (23.91 LD) and reaches its maximum in *min-I-Q-eq* (29.91 LD). Hereby, average payoffs are significantly larger under all rules than under *VCM* ($p < 0.05$ for *min-I-q*, $p < 0.01$ for all other rules).[4] These benefits accrue in particular to high-type agents ($p < 0.01$ in all treatments relative to VCM), while low-types benefit particularly in treatments that differentiate the burden ($p < 0.01$, *min-II-q*, *min-I-Q-eq* relative to *VCM*), while not significantly doing better in treatments that require identical contributions from all players (*min-I-q* and *min-I-Q*).

These results on payoff comparisons are confirmed by a series of random-effects regression models[5] (see Table 5). Average profits over all players and periods are significantly higher in all treatments than in *VCM* except in *min-I-q* (at least $p < 0.10$ for all other rules) (column 1). This average treatment effect is largest for *min-I-Q-eq*.[6] A closer look indicates differences in payoffs between the two types because of higher benefits for high-type players in all treatments ($p < 0.01$). These differences are most pronounced in *min-I-q* and *min-I-Q* where equal minima for all types are implemented (column 2), while tendencies of payoff harmonization exist for rules that explicitly address the differentiation of burdens (*min-II-q* and *min-I-Q-eq*). Payoff gains for low-type agents are largest in *min-I-Q-eq* ($p < 0.01$). In *min-I-q*, they loose in contrast to VCM ($p < 0.05$).

The benefits of rule-based provision of public goods relative to *VCM* particularly occur over time. While we confirm the standard result that contributions in VCM decline over time (column 3), the downward trends are weaker in all other treatments (column 3). For low-type agents profits in *min-I-Q-eq* are even increasing over time ($p < 0.01$). An additional downward trend for high-type agents relative to the trend for low-type players only occurs in *VCM* and *min-II-q*.

While Result 1 was expected under our theoretical predictions, it nicely adds to findings by Orzen (2008) and Dannenberg et al. (2010) who show the benefits from minimum-rules for homogeneous agents. We show that such minimum-contribution rules may also generate efficiency gains when agents differ significantly in their benefits from the public good. This even holds for rules that require equal contributions from all players. However, our results also

[4] In this section we refer to exact two-sided Mann-Whitney U (MW U) tests with the average contribution by one group or subgroup (high-type or low-type) as the unit of observation.
[5] This estimation procedure enables us to allow for unobserved subject-specific differences. We use a random-effects Feasible Generalized Least Square estimator (RE FGLS) for determining differences in individual payoffs.
[6] Throughout the paper, the discussion on differences among estimated regression coefficients is based on underlying Wald Tests.

indicate important benefits from differentiating the burden across players by accounting for their different benefits from the public good. In particular, we observe that low-type players obtain significantly larger payoffs under rules that do not require them to contribute at the same rate as high-type agents: *min-II-q* (24.45 LD) leads to larger payoffs than *min-I-q* (21.91 LD) and *min-I-Q* (22.06 LD); *min-I-Q-eq* (28.51 LD) leads to larger payoffs than any other rule (all differences significant, $p < 0.01$). While these profit gains for low-type agents hurt the high-type agents when comparing *min-I-Q* (32.10 LD) with *min-II-q* (29.14 LD) ($p < 0.05$), also high-type agents benefit from the equal payoff rule *min-I-Q-eq* (31.32 LD) ($p < 0.01$, compared with all rules besides *min-I-Q*).

We therefore obtain the following result:

Result 2.

The equal payoff rule Pareto-dominates all other burden sharing rules, including the VCM.

Table 5 provides further evidence for this result. It should be noted that the benefits from *min-I-Q-eq* relative to other treatments for low-type agents already accrue in the first five periods. The important difference, however, occurs over time. Average profits in all treatments tend to decrease over periods, except for *min-I-Q-eq*. In this treatment profits for low-type subjects are increasing in the last 5 periods ($p < 0.01$). Our regression results suggest that this effect may be smaller for high-type players, but the difference is not significant.

It should be noted, however, that almost no group fully coordinates on the provision level that was predicted by the theory. Figure 3 plots average profits for high- and low-type players for each group in the last 5 periods. As stated in the previous section, the points B, C, and D denote the equilibrium payoffs that would be predicted under the respective burden sharing rules. Point A corresponds to the zero contributions as predicted for *VCM*. While significant profit gains relative to *VCM* predictions are realized, most groups do not come close to the Pareto frontier. For example, many groups in *min-I-q* and *min-I-Q* coordinated along the line AB towards the Pareto frontier, thereby suggesting that they did not contribute more than was demanded by the minimum rule, but only few groups came close to achieving efficiency. In *min-II-q*, only one group coordinated along AC, for all other groups low-type players contributed a positive amount and thereby benefited the high-type players more. For the payoff equality rule in *min-I-Q-eq* (along AD) average efficiency gains were largest.

These payoff differences correspond to different contribution levels that can be observed in our random-effects regression models[7] in Table 6a and 6b. Average contributions to the public good across all players and time periods in all treatments are higher than in *VCM* (at least $p < 0.05$ except for *min-I-q*), with the effect being strongest in *min-I-Q-eq* (columns 1). The increases in average contributions relative to *VCM* in *min-II-q* and in *min-I-Q-eq* are thereby largely driven by high-type players (columns 3 and 4). No difference exists between the contributions of low type players between *min-II-q* and *min-I-Q-eq*, while high-type players give significantly more in *min-I-Q-eq*.

These treatment differences are particularly driven by different time trends: looking at the underlying contribution decisions in Figure 1, it is easily seen that mean contributions do not differ across treatments in the first period. Figure 1 indicates that the contributions in all treatments, except *min-I-Q-eq*, are decreasing over time. The drop in contributions is strongest in *VCM*. The lower part of Figure 1 shows how both types contribute to these differences.

The temporal trends can also be identified in the random-effects regressions in Table 6a and 6b. Overall, we observe a positive trend for *min-I-Q-eq* ($p < 0.01$), but declining contributions for all other treatments (significant only for *VCM* at $p < 0.01$ in FGLS (Table 6a, column 2), but for all other treatments in Tobit (Table 6b, column 2)). Concentrating on low type players (column 4 in Table 6a and 6b), we observe that average contribution decline over time in *VCM* and *min-II-q*, but are rather stable in the other treatments. Coordination of high-type players *min-II-q* counterbalances the downward time trend by low-type players, but in aggregate only leads to stable contributions of high-type players over time. In *min-I-Q-eq*, however, no downward trend for low-type players exists while contributions for high-type subjects are rising in the last 5 periods ($p < 0.01$). This increase in contributions by high type players thereby drives the dominance of the equal-payoff rule as observed in Result 2.

[7] We follow our estimation strategy which we applied for determining differences in individual payoffs and use a random-effects Feasible Generalized Least Square estimator (RE FGLS) for analyzing individual contribution behavior. In addition, for robustness check, we further apply a Tobit estimator (RE Tobit). The latter estimator controls for the fact that the dependent variable (individual contributions to the public good in each period) is both left- and right-censored with a lower limit of 0 (20.12% of all contribution decisions) and an upper limit of 20 (9.67% of all contribution decisions). Specification tests suggest that the results of the Tobit estimator are not sensitive to the number of quadrature points used in the estimation process.

We can therefore formulate the following result that complements our previous results:

Result 3.

Contributions increase over time in min-I-Q-eq, but show a downward trend in all other treatments, particularly in VCM. For low-type players, there is no downward trend in min-I-q and min-I-Q, such that these treatments lead to higher contributions by low-type players in the last periods than the other treatments. For high-type players contributions are largest in min-I-Q-eq and *even increase over time.*

Result 3 already demonstrates different time trends for low- and high-type players: the dominance of *min-I-Q-eq* appears to be primarily driven by increased contributions by high-type players themselves. They contribute 16.4 tokens on average in the last 5 periods in *min-I-Q-eq*, while their contributions are significantly smaller in all other treatments ($p < 0.01$). Conversely, low-type agents contribute less in this treatment (3.4 tokens) than under any other non-differentiating rule-based scheme (5.7 in *min-I-q*, 6.2 in *min-I-Q*, $p < 0.01$). Interestingly, low-type agents' contributions are not significantly different in *min-II-q* (3.7) than under the equal payoff treatment. This implies that *min-I-Q-eq* allows high-type agents to better coordinate their own actions than they do under the *min-II-q* treatment which also had predicted a coordination of the two high-type players on full contributions. Instead, they only achieve an average 9.9 tokens in this treatment.

These lower contribution levels are primarily driven by the lower minimum proposals. In fact, only 3 out of 18 groups of high type players in *min-II-q* achieve a coordinated minimum proposal of at least 18 in period 10. Seven groups of high type players do not achieve any coordination, i.e. stay at a zero level in period 10. In contrast, 14 out of 18 groups achieve a coordination that requires high-type players to contribute at least 18 in period 10. Considering only the minimum proposals by high-type players, all 18 groups of two would suggest to take on at least 18 tokens as obligation In fact, 16 pairs of high type players in *min-I-Q*-eq suggest provision levels in period 10 that would require them to contribute all 20 tokens.

We therefore formulate the following result:

Result 4.

An appropriately designed burden sharing scheme that involves all players may allow high-type players to coordinate over time more effectively than a scheme under which players of the same type only coordinate contributions among themselves.

We consider Result 4 as being rather surprising: it is obvious that low-type agents under the equal payoff scheme will suggest high provision levels up to $Q^{min} = 44$) which would require almost full contribution of high-type subjects, but relatively little from low type players (less than 3, see Table 1). Anticipating low-types' payoff maximization behavior, high-type agents' best answer is to suggest a minimum which is equal or higher than $Q^{min} = 44$. Effectively, this scheme therefore should have similar coordination effects as the *min-II-q* treatment where the two high-type players coordinate only among themselves. However, we observe significantly less coordination in *min-II-q* which leads to the dominance of the equal payoff rule.

The missing coordination among high-type players in *min-II-q* stands in conflict with findings by Orzen (2008) and Dannenberg et al. (2010) who show that homogenous groups achieve large cooperation levels under the lowest common denominator scheme. Our results therefore suggest that coordination is hampered when other, different-type players, are present.

This difference in the coordination by high-type players in *min-II-q* and *min-I-Q-eq* is particularly surprising as the contributions of low-type players do not differ between the two treatments. We can therefore only speculate about the reasons for this dominance of the equal-payoff treatment: on the one hand, *min-I-Q-eq* may have intuitively appealing properties when agents are sufficiently inequality-averse (compare Fehr and Schmidt 1999, Charness and Rabin 2002). On the other hand, coordination may be improved in *min-I-Q-eq* since *all* players suggested minimum levels for the aggregate provision level are treated identically. Differently in *min-II-q*, each player type makes proposals that are treated separately. As a result, high-type players may be influenced by explicitly observing small minimum proposals from low-type players, while not recognizing that decoupling from those by coordinating only among themselves is optimal for the two high-type players.

5. Conclusions

Forming institutions to secure the provision of global public goods is a complicated endeavor. In general, the success of a decentralized institution to provide a public good depends on two interlinked challenges: on the one hand, the institutional arrangements need to overcome free rider incentives. On the other hand, as soon as subjects are heterogeneous, any given institution has to cope with equity issues or equivalently the burden sharing of the total costs. In this paper, we tested different institutions with respect to their ability to succeed along these two dimensions. In particular, we investigate how burden sharing rules may impact the provision level of a public good that all agents voluntarily accept. We focus on different rule-based contribution mechanisms that are based on the principle of the smallest common denominator: all agents can suggest a minimum provision level of the public good that is allocated across agents according to some predetermined rule. The minimum of all proposals, i.e. the lowest common denominator, then creates a threshold for the own contribution. We introduced heterogeneity as our players differ with respect to their marginal benefit from the public good.

Our results indicate that rule-based contribution schemes significantly increase payoff levels relative to the voluntary contribution mechanism. Interestingly, the equal-payoff rule where the minimum threshold is chosen in a way that payoffs are equalized Pareto-dominates all other rules. This finding is particularly surprising since all rules are predicted to generate coordination on efficient, but differing allocations. Enforcing redistribution among heterogeneous players by equalizing payoffs performs best due to substantially higher contributions from high-type players. This holds in particular relative to the scheme where high- and low-type players separately can determine their minimum contribution: here, low-type agents end up contributing at the same rate as in the equal-payoff treatment while high-type agents fail to efficiently coordinate. This result may shed some light on the recent discussion in climate policy. In order to accelerate negotiations for a post-Kyoto agreement sub-agreements between rather homogenous countries are suggested. In our environment, these sub-agreements fail to produce efficiency. Instead, subjects with high marginal benefit contribute at a significantly higher level only when they know that the redistribution is explicitly enforced by the mechanisms.

Compared to the equal payoff-rule the performance of the single (“one for all”) smallest common denominator rule in our experiment is rather weak. While recent experiments have shown that this rule is quite successful under homogeneous players, we get a different picture under heterogeneity. This result underlines the importance of equity in the provision of public goods and of robustness checks for mechanisms under various conditions. Other aspects of heterogeneity such as heterogeneous costs, endowments or ways to generate the endowment (“house money effects”) may alter the picture, particularly as the per. The experimental investigation of such heterogeneities on the performance of the different institutions and their possible adjustments are fruitful areas of further research.

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Appendix

Table 1: Summary of predictions with standard preferences

	$q_{i,low}$	$q_{i,high}$	$\pi_{i,low}$	$\pi_{i,high}$	Π	π_{all}
VCM	0	0	20	20	80	20
min-I-q	20	20	24	56	160	40
min-II-q	0	20	32	28	120	30
min-I-Q	20	20	24	56	160	40
min-I-Q-eq	2.2	19.8	31	31	124	31

Table 2: Summary of experimental design

Treatment	Stages	Separated minimum rules for low-type and high-type players	*n*	b_i	No. of subjects (ind. obs.)
VCM	contribution		4	$b_{i,low} = 0.3$ $b_{i,high} = 0.7$	48 (12)
min-I-q	minimum contribution	no	4	$b_{i,low} = 0.3$ $b_{i,high} = 0.7$	72 (18)
min-II-q	minimum contribution	yes	4	$b_{i,low} = 0.3$ $b_{i,high} = 0.7$	72 (18)
min-I-Q	minimum contribution	no	4	$b_{i,low} = 0.3$ $b_{i,high} = 0.7$	68 (17)
min-I-Q-eq	minimum contribution	yes	4	$b_{i,low} = 0.3$ $b_{i,high} = 0.7$	72 (18)

Table 3: Summary statistics for all treatments

Treatment	q_{all}	q_{low}	q_{high}	q_{ratio}	π_{low}	π_{high}	π_{ratio}	Π	π_{all}
	All periods								
VCM	5.5	3.2	7.7	2.41	23.33	27.59	1.18	101.84	25.46
min-I-q	6.4	5.8	7.3	1.26	22.05	31.10	1.41	106.29	26.57
min-II-q	7.2	4.5	9.9	2.20	24.13	30.21	1.25	108.68	27.17
min-I-Q	7.4	6.3	8.4	1.33	22.54	32.37	1.44	109.28	27.32
min-I-Q-eq	9.4	3.6	15.1	4.19	27.65	31.02	1.12	117.34	29.34
	Periods 1-5								
VCM	7.0	4.4	9.6	2.18	23.97	30.05	1.25	108.05	27.01
min-I-q	6.8	5.9	7.6	1.29	22.19	31.35	1.41	107.07	26.77
min-II-q	7.6	5.2	9.9	1.90	23.82	31.27	1.31	110.17	27.54
min-I-Q	7.9	6.4	9.3	1.45	23.01	32.64	1.42	111.29	27.82
min-I-Q-eq	8.8	3.7	13.8	3.73	26.79	30.73	1.15	115.04	28.76
	Periods 6-10								
VCM	3.9	2.0	5.8	2.90	22.69	25.13	1.11	95.63	23.91
min-I-q	6.4	5.7	7.0	1.23	21.91	30.85	1.41	105.51	26.38
min-II-q	6.8	3.7	9.9	2.68	24.45	29.14	1.19	107.19	26.80
min-I-Q	6.9	6.2	7.5	1.21	22.06	32.10	1.46	107.26	26.82
min-I-Q-eq	9.9	3.4	16.4	4.82	28.51	31.32	1.10	119.65	29.91

Notes: q_{all} = average contribution per group, q_{low} = average contributions for low-type, q_{high} = average contributions for high-type, $q_{ratio} = q_{high}/q_{low}$, π_{low}= average profits for low-type, π_{high} = average profits for high-type, $\pi_{ratio} = \pi_{high}/\pi_{low}$, Π = sum of profits for all players, π_{all} = average profit per group.

Table 4: Tests between treatments (MW U test)

Treatment	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*
q_i all players	Period 1-10				Period 6-10			
min-I-q	>				>**			
min-II-q	>	>			>***	>		
min-I-Q	>	>	>		>***	>	>	
min-I-Q-eq	>***	>**	>***	>*	>***	>***	>***	>***

Treatment	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*
q_{low}	Period 1-10				Period 6-10			
min-I-q	**				>***			
min-II-q	>	<			>***	<***		
min-I-Q	>**	>	>*		>***	>	>***	
min-I-Q-eq	>	<**	<	<***	>***	<***	<	<***

Treatment	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*
q_{high}	Period 1-10				Period 6-10			
min-I-q	<				>			
min-II-q	>	>*			>***	>***		
min-I-Q	>	>	<		>	>	<***	
min-I-Q-eq	>***	>***	>***	>***	>***	>***	>***	>***

Treatment	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*
π_i all players	Period 1-10				Period 6-10			
min-I-q	>				>**			
min-II-q	>	>			>***	>		
min-I-Q	>	>	>		>***	>	>	
min-I-Q-eq	>**	>**	>***	>*	>***	>***	>***	>***

Treatment	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*
π_{low}	Period 1-10				Period 6-10			
min-I-q	<				<			
min-II-q	>	>***			>***	>***		
min-I-Q	<	>	<**		<	>	<***	
min-I-Q-eq	>***	>***	>***	>***	>***	>***	>***	>***

Treatment	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*	*VCM*	*min-I-q*	*min-II-q*	*min-I-Q*
π_{high}	Period 1-10				Period 6-10			
min-I-q	>				>***			
min-II-q	>	<			>***	<		
min-I-Q	>**	>	>		>***	>	>**	
min-I-Q-eq	>**	<	>	<	>***	>***	>***	<

Note: We compare rows with columns. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 5: Random-effects regression of profit levels for all treatments

VARIABLES	(1) RE FGLS All per. Profit	(2) RE FGLS All per. Profit	(3) RE FGLS All per. Profit	(4) RE FGLS Last 5 per. Profit
min_I_q	1.112	-1.284**	-1.787**	-0.781
	(0.995)	(0.592)	(0.747)	(0.542)
min_II_q	1.709*	0.802	-0.157	1.761**
	(0.911)	(0.663)	(0.747)	(0.733)
min_I_Q	1.991*	-0.796	-0.962	-0.630
	(1.016)	(0.624)	(0.748)	(0.611)
min_I_Q_eq	3.876***	4.314***	2.813***	5.815***
	(0.778)	(0.620)	(0.750)	(0.642)
high_VCM		4.257***	6.078***	2.437**
		(1.027)	(1.320)	(1.024)
high_min_I_q		9.049***	9.160***	8.938***
		(1.177)	(1.151)	(1.525)
high_min_II_q		6.071***	7.450***	4.692***
		(1.174)	(1.300)	(1.229)
high_min_I_Q		9.831***	9.624***	10.04***
		(1.128)	(1.500)	(1.451)
high_min_I_Q_eq		3.381***	3.945***	2.816***
		(0.911)	(1.104)	(0.993)
per6_10_VCM			-1.283***	
			(0.392)	
per6_10_min_I_q			-0.278	
			(0.381)	
per6_10_min_II_q			0.634	
			(0.522)	
per6_10_min_I_Q			-0.952**	
			(0.393)	
per6_10_min_I_Q_eq			1.719***	
			(0.503)	
high_per6_10_VCM			-3.642***	
			(1.162)	
high_per6_10_min_I_q			-0.222	
			(1.320)	
high_per6_10_min_II_q			-2.758***	
			(0.936)	
high_per6_10_min_I_Q			0.415	
			(1.899)	
high_per6_10_min_I_Q_eq			-1.129	
			(1.039)	
Constant	25.46***	23.33***	23.97***	22.69***
	(0.598)	(0.489)	(0.577)	(0.473)
Observations	3,320	3,320	3,320	1,660
R-sq	0.0253	0.2372	0.2494	0.2419

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Definition of variables

qi	Subject's contribution
Profit	Subject's payoff
min_I_q	=1 if subject played treatment *min-I-q*, 0 otherwise
min_II_q	=1 if subject played treatment *min-II-q*, 0 otherwise
min_I_Q	=1 if subject played treatment *min-I-Q*, 0 otherwise
min_I_Q_eq	=1 if subject played treatment *min-I-Q-eq*, 0 otherwise
high_*treatment*	=1 if subject played *treatment* and is a high-type, 0 otherwise
per6_10_*treatment*	=1 for the last 5 periods and subject played *treatment*,0 otherwise
high_per6_10_*treatment*	=1 for the last 5 periods and subject is a high-type and subject played *treatment*, 0 otherwise

Table 6a: FGLS Random-effects regression of contributions to the public good

VARIABLES	(1) All per. qi	(2) All per. qi	(3) All per. qi	(4) All per. qi	(5) Last 5 per. qi
min_I_q	1.112	-0.246	1.260	1.492*	3.744***
	(0.793)	(0.912)	(0.859)	(0.895)	(0.969)
min_II_q	1.709**	0.529	0.0687	0.792	1.706**
	(0.851)	(0.963)	(0.953)	(0.993)	(0.846)
min_I_Q	1.859**	0.811	2.002**	1.935*	4.165***
	(0.778)	(0.980)	(0.991)	(1.085)	(0.945)
min_I_Q_eq	3.876***	1.747	-1.792**	-0.717	1.391*
	(0.999)	(1.069)	(0.858)	(0.908)	(0.722)
per6_10_VCM		-3.104***	-3.104***	-2.442***	
		(0.520)	(0.520)	(0.617)	
per6_10_min_I_q		-0.389	-0.389	-0.189	
		(0.542)	(0.543)	(0.754)	
per6_10_min_II_q		-0.744	-0.744	-1.528***	
		(0.508)	(0.508)	(0.425)	
per6_10_min_I_Q		-1.009	-1.009	-0.212	
		(0.787)	(0.788)	(0.999)	
per6_10_min_I_Q_eq		1.154**	1.154**	-0.334	
		(0.552)	(0.552)	(0.490)	
high_VCM			4.479***	5.142***	3.817***
			(1.036)	(1.266)	(1.035)
high_min_I_q			1.467	1.667	1.267
			(0.998)	(1.068)	(1.201)
high_min_II_q			5.400***	4.617***	6.183***
			(1.003)	(1.124)	(1.118)
high_min_I_Q			2.097**	2.894**	1.300
			(0.931)	(1.253)	(1.179)
high_min_I_Q_eq			11.56***	10.07***	13.04***
			(0.800)	(1.005)	(0.905)
high_per6_10_VCM				-1.325	
				(1.024)	
high_per6_10_min_I_q				-0.400	
				(1.085)	
high_per6_10_min_II_q				1.567	
				(1.000)	
high_per6_10_min_I_Q				-1.594	
				(1.565)	
high_per6_10_min_I_Q_eq				2.976***	
				(1.047)	
Constant	5.460***	7.013***	4.773***	4.442***	2***
	(0.610)	(0.733)	(0.594)	(0.663)	(0.454)
Observations	3,320	3,320	3,320	3,320	1,660
R-sq	0.0328	0.0439	0.2593	0.2637	0.3155

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6b: Tobit Random-effects regression of contributions to the public good

VARIABLES	(1) All per. qi	(2) All per. qi	(3) All per. qi	(4) All per. qi	(5) Last 5 per. qi
min_I_q	2.601**	0.696	2.860*	2.811*	7.062***
	(1.262)	(1.316)	(1.487)	(1.530)	(1.817)
min_II_q	3.152**	1.544	0.875	1.666	3.789**
	(1.262)	(1.317)	(1.491)	(1.534)	(1.824)
min_I_Q	3.470***	1.917	3.583**	3.158**	7.742***
	(1.277)	(1.332)	(1.507)	(1.552)	(1.835)
min_I_Q_eq	6.738***	3.608***	0.0621	1.093	5.866***
	(1.263)	(1.317)	(1.487)	(1.530)	(1.811)
per6_10_VCM		-4.919***	-4.861***	-4.737***	
		(0.623)	(0.617)	(0.907)	
per6_10_min_I_q		-0.790*	-0.776*	-0.582	
		(0.472)	(0.469)	(0.661)	
per6_10_min_II_q		-1.402***	-1.406***	-2.987***	
		(0.477)	(0.475)	(0.694)	
per6_10_min_I_Q		-1.504***	-1.491***	-0.536	
		(0.487)	(0.485)	(0.689)	
per6_10_min_I_Q_eq		1.640***	1.655***	-0.320	
		(0.469)	(0.469)	(0.645)	
high_VCM			6.481***	6.568***	6.869***
			(1.586)	(1.678)	(1.980)
high_min_I_q			1.941	2.124	1.988
			(1.270)	(1.350)	(1.552)
high_min_II_q			7.545***	6.098***	9.221***
			(1.274)	(1.352)	(1.560)
high_min_I_Q			2.933**	3.847***	1.899
			(1.309)	(1.392)	(1.592)
high_min_I_Q_eq			13.32***	11.28***	15.61***
			(1.272)	(1.350)	(1.555)
high_per6_10_VCM				-0.215	
				(1.231)	
high_per6_10_min_I_q				-0.381	
				(0.933)	
high_per6_10_min_II_q				2.976***	
				(0.949)	
high_per6_10_min_I_Q				-1.859*	
				(0.963)	
high_per6_10_min_I_Q_eq				4.128***	
				(0.934)	
Constant	3.184***	5.490***	2.385**	2.346*	-2.724*
	(0.984)	(1.025)	(1.164)	(1.197)	(1.450)
Observations	3,320	3,320	3,320	3,320	1,660

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Figure 1: Mean contributions over time

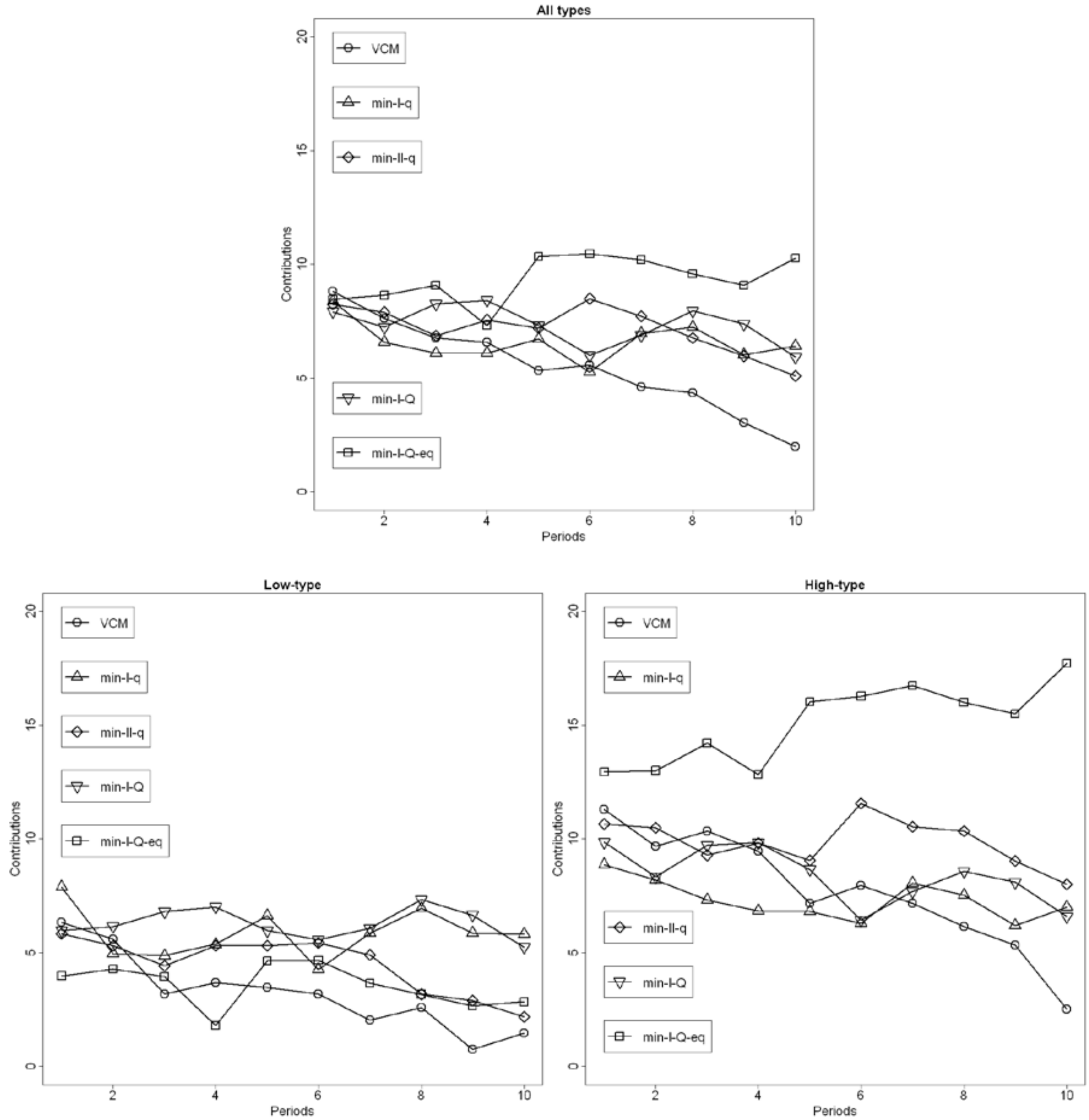


Figure 2: Mean profits over time

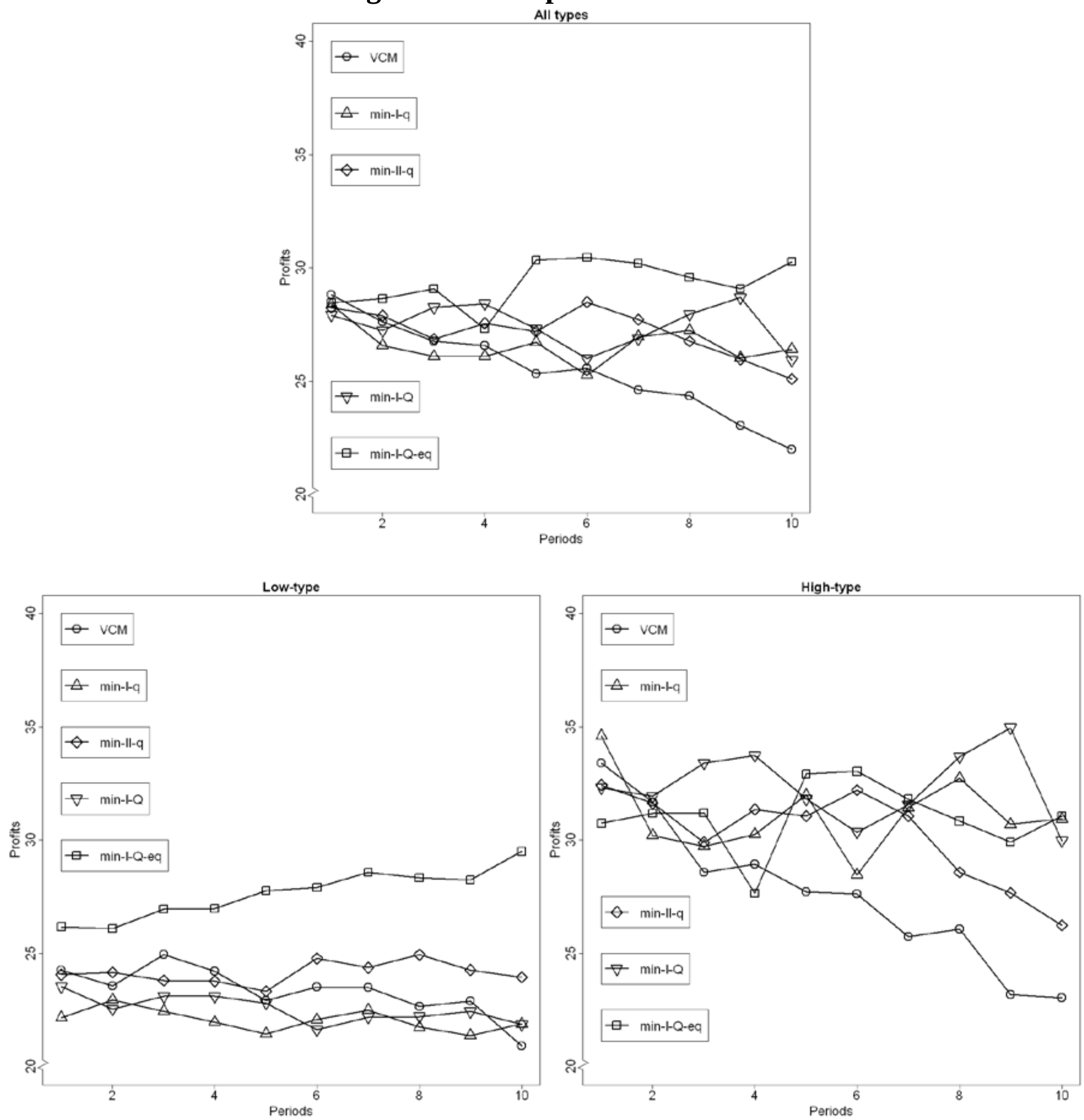
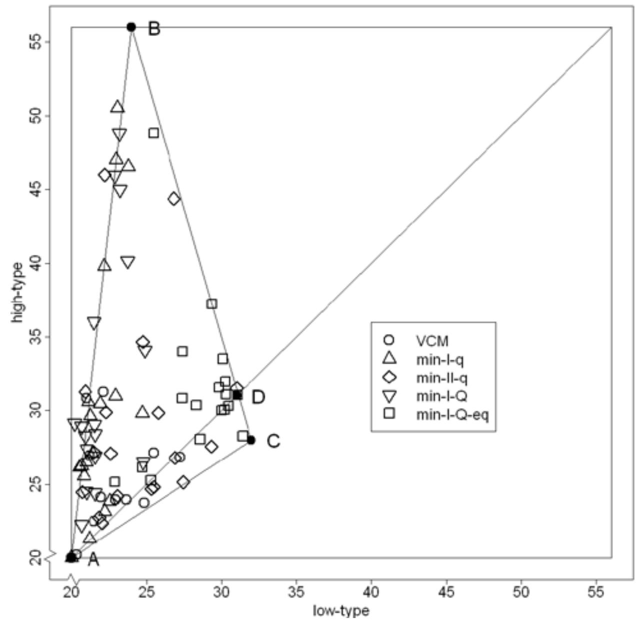


Figure 3: Profits per group (average over periods 6 to 10)



Experimental instructions for ***min-I-Q-eq*** treatment

Instructions

Welcome to the Magdeburg Experimental Laboratory MaXLab!

Please read these instructions carefully and should you have any questions please signal us by opening the door or a show of hands. Please do not talk to other participants.

In the laboratory experiment you are taking part in, you can win money depending on your decisions and the decisions of your fellow players. Your payout from the experiment will be calculated in LabDollars (LD). The conversion rate between € and LD is **1:2.5**, i.e. 1 LD are 0.40 €. All your decisions made in the experiment will remain **anonymous**. Only the experimenter will know your identity, but your data will be treated confidentially.

Rules of the game

Now you will learn more about the rules of the game you will be participating in. Altogether **4 players** take part in the game, so besides you there are 3 more players. Each player has an initial endowment of 20 points. Your task in the game, and also your fellow players' task, is to decide how many points you would like to contribute to a **joint project**. Your contribution, q, can be set between 0 and 20 points.

Your individual and also your fellow players' **payout** will be calculated as follows:

Your payout = (20 − your contribution to the project) + b (sum of all contributions of all players to the project)

The parameter *b* is *b* = 0.3 for two players (in the following called "low-type") and *b* = 0.7 for the remaining two players (in the following called "high-type"). There will be a random selection whether you are a low-type or a high-type.

Assuming you to be a low-type: Your payout (in LD) will be calculated as follows:

Payout = (20 – your contribution to the project) + 0.3·(sum of all contributions of all players to the project)

That is, if for example all other players have contributed altogether 60 points to the project and your contribution is 20, then your payment will be:

Payout = (20 – 20) + 0.3·(60 + 20) = 24

If, however, all other players have contributed a total amount of 60 points and you do not contribute anything, your payout will be:

Payout = (20 – 0) + 0,3·(60 + 0) = 38

If you are a high-type, then your payout (in LD) will be calculated as follows:

Payout = (20 – your contribution to the project) + 0.7·(sum of all contributions of all players to the project)

The information, whether you are a low-or a high-Type will be displayed on your screen.

There are **two stages** in this game. In **stage 1** you decide on the **minimum contribution,** Q_{min}, that should be contributed to the joint project by the group as a whole. Simultaneously, all other players make their suggestions on a group minimum contribution level, Q_{min}. The minimum of the suggested levels, min(Q_{min}), is then decisive for contributions in the second stage. In **stage 2** you decide on your contribution, q, to the joint project, thereby keeping in mind that for each player an individual minimum contribution level, q_{min}, will be calculated from min(Q_{min}). The implementation of these individual minimum contributions, q_{min}, yields to **equal** payoffs for all players or payoffs will at least be harmonized as far as possible if a player faces $q_{min} = 20$.

Example: If the group minimum contribution level is $Q_{min} = 40$, low-type players are bounded to an individual minimum contribution of $q_{min} = 2$ and high-type agents face $q_{min} = 18$. Assuming these contribution levels, the payoff for each player would be 30 LD. If, however, $Q_{min}= 60$, minimum contribution for high-types is $q_{min} = 20$ and for low-types $q_{min} = 10$. The payoff for a high-type subject would be 42 LD and for a low-type subject would amount 28 LD.

The game consists of **10 separate rounds** in each of which you will play the same two-stage game remaining the same type. The three other players you will interact with will be the same in every round. In each round you will receive information on suggestions on group minimum contribution levels (Q_{min1} to Q_{min4}), individual contributions (q_1 to q_4), payoffs ($Payoff_1$ to $Payoff_4$) for all your group members and average levels (D).

If the experiment is complete you will receive the **payout of one of the rounds** in € (according to the conversion rate stated above). The round to be paid out will be determined **randomly**. This means you should behave in **each** round as if it were the round relevant for payout. In the beginning, **two trial rounds** will be played which are **not relevant for payout**.

Control questions

If you have read the instructions and do not have any questions, please answer the following control questions (hint: use the simulator).

1. Please assume that calculating individual minimum contribution levels, q_{min}, leads to 2 for each of the two low-type players and to 18 for the two high-type players respectively. Please indicate the range of your possible contribution levels to the joint project if you are a low-type.

More than _____ and less than or equal _____

2. Please assume that your contribution as a low-type to the joint project is 10 points. The contributions of the three other group members are 0, 10 and 20. What is your payout?

My payout is _______

3. Please assume that your contribution as a low-type to the joint project is 0 points. The contribution of the three other group members is 0, 10 and 20. What is your payout?

My payout is _______

4. Please assume that all three players have contributed 20 points to the project. Which of the following contribution levels results in **your** highest payout (please check the according box)?

   O 0 points O 5 points O 10 points O 20 points

5. Please assume that all three players have contributed 20 points to the project. Which of the following contribution levels results in the highest payout **for the group** (please check the according box)?

   O 0 points O 5 points O 10 points O 20 points

If you have answered all questions, please signal us. We will then check your answers. The game begins when all participants in the experiment have successfully completed the test.

Good luck in the experiment! The MaXLab-Team

Selected Screenshots for *min-I-Q-eq* treatment

Runde 1 von 3 | verbleibende Zeit 56

Beitragsentscheidung

Information

Periode	Vorschlag Mindestbeitrag Qmin1	Vorschlag Mindestbeitrag Qmin2	Vorschlag Mindestbeitrag Qmin3	Vorschlag Mindestbeitrag Qmin4
1	0	0	0	0

Achtung: Sie sind **Spieler 1, ein Low-Typ.** Spieler 2 ist ebenfalls ein Low-Typ. Spieler 3 und 4 sind High-Typen.

Hinweis: Der Gruppenbeitrag in Ihrer Gruppe, Q, ist mindestens 0.

Hinweis: Die Untergrenze für Ihren Beitrag, q, ist 0.

Mein Beitrag, q, ist

Subject 1

group 1

weiter

Hilfe

Wenn Sie Fragen haben, öffnen Sie bitte die Tür oder geben Sie uns ein Handzeichen.

Runde 1 von 3 | verbleibende Zeit 27

Beitragsentscheidung

Ausgabe

Periode	Beitrag q1	Beitrag q2	Beitrag q3	Beitrag q4	D-Beitrag	Auszahlung1	Auszahlung2	Auszahlung3	Auszahlung4	D-Auszahlung
1	0	0	0	0	0.00	20.00	20.00	20.00	20.00	20.00

Ihr Beitrag q 0

Summe aller Beiträge Q 0

Durchschnittsbeitrag 0.00

Ihre Auszahlung 20.00

Durchschnittsauszahlung 20.00

Subject 8

Achtung: Sie sind **Spieler 4, ein High-Typ.** Spieler 3 ist ebenfalls ein High-Typ. Spieler 1 und 2 sind Low-Typen

OK

Hilfe

Wenn Sie Fragen haben, öffnen Sie bitte die Tür oder geben Sie uns ein Handzeichen.