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Is there a hidden cost of imposing a minimum contribution level for public good contributions?

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Abstract: We examine the effects of either exogenously imposing or endogenously letting subjects choose whether to impose minimum contribution levels (MCLs) in a linear public goods experiment using the strategy method. Our results on contribution levels to the public goods are fairly independent of how MCLs are imposed. We find that the main effect of an MCL on unconditional contributions is that it increases low contribution levels to the MCL imposed, while the effect of those contributing more than the MCL before its introduction depends on the size of the MCL. Unexpectedly, there is much more crowding out for a low MCL than for a relatively high MCL. However, the distribution of contribution types is stable across different MCLs.

Keywords: Cooperation; China; experiment; minimum level; public good.

JEL classification: *C91, D03, D64.*

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1. Introduction

One option available to policy makers for increasing contributions to public goods is to introduce minimum contribution levels (MCLs). For example, some municipalities introduce minimum levels regarding the sorting of waste, while others introduce driving restrictions in order to contribute to the public good of clean air or of low emission levels. Other examples are requests of minimum monetary contributions in disaster relief or in keeping the sidewalks in front of one's house free of snow and ice in winter; in the former case there are such practices in China after the *Wenchuan* earthquake, and in the latter case, there are certain minimum requirements established by law in Germany and Austria. Existing studies have analyzed the effects of an MCL, often framed as a tax, on voluntary contributions using public goods experiments (e.g., Andreoni, 1993; Chan *et al.*, 2002; Sutter and Weck-Hanneman, 2004; Eckel *et al.*, 2005; Gronberg *et al*., 2012). The general finding is that a minimum level does not completely crowd out voluntary contributions by reducing intrinsic motivations to contribute to the public good (for an in-depth discussion on motives, see, e.g., Bénabou and Tirole, 2006). In the context of principal-agent games where the principal can set a minimum effort level that has to be exerted by the agent, Falk and Kosfeld (2006) find that MCLs have a negative overall effect on voluntary contributions, while in a follow-up study Ziegelmeyer *et al.* (2012) do not generally find a similar effect.

The objective of this paper is to provide a more detailed account of how contributions to a public good are affected by an MCL. To this end, we augment an incentivized version of eliciting individual cooperative preferences based on the strategy method (Fischbacher *et al.*, 2001; Kocher *et al.*, 2008; Herrmann and Thöni, 2009; Fischbacher and Gächter, 2010; Martinsson *et al*., 2013; Martinsson *et al*., 2015) with two different MCLs. In the design introduced by Fischbacher *et al.* (2001), individuals make two types of contribution decisions for the public good: (i) unconditional contributions and (ii) conditional contributions, i.e., what the subject would contribute to the public good given different average contribution levels by the other group members. The setup eliminates the strategic uncertainty that is inherent to social dilemma games, and thus lets us focus on the incentive effects of MCLs and their potential side effects. It allows for distinguishing between two types of players in a social dilemma (accounting for about three-fourths of the population): free riders, who contribute nothing regardless of the contributions of others, and conditional cooperators, who are willing to increase their own contribution if they know that others will do so as well (see also Kelley and Stahelski, 1970; Keser and van Winden, 2000). In our laboratory experiment, we implement two different MCLs – a low and a high (2 out of 20 and 7 out of 20 tokens, respectively) – in order to assess their potentially distinct impact on voluntary contributions.

We are primarily interested in three effects of MCLs on the level of conditional cooperation: (i) Does the MCL affect those who are actually bound by the minimum level in addition to the pure effect of introducing the MCL? For example, do subjects who contribute fewer or equal to 2 tokens without an MCL contribute exactly 2 tokens with an MCL=2? (ii) Is the distribution of contributions among those contributing more than the imposed minimum level unaffected by the introduction of the minimum level? And (iii), does the introduction of MCLs change the distribution of contributor types, i.e., does the distribution of free riders and conditional cooperators change?

Our first experiment implements exogenous MCLs. The data show that decision makers are affected by MCLs and that the effects on contributions under the low MCL and the high MCL are different. In the case of a low MCL, average contributions remain largely the same as without an MCL, despite the forced increase in contributions for very low contributors. This is explained by a decrease in average contributions by those who have been willing to contribute more than the minimum requirement without the MCL already. Hence, there is crowding out. Under the higher MCL, conditional contributions among those contributing more than the minimum level already before the implementation of the MCL are also affected negatively. However, it seems that those who contribute less than the MCL without an MCL "overshoot" the MCL. Looking at the contribution schedules of the conditional contribution elicitation, we see that conditional cooperators decrease their contributions for MCL=2 (a smaller slope) compared to MCL=0, whereas the contribution function for MCL=7 looks almost identical to the one for MCL=0, taking into account the lower-limit censoring at 2 and 7, respectively.

Since the efficiency of institutional mechanisms may depend on how they are implemented (e.g., Tyran and Feld, 2006), we run a second experiment where MCLs are implemented endogenously. More precisely, we elicit preferences over the implementation of the MCL by letting group members choose whether to implement an MCL or not. One randomly selected group member's choice then decides whether the MCL is implemented or not.[1] Interestingly, we find less "overshooting" but also less crowding out compared to exogenously implemented MCLs.

One explanation for the different impact of the two MCL regimes in both experiments is that MCLs could serve as signals, anchors, or reference points for intrinsically cooperative decision makers. While a low MCL drags the contribution of some decision makers slightly downwards, because the bulk of the distribution of contributions is above the MCL without any restriction, it could be the opposite for higher MCLs. Note however that any potential reference point effects are not as straightforward as they seem: We do not observe the mass of distribution of contributions moving exactly to the levels of the MCLs. In fact, the shifts are more gradual. As a practical implication of our results, it seems important not to introduce too low MCLs in the field in order to avoid potentially adverse reference point effects.

[1] We thank an anonymous referee for this suggestion.

The remainder of the paper is organized as follows. Section 2 presents the design and the results of our first experiment. In Section 3 we focus on our second experiment with endogenous MCLs. Section 4 discusses the results and concludes the paper.

2. Experiment 1 – Exogenously imposed MCLs

2.1 Design of Experiment 1

Our experimental setup builds on the design by Fischbacher *et al.* (2001). It is a one-shot linear public goods experiment, using a variant of the strategy method. In the experiment, subjects were randomly matched into groups of four. Each member received an endowment of 20 tokens and had to decide how much to allocate to a private and a public good, respectively. The payoff function for subject *i* is given by

$$\pi_i = 20 - c_i + 0.6\sum_{j=1}^{4} c_j \;, \qquad (1)$$

where c_i denotes the contribution of subject *i* to the public good. In the experiment, each token was exchanged for 0.7 yuan.[2] Assuming that subjects are selfish and rational, the dominant strategy for any marginal per capita return below one is to free ride, i.e., to contribute nothing to the public good. However, since the social return from any contribution to the public good was 2.4 tokens, everybody is better off if all group members contributed. Hence, the participants faced a social dilemma between privately optimal and socially optimal behavior.

In the Fischbacher *et al.* (2001) design, subjects are asked to make two decisions: first an unconditional contribution to the public good and then a conditional contribution. The unconditional contribution is an integer number of tokens in the permissible range. Our three treatments (see Table 1) allow for $c_i \in [0,20]$ (as in Fischbacher *et al.*, 2001), $c_i \in [2,20]$ (low MCL treatment), and $c_i \in [7,20]$ (high MCL treatment). For the conditional contributions, each subject stated how much she would contribute to the public good for any possible average contribution of the three other players in her group (rounded to integers). In order to make each choice in the experiment incentive-compatible, both the unconditional and the conditional contribution must be potentially payoff-relevant. Thus, one of the four subjects was randomly selected, and her conditional contribution, corresponding to the average of the other three members' unconditional contributions, was relevant as the contribution to

[2] At the time of the Experiment 1 USD = 6.45 yuan.

the public account. Individual earnings can then be calculated according to equation (1).[3] Essentially, the mechanism transforms the simultaneous public goods game into a sequential variant.

Table 1. Summary of the experimental design.

	Part I	*Part II*	*No. of subjects*
Sequence 1	MCL=0	MCL=2	36
Sequence 2	MCL=2	MCL=0	36
Sequence 3	MCL=0	MCL=7	36
Sequence 4	MCL=7	MCL=0	36

Note: MCL = minimum contribution level.

We implemented a mixture of a within-subject and a between-subject design with full control for potential order effects. The design gives four combinations (sequences) of two one-shot public goods experiments (here denoted Part I and Part II), as summarized in Table 1, given that we always wanted to keep the comparison with the treatment MCL=0. There was no feedback between Part I and Part II. After conducting Part I, our subjects were randomly matched into groups with new members in Part II, i.e., we implemented a perfect stranger matching, and this procedure was common knowledge from the beginning of the experiment. Both parts were payoff-relevant. The experiment was run with context-free instructions.[4] It was computerized using z-tree (Fischbacher, 2007) and conducted at Renmin University of China in Beijing. Average earnings amounted to 43.90 yuan.[5]

2.2 Results of experiment 1

We distinguish between results for unconditional contributions (Section 2.2.1) and results for conditional contributions (Section 2.2.2).

2.2.1 Unconditional contributions

We begin by testing whether order effects are present in our data. For each minimum level, we test whether unconditional contributions are the same in Part I and Part II. Since we cannot reject the hypothesis of no order effects in any of the combinations at the 5% significance level based on a two-sided Mann-Whitney U-test, we pool the data over the different orders in the following analyses. The unconditional contributions with MCL=0 are well in line with comparable studies that use a similar one-shot design in other countries. Kocher et al. (2008), for instance, report averages for unconditional contributions of 8.11 in the U.S.A, 7.53 in Austria, and 7.22 in Japan.

[3] Moreover, subjects in the experiment were asked to guess the average unconditional contribution of the other three group members (rounded to integers). The subjects were monetarily rewarded depending on the accuracy of their guesses as in Gächter and Renner (2010).

[4] Available from the authors upon request.

[5] For comparison, a lunch in the student restaurant cost 10 yuan at the time of the experiment.

In Table 2, we summarize unconditional contributions to the public good. As expected, average contributions are higher when a minimum level of 7 is introduced (8.44 vs. 10.92), and this increase is significant at the 1% level compared with MCL=0, using a within-subject comparison (two-sided Wilcoxon signed-ranks test, $p < 0.01$; $N = 72$). There is no significant change in the levels of contributions when a minimum level of 2 is introduced compared to MCL=0 (7.58 vs. 7.69). Comparing across treatments, contributions with MCL=7 are significantly higher at the 1% level than with MCL=2 (two-sided Mann-Whitney U-test, $p < 0.01$; $N = 144$). It is important to note that the baseline level of cooperation under MCL=0 is not significantly different between the two treatments, i.e. Sequences 1 and 2 versus Sequences 3 and 4 (two-sided Mann-Whitney U-test, $p = 0.32$; $N = 144$).

Table 2. Average unconditional contributions (standard deviations in parentheses).

Treatment	*MCL=0*	*MCL=2*	*MCL=7*
Sequences 1 and 2	7.58 (6.53)	7.69 (5.81)	
Sequences 3 and 4	8.44 (6.02)		10.92 (3.83)

Null hypothesis	*P-values*
Contributions in MCL=0 (Sequences 1 and 2) = MCL=0 (Sequences 3 and 4) (N = 144)	0.32
Contributions in MCL=2 = MCL=7 (N = 144)	< 0.01

Note: We use Mann-Whitney U-tests. Sequences 1 and 2: MCL=0-MCL=2 and MCL=2-MCL=0; Sequences 3 and 4: MCL=0-MCL=7 and MCL=7-MCL=0.

We now look at two questions related to the effects of MCLs on the level of conditional cooperation: (i) Does the MCL affect those who are actually bound by the minimum level in addition to the pure effect of introducing the MCL? And: (ii) Is the distribution of contributions among those contributing more than the imposed minimum level unaffected by the introduction of the minimum level? Table 3 provides detailed analyses of the effects of introducing an MCL. If behavior is unaffected by the introduction of an MCL of 2 (of 7), the proportion of subjects contributing 2 (7) in treatment MCL=2 (MCL=7) is expected to be equal to the proportion contributing 0, 1, and 2 (0, 1, 2, 3, 4, 5, 6, and 7) in treatment MCL=0.

We start our analysis with the low MCL, i.e., MCL=2. In the case of MCL=2, 29.2% of decision makers contribute 2 tokens to the public good, compared with 30.6% contributing 0, 1, and 2 under MCL=0. If all decision makers that are bound by the MCL would contribute exactly 2 tokens in MCL=2, the average would be 2, obviously. However, the average contribution is 4.50 tokens under MCL=2. This difference between the “projected” contribution of 2 and actual average contributions is highly significant (two-sided Wilcoxon signed-ranks test comparing actual contribution levels and the projected level of 2, $p < 0.01$; $N = 22$). Interestingly, low contributors seem to “overshoot” the MCL on average. When looking at those who contribute more than 2 tokens under MCL=0, we observe averages of 10.76 when MCL=0 and 9.10 when MCL=2. Hence, on average, a highly significant crowding out effect occurs (two-sided Wilcoxon signed-ranks test, $p < 0.01$; $N = 50$). Taking the two groups together, the overall small change in average contributions from MCL=0 (7.58) to MCL=2 (7.69) can be explained by the offsetting effects of "overshooting" the MCL and the occurrence of crowding out for contributors who contribute more than 2 tokens even when MCL=0.

Table 3. Detailed descriptive statistics of unconditional contributions in the treatments.

Treatment	*Contributions considered*	*Proportion of subjects*	*Average contribution*
Sequences 1 and 2			
MCL=0 (contributions 0 to 2)	0,1,2	30.6%	0.36
MCL=0 (contributions 3 to 20)	3,4,…,20	69.4%	10.76
MCL=2 (contributions 2)	2	29.2%	2.00
MCL=2 (contributions 3 to 20)	3,4…,20	70.8%	10.04
MCL=2 (those who contribute 0,1,2 in MCL=0)	ALL	30.6%	4.50
MCL=2 (those who contribute > 2 in MCL=0)	ALL	69.4%	9.10
Sequences 3 and 4			
MCL=0 (contributions 0 to 7)	0,1,2,4,5,6,7	41.7%	2.90
MCL=0 (contributions 8 to 20)	8,9…,20	58.3%	12.40
MCL=7 (contributions 7)	7	16.7%	7.00
MCL=7 (contributions 8 to 20)	8,9…,20	83.3%	11.70
MCL=7(those who contribute 0,1,…,7 in MCL=0)	ALL	41.7%	9.40
MCL=7 (those who contribute > 7 in MCL=0)	ALL	58.3%	12.00

Null hypothesis	*P-values*
Sequences 1 and 2	
Contributions in MCL=2 of those who contribute 0,1,2 in MCL=0 are equal to 2	< 0.01
Contributions in MCL=2 of those who contribute > 2 in MCL=0 are equal in MCL=0 and MCL=2	< 0.01
Sequences 3 and 4	
Contributions in MCL=7 of those who contribute 0,1,…,7 in MCL=0 are equal to 7	<0.01
Contributions in MCL=7 of those who contribute > 7 in MCL=0 are equal in MCL=0 and MCL=7	0.60

Note: We use two-sided Wilcoxon signed-ranks tests.

We conduct an analogous analysis for MCL=7, compared with MCL=0. The proportion of decision makers contributing at most 7 when MCL=0 is 41.7%, while it is only 16.7% when MCL=7. We can thus confirm the behavioral regularity of "overshooting" that we observed under MCL=2. If all of our decision makers, contributing 0-7 tokens under MCL=0, would contribute exactly 7 tokens when MCL=7, the average contribution should be 7; however, their actual average contribution is 9.40 tokens under MCL=7. The difference between the projected and actual average contributions is highly significant (two-sided Wilcoxon signed-ranks test comparing actual contribution levels and the projected level of 7, $p < 0.01$; $N = 30$). When looking at those who contribute more than 7 tokens without an MCL, we observe averages of 12.40 when MCL=0 and 12.00 when MCL=7. Our data therefore imply that, as for MCL=2, there is crowding out for MCL=7, yet it is relatively weaker and far from being significant (two-sided Wilcoxon signed-ranks test, $p = 0.60$; $N = 42$). The significant overall increase in contribution levels from MCL=0 (8.44 tokens) to MCL=7 (10.92 tokens) is a combination of the mechanical increase of contributions to the MCL, of "overshooting" of decisions makers who are forced to increase their contribution levels under MCL=7 compared to MCL=0, and of almost no crowding out effects of MCL=7 on those theoretically not bound by the MCL.

Table 4 shows the transition matrix in the two treatments in order to give information on the distribution of changes when the MCL is introduced. Not surprisingly, the vast majority of decision makers either adjust exactly to the MCL if they contribute less without an MCL (i.e., they contribute exactly 2 and 7 if they contribute less than 2 and 7 without the relevant MCL) or stick with higher contributions when they already contributed more than the MCL before its introduction. If we take such behavior as a measure of stability across different institutional setups, 76.4% are classified as stable when an MCL=2 is introduced, and 66.7% behave in a stable way when an MCL=7 is implemented. A much more rigorous definition of stability is one that does not allow for changes at all across institutional environments, except for forced ones (increasing one's contribution to the MCL if one contributed below this level without an MCL). For instance, if one contributes 1 token under MCL=0, then the only "stable" choice of the same person under MCL=2 is 2 tokens; if one contributes 5 tokens under MCL=0, then the only "stable" choice of the same person under MCL=2 is also 5 tokens. Taking such a strict definition, 40.3% of the decision makers submit stable decisions across MCL=0 and MCL=2, and 39. 0% of the decisions makers do the same across MCL=0 and MCL=7.

Table 4. Transition probabilities in the treatments.

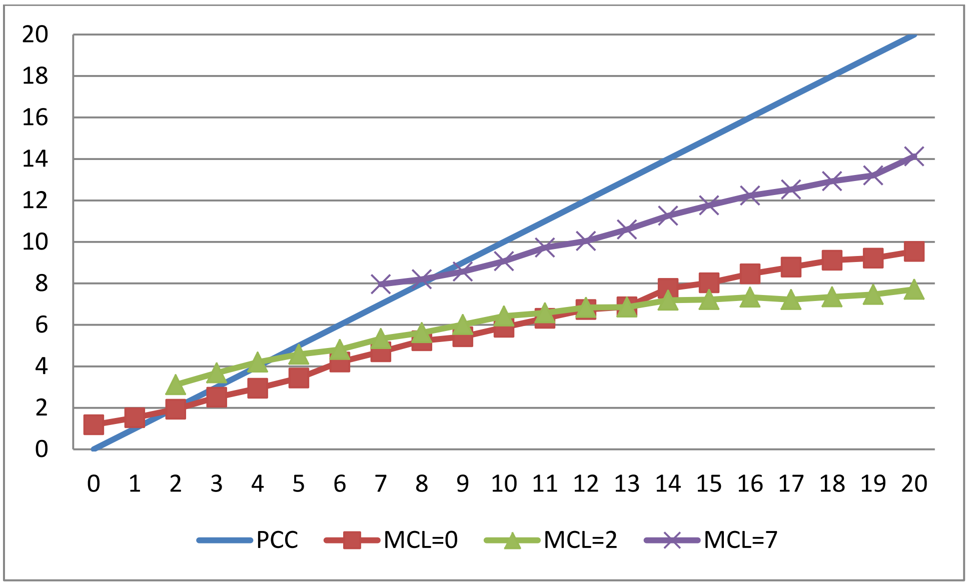
	MCL=2	
MCL=0	Contribution > 2	Contribution = 2
Contribution > 2	58.3%	11.1%
Contribution = 0,1 or 2	12.5%	18.1%

	MCL=7	
MCL=0	Contribution > 7	Contribution = 7
Contribution > 7	54.2%	4.2%
Contribution = 0,1,2,3,4,5,6 or 7	29.1%	12.5%

2.2.2 Conditional contributions

Does the introduction of MCLs change the distribution of contributor types, i.e., does the distribution of free riders and conditional cooperators change? Figure 1 presents the average results from the contribution table. As expected, on average, the contributions increase as the average contributions of others increase, regardless of the MCL. Interestingly, however, while the slope in MCL=2 is smaller than in MCL=0 and, hence, the MCL does not increase average conditional contributions throughout the whole interval of others' average contributions, the slope in MCL=7 is approximately similar to the one in MCL=0. As a consequence, conditional contributions are higher in MCL=7 than in the other two treatments, also in the range clearly above the lower censoring limit of 7. In order to study this effect further, we ran regressions to explain contributions as a function of others' average contributions, clustering on the individual level in order to account for multiple entries for the individual. The results confirm the visual impression from Figure 1 and are available on request.

Figure 1. Average conditional contribution (others' average contributions on the horizontal axis and own average conditional contribution on the vertical axis).



Note: PCC = perfect conditional cooperation.

Based on the conditional contribution schedules, we can classify subjects into different types of contributors. We follow the convention (e.g., Fischbacher *et al.*, 2001) and define four general types of subjects: *conditional cooperators*, *free riders*, *hump-shaped contributors*, and *others*. Here are the definitions that we use: If a subject's conditional contribution increases weakly monotonically with the average contribution of the other group members, the subject is classified as a *conditional cooperator*.

A subject is also classified as a *conditional cooperator* if the relationship between own and others' average contributions is positive and significant at the 1% significance level based on the Spearman rank correlation coefficient. *Hump-shaped contributors* are subjects who show weakly monotonically increasing (or increasing with a Spearman rank correlation coefficient at the 1% significance level) contributions up to some, non-maximal level of others' contributions; above that level, their conditional contributions decrease based on a reversed classification as the one used up to the inflection point. A *free rider* is a subject who contributes zero for all levels of the other group members' contributions under MCL=0, 2 tokens under MCL=2, and 7 tokens under MCL=7. Finally, those who cannot be categorized into any of the above categories are referred to as *others*.

Table 5. Distribution of contributor types at MCL=0 and MCL=2 (at individual level).

		MCL=2			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	33.3%	4.2%	4.2%	4.2%
	Free riders	6.9%	27.8%	5.6%	0.0%
	Hump-shaped	0.0%	2.8%	0.0%	2.8%
	Others	1.4%	0.0%	2.8%	4.2%

Table 6. Distribution of contributor types at MCL=0 and MCL=7 (at individual level).

		MCL=7			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	44.4%	8.3%	1.4%	0.0%
	Free riders	1.4%	16.7%	0.0%	0.0%
	Hump-shaped	9.7%	2.8%	2.8%	1.4%
	Others	1.4%	0.0%	4.2%	5.6%

Tables 5 and 6 report results on the stability of the classification across different MCLs by providing a transition matrix with regard to types. Overall, the distributions of contribution types are quite stable across MCLs (see Ruigrok *et al.*, 2012, for an assessment of temporal stability of contribution types, but not across different institutional environments). The tables show, by looking at the diagonal, that a large proportion of subjects do display the same type of behavior under different institutional mechanisms. The few changes go in all directions and seem to be more or less random. Some conditional cooperators become free riders; particularly under MCL=7, these are decision makers who have an increasing contribution schedule under MCL=0 with a maximum contribution of 7 tokens or less. Overall the distribution of conditional cooperators and free riders are not out of the ordinary (see for instance, Fischbacher *et al.*, 2001; Kocher *et al.*, 2008; Herrmann and Thöni, 2009;

Fischbacher and Gächter, 2010; Martinsson *et al*., 2013; Martinsson *et al*., 2015) and switches from one type to another are rare.

3. Experiment 2 – Endogenously imposed MCLs

3.1 Design of Experiment 2

The setup follows Experiment 1 closely. As in Experiment 1, subjects were randomly matched into groups of four, and they made contribution decisions following the Fischbacher *et al.* (2001) design. Again, we implemented a mixture of a within-subject and a between-subject design with full control for potential order effects. The design gives four combinations (sequences) of two one-shot public goods experiments (denoted Part I and Part II), as already summarized in Table 1. The only new feature is the endogenous determination of the MCL: the experiment began with a "voting" stage where subjects indicated whether they wanted Part I or Part II to be payoff-relevant. This choice indicates the preference for either MCL=0 or MCL=2 in Sequences 1 and 2, and the preference for either MCL=0 or MCL=7 in Sequences 3 and 4. Once everyone had casted their vote, Experiment 2 proceeded as Experiment 1. It was common knowledge that, in the end, one participant in each group would be randomly selected and her choice would be implemented (thus determining which part of the experiment would be payoff-relevant). This means that contribution decisions in both parts of the experiment were made in a situation where the MCL is endogenously imposed by one randomly selected group member.

The experiment was run by using context-free instructions that followed the instructions in Experiment 1, except for the necessary changes to explain the choice.[6] It was again computerized using z-tree (Fischbacher, 2007) and conducted in the same experimental lab at Renmin University of China in Beijing as the first experiment. A total of 96 subjects participated in the experiment (24 in each sequence). Since only one part was payoff-relevant in Experiment 2 by the design of the endogenous mechanism, we doubled the exchange rate compared to Experiment 1 to make the monetary incentives comparable in the two experiments. Average earnings amounted to 44.0 yuan.

3.2 Results of Experiment 2

In order to facilitate comparisons of the two experiments, we proceed with our analysis of Experiment 2 in the same way as for Experiment 1. We first present results for unconditional contributions (Section 3.2.1) and then results for conditional contributions (Section 3.2.2). Finally, we show the

[6] The instructions are available from the authors upon request.

results on subjects' choices for the implementation of the MCLs and also how they relate to unconditional contributions and the distribution of contribution types (Section 3.2.3).

3.2.1 Unconditional contributions

Since there are again no significant order effects, we pool the data over the different orders. Unconditional contributions are summarized in Table 7. One can see a significant increase in contributions following the introduction of a minimum level of 7 tokens (6.27 vs. 10.17) (two-sided Wilcoxon signed-ranks test, $p < 0.01$; $N = 48$). There is also a small increase in contributions following a minimum level of 2 tokens, but it is only significant at the 10%-level (6.58 vs. 6.83) (two-sided Wilcoxon signed-ranks test, $p = 0.09$; $N = 48$). Qualitatively, overall unconditional contributions in Experiment 2 are very similar to the unconditional contributions in Experiment 1.

Table 7. Average unconditional contributions (standard deviations in parentheses) for Experiment 2.

Treatment	*MCL=0*	*MCL=2*	*MCL=7*
Sequences 1 and 2	6.58 (5.93)	6.83 (5.49)	
Sequences 3 and 4	6.27 (5.74)		10.17 (4.46)

Null hypothesis	*P-values*
Contributions in MCL=0 (Sequences 1 and 2) = MCL=0 (Sequences 3 and 4) (*N* = 96)	0.77
Contributions in MCL=2 = MCL=7 (*N* = 96)	< 0.01

Note: We use Mann-Whitney U-tests. Sequences 1 and 2: MCL=0-MCL=2 and MCL=2-MCL=0; Sequences 3 and 4: MCL=0-MCL=7 and MCL=7-MCL=0.

We provide a more detailed analysis in Table 8. In the case of the low MCL of 2 tokens, 35.4% of our subjects contribute 2 tokens to the public good, compared with 33.3% contributing 0, 1, and 2 under MCL=0. The average contribution in MCL=2 for this group of subjects is 2.25, and it is not significantly different from the "projected" contribution of exactly 2 (two-sided Wilcoxon signed-ranks test, $p = 0.16$; $N = 16$). For subjects who contribute more than 2 tokens under MCL=0, the average contribution decreases from 9.59 in MCL=0 to 9.13 in MCL=2, but the change is not significant on conventional levels (two-sided Wilcoxon signed-ranks test, $p = 0.37$; $N = 32$). Thus, in the case of a low MCL in our endogenous treatments, neither do we observe significant "overshooting" among low contributors, nor significant crowding out among high contributors.

In case of the high MCL of 7 tokens, 43.8% of subjects contribute 7 tokens to the public good, compared to 60.4% contributing at most 7 tokens in MCL=0. We observe significant overshooting among this group of subjects, since the average contribution of 8.21 in MCL=7 is significantly different from the projected contribution of 7 (two-sided Wilcoxon signed-ranks test, $p < 0.01$; $N = 29$). However, we do not see significant crowding out in MCL=7 for subjects who contribute more than 7 tokens under MCL=0 (11.89 vs. 13.16) (two-sided Wilcoxon signed-ranks test comparing contribution levels in MCL=0 and MCL=7, $p = 0.21$; $N = 19$).

Table 8. Detailed descriptive statistics of unconditional contributions in the treatments for Experiment 2.

Treatment	*Contributions considered*	*Proportion of subjects*	*Average contribution*
Sequences 1 and 2			
MCL=0 (contributions 0 to 2)	0,1,2	33.3%	0.56
MCL=0 (contributions 3 to 20)	3,4…,20	66.7%	9.59
MCL=2 (contributions 2)	2	35.4%	2.00
MCL=2 (contributions 3 to 20)	3,4…,20	64.6%	9.48
MCL=2 (those who contribute 0,1,2 in MCL=0)	ALL	33.3%	2.25
MCL=2 (those who contribute > 2 in MCL=0)	ALL	66.7%	9.13
Sequences 3 and 4			
MCL=0 (contributions 0 to 7)	0,1,2,4,5,6,7	60.4%	2.59
MCL=0 (contributions 8 to 20)	8,9…,20	39.6%	11.89
MCL=7 (contributions 7)	7	43.8%	7.00
MCL=7 (contributions 8 to 20)	8,9…,20	56.2%	12.63
MCL=7(those who contribute 0,1,…,7 in MCL=0)	ALL	60.4%	8.21
MCL=7 (those who contribute > 7 in MCL=0)	ALL	39.6%	13.16

Null hypothesis	*P-values*
Sequences 1 and 2	
Contributions in MCL=2 of those who contribute 0,1,2 in MCL=0 are equal to 2	0.16
Contributions in MCL=2 of those who contribute > 2 in MCL=0 are equal in MCL=0 and MCL=2	0.37
Sequences 3 and 4	
Contributions in MCL=7 of those who contribute 0,1,…,7 in MCL=0 are equal to 7	<0.01
Contributions in MCL=7 of those who contribute > 7 in MCL=0 are equal in MCL=0 and MCL=7	0.21

Note: We use two-sided Wilcoxon signed-ranks tests.

Table 9 shows the transition matrix in the two treatments. As in Experiment 1, stability in MCL=2 entails either (i) a contribution of 0, 1, or 2 tokens in MCL=0 and exactly 2 tokens in MCL=2, or (ii) a contribution of more than 2 tokens in both MCL=0 and MCL=2; and likewise for decision makers in MCL=7. Table 9 shows that stability levels according to our definition are high: 89.6% and 79.3% in MCL=2 and MCL=7, respectively.

Table 9. Transition probabilities in the treatments in Experiment 2.

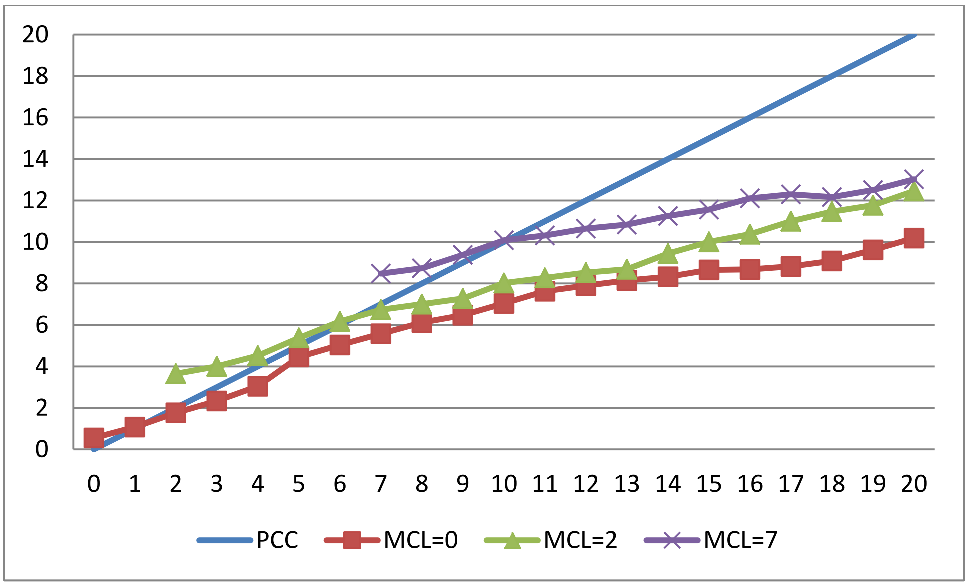
	MCL=2	
MCL=0	Contribution > 2	Contribution = 2
Contribution > 2	60.4%	6.3%
Contribution = 0,1 or 2	4.2%	29.2%

	MCL=7	
MCL=0	Contribution > 7	Contribution = 7
Contribution > 7	37.5%	2.1%
Contribution = 0,1,2,3,4,5,6 or 7	18.8%	41.7%

3.2.2 Conditional contributions

Figure 2 presents the average results from the contribution table. By and large, the slopes for MCL=0, MCL=2, and MCL=7 are very similar to the ones in Experiment 1.

Figure 2. Average conditional contribution in Experiment 2 (others' average contributions on the horizontal axis and own average conditional contribution on the vertical axis).



Note: PCC = perfect conditional cooperation.

In a more detailed analysis we classify subjects into contribution types. The definitions are identical to the ones used in Experiment 1. In Tables 10 and 11 we present the transition matrices with regard to the type classification across the different MCLs. The proportions shown on the diagonal indicate those who were classified as the same contribution type in the different MCLs.

Table 10. Distribution of contributor types at MCL=0 and MCL=2 in Experiment 2 (at individual level).

		MCL=2			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	62.5%	4.2%	0.0%	0.0%
	Free riders	0.0%	25.0%	0.0%	0.0%
	Hump-shaped	2.1%	0.0%	4.2%	0.0%
	Others	2.1%	0.0%	0.0%	0.0%

Table 11. Distribution of contributor types at MCL=0 and MCL=7 in Experiment 2 (at individual level).

		MCL=7			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	56.3%	4.2%	0.0%	0.0%
	Free riders	2.1%	25.0%	0.0%	0.0%
	Hump-shaped	0.0%	0.0%	8.3%	2.1%
	Others	0.0%	0.0%	0.0%	2.1%

3.2.3 Preferences for MCLs and contribution behavior

In Table 12, we summarize unconditional contributions, separating the results by preference for MCL. A majority of subjects (66.6%) prefer MCL=2 to be payoff-relevant over MCL=0 in Sequences 1 and 2, and almost everyone (87.5%) prefers MCL=7 over MCL=0 in Sequences 3 and 4. On average, unconditional contributions are higher for subjects who prefer non-zero MCLs. For example, in MCL=2, the average contribution is 7.78 tokens for subjects with a preference for MCL=2, and this is significantly larger than the average of 4.94 tokens for subjects who prefer MCL=0 (two-sided Mann-Whitney U-test, p = 0.03; N = 48). Similarly, the average contribution for subjects with a preference for MCL=7 is 3.05 tokens larger than the average contribution from subjects with a preference for MCL=0 (two-sided Mann-Whitney U-test, p = 0.05; N = 48).

Table 12. Average unconditional contributions separated by preference for MCL.

Treatment	*Preference*	*MCL=0*	*MCL=2*	*MCL=7*
Sequences 1 and 2	MCL=0 (33.3%)	4.19 (5.52)	4.94 (4.82)	
Sequences 1 and 2	MCL=2 (66.6%)	7.78 (5.84)	7.78 (5.63)	
P-values		0.01	0.03	
Sequences 3 and 4	MCL=0 (12.5%)	3.50 (4.28)		7.50 (1.22)
Sequences 3 and 4	MCL=7 (87.5%)	6.67 (5.85)		10.55 (4.63)
P-values		0.19		0.05

Note: We use Mann-Whitney U-tests. Sequences 1 and 2: MCL=0-MCL=2 and MCL=2-MCL=0; Sequences 3 and 4: MCL=0-MCL=7 and MCL=7-MCL=0.

Tables 13–16 report results on the distribution of contribution types. By and large, one can see that the proportion of free riders is smaller with those who have a preference for non-zero MCLs. For example, while 43.7% of subjects who prefer MCL=0 are classified as free riders in MCL=2, only 21.9% of subjects with the opposite preference are classified as free riders in the same situation (MCL=2). The pattern is similar but less pronounced for MCL=7. Taken together, the results on unconditional contributions and contribution types seem to indicate that subjects who prefer non-zero MCLs are more cooperative.

Table 13. Distribution of contributor types at MCL=0 and MCL=2 (at individual level) for subjects who prefer MCL=0 (*N* = 16).

		MCL=2			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	50.0%	0.0%	0.0%	0.0%
	Free riders	0.0%	43.7%	0.0%	0.0%
	Hump-shaped	0.0%	0.0%	0.0%	0.0%
	Others	6.3%	0.0%	0.0%	0.0%

Table 14. Distribution of contributor types at MCL=0 and MCL=2 (at individual level) for subjects who prefer MCL=2 (*N* = 32).

		MCL=2			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	68.8%	6.3%	0.0%	0.0%
	Free riders	0.0%	15.6%	0.0%	0.0%
	Hump-shaped	3.1%	0.0%	6.3%	0.0%
	Others	0.0%	0.0%	0.0%	0.0%

Table 15. Distribution of contributor types at MCL=0 and MCL=7 (at individual level) for subjects who prefer MCL=0 (*N* = 6).

		MCL=7			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	33.3%	0.0%	0.0%	0.0%
	Free riders	16.7%	33.3%	0.0%	0.0%
	Hump-shaped	0.0%	0.0%	16.7%	0.0%
	Others	0.0%	0.0%	0.0%	0.0%

Table 16. Distribution of contributor types at MCL=0 and MCL=7 (at individual level) for subjects who prefer MCL=7 (*N* = 42).

		MCL=7			
		Conditional cooperators	Free riders	Hump-shaped	Others
MCL=0	Conditional cooperators	59.5%	4.8%	0.0%	0.0%
	Free riders	0.0%	23.8%	0.0%	0.0%
	Hump-shaped	0.0%	0.0%	7.1%	2.4%
	Others	0.0%	0.0%	0.0%	2.4%

4. Discussion and conclusion

We study different MCLs experimentally in a linear public goods game, where we elicit both unconditional and conditional contributions. An obvious direct effect of introducing a minimum level is that all subjects intending to contribute less than the minimum level have to increase their contributions. If this is the only behavioral change, the proportion contributing at most the introduced minimum contribution level before it is introduced is the same as the proportion contributing exactly the minimum level after it is introduced, resulting in an overall positive effect on contributions. However, there are two potential behavioral effects of introducing a minimum level: (i) the aforementioned proportion is not stable and (ii) the distributions of contributions among subjects contributing more than the imposed minimum level differ, when the minimum level requirement is imposed.

Our experimental results indicate that decision makers are affected by MCLs, but, interestingly, the effects on contributions under the low MCL and the high MCL are not necessarily the same. Our first experiment investigates the effect of exogenous MCLs. In the case of a low MCL, average contributions remain largely the same as without an MCL, despite the forced increase in contributions for very low contributors. This is explained by the fact that the positive shift for low contributors –

indeed, on average, “overshooting” the MCL – is offset by a crowding out effect of the MCL for relatively high contributors. The latter effect is also present in our high MCL environment, but it is much less pronounced, making the former effect take over. Looking at the full contribution schedules of the conditional contribution elicitation, we see that conditional cooperators decrease their contributions under MCL=2 (a smaller slope) compared with MCL=0, whereas the contribution function for MCL=7 looks almost identical to the one for MCL=0, taking into account the lower-limit censoring at 2 and 7, respectively.

In a second experiment, we investigate the effects of endogenous MCLs. The second experiment can also be seen as a robustness check for the results in Experiment 1, since the implementation of the common decision for the MCL is deliberately very weak. We have no voting, no group discussion, and no other form of group interaction that would give the MCL a stronger normative connotation. Nonetheless, in comparison with exogenous MCLs, the endogenous implementation of an MCL could send a signal of distrust to group members, similar to the hidden cost of control in Falk and Kosfeld (2006), crowding out voluntary cooperation. Comparing the effect of MCLs across the two experiments, we find that there is less “overshooting” but also less crowding out when MCLs are endogenously imposed by one randomly selected individual in each group. Overall, the endogenously implemented MCLs work marginally better than the exogenously implemented ones, but given the size of the difference, one has to be careful not to over-interpret the result. In any case, the endogenous implementation seems to induce a more stable behavior (less “overshooting” and crowding-out). If stability is an objective, an endogenous implementation should be preferred. Taking a look at the contribution schedules, MCL=2 leads to a steeper slope in Experiment 2 than in Experiment 1; for MCL=7, we observe the reverse. However, the overall picture (positive slope) looks similar. When one wants to interpret the differences between the two experiments cautiously, one could argue that the endogenous MCL sends a positive signal to the group members rather than one of mistrust. However, one has to be careful in directly comparing results from Experiment 1 and Experiment 2. Experiment 2 was added later on, following the request of a referee. Given that some time has passed between the two experiments, it is unclear whether we can assume full randomization of participants *across* the two experiments. *Within* the experiments, this is not an issue, but across the experiments the subject pool might have changed in dimensions that are difficult to observe (e.g., cohort effects).

One general explanation for our results is that MCLs might serve as signals, anchors, or reference points to intrinsically cooperative decision makers. Although future research has to look deeper into the relationship between MCLs and behavioral responses, it seems that higher MCLs shift contribution levels upwards without resulting in crowding out. While a low MCL seems to drag the contribution of some decision makers downwards, because the bulk of the distribution of contributions is above the MCL without any restriction, it seems that a higher MCL has the opposite behavioral effect. However, any reference point effect is more involved than a simple clustering, since we do not observe significantly more mass exactly at the levels of the introduced minimum contributions. The shifts and crowding out effects are more gradual and particularly affect decision makers way above the MCLs. In principle, these results are consistent with the findings of Falk and Kosfeld (2006), which seem to indicate that the effect of minimum control on profits is non-monotonic, with low levels of control generating lower profits. Similarly, Wang (2012) finds that when a minimum wage policy is introduced, the signaling or anchoring effect of a low level of the minimum wage results in a strong negative effect on wages offered by firms. However, Ziegelmeyer *et al.* (2012) do not generally observe a hidden cost of control in a follow-up study based on Falk and Kosfeld (2006), and, moreover, the results from our second experiment using endogenous MCLs do not fully support an interpretation where the MCL sends a strong signal of distrust. Thus, more research seems warranted to better understand the psychology behind the effects. A natural extension of our setup, for instance, would introduce an MCL that is not fully binding but that involves a monitoring or auditing mechanism in order to increase compliance.

MCLs seem to be fairly independent of how they are imposed and this is a relevant result for policy makers. Additionally, our result of crowding out at low MCLs is a significant finding, since in most cases the only feasible MCL for policy makers is to impose a low MCL, which should be evaluated against the case of no MCL at all, or even better a higher MCL. Potential reference point effects seem to be less straightforward in an environment with MCLs. Interestingly, crowding out appears to become less relevant when the minimum requirement is higher; intuitively, one would probably have expected the opposite.

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