Obligations and Cooperative Behaviour in Public Good Games

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Abstract

Laws express rules of conduct ('obligations') enforced by the means of penalties and rewards ('incentives'). The role of incentives in shaping individual behaviour has been largely analysed in the traditional economic literature. On the contrary, very little is known about the specific role of obligations. In this paper we test whether or not obligations have any independent effect on cooperation in a public good game. The results show that, for given marginal incentives, different levels of minimum contribution required by obligation determine significantly different levels of average contributions. Moreover, obligations *per se* cannot sustain cooperation over time, even if they affect the rate of decline of average contributions. Finally, unexpected changes in the minimum contribution have asymmetric dynamic effects on the levels of cooperation: a reduction does not alter the descending trend of cooperation, whereas an increase induces a temporary re-start in average contributions.

JEL classification: C91; C92; H26; H41; K40

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1. Introduction

In human societies individual behaviours and social interactions are often regulated by means of the law. In particular, laws set constraints and determine how people should behave in social dilemma situations, where individual interests and the common good conflict. This is apparent by observing the role of legal rules in the provision of public goods, in local environmental control, in road safety and in numerous other situations. In such contexts, laws may serve the purpose to induce efficient behaviours, thus aligning individual and collective interests.

A well established Anglo-Saxon jurisprudence tradition (Raz, 1980) defines legal rules as 'obligations backed by incentives.'[1] A legal rule is typically a statement of this kind: 'you ought to...or else you will pay...'. In this sentence, incentives are captured by 'or else you will pay', while obligations by 'you ought to ...'. In other terms, obligations consist in what laws ask people to do, whereas incentives define which consequences people face if they violate or comply with obligations. The role of incentives in shaping individual behaviour has been largely analysed in the traditional economic literature and in recent contributions in psychology and economics (see Fehr and Falk, 2002). On the contrary, very little is known about the specific role of obligations. The aim of this paper is to shed light on the effects of obligations on individual behaviour in social dilemmas.

According to the traditional economic analysis of law, legal rules can influence individual behaviours only through the effect of incentives on individual material payoffs (see Polinsky and Shavell, 2000; Cooter and Ulen, 2003). Despite its success in other contexts, this view can hardly explain why most people cooperate and obey legal rules even when by violating an obligation a party can improve its material payoffs relatively to a situation where it meets the obligation (see Tyler, 1990; Robinson and Darley, 1997; Kahan, 2002). In order to provide a rationale for these phenomena, legal theorists and economists have recently advanced the hypothesis that law has an expressive function: in some contexts what a legal rule asks people to do can affect individual behaviour independently from the material consequences set up in the form of sanctions or rewards. Two theories are particularly noteworthy. The first suggests that, in social interactions with coordination problems or conflicting interests and where multiple equilibria are possible, laws may act as coordination devices which channel individuals' beliefs about others' behaviours to a common focal point tipping the system into a certain equilibrium (see Cooter, 1998; Bohnet and Cooter, 2005; McAdams and Nadler, 2005). According to the second line of reasoning, laws may influence individual behaviours even through direct psychological effects on individual preferences. In particular, as long as individuals have personal norms suggesting what the 'fair rules' to follow are, the message conveyed by the law may urge people to update their values and subsequently their behaviours (see Kahan, 1997 and Cooter, 1998).

These theories have gained a widespread and growing success among theoretical scholars. However, there is a marked paucity of clean and consistent empirical evidence.[2] In this paper we analyse the independent effect of obligations on individual behaviours in a social dilemma situation. In particular we run a finitely repeated public good game with the peculiarity that individuals face an obligation of 'minimum contribution' which is fixed exogenously and a structure of incentives: an individual contributing less (more) than the minimum contribution is subject to a probabilistic penalty (reward). According to the traditional theory, only the economic incentives drive individual behaviours. This means that, for given marginal incentives, the level of minimum contribution set up by obligation is not expected to affect individual behaviours. We want to test this conclusion versus the alternative hypothesis that, for given marginal incentives, different levels of the minimum contribution set up by obligation may imply different levels of

[1] With the term 'incentives' we refer to both rewards and sanctions.

[2] As far as we know recent papers testing some complementary effects of laws are: Cardenas et al. (2000), Gneezy and Rustichini (2000), Bohnet and Cooter (2005), McAdams and Nadler (2005), Tyran and Feld (2006).

cooperation. In order to test these hypotheses, we let vary across the different treatments the minimum fraction of the endowment the individuals are required to contribute while we keep the marginal incentives unaltered. Our results show that obligations *per se* significantly affect the average level of individual contributions. Moreover, in all treatments, average contributions tend to decline over time, suggesting that, with low incentives, obligations *per se* cannot sustain cooperation in repeated interactions. Nonetheless, we find that obligations affect the rate of decline of cooperation over time. Finally, we provide evidence that unexpected changes in the level of the minimum contribution set up by obligation have asymmetric dynamic effects on the levels of cooperation: a reduction does not alter the pattern of deterioration of cooperation over time, whereas an increase triggers a re-start in cooperation.

The paper is organised as follows. In Section 2 we describe in detail the experimental design. Section 3 analyses and discusses the experimental results. The last section draws some concluding remarks.

2. The experimental design

2.1. The experimental game

Consider $n \geqslant 2$ individuals ($j = 1, \ldots, n$) who participate to a finitely repeated public good game. It is common knowledge that the game lasts exactly 10 periods. In each of the 10 periods each individual receives an endowment y and has to decide how much to keep for herself and how much to invest into the public project. Moreover suppose that an obligation of minimum contribution $\hat{a} < y$ is imposed by an external authority. This obligation fixes a minimum level of contribution that each individual is required to provide in order to finance the public good. The obligation is highlighted and enforced by a structure of incentives. In particular each individual is monitored by the authority with a probability p (with $0 < p < 1$). In case of monitoring, if the individual's actual contribution a_i is lower than the required contribution $\hat{a}$, she has to pay a penalty equal to $g(\hat{a} - a_i)$, where $g > 1$; on the contrary, if her actual contribution a_i is higher than the minimum one required, the monitored individual receives a positive reward equal to $g(a_i - \hat{a})$.[3] No penalty or reward is assigned to a monitored individual whose actual contribution is exactly equal to the minimum contribution set up by obligation.

In each period, the expected monetary payoff of an individual i is:

$$X_i = y - a_i + m \sum_{j=1}^{n} a_j - pg(\hat{a} - a_i) \tag{1}$$

where m indicates the marginal per capita return to the public good $A \equiv \sum_{j=1}^{n} a_j$. We set the parameters such that the following inequalities hold: $m > 1/n$ and $m + pg < 1$. The first inequality implies that the aggregate monetary payoff is maximised when each individual fully cooperates. The second inequality guarantees that the expected individual monetary return from one unit of contribution is negative.[4]

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[3] The parameters y, p and g are held constant for all 10 periods.

[4] Given these hypotheses, this framework represents a standard social dilemma with the peculiarity that an exogenous obligation of minimum contribution, backed by a structure of incentives, is introduced. Therefore this simple design captures a situation having the characteristics of the introduction of a law in a social dilemma situation. Notice that this setting reflects the standard view that both obligations and incentives are necessary components to define laws. Indeed,

2.2. Theoretical predictions

Consider in our setting the optimal choice of a risk neutral and fully self-interested individual. Her optimal contribution, a_i^*, is the value of a_i which maximises (1). The first order condition of the maximisation problem yields:

$$\frac{\partial X_i}{\partial a_i} = -1 + m + pg < 0. \tag{2}$$

Hence the dominant strategy for a risk-neutral and self-interested individual is always the full free-riding: $a_i^* = 0$. This result depends crucially on the assumption that $m + pg < 1$,[5] meaning that the monetary incentives are not sufficiently high to make the expected return from one unit of contribution higher than one unit kept for herself. Condition (2) predicts that the level of minimum contribution $\hat{a}$ required by obligation does not affect the optimal choice of a self-interested individual ('no obligation effect prediction'). This result is straightforward under the hypotheses that a self-interested individual cares only about her monetary payoff and that obligations do not affect the individual monetary outcomes.

Notice that in condition (2), given the values of the parameters p and g, the marginal effects of the monetary incentives designed to enforce the obligation are fixed and do not depend on the minimum contribution required $\hat{a}$. This is a crucial condition which is necessary in order to separate the effect of obligations from the one of incentives and it is achieved by introducing a reward (symmetric to the penalty) for the individuals contributing more than the minimum contribution.[6] Instead, considering only a probabilistic penalty for the individuals who contribute less than $\hat{a}$, we would obtain two distinct first-order conditions for the maximisation problem, one for the interval $a_i \leqslant \hat{a}$ and the other one for the interval $a_i > \hat{a}$. But in this case different levels of $\hat{a}$ would imply different marginal incentives, which instead we want to keep fixed in order to isolate the effect of different obligations.

A well supported result in the experimental literature on public goods games[7] is that a fraction of individuals make positive contributions to the public good. This is generally explained with the idea that these individuals are characterised by social preferences, that is to say they are also other-regarding and/or process-regarding. When social preferences are taken in account, it is possible to conjecture that in a public good environment the level of minimum contribution set up by obligation might affect the cooperative behaviour for different reasons:

(i) Some individuals may exhibit some form of reciprocity (e.g. they may be conditional cooperators—Fischbacher et al., 2001—or inequality averse—Fehr and Schmidt, 2001).[8] Since

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incentives make sense only if there is any obligation to be met. At the same time incentives not only 'enforce' but also contribute to 'define' the obligation: indeed a rule represents an obligation only if the individual behaviour with respect to this rule is subject to some consequences.

[5] Instead, with $m + pg > 1$, the optimal contribution for a self-interested individual would be the entire endowment, whereas, with $m + pg = 1$, she would be indifferent to any feasible level of contribution. In both cases the setting would not represent a public good game.

[6] It is worth noting that there are cases in the real world in which penalties are given to those breaking the law and rewards are given to those who follow the law. For instance, in Italy, penalties (in form of a reduction of points on the driving licence) are implemented for those who violate the driving code, while rewards (in form of more points added to the driving license) are given to those who for two consequent years do not violate the driving code. This case is very similar to ours since street safety could be easily thought as a public good.

[7] For a survey of the literature on public good experiments, see Ledyard (1995).

[8] For a description of different possible forms of other-regarding behaviour and a summary of recent theories see: Camerer and Fehr (in press) and Fehr and Schmidt (2001).

in each period all contributions are made simultaneously, individuals do not know others' contributions but have some *beliefs* about them. An obligation, highlighting a certain level of minimum contribution, could coordinate individual beliefs and, through this channel, could affect the behaviour of reciprocal individuals.

(ii) Some individuals may have internalised norms of contribution and may suffer emotional disutility when their actual contributions depart from their personal norm (Bowles and Gintis, 2002). An obligation, expressing a certain level of 'fair contribution' for the community, may affect an individual's personal norm of contribution: in this case, the individual will adapt her behaviour to the values expressed by the obligation in order to minimise a negative emotional cost.

These motives of behaviour are possible explanations of eventual departures from the 'no obligation effect prediction', which is what we test in this paper.

2.3. Experimental treatments, parameters and information conditions

The experiment consists of a repeated public good game lasting for 10 periods. Differently from a standard voluntary public good game, we fix exogenously an *obligation* of minimum contribution. This obligation indicates a minimum level of contribution to the public good required to each individual.[9] We implement three different conditions for the minimum contribution: a 'zero obligation condition' ('0 condition')[10] where the minimum contribution is zero, a 'low obligation condition' ('L condition') where in each period subjects are required to contribute a fraction of 2/5 of their total endowment and a 'high obligation condition' ('H condition'), where the minimum contribution required in each period corresponds to 4/5 of an individual's total endowment. The obligation expressed by the minimum contribution is enforced by a structure of incentives: in particular there is a probability of monitoring and a probabilistic penalty (reward) when contributions are lower (higher) than the level of minimum contribution required[11]. As we are interested in the effects of obligations *per se*, we keep as fixed across all treatments the level of marginal incentives, i.e. the probability to be monitored and the penalty/reward rate. On the contrary, the level of the minimum contribution required by obligation changes across the treatments. In the instructions we stress that the obligation fixes a minimum contribution required to each individual, but that in each period the feasible contribution for each participant varies between 0 and the endowment. Moreover we explain in detail the consequences of each choice on individual payoffs.

The incentives are fixed at a very low level. This choice is due to two reasons: firstly, we aim at testing whether or not an obligation of minimum contribution affects cooperation when incentives are such that the optimal strategy for self-interested individuals is the full free-riding

[9] Notice that the minimum level of contribution required is an individual obligation. Differently from a step level public good game (see among the others: Offerman et al., 2001 and the literature quoted there), we do not impose any collective threshold to be reached in order to provide the public good. As in a step level public good game, we maintain that the presence of the obligation may affect beliefs about others' cooperation. However our setting does not imply multiple equilibria for self interested players.

[10] In the '0 condition' treatment there is no explicit mention to any minimum contribution required. Moreover notice that in this treatment there is a probabilistic reward (proportional to the actual contribution of a monitored individual) but not a probabilistic penalty (since negative contribution are obviously not allowed).

[11] The penalty (reward) is proportional to the negative (positive) difference with respect to the minimum contribution required.

even if they are risk averse within reasonable degrees. Secondly, we want to minimise the possible bias in our results caused by differences in risk preferences across samples (even if we control for this bias using the test described in Section 2.3).

As we are interested in the possible effects of a change in the obligation on the overall level of cooperation, in some sessions we extend the public good game for other 10 periods. Hence, in these sessions we implement a repeated public good game for twenty periods divided into two segments of 10 periods. In the second 10-periods segment we change the minimum contribution required with respect to the first 10-periods segment. In all treatment conditions, subjects are informed that the experiment lasts exactly 10 periods. When a second segment is added, subjects play the first treatment condition without knowing that the experiment would be continued for other 10 periods. After period 10, subjects are informed that a new experiment is beginning, lasting again 10 periods.

Table 1 provides some information about the different experimental sessions and treatments. In each session participants are divided into 6 groups of size 6 (except for Session 6 where we had 5 groups of size 6) and play the repeated public good game[12]. In Session 1 subjects play the first 10-periods segment with the ‘O condition’ and the second 10-periods segment with the ‘L condition’. In Session 2 subjects play the first segment under the ‘L condition’ and the second segment under the ‘O condition’. In Session 3 the ‘L condition’ is implemented for the first segment and the ‘H condition’ for the second segment. Session 4 begins with the ‘H condition’ in the first segment and then implements the ‘L condition’ in the second segment. In Session 5 and Section 6 only a 10-periods segment is played, respectively with the ‘L condition’ and the ‘H condition’.

The experiment was conducted in a computerised laboratory where subjects anonymously interacted with each other[13]. No subject is ever informed about the identity of other group members. The composition of each group is held constant during the whole experiment (*partner condition*) and subjects know it. In all treatments, the individual endowment in each period is equal to $y = 25$ tokens. The marginal per capita return of the public good is fixed at $m = 0.3$. In each period contributions take place simultaneously. Each group is monitored with a probability of $\frac{1}{2}$. In case a group is selected, only one of the six members of the group is randomly chosen to

Table 1
Characteristics of the experimental treatments and sessions

Session	Number of subjects	Minimum contribution required	
		1st 10-periods segment	2nd 10-periods segment
1	36	O	L
2	36	L	O
3	36	L	H
4	36	H	L
5	36	L	–
6	30	H	–

[12] We conduct the experiment with constant groups (partner design) as we are interested in observing the effect of different levels of minimum contributions on the evolution of contribution over time in groups who are hold constant. In other words we do not want to avoid the effects of within group interactions over time but we are interested in observing the effects of obligations on these possible interactions.

[13] For conducting the experiment we used the experimental software ‘*z*-Tree’ developed by Fischbacher (1999).

be monitored. Hence the probability of being monitored for a subject is equal to $p = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12}$. The sanction/reward rate is equal to $g = 1.2$. Both the probability of being monitored and the sanction/reward rate are held constant for all treatments. In all treatments the payoff functions and the parameters y, n, p and g are common knowledge. Furthermore in the instructions we stress that in each period the probability of being monitored is independent from the probability of having been monitored in a former period and does not affect the probability of being monitored in a following period. The monitoring of contributions takes place by a computerised random extraction and all subjects are informed about it. The minimum level of contribution required by obligation is $\hat{a} = 0$ in the '0 condition', $\hat{a} = 10$ in the 'L condition' and $\hat{a} = 20$ in the 'H condition'.

At the end of each period, participants are informed about the total contributions to the public good in their group, and receive information about the results of the monitoring process. In particular they know whether or not the group has been monitored, whether or not their own contribution has been monitored and, in this case, the effect of monitoring on their own payoff. However, in case their group is monitored but they have not been selected for the monitoring, they do not know the identity of the monitored group mate. This condition guarantees that participants do not take their choices in order to avoid being ashamed by group mates in case they are monitored and rules out any reputation effect.

2.4. The role of risk preferences: a control test

In presence of a probabilistic punishment/reward enforcing a certain obligation, risk preferences may contribute to explain differences in individual contributions. In particular, *ceteris paribus*, risk averse people will contribute closer to the minimum level of contribution required by obligation because they prefer to insure themselves.

In order to control for the possible effect of risk preferences, at the end of each public good session we run a lottery to single out subjects' risk preferences. In the lottery we implement an experimental design similar to that implemented by Holt and Laury (2001). The experimental test is based on five choices between the paired lotteries reported in Table 2.

In each paired lottery, subjects choose between an alternative A and an alternative B. Once all subjects have taken their choice, a pair of lotteries is randomly chosen and the computer assigns to each subject the option she has chosen before. Finally the lottery is run in order to determine each subject's payoff. Following the method proposed by Holt and Laury (2001), we classify individual risk preferences according to the sequence of choices taken in the lottery (see Table 3). These individual data are used to test whether risk preferences are significant in explaining differences in individual contributions.

Table 2
Paired lottery choices

Option A	Option B	Payoff differences (A-B)
1/10 100 tokens; 9/10 80 tokens	1/10 170 tokens; 9/10 10 tokens	56
3/10 100 tokens; 7/10 80 tokens	3/10 170 tokens; 7/10 10 tokens	28
5/10 100 tokens; 5/10 80 tokens	5/10 170 tokens; 5/10 10 tokens	0
7/10 100 tokens; 3/10 80 tokens	7/10 170 tokens; 3/10 10 tokens	−28
9/10 100 tokens; 1/10 80 tokens	9/10 170 tokens; 1/10 10 tokens	−56

Table 3
Risk preferences associated to lottery choices

Sequence of choices	Risk type
A-A-A-A-A	highly risk averse
A-A-A-A-B	risk averse
A-A-A-B-B or A-A-B-B-B	risk neutral
A-B-B-B-B	risk lover
B-B-B-B-B	highly risk lover
Other sequences	inconsistent choices

3. Experimental results

All sessions were held in October 2004 in the computerised lab of the University of Siena (Italy). In total, 210 subjects took part in the experiment. All subjects were students recruited from undergraduate courses in different fields. Participants were recruited via web announcement and flyers. Nobody had previously participated to a public good game. Each subject took part only in one of the six sessions. An experimental session lasted about 60 minutes and the average earning was 12 euros (about 16 dollars), including a show-up fee of 3 euros.

3.1. Obligations and cooperation levels

In Fig. 1 we report the time series of average contributions from period 1 through 10 for the three different treatments. Figure 1 shows that similar average contributions characterise the treatment in which there is no minimum contribution required ('0 condition' – 'MC = 0') and the treatment in which the minimum contribution required is 10 tokens ('L condition' – 'MC = 10'). Instead, average contributions in the treatment where the minimum contribution required is 20 tokens ('H condition' – 'MC = 20') are clearly higher than in the other two treatments characterised respectively by the '0 condition' or and 'L condition'.

In Table A.1 in the appendix we present data on average contributions disaggregated by group. It is worth noting that average contributions are very similar in the sessions characterised by the same level of minimum contribution set up by obligation. Moreover the group level data confirm the results shown in Fig. 1 for data aggregated by treatment conditions.

Table 4 reports the results of a Mann–Whitney rank-sum test[14] of the difference in contribution levels between treatments in periods 1–10.[15] We find that mean contributions under the 'H condition' are higher at significant statistical levels than mean contributions both in the treatment with the '0 condition' and in the treatment implementing the 'L condition'. Instead, average contributions under the '0 condition' are not significantly different at conventional statistical levels than average contributions under the 'L condition'.

These results suggest that, for given marginal incentives, the minimum contribution set up by obligation can affect average cooperation. In particular, when the minimum contribution required is high ('H condition'), the level of cooperation is significantly higher than in presence of low or null obligation.

In order to better interpret the previous findings based on comparisons of average contributions, it is worth analysing how the patterns of individual data vary across treatments. In Figs.

[14] The unit of observation in the statistical test is the group average contribution.

[15] We report both the values of the test (z) and the p-values (p).

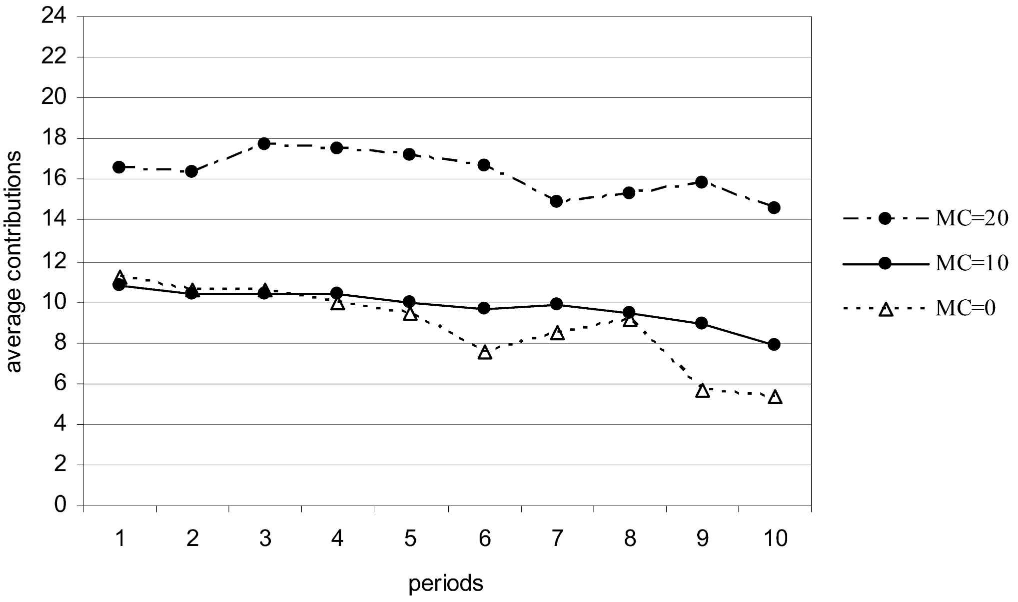

Fig. 1. Average contributions in periods 1–10.

Table 4
Mann–Whitney test results for differences in contributions between treatments

Treatment conditions	MC = 10	MC = 20
MC = 0	$z = -0.600$; $p = 0.549$	$z = -2.714$; $p = 0.007$
MC = 10		$z = -3.191$; $p = 0.001$

MC = Minimum contribution required.

A.1–A.6 in the appendix we report the distributions of individual contributions in the first round of Sessions 1–6. It is possible to notice that the distribution of individual contributions in the first period is quite similar in Sessions 1, 2, 3 and 5 (where the minimum contribution is 0 or 10 tokens), whereas it differs in a relevant way in Sessions 4 and 6, where the minimum contribution is fixed at 20 tokens. In particular, while the distribution of contributions tends to be concentrated around the level of 10–12 tokens when the '0 condition' or the 'L condition' is implemented, under the 'H condition' the distribution is significantly shifted towards the right, with individual contributions concentrated around the level of 20–25 tokens. Instead the number of individuals contributing 0 or close to 0 (self-interested individuals) is quite similar across all sessions (with the partial exception of Session 5, characterised by a larger proportion of self-interested subjects).

We can interpret this evidence as follows. In the first round of a public good game, selfish individuals do not contribute, whereas other individuals such as altruist, reciprocators, conditional co-operators[16] may have preferences for positive contributions. In our sample, when no mini-

[16] Conditional cooperators are those individuals who are willing to contribute more to a public good the more others contribute. For references and clean empirical evidence about conditional cooperation see Fischbacher et al. (2001).

mum contribution is required, those who are willing to make positive contributions tend to give about 10–12 tokens to the public good. When the minimum contribution required is 10 tokens, a very similar pattern emerges in both our samples. A possible explanation of these findings is that, fixing exogenously the minimum contribution required at a level very close to 40–50% of the endowment (as in our 'L condition'), the subjects who are willing to cooperate in the first rounds tend to find confirmation (on average) of their preferences and/or beliefs when no obligation exists, so they will contribute at similar levels than in the no obligation case. This may explain why there is no significant difference in average contributions between the treatment with the '0 condition' and the one with the 'L condition'.

Instead, when the minimum contribution required is significantly higher than 40–50% of the endowment (as in our 'H condition'), some individuals (for instance those who internalise cooperation norms) are induced to contribute more, making average contributions under the 'H condition' significantly higher than under the two other conditions.

The previous evidence can be summarised as follows:

Result 1. Obligations affect the levels of average contributions to a public good. In particular average contributions are significantly higher when the minimum contribution required by obligation is sufficiently higher than average contributions as emerging in the 'no obligation' case.

3.2. Obligations and the dynamics of cooperation

Figure 1 suggests that the trend of average contributions from period 1 through 10 is decreasing in all treatments, the same pattern found in standard linear public good games. We can give this evidence the following explanation. Whatever is the level of minimum contribution and the initial levels of average contributions, in presence of selfish individuals who never contribute, reciprocal individuals observing declining levels of contributions notice that they are matched with free riders and refuse to be taken advantage of, so they gradually reduce their contributions.[17] We can better understand temporal pattern of contributions and the factors that affect contributions by estimating a random effects Tobit model.[18] The dependent variable is the individual level contribution by player i at round $t(C_{i,t})$. The set of independent variables is given by:

(a) three treatment dummies (0 condition, L condition H condition), with the 0 condition;
(b) the inverse of time $(1/t)$, which captures the non-linearity in the effect of time on contributions and also distinguishes between the effects of early and later rounds on contributions;
(c) the contribution made by each subject in the previous round $(C_{i,t-1})$;
(d) the deviation of an individual's contribution from the group (g) average in the previous round, i.e. $\Delta_{i,t-1} = \overline{C}_{g,t-1} - C_{i,t-1}$[19] where $\overline{C}_{g,t-1} = \frac{1}{6}\sum_{j=1}^{6} C_{j,t-1}$;
(e) the constant term.

[17] This is the standard explanation of why cooperation tends to decay in voluntary public good games (see Fehr and Gaechter, 2000; Camerer and Fehr, in press).

[18] We estimate a Tobit model as each subject's contribution is bounded by 0 below and by 25 (the token endowment) above. Notice that we cannot compute the corresponding fixed effects Tobit model as there does not exist a sufficient statistic allowing the fixed effects to be conditioned out of the likelihood function.

[19] Note that a positive $\Delta_{i,t-1}$ implies that individual i contributed less than the group average in the previous round and a negative $\Delta_{i,t-1}$ implies that individual i contributed more than the group average in the previous round.

Table 5
Regression results for contributions to the public good

	Random effect tobit
L condition	0.8998293
	(1.34)
H condition	4.84485
	(6.10)
l/t	5.673603
	(4.05)
Lag contribution	0.3569708
	(6.90)
Lag difference from group	0.338929
average contribution	(5.69)
Constant	5.13506
	(6.42)
Log likelihood	−5318.9624
Wald chi2	216.49
Number of observations	1890
Number uncensored	1357
Number low censored	351
Number upper censored	182
Number of subjects	210

Note: Z-statistics in parenthesis.

Table 5 reports the regression results. First, relative to the '0 condition', (the reference category) contributions are significantly higher in the 'H condition'. However, there are no significant differences between contributions in '0 condition' and in the 'L condition'. This regression results confirm Result 1. Second, contributions fall over time, as t increases, $1/t$ decreases and this is associated with a reduction in contributions and hence the positive (and significant) coefficient of $1/t$. Third, an increase in the previous round's contribution increases the current round's contribution. The coefficient estimate of $C_{i,t-1}$ is positive and statistically significant. Finally, the coefficient estimate of the lag difference from individual level from group level contribution is positive and statistically significant. This means that and increase in $\Delta_{i,t-1}$ is associated with an increase in individual contributions. While a decrease in $\Delta_{i,t-1}$ drives a decrease in individual contributions. Furthermore, the more distant an individual's contribution is from the group average in the previous round, the greater is the increase or decrease in his or her contribution in the current round.

Despite time affects contributions, Fig. 1 suggests that the rate of decline of average contributions seems to be affected by the level of minimum contribution required by obligation. Average contributions decrease from 11.17 to 5.36 (−51.99%) in the no obligation case, from 10.78 to 7.86 (−27.06%) under the 'L condition' and from 16.50 to 14.56 (−12.24%) under the 'H condition'. In other terms, the rate of decline of cooperation seems to be inversely proportional to the level of minimum contribution required by obligation. Table 6 reports the results of a Wilcoxon matched-pairs test of the difference in average contributions between the 1st and the 10th round. We observe that these differences are statistically significant in both treatments with 0 and low obligation (p-values are respectively 0.028 and 0.009). Instead, in the treatment with high obligation the difference in average contributions between the 1st and the 10th round are not statistically significant at conventional levels (p-value is equal 0.168).

Table 6
Wilcoxon matched-pairs test results for differences in average contributions (1st–10th period)

	MC = 0	MC = 10	MC = 20
1st period–10th period	$z = 2.201$; $p = 0.028$	$z = 2.621$; $p = 0.009$	$z = 1.379$; $p = 0.168$

MC = Minimum contribution required.

Result 2. Contributions tend to decline over time for any of minimum contribution required by obligation. Nonetheless, in presence of a sufficiently high level of minimum contribution, the reduction is not statistically significant, suggesting that obligations may affect the dynamics of cooperation.

3.3. Changes in obligations and cooperation levels

In Sessions 1–4 individuals play a first segment of 10 periods with a certain level of the minimum contribution. At the end of the 10th period, subjects are informed that they have to play a second segment of 10 periods of the same game, but with a different level of the minimum contribution. In Fig. 2 we report the time series of average contributions for the first segment (labelled as periods: 1 to 10) and the second segment (labelled as periods: 11 to 20) of Sessions 1–4.

It is worth noting that in sessions where the minimum contribution is reduced in the second segment of the game (in Session 2, shifting from L to 0 and in Session 4 from H to L), no re-starting effect is observed at the 11th round: average contributions in the 11th period of these sessions are very close to average contributions in the 10th period and the contribution rates keep on declining at the same rate.

Instead, in sessions where the minimum contribution is raised in the second segment, we observe a relevant upwards re-starting effect. In Session 1 (from 0 to L), average contributions in the 11th period are higher than average contributions in the 10th period and are very close to average contributions in the 1st period. In Session 3 (from L to H), average contributions in the 11th period are not only higher than in the 10th, but they also overshoot the 1st period average contributions. Then, after the 11th period, contributions decline over time in both sessions.

In Table 7 we report the results of a nonparametric Wilcoxon matched-pairs test[20] applied, for each session, to evaluate the difference in average contributions between the first segment (periods 1–10) and the second segment (periods 11–20) and between the last period of the first segment (period 10) and the first period of the second segment (period 11). Notice that in Sessions 1 and 3 (where the minimum contribution increases in the second treatment), the differences in average contributions between periods 1–10 and periods 11–20 are not significant at conventional levels, whereas the difference in contributions between period 10 and 11 are significant. For Sessions 2 and 4, the opposite result is obtained: there is a significant difference in average contributions between periods 1–10 and periods 11–20, whereas there is no statistically significant difference in contributions between period 10 and period 11.

In order to better interpret the previous results, we analyse individual data by comparing the distributions of individual contributions respectively in the 10th and 11th period of Sessions 1–4 (Figs. A.7–A.14 in the appendix). In Sessions 1 and 3, characterised by an increase in the minimum contribution, the distributions of individual contributions tend to shift towards the right

[20] The unit of observation in the statistical test is the group average contribution.

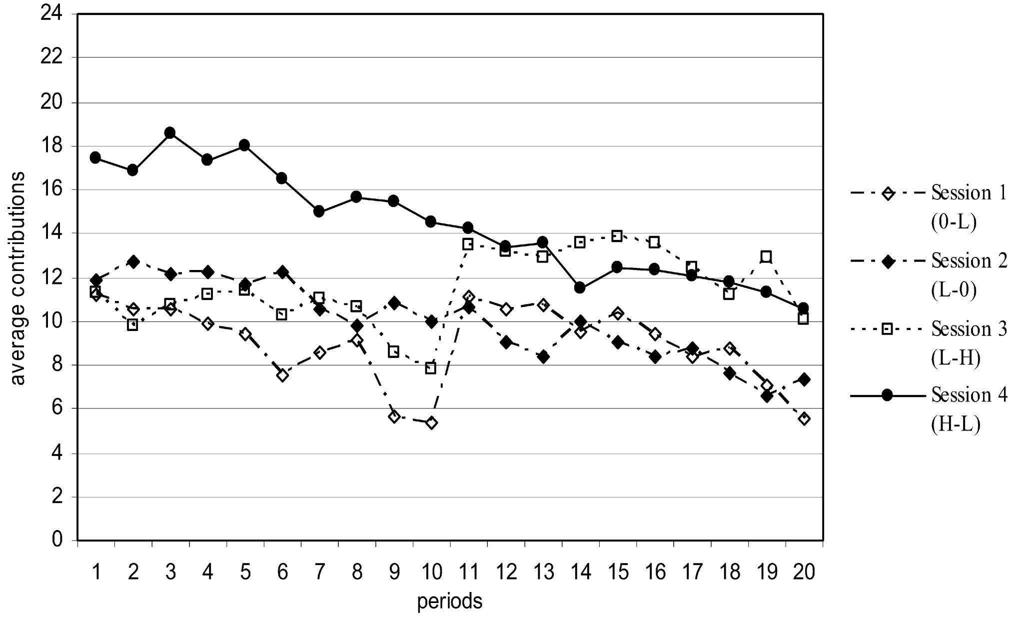

Fig. 2. Average contributions in periods 1–20.

Table 7
Wilcoxon matched-pairs test results for differences in average contributions

	Session 1: MC1 = 0–MC2 = 10	Session 2: MC1 = 10–MC2 = 0	Session 3: MC1 = 10–MC2 = 20	Session 4: MC1 = 20–MC2 = 10
1st segment–2nd segment	$z = -0.314$; $p = 0.753$	$z = 2.201$; $p = 0.028$	$z = 1.363$; $p = 0.173$	$z = 2.201$; $p = 0.028$
10th period–11th period	$z = -2.201$; $p = 0.028$	$z = -0.943$; $p = 0.345$	$z = -2.201$; $p = 0.028$	$z = 0.314$; $p = 0.753$

MC1: minimum contribution required in the 1st 10-periods segment.
MC2: minimum contribution required in the 2st 10-periods segment.

when the new condition is implemented. In particular in Session 1 individual contributions are concentrated around 0–2 tokens in the 10th period, when the level of minimum contribution is still 0 tokens, whereas they become concentrated around 10–13 tokens in the 11th period, when the level of minimum contribution is 10 tokens. Instead, in Session 3, individual contributions tend to be concentrated around 0 tokens and 10 tokens in the 10th period (when the level of minimum contribution is 10 tokens), whereas they are polarised around 0 and 20 tokens in the 11th period. These results suggest that with the implementation of the new condition some individuals are pushed to contribute more and closer to the level of minimum contribution set up by obligation.

Instead, in Sessions 2 and 4, characterised by a decrease in the minimum contribution, we do not observe relevant changes in the distributions of individual contributions from period 10 to period 11. When a lower obligation is implemented, on average, individuals are not pushed to re-start their initial level of contributions.

In the two treatments the individuals experience a similar pattern of decay of cooperation in the first 10-periods segment. However, when the new treatment is implemented, highlighting a higher obligation triggers some individuals' reactions (e.g. via a change of their beliefs or propensity to cooperate), whereas when a lower obligation is highlighted these individuals' reactions are not triggered.

Summarising, these results point out that unexpected changes in the level of the minimum contribution required by obligation have asymmetric dynamic effects on the levels of cooperation. Lowering the minimum contribution does not alter the pattern of decay of cooperation, whereas increasing the minimum contribution gets cooperation to re-start (even with overshooting of the initial level when the minimum contribution passes from 10 to 20). Nevertheless, in both cases, in subsequent periods cooperation tends to decline over time.

The following statement summarises the above evidence:

Result 3. An unexpected increase in the minimum contribution required by obligation triggers a temporary re-start in the cooperation deteriorated in the first 10 periods. Instead, an unexpected reduction in the minimum contribution does not alter the descending trend of cooperation.

3.4. Controlling for differences in risk preferences

In Table 8 we report the frequencies of subjects by class of risk preferences as obtained by running the experiment described in Section 2.3.

It is worth noting that the frequencies are very similar for the samples of the different sessions, with the partial exception of Session 6, where highly risk averse subjects represent a higher proportion in the sample. Furthermore, we notice that the number of risk-lover or highly risk-lover individuals is very small.

In order to test whether or not differences in risk preferences are relevant in explaining differences in contributions, we have subdivided our sample into three groups: the first group is composed of risk-neutral individuals, the second is composed of risk-averse individuals and the third one is composed of highly risk-averse individuals.[21] Moreover we compute for each subject an index given by the mean (for all periods) of the differences between her contribution and the minimum contribution required. Then we apply a Mann–Whitney rank-sum test of the difference in this index between each pair of groups. The Mann–Whitney rank-sum test of the difference in this index between risk neutral and highly risk averse individuals yields $z = -0.084$, which is not

Table 8
Frequencies of subjects by classes of risk preferences

Classes of risk preferences/Session	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
Highly risk averse	4	6	5	3	5	9
Risk averse	6	5	5	5	8	4
Risk neutral	16	12	12	15	12	9
Risk lover	1	1	3	0	0	1
Highly risk lover	0	0	0	1	0	1
Inconsistent choices	9	12	11	12	11	6

[21] We have not considered risk-lover or highly risk-lover individuals, who represent a negligible fraction of subjects in the sample, nor individuals whose choices are inconsistent.

statistically significant at conventional levels ($p = 0.933$). The same test applied to the difference in this index between risk neutral and risk averse individuals yields $z = 0.026$, which is certainly not statistically significant ($p = 0.979$). Finally, the difference between highly risk averse and risk averse individuals is also found not statistically significant ($z = -0.315$, $p = 0.753$).

Hence, differences in subjects' risk preferences across the different samples do not affect our results for two reasons. First, the distribution of subjects by class of risk preferences is very similar in the different sessions. Second, there is no significant difference in individual behaviours with respect to the minimum contribution between highly risk averse, risk-averse and risk-neutral individuals. This last result can be explained by the fact that the probability to be monitored in each round and the penalty rate are very low.

4. Concluding remarks

This paper investigates the possibility that obligations, i.e. what formal rules ask people to do (or not to do), produce some effects on individual behaviour in social dilemmas that cannot be explained by variations in the marginal incentives backing the obligations themselves. In particular, we report the results of a finitely repeated public goods game where individuals are required to contribute a minimum fraction of their endowment for a public project facing a given structure of incentives. Keeping as fixed across all treatments the level of marginal incentives whereas changing the level of minimum contribution required by obligation, we test whether obligations *per se* can affect individual contributions to the public good. Our results show that the level of minimum contribution significantly affects both average contributions and their distributions in the samples. Nevertheless, in all treatments, average contributions tend to decline over time, suggesting that, with low incentives, obligations *per se* cannot sustain cooperation in repeated interactions. Nonetheless obligations affect the dynamics of cooperation over time: when a high minimum contribution is required, the rate of decline in average contributions slows down. Finally, our results show that unexpected changes in the level of minimum contribution set up by obligation have asymmetric dynamic effects on the levels of cooperation: a weakening in the obligation does not alter the pattern of deterioration of cooperation, whereas an increase induces a (provisional) re-start in cooperation.

These results support the idea that lawmaking has an 'expressive power' carried out by the obligations imposed regardless the incentives backing them. In line with Falk et al. (2006) on the effects of minimum wage, our findings highlight how a systematic analysis of these neglected elements is crucial in order to understand the behavioural effects of public policies.

Acknowledgments

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Appendix A

Table A.1
Average contributions in Sessions 1–6: rounds 1, 1–10 (average), 11, 11–20 (average)

Session	Group	Period 1	Periods 1–10	Period 11	Periods 11–20
1	1	15.67	12.22	12.33	6.82
	2	8.17	6.42	13.33	9.17
	3	13.00	10.72	10.50	10.25
	4	12.83	9.47	9.00	9.08
	5	10.17	8.18	11.67	9.50
	6	7.17	5.70	9.83	9.95
	Overall mean	11.17	8.78	11.11	9.13
2	1	9.17	8.97	11.00	7.63
	2	9.83	10.05	8.33	6.78
	3	10.00	8.23	7.50	3.53
	4	12.67	10.63	10.17	7.63
	5	12.17	10.10	7.50	8.27
	6	17.17	20.35	19.17	17.55
	Overall mean	11.83	11.39	10.61	8.57
3	1	13.33	15.12	22.83	20.47
	2	9.50	6.88	6.17	2.57
	3	8.33	6.73	9.33	6.45
	4	13.67	12.93	14.17	15.78
	5	10.67	8.82	16.83	14.65
	6	12.50	11.12	11.17	16.30
	Overall mean	11.33	10.27	13.42	12.70
4	1	12.67	9.17	8.50	6.07
	2	13.00	15.13	12.83	11.55
	3	22.17	20.55	20.67	19.72
	4	20.50	19.67	15.00	13.92
	5	18.33	17.83	18.33	13.38
	6	17.67	16.63	10.00	9.08
	Overall mean	17.39	16.50	14.22	12.29
5	1	10.33	5.18		
	2	6.00	5.75		
	3	11.33	12.57		
	4	3.83	3.25		
	5	11.83	11.02		
	6	11.67	8.22		
	Overall mean	9.17	7.66		
6	1	21.00	21.41		
	2	14.67	17.57		
	3	21.00	19.45		
	4	9.00	10.87		
	5	12.50	10.60		
	Overall mean	15.63	15.98		

FIGURE A1: SESSION 1 (MC=0), ROUND 1

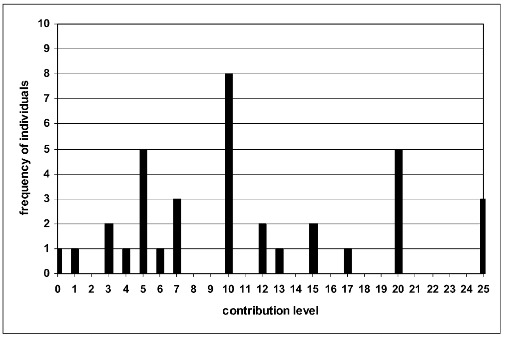


FIGURE A2: SESSION 2 (MC=10), ROUND 1

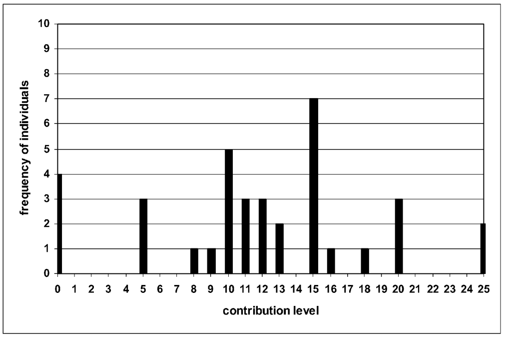


FIGURE A3: SESSION 3 (MC=10), ROUND 1

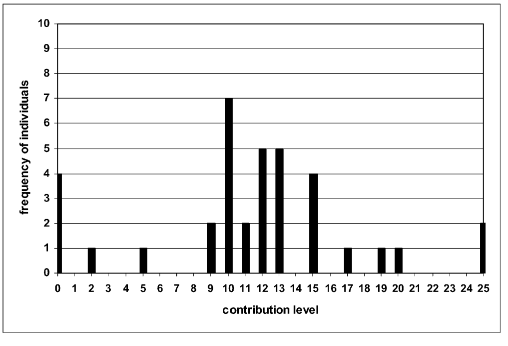


FIGURE A4: SESSION 4 (MC=20), ROUND 1

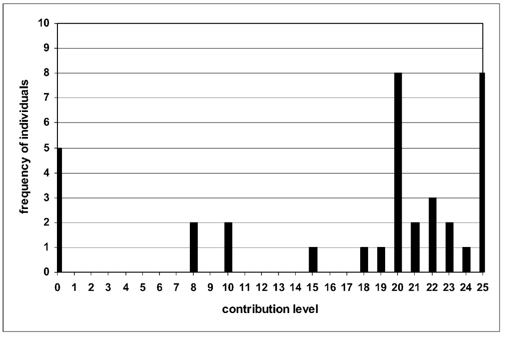


FIGURE A5: SESSION 5 (MC=10), ROUND 1

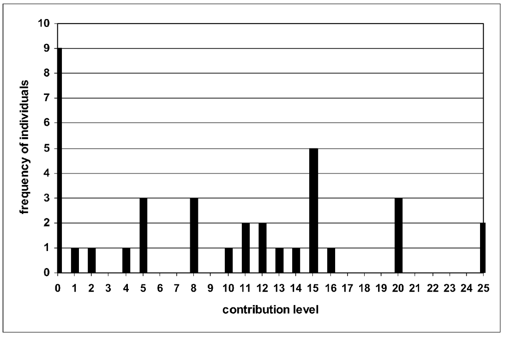
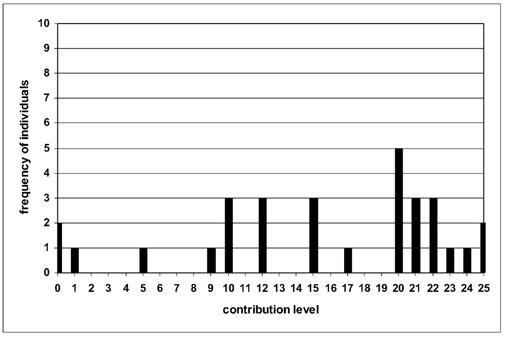


FIGURE A6: SESSION 6 (MC=20), ROUND 1



Figs. A.1–A.6.

FIGURE A7: SESSION 1, ROUND 10 (MC=0)

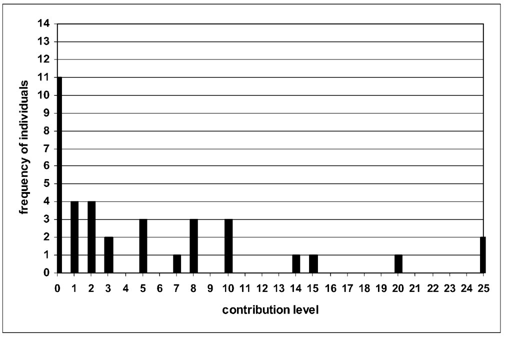


FIGURE A8: SESSION 1, ROUND 11 (MC=10)

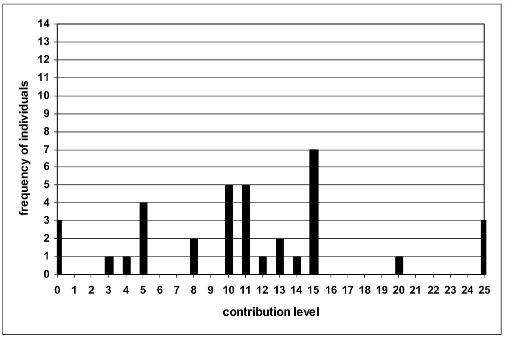


FIGURE A9: SESSION 2, ROUND 10 (MC=10)

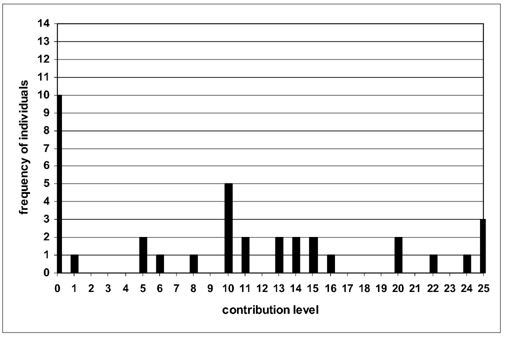


FIGURE A10: SESSION 2, ROUND 11 (MC=0)

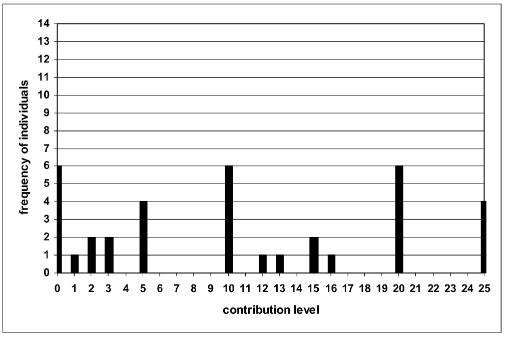


FIGURE A11: SESSION 3, ROUND 10 (MC=10)

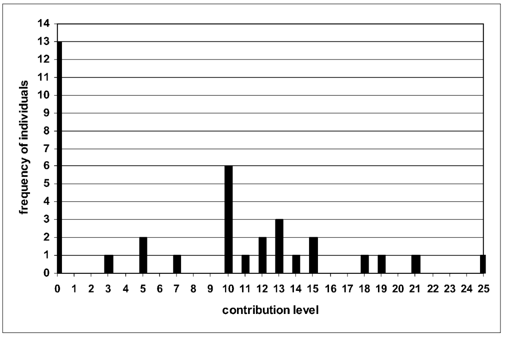
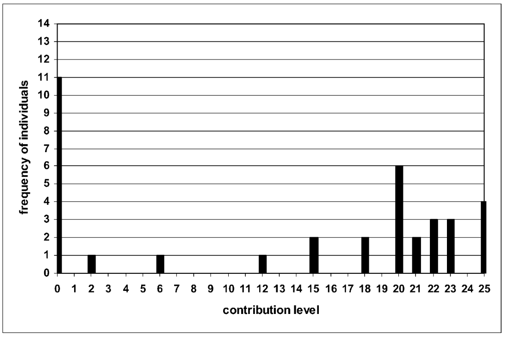


FIGURE A12: SESSION 3, ROUND 11 (MC=20)



Figs. A.7–A.12.

FIGURE A13: SESSION 4, ROUND 10 (MC=20)

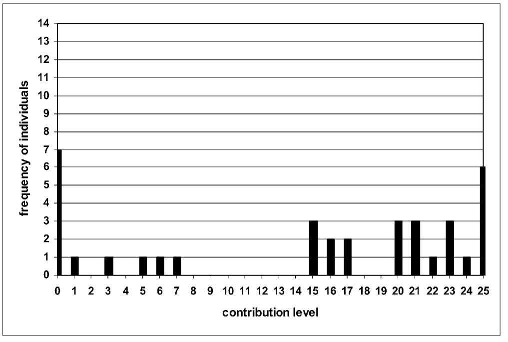
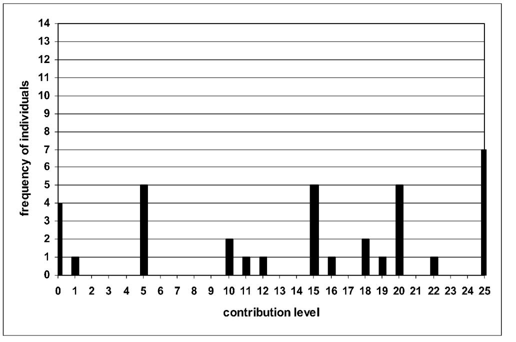


FIGURE A14: SESSION 4, ROUND 11 (MC=10)



Figs. A.13–A.14.

Appendix B. Instructions

The following instructions were originally written in Italian. We document the instructions used in Session 3 (both for the public good game and the lottery).

B.1. The public good game

B.1.1. Instructions for the first treatment (periods 1–10)

Instructions

Welcome in the Lab and thanks for participating in this experiment. You are now taking part to an economic experiment in which, depending on your decisions, you can earn a considerable amount of money.

From now on, it is prohibited to communicate with the other participants during the experiment. If you violate this rule you will be excluded from the experiment and from all payments.

Hereafter we describe the experiment in detail. Please, read the following instructions carefully. It is in your and our best interest that you fully understand the instructions, so please feel free to ask any question.

How will your income be paid?

During the experiment your entire earnings will be calculated in tokens. At the end of the experiment the total amount of tokens you have earned will be converted to Euros at the following rate:

100 tokens = 1 Euro.

Each participant receives a lump sum payment of 3 Euros for participating. At the end of the experiment your earnings and the 3 Euros for participating will be immediately paid to you in cash.

How long is the experiment? How many people do take part to it?

The experiment is divided into different periods. In all, the experiment consists of 10 periods. In each period the participants are divided into groups of six. Therefore you will therefore be in a group with 5 other participants. The composition of the groups will not change during the experiment. Therefore in each period your group will consist of the same participants (whose identity you do not know).

Which kind of decisions do you have to take during the experiment?

In each of the 10 periods of the experiment you have to decide the amount of your contribution to a *common project.*

At the beginning of each period, as all your group members, you will receive an *endowment* of 25 tokens. Your task is to decide how to use your *endowment*. In particular, you have to decide how many of the 25 tokens you want to contribute to the *project* (notice that you have to choose a natural number between 0 and 25). The remaining tokens (25 − your contribution) are kept for yourself.

What is the aim of the project?

The project returns to the group a *common product*. The *common product* is an amount of tokens higher than the total sum of the contributions to the project made by the members of your group. The *common product* is divided equally among all the group members. Each group member obtains an *individual product*. In particular, the sum of the individual contributions to the project will be multiplied by 1.8 before being divided equally among the six group members.

The individual product can be represented by this simple expression:

$$\textit{individual product} = \frac{G \times 1.8}{6}$$

where:
G = sum of the individual contributions of all group members to the project;
6 = number of group members.

An example. Suppose that the sum of the contributions to the project from all the group members is 60 tokens. The project returns a total amount of:

$$60 \times 1.8 = 108 \text{ tokens.}$$

This amount of tokens will be equally redistributed among the group members. Hence, each member of the group earns from the project:

$$\frac{60 \times 1.8}{6} = 60 \times 0.3 = 18 \text{ tokens.}$$

Therefore, your contribution to the project also raises the income of the other group members. On the other hand, you earn an income from each token contributed by the other members. For each token contributed by any other member you will earn 0.3 tokens. Remember that, in each period, your feasible contribution is any integer number between 0 and 25.

The minimum contribution

In each period, a *minimum contribution* to the project equal to 10 tokens is required to each individual. The amount of tokens required as minimum contribution will not change during the experiment, remaining the same (10 tokens) for all the 10 periods.

The monitoring

In each period there will be the possibility that the contribution of a group member will be monitored. The choice will be random. The computer, after all members of your group have made their decision, will randomly select an even or odd number. The extraction of an even number implies that there will be a monitoring of the contributions; on the other hand if the result of the extraction is an odd number the contributions will not be monitored. If the contributions within the group will be monitored, the computer will randomly choose an integer between 1 and 6, corresponding to the identification number of the subject that will be monitored. Notice that for each member of the group the probability of being monitored in a certain period will be the probability of the extraction of an even number multiplied by the probability of being extracted in a group of six members, that is to say:

$$p = \frac{1}{2} \times \frac{1}{6} = \frac{1}{12} \cong 8.33\%.$$

This procedure will be repeated in each period; notice that the probability of being monitored in a certain period is independent from the probability of being monitored in a former or following period.

What is the effect of the monitoring?

If the contribution of the monitored member is equal to the minimum contribution required, the monitoring will not have any effect on her earnings.

If the contribution of the monitored member is lower than the minimum contribution required, an amount of 1.2 tokens will be subtracted from her endowment for each token of difference between the minimum contribution and her actual contribution.

If instead the contribution of the monitored member is higher than the minimum contribution required, an amount of 1.2 tokens will be added to her endowment for each token of difference between the minimum contribution and her actual contribution.

Notice that the tokens subtracted from the monitored subjects who contribute less than the minimum contribution will not be added to the common project and the tokens received by the monitored subject whose contribution is higher than the minimum one will not be subtracted from the common project.
An example. Suppose that the minimum contribution is fixed to 3 tokens.

- Suppose that the subject contributes 1 token. In case her contribution is monitored, 2.4 more tokens will be subtracted from her endowment, that is to say:

$1.2 \times$ (minimum contribution $-$ actual contribution of the subject) $= 1.2 \times (3-1) = 2.4$.

- Suppose now that the subject contributes 5 token. In case her contribution is monitored, she will receive 2.4 more tokens, that is to say:

$1.2 \times$ (actual contribution of the subject $-$ minimum contribution) $= 1.2 \times (5-3) = 2.4$.

How will your income be calculated?

In each period, after all group members have decided how much to contribute to the common project and after a possible monitoring, your income is calculated by summing three components**:**

1. The tokens you have kept for yourselves, that is to say:

   $$\textit{Endowment} - \textit{your contribution}.$$

2. The *individual product* from the common project:

   $$\textit{Total group contributions} \times \frac{1.8}{6}.$$

3. The effect of a possible monitoring:
   a. 0, if you have not been monitored or if you have been monitored but you have contributed exactly 10 tokens (the minimum contribution);
   b. if you have been monitored and you have contributed less than the minimum contribution required, your income will be reduced by:

   $$(\textit{minimum contribution} - \textit{your actual contribution}) \times 1.2;$$

   c. if you have been monitored and you have contributed more than the minimum contribution, your income will be increased by:

   $$(\textit{your actual contribution} - \textit{minimum contribution}) \times 1.2.$$

The income in each period can be expressed by the following expression:

$$s = D - c + \frac{G \times 1.8}{6} + (c - m) \times 1.2$$

where: $s =$ income in each period; $D =$ initial endowment; $c =$ your contribution to the project; $G =$ total group contribution to the project; $m =$ minimum required contribution.

The input screen

At the beginning of each period the following input screen will appear:

The number of the period appears in the top left corner of the screen. In the top right corner you can see how many more seconds remain for you to decide about your contribution. In the first 2 periods you have 45 seconds, whereas in the remaining 8 periods you have 30 seconds. Your decision must be made before the time displayed is 0 seconds. In the middle of the screen, it appears the minimum contribution. Below it, you can see your endowment and then the input field where you have to write a number between 0 and 25. On the right down corner there is the button OK to confirm your choice.

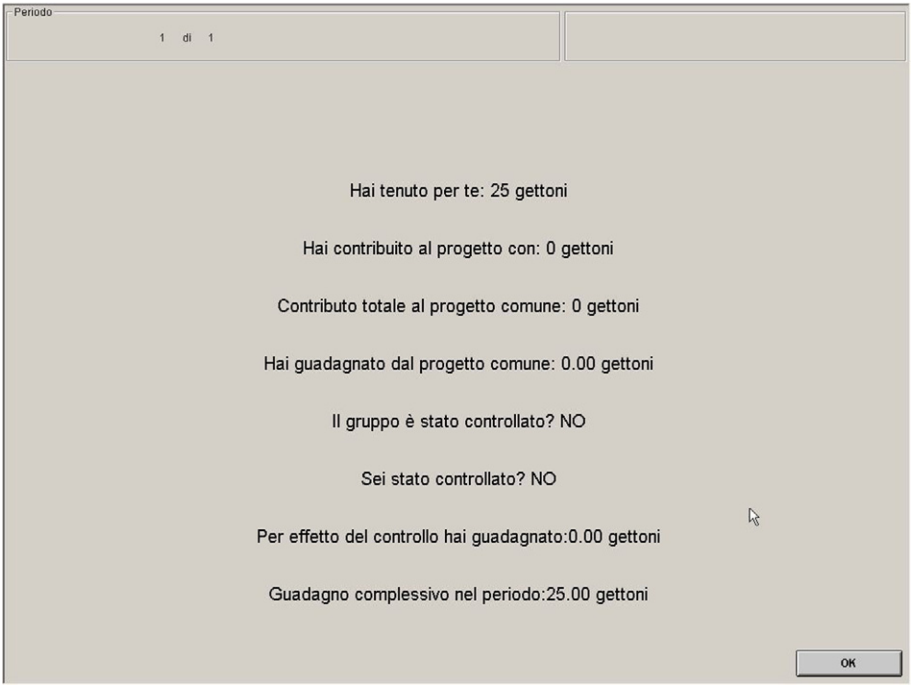
Let's sum up the procedure. You have to decide how much to contribute to the project by writing a number between 0 and 25 in the input field. By deciding how much to contribute you decide also how much you keep for yourself, that is to say: (25 – your contribution). After having written your contribution, you have to click on the OK button. Once you have done this, your decision can no longer be revised.

After all members of your group have made their decision, the computer will extract an even or odd number in order to decide whether or not a member group will be monitored. If it is decided to monitor a contribution in the group, another extraction will determine which member of the group will be monitored.

In case of monitoring, if the contribution of the monitored member is equal to the minimum contribution, her earnings will not be affected. If the contribution of the monitored member is lower than the minimum contribution, some tokens will be taken from her endowment. If the contribution of the monitored member is higher than the minimum required, some tokens will be added to her endowment.

The income screen

After this procedure, the following screen ('income screen') will appear:



On the income screen, you will see the sum of the contributions of the members of your group to the common project (including your contribution) and you will know if the contributions of a member of the group have been monitored or not.

The income screen shows you also your total income including the possible reduction or increase of tokens in case your contribution has been monitored. Notice that if your contribution is monitored, the other members of the group know that there has been a monitoring within the group but they do not know which specific person has been monitored. In the first two periods you have 45 seconds and in the remaining periods 30 seconds to see the income screen. If you have finished with it before the time is expired, please press the OK button.

B.1.2. Instructions for the second treatment (periods 11–20)

Instructions

Now you will participate to a second experiment. This second experiment is analogous to the first except for a change. The experiment lasts 10 periods as before. In each period you have to decide how much to contribute to a *common project*. At the beginning of each period your endowment is equal to 25 tokens.

The aim and the return from the common project does not change with respect to the first experiment.

The minimum contribution

Nonetheless there is a change with respect to the first experiment. In each period the minimum contribution required to the common project is now set up at the level of 20 tokens. The minimum contribution required will not change during the experiment, remaining the same (20 tokens) for all the 10 periods.

The monitoring

As before, in each period there is the possibility that the contribution of *one member* of the group is monitored. In particular, as before, for each subject the probability of being monitored in a certain period is equal to $\frac{1}{12}$ (about 8.33%).

What is the effect of the monitoring?

If the contribution of the monitored member is equal to the minimum contribution required, the monitoring will not have any effect on her earnings.

If instead the contribution of the monitored member is lower than the minimum contribution required, an amount of 1.2 tokens will be subtracted from her endowment for each token of difference between the minimum contribution and her actual contribution.

If instead the contribution of the monitored member is higher than the minimum contribution required, an amount of 1.2 tokens will be added to her endowment for each token of difference between the minimum contribution and her actual contribution.

Thank you for participating!

B.2. The lottery

Instructions

You are now taking part to a last experiment in which, depending on your decisions, you can earn an additional sum of money. We ask you not to talk with others until the end of the experiment. Hereafter the experiment is described in detail.

If you do not have perfectly understood the rules of the experiment, do not hesitate to ask for further explanations to the experimenters.

What is the income from the experiment?

In the experiment your income is calculated in tokens. At the end of the experiment, your income in tokens will be converted to euros at the rate of:

100 tokens = €1.

The income will be paid to you in cash together with the show up fee of €3 and the income gained in the previous experiment.

In this experiment you are not part of any group. Your decisions do not influence others' income and others' decisions do not influence your income.

What do you have to decide in the experiment?

Hereafter you will see a screen with a sequence of 5 choices you have to take. For each choice you have to indicate if you prefer a lottery A or a lottery B.

Let's give an example of the possible choice:

	Lottery A		**Lottery B**
CHOICE 1	70% 50 tokens	**or**	50% 90 tokens
	30% 200 tokens		50% 100 tokens.

Lottery A gives a gain of 50 tokens with a probability of 70% and a gain of 200 tokens with a probability of 30%. Lottery B gives a gain of 90 tokens with a probability of 50% and a gain of 100 tokens with a probability of 50%. You have to indicate if you prefer the lottery A or the lottery B.

You must take 5 choices, where each choice is between a lottery A and a lottery B.

How your earnings are calculated?

Once you have taken the five choices (and so indicated five lotteries, one for each pair A-B), the computer will randomly extract one of the five lotteries you have chosen. At this point, given the chosen lottery, the computer will extract your gain accordingly to the probability indicated by this lottery.

Example. Suppose the computer extracts the following lottery (one of those you have chosen):

60% 100 tokens

40% 180 tokens.

At this point the computer will extract your gain from the experiment: with a probability of 60% it will extract a gain of 100 tokens, whereas with a probability of 40% a gain of 180 tokens.

The equivalent in euros of your gain will be paid to you in cash at the end of the experiment together with the show up fee (€3) and your income from the previous experiment.

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