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Does Aversion to the Sucker's Payoff Matter in Public Goods Games?

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Abstract: A usual explanation to low levels of contribution to public goods is the fear of getting the sucker's payoff (cooperation by the participant and defection by the other players). In order to disentangle the effect of this fear from other motives, we design a public good game where people have an assurance against getting the sucker's payoff. We show that contributions to the public good under this 'protective' design are significantly higher and interact with expectations on other individuals' contribution to the public good. Some policy implications and extensions are suggested.

Key-words: Experiments; Public good; Sucker's payoff; Assurance.

JEL codes: C72; C91; H41.

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Do Aversion to the Sucker's Payoff Really Matter in Public Goods Games?

I. Introduction and motivation

A frequent explanation of low levels of contributions in public good games is the individual fear of getting the so-called sucker's payoff or outcome, that occurs when the individual contributes while the other player defects. In order to disentangle the effect of this aversion from other factors on the level of contributions, we design a public good game where participants are partially assured against defection by other players. *In other words, does the provision of an assurance mechanism lead to higher levels of contribution to public goods and to what extent?* We report two main results. First, there is a significant effect of aversion to the sucker's payoff on overall contribution to public goods. Implementing an assurance mechanism has a positive impact on the individual's contribution. Second, the role of expectations of other individuals in the group in explaining contributions interacts with the existence of an assurance device. Expectations have a negative principal effect on contribution but a positive effect in interaction with the *Assurance* treatment.

The remainder of the paper is organized as follows. Section II reviews the relevant literature. Section III describes the experiment and stipulates the theoretical predictions. Section IV presents and discusses the results. Section V concludes and provides some policy implications.

II. Related literature

The aversion to the sucker's payoff has been notably introduced in the analysis of public goods with threshold effects. In this case, the agent does not contribute for the production of a public good because he fears that the good will not be produced because too many other players will defect. Given that the production of the public good requires a minimum level of contributions, if the contributions are insufficient, the good will not be produced and the individual thinks he squandered his contribution (Sen, 1967; Runge, 1984; Schmidtz, 1991). While this aversion is exacerbated in the case of public goods with threshold effects, we contend that it remains an impediment to higher contributions, even where there is no threshold effect. In a survey, Rapoport and Chammah (1965) showed that cooperation rates in prisoner's dilemmas increase when the 'sucker' payoff decreases. Using experimental games, Fehr and Gachter (2000) demonstrate that people are willing to punish free-riding, even if it is costly for them in order to avoid getting the sucker's outcome. Nevertheless, the contribution level to public goods when a partial assurance mechanism is implemented has not been investigated. Rather than advocating for assurance schemes from a theoretical viewpoint (e.g., Schmidtz, 1991), we question their effectiveness to improve the funding of public goods.

III. Experimental Design and Implementation

Basic design

In treatment *Reference*, subjects are endowed with 20 tokens they allocate between a private investment which earns one euro per token and a public investment which earns 0.4€ per token as in any standard public good experiment. Given other players' contribution c_{-i}, player i chooses the level of contribution c_i that maximizes the following payoff function:

$$u(c_i, c_{-i}) = 20 - c_i + 0.4\sum_{k=1}^{n} c_k = 20 - 0.6c_i + 0.4c_{-i}.$$

In treatment *Reference*, the Nash equilibrium is to contribute nothing and the social optimum to contribute all the endowment. The reason for low contributions may lie in free riding behavior but also in the aversion to the sucker payoff. To distinguish these effects, we design a second treatment.

In treatment *Assurance*, subjects have the same payoff function as in *Reference* except that another payoff function (alternative payoff) substitutes to it if the contribution of the other players in the group is too low. Given other players' contribution c_{-i}, player i chooses the level of contribution c_i that maximizes the following payoff function::

$$v(c_i, c_{-i}) = Max\ [(20 - 0.6c_i + 0.4c_{-i});(20 - 0.3c_i)\ ].$$

The Nash equilibrium of this game is still to contribute nothing and the social optimum to contribute all. However, the worst payoff for player i that is to be the only one to contribute ("sucker's payoff") is now relatively better, $v(c_i, 0) = 20 - 0.3c_i$. In treatment *Reference*, this worst payoff was $u(c_i, 0) = 20 - 0.6c_i$.

Predictions

Figure 1 displays (i) in plain lines, the payoff of player i as a function of his own contribution and depending on the contribution of the three other players and (ii) in dotted lines, the alternative payoff of player i as a function of his own contribution.

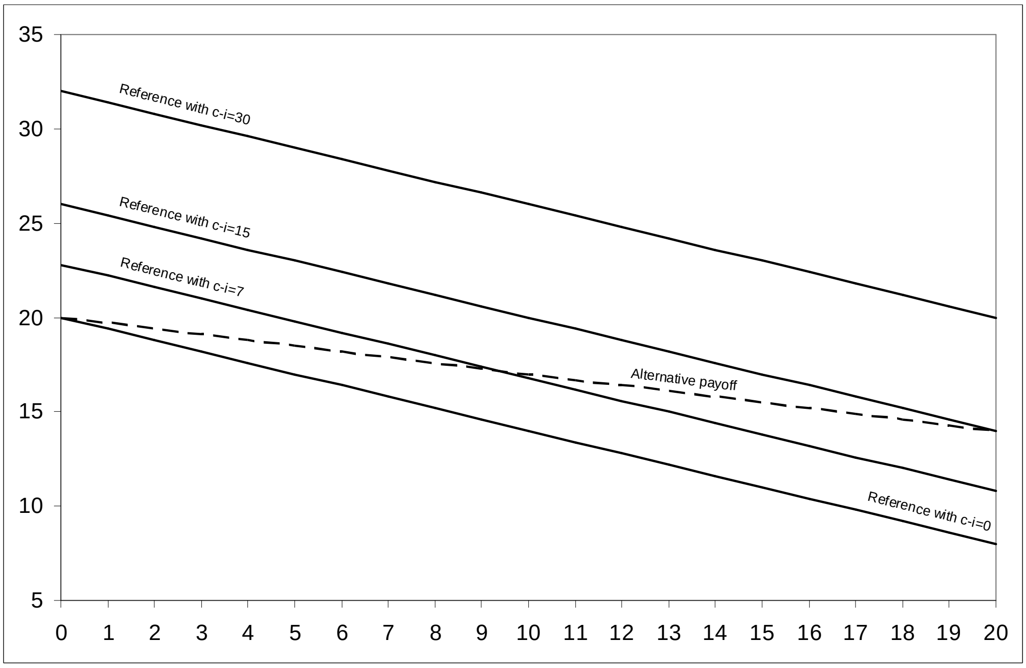

Figure 1. Player i's payoff as a function of his own contribution in treatment *Reference* (with increasing levels of contribution of the three other players) and in the alternative payment scheme (dotted line)

First, notice that all the payoffs functions in treatment *Reference* have the same slope (-0.6) and are upward shifted with an increase of the other players' contributions. Second, notice that the alternative payoff scheme has a negative lower slope of -0.3 and is independent of the other players' contribution. In other words, it constitutes a partial and imperfect assurance mechanism against non or too weak contributions by other players. Third, in the *Reference* treatment, we clearly see the Nash equilibrium for player i: whatever the contribution of the other players, payoff is maximized for a zero individual contribution.

Several cases appear revealing player i's strategy in *Assurance* as compared to *Reference* treatment:

When $c_{-i} = 0$, the alternative payoff is always higher than the *Reference* payoff. If player i has an aversion to the sucker payoff, then contributions should be higher in the *Assurance* treatment as compared to the *Reference* treatment.

When $c_{-i} \geq 15$, the payoff of player i in the *Reference* treatment is always higher than the alternative payoff. Thus, whatever the contribution of the other players, player i should display the same type of strategy in the *Assurance* and *Reference* treatments.

When $0 < c_{-i} < 15$, the lines representing the *Reference* payoff and the alternative payoff cross each other. If player i is a relatively big contributor to the public good ($c_i > 4/3 c_{-i}$), then the *Assurance* treatment provides higher payoffs than the *Reference* treatment. However, if player i is a relatively small contributor ($c_i \leq 4/3 c_{-i}$), the *Assurance* treatment is equivalent to the *Reference* treatment. In a "homo economicus" model, assurance should play no role even when 0<c-i<15. Non contribution is still the dominant strategy. However, with other models of behavior, Assurance will play a role. What effect can be predicted? If individuals have a reciprocal behavior, they contribute more when they expect others to contribute more. By providing an assurance against the sucker payoff, assurance is expected to increase contributions. If individuals are altruistic, it means that contributions decrease when expectations of others increase (crowding out). The assurance mechanism should induce individuals to expect other individuals contribution will be higher and thus should trigger the negative correlation between contributions and expectations.

IV. Experimental results

We first present the sample and the sessions, then some summary statistics and finally the econometric results.

Sample and sessions

The experiment has been performed at the ENGREF (Nancy, France) and gathered a sample of 64 students. Subjects were randomly distributed among groups of four players. In each session, there were 4 groups. There were two sessions per treatment.

Table 1. Organized sessions

Session	Treatment	Number of groups	Number of participants
1	Reference	4	16
2	Reference	4	16
3	Assurance	4	16
4	Assurance	4	16

Sample statistics

The average group contribution is 22.625 tokens (standard deviation: 18.226) for the *Reference* treatment and 27.863 (stander deviation: 15.532) for the *Assurance* treatment. Figure 2 gives a box plot representation of group contributions and reveals a higher median for the groups in the Assurance treatment. A two-sample Wilcoxon rank-sum test is performed to test for a difference of distribution of group contributions between the two treatments. The results suggests group contributions were higher in the Assurance treatment at a 1% significance level (z= -6.258).

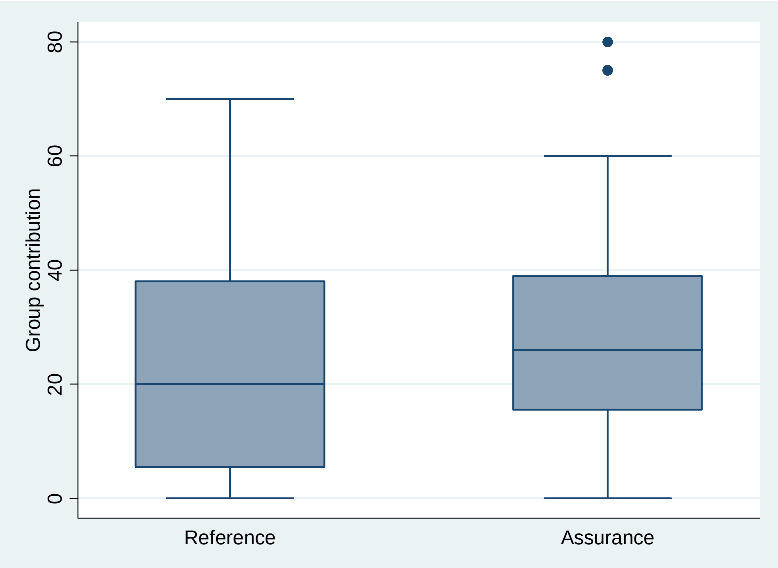

Figure 2: Box plot of group contribution as a function of the treatment

The statistical analysis does not take into account the panel structure of the data. We take it into account in the econometric analysis.

Econometric results

Our data displays a panel structure. Moreover, we are interested in time-invariant variables such as the treatment. We thus use a random effect model.

$$c_{it} = \alpha_0 + \alpha_1 Assurance + \alpha_2 E(c_{-i})_{it} + \alpha_3 Period + \sum_{k\neq 1} \alpha_{4k} Group_k + e_{it}$$

The dependent variable is an individual i's contribution to the public good in period t (c_{it}). Independent variables are the treatment dummy variable (*Assurance*) equal to one if the treatment is the Assurance treatment, an individual i's expectations on what the other three individuals in his group will contribute in the same period t ($E(c_{-i})_{it}$), the period number

(*Period*), and an indicator variable for each group minus one (*Group*). Table 3 presents summary statistics for the dependent and independent variables.

Table 3. Meanings and statistics of variables used in the regression analysis

Variable	Description	Nb. Obs.	Mean (SD)
c_{it}	Individual i's contribution to the public good	1280	6.311 (6.732)
Assurance	Dummy (=1 if *Assurance* treatment and 0 otherwise)	1280	0.500 (0.500)
Expectations $E(c_{-i})_{it}$	Individual i's expectations on what the other three individuals in his group will contribute in period t. Three proxies are used:		
	• <u>Actual</u>: Actual contribution of the other three individuals in i's group (c_{-i})	1280	18.933 (13.856)
	• <u>Myopic</u>: Expected average contribution at period (N+1) is the contribution at period N	1216	19.354 (13.894)
	• <u>Non-myopic</u>: Expected average contribution at period (N+1) is equal to (N-1) times the average contribution at period (N-1) plus the average contribution at period N divided by N.	1152	19.658 (13.486)

Individual i's expectations on others' behavior is unobservable. Thus, we use three proxies for the variable $E(c_{-i})_{it}$ (as in Cason and Gangadarhan, 2002 or in Croson, 2007). We consider that player i updates his beliefs on others' behavior on a period by period basis. In the actual computation method, we simply use the actual contribution of other players in the group as a proxy for individual i's expectations. In the myopic computation method, player i takes account only of the last period without considering the preceding periods. In the non-myopic computation method, player i updates his beliefs in period (N+1) by a weighted mean where the behavior of others in period (N-1) is projected on periods 1 to (N-2). The econometric results for all individuals are presented in Table 4. We have introduced an interaction effect between the treatment and the expectations.

Table 4. Random Effect Regression of individual i's contribution to the public good for all individuals

Proxy for expectations	**Actual**	**Myopic**	**Non Myopic**
Assurance	8,069	2,122	7,014
	(7,63)***	(2,17)***	(6,23)***
Expectations	-0,136	-0,097	-0,176
	(4,91)***	(3,39)***	(5,68)***
*Assurance*Expectations*	0,068	0,074	0,135
	(2,13)**	(2,24)**	(3,79)***
Period	-0,401	-0,358	-0,391
	(12,32)***	(10,28)***	(10,49)***
Dummies for group (not reported here)			
Constant	6,905	6,100	6,993
	(8,90)***	(7,47)***	(8,21)***
Nb obs.	1280	1216	1152
Adj-R2	0.6158	0.5827	0.6349

From table 4, we see that the *Period* has always a negative effect on individual contributions. It is a common result in experimental data. The data analysis shows a positive effect of the principal effect of *Assurance* treatment. The alternative payoff provides participants with an assurance against the risk of getting the sucker's payoff. Individuals are averse to the sucker's payoff. The principal effect of expectations is negative, although small. According to the analysis performed by Croson (2007), this negative correlation associated with positive levels of contributions reveals altruism on the part of participants. There is a crowding out effect. When participants expect high contributions from others in the group, they will decrease their contribution to the public good. Given such behavioral patterns, we predicted an increased negative effect of expectations in the Assurance treatment. However, the interaction effect between the *Assurance* treatment and the expectations is positive, although small. When the treatment has an assurance device against the sucker payoff, higher expectations will lead to higher contributions.

V. Conclusion

We examined the effect of the aversion to the sucker's payoff on contribution to public goods, using experimental games. Our results confirm that the aversion to the sucker's payoff plays a significant role in explaining contribution to public goods. Implementing an assurance mechanism plays a direct positive role on the individual's contribution and a positive indirect role through the individual's expectations on other's contribution.. When the expected cooperation rate is relatively high, the assurance scheme reinforces the positive role of expectations.

Moreover, our study has limitations that open room for several extensions. For example, our assurance mechanism was partial and we do not investigate how different levels of assurance (from 0 assurance to full assurance) can impact on overall contribution to public goods with respect to the anticipated cooperation rate. An additional extension relates to the effect of heterogeneous agents (e.g. big and small contributors to public goods) on the functioning of assurance schemes. Moreover, in real life, assurance mechanisms can correspond to various devices that are likely to impact differently on contributions. We contend that people may, regardless from the end-outcome, extract 'procedural' utility from the way the assurance scheme is functioning. For instance, the common knowledge of the presence of a sufficient portion of individuals willing to contribute to the public goods, regardless of others' contributions in the population can provide a natural 'assurance mechanism' preventing to some extent the aversion to the sucker's payoff in a different way when compared to a formal contract reimbursing people in case of insufficient overall contributions.

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