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Abstract

Conservation policies provide strong incentives to farmers to contribute to the environmental protection. One concern of such policies is to *create* and/or *maintain* a variety of valuable public goods. One main difference between creating and maintaining public good is that farmers are asked to create resources in the first policy, while in the other, they have to maintain unchanged an existing level of resources. While conservation policies indifferently aim at both creating and maintaining a variety of public goods since they provide similar incentive for both policies, it is possible that farmers behave differently in the two contexts. This paper aims at testing this framing effect. The originality of our approach is to combine both framing and threshold dimensions by comparing maintaining and creating contexts using threshold public goods experiments. First, the *creating* treatment corresponds to a classical Voluntary Contribution Mechanism whereas the *maintaining* treatment corresponds to a setting where all tokens are initially placed in the public investment and subjects can withdraw tokens. Second, we test for this hypothesis in the case of Provision Point Mechanism experiments with three different threshold levels. The results are that first, consistent with theoretical predictions, contributions rise with threshold level, with exception for the highest level. Second, individuals tend to be less cooperative in the maintaining frame rather than in the creating frame. Finally, framing effects seem to be more effective under higher threshold levels. Important consequences of these results can be found for the management of agri-environmental resources.

Key words: Public good experiment, threshold, framing effects, conservation policies

JEL Classification: H41, Q18, Q5, C92

Créer ou maintenir un bien public avec seuil dans les politiques agri-environnementales

Résumé

Les mesures agri-environnementales mises en œuvre par de nombreux pays visent à rémunérer les agriculteurs pour le maintien ou même la création de ces biens. Cette distinction entre *maintien* et *création* apparaît souvent dans l'exposé des motivations de ces politiques.

Par exemple, le site de la Commission Européenne indique que l'agriculture "a contribué à travers les siècles à créer et entretenir toute une gamme d'habitats semi-naturels précieux". Ce projet vise à montrer que cette distinction n'est pas anodine. Nous supposons ici que le comportement des agriculteurs vis-à-vis du maintien ou de la création d'un bien non marchand va sans doute différer. Nous nous appuyons pour cela sur des travaux d'économie expérimentale montrant le rôle du contexte quand il s'agit de contribuer à un bien public. La contribution la plus significative étant celle d'Andreoni (QJE, 1995) qui déduit de son protocole que les individus semblent contribuer plus lorsqu'il s'agit de créer un bien public que lorsqu'il s'agit de le maintenir. Les sujets se comportent comme s'ils préféraient faire du bien aux autres plutôt que de ne pas leur faire du mal. Notre premier apport consiste à vérifier ce résultat de manière directe avec un protocole modifié. Par ailleurs, nous croisons l'effet de contexte avec l'existence de non-linéarité dans la production du bien public. De nombreux auteurs se sont intéressés aux biens publics avec seuil. Néanmoins, il n'y a pas à notre connaissance de papier qui croise effet de contexte et niveau du seuil. Notre second apport consiste donc à vérifier l'hypothèse d'Andreoni (1995) en présence de non linéarités. Nous montrons (1) que conformément aux prédictions théoriques, les contributions augmentent avec le seuil, excepté pour le niveau de seuil le plus élevé, (2) que les individus sont moins coopératifs dans le maintien d'un bien public que dans sa création, et enfin, (3) que ce dernier effet augmente avec le seuil. Des implications importantes sont dérivées quant à la mise en œuvre des mesures agri-environnementales.

Mots-clés : Bien public, économie expérimentale, seuil, effet de contexte, agri-environnement

Classification JEL : H41, Q18, Q5, C92

Creating vs. Maintaining Threshold Public Goods in Conservation Policies

1. Introduction

Conservation policies provide strong incentives to farmers to contribute to the environmental protection. Most conservation policies are based on the individual efforts of farmers and pay them individually for maintaining or changing their practices. These policies are designed to compensate farmers for specific agri-environmental measures. For example, policies such as the EU agri-environmental schemes or the US Fish and Wildlife Service and non-profit land trusts give private landowners or land-operators the opportunity to enroll in a conservation program. Whereas policies often try to modify individual behavior of farmers, environmental degradation is often linked to the interaction between farmers in a given area. Moreover the program environmental efficacy often depends on the total number of enrolled acres. For example, some species need a minimum area for their habitat that often falls across private boundaries of individual farms. As for hedgerows, they not only provide a shelter for associated species, but also act as a corridor between other habitats. As such, they also fall across private boundaries of individual farms.

In order to overcome these limitations, some policies, although scarce, have been designed on the environmental results (some schemes in the UK, in Holland and in Switzerland) rather than on the efforts of farmers. When policies are objective oriented, farmers who are enrolled in a conservation program are paid only if they adopt practices that lead to the objective set by the program. In other words, it means that farmers in a given area are paid only if the program leads to environmental improvement (Parkhurst et al., 2002; Muradian, 2001; Wu and Boggess, 1999). Landscape enhancement in a given area becomes visible as a result of individual efforts of a group of farmers to plant and maintain hedgerows for example. Payment for conservation becomes then a threshold public good for farmers. In economic terms, this phenomenon corresponds to nonlinearity in the function linking the sum of environmental efforts of farmers and environmental impacts.

One concern of these environmental policies is to *create* and/or *maintain* a variety of valuable public goods. Numerous policies aim at reducing negative externalities of farming such as water pollution or at encouraging positive externalities such as hedgerows maintenance (biodiversity). One main difference between creating and maintaining policies is that farmers are asked to create resources in the first policy, while in the other, they have to maintain unchanged an existing level of resources. To differentiate between creating and maintaining a

public good, take the example of a program aimed at conserving ponds on agricultural land[1]. The program describes its objectives and targets as (1) to return existing ponds to favorable condition through promotion of appropriate management and (2) take opportunities to create new ponds where appropriate. On the one hand, the program aims at encouraging farmers to maintain existing ponds so that their valuable habitat is protected. On the other hand, it sets an objective of creating new ponds. Formally, the creating context is related to public good experiments in which each individual member of a group has an opportunity to "create resources" by contributing any fraction of his/her initial endowment to a "group account". (see Ledyard, 1995, for a survey). The total amount of resources that all agents contribute is multiplied by a factor greater than 1 and then divided equally between all of the members of the group. Each individual has a dominant strategy to allocate zero to the group account, whereas the highest group payoff is reached if all members contribute their entire endowment to the group account. The main overall pattern observed in laboratory experiments is that subjects tend to contribute more in the public good compared to theoretical predictions (Isaac et al., 1984; Andreoni, 1988; Isaac and Walker, 1988a; Ledyard, 1995)[2]. Whereas the level of contribution can be interpreted in term of a "creating context", the situations of maintaining resources including open-sea fisheries, ground water basins or forest biodiversity are more related to Common Pool Resource (CPR) situations. In a CPR experiment, a finite number of individuals are given an initial endowment they can allocate between resource extraction activities and an alternative activity. The total revenue obtained from resource extraction depends on the total amount allocate in this activity. Theoretical predictions of this simple game are that unrestricted accesses to CPR lead individuals to withdraw more of the resources than is Pareto optimal. As a consequence, human over-exploitation of the resources can lead to destruction of the common resources. Results from common pool experiments are compatible with theoretical predictions, showing that individuals decisions rapidly converge toward Nash equilibrium (Ostrom et al., 1994). These results contrast sharply with those obtained in public good experiments despite similar theoretical predictions.

While conservation policies indifferently aim at both creating and maintaining a variety of public goods since they provide similar incentive for both policies, individuals behave differently in the two contexts. One possible reason is that individuals may be influenced by a

[1] See for example:
http://www.wirral.gov.uk/LGCL/100006/200029/745/content_0000618.html

[2] Initial contributions are substantial, but decline as the game is repeated and cooperation converges to a near-negligible level in the long run.

pure framing effect and may perceive that creating resources would induce more positive externalities than maintaining. The aim of this study is to experimentally investigate this pure framing effect in the context of a public good experiment with threshold. In particular, we examine to what extent individuals behave differently under a positive context (creating) and a negative (maintaining) context. This is done by comparing two public good games with identical theoretical predictions but with different frames called maintaining and creating frames. The originality of our approach is to combine both framing and threshold dimensions. We design several treatments varying in two dimensions based on public good games. First, the *creating* treatment corresponds to a classical Voluntary Contribution Mechanism (VCM) whereas the *maintaining* treatment corresponds to a setting where all tokens are initially placed in the public investment and subjects can withdraw tokens. Second, we test this hypothesis in the case of Provision Point Mechanism (PPM) experiments with three different threshold levels.

Our analysis is related to Andreoni (1995) who investigated to what extent this difference could be due to the fact that subjects are asked to generate positive externalities in a public good experiment whereas subjects generate negative externalities in a common pool experiment. The author examined the effects of positive and negative frames on cooperation by comparing a standard public good game, called positive frame condition, with a negative frame condition where subjects' choice to purchase a private good makes the other subjects worse off. The results of the experiment indicate that subjects contribute more under the positive frame condition, despite similar incentives in both games. Willinger and Ziegelmeyer (1999) replicated Andreoni's results in the case of an interior solution and found similar results. Our analysis builds on the work of Andreoni (1995) with the notable exception that first we compare creating and maintaining situations in a more direct manner by explicitly placing all tokens in the private account in one treatment and all tokens in the public account in the other, and secondly that we test whether Andreoni's proposition hold in the context of a PPM.

Formally, in a standard provision point experiment, participants in a group are given an initial endowment they can allocate to the group account, knowing that the good will be provided only if contributions reach a threshold. The PPM has multiple efficient Nash equilibrium where the cost of the public project is exactly covered. The empirical evidence from experiments indicate that the effect of increasing the threshold is not clear-cut. Indeed, some studies found no significant differences between PPM and VCM (Asch et al., 1993) whereas some other reported significant and positive effects from a PPM (Isaac et al., 1989). Isaac et

al. have tried to solve this apparent contradiction by suggesting the existence of two opposite effects induced by the existence of threshold: the focal point and the assurance effects. According to the *focal point assumption*, contributions should be higher under the PPM because the provision point serves as a focal point for individual decisions. The opposite effect, called *assurance effect*, conjectures that contributions will be lower in PPM since subjects are risk averse and would prevent from large penalties imposed by other participants who would withdraw a small amount of money. In the context of creating and maintaining situations, we conjecture that the assurance effect should dominate in the maintaining treatment as compared to the creating treatment when the threshold increases. Indeed, when the threshold is high, the risk of wasting contributions is particularly high in the maintaining treatment since small departures from equilibrium contributions can lead to high losses. As a consequence, we should expect higher differences between creating and maintaining contexts when the threshold level increases.

To anticipate our results, we found that individuals tend to be less cooperative in the maintenance frame rather than in the creating frame, which is consistent with previous other results. Second, consistent with our assumptions, we found that subjects contribute even more under the creating treatment when the threshold increases compared to maintaining treatment, suggesting that the framing effects are stronger under higher threshold levels. Finally, our results show that contributions rise with threshold level, (with exception for the highest level), which is consistent with some previous studies on PPM.

The paper is organized as follows. Section 2 briefly surveys the literature on framing and threshold public good experiments. The treatments, as well as other procedural details of the experiment, are described in more detail in section 3. The results of the study are presented in section 4. Section 5 contains our concluding remarks.

2. Related literature and propositions

As such, the objectives of the paper strongly relate to the literature on the endowment effect. The endowment effect describes the fact that people value more goods they possess than they are willing to spend to acquire those (Thaler, 1980). This phenomenon has largely been shown to be an observed regularity in experimental contexts. Rather high discrepancies between willingness to accept (WTA) and willingness to pay (WTP) have been reported in the literature for many years now. For example, Kahneman et al. (1990) report that they distributed coffee mugs to half the students in a classroom so that half were owners and the

other half non owners. The authors then elicited owners' willingness to accept to give up their mug and non owners' willingness to pay to acquire a mug. The results show that WTA was about twice as high as WTP. Many papers have since confirmed such results (Kahneman et al., 1991). The endowment effect has mostly been studied in market contexts. Few papers dealt with this phenomenon in a public good game context. Yet many factors argue in favor of considering such a setting. For example, in the perspective of contributing to the debate over the substitution vs. endowment effect, López and Nelson (2005) argue that a public good game setting allows controlling for substitution effects. Although we do not aim at answering such questions, we also use a public good context. We focus on the implications of such phenomenon in the environmental policy field where public goods either (1) have been destroyed and are restored or (2) exist and are protected. In situation #1 the environmental good does not exist and individuals invest to provide it whereas situation #2 relates to an environmental good being commonly owned and protected. Situation #1 relates to what we will call a Creation setting whereas situation #2 relates to a Maintenance setting. Revealing the existence of this difference is important since understanding the behavior of agents in these two situations allows giving the appropriate incentives for the protection and/or restoration of environmental goods.

Andreoni (1995) provided a significant contribution for our discussion. The author observed that in VCM environments, people tend to cooperate more than in Common Pool Resource environments. This led the author to propose the following explanation. In VCM, people benefit externalities from other participants' contributions whereas in common pool resource, people suffer from externalities from other participants' use of the resource. Andreoni (1995) designed a public good experiment with two frames. Five subjects are endowed with tokens that they may allocate between a private and a group account. The positive frame corresponds to the standard public good game with a 60-token endowment where individual contributions to the public good yield a positive externality on other subjects. The payoff of player *i* is: $u_p(x_i) = x_i + \frac{1}{2} g_i + \frac{1}{2} \sum_{j \neq i} g_j$ where $e_i = g_i + x_i = 60$ with e_i, player *i*'s endowment, x_i, player *i*'s contribution to the private account, g_i, player *i*'s contribution to the public account and g_j, player *j*'s contribution to the public account. The negative frame endows subjects with $e_i = 60$ tokens and an automatic earning of 120 tokens per period (independent of their choices) and tells subjects that each token they invest in the private account will reduce the

earnings of the other players (contributions to the private good yields a negative externality on other subjects). The payoff of player *i* is: $u_n(x_i) = x_i + \frac{1}{2}g_i - \frac{1}{2}x_j + \frac{1}{2}\sum_{j \neq i} e_j$ where $e_i = 60$ and $\frac{1}{2}\sum_{j \neq i} e_j = 120$. The result of the paper is that cooperation is improved in the positive externality context as compared to the negative externality context. Thus, according to the author, *"it must be that people enjoy doing a good deed more than they enjoy not doing a bad deed"* (Andreoni, 1995, p. 11).

At this point, we must stress that Andreoni's objective was to compare positive and negative externality frames. His protocol enables to discuss the endowment effect in a public good setting but the author did not test it directly since in the negative frame, tokens were not placed in a public account and moved to a private account. As stated by Andreoni (1995, p. 6), "*the original positive-frame experiments suggest that the game is beginning with all the tokens already placed in the private good [...] and by moving them to the public good all can be better off. In the negative-frame condition, the opposite is true. The frame suggests that subjects are endowed with their opponents' tokens in the public good, that is the 120 of automatic earnings, which will be eroded only if subjects move the tokens to the private good*". The negative frame treatment behaves as if all tokens were initially in the public account. The 120 period-by-period automatic earning was manna from the experimenter and did not come from a group account (although the experiment behaved as if tokens were in the public account). In this paper, our first objective is to test for Andreoni's proposition in a more direct manner. Our work is distinct in that we explicitly place all tokens in the private account in one treatment and all tokens in the public account in the other so that we can directly test for the endowment effect in a VCM environment. As stated earlier, López and Nelson (2005), in order to answer a question different from ours, compare the two treatments and find that subjects contribute more in the treatment where all tokens are initially in the private account. Thus, we test for the following proposition:

Proposition 1: *Subjects will contribute more to the public good when all tokens are initially placed in the private account than when all the tokens are initially placed in the public account.*

The second objective of the paper is to consider whether such proposition hold in the case of a PPM setting. The literature on discrete public goods (public goods that are provided only if a threshold is met) is vast and divides into two main branches. In threshold public good games, if more money is contributed than is necessary for provision, it is lost to the contributors, but has no effect on the level of utility associated with provision (Cadsby and Maynes, 1999; Rapoport and Eshed-Levy, 1989; Bagnoli and Lipman, 1989; Van de Kragt et al., 1983; Palfrey and Rosenthal, 1984). In PPM, a public good is provided in an amount increasing with the aggregate level of contributions as long as a specified provision-point is met (contributions above the provision point are not wasted, but result in further group benefit) (Marks and Croson, 1998; Isaac et al., 1989). Most of the preceding experimental research deals with comparing contributions to public goods with and without a threshold and revealing the underlying motivations while later work considers the effect of threshold uncertainty on contributions (Nitzan and Romano, 1990; Suleiman, 1997; McBride, 2006a, 2006b).

The PPM can be formalized as a large N person coordination game as it is shown by Bagnoli and Lipman (1989). The game has multiple efficient Nash equilibrium where the cost of the public project is exactly covered. Let us turn now to the varying threshold levels in PPM settings. Several authors have studied the effect of increasing threshold levels. Isaac et al. (1989) use three provision point levels: a high (248), a medium (216) and a low (108) level which correspond to respectively 100%, 87% and 44% of total tokens endowed in the group. The effect of increasing the threshold is not clear-cut. Asch et al. (1993) find that contribution levels were similar in PPM and VCM[3]. In contrast Isaac et al. (1989) report that when compared with a VCM, a PPM improves cooperation in early periods (focal point hypothesis), but does not succeed in increasing overall contributions (assurance problem). In fact, Isaac et al. (1989) tested for two hypotheses. Under the focal point hypothesis, contributions are higher for the PPM as compared to the VCM since *"the provision point is common knowledge and should serve as a focal point for individual decisions"* (Isaac et al, 1989, p. 223). In contrast, under the assurance problem conjecture, contribution will be lower in PPM since *"small departures from equilibrium contributions by other participants can impose large penalties upon those attempting to contribute enough to obtain high provision equilibria"* (Isaac et al, 1989 p. 223). Thus, the following proposition to compare VCM and PPM:

[3] In a different environment (with a money back guarantee and a proportional rebate rule), Rondeau et al. (1999) find that the PPM is generally superior to VCM in terms of efficiency.

Proposition 2a: *If the focal point hypothesis dominates, one should observe that subjects contribute more to the threshold public good than to the standard public good. In contrast, the reverse is observed if the assurance problem dominates.*

We are aware of no paper comparing the effect of a Creation vs. a Maintenance treatment in a threshold public good setting. If we turn back to the focal point vs. assurance hypothesis (proposition 2a), we expect the assurance effect to dominate in the maintaining treatment as compared to the creating treatment when the threshold increases. Indeed, when the threshold is high, the risk of wasting contributions is particularly high in the maintaining treatment since small departures from equilibrium contributions can lead to high losses. That is because of one individual's withdrawal, payoffs of all the members in the group can collapse. Indeed, some participants may be willing to withdraw money to prevent themselves from such risk. Thus, the following proposition conjectures about the different behaviors that should be observed in the creating and in the maintaining contexts:

Proposition 2b: *Subjects will contribute all the more in the creating treatment as compared to the maintaining treatment when the threshold level increases.*

Finally, the third objective of the study is more methodological. It relates to an observation we made that the experimental literature on standard public good games reports two kinds of protocols. In a first protocol (called "allocation protocol"), subjects are asked to allocate a given number of token between a public investment and a private investment. This protocol is reported by Isaac et al. (1984) who state *"participants faced the decision of allocating [tokens] between an individual exchange (private good) and a group exchange (public good)"*. But also by Andreoni (1988) who tells subjects: *"Your task is to decide how many of your tokens to invest in the Individual Exchange and how many to invest in the Group Exchange. You are free to put some tokens into the Individual Exchange and some into the Group Exchange. Alternatively, you can put all of them into the Group Exchange or all of them into the Individual Exchange."* In a second protocol (called "endowment protocol"), subjects are endowed a given number of tokens and asked to allocate part of the endowment in a public account. For example, Palfrey and Prisbrey (1997, p.844) use the following instructions: *"each round of the experiment you will have nine tokens. You must choose how many of these tokens you wish to keep and how many tokens you wish to spend"*. Andreoni

(1993) also use a protocol where subjects are first endowed with an amount of tokens, a proportion of which they can invest in the group account. In line with the endowment effect literature, we expect these two protocols to lead to different behaviors. Thus, the following proposition:

Proposition 3: *People will contribute less to the public good in the endowment protocol than in the allocation protocol.*

3. Experimental design

3.1. Treatments

Our experimental design consists of two main settings[4]. The Creation setting refers to a standard public good game where all tokens are in the private account. Four subjects are endowed with 20 tokens. We consider a high (T=80), medium (T=60), low (T=28) and zero (T=0) threshold level. In provision point settings, the good is provided only if contributions reach a threshold. Excess contributions enable to get a higher level of public good according to a given linear function. The payoff function of participant i contributing c_i to the public account is the following:

$$\begin{cases} u(c_i) = 20 - c_i + 0.4\sum_{k=1}^{4} c_k & \text{if } \sum_{k=1}^{4} c_k \geq T \\ u(c_i) = 20 - c_i & \text{if } \sum_{k=1}^{4} c_k < T \end{cases} \quad (1)$$

where c_i is the contribution of player i, 20 is the initial endowment of each agent. The marginal return of the public good is 0.4. So each ECU (Experimental Currency Unit) contributed to the group account yielded a payoff of 0.4 ECU to each of the four members of the group. Each ECU not contributed by the subject was credited to the subject's private account.

The second setting is called the Maintenance setting and corresponds to a public good game where all tokens (80) are in the group account. Four subjects are allowed to withdraw up to 20

[4] The instructions for the experiment can be found at http://perso.univ-rennes1.fr/david.masclet/

tokens from the group account. We also consider four threshold levels (80, 60, 28 and 0). The payoff function of participant i withdrawing w_i from the public account is the following:

$$\begin{aligned} u(w_i) &= w_i + 0.4\times\left[80-\sum_{k=1}^{4} w_k\right] \quad \text{if } 80\text{-}\sum_{k=1}^{4} w_k \geq T \\ u(w_i) &= w_i \quad \text{if } 80\text{-}\sum_{k=1}^{4} w_k < T \end{aligned} \tag{2a}$$

Which is equivalent to

$$\begin{aligned} u(w_i) &= w_i + 32 - 0.4\sum_{k=1}^{4} w_k \quad \text{if } 80\text{-}\sum_{k=1}^{4} w_k \geq T \\ u(w_i) &= w_i \quad \text{if } 80\text{-}\sum_{k=1}^{4} w_k < T \end{aligned} \tag{2b}$$

The equilibria in both settings are the same. It is easily seen from (1) that individual *i*'s earnings are maximized at $c_i = 0$ in the case where T=0 (i.e. without threshold). Therefore, if the game is played once, there is a dominant strategy to contribute zero. If the game is finitely repeated, the only subgame perfect equilibrium of the game is for all players to contribute zero in each period. Respectively, in the maintaining context, all subjects should withdraw all their 20 tokens from the group account.

Let's consider now the theoretical predictions of threshold games with T>0. Threshold games have multiple Nash equilibria in which the level of threshold is exactly allocated to the group account. No equilibrium can exist in which more than T tokens are so allocated; Each player would prefer to keep the extra tokens and invest them in her or his private account. In the low threshold game, all combinations totalizing 28 are equilibriums provided subjects contribute strictly less that 12 tokens: (7, 7, 7, 7) (6, 8, 7,7)…. (10, 10, 4, 4). The medium threshold game (T=60) also includes several equilibria totalizing each 60 tokens. In the high threshold game (T=80), there are two equilibria: (20,20,20,20) and (0,0,0,0). Symmetric equilibria are obtained in the maintaining situations.

Finally, we also conducted an additional setting called Allocation setting that is an intermediate setting between creation and maintenance. Indeed, in the Allocation setting, subjects are neither endowed with an initial endowment neither asked to withdraw tokens

from a group account but rather asked to allocate a given number of token between a public investment and a private investment.

3.2. Participants and sessions

The experiment consisted of 19 sessions. We ran a within subjects design where the same subjects play the creating and maintaining settings. To control for order effects, we ran half the sessions in one order and the other half in the other order. Thus, in each session, there are 30 periods of interaction, divided into two segments of 15 periods. All of the sessions were conducted at the LABEX, at the University Rennes I, Rennes, France. 12 individuals participated in each session, for a total of 216 participants. In each session, subjects were randomly assigned to three groups of four individuals. The experiment is computerized and the scripts are programmed using the Z-tree platform (Fischbacher, 2007). No subject participated in more than one session. We ran the experiment under a partner matching protocol.

Table 1 contains some summary information about each of the sessions. The first four columns indicate the session number, the number of subjects that took part in the session, the number of four-person groups in the session, and the treatment effect. The fifth through seventh columns indicate the particular rules in effect in each of the two fifteen-period segments of the session.

Table 1: Characteristics of the experimental sessions

Session number	Number of subjects	Number of groups	Treatments	Periods 1-15	Periods 16-30	Threshold
1	12	3	C0+M0	C0	M0	No threshold
2	12	3	C0+M0	C0	M0	No threshold
3	12	3	C0+M0	C0	M0	No threshold
4	12	3	M0+C0	M0	C0	No threshold
5	12	3	M0+C0	M0	C0	No threshold
6	12	3	C28+M28	C28	M28	Low threshold
7	12	3	C28+M28	C28	M28	Low threshold
8	12	3	M28+C28	M28	C28	Low threshold
9	12	3	M28+C28	M28	C28	Low threshold
10	12	3	C60+M60	C60	M60	Medium threshold
11	12	3	C60+M60	C60	M60	Medium threshold
12	12	3	M60+C60	M60	C60	Medium threshold
13	12	3	M60+C60	M60	C60	Medium threshold
14	12	3	C80+M80	C80	M80	High threshold
15	12	3	C80+M80	C80	M80	High threshold
16	12	3	M80+C80	M80	C80	High threshold
17	12	3	M80+C80	M80	C80	High threshold
18	12	3	Allocation+M0	Allocation	M0	No threshold
19	12	3	Allocation+M0	Allocation	M0	No threshold

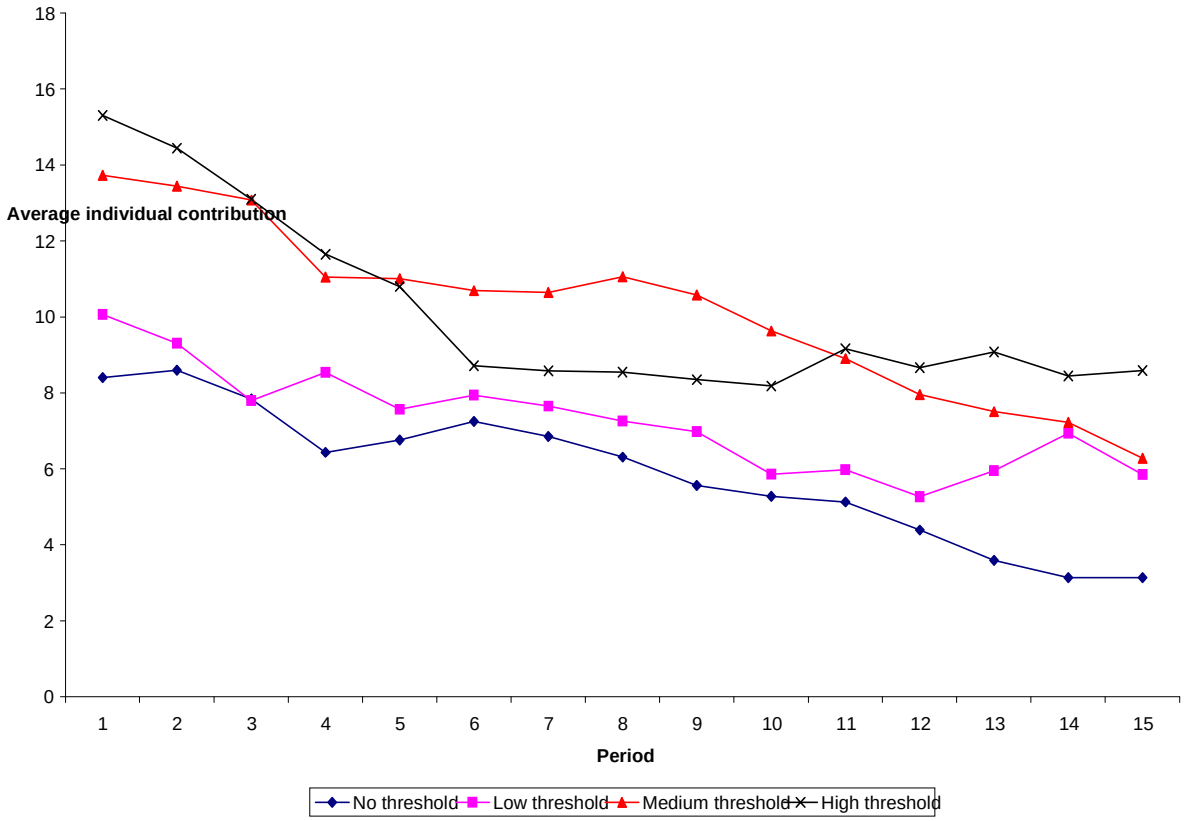
4. Results

This section is organized as follows. Subsection 4.1 investigates threshold effects. Subsection 4.2 reports patterns in average contributions investigating framing effects. It compares maintaining and creating frames as well as allocation frame and provides results that show to what extent framing effects are influenced and interact with threshold effects.

4.1. Threshold effects

Figure 1 illustrates the time path of individual contributions by period for all threshold levels. The period number is shown on the horizontal axis and the average individual contribution on the vertical axis, where the maximum possible individual contribution is 20. These figures show the same pattern for all threshold levels: there is initially a positive level of contribution to the group account and the level of contribution declines with repetition. This result is in line with several other experiments that have documented that the contributions tend to decline with repetition (Isaac et al. 1984, Isaac and Walker, 1988, Andreoni, 1988, Weimann, 1994, Keser, 1996). Figure 1 also indicates that the average contribution increases with threshold. This is stated more precisely in result 1.

Figure 1. Average contribution depending on the threshold level



Result 1 summarizes our findings about the framing effects.

Result 1: *Consistent with the focal point assumption from proposition 2a, average individual contribution increases with thresholds. Our results also indicate an optimal threshold level since above the medium threshold, contributions tend to decrease or remain unchanged by discouraging provision.*

Support for result 1 : Table 2 shows the average group contribution and standard deviations in each treatment. It indicates that both in the maintaining and creating contexts, the average contribution increases with threshold, except for the high threshold level in the maintaining treatment. A Mann-Whitney pairwise statistical test comparing contributions between treatments, maintaining the conservative assumption that each group's activity over the session is a unit of observation, yields the results shown in table 3 (two-tailed test). The unit of observation is the average contribution of the group over the session, and the null hypotheses are that the median group contributes an identical amount.

Table 2. Average group overall contribution per treatment (standard errors in parentheses)

		Threshold levels			
		T=0	**T=28**	**T=60**	**T=80**
Frames	**Maintaining frame**	22.92 (15.25)	25.96 (16.96)	36.83 (25.93)	33.37 (31.60)
	Creating frame	26.6 (14.46)	32.18 (10.75)	44.67 (22.89)	47.52 (32.09)
	Diff. between treatments	3.68	6.22	7.84	14.15

Table 3: Results of Mann-Whitney Rank Sum Tests of Differences in Contribution Levels Between Treatments (two tailed) on pooled data (both maintaining and creating contexts)

	No threshold	Low threshold	Medium threshold	High threshold
No threshold	–	***p* < .05**	***p* < .01**	***Borderline***
Low threshold	–	–	***p* < .05**	**Not sig.**
Medium threshold	–	–	–	**Not sig.**
High threshold	–	–	–	–

(Level of confidence at which null hypothesis of no differences between treatments can be rejected, each session mean is a unit of observation)

Introducing thresholds has the effect of increasing contribution levels. The statement is based on the fact that the difference in contributions between the No Threshold treatment and each threshold treatment are significant. Thus we observe a similar effect as Isaac et al. (1989), Suleiman and Rapoport (1992), and Dawes et al. (1986) who reported that simply creating a threshold cost of provision had a significant positive impact on contributions compared to similar VCM treatments. Our results also indicate that the differences between the medium and the high threshold treatments are not significant, suggesting that a high threshold may discourage provision. Finally, the (borderline, $p < .1$) significant difference between the no threshold treatment and the high threshold treatment provides additional support for the fact that a very high threshold discourages contributions.

Figure 2 provides further evidence that the threshold effect is non linear, in particular under the maintaining condition. It shows that average group contribution increases with threshold except for the highest threshold in which contribution tend to slightly decreases compared to the level obtained at the medium threshold which is consistent with the assurance hypothesis for very high threshold. Figure 2 also provides interesting results about the differences between average contribution and theoretical predictions. Concerning the No threshold treatments, it appears that subjects significantly over contribute compared to the theoretical predictions where the sum of individual contribution should be null. In contrast, group average contribution is relatively close to the theoretical predictions in the Low threshold condition. Recall that in the Low threshold treatments, all individual combinations totalizing 28 tokens are equilibria provided subjects contribute strictly less that 12 tokens. If one considers now the Medium threshold treatments, one observes that group contributions are on average under the theoretical predictions where equilibria include all combinations with the sum of contributions equals 60. Finally, average contributions in the High threshold treatment reveal a strong heterogeneity among subjects since contributions levels in this treatment are exactly between the two equilibria of this treatment (the risk dominant equilibrium and the Pareto dominant equilibrium)[5].

[5] The comparison between theoretical predictions and empirical results may provide additional explanations for the decline of contribution in the higher threshold treatment compared to the medium treatment. Indeed, whereas equilibria in the medium treatments include all combinations with the sum of contributions equals 60, contributions levels in the high threshold treatment reflect intermediate levels between 80 and 0, which correspond to the theoretical predictions at the collective level.

Figure 2. Comparison between average contribution levels and theoretical predictions

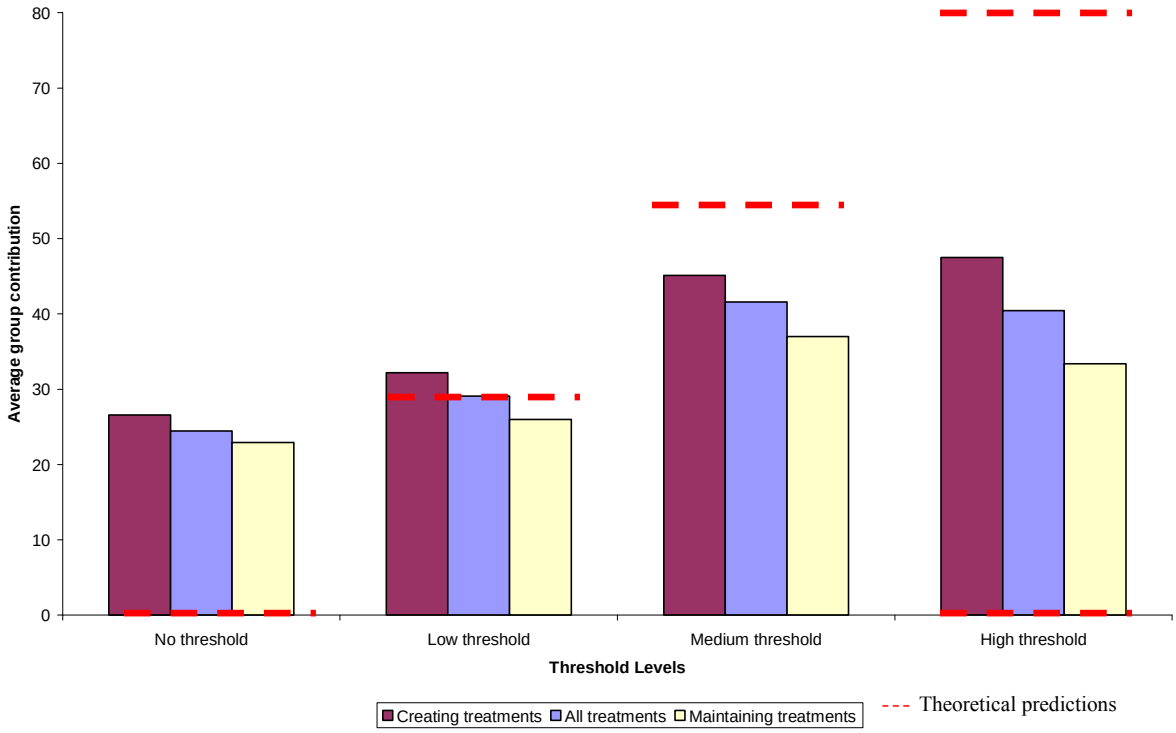


Table 4 provides a formal evidence of the existence of threshold effects. The dependent variable is the amount of tokens contributed in the t^{th} period. The independent variables include several dummy variables controlling for each threshold. The results are interpreted in relation with the omitted category, i.e. the case without threshold. Finally, we also introduced in the estimations the variable "period" which is a counter variable.

Table 4. Determinants of contribution and threshold effects

	All treatments (1)	Creating treatments (2)	Maintaining treatments (3)
Low threshold	1.280***	1.246***	1.316***
	(0.232)	(0.322)	(0.327)
Medium threshold	4.201***	4.368***	4.035***
	(0.232)	(0.322)	(0.327)
High Threshold	4.124***	5.081***	3.168***
	(0.232)	(0.322)	(0.327)
Period	-.394***	-0.332***	-0.457***
	(0.0197)	(0.027)	(0.028)
Constant	9.144***	9.456***	8.833***
	(0.211)	(0.292)	(0.297)
Observations	6840	3420	3420
R-squared	0.115	0.125	0.119

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

The first column of Table 4 confirms our previous findings. It reveals that individuals increase their contribution with an increase of threshold. Table 4 also indicates that a peak is attained for Medium threshold since contributions fall below the peak and remain constant above. The two last columns of Table 4 show the estimation results for creating and maintaining treatments. The comparison of these two columns reveals some differences between the two treatments. In particular, it indicates that contributions attain a peak with the medium threshold and significantly decrease with a higher threshold in the maintaining treatment whereas contributions still increase with threshold in the creating treatments. Finally, Table 4 indicates that contribution declines over time, which is consistent with previous experiments on public good games.

Next subsection investigates in more detail the differences between creating and maintaining treatments.

4.2. Creating *vs.* Maintaining frames

In this section we seek to measure the influence of three frames : creating, maintaining and allocation effects as well as the interaction between threshold and framing effects. Are framing effects higher for higher thresholds? Figures 3-6 illustrate the time path of individual contributions by period in all treatments comparing maintaining and creating contexts.

Consistent with proposition 1, our results indicate that subjects contribute significantly more under the Creation setting. This is stated more precisely in result 2.

Figure 3. Average contribution in the M0 and C0 treatments

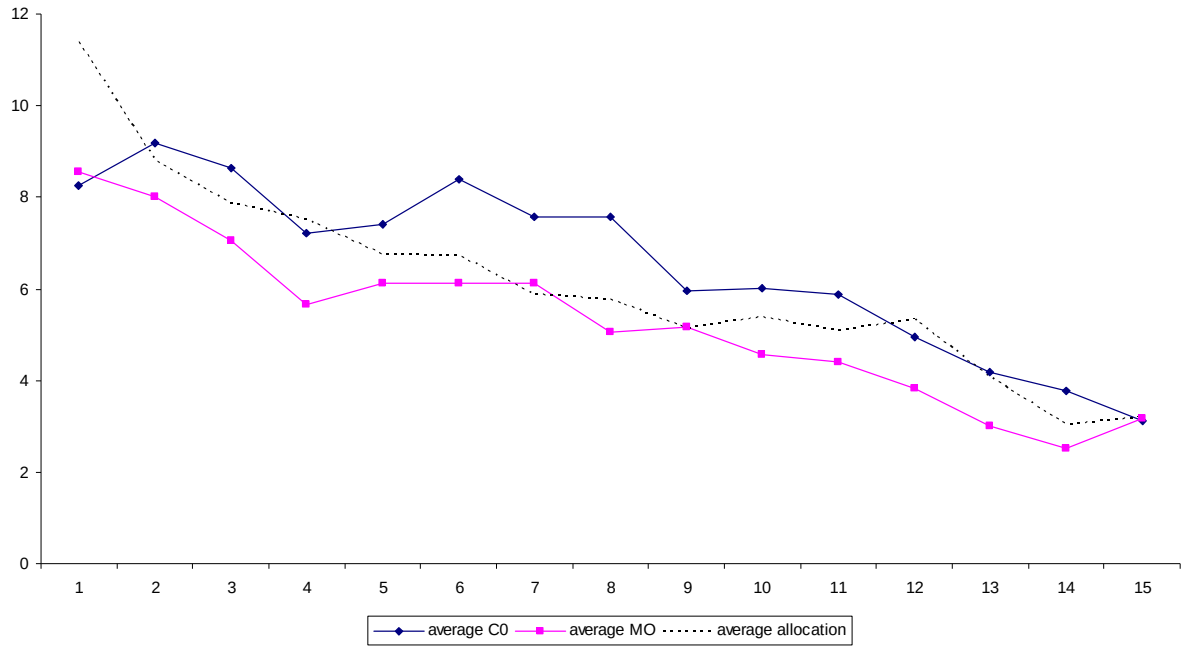


Figure 4. Average contribution in the M28 and C28 treatments

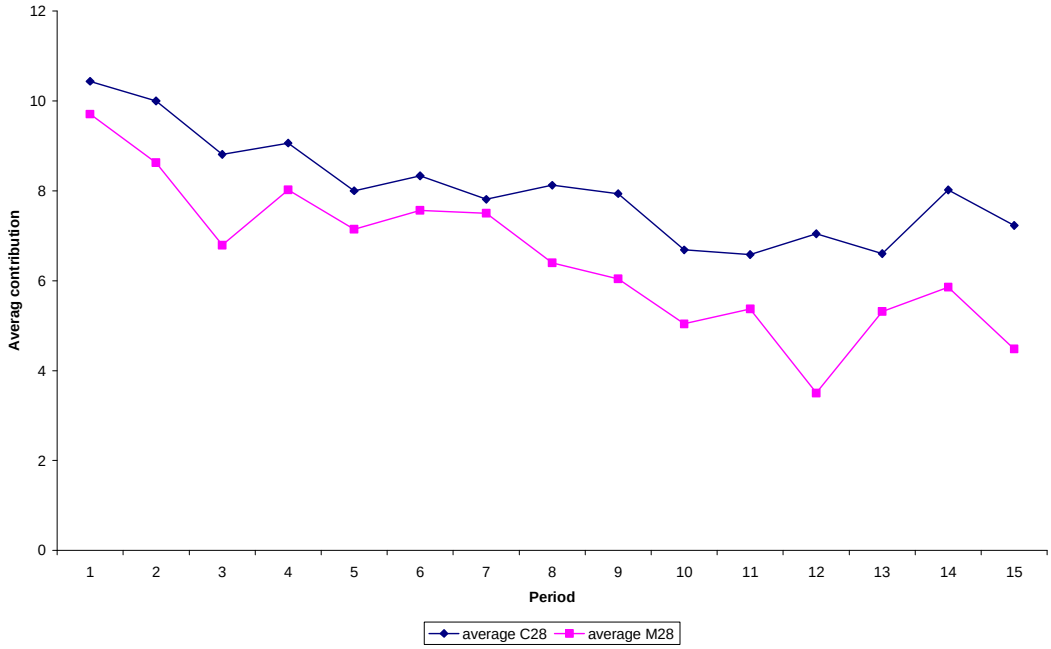


Figure 5. Average contribution in the M60 and C60 treatments

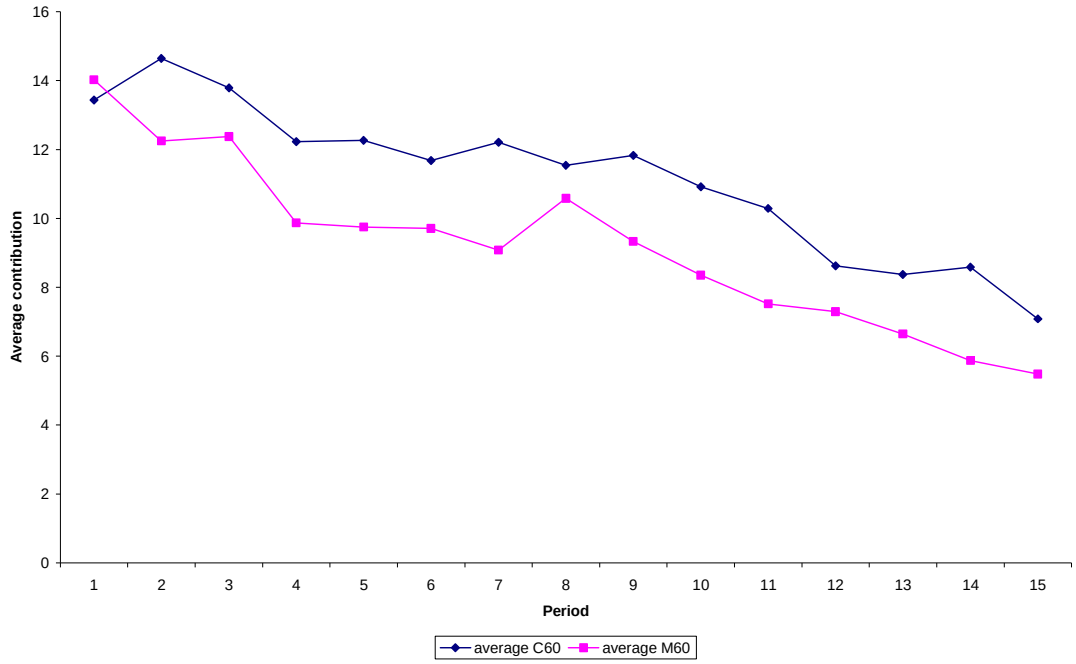
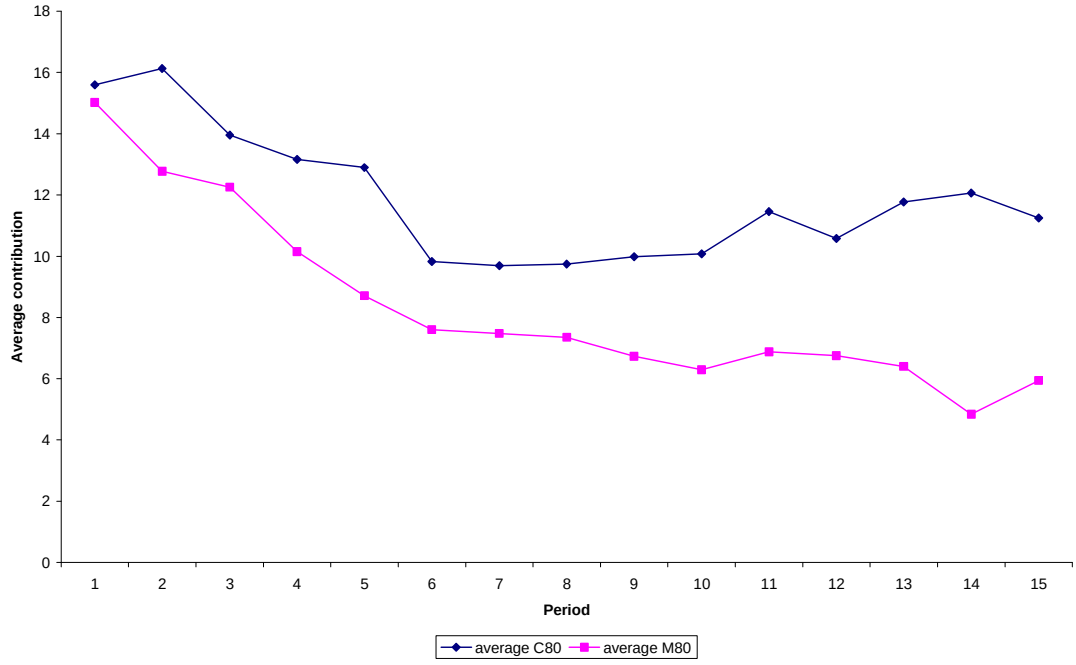


Figure 6. Average contribution in the M80 and C80 treatments



Result 2 summarizes our findings about the framing effects.

Result 2a: *Contribution levels are significantly greater under creating condition, which is consistent with our proposition 1. Moreover, consistent with proposition 2b, framing effects seem to be stronger under high threshold levels, which is consistent with our conjecture that the assurance effect dominates in the maintaining situations whereas the focal point assumption is supported in the creating context.*

Support for result 2a: Table 2 indicates that for all threshold conditions, average contributions are higher under the creating frame than under the maintaining frame. Nonparametric Wilcoxon matched pairs tests report significant differences between creating and maintaining treatments[6]. In all statistical tests reported in this paper, the unit of observation is the group. These tests show that the difference in average contributions between the C28 and M28 as well as between C60 and M60 treatments are statistically significant (z=-1,688 and z=-1,923 respectively). A similar test also indicates that average contributions are significantly higher under the C80 treatment than in the M80 treatment (z=-1,76). Finally, the comparison between the C0 and M0 treatments indicates a borderline significant effect at the $p < .10$ ($z = -1,63$).

Table 5 provides more formal proofs of these results. It contains the estimates of regression models of the determinants of contribution investigating for all framing effects. The independent variables are variables for creating and allocation frames. The variable "creating" takes value 1 if subjects are playing treatments C0, C28, C60 or C80 and 0 otherwise. The variable "Allocation" takes value 1 in the case that the “Allocation” treatment is played and 0 otherwise. The independent variables also include dummy variables that control for thresholds. Finally we also introduced in the estimations a counter variable.

[6] A between treatment analysis using Mann-Whitney rank-sum tests also provide similar significant results between maintaining and creating treatments.

Table 5. Determinants of contribution and framing effects

	All treatments	All treatments	All treatments	Treat. C0 and MO	Treat C28 and M28	Treat C60 and M60	Treat C80 and M80	Treat C0, M0 and Allocation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Creating	2.082***	2.064***	1.475***	1.439***	1.556***	1.958***	3.537***	
	(0.188)	(0.174)	(0.304)	(0.276)	(0.312)	(0.389)	(0.478)	
Allocation		0.182	0.525					0.233
		(0.409)	(0.434)					(0.378)
Threshold 28		1.307***	1.316***					
		(0.237)	(0.325)					
Threshold 60		4.228***	4.035***					
		(0.237)	(0.325)					
Threshold 80		4.150***	3.168***					
		(0.237)	(0.325)					
Interaction variable:								
Threshold 28*Creating			0.080					
			(0.476)					
Threshold 60*Creating			0.483					
			(0.476)					
Threshold 80*Creating			2.062***					
			(0.476)					
Period	-0.387***	-0.395***	-0.395***	-0.359***	-0.270***	-0.494***	-0.433***	-0.414***
	(0.022)	(0.019)	(0.019)	(0.032)	(0.036)	(0.045)	(0.055)	(0.041)
Constant	10.287***	8.086***	8.332***	8.082***	8.653***	13.158***	11.809***	10.251***
	(0.219)	(0.228)	(0.250)	(0.321)	(0.363)	(0.453)	(0.557)	(0.396)
Observations	6120	6840	6840	1800	1440	1440	1440	1080
R-squared	0.067	0.135	0.137	0.079	0.053	0.092	0.075	0.086

Standard errors in parentheses, * significant at 10%; ** significant at 5%; *** significant at 1%

The estimates presented in Table 5 confirm our previous findings. Estimates reveal that individuals increase their contribution when they are confronted with a creating frame. These results remain unchanged when we control for threshold effects. If one considers now the interaction variables between threshold and framing effects, it appears that framing effects seem to be higher for higher levels of threshold.

Support of result 2a shows that framing significantly influences individual decisions, despite similar theoretical predictions. Our result 2a replicates Andreoni (1995), who found that subjects contribute more under the positive frame condition. The interesting finding of our

study is that we generalized this finding in the case of threshold public good experiment where the zero threshold condition corresponds to the standard public good game.
Moreover, we observe that assurance effect is stronger in the maintaining frame compared with the creating frame. This assurance effect could be explained by subjects' risk aversion. Such a result could be simply explained by the fact that initial income is not the same in the two contexts. In the maintaining context, individuals' initial wealth is 32 (.4 X 80) whereas in the creating context, initial individual wealth is 20. If individual risk aversion is to be increased with stakes, as it has been shown by Holt and Laury (2002) then the assurance effect grows. Finally, the non-linearity of average contribution levels when threshold is to be increased could be explained in the following manner: A constant focal point effect balanced by an increasing assurance effect.

We next explore whether such framing effect also exists when one compares the allocation and endowment protocols presented in detail in section 3. In the allocation protocol, subjects are asked to allocate a given number of token between a public investment and a private investment. In contrast, in the endowment protocol, subjects are endowed a given number of tokens and asked to allocate part of the endowment in a public account. Our results show no significant difference between the two treatments. This is more clearly stated in result 2b.

Result 2b: *Average contribution is not significantly different between the endowment treatments (M0 andC0) and the allocation treatment.*

Support for result 2b : A Mann-Whitney rank-sum test shows that the difference in average contributions between the M0 and Allocation treatments is not significant at the $p < .10$ ($z=-0.48$, two-tailed). A Wilcoxon matched pair test provides similar results. Similar results are obtained in Table 5 that indicates that the coefficient associated with the variable "allocation" is not significant.
Finally, interestingly, as shown in figure 1, contribution level in the allocation treatment is at an intermediary level between the average contribution in the M0 and C0 treatments.
As we indicate in our support of result 2b, the introduction of framing alone is not sufficient to influence contribution levels significantly. However, both results 2a and 2b indicate that framing may affect individual decisions significantly when externalities (positive or negative) are induced by slight changes in the context.

5. Discussion and policy implications

Our aim in this study was to analyze the combination of two effects, the effect of framing for the efficient production of public goods and the effect of threshold by implementing provision point in public good games. This combination is in line with some agri-environmental concerns in which collective resources could suffer from insufficient level of effort from individuals if the aggregate effort is too low. Moreover, in this field, contracts between local authorities and farmers for instance are often labeled in terms of preservation.

Our results are quite intriguing for some of them. Our principal findings are the following. First, we find that average contribution increases with threshold level. Nevertheless, our results also indicate the existence of an optimal threshold level since above the medium threshold, contributions tend to discourage provision. Our results indicate that it is easier to promote cooperation when individuals are settled in a creating context rather than a maintaining context. Such a result, although consistent with Andreoni's results, could be viewed as counterintuitive because one can think initially that it will be easier to maintain a public good than to create it. Our key finding is that we found that Andreoni's assumption holds in the situation of threshold public goods and that these framing effects are even stronger under very high threshold levels, which is consistent with the assurance problem interpretation.

Such results have important implications for conservation policies especially in a context of reduced budgets. For example, in the EU, the 2006 Rural Development Regulation calls for an increasing implication of local actors in defining agri-environmental schemes. Such actors may favor contracts over local public goods. Most of the time local public goods are less destroyed than global public goods. Thus, new conservation policies may shift to preserving existing local public goods (landscape with hedgerows) rather than creating new public goods.

Our results can also be interpreted in line with the actual debates concerning the evolution of the rules and policies provided by the Kyoto Protocol on Climate Change. The objective of the agreement negotiated in Kyoto, Japan in December 1997 was the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system". One policy included in the Kyoto Agreement and called the Protocol's Clean Development Mechanism aims at creating new

resources via tree planting in order to absorb carbon dioxide from the atmosphere.[7] However many countries have shed light on the paradoxical situation engendered by the Kyoto Protocol that provides credits to countries to plant trees in order to reduce carbon dioxide emissions whereas nothing is really done to encourage countries not to engage in deforestation. Recently a group of countries called the "Tropical Rainforest" coalition has made an alternative proposition to preserve the environment by providing credits to countries not only to plant trees but also in order to preserve the actual rainforest ecosystem from deforestation.
As shown by our results, policies focusing on environmental goods to be maintained need to give more incentives to individuals than policies focusing on goods to be created.

[7] The CDM allows industrialized countries to pay for projects in developing countries that cut emissions of carbon dioxide via tree planting. Countries can get credit for new planting and for re-planting areas that were previously forested. On average one carbon credit requires a little more than five trees to be planted and cared for.

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