Working Paper Series 617
(ISSN 1211-3298)

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CERGE-EI
Prague, April 2018

ISBN 978-80-7343-424-3 (Univerzita Karlova, Centrum pro ekonomický výzkum a doktorské studium)
ISBN 978-80-7344-460-0 (Národohospodářský ústav AV ČR, v. v. i.)

Do Fixed-Prize Lotteries Crowd Out Public Good Contributions Driven by Social Preferences?

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Abstract

Fundraising for public goods by private contributions is often undermined by free-riding. One prominent mechanism suggested to alleviate problem of free-riding is a fixed-prize lottery with winning probabilities proportional to individual contributions (Morgan, 2000; Morgan and Sefton, 2000). Yet, as extensively documented by economic experiments, subjects often contribute even in the absence of incentives of this kind, suggesting that their contributions are driven social preferences. This raises a question of how the lottery incentive interacts with social preferences. We present an experiment in which we de-couple the contribution effect of own prize seeking from the potential crowding out effect due to the perception that the others contribute because of their prize seeking, rather than to benefit the group. Even though the lottery increases contributions relative to the voluntary contribution case, we find that it also crowds out voluntary contributions that are likely driven by social preferences.

Keywords: public good game, crowding out, social preferences, lottery

JEL Classification: C91, D91, D03

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1 Introduction

There is extensive theoretical and experimental research on designing mechanisms that overcome under-provision of pure public goods under the voluntary contributions mechanism (VCM).[1] One particular line of research, starting with Cornes and Sandler (1984, 1994) and Andreoni (1990), proposes bundling public goods together with private goods. Morgan (2000) considers an environment in which the private good component consists of a lottery (raffle) ticket that gives the owner a chance to win a prize financed by a portion of collected contributions. Each contributor receives the number of lottery tickets that is proportional to his or her contribution (e.g., one ticket for each contributed Euro). At the end, one lottery ticket is drawn at random and the winner receives the prize. Therefore, the probability of winning the prize is equal to the share of a given individual's contributions to the total sum of all contributions. Morgan (2000) shows theoretically that fixed-prize lotteries with large prizes can induce equilibrium contributions that, after subtracting the prize, generate amounts of the public good arbitrarily close to the social optimum. The underlying idea is that one could move toward the efficient level of public good contributions if the positive externality inherent in contributions could be counterbalanced by an artificially designed negative externality. Under a fixed lottery prize, holding other contributions fixed, whenever an individual contributes an additional Euro, his or her expected winnings rise, at the expense of the expected winnings of the other contributors. This is the negative externality artificially introduced by the lottery.[2] Morgan and Sefton (2000) conduct an experimental test of this theory and indeed find that contributions increase with the size of the lottery prize.[3]

Contrary to the theoretical prediction of complete free riding, there is a large experimental literature (Chen, 2008) documenting that subjects contribute positive amounts to

[1]This literature is surveyed by, among others, Ledyard et al. (1997), Chen (2008) and Chaudhuri (2011).

[2]On the other hand, Morgan shows that pari-mutuel lotteries, in which the prize is equal to a fixed share of the collected contributions, do not alleviate the free-rider problem. The reason is that the negative effect of a larger contribution on the expected winnings of the others is fully offset by the increasing size of the prize.

[3]Alternative contribution-boosting mechanisms are based on the use of (all-pay) auctions. Goeree et al. (2005) theoretically compare performance of various types of mechanisms. Even though experimental results (Orzen et al., 2008; Schram and Onderstal, 2009) are not always consistent with theoretical predictions, the findings confirm the basic theoretical conclusion that the prize-based mechanisms (both lotteries and auctions) raise more contributions than the VCM. Further empirical literature focuses on different parameters of the prize-based mechanisms, such as the effect of multiple prizes (Faravelli and Stanca, 2007; Lange et al., 2007) or an asymmetry in valuations of public goods (Lange et al., 2007).

the public good under the VCM. Importantly, this happens even in one-shot settings and in repeated play under the "stranger" protocol, in which contribution groups are randomly rematched in every round and, hence, repeated interaction effects do not play a significant role. Virtually all systematic explanations of this finding appeal to subjects having social preferences of some kind. Subjects could be altruistic (Becker, 1974, Andreoni, 1989, 1990), or they could be social welfare maximizing (Laffont, 1975), or they could act out of reciprocity (Dufwenberg and Kirchsteiger, 2004, Falk and Fischbacher, 2006, Rabin, 1993, Sugden, 1984) to positive expected contributions of the others. In addition, subjects could also be driven by inequality aversion (Fehr and Schmidt, 1999, Bolton and Ockenfels, 2000) given positive expected contributions of the others, but such an argument relies specifically on *advantageous* inequality aversion. Assuming utility is linear in the public good, altruism and social welfare maximization predict that one's contribution is independent or decreasing in the average expected contribution of the others (depending on whether utility is linear or concave in the well-being of the others/the group, respectively). On the other hand, reciprocity and inequality aversion predict an increasing pattern. Fischbacher et al. (2001) implement a direct contribution elicitation tool based on the strategy method, with subjects deciding how much to contribute conditional on the average contribution of the other group members. They find that about half of the subjects can be classified as "conditional cooperators" in that their conditional contribution increases with the average contribution of the others, another third are "conditional free-riders," with the remaining one sixth displaying other patterns of conditional contributions.[4] Among the theories mentioned earlier, these findings unambiguously favor the reciprocity/inequality aversion explanation.[5] Croson (2007) comes to the same conclusion analyzing experimental data on unconditional contributions and beliefs about the contributions of others, and also dynamic contribution responses in a repeated linear public goods game.

If positive contributions in the VCM are driven by reciprocity to positive expected

[4]The empirical result that one's own conditional contribution on average increases with the contributions of the other group members was obtained even earlier by Weimann (1994) and Bardsley (2000). However, they only consider two realizations of the contributions by the other group members (a low one and a high one).

[5]In principle, conditional cooperation might be an artifact of subject desire for conformity, rather than reciprocity or inequality aversion. Bardsley and Sausgruber (2005) find that about one third of conditional cooperation is indeed driven by preferences for conformity. However, that still leaves an important role for reciprocity and inequality aversion.

contributions of the others, then introduction of a lottery may (partially) crowd out this motivation to contribute. The reason is that whereas positive contributions under the VCM are clearly interpretable as an attempt to benefit the group, this is no longer the case under the lottery. In the latter case, contributions are likely to be at least partially driven by a private motive to win the lottery prize. As a result, contributing out of reciprocity becomes at least partially crowded out. Indeed, there is evidence from many domains that introducing monetary incentives crowds-out pro-social behavior. For example, crowding our has been identified in contract design (Fehr and Gächter, 2000, Falk and Kosfeld, 2006), volunteering (Frey, Goette, et al., 1999, Gneezy and Rustichini, 2000), charitable giving (Meier, 2007), adherence to civic duties (Frey and Oberholzer-Gee, 1997), and trust relationship (Bohnet, Frey, and Huck, 2001, Fehr and List, 2004).[6] In fact, for the case of lottery financing of public goods, Morgan (2000) himself points out that:

> "One possible drawback of employing lotteries in financing public goods is that the linkage between private gain from a lottery and public goods provision may actually reduce a taste for altruism or "warm glow" that individuals obtain through giving behavior. Depending on the magnitude of this effect, it would certainly narrow (or possibly reverse) the predicted gap between the provision of public goods through voluntary means and that obtained through lotteries."

If positive contributions in the VCM are instead driven by inequality aversion (IA) in combination with positive expectations of other's contributions, less obvious the effect of introducing a lottery on this motivation to contribute is. As we argued before, the basic argument for giving a positive amount under the VCM relies on *advantageous* IA. As argued by Fehr and Schmidt (1999), it is reasonable to assume that *disadvantageous* IA is at least as strong as advantageous IA. It is therefore reasonable to assume that both types of IA are present. Starting from the VCM, consider what impact introduction of the lottery has on other's contributions and payoffs. It is likely that others' contributions are higher due to prize seeking. Holding one's contribution fixed, this increases one's own payoff relative to the payoffs of non-winners. On the other hand, one's own payoff is likely to decrease relative to the payoff of the lottery winner, if among the others. Since it is not clear whom one takes as a reference point for the evaluation of inequality, it is impossible

[6] Frey and Jegen (2001) provide a more detailed overview of crowding-out effects in various domains. Benabou and Tirole (2003) outline a possible theoretical underpinning for the crowding-out effect.

to determine what the impact of introducing the lottery is on the original motivation to contribute due to IA.

Regardless of what specific type of social preferences drive positive contributions in the VCM, little is known about the presence or magnitude of potential crowding-out effects of various contribution-boosting mechanisms. The aim of this study is to contribute to filling this gap by shedding light on the extent to which lottery financing of public goods crowds-out pro-social giving. Our study thus contributes to two streams of literature. First, it informs the literature on the design of fundraising campaigns. Second, it adds to the broad literature on crowding-out of intrinsic motivation.

We find the presence of a crowding-out effect robust across various parametrizations. Looking at results from the pooled sample, crowding-out of intrinsic motivation decreases the effect of the additional monetary incentive by roughly one third. Moreover, for conditional cooperators, as defined by Fischbacher et al. (2001), the analogous figure reaches more than 60% under a high lottery prize. We thus document that although the lottery increases contributions over all (which replicates the result of Morgan and Sefton (2000)), such gain comes at a significant cost in terms of crowding out giving driven by pro-social intrinsic motivation. Moreover, from the point of view of fundraising design, our results suggest that the ability of a self-financing lottery to increase net fundraising is sensitive to the social preference profile of the population targeted by the fundraising campaign.

The rest of the paper is structured as follows. Section 2 describes our experimental design. Section 3 presents experimental results. Finally, Section 4 concludes and discusses interpretation of the results.

2 Design

As documented by Morgan and Sefton (2000), introduction of a lottery is likely to increase individual contributions. Such an overall effect combines the effect of the one's own prize-seeking incentive to contribute, with the potential crowding-out effect due to others contributing due to prize-seeking rather than to benefit the group. The key to our experimental design is therefore to separate the two effects. We achieve this by introducing an *intermediate* treatment in which one group member cannot win in the lottery, so his or her contribution is affected by the potential crowding-out effect, but not by the prize-seeking effect. A comparison of the intermediate treatment with the VCM treatment then identifies the crowding-out effect. On the other hand, a comparison of the intermediate treatment with the lottery treatment then identifies the pure effect of prize-seeking.

In order to be able to identify the crowding-out effect at the individual level, we utilize a within-subject design with the three treatments mentioned above. For all three treatments, we use modifications of the voluntary contribution mechanism (VCM) frequently employed in public goods experiments in the related literature. Each contribution group consists of 4 subjects.[7] Each subject is endowed with 10 tokens, which he or she can allocate between a private account and a "group project". For future reference, the number of tokens a subject allocates to the group project will be called his or her "contribution". A token allocated to the private account generates a payoff of 1 experimental point for the given subject and 0 for anyone else. A token allocated to the group project generates a payoff (marginal per capita return, or MPCR) of 0.75 experimental point to each group member.[8] Our choice of the MPCR is motivated by several previous experiments in the same laboratory showing that lower levels of MPCR are insufficient to generate a significant incidence of positive contributions in the VCM treatment and therefore space for potential crowding-out effects.

Each treatment is further augmented by the presence of an account of R tokens that is provided from outside the subjects' endowments. In the lottery treatment, this account is used to finance the lottery prize. We use an external account rather than a part of subjects' contributions to finance the prize in order to make sure that the prize can be paid out irrespective of the level of contributions (which could be insufficient to finance the prize). The addition of this external account to the lottery treatment introduces a wealth effect, however. In order to neutralize this effect across the three treatments, we also add the same external account to the other two treatments. The following subsections detail how we use the external account in the other two treatments. We use two different parametrizations for R: $R = 8$ and $R = 12$. This choice is motivated by the divisibility of R by 4 (important in the VCM and the intermediate treatment, see below) and by the resulting Nash equilibrium contribution levels in the lottery treatment being in the interior of the contribution choice space. As shown in the Appendix, the only values of

[7] This is the group size used by Morgan and Sefton (2000) in their Iowa experiment and by Lange et al. (2007) and Orzen et al. (2008). In addition, this is also the group size used by Fischbacher et al. (2001) and Herrmann and Thöni (2009).

[8] This is the same MPCR as that used by Morgan and Sefton (2000) in their Iowa experiment.

R that satisfy these requirements are $R = 4$, $R = 8$ and $R = 12$. We do not use the smallest of the three possible lottery prizes because it arguably generates the smallest difference across the three treatments.[9] We implement the variation in lottery prize in a between-subjects design.

Using this setup, in each treatment we first elicit unconditional contributions. Using the instrument of Fischbacher et al. (2001), we then also elicit contributions conditional on various possible average unconditional contributions (rounded to the nearest integer in the set $\{0, 1, 2, .., 10\}$) of the other three group members. We label this instrument for subjects as a "contributions table". A contribution, unconditional or conditional, can be any integer from the set $\{0, 1, 2, .., 10\}$.

There is no feedback on one's payoffs or on others' contributions, or on payoffs from the previous decisions until the very end of the experiment. We implement this in order to avoid subjects affecting one another's decisions throughout the course of the experiment. As a result, each subject can be treated as an independent unit in a statistical analysis.

To avoid potential wealth and hedging effects, we pay for only one elicited contribution situation. This random choice has three dimensions. First, we pay for one randomly selected treatment. All the subjects within the same contribution group in that treatment are paid for the same treatment. Second, within that treatment, the payoffs are determined using the contributions table of one randomly selected group member and the unconditional contributions of the other three group members. Third, if the payoff-relevant treatment is the intermediate treatment, then one randomly selected group member is a lottery non-participant, while the other three are lottery participants. The three dimensions of randomness are independent of one another. Further details of how we implement these random draws are provided below.

The following subsections describe the three treatments in detail. The next subsection then describes the logistics of the experiments, the subject pool and the sample size.

2.1 Voluntary Contribution Mechanism (VCM)

This is one of our two baseline treatments. The only modification in comparison with the standard way VCM is usually implemented in laboratory experiments is the addition of an external account of R tokens. This account is evenly split among the four group

[9] Our choices of R are analogous to those used by Morgan and Sefton (2000).

members and added to their private accounts. Note that this transfer cannot be used to increase one's contribution beyond the initial constraint of 10 tokens. Subjects are informed of the transfer before they make their contribution decision.

2.2 Lottery (LOT)

This is the other of our two baseline treatments. It introduces a fixed-prize lottery on top of the VCM, closely following the design of Morgan and Sefton (2000). Relative to the VCM, each token contributed automatically buys one lottery ticket. After the four group members decide on their contributions, one lottery ticket is drawn at random, and the winner receives the prize of R. That is, each of the four group members has a probability of winning the prize equal to the proportion of his or her contribution in the total group contribution. In case all contributions are zero, the prize is randomly allocated to one of the group members, with each group member having an equal probability to win the prize.

2.3 Intermediate Treatment (IM)

This is the crucial treatment in between VCM and LOT aimed at disentangling a potential crowding-out effect of lottery introduction from the effect of own prize seeking. This treatment is analogous to LOT with one modification: one group member is excluded from the possibility to win the lottery prize. The probabilities of winning the prize for the other three group members are analogous to LOT. This exclusion creates a wealth effect, however. Given the four contributions, the excluded group member is poorer in expectation relative to VCM or LOT, while the opposite is true for the other three group members. In order to counterbalance this wealth effect, the lottery non-participant receives a fixed transfer of $0.25R$ to his private account. As in VCM, this transfer cannot be used to increase the subject's contribution beyond the budget constraint of 10 tokens. The lottery prize that the other three group members compete for is then given by $0.75R$.

The idea behind this treatment is that the non participants' material incentives to contribute are the same as in VCM. However, his or her contribution may be different in reaction to the fact that the other three group members now have a stronger private material motive to contribute. Hence a comparison of the contribution of this subject in IM and in VCM identifies the crowding-out effect. On the other hand, a comparison of the contribution if this subject in LOT and in IM identifies the contribution effect of his own lottery prize seeking.

We elicit each subject's contribution in two situations (sub-treatments): in the position of a lottery participant, a sub-treatment we label *intermediate-lottery* (IM-LOT), and in the position of a lottery non-participant, a sub-treatment we label *intermediate-fixed* (IM-FIX). In order to minimize any order effects, we exactly balance the order of the two sub-treatments within each contribution group. As in the other two treatments, we first elicit unconditional contributions, followed by conditional contributions. At the end of the experiment, conditional on the IM treatment being chosen to be payoff-relevant, one of the four group members is randomly chosen to be in IM-FIX, while the other three are assigned to IM-LOT.

2.4 Logistics, subject pool and sample size

The experiment consists of 8 sessions of 24 subjects, giving 192 subjects in total[10]. One half of the sessions (96 subjects) is implemented with $R = 8$, the other half with $R = 12$. All sessions were conducted at the *Laboratory of Experimental Economics* (LEE) at the University of Economics in Prague, in October 2013. The experiment was conducted using a computerized interface programmed in zTree (Fischbacher, 2007). Subjects were recruited using the Online Recruitment System for Economic Experiments (Greiner, 2015) from a subject database of the lab. Our subjects are students from various universities in Prague, most from the University of Economics. Almost 70% of the subjects report "Economics or Business" as their field of study, with the remaining subjects reporting other fields. Of the 192 subjects, 103 are female and 89 are male.

A session begins with an introductory stage and proceeds with general instructions, three treatment stages (labeled as "decision" stages for subjects), a demographic questionnaire, a feedback stage and a cash payment stage. The general instructions describe the outline of the experiment and the exchange rate used for cash payments. The subjects are informed that they will receive stage-specific instructions at the beginning of each treatment stage. They are told that they are anonymously matched to three different

[10] This sample size allows for statistical testing with sufficiently high power. A power calculation with the GPower program ((Faul et al., 2009)) indicates that total sample of 96 subjects detects potential small treatment effects (0.25 times the standard deviation) with power 78.4% (using matched pair t-test and 0.05 significance level). Effects with a size of 0.4 times the standard deviation are identified with 99.98% power (same test and significance level).

other subjects in each stage. The subjects are further told that they will not be receiving any feedback on other subjects' decisions or on anyone's payoffs until the feedback stage. Finally, they are told that only one of the three treatments is chosen at the end of the experiment to be payoff-relevant.

Each treatment stage starts with printed instructions specific to that stage. The instructions first describe the basic game and the resulting payoff structure. They then describe how the unconditional contribution and the contributions table will be elicited. The subjects are informed that if the given stage is selected to be payoff-relevant at the end of the experiment, then the payoff or a group member randomly chosen at the end of the experiment is determined using his contributions table, while the payoffs of the other three group members are determined using their unconditional contributions. In IM, the instructions also mention that if that stage is selected to be payoff-relevant, then a group member randomly chosen at the end of the experiment is assigned to the role of lottery non-participant, while the other three group members are assigned to the role of lottery participants. Finally, the subjects are provided with two examples of payoff computation.

The instructions are followed by a quiz to check understanding. An experimenter checks the answers of each subject. In case of an incorrect answer, a subject is given an explanation and asked to submit a new answer. The experiment continues only after each subject answers all the quiz questions correctly.[11] Afterwards, subjects submit their unconditional contributions, followed by their conditional contributions (contributions table). There is no time limit to submit the decisions, but if some subjects are very slow, we gently prompt them to submit the response by mentioning that there are only few remaining subjects who have not submitted their responses. During the treatment stages, the subjects have access to a Windows calculator.

To minimize a potential impact of order effects, in each session we exactly balance all six permutations of the three treatments. That is, each of the six permutations is used for exactly 4 subjects. The text of the treatment-specific instructions is identical across all six permutations. However, in the second and the third chronological treatment, separately for each permutation, we highlight differences compared to the previous treatment.[12]

After all subjects are finished with their choices, we administer a demographic questi-

[11]No subject had to be excluded from the experiment due to not being able to successfully answer the quiz questions, potentially after some corrections.

[12]We implemented the highlighting based on pilot experiments in which subjects expressed frustration over having to repeatedly read a lot of the same information.

onnaire. We elicit gender, age, country of origin, number of siblings, academic major, the highest achieved academic degree so far, estimate of monthly spending budget and the number of other subjects in the lab a subject knew before coming to the lab. In addition, for female subjects, we administer an additional questionnaire eliciting menstrual cycle information.[13]

After the demographic questionnaire, three volunteer subjects are asked to draw a token with a number from a non-transparent bag. The first token determines the number of the payoff-relevant treatment stage (1, 2 or 3, in the chronological order). As a result, one third of the subjects in any session are paid according to each of the three treatments (VCM, LOT, IM). The second token determines whose payoffs are determined by the contributions table, whereas the payoffs of the others are determined using their unconditional contributions. The third token determines the identity of the lottery non-participant for IM. For the purpose of the second and the third draw, each subject is assigned an order number (1, .., 4) within his or her group and each of the two draws chooses a token from the set $\{1, .., 4\}$.

The experimental point payoffs are converted into cash payments at the exchange rate of 1 experimental point for 10 Czech koruna (CZK).[14] The average cash payoff, including a 100 CZK show-up fee, is 332 CZK[15] for about 2 hours of participation.[16]

3 Results

In this section, we discuss our results. Subsection 3.1 focuses on unconditional contributions, while subsection 3.2 discusses conditional contributions.

3.1 Unconditional contributions

Table 2 presents means of unconditional contributions in all treatments, separately for the two values of R, with IM separated into IM-FIX and IM-LOT. Standard deviations are presented in the parentheses. Of the two IM sub-treatments, only decisions in IM-FIX

[13]The purpose of collecting this information is to continue in the line of research started by one of the coauthors in Chen et al. (2013).

[14]1 EUR was equal worth around 25.7 CZK and 1 USD was worth around 18.8 CZK at the time of the experiment

[15]This was approximately 12.9 EUR or 17.7 USD at the time of the experiment.

[16]For a comparison, the hourly wage that students could earn at the time of the experiment in research assistant or manual jobs typically ranged from 75 to 100 CZK.

Table 1: Treatments

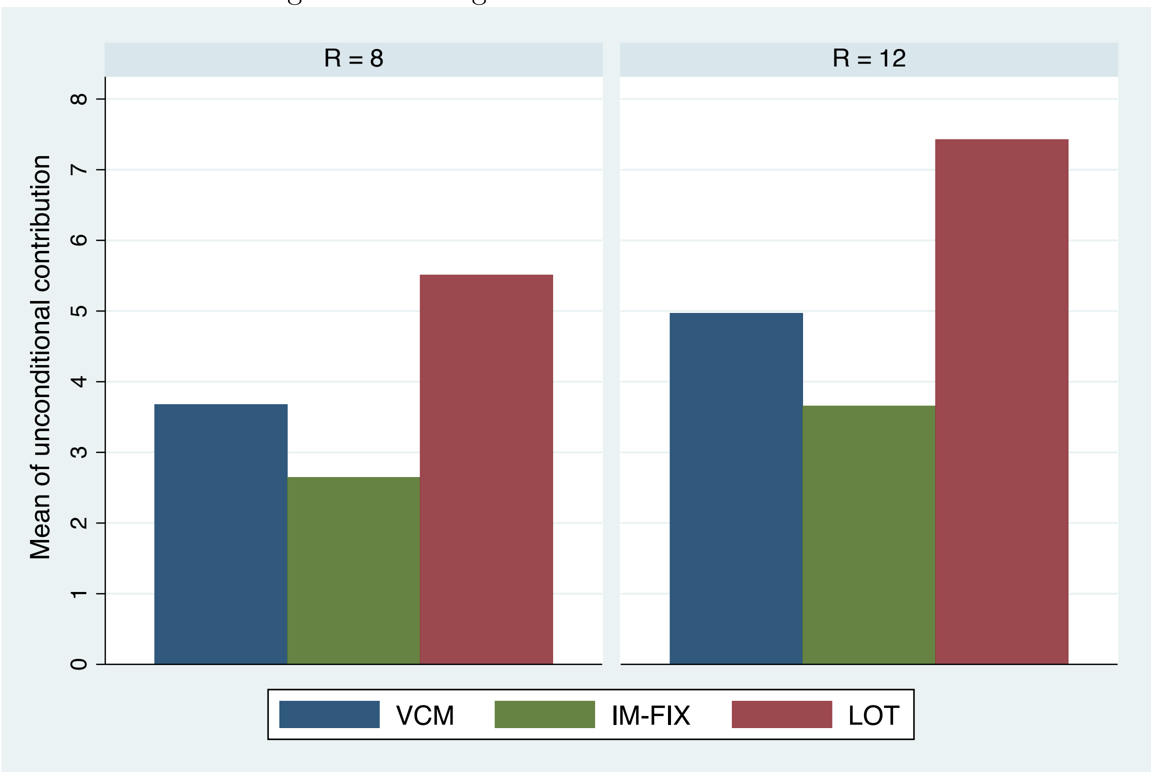
For all treatments: 4 subjects in the group Endowment: 10 tokens MPCR=0.75		**Between-subject treatments** **R=8**	**R=12**
	VCM	+ 2 tokens to private account	+ 3 tokens to private account
	LOT	lottery prize 8 tokens all 4 subjects participate	lottery prize 12 tokens all 4 subjects participate
Within-subject treatments	**IM- FIX**	+ 2 tokens to private account no lottery participation other 3 subjects participate	+ 3 tokens to private account no lottery participation other 3 subjects participate
	IM- LOT	lottery prize 6 tokens 3 potential participants	lottery prize 9 tokens 3 potential participants

Table 2: Average unconditional contributions

	Treatment			
Lottery prize	VCM	LOT	IM-FIX	IM-LOT
R=8	3.677	5.510	2.646	5.760
	(3.594)	(3.476)	(3.458)	(3.396)
R=12	4.969	7.427	3.656	7.312
	(4.011)	(2.983)	(3.778)	(3.048)

are relevant for the purpose of the analysis. Therefore, we do not report any results based on contributions in IM-LOT in the rest of the paper. The means are also presented in the Figure 1 for a better illustration.

Figure 1: Average unconditional contributions



Consistent with the previous literature, we find sizable positive contributions in VCM. Moreover, consistent with Morgan and Sefton (2000) and Orzen et al. (2008), we find even higher positive contributions in LOT. More importantly for the purpose of this paper, however, we observe a sizable drop in average contribution in IM-FIX relative to VCM. For $R = 8$, the average contribution drops from 3.677 to 2.646. For $R = 12$, the average contribution drops from 4.969 to 3.656. The treatment differences are statistically significant at any conventional level. Table 3 presents results of the corresponding t-

tests.[17]. This drop in the average contribution indicates the presence of a significant, lottery-induced, crowding-out effect of pro-social behavior under VCM. The size of the effect is 1.031, or by approximately 18% of the average VCM contribution, under $R = 8$ and 1.313, or by around 16% of the average VCM contribution, under $R = 12$.

Table 3: Treatment effects on average unconditional contribution

	Lottery prize:	
	$R = 8$	$R = 12$
LOT - VCM	1.83***	2.46***
	(0.33)	(0.35)
IM-FIX - VCM	-1.03***	-1.31***
	(0.32)	(0.40)
LOT - IM-FIX	2.86***	3.77***
	(0.38)	(0.41)

Notes:
[1] Standard errors are presented in parentheses.
[2] *** denotes significance at 1% level.

Even though introduction of the lottery results in an approximately one-half increase in the average contribution (from 3.677 to 5.510 under $R = 8$ and from 4.969 to 7.427 under $R = 12$), the pure effect of the material incentives introduced by the lottery is even higher. This effect is identified by comparing LOT with IM-FIX. Under $R = 8$, the average contribution increases by 2.864 from 2.646 under IM-FIX to 5.51 under LOT. Under $R = 12$, it increases by 3.771 from and from 3.656 to 7.427. In both cases, this constitutes slightly more than a two-fold increase in the average contribution. As a result, the crowding-out effect reduces the pure effect of the material incentives by approximately 35% (1.031/2.864 under $R = 8$ and 1.313/3.771 under $R = 12$).

These calculations indicate that approximately one third of the intended lottery-driven material incentive on contributions is crowded-out by elimination of purely socially-driven giving. The crowding-out effect poses an important fundraising challenge in the context of our experiment. If the introduction of the lottery had only a pure material incentive effect on contributions as identified by LOT minus IM-FIX, the aggregate increase in contributions would be $4 \times (5.51 - 2.646) = 11.456$ under $R = 8$ and $4 \times (7.427 - 3.656) = 15.084$ under $R = 12$. Hence in both cases the additionally generated contributions would exceed the lottery prize by about quarter to a third. This suggests that if the prize were

[17] All tests presented in the paper are two-sided tests.

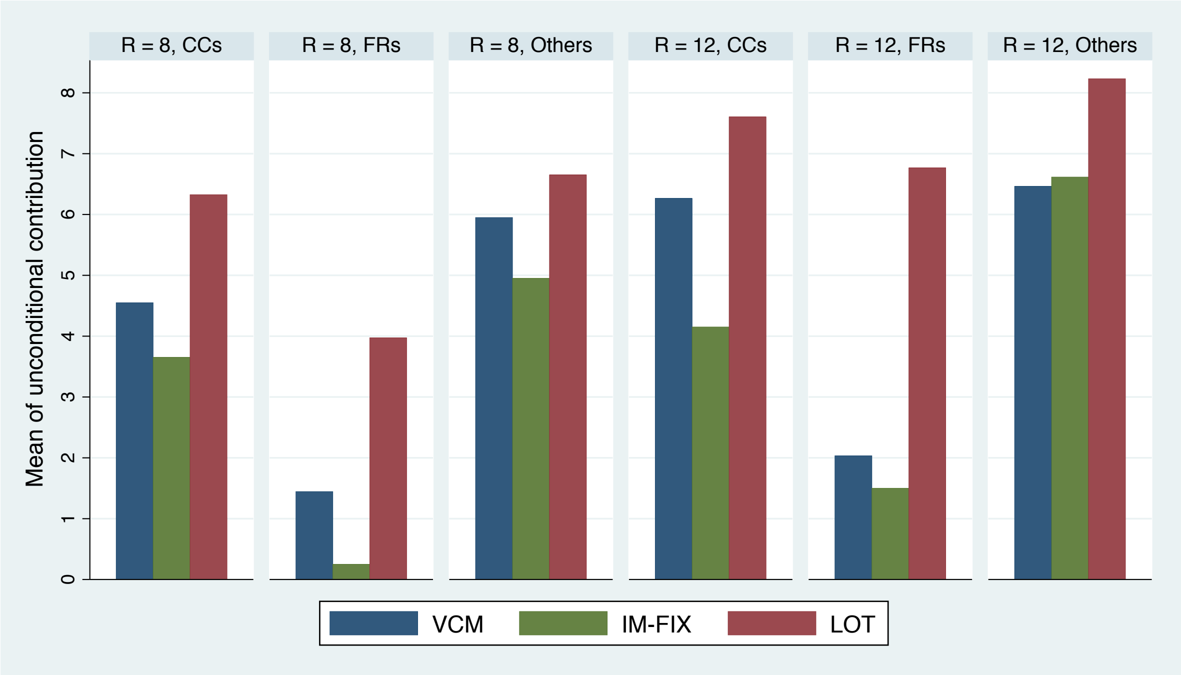
to be self-financing, as is the case in vast majority of field applications, introduction of the lottery would more than pay for itself, hence increasing the net fundraised amount.[18] On the other hand, although LOT does increase contributions relative to VCM, the aggregate increase falls short of the lottery prize. The observed aggregate increase is $4 \times (5.51 - 3.677) = 7.332$ under $R = 8$ and $4 \times (7.427 - 4.969) = 9.832$ under $R = 12$. Therefore, within the context of our experiment, the crowding-out effect makes the difference between the lottery being able to increase the net amount fundraised and not being able to.

The presence of the sizable crowding-out effect in the pooled sample raises a question of how large the effect is in different sub-populations of subjects. In particular, some contributors may be strongly driven by pro-social incentives, while others might be mostly driven by a participant's own material incentives. We would expect a stronger crowding-out effect in the former group relative to the latter group. However, it is hard to judge a subject's pro-sociality based on his or her unconditional contribution. A low unconditional contribution might be interpreted as a lack of pro-social motivation, but it might also be interpreted as the reaction of someone with strong pro-social incentives to low beliefs about expected contributions of the others. To avoid this problem, we classify subjects using their *conditional* contributions in VCM. To do so, we use the methodology of Fischbacher et al. (2001). First, subjects who have a profile of conditional contributions that is (weakly) increasing in the average contribution of the others, with a Spearman correlation between the two positive and significant at 1%, are called *conditional cooperators* (CCs). Second, subjects whose every conditional contributions is zero are called *free-riders* (FRs). Third, all conditional contribution profiles not fitting the first two categories are lumped into the category called *others*. This group includes various conditional contribution profiles such as full contributions, a hump-shaped profile, and a set of not easily classifiable profiles. This classification results in 93 CCs (48.4%), 66 FRs (34.4%) and 33 others (17.2%). The type distribution is very similar to those identified by Fischbacher et al. (2001) and Herrmann and Thöni (2009), although they used the MPCR of 0.4.

Using this categorization, we examine the crowding-out effect in unconditional contributions separately for each category. It might be puzzling that subjects categorized as free-riders have positive unconditional contributions on average in VCM. This follows

[18] We use the term "suggests", since the behavior of subjects under a self-financing prize design might be different than in our setting, even though we believe that any such difference would be small.

Figure 2: Unconditional contributions by conditional cooperation type



from the fact that the categorization is determined by conditional contributions, which might all be zero even if the unconditional contribution is positive. Overall, 18 of the 66 subjects categorized as free-riders have a positive unconditional contribution in VCM. Such a discrepancy might be accounted for by, for example, noise in the submission of subjects' decisions.[19]

Figure 2 displays the average unconditional contribution for each conditional cooperation type, separately by the two lottery prizes. The crowding-out effect is identifiable in each of the six plots with the exception of the "others" group under $R = 12$. Based on these averages, Table 4 presents pair-wise treatment effects by type and lottery prize, together with t-tests for their statistical significance. The first block of results (IM-FIX - VCM) is the most important for our purpose, it measures the size of the crowding-out effect. For CCs, there is a robust crowding-out effect for both prize sizes, although the effect is only marginally statistically significant for $R = 8$. For FRs, there is a statistically significant crowding-out effect for $R = 8$, but not for $R = 12$. For the others, there is no statistically significant treatment effect for either of the two prize sizes. The last line of the table present the difference between the size of the crowding-out effect for CCs and the FRs, separately for each prize size. The size of the effect is not significantly different

[19]Fischbacher et al. (2001) and Fischbacher and Gächter (2006) identify analogous discrepancies in the behavior of free-riders.

for $R = 8$, but it is marginally statistically significant for $R = 12$, with CCs having a stronger crowding-out effect than FRs. The latter finding is consistent with the hypothesis presented above: subjects with stronger pro-social motivations are more strongly affected by crowding-out in comparison to subjects more strongly driven by their own material incentives.[20]

Regarding the pure material incentive (LOT - IM-FIX), the second block of Table 4 shows that the effect is strongly present for both CCs and FRs for both prize sizes, with the effect being stronger for FRs, statistically significantly so for $R = 12$. Again, this finding is consistent with the hypothesis that FRs are more strongly driven by own material incentives to win the prize in comparison to CCs. The pure material incentive effect is also present for the others, but only with marginal statistical significance.

Finally, the last block of Table 4 presents the overall effect of introducing the lottery (LOT - VCM). Both CCs and FRs display a strong positive increase in the average contribution, with the effect being stronger for FRs, statistically significantly so for $R = 12$, reflecting the analogous finding from the previous block of the table. The lottery introduction also increases the average contribution of the others, but statistically only marginally significantly so, and only for $R = 12$. Overall, the results for the others indicate a combination of a smaller sample size (33 subjects) and a larger amount of noise in their decisions.

Replicating the calculation presented earlier for the pooled sample, we observe that, for CCs, the crowding-out effect reduces the pure material incentive effect by around 34% (0.90/2.68) for $R = 8$ and 61% (2.11/3.45) for $R = 12$. In comparison, the corresponding figures for FRs are 32% (1.19/3.72) for $R = 8$ and 10% (0.53/5.27) for $R = 12$. The proportional crowding out is barely different across the two types for $R = 8$. On the other hand, it is 6 times larger for CCs in comparison to FRs for $R = 12$. Hence the hypothesis that subjects with stronger pro-social motivations are more strongly affected by crowding-out in comparison to subjects more strongly driven by their own material incentives is not supported for the lower prize size, but it is strongly supported for the higher prize size.

These findings allow us to obtain a deeper insight into the net fundraising challenge of insufficient additional contribution generation in LOT vs. VCM in the pooled sample.

[20] We do not test for differences in the size of the crowding-out effect relative to the others, since we do not know how to interpret the findings of such a test.

Table 4: Treatment effects on average unconditional contribution by conditional cooperation type

	IM-FIX - VCM		LOT - IM-FIX		LOT - VCM	
	$R = 8$	$R = 12$	$R = 8$	$R = 12$	$R = 8$	$R = 12$
CCs	-0.90*	-2.11***	2.68***	3.45***	1.78***	1.34***
	(0.53)	(0.55)	(0.57)	(0.56)	(0.50)	(0.31)
FRs	-1.19**	-0.53	3.72***	5.27***	2.53***	4.73***
	(0.50)	(0.77)	(0.62)	(0.71)	(0.58)	(0.74)
Others	-1.00	0.15	1.7*	1.62*	0.70	1.77*
	(0.64)	(0.59)	(0.85)	(0.75)	(0.63)	(0.91)
CCs - FRs	0.29	-1.58*	-1.05	-1.81**	-0.75	-3.39***
	(0.73)	(0.94)	(0.84)	(0.90)	(0.76)	(0.80)

Notes:

[1] Standard errors are presented in parentheses.

[2] * , ** and *** denote significance at 10%, 5% and 1% level, respectively.

The finding that if the lottery had only a pure material incentive effect on contributions, as identified by LOT minus IM-FIX, there would be an aggregate increase in contributions in excess of the lottery prize, holds true in any population comprised of CCs and FRs (but not of the others) for both prize sizes. However, the findings differ when it comes to the actual increase in aggregate contributions from VCM to LOT. In a population comprised only of CCs, the increase in aggregate contributions falls short of the lottery prize under both prize sizes. On the contrary, in a population comprised only of FRs, the increase in aggregate contributions exceeds the lottery prize under both prize sizes.[21] Therefore, within the context of our experiment, these results suggest that a self-financing lottery increases net fundraising in a population dominated by FRs, but decreases net fundraising in a population dominated by CCs.

3.2 Conditional contributions

In this subsection, we analyze treatment effects on conditional contributions. Figure 3 displays average conditional contribution profiles by treatment and prize size. As in the unconditional contribution data, we observe a consistent increase in contributions in LOT relative to VCM under both prize sizes. However, the crowding-out effect is absent under

[21] The calculations underlying these claims can be easily carried out based on the effects reported in Table 4, analogously to how we carried out the calculations for the pooled sample (see above).

$R = 8$.[22] Under $R = 12$, it is present, but only for higher values of the conditioning variable (CV). In particular, the treatment effect IM-FIX minus VCM is numerically small (less than 0.1 in absolute value) for $CV \leq 2$ and statistically insignificant. For $CV = 3$ and $CV = 4$, the difference is -0.24 and -0.43, respectively, and it is statistically insignificant at conventional levels. For values of CV between 5 and 10, the difference ranges from -0.74 for $CV = 5$ to -1.19 for $CV = 10$, with the t-test p-value ranging from 0.006 to 0.015.[23] In comparison to the average effect of the pure material incentive (LOT minus IM-FIX) of approximately 3.55 on average, which is quite stable across all levels of CV[24], this constitutes roughly a one-fifth to one-third crowding out effect for values of CV between 5 and 10.

Differentiating subjects by their conditional cooperation type as in the previous subsection, Figure 4 displays average conditional contribution profiles by treatment, type and prize size. By construction, there cannot be any crowding-out effect for FRs. In comparison to the results from the pooled sample, the crowding-out effect is stronger for CCs.[25] In particular, it is now statistically significantly present for values of CV in the range $\{8, 9, 10\}$ under $R = 8$ and in the range $\{5, .., 10\}$ under $R = 12$. In these ranges, this constitutes approximately a one-third to 80% (for $R = 12$), a sometimes even more than 100% (for $R = 8$) crowding-out effect of the pure material incentive.

[22] The difference IM-FIX minus VCM is numerically small and statistically insignificant for any value of the conditioning variable. The results are available from the authors upon request.

[23] Detailed results are available from the authors upon request.

[24] In a regression of this treatment effect on CV, the slope coefficient (and its standard error) is -0.012(0.057).

[25] The data for the others is too noisy and the sample size is too small to draw any reliable conclusions.

Figure 3: Average conditional contributions

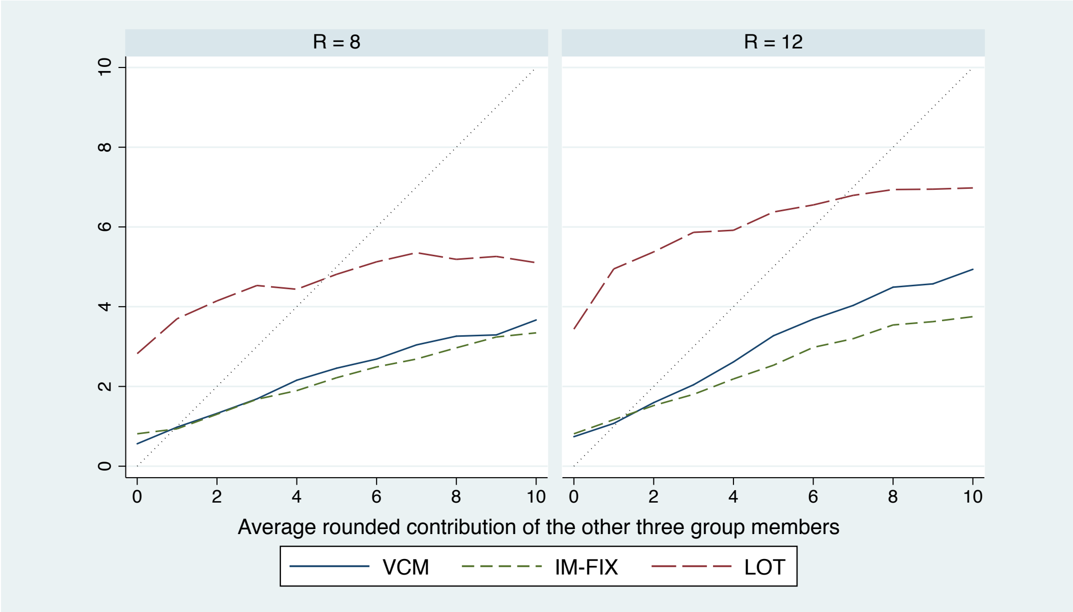
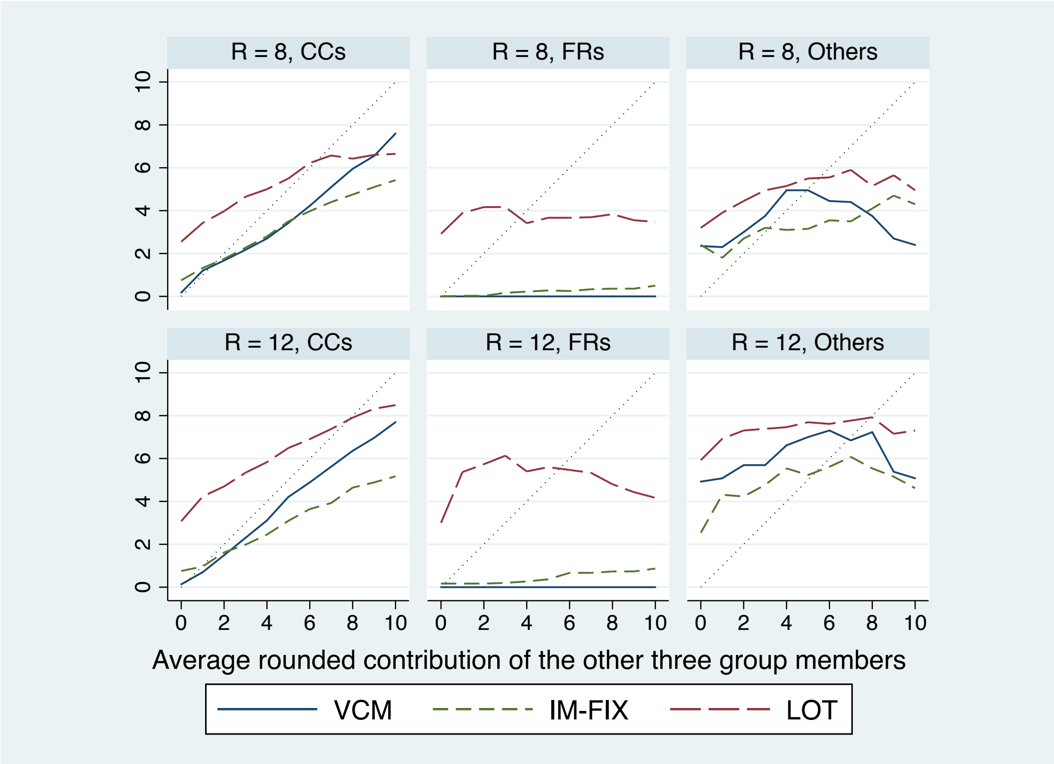


Figure 4: Average conditional contributions by conditional cooperation type



4 Conclusion and discussion

We investigate a possible crowding-out of pro-social incentives in fundraising for public goods by provision of explicit monetary incentives in the form of a fixed-prize lottery.

Our paper extends the theoretical findings of Morgan (2000) and the empirical findings of Morgan and Sefton (2000), Orzen et al. (2008) and Schram and Onderstal (2009), showing that introduction of a lottery increases contributions (on average). To identify the crowding-out effect, we introduce a new treatment in addition to the VCM and lottery treatments considered in the previous literature. In this treatment, three contribution group members are in a position analogous to the lottery treatment, competing for a lottery prize of three quarters the size of the prize in the standard lottery treatment. The remaining group member does not compete for the prize, but receives a compensatory transfer in the amount of one quarter of the prize in the standard lottery treatment. This subject is therefore faced with the same mapping of her own and others' contributions into her own payoff as in the VCM, with her own material incentive to seek the prize being switched off. Therefore the change in contribution between this treatment and the VCM identifies the crowding-out effect of pro-social contributions stemming from others having incentives to contribute driven at least partially by their own material gain.

We find a strong crowding-out effect on unconditional contributions in a pooled sample. This effect reduces the overall prize-seeking effect on contributions by about one third. Moreover, the effect is robust over a range of lottery prizes consistent with non-maximal Nash equilibrium contributions in the lottery game. We then separate the sample into three distinct groups by the pattern of conditional cooperation in VCM as defined by Fischbacher et al. (2001): conditional cooperators (CCs), free-riders (FRs) and others. Identifying conditional cooperation with pro-sociality, we hypothesize that the crowding-out effect identified in the pooled sample is stronger for CCs than for FRs. We do not find support for this hypothesis in case of lower prize size. The size of the crowding-out effect is approximately one third of the prize-seeking effect, as in the pooled sample. On the other hand, we find support for the hypothesis in case of the higher prize size. The size of the crowding-out effect for FRs is around 10% of the prize-seeking effect, while it is approximately 60% of the prize-seeking effect for CCs.

Regarding conditional contributions, in the pooled sample, there is no crowding-out effect for the smaller lottery prize, while there is a statistically significant crowding out effect for the larger lottery prize in the upper half of the conditioning domain. In proportion to the prize-seeking effect, the size of the crowding-out effect in this sub-domain ranges from one fifth to one third. When separating subjects into conditional cooperation types, we find, analogously to unconditional contributions, a stronger than average level of the crowding-out effect. Among CCs, the effect is present for both prize sizes, but again only in the upper part of the conditioning domain. In proportion to the prize-seeking effect, the size of the crowding-out effect in this sub-domain ranges from one third to more than 100%.

Our findings extend the evidence on the presence of crowding-out effects of pro-social motives by monetary incentivization into an important and empirically relevant mechanism of lottery fundraising for public goods. The results also suggest that the strength of the aggregate crowding-out effect is sensitive to the distribution of pro-social preferences in the population. In particular, for relatively high prizes, the crowding-out effect is likely to be stronger in populations with a majority of pro-social types in comparison to populations with a majority of self-regarding types. These findings have an important implication for fundraising design: the effectiveness of lottery incentivization is likely to be a function of social preference distribution in the target population. Lotteries, as opposed to pure contribution campaigns, are likely to be more effective in populations dominated by self-regarding individuals than in populations dominated by more pro-social types. Moreover, our results suggest that the difference might be between being able and being unable to increase net aggregate contributions when introducing a self-financing lottery.

Our study also has its limitations. Most importantly, although we believe that the identified crowding-out effect is predominantly driven by reciprocity to (expected) contributions of the others, we cannot rule out other theoretical explanations, such as inequality aversion. This complicates precise theoretical extrapolation from our results. More research is necessary to disentangle the two theories as explanations of giving in the VCM. Also, although we manage to consider a range of lottery prizes in our environment, due to budgetary and logistical constraints, we do not vary other parameters such as group size and MPCR. It would therefore be interesting to examine the results we have obtained vis-a-vis results obtained for other parameterizations. Finally, in order to provide a more direct examination of circumstances and population preference profiles under which a self-financing lottery prize increases net fundraising, it would be desirable to run an experiment with the lottery being self-financing. However, as mentioned earlier, this poses a challenge of how to finance the prize in cases of insufficient contributions. One solution would be to cap the prize by the amount of collected contributions. Although a such solution might be experimentally desirable for a study more focused on fundraising design, the uncertainty in the prize size it introduces makes it undesirable for a clean study of contribution incentives, as we pursue in in this study.

Acknowledgments

We would like to thank Christian Grund, seminar participants at the University of Vienna and RWTH Aachen and numerous conference participants for useful comments and suggestions. This research was supported by a grant from the CERGE-EI Foundation under a program of the Global Development Network (GDN grant RRC 12+77). All opinions expressed are those of the authors and have not been endorsed by RWTH Aachen University, CERGE–EI or the GDN.

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Appendix

Risk-Neutral Nash Equilibrium in the Lottery Treatment

Let $n \geq 2$ be the size of a contribution group, $w > 0$ be each player's initial endowment, $\alpha \in (0,1)$ be the MPCR, $R \geq 0$ be the externally-financed lottery prize, g_i be the contribution of player i and $\bar{g}_{-i}$ be the average contribution of the other three group members to the group project. Then the expected monetary payoff of player i is given by

$$E(\pi_i) = w - g_i + \alpha[g_i + (n-1)\bar{g}_{-i}] + \frac{g_i}{g_i + (n-1)\bar{g}_{-i}} R$$

if at least one of the contributions is strictly positive and

$$E(\pi_i) = w + \frac{R}{n}$$

otherwise (that is, in case of all contributions being 0, the prize is allocated randomly with equal probabilities). Note that if $R = 0$, this setup corresponds to the standard VCM in which each player's strictly dominant strategy is to contribute zero. If $R > 0$, then it is always preferable to contribute a positive amount rather than 0 if everybody else contributes zero, but the best response is not well-defined. Otherwise, if $R > 0$ and $\bar{g}_{-i} > 0$, note that the expected payoff is strictly concave in g_i. Hence the best response can be derived by considering the sign of the first derivative. In particular, since for this case we have that

$$\frac{\partial E(\pi_i)}{\partial g_i} = -(1-\alpha) + \frac{(n-1)\bar{g}_{-i}}{[g_i + (n-1)\bar{g}_{-i}]^2} R,$$

the best response is given by

$$g_i(\bar{g}_{-i}) = \begin{cases} \min\left\{\sqrt{\frac{(n-1)R\bar{g}_{-i}}{1-\alpha}} - (n-1)\bar{g}_{-i},\, w\right\} & \text{if } 0 < \bar{g}_{-i} < \min\left\{\frac{R}{(1-\alpha)(n-1)},\, w\right\} \\ 0 & \text{if } \frac{R}{(1-\alpha)(n-1)} \leq \bar{g}_{-i} \leq w \end{cases}$$

This statement also includes of the case $R = 0$, but, for the reasons stated earlier, it excludes the case $R > 0$ and $\bar{g}_{-i} = 0$. Note that the best response function has a limit point at the origin, is continuous, concave on the part of the domain on which it is positive, and it has an infinite slope at 0. As a result, for any admissible combination of parameter values, there is a unique Nash equilibrium that is symmetric with

$$g_i^* = g^* \equiv \begin{cases} 0 & \text{if } R = 0 \\ \frac{n-1}{n^2(1-\alpha)}R & \text{if } 0 < R < \frac{n^2(1-\alpha)w}{n-1} \\ w & \text{if } \frac{n^2(1-\alpha)w}{n-1} \leq R \end{cases}$$

Under the parametrization $n = 4$, $w = 10$ and $\alpha = 0.75$ that we use in the experiment, it follows that

$$g^* = \begin{cases} 0 & \text{if } R = 0 \\ \frac{3}{4}R & \text{if } 0 < R < 13\frac{1}{3} \\ 10 & \text{if } 13\frac{1}{3} \leq R \end{cases}$$

As a result, the only values of R that are divisible by 4 and that generate Nash equilibrium contribution levels strictly within $(0, 10)$ are $R = 4$, $R = 8$ and $R = 12$. Also, note that the optimal conditional contribution is given by

$$g_i(\bar{g}_{-i}) = \begin{cases} \min\left\{\sqrt{12R\bar{g}_{-i}} - 3\bar{g}_{-i},\, 10\right\} & \text{if } 0 < \bar{g}_{-i} < \min\{\frac{4R}{3},\, 10\} \\ 0 & \text{if } \frac{4R}{3} \leq \bar{g}_{-i} \leq 10 \end{cases}$$

For the values $R = 8$ and $R = 12$ that we use in the experiment, the optimal conditional contribution is inverse U-shaped in $\bar{g}_{-i}$ and always positive. Moreover, for $R = 8$, it reaches its maximum of 8 at $\bar{g}_{-i} = 2\frac{2}{3}$ (or $\bar{g}_{-i} \in \{2, 3\}$ for the provided rounded values). For $R = 12$, there is a flat maximum of 10 on the interval $[4 \pm \sqrt{96}/3]$ (or $\bar{g}_{-i} \in \{1, .., 7\}$ for the provided rounded values).

Abstrakt

Fundraising soukromých příspěvků na veřejné statky je často oslaben free-ridingem. Jeden z předních mechanismů, navržených pro zmenšení problému free-ridingu, je loterie s fixní cenou, kdy je pravděpodobnost výhry úměrná jednotlivým příspěvkům. Jak bylo značně zdokumentováno ekonomickými experimenty, subjekty často přispívají i bez pobídek tohoto druhu, jelikož jejich příspěvky jsou motivovány sociálními preferencemi. To nám klade otázku, jak finanční motivace loterií interaguje se sociálními preferencemi. Představujeme experiment, kde oddělujeme efekt přispívaní motivován snažením se o vlastní výhru od efektu potenciálního vytěsňování kvůli přesvědčení, že ostatní přispívají, kvůli výhře a ne proto, aby z toho měla užitek celá skupina. I když loterie relativně zvyšuje příspěvky vzhledem k dobrovolnému přispívání, zjistili jsme, že taky potlačuje dobrovolné příspěvky, motivované sociálními preferenciemi.

Working Paper Series
ISSN 1211-3298
Registration No. (Ministry of Culture): E 19443

Individual researchers, as well as the on-line and printed versions of the CERGE-EI Working Papers (including their dissemination) were supported from institutional support RVO 67985998 from Economics Institute of the CAS, v. v. i.

Specific research support and/or other grants the researchers/publications benefited from are acknowledged at the beginning of the Paper.

Published by
Charles University, Center for Economic Research and Graduate Education (CERGE)
and
Economics Institute of the CAS, v. v. i. (EI)
CERGE-EI, Politických vězňů 7, 111 21 Prague 1, tel.: +420 224 005 153, Czech Republic.
Printed by CERGE-EI, Prague
Subscription: CERGE-EI homepage: http://www.cerge-ei.cz

Phone: + 420 224 005 153
Email: office@cerge-ei.cz
Web: http://www.cerge-ei.cz

Editor: Byeongju Jeong

The paper is available online at http://www.cerge-ei.cz/publications/working_papers/.

ISBN 978-80-7343-424-3 (Univerzita Karlova, Centrum pro ekonomický výzkum a doktorské studium)
ISBN 978-80-7344-460-0 (Národohospodářský ústav AV ČR, v. v. i.)