Coming and going: Experiments on endogenous group sizes for excludable public goods ☆

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ABSTRACT

When a public good is congestible, individuals wanting to provide the public good face challenges in forming groups of optimal size, selecting the members of the group, and encouraging members to contribute for the public good. We conduct a series of experiments in which subjects form groups using three different entry and exit rules. The experimental results are analyzed in terms of group size, the level of public good provision, social efficiency, congestion and group stability. We find that entry restriction improves the average earnings for some individuals compared to free entry/exit or restricted exit. For a given group size, individuals under the restricted entry rule contribute more for the provision of the collective good. Also, for a given average contribution level of group members, subjects under the restricted entry rule suffer less from the congestion problem and are better able to form groups of sizes closer to the optimal.

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1. Introduction

A congestible public good is neither purely private nor purely public and, thus, the optimal size of the group to jointly provide and consume its benefits is somewhere between one and the number of the entire potential users. When exclusion is feasible, a congestible public good can be provided as a club good.[2] Collective action problems involving congestible public goods pose multiple related 50 challenges of which the primary one is in determining the size of the group.

The problem of optimal group size is extensively discussed by Buchanan (1965) and Olson (1965) with Buchanan focusing mostly on how the production technology determines the optimal size of the group while Olson focuses more on how the behavior of group members may limit the size and even how the behavior of group members may vary with the size of the group. Olson's main argument regarding the relationship between group size and collective action was that the larger the group size the less optimal will be the provision of a collective good. Many scholars showed later that the relationship is not as simple as what Olson

argues but depends on the characteristics of the collective good such as the congestibility and the individual costs of contribution toward the public good (Chamberlin, 1974; Esteben and Ray, 2001; Frohlich and Oppenheimer, 1970; Hardin, 1982; Oliver and Marwell, 1988). More recently Barham et al. (1997) point to the importance of both the factors of provision technology and individual behavior in determining the optimal size of a group especially when the provision of the good is voluntary. The point is that the optimal size of a group is a complicated mix of the underlying technology of the provision, how group members behave and then how individual behavior in the group varies as the size and composition of the group vary.

To demonstrate the interaction between technology and individual behavior, consider the attributes of a community swimming pool. Technologically, there is some capacity limit to the number of swimmers that can be supported in the pool before it gets too crowded and the enjoyment of the pool is negatively impacted by more swimmers. The practical point at which this occurs, though, also depends on the behavior of those in the pool. A group of people who are polite and considerate of others can likely grow relatively large before the negative externality becomes a problem. However, even a small number of people who act in a less considerate manner can impair the enjoyment of the pool at a much lower group size. So a group attempting to provide a congestible public good for its members faces this complex problem of determining and regulating the size of the group to achieve optimal levels of public good production, which is a function of the technology of the good itself as well as the behavior of the group members.

When faced with these issues, an important tool to a group is the ability to determine its own membership. Ostrom (2005:260-1), for example, argues that "groups' determining their own membership" is the first step toward "developing a greater trust and reciprocity." While some groups may not be allowed to exclude others from consuming the public good (e.g. cities can not ban non-residents from driving on their roads), there are a variety of existing arrangements currently in use for exactly this purpose. Country clubs, cooperative apartments, and medical practices, for example, have well specified rules for who can join, while neighborhood associations[3] and religious denominations have rules about who may leave. Ostrom (2005) calls these rules of entry and exit "boundary" rules.

Boundary rules define (1) who is eligible to enter and take a position in the group, (2) the process of selecting among potential members, and (3) how an individual may leave (or must leave) the group. While these rules can be useful in regulating the size and composition of a group, they may lead to yet another complication for a group. That is, the behavior of group members may change as a function of the particular set of boundary rules chosen to govern group membership.

The question we focus on in this study is how different sets of boundary rules may affect the extent to which groups of efficient sizes are formed and the level of cooperation among group members in providing a congestible public good. To address this issue, we conduct a series of experiments in which 12 subjects form groups using different entry and exit rules and make decisions on the level of contribution for a congestible public good. In our experiment group formation is fully endogenized in terms of group size and composition. The experiments are conducted under three different entry and exit rules: 1) free entry and free exit (FEE), 2) restricted entry and free exit (RE), and 3) free entry and restricted exit (RX). When entry (exit) is restricted, an individual hoping to join (leave) a group must obtain the approval of a majority of group members.

To the extent that the subjects in our experiment can freely enter or freely exit a group, the experimental environment also relates to Tiebout's (1956) model of "voting with feet." But, of course, the foot-voting in our experiment is limited by the rules of entry and exit while Tiebout's original model assumes fully mobile consumer-voters. In addition, while several Tiebout models assume that groups determine the level of public goods provision by a majority rule (Epple et al., 1984; Goodspeed 1989; Epple and Romer, 1991; Nechyba, 1997; Fernandez and Rogerson, 1996, 1998, for example), our experimental design lets group composition be determined partially by majority rule (in RE and RX) and the provision level determined by a voluntary contribution mechanism. Ultimately whether our environment is seen as a specialization of a Tiebout model in regard to how the public good is provided or as a broadened public good model with group formation, the ultimate issues to be examined are the same.

One obvious group formation tool we leave out of our analysis is "forced exit," or "expulsion." One might question this choice since it would be reasonable to expect that expulsion would be the most powerful group formation rule to boost cooperation among group members. This issue has received previous investigation though as in Cinyabuguma et al. (2005) which reports that when there is a threat of expulsion the level of contribution for the provision of a public good rises to nearly 100% of the social optimum. Were we to include expulsion in our environment, there is every reason to expect similar results. Examining group formation without expulsion is still a worthwhile exercise because while many groups in the real world use expulsion as an instrument to regulate membership, there are many other groups for which expulsion is either infeasible or too costly an option to exercise. Examples include forcing a city or township to de-annex from a larger unit, evicting a resident from a co-op apartment building, expelling a tenured faculty member and so forth. In these examples, expulsion is, if not physically impossible, often impractical, and the rules of entry and exit play a more important role in determining group size and membership. Consequently we designed our study to investigate the marginal effects of these perhaps less powerful tools of regulated entry and exit compared to a baseline condition of free entry and exit to determine if they can be used to increase or decrease pro-social behavior in settings for which exclusion is infeasible.[4]

The experimental results are analyzed in terms of five key variables: group size, contribution level, social efficiency, congestion, and group stability. The key result we will show is that subjects in the restricted entry treatment are able to achieve substantially higher earnings than subjects in the other treatments. The subjects in the restricted entry treatment will generally form smaller

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[3] While most religious organizations may not restrict individual people from exiting, there are many current debates about whether the Episcopal and Presbyterian Churches in particular can restrict individual congregations from leaving. In certain "cult" religions individual exit is of course prohibited and in some countries with official religions, individual exit will also be restricted.

[4] We note that we are not the first to examine group formation in games of this nature with a focus on mechanisms other than exclusion. Several other studies such as Coricelli et al. (2003), Gunthorsdottir et al. (2001) and Page et al. (2002) have experimentally examined various forms of less severe group formation rules, but with exogenously determined group size. Our intention in this study is to study the marginal effects of entry and exit restriction in a fully endogenized group formation context.