Journal of Public Economics 121 (2015) 52–65

Contents lists available at ScienceDirect

Journal of Public Economics

journal homepage: www.elsevier.com/locate/jpube

Cursed beliefs with common-value public goods

Caleb A. Cox *

Department of Economics and Finance, Durham University Business School, Mill Hill Lane, Durham DH1 3LB, United Kingdom

ARTICLE INFO

Article history:
Received 19 December 2013
Received in revised form 18 November 2014
Accepted 19 November 2014
Available online 26 November 2014

JEL classification:
C72
C92
D03
D71
H41

Keywords:
Public goods
Experiments
Cursed equilibrium
Game theory

ABSTRACT

I show how improper conditioning of beliefs can reduce contribution in public goods environments with interdependent values. I consider a simple model of a binary, excludable public good. In equilibrium, provision of the public good is good news about its value. Naive players who condition expectations only on their private information contribute too little, despite the absence of free-riding incentives. In a laboratory experiment, contributions indeed fall short of the equilibrium prediction. Using modified games with different belief-conditioning effects, I verify that subjects fail to condition beliefs properly. However, improper belief conditioning cannot fully explain the results.

1. Introduction

The provision of public goods is a central issue in economics. Research on public goods has primarily focused on incentives to free-ride and various mechanisms for overcoming these incentives. In this paper, I demonstrate another force that may impede the provision of public goods, even in the absence of free-riding. In public goods environments with common or interdependent values, individuals may fail to correctly condition their beliefs about the uncertain value of a public good. Many public goods in the real world may have substantial common-value components, such as dispersed information about uncertain quality. Real-world public goods such as pollution abatement, national defense, police protection, and flood control may be of uncertain value, and information about the value may be decentralized. Individual contributors to such public goods should condition their beliefs about value on not only their private information, but also the information implicit in the strategic contribution choices of others. Failure to do so may lead to incorrect expectations about the value of the public good.

To isolate the belief-conditioning effect of interest in the absence of free-riding incentives, I consider a simple case of a binary, excludable public good (or club good), such as a toll road or private park. To illustrate, consider the choice of whether to participate in some costly group activity. The value of this activity is unknown, and information about the value is dispersed among the potential participants. Such information might come from individual experiences and knowledge or simply from intuition. Examples of such activities might include purchasing a membership to a planned recreation facility or a home in a new gated community, joining a joint business venture or working on a co-authored research project, or registering as a student in a new course at a university.[1] In order for the group activity to be viable, some minimum threshold of participants must be reached. If the threshold is not reached, the activity is canceled and individuals who chose to participate pay no cost. Potential participants each observe private signals correlated with the uncertain value, and then simultaneously choose whether or not to participate. Each individual should consider two possible cases: the minimum threshold of participants is either reached or it is not. If the threshold is not reached, her decision to participate is inconsequential, as she will pay no cost. Thus, she should condition her expectations on the event that the threshold is reached. It is important to note that this event contains useful information about

* Tel.: +44 191 33 45425; fax: +44 191 33 45201.
E-mail address: caleb.cox@durham.ac.uk.

[1] The last example comes from personal experience as a student registering for new course in game theory and experimental economics at the University of North Carolina at Charlotte in 2007, which I feared might be canceled due to low enrollment.

http://dx.doi.org/10.1016/j.jpubeco.2014.11.006
0047-2727/

the value of the activity, since in equilibrium it implies that other participants observed relatively favorable signals. Thus, an individual who correctly conditions her beliefs on this event should expect the value to be higher than she would conditional on her private signal alone. Failure to properly condition beliefs would reduce contribution and provision relative to equilibrium.

The ability to share private information might alleviate this problem. However, there are a number of reasons why it may be difficult to share information. Beyond simple barriers to communication (such as difficulty sharing technical knowledge or simply not knowing each other), there may be incentives not to be truthful about private information. If there is a private value component so that the total value of the public good is not purely common to everyone, then there may be an incentive to lie to influence others. Similarly, if the good is not purely excludable, or if contributions may be unequal, then some form of free-riding incentive may prevent truthful communication. If the good is congestible, again it may be in an individual's interest to misrepresent her private information. In the simple case I consider in the experiment, incentives are fully aligned so that individuals would have no incentive to lie if they could communicate. However, incentives to lie may exist in more complex cases.[2]

In the theoretical portion of this paper, I develop a simple model of excludable public goods with interdependent values and compare the predictions of Bayesian Nash equilibrium with naive strategies, formalized by the cursed equilibrium model of Eyster and Rabin (2005). In their model, agents believe that, with some probability, others ignore their private information and choose an action according to the (equilibrium) ex ante distribution of actions. For this reason, each agent's belief about the distribution of actions chosen by others is correct, but agents do not fully account for the link between others' actions and their private information. I show that cursed beliefs reduce contribution relative to Bayesian Nash equilibrium, including the possibility of zero contribution for some parameter values.

Testing these predictions in the field would be problematic, since individuals' private information is unobservable. Therefore, I design a laboratory experiment to test whether improper conditioning of beliefs reduces contribution. The main treatment (the common-value threshold game) has 5 players in a group, with a threshold of 4 contributors required for provision. I vary the cost of contribution to determine whether contribution levels conform to Bayesian Nash equilibrium or naive strategies for high, low, and intermediate costs. Rather than closely mimicking any particular real-world application, the experiment is designed to create a stark separation between the Bayesian Nash equilibrium and fully-cursed equilibrium predictions to examine the degree to which subjects (fail to) properly condition beliefs in making contribution choices.

Improper belief conditioning has been previously observed in other contexts, such as the winner's curse in common-value auctions. In common-value auctions, bidders should update their belief about value downward conditional on winning, while in my context, contributors should update their belief about value upward conditional on provision of the public good. In order to compare the results of the main treatment to the more well-known winner's curse in common-value auctions, I consider an "anti-threshold" game with the same environment, except that the public good is provided to contributors if and only if *no more* than 2 players contribute. The anti-threshold game is analogous to a simple common-value, two-unit auction with restricted bids and no trade in the case of excess demand. This treatment allows for comparison of behavioral responses to favorable and unfavorable belief conditioning effects, as well as comparison of how subjects learn to account for these effects over several rounds of play.

Sources of error other than improper belief conditioning might drive behavior away from equilibrium. To isolate the effect of belief conditioning, I consider a treatment with uncertain private values. Each subject has an uncertain private value for the excludable public good and observes a signal correlated with this value. While there is still uncertainty in this treatment, a given subject's value is uncorrelated with other subjects' signals. Therefore, no subject has information about the value of the public good to others, which is a key difference from the common-value case. Play proceeds as in the main treatment. In this case, the symmetric Bayesian Nash equilibrium strategy precisely corresponds to the naive (or fully-cursed) strategy from the common-value threshold game. Thus, if subjects are naive, there should be no difference in behavior between these treatments, while correct conditioning of beliefs should lead to higher contribution in the common-value setting than the uncertain private values setting.

The experimental results show that contribution falls well below the BNE benchmark in the main treatment. Despite sharp differences in the Bayesian Nash equilibria of the games with favorable, unfavorable, and no belief-conditioning effects, actual behavior is quite similar between games, and in fact indistinguishable between the main treatment and the uncertain private values treatment. Thus, the results suggest that subjects *completely* fail to condition their beliefs in the proper direction. While fully-cursed equilibrium succeeds in predicting this similarity between treatments, it does not predict contribution levels very accurately. Moreover, behavior differs substantially from equilibrium even in the uncertain private values treatment, which cannot be explained by cursedness. This result highlights the importance of including a baseline without the potential for belief conditioning rather than using only theoretical benchmarks to examine belief conditioning effects.

The paper is organized as follows. Section 2 explores the related literature. Section 3 describes the model and theoretical predictions. Section 4 details the experimental procedures. Section 5 shows the results. Section 6 concludes with a discussion of the key findings. The Appendix contains proofs of the theoretical results from Section 3. Separate Online Appendices A and B contain supplementary data analysis and experimental instructions, respectively.

2. Related literature

Many previous experiments consider non-excludable, step-level public goods and provision points, including Van de Kragt et al. (1983), Dawes et al. (1986), Isaac et al. (1989), Marks and Croson (1999), and Croson and Marks (2000). Provision point or threshold mechanisms have been generally successful in such environments under complete information or private values. Several experiments, such as Croson et al. (2006), Kocher et al. (2005), Swope (2002), and Bchir and Willinger (2013) find that excludability tends to increase contribution in a variety of linear and step-level public goods environments, while Czap et al. (2010) find higher contribution to non-excludable projects compared to excludable projects. Gailmard and Palfrey (2005) compare alternative cost-sharing mechanisms for excludable public goods and find that a voluntary cost-sharing mechanism with proportional rebates performs best.

Several papers explore uncertain returns in public goods experiments. In a voluntary contribution, linear public goods game, Dickinson (1998) finds that uncertain provision of the public good reduces contribution relative to certain returns in early rounds of play by a small but significant amount. Gangadharan and Nemes (2009) also find reduced contribution under uncertain provision of the public good in cases of known and unknown probability of provision. In a strategy-method public goods game with heterogeneous marginal returns, Fischbacher et al. (2014) find that uncertainty about one's

[2] These barriers to communication are similar to the discussion of Fedderson and Pesendorfer (1998) about why jury members may be unable to fully share private information.