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Community enforcement when players observe partners' past play ☆

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Abstract

I investigate whether a large community can sustain cooperation in the repeated prisoner's dilemma by having cheaters punished not by their victims but by third parties. In the setting where players can observe their partners' past play only, I show that cooperation can be sustained by an equilibrium that has the following two properties: players choose their actions independently of their own past play, and they are indifferent between cooperation and defection at all histories. This equilibrium carries over to the finite-population setting and is robust to noise in the process of choosing actions or of recording past play.

JEL classification: C70; C72; C73

Keywords: Repeated game; Random matching; Community enforcement; Belief-free equilibrium; First-order information

1. Introduction

There are various mechanisms that sustain cooperation in the repeated prisoner's dilemma. In a small community where each player meets the same partner frequently, players can sustain cooperation through *personal enforcement*, having cheaters punished by their victims. In a large

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community where players interact with varying partners over time, however, personal enforcement may not provide enough incentives to cooperate. Even in such a case, cooperation can be sustained if third parties punish deviators. This mechanism is called *community enforcement*. To implement this mechanism, it is important for the community to share enough information about past plays so that players know who needs to be punished.

This paper investigates whether sharing first-order information can sustain cooperation in a large community. Here, first-order information is a record of the current partner's past play, whereas second-order information is a record of the current partner's past partners' past play, third-order information is a record of the current partner's past partners' past partners' past play, and so on.

This information structure is motivated by consumer credit histories and online feedback.[1] At eBay, for example, after each transaction, both the seller and the buyer can post a rating (positive, negative, or neutral) and a short comment. An eBay member is asked "to leave only fair and factual comments and ratings that relate to a specific transaction you [the eBay member] had with your trading partner."[2] If customers follow this instruction, feedback scores contain only first-order information.[3] There are several reasons not to use higher-order information. First, first-order information is arguably less costly to be stored and transmitted than higher-order information. For example, it is easier to know whether one uses violence against another than to understand their circumstance that justifies the violence as self-defense. Second, first-order information is cognitively less demanding to be processed. Milinski et al. [22] report that, in their experiment, subjects who were given first- and second-order information needed significantly more time to respond than those who were given only first-order information. Moreover, subjects with higher-order information often failed to distinguish simple cheating from punishment.[4]

The main difficulty in sustaining cooperation without higher-order information is that players cannot distinguish cheaters from those who punish cheaters. Despite this difficulty, I show that cooperation can be sustained with first-order information. I use two different classes of equilibria to sustain cooperation. The first class consists of the grim-trigger strategy and its modifications, which sustain cooperation in strict equilibria if the stage game is strictly supermodular. If the stage game is submodular, however, there is no strict equilibrium other than permanent defection.[5] To sustain cooperation in both cases, I consider the second class of equilibria that satisfy the following two properties: players choose actions independently of their own records of play, and they are indifferent between cooperation and defection at all histories. I call such equilibria *independent and indifferent equilibria*. Due to the first property, each player's continuation payoff is independent of who he meets or what record of play his partner has. Moreover, due to the second property, he has weak incentives to vary the probability of cooperation based on his partner's record of play. I control this probability carefully so that the partner actually becomes indifferent between cooperation and defection.

[1] Credit histories, however, may include higher-order information. For example, a consumer's outstanding debts reflect not only that he has borrowed money from creditors but also that creditors have decided to lend money to him, which is second-order information.

[2] http://pages.ebay.com/help/feedback/questions/feedback.html.

[3] Higher-order information may be available through feedback comments.

[4] Panchanathan and Boyd [24], however, argue that people do not directly use higher-order information as in [22], but rely on summary statistics such as "good" or "bad." Conducting an experiment similar to [22], Bolton et al. [2] find that second-order information increases the ratio of cooperation.

[5] Supermodularity and submodularity are defined in Section 2.