3 Social Interaction in Anti-Coordination Games

D. López-Pintado, Y. Bramoullé, S. Goyal and F. Vega-Redondo
University of Alicante
dunia@merlin.fae.ua.es

Abstract

We study a setting in which individual players choose their partners as well as a mode of behavior in 2 × 2 anti-coordination games. We characterize the nature of equilibrium network structures as well as study the effects of network structures on individual behavior. Our analysis shows that the structure of the equilibrium networks depends on the value of the cost of forming links. As the cost grows the structure is less connected and we get stable bipartite graphs. We also show that, the relative magnitude of the individuals doing each action in the anti-coordination game depends crucially on the cost of forming links. If the costs are high, then there is a wide variety of stable networks, some of them being very asymmetric bipartite graphs. However, if they are low, only the complete and essential graph with a particular proportion of individuals doing each action is stable.

Introduction

In the past few years, there has been an extensive literature on social networks which shows that the structure of interaction between individuals can be decisive in determining the nature of the outcomes and, in particular, the players’ action choices in an underlying game. In much of this literature, the structure of interaction is exogenously specified and the nature of the outcome under different specifications is examined (see e.g., Ellison, 1993; Goyal, 1996; Morris, 2000).

Recently, interest has grown in understanding the process through which the interaction structure itself develops. The earlier part of this literature (e.g. Jackson and Wolinsky (1996) or Bala and Goyal (2000)) has focused on contexts where players choose links with others and there is no additional strategic dimension (i.e. there is no explicit game being played among connected players). Later contributions, such as Jackson and Watts (2000) or Goyal and Vega-Redondo (2000), have studied settings in which each agent plays a game with each of her ‘partners’ and therefore (in addition to connecting decisions) has to choose a mode of behavior in the accompanying game. This research has focused on a class of games where individuals have an incentive to choose the same action as their partners; these games are referred to as coordination games. In the present paper, we wish to consider the role of network formation in the polar case, where individuals prefer to choose an action unlike the action chosen by their partners. We shall refer to these interactions as games
Many interesting situations can be suitably conceived in this fashion, e.g., when the successful completion of a task requires that the individuals involved adopt complementary actions (or skills), or when a meaningful interaction can only be conducted when the agents adopt different roles (say, buyers and sellers), or when in the contest for a certain resource (say, in a Hawk-Dove game), an optimal response is not to respond with the same behavior (aggressive or peaceful) as one's opponent.

We study the following model: We consider a model where individuals can form pair-wise links on their own, i.e., the link formation is one-sided. The players initiating the link pay for the link. In addition to the links, each player also chooses between two actions that he uses in the interaction with his partners. The payoffs to a players consist of returns in each of the pairwise interactions less the costs of forming links.

In this setting, we first characterize the Nash equilibria. We find that the nature of the stable networks (complete, bipartite, semi-bipartite,...) depends crucially on the range of cost values. If the costs are high, then very asymmetric bipartite graphs are stable, whereas if they are low only the complete networks with a particular proportion of individuals doing each strategy are stable. This variety of equilibria motivates an examination of the dynamic stability of different outcomes. Our analysis however demonstrates that all Nash equilibria are stochastically stable, i.e., they are robust to small but persistent perturbations.

Finally, we also study the efficiency of the different network structures. We obtain that when costs are low, the equilibrium and efficient networks coincide only under very specific payoffs configurations of the anti-coordination game. Notwithstanding, in general, equilibrium and efficient profiles are two disjoint sets. When costs are sufficiently high we observe that, in general, there are some efficient networks which are also equilibrium, but there is a wide range of equilibria highly inefficient.

It is interesting to relate these results to the findings concerning coordination games. Goyal and Vega-Redondo (2000) show that the unique stochastically stable interaction structure is the complete network (with every pair of players linked). Moreover, social conformism obtains, with everyone doing the same action. When costs are low, the risk dominant action is obtained in the stochastically stable outcome, whereas when costs are high it is the efficient action the one that arises in a stochastically stable state. The results of this paper suggest that anti-coordination games have very different properties: a wide variety of network structures can arise and they have widely varying levels of efficiency.

\cite{Bramoullé2001} analyzes anti-coordination games played on a fixed structure. He shows that anti-coordination games lead to much richer outcomes than coordination games. Notably, equilibria are more sensitive to the structure.