Efficiency, Networks and Evolution of Conventions

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Abstract

In this paper we present a simple evolutionary model of mobile agents where different 2x2 games exist at different locations. The role of information, mobility, and the payoff structure is examined for achieving global efficiency. We apply our results to network design and institutional choice. Our model is an extension of Ely's (2002) model in two directions: (1) we assume that agents have information about and can move only to *neighboring* games – we explicitly consider different network structures; (2) we allow coordination games to be different at different locations – we model heterogeneous payoff structures.

We show several important results. First, we are able to describe all short run outcomes: absorbing states and sets. In the short run, agents coordinate on a pure strategy Nash equilibrium in each game. This is consistent with the previous literature such as Ely (2002) and Anwar (2002). It is standard to have only absorbing states in models with mobile agents, see Ely (2002) and Anwar (2002). However, absorbing sets are new features in the literature. These sets arise in our model, because of assumption (1). It turns out that the number of absorbing sets (and states) is decreasing in the number of neighbors one has. If each location is a neighbor of every other location (complete network), then *all* absorbing sets will vanish.

Second, we characterize long-run outcomes. In particular, we find conditions for the payoff structure and the network structure, which guarantee that the globally efficient outcome will be the unique prediction in the presence of vanishingly small perturbations. It turns out that the global efficiency cannot be the unique prediction in general, if we can

manipulate the number of neighbors. However, we do show an `at least second best' result: either the risk-dominant equilibrium at the globally efficient location or the efficient outcome, can *always* be the unique long run prediction.

We also consider applications of our results. For example, we examine several network structures including completely connected networks, star networks and wheel networks and show how a social planner may design networks to achieve efficiency.

We find that the social planner faces a trade off between the two assumptions (1) and (2). If he knows the payoff structure than he can use sparse network to achieve "near" efficiency. Alternatively, the social planner can use complete network, then he does not need to know the payoff structure in order reach "near" efficiency.

Game theorists have long been interested in efficient equilibrium selection. Among others Kandori, Mailath, and Rob (1993); Young (1993, 1998); Ellison (1993, 2000); Ely (2002); Anwar (2002). We provide more general framework and find conditions for efficiency.