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Noise-independent selection in multidimensional global games ☆

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Abstract

This paper examines many-player many-action global games with multidimensional state parameters. It establishes that the notion of noise-independent selection introduced by Frankel, Morris and Pauzner [D. Frankel, S. Morris, A. Pauzner, Equilibrium selection in global games with strategic complementarities, J. Econ. Theory 108 (2003) 1–44] for one-dimensional global games is robust when the setting is extended to the one proposed by Carlsson and Van Damme [H. Carlsson, E. Van Damme, Global games and Equilibrium selection, Econometrica 61 (1993) 989–1018]. More precisely, our main result states that if an action profile of some complete information game is noise-independently selected in one-dimensional global games, then it is also noise-independently selected in all multidimensional global games.

MSC: C72; D82

Keywords: Equilibrium selection; Global games; Strategic complementarities; Robustness

1. Introduction

A global game extends a complete information game g by a payoff function u that depends on an additional state parameter t. In this approach, each agent receives a noisy private signal about the true state. Hence, at equilibrium, he's uncertain not only about his own payoff function but also – and more importantly – about other agents' beliefs and behavior. In their seminal paper,

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Carlsson and Van Damme [3] (hereafter, "CVD") showed that, for two-player two-action games, the set of rationalizable strategies shrinks to a unique equilibrium as the noise in private signals vanishes. Frankel, Morris and Pauzner [6] (henceforth "FMP") extended CVD's approach to many-player many-action games with strategic complementarities by showing that as the amplitude of the noise goes to zero, the limit uniqueness result of CVD holds: agents coordinate on some action profile that is a Nash equilibrium of the complete information game g.

FMP's extension of CVD's setting allowed to apply the global game approach, which is rich enough to capture the important role of higher-order beliefs, but simple enough to allow tractable analysis, to a wide range of topics including currency and financial crises, models of pricing debt, bank runs,[1] etc.

However, there are two important differences between CVD and FMP. Firstly, in contrast to CVD, FMP restrict their analysis to settings where the state parameters belong to the real line and assume that higher states lead to higher actions. Such an assumption is restrictive since in involved coordination problems, agents often have to examine several different criteria. For example, in currency attacks against a peg exchange rate, both the level of international reserves and interest rate policy can affect the outcome of the attack (Flood and Jeanne [5]). In addition, restricting to one-dimensional settings may imply too much homogeneity among the agents: indeed, in the one-dimensional setting, if the switch from one state to another gives to *one* agent an incentive to play a higher action, then it must also be the case for *all* the other agents. Multidimensional settings do not impose this limitation at all: an N-player complete information game may be embedded in an N-dimensional global game where the payoff of each player i is given by the value of the i-th coordinate of the payoff parameter.

Secondly, while CVD established that in two-player two-action games, the selected equilibrium is to play the risk-dominant strategy (Harsanyi and Selten [7]), FMP provide a counterexample showing that, unfortunately, in many-player many-action games, the selected action profile may depend on the fine details of the noise distribution. They thus define the notion of noise-independent selection: an action profile is said to be noise-independently selected at some state parameter if it is played at this state parameter regardless of the noise structure. Not being noise-independent is a weakness for a given selection since the global games approach considers situations where the noise shrinks to zero: in general, there is no specific rationale for choosing a noise structure rather than another.

The present paper considers a setting generalizing both the framework of CVD and that of FMP: (i) the complete information game g has an arbitrary number of players and actions[2] and the state parameter t is multidimensional; (ii) in addition, in contrast with FMP, it is not assumed that for each state parameter t in the support of the prior distribution, the complete information game associated with t is supermodular[3]; (iii) finally, the noise structure may vary (in a continuous way) with the payoff parameter t. (Notice that, since (iii) is not satisfied in FMP's setting, our definition of one-dimensional global games is strictly more general than the one of FMP.

[1] For a survey of the applied literature, see Morris and Shin [10] and Morris [9].

[2] In FMP's setting, the action set of each player i, $A_i \subseteq [0, 1]$ can be any closed, countable union of closed intervals and points. Nevertheless, in this paper, since we need to use compactness arguments in our proofs, we restrict our analysis to finite action sets.

[3] More precisely, it is only assumed that supermodularity is satisfied in the neighborhood of some path which includes the complete information game g and reaches the dominance regions. Hence, the ex ante probability of supermodularity can be chosen arbitrarily close to zero. See Assumption 4 for more details.