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Tractable dynamic global games and applications ☆

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Abstract

We present a family of tractable dynamic global games and its applications. Agents privately learn about a fixed fundamental, and repeatedly adjust their investments while facing frictions. The game exhibits many externalities: payoffs may depend on the volume of investment, on its volatility, and on its concentration. The solution is driven by an invariance result: aggregate investment is (in a pivotal contingency) invariant to a large family of frictions. We use the invariance result to examine how frictions, including those similar to the Tobin tax, affect equilibrium. We identify conditions under which frictions discourage harmful behavior without compromising investment volume.

JEL classification: C7; D8; H2

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1. Introduction

Many phenomena modeled as global games, be it bank runs, political revolutions, or creditors' panics, are inherently dynamic processes. Yet, the global games commonly applied to these problems are static, simultaneous-move games. This paper develops a tractable dynamic global game with a flexible parametrization. Under some conditions on payoff externalities, the game reduces in equilibrium to a static global game, justifying the static approach used in the applied literature. Under other conditions, however, the dynamic effects prevail. In these cases, adjustment frictions can significantly affect the ex ante probability of successful coordination, impacting welfare.

A continuum of agents interact in a coordination game where expectations of both high and low economic activity can become self-fulfilling. Agents gradually and privately learn about the fixed state of the economy, form expectations about the coordination outcome of the economy, and perpetually adjust their investment positions. An agent's payoff depends on her investment path and on the outcome of the economy, which either succeeds or fails. The outcome is a function of the state and of various statistics of investors' behavior, including the terminal volume of investment, the volatility of investment, the exit rate, and the dispersion of investment across agents. Allowing for general transaction costs, we examine how frictions impact these statistics and ultimately how they affect the likelihood of successful coordination in equilibrium.

Our main technical contribution is the *invariance result*, which characterizes the volume of aggregate investment at the end of the adjustment process in a critical state of the economy. The state of the economy is drawn from the real line, and agents repeatedly learn about the state from private signals. We examine monotone equilibria with a critical state such that the economy succeeds when the realized state exceeds the critical state and fails otherwise. The invariance result shows that aggregate investment in the critical state depends only on a small subset of the model's parameters. It depends only on payoffs along the two extreme investment paths preferred by an agent who knows that the economy fails or succeeds, respectively. The invariance result allows us to solve for the equilibrium critical state, and to analyze the welfare effects of frictions.

The invariance result is driven by the *translational* symmetry of the model; it requires local properties of the information structure to be independent of the realized state. The same assumption underlies the existing solutions in static global games. For example, selection of the risk-dominant action in Carlsson and van Damme [8] or selection of the Laplacian[2] action in Morris and Shin [28] are driven by this assumption. Kováč and Steiner [22] use the symmetry to derive a partial equilibrium characterization in a two-stage global game.

Let us illustrate the invariance result on an emerging economy attempting to attract foreign investments and to discourage capital reversals. Exit penalties may help achieve the latter goal, but their effect on the investment volume is seemingly inconclusive. While investors become less likely to exit upon receiving bad news about the economy, they are also less likely to enter in the first place. In our model, these two effects offset each other *exactly* and under general conditions (in the critical state). The volume of capital that the economy attracts and retains is independent of the frictions. Guided by this invariance result, the policy maker may introduce efficiency-enhancing frictions based on their effect on capital reversals only. Section 2 develops this example further.

[2] Morris and Shin use the term "Laplacian action" for the action preferred by an agent who has uniform belief about the aggregate behavior.