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Intertemporal coordination with delay options

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Abstract

This paper studies equilibrium selection in intertemporal coordination problems with delay options. The risk-dominant action of the underlying one-shot game is selected when frictions are arbitrarily small. Larger frictions introduce real option effects in the model and inhibit coordination.

JEL classification: C73; D84

Keywords: Intertemporal; Coordination; Delay options; Overlapping generations

1. Introduction

Intertemporal coordination problems, where an agent's payoff depends on the future behavior of other agents, are frequent in economics. In the R&D industry, the benefit of current innovations depends on the emergence of complementary future innovations. In asset markets, the benefit of holding a particular asset depends on its fundamental value but also on its liquidity, i.e., the facility with which the asset may be accepted in trade in the near future. Of particular importance in such problems is how the possibility of delaying a costly action (e.g., an innovation, the acquisition of an asset) may impact coordination. In this paper we examine this issue in

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the context of an OLG model, a prototypical environment in which intertemporal coordination matters.

In the standard OLG model, an agent that exerts effort when young is entitled to a benefit when old only if the young agent of the following generation exerts effort as well. By assumption, there are no delays, i.e., a young agent only gets one chance to exert effort, and an old agent only gets one chance to receive the benefit. If one abstracts from the coordination problem and let agents believe future agents will always exert effort, there exists an equilibrium in which every young agent exerts effort. This equilibrium is immune to the introduction of delay options since this option is never exercised.

We augment the standard OLG model in two ways. First, we let the economy experience different states over time, which evolve according to a random walk, and the cost of exerting effort is an increasing function of the current state. In a large region of states, the region of interest, the present value of receiving the benefit in the next period is larger than the cost of exerting effort in the current period. There exist though faraway states in which it is strictly dominant to exert effort and faraway states in which it is strictly dominant not to do so. Second, we introduce delay options. In every period, a young agent (relabeled active agent) chooses between exerting and delaying effort to an old agent (relabeled passive agent). If she chooses effort, she incurs a sunk cost, which depends on the current state, and becomes a passive agent, while the passive agent receives the benefit and is replaced by a newly born active agent. If she chooses to delay effort, nothing changes and both active and passive agents move to the next period.

We first prove that there exists a unique equilibrium characterized by a threshold: agents exert effort if and only if the current state is at the left of the threshold. We then show that, in the case of vanishing shocks, delay options do not matter: effort is exerted if and only if effort is also exerted in the hypothetical scenario where the agent only gets one chance to exert effort and only one chance to receive the benefit from her future partner. A corollary of this result is that if the state evolves according to a symmetric distribution, effort is exerted if and only if it is the risk dominant action in the corresponding one-shot game between the current active agent and her future partner. In fact, in the absence of delays, agents are essentially playing a one-shot game: they can neither delay effort nor wait longer to receive the benefit from their future partner's effort. If the agent is currently at the equilibrium threshold, his future partner will choose effort with probability half. This implies that the agent will exert effort if and only if it is the risk dominant action in the corresponding one-shot game.[1]

The result that delay options do not matter for equilibrium selection in the limit of vanishing shocks is quite surprising. Indeed, the possibility of delays substantially complicates the problem of equilibrium selection: an agent knows she can wait for many periods before getting the benefit of her effort, and also that she will have further opportunities for effort. It turns out that, if an agent is at the equilibrium threshold, the extra benefits from immediate effort and the possible gains from exerting effort later exactly offset each other. Thus although standard OLG models do not allow for the possibility of delays, this restriction has no effect on coordination in the case of vanishing shocks.

The selection of the risk dominant-action is a result that often emerges in the literature of coordination games. In two-by-two coordination games with incomplete information (global games),

[1] The risk dominance criterion implies that the agent chooses the most profitable action under maximum uncertainty about the others' actions. In a two-by-two game, that means assuming the other agent will choose either action with probability half.