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Recursive Nash bargaining over a productive asset ☆

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Abstract

We propose an equilibrium concept (the recursive Nash bargaining solution) that describes the outcome of repeated negotiations between two rational agents under the assumptions that the state of the economic system under consideration changes according to the actions of the players and that neither party can make binding commitments to future behavior. This equilibrium is dynamically consistent but typically not Pareto-efficient. As an application, we compute the recursive Nash bargaining solution in a model of two heterogeneous agents bargaining over the use of a productive asset with constant gross rate of return and study how the time-preference rates and the elasticities of substitution affect the solution.

JEL classification: C78; D91

Keywords: Multi-period bargaining; Dynamic consistency; Common property assets

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1. Introduction

In this paper we discuss the *recursive Nash bargaining solution*, an equilibrium concept that describes the outcome of repeated negotiations between two rational agents under the assumptions that the state of the economic system under consideration changes according to the actions of the players and that neither party can make binding commitments to future behavior. A typical situation in which this solution concept becomes relevant is the joint extraction from a common property asset stock (like a fish population in the sea) by two agents (countries). Suppose that the two parties meet regularly, say, once in every period in order to bargain over their extraction quota for that period. The extraction rates for later periods are left as the subject of future negotiations. However, since the agreed extraction rates determine not only the well-being of the two agents in the current period but also the stock of the resource in the next period, the solution to the bargaining problem in any given period has a direct impact on later bargaining rounds, which the agents need to take into account.

We assume that the outcome of the negotiations in each period can be described by the (asymmetric) Nash bargaining solution. Due to the lack of a commitment technology, the agents do not negotiate over entire extraction paths. Instead they bargain only over the extraction rates for the current period and they have to form expectations about the outcomes of future negotiations. We assume that these expectations are rational in the sense that the agents correctly anticipate their own and their opponent's future behavior. The agents take the rationally expected outcomes of future bargaining rounds as given when they decide on current extraction rates. Thus, the two parties act *cooperatively within any given period* but *non-cooperatively across periods*. These features have two important implications. On the one hand, since no decisions for future behavior are ever made, none of the two agents ever has an incentive to deviate from any of his or her previous decisions. The solution is therefore dynamically consistent. On the other hand, non-cooperative behavior across periods typically prevents that full Pareto-efficiency is achieved.

We illustrate the properties of the recursive Nash bargaining solution by applying it to a model in which two agents, whose instantaneous utility functions exhibit constant elasticity of intertemporal substitution, extract a common property asset with constant rate of return. We derive the equilibrium conditions for this model and solve them by analytical and numerical methods. We present results under two alternative assumptions regarding the relative bargaining power of the two agents. According to the first one, which is the one that has been used by Nash (1950, 1953), the agents have equal bargaining power. The second one is based on a Rubinstein-type alternating-offers model and allocates more bargaining power to the more patient player; see, e.g., Binmore (1987). Our numerical results illustrate how the recursive Nash bargaining solution depends on various model parameters, notably on the time-preference factors of the two agents.

There is only a small literature that is closely related to the present paper. The papers by Houba et al. (2000) and Flamini (2004, 2005) are the most relevant ones. Houba et al. (2000) study an alternating-offers bargaining model of common