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Optimism, delay and (in)efficiency in a stochastic model of bargaining

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ABSTRACT

I study a bilateral bargaining game in which the size of the surplus follows a stochastic process and in which players might be optimistic about their bargaining power. Following Yildiz (2003), I model optimism by assuming that players have different beliefs about the recognition process. I show that the unique subgame perfect equilibrium of this game might involve *inefficient* delays. I also show that these inefficiencies disappear when players can make offers arbitrarily frequently.

1. Introduction

Experimental and field evidence shows that, when bargaining, people tend to form optimistic beliefs about how future uncertainty will be resolved (e.g. Babcock and Loewenstein, 1997). This evidence also shows that there is a positive correlation between the optimism of the parties and the probability that bargaining ends in an impasse. In other words, this evidence identifies optimism as a possible explanation for bargaining delays.

However, Yildiz (2003) showed that optimism by itself cannot cause delays in bargaining. Yildiz (2003) studied a complete information bilateral bargaining game *a la* Rubinstein (1982) in which players have optimistic beliefs about their future bargaining power. The main result of his paper is that agreement will always be immediate whenever optimism is persistent and the number of bargaining rounds is sufficiently large.

In this paper, I extend Yildiz's (2003) model by allowing the size of surplus that the players are bargaining over to follow a stochastic process. The game has an infinite horizon and players have optimistic beliefs about their bargaining power. The model in this paper can also be thought of as an extension of the stochastic bargaining model of Merlo and Wilson (1995, 1998), allowing agents to have different beliefs about the recognition process. One of the main goals of the current paper is to show that persistent optimism *can* lead to costly delays in this stochastic environment.[1]

The following is a description of this paper's model and an overview of its main results. Let S be a finite set of states and let P be a transition matrix over elements in S. At each period until players reach an agreement, nature selects a state s according to the one period ahead distribution implied by P. The state s determines the size of the surplus. After agents learn the state, one player is recognized to make an offer. Players may have optimistic beliefs about the recognition process. The recognized player can either make a feasible offer or pass. In the first case, the responder can either accept or reject

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[1] Cripps (1998) also considers a bargaining game in which the size of the surplus follows a Markov process. However, there are no differences in beliefs in his model, and inefficiencies can only arise in equilibrium when the buyer and the seller have different discount factors.

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the offer. If she accepts the proposal the game ends. If the proposer chooses to pass or if the responder rejects the current offer, the game moves on to the next bargaining period.

By adapting arguments in Merlo and Wilson (1995, 1998), I show that this game has a unique subgame perfect equilibrium. The unique equilibrium satisfies the following property: there exists a set of states S^a such that agents come to an agreement in period t if and only if $s_t \in S^a$. Therefore, whether there is agreement or not at any given period depends only on the size of the surplus, and is independent of the proposer's identity that period.

Suppose an agent is endowed with a surplus whose size follows the Markov process above. At each period, the agent must decide whether to consume the surplus or to wait. This problem is an optimal stopping problem, whose solution is given by an optimal stopping region S^*. At every state in S^* it is optimal for the agent to stop the process and consume the surplus, while at any other state it is optimal to wait. Say that the outcome of the stochastic bargaining game is efficient if the set of states S^a at which there is agreement is equal to S^*. Merlo and Wilson (1998) showed that these two sets are identical when agents have common beliefs about the recognition process. In contrast, in this paper I show that S^a is always a subset of S^* when agents hold optimistic beliefs. Importantly, this set inclusion might be strict. That is, there might be states at which it is optimal to consume the surplus but at which players fail to reach an agreement, as the following example shows.

Example 1. Suppose the surplus can take two possible values, $h = 1$ and $l < h$. Let $\delta < 1$ be the common discount factor. State h is an absorbing state, while $\Pr(s_{t+1} = l | s_t = l) = P_{ll}$. Both players believe that they will make offers next period with probability 1 (regardless of the state next period). In this setting it is always efficient to consume the surplus at state h. Moreover, consuming the surplus at state l is efficient if and only if

$$l \geqslant \delta\big(P_{ll} l + (1 - P_{ll})\big) \quad \Longleftrightarrow \quad l \geqslant \frac{\delta(1 - P_{ll})}{1 - \delta P_{ll}}. \tag{1}$$

Since h is an absorbing state, the results in Yildiz (2003) imply that players will reach an agreement the fist time $s_t = h$: the proposer will obtain a payoff of $1/(1+\delta)$ and the responder will obtain $\delta/(1+\delta)$.

Let $V_i(l)$ be player i's payoff at state l from delaying an agreement until the state reaches h:

$$V_i(l) = \delta\left(P_{ll} V_i(l) + \frac{1 - P_{ll}}{1+\delta}\right) \quad \Longrightarrow \quad V_i(l) = \frac{\delta(1 - P_{ll})}{(1+\delta)(1 - \delta P_{ll})}. \tag{2}$$

With probability P_{ll} the state will be l next period, in which case player i again gets $V_i(l)$. With probability $1 - P_{ll}$ the state will be h next period, in which case player i expects to obtain $1/(1+\delta)$ since she believes she will make offers with probability 1. If $V_1(l) + V_2(l) > l$ players will delay at state l, since there is no agreement that can satisfy both players' expectations. Since $V_1(l) + V_2(l) > \delta(1 - P_{ll})/(1 - \delta P_{ll})$, there are values of δ, P_{ll} and l for which is efficient to consume the surplus at state l but for which players delay at this state.

The intuition behind these inefficiencies is as follows. When players reach an agreement, the player who makes the offer extracts a non-informational rent. If the surplus is expected to grow in the near term, the non-informational rent that the proposer gets in the future might be large relative to the current size of the surplus. When players are optimistic about the recognition process, they both expect to extract this large non-informational rent with high probability. In this case, the sum of what the players expect to get from delaying might be larger than the size of the surplus today, thereby making it impossible for them to reach an agreement. As Example 1 shows, this might occur even at states at which it is optimal to consume the surplus right away. The ultimate reason for this is that optimism about bargaining power has more impact in this stochastic environment, since now players can be optimistic about their bargaining power at states at which the surplus is large.

Example 1 shows how inefficient delays can arise when optimistic players bargain over a stochastic surplus. However, this paper also shows that these inefficiencies can only occur when there are non-negligible frictions in the bargaining process, and that they disappear when players can make offers arbitrarily frequently. The intuition behind this result is as follows. As the time between bargaining rounds goes to zero, the non-informational rent that the proposer gets also vanishes to zero: in the continuous-time limit the right to make an offer becomes extremely transient, so players get the same share of the surplus when they are making offers and when they are not. Therefore, when offers are arbitrarily frequently, the differences in beliefs about the recognition process no longer have an effect on the sum of the players expected continuation payoffs from delaying, and the outcome becomes fully efficient. The following example illustrates this.

Example 2 *(Example 1 continued).* Suppose that the surplus can take two possible values, $h = 1$ and $l < h$. Let Δ measure the time between offers, with $\delta^\Delta = e^{-r\Delta}$ the discount factor. Suppose h is an absorbing state, while $\Pr(s_{t+\Delta} = l | s_t = l) = e^{-\lambda\Delta}$ for some $\lambda \in (0, \infty)$. Both players believe that they will make offers next period with probability 1. By Eq. (1), it is efficient to consume the surplus at state l if and only if

$$l \geqslant \frac{e^{-r\Delta}(1 - e^{-\lambda\Delta})}{1 - e^{-r\Delta} e^{-\lambda\Delta}} \underset{\text{as } \Delta \to 0}{\longrightarrow} \frac{\lambda}{r+\lambda}.$$