



A theory of bargaining deadlock [☆]

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ABSTRACT

I study a dynamic one-sided-offer bargaining model between a seller and a buyer under incomplete information. The seller knows the quality of his product, while the buyer does not. During bargaining, the seller may receive an outside option, the value of which depends on the quality of the product. If the outside option is sufficiently important, there is an equilibrium in which the buyer's belief about the product's quality stays constant and she continues to make the same randomized offer throughout the bargaining process. As a result, the equilibrium behavior produces an outcome path that resembles a bargaining deadlock and its resolution. The equilibrium outcome exhibits bargaining delay that does not vanish even with frequent offers, and the limiting delay may exist even without a static adverse selection problem. Under stronger parametric assumptions, the equilibrium with deadlock is the only one in which behavior is monotonic in the buyer's belief.

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1. Introduction

Bilateral bargaining is rarely exclusive. It is not uncommon for bargainers to receive outside offers during the negotiation process. For example, consider an entrepreneur who negotiates the sale of his company to a private equity firm. The entrepreneur knows the company's fundamentals but is unable to verify them for the private equity firm. During the bargaining process, a competitor might arrive and make an offer to buy the entrepreneur's firm. Suppose that the competitor is better informed than the private equity firm so that his offer is correlated with the fundamentals of the company.¹ In this example, when a bargainer is deciding whether to take the outside option, he must consider the fact that choosing not to opt out may signal his private information. This paper analyzes the interplay of outside options and incomplete information in bargaining. Specifically, I analyze the equilibrium effects of additional information provided by how bargainers respond to an outside option.

I study a model of an infinite-horizon bargaining game between a seller (he) and a buyer (she). The seller privately knows his type, i.e., the quality of his product, which is labeled as either high or low. In each period, the buyer offers a price and the seller decides whether or not to accept the offer. If the seller accepts the offer, the players receive payoffs

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¹ In corporate finance, buyers of businesses are generally classified into two different categories: financial buyers and strategic buyers. Financial buyers are mostly equity funds interested in the return they can achieve by buying a business. Strategic buyers are typically a competitor or a company in the same industry, and they look for companies that will create a synergy with their existing businesses.

according to the offer and the seller's type, and the game ends. After rejection, the seller's outside option privately arrives with positive probability. Then, the seller who receives the outside option decides whether or not to opt out of further negotiation by taking that option. The value of the outside option is correlated with the seller's type. If the seller does not receive an outside option or he chooses not to opt out of the game by accepting the outside offer, bargaining continues into the next period.

There are two sources of information the buyer uses to update her belief about the seller's type: the seller's decision to accept/reject the buyer's offer (acceptance behavior) and his decision to take the outside option (opting-out behavior). If the buyer's offer is rejected, then she believes that the seller is more likely to be a high type since a high-type seller places a higher reservation value on his product. This informational effect of acceptance behavior is commonly incorporated into the standard models of incomplete-information bargaining (Ausubel and Deneckere, 1989; Deneckere and Liang, 2006). Such models consider only the seller's acceptance behavior, as there is no outside option built into them. As a result, the buyer's equilibrium belief about the seller's type increases over time, as does the equilibrium price. This is the well-known *skimming property* (Fudenberg et al., 1985).

However, in the model studied in this paper, additional information is provided by the seller's opting-out behavior—and it has an opposite effect on belief updating. The buyer expects that a high-type seller will receive more lucrative outside offers, which makes him more likely to leave. Therefore, if the seller stays in the negotiation, the buyer's belief about the seller's type may decrease.

I show that when the outside option arrives frequently, there is an equilibrium in which the two countervailing forces in belief-updating exactly offset each other. As a result, the buyer's belief stays constant over time, and she continues to make the same randomized offer throughout the bargaining process. Since the buyer does not make more generous offers in response to continued rejections and the seller's behavior does not change, the equilibrium behavior produces an outcome path that resembles a *bargaining deadlock*.² For simplicity, I refer to such an equilibrium as a *deadlock equilibrium*.

In the deadlock equilibrium, there is a threshold belief point (called *deadlock belief*) at which the players' behavior does not change over time. If the buyer's prior belief is lower than the deadlock belief, she starts by offering a low price and makes an agreement only with a low-type seller. In this phase, the buyer's belief increases in each period. Once the buyer's posterior reaches the deadlock belief, she uses a mixed strategy between offering a bargaining-ending high price (with a small probability) and a low price. In response to the buyer's low price offer, only the low-type seller accepts, with a probability equal to the arrival probability of the outside option. Then, only the high-type seller exercises the outside option if it arrives. Since both types of sellers exit the game with the same probability, the posterior belief of the buyer remains the same in the next period, and the players continue to play in the same way.

I show that when the time lag between the successive offers vanishes, the limiting outcome of the deadlock equilibrium exhibits a bargaining delay in real time. While the negotiation reaches the deadlock phase almost immediately, the expected real-time length of the deadlock phase does not vanish. Furthermore, the real-time delay may exist even when the static incentive constraints permit first-best efficiency or, equivalently, when there is no static adverse selection problem.³ This contrasts with the result in the existing literature on bargaining with interdependent values (Deneckere and Liang, 2006).

The mechanism behind the limiting delay in the deadlock equilibrium is novel in the existing bargaining literature. To have a real-time delay, the buyer must sustain a low-price offer. Typically, such a strategy is not credible when the buyer can make successive offers frequently, because once the buyer's low-price offer is rejected, then her belief about the seller's type increases, so that the buyer has an incentive to raise her offer price. In this paper, however, the buyer understands that the high-type seller is more likely to leave the market by taking an outside option. Therefore, the buyer's belief about the seller's type does not increase, which gives the buyer an incentive to prolong a low price. This mechanism cannot appear in the standard dynamic bargaining models where only the *skimming property* exists, and this explains why the limiting delay exists in this model even without the static adverse selection problem.

In general, the model has multiple equilibria. There may exist an equilibrium where the informational effect of the acceptance behavior dominates that of the opting-out behavior so that the equilibrium exhibits Coasian dynamics and there is no limiting delay. However, I show that under stronger parametric assumptions, the deadlock equilibrium is the only equilibrium that satisfies a natural monotonicity criterion that requires that the buyer's equilibrium offer be nondecreasing in the posterior belief of the seller's type. Moreover, I show that under the same condition, all equilibria exhibit similar characteristics, specifically the partial failure of learning and the inefficiency in the bargaining outcome, as neither source of information dominates the other.

² I use the notion of "bargaining deadlock" instead of "bargaining delay" to describe a situation in which the agreement is not only delayed but in which there also seems to be no progress in the negotiation because the bargainers' offer-and-response pattern does not change over time.

³ A static adverse selection problem arises when the average value of the product is lower than the highest possible reservation value of the seller (Akerlof, 1970).

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