Bargaining and Commitment in a Permanent Relationship

Steinar Holden*

Department of Economics, University of Oslo, Box 1095 Blindern, 0317 Oslo 3, Norway

Received November 22, 1991

When bargaining over a flow of trades, the players may decide themselves whether or not to continue trade during the bargaining. Previous work has shown that if one extends the Rubinstein alternating offers bargaining model by adding the feature that one of the players (the union) in each period can choose whether to disrupt trade (strike) in that period, then there is a multiplicity of equilibria. This paper shows that if one of the players is able to commit to disrupt trade for two periods, then there is a unique subgame perfect equilibrium. *Journal of Economic Literature Classification Numbers: J5, C78.* © 1994 Academic Press, Inc.

INTRODUCTION

Strategic bargaining models of the perfect information alternating offers type (Rubinstein, 1982; Ståhl, 1972) usually consider bargaining as an on–off event, where an agreement on how to divide the “cake” must be reached before the cake is eaten. However, when there is bargaining in a permanent relationship, over a flow of trades (for example, when a union and a firm bargain over wages), the parties may decide themselves whether or not they will share the surplus (perhaps according to an old contract) while they are bargaining over a new contract. To explore the consequences of this possibility, Fernandez and Glazer (1991) and Haller and Holden (1990) extended the Rubinstein model in the following way: In

* This paper is part of the research project “Unemployment, Institutions, and Economic Policy” at SNF Oslo. Financial support from the Research Council of Norway is gratefully acknowledged. Comments from Hans Haller, Michael Hoel, Karl Ove Moene, Ariel Rubinstein, Abjørn Rødseth and two referees on earlier versions are appreciated.
each period until an agreement is reached, one party (the union) can decide whether or not it will strike in that period. If the union strikes, both parties get zero payoff in that period, otherwise the firm and the union share the value added in a prespecified way. This extension has important implications. There is no longer a unique subgame perfect equilibrium, and strikes with a length in real time can occur in equilibrium, in spite of both parties having perfect information.

When one applies the original Rubinstein model on bargaining over a flow of trades, it is implicitly assumed that there is no trade until an agreement has been reached. One possible interpretation of this is that one of the parties has committed itself not to trade until an agreement is reached, however long a time that may take. In many cases this is unrealistic.

In this paper I explore the consequences of a weaker type of commitment. Specifically, I show that if one of the players can commit to disrupt trade for two periods unless there is an agreement before that, then there is always a unique solution to the model used by Fernandez and Glazer and Haller and Holden. However, the solution is not always the same as the outcome of the Rubinstein model.

THE BARGAINING MODEL

The setup of the model is the following. There is an infinite number of periods, and in each period of normal production the firm has a value added of one unit of a good which the firm and the union can divide between them. The union’s share is $W \in [0, 1]$ and the firm’s share is $(1 - W)$. If the union calls a strike, then both parties get zero in that period. Initially the union’s share is $W_0$ (the wage level in the previous contract). $W_0$ is assumed to be the prevailing division until a new agreement is reached. For simplicity, both parties are assumed to have linear utility functions, so their payoffs can be represented by the discounted sum of future shares. For the union this is

$$U = \sum_{t=1}^{\infty} \delta^{t-1} u_t,$$

(1)

where $u_t = 0$ if there is a strike in period $t$, $u_t = W_0$ if there is no strike and an agreement has yet to be reached, and $u_t = W$ if an agreement is reached. $\delta$ is the discount factor.
For the firm we have correspondingly

$$V = \sum_{t=1}^{\infty} \delta^{t-1}v_t,$$

where $v_t = 0$ if there is a strike in period $t$, $v_t = 1 - W_0$ if there is no strike and an agreement has yet to be reached, and $v_t = 1 - W$ if an agreement is reached.

The parties are assumed to make offers alternately, one offer per period. Without loss of generality the firm is assumed to make an offer in the beginning of period 1. The union can then accept or reject this offer. If the union accepts, the bargaining ends. If the union rejects it decides whether it will strike in periods 1 and 2 (the strike in period 2 being contingent on no agreement being reached in period 2. Moreover, the union cannot commit to strike in period 2 without striking in period 1). If the firm’s offer is rejected, the union makes a new offer in period 2, which the firm accepts or rejects. If the offer is accepted, the game ends. If it is rejected, and a strike were initiated in period 1, there is a strike in period 2 also. If the offer is rejected and no strike was initiated in period 1, the union decides whether it will strike in periods 2 and 3. (The strike in period 3 is contingent on no agreement being reached in period 3). In period 3, it is the firm’s turn to make an offer, which the union can accept or reject. If the offer is accepted the game ends. If the offer is rejected and a strike was initiated in period 2, there is a strike in period 3 also. If the offer is rejected and no strike was initiated in period 2, the union decides whether it will strike in periods 3 and 4, etc. Both parties are assumed to have perfect information.

The underlying intuition behind the commitment assumption is that normal production can be resumed more rapidly if an agreement is reached than if there is not yet an agreement. In wage negotiations, a possible justification might be that the union tells its members in advance that it will continue on strike unless an agreement is reached. It may be difficult for the union to go back on this promise. It could also be the case that the individual workers are more reluctant to come to work if no agreement is reached than if an agreement is reached.

Note that there is nothing special about the commitment for two periods; the results would not be changed if the commitment were for any higher even number instead. However, if the union were allowed to commit for an odd number of periods, this could be exploited by the union so that it strikes more often after rejections of its own proposals than after rejections of proposals by the firm. Such a strategy has however no meaningful real-life interpretation.
It is convenient to investigate another game where the union strike decision is taken as exogenous: the union is assumed to strike in every period until an agreement is reached. (This corresponds to the original Rubinstein game.) The unique subgame perfect equilibrium (SPE) outcomes, $W^S (W^U)$ when the firm (union) makes the first offer, are (Rubinstein, 1982; or Shaked and Sutton, 1984)

$$W^S = \delta/(1 + \delta), \quad W^U = 1/(1 + \delta). \tag{3}$$

We now return to the more general bargaining model, where the union strike decision is endogenous. Proposition 1 contains a complete characterization.

**Proposition 1.** The unique SPE outcome is $W^* = \max \{W_0, W^S\}$.

*Proof.* First consider the case $W_0 \leq W^S$, where I first show that $W^S$ is indeed a SPE outcome. The equilibrium strategies are the following:

**Union.** In odd periods: Accept any $W \geq W^S$; strike and commit to strike in the following period unless an agreement is reached. In even periods: Propose $W^U$; do not strike unless being committed.

**Firm.** In odd periods: Propose $W^S$. In even periods: accept any $W \leq W^U$ if the union is committed to strike; accept any $W \leq W' = (1 - \delta)W_0 + \delta W^S$ if the union is not committed to strike.

The parts of the strategies concerning proposals and acceptance as long as a strike takes place follow directly from the original Rubinstein model. Consider the decision of the firm in an even period, where the union is not committed to strike in this period. If the firm rejects the offer by the union it obtains one period payoff of $1 - W_0$ and then an agreement on $W^S$ in the following period, giving a total payoff $(1 - W_0 + \delta(1 - W^S))/(1 - \delta)$. The firm clearly will not accept any offer giving a lower payoff, thus $W'$ is given by $(1 - W')/(1 - \delta) = 1 - W_0 + \delta(1 - W^S)/(1 - \delta)$.

Then consider the decision of union, when it is not committed to strike. If the union proposes $W'$ it will be accepted, and the union obtains $W'/(1 - \delta)$. If the union proposes $W > W'$ it will be rejected, and the union obtains $W_0 + \delta W^S/(1 - \delta) = W'/ (1 - \delta)$. Thus, any proposal $W \geq W'$ gives the same payoff to the union in this situation.

Finally, I show that the strike threats of the union are indeed credible. Suppose that the firm offers $W < W^S$ in an odd period, and the union rejects. If the union strikes, and thus commits to a strike in the following period, the firm will accept a proposal of $W^U$ in the following period, giving a total payoff to the union of $\delta W^U/(1 - \delta) = W^S/(1 - \delta)$. If the union fails to strike, it will obtain a total payoff of $W_0 + \delta W_0 + \delta^2 W^S/(1 - \delta) = [(1 - \delta^2)W_0 + \delta^2 W^S]/(1 - \delta)$, which is lower. Thus, the union
will indeed commit to strike. It follows that the strategies above constitute a SPE.

I now want to show that \( W^S \) is the unique SPE outcome. Let \( M \) be the supremum of payoffs to the firm in a SPE in the subgame starting in period 1. \( M \) is thus also the supremum of payoffs to the firm in a subgame starting in any odd period where the union is not already committed to strike. Assume that \( M \) is associated with a wage \( W'' < W^S \), so that \( M > (1 - W^S)/(1 - \delta) = 1/(1 - \delta^2) \). I show that if the firm offers \( W'' \), then the union benefits from rejecting the offer, striking, and committing to strike in the following period. If the union does so, the firm will at least accept a payment of \( \delta M \) by the union’s offer in the following period, as this is the very best the firm can obtain by rejecting the offer (a rejection involves one period of strike and then at best an agreement on \( M \) in the following period). Thus, by rejecting the offer \( W'' \), striking, and committing to strike in the following period, the union can at least obtain a total discounted payoff \( \delta[(1 - \delta)^{-1} - \delta M] \) by its proposal in the following period. This is better than accepting \( W'' \), as \( \delta[(1 - \delta)^{-1} - \delta M] > 1/(1 - \delta) - M \), or equivalently, \( M(1 - \delta^2) > 1 \), which clearly holds for \( M > 1/(1 - \delta^2) \). Thus, a payoff \( M > 1/(1 - \delta^2) \) to the firm (associated with a SPE outcome \( W'' > W^S \)) cannot be implemented by the firm’s offer in any odd period. Clearly, a payoff \( M > 1/(1 - \delta^2) \) to the firm cannot be implemented by the union’s offer in even periods, because as shown above, if the union in the preceding odd period rejects the offer, strikes, and commits to strike in the even period, the firm will be willing to accept a payoff \( \delta M \) by the union’s offer. Hence the supremum of payoffs to the firm in a SPE in a subgame starting in an odd period cannot be more than \( 1/(1 - \delta^2) \), corresponding to the wage level \( W^S \).

I then proceed to show that the union cannot obtain a higher wage than \( W^S \) in a SPE. To do this we must consider three possible strategies of the union: (1) initiate a strike in period 1, and thus be committed to strike in period 2 also; (2) do not strike in periods 1 and 2; and (3) do not strike in period 1, initiate a strike in period 2, and thus be committed to strike in period 3 also. Let \( M \) be the infimum of payoffs to the firm in the subgame starting in period 3, for any possible strategy of the union.

If the union rejects the offer of the firm in period 1, strikes in period 1, and commits to strike in period 2, then the firm will not accept less than \( \delta M \) from the union’s offer in period 2, as the firm can at least obtain this payoff from its own offer in period 3. Thus, by striking in period 1 the union cannot obtain more than \( (1 - \delta)^{-1} - \delta M \) by its offer in period 2. Thus, if the union has decided to strike in period 1, it will at least accept a payoff \( \delta[(1 - \delta)^{-1} - \delta M] \) from the firm’s offer in period 1, giving the firm a payoff of

\[
(1 - \delta)^{-1} - \delta[(1 - \delta)^{-1} - \delta M].
\] (4)
Then consider the case if the union rejects the offer of the firm in period 1, without striking in periods 1 and 2. Then the firm will not accept less than \(1 - W_0 + \delta M\) from the union's offer in period 2, as the firm can at least obtain this payoff from its own offer in period 3. Hence, the union cannot obtain more than \((1 - \delta)^{-1} - (1 - W_0) - \delta M\) by its offer in period 2. Thus, if the union has decided not to strike in period 1, it will at least accept a payoff \(W_0 + \delta[(1 - \delta)^{-1} - (1 - W_0) - \delta M]\) from the firm's offer in period 1, giving the firm a payoff of

\[(1 - \delta)^{-1} - W_0 - \delta[(1 - \delta)^{-1} - (1 - W_0) - \delta M].\]  

(5)

Finally, consider the case if the union rejects the offer of the firm in period 1, without striking in period 1 but initiating a strike in period 2. I show that this strategy is not credible, as it is not optimal for the union to initiate a strike in period 2. Let \(R\) be the supremum of payoffs to the union in a SPE in a subgame starting in period 2, which in this case is identical to the supremum of payoffs to the union in the subgame starting in period 4. By the same reasoning as above, the union accepts an offer from the firm in period 3 giving a payoff \(\delta R\), as this is the best the union can obtain by rejecting the offer. Hence the firm at least obtains a payoff \((1 - \delta)^{-1} - \delta R\) from its offer in period 3. Thus, the firm rejects any offer giving a payoff of less than \(\delta[(1 - \delta)^{-1} - \delta R]\) in period 2, so the union cannot obtain more than \((1 - \delta)^{-1} - \delta[(1 - \delta)^{-1} - \delta R]\) from its offer in period 2, which consequently must be the supremum of payoffs to the union in period 2. \(R\) can thus be obtained from \(R = (1 - \delta)^{-1} - \delta[(1 - \delta)^{-1} - \delta R]\), which solves for \(R = 1/(1 - \delta^2)\), which is the payoff associated with the wage level \(W^U = 1/(1 + \delta)\).

Note that with this latter strategy of the union, the firm can obtain a payoff \((1 - \delta)^{-1} - \delta R\) from its offer in period 3, which, by substituting out for \(R\), corresponds to the wage \(W^S\). However, the union can also obtain this wage level by not striking in period 2, as \(W^S\) corresponds to the supremum of payoffs to the firm in a subgame starting in an odd period when the union is not committed to strike (as shown above). Thus, if the union strikes in period 2, this involves a one period loss of \(W_0\), without increasing the total payoff the union can obtain in the subsequent period, so the union will not initiate a strategy in period 2.\(^1\)

The optimal strategy of the union must thus be either to threaten to strike in periods 1 and 2, or not to threaten to strike in periods 1 and 2.

\(^1\)By the same reasoning it follows that if the extensive form of the game were different so that the union were to make the first offer in the bargaining, then the unique SPE outcome (for \(W^S > W_0\)) would not be \(W^U\) but \(W' = (1 - \delta)W_0 + \delta W^S\), as a strike in period 1 would not be credible.
Comparing (4) and (5) we find (as \( W_0 < 1/(1 + \delta) = W^S \)) that striking gives a lower payoff to the firm, and thus is the optimal strategy for the union. The infimum of payoffs to the firm in the subgame starting in period 1 can thus be found by assuming that the union strikes in every period until an agreement is reached, so that \( M \) is given by \( M = (1 - \delta)^{-1} - \delta[(1 - \delta)^{-1} - \delta M] \), which solves for \( M = 1/(1 - \delta^2) \), which is the payoff associated with the wage level \( W^S = 1/(1 + \delta) \). It follows that \( W^S \) is the unique SPE outcome.

In the case where \( W_0 > W^S \), it is clear that the union will never strike, and \( W_0 \) is the unique SPE outcome. Q.E.D.

The intuition behind the effect of the commitment assumption can perhaps best be conveyed by starting with an explanation of the multiplicity of equilibria in the model of Fernandez and Glazer (1991) and Haller and Holden (1990). In this model there exist equilibria where strike threats are not credible also in the case where \( W^S > W_0 \). The logic behind these equilibria lies in that the firm may adopt the following "non-concession" strategy: always offer \( W_0 \), never accept more than \( W_0 \). This strategy is clearly optimal as long as the union never strikes. If the union strikes in this situation, it will be "interpreted" as a one-period deviation with no consequences for future payoffs. Thus, the union will not strike, and the firm's strategy is indeed a best reply.

In the present model, by contrast, \( W_0 \) cannot be an equilibrium (for \( W_0 < W^S \)) since a strike in one period necessarily commits the union to a strike in the following period (following a rejected offer), so that the firm will be willing to accept a higher wage than \( W_0 \) in order to avoid another period of strike. Thus, the union will benefit from rejecting an offer of \( W_0 \) and striking, with the consequence that the "non-concession" strategy of the firm unravels.

Note also that it is not the fact that the union can commit to strike for two periods that yields uniqueness, but rather that the union can commit to a strike in the subsequent period. Thus, it is also possible to show uniqueness in a game with a slightly modified extensive form, where the union does not have to strike in the current period in order to commit to a strike in the subsequent period. In this game the union will always commit to strike in even periods, and it will not strike in odd periods, and the unique SPE outcome will be \( W^f = (W_0 + \delta)/(1 + \delta) \) when the firm makes the first offer.

**Concluding Remarks**

In empirical applications on bargaining situations one often distinguishes between disputes where trade takes place during the negotiations and disputes where trade is disrupted. The present paper shows that if one of
the players is able to commit to disrupt trade for two periods, then this player is able to enforce his most favourable outcome among these two alternatives. The outcome is therefore only identical to the outcome in the original Rubinstein model (that is, no trade during negotiations) when this outcome is the more favorable to the player that has the possibility to disrupt trade. If the game is symmetric, so that both players are able to commit to disrupt trade for two periods, then it can be shown that the outcome is always identical to the outcome in the original Rubinstein model ($W^S$ is the unique SPE outcome). Thus, for empirical applications on bargaining situations it seems crucial to evaluate to what extent the parties have a possibility to commit to disrupt trade.

REFERENCES


