



Simultaneous versus sequential offers in dominant player bargaining

by
Derek J. Clark & Jean Christophe Perea

Working Paper Series in Economics and Management
No. 01/08, January 2008

**Department of Economics and Management
Norwegian College of Fishery Science
University of Tromsø
Norway**

Simultaneous versus sequential offers in dominant player bargaining*

Derek J. Clark[†] & Jean Christophe Perea[‡]

January 10, 2008

Abstract

We consider bargaining between a number of players that are all essential in creating a surplus. One of the players is dominant in the sense that it ultimately decides whether the surplus will be created. The other players have an incentive to get a large share of the pie for themselves, but leaving enough for the dominant firm that it finds it profitable to create the surplus. Hence, the smaller players have preferences over who they take their share from. When the dominant player makes the first offer in an alternating offer framework, we analyse whether it should conduct negotiations sequentially with some grouping of players, or simultaneously. We demonstrate that the dominant player will prefer simultaneous negotiation. The other players would prefer to negotiate early with the dominant one, and then to see remaining rivals negotiate simultaneously.

JEL Classification: C78

Keywords: bargaining, dominant player, sequential negotiation, simultaneous negotiation.

*This paper is part of the project "The knowledge-based society" sponsored by the Research Council of Norway.

[†]Department of Economics and Management, NFH, University of Tromsø, N-9037 Tromsø, Norway. E-mail: derek.clark@nfh.uit.no

[‡]Université Paris Est, OEP and TEPP (FR n°3126, CNRS), Cité Descartes, 5 bd Descartes, 77454 Champs sur Marne Cedex 2, France. E-mail: pereau@univ-mlv.fr

1 Introduction

When your expected payoff depends on what your partners grant you, should you bargain with them in sequence or simultaneously? Many economic agents face this kind of question, and the answer depends on the underlying structure of the bargaining framework. Based on the Rubinstein (1982) alternating offers model, the theoretical literature considers various configurations of bargaining depending on the number of players and the number of different surpluses (cakes) that are to be divided. This paper is a contribution to the strand of the literature in which n players divide a single surplus.

A typical illustration of the choice of sequential versus simultaneous procedures in Rubinstein bargaining can be found in Barneji (2002). One union is assumed to bargain over a wage/employment contract with two Cournot duopolists, where one contract is specified for each firm. The simultaneous procedure means that the union bargains with the two firms at the same time while the sequential protocol means that the union bargains first with one firm and then, on agreement being reached, with the other firm. The author assumes that, during a round of bargaining, no production takes place within the negotiating firm whereas the other firm produces according to the terms of the preexisting contract (in the first round) or the newly signed contract (in the second round). The union will get a higher discounted payoff in the sequential procedure when the wage bill of the preexisting contract of the firm involved in the second round of bargaining exceeds its wage bill defined in the simultaneous procedure. Moreover, the union prefers to bargain first (second) with the firm that has the smallest (largest) difference between the preexisting contract and the simultaneous contract. In a right-to-manage model and using the Nash solution, Barneji (2002) shows that the union prefers sequencing to simultaneity when the higher wage it gets from one firm increases the payoffs of its Cournot rival and thus enhances this firm's willingness to contract on a higher wage in the second round. However the optimal order in sequencing cannot be determined. Extending Horn and Wolinsky's (1988) model¹, Marshall and Merlo (2004) show that a union prefers to bargain in sequence rather than simultaneously whatever the order of negotiation. Furthermore, the firm that bargains first with the union in the sequential case would prefer to be second whatever the procedure since

¹Horn and Wolinsky (1988) study the conditions under which an upstream supplier prefers to bargain in sequence or simultaneously with two downstream cournot dupolists.

the simultaneous and the sequential bargaining yield the same payoff. Since firms are identical, the game is symmetric. The authors also show that a union always prefers "pattern bargaining" to the other procedures, although the opposite is true for firms. Pattern bargaining is defined as a sequential negotiation where the agreement with the first firm determines the take-it-or-leave-it offer that the union makes to all remaining firms.

The bargaining literature on multi-issues deals with two players who are bargaining over n cakes. The analysis of the order in which the issues are negotiated has been conducted in complete and incomplete information settings. With complete information, the inaugural literature assumed an exogenous agenda. Fershtman (1990) determines the conditions under which players prefer to bargain in sequence or simultaneously over two issues. However, the difference between the two procedures disappears as players' discount rates become identical. Bush and Horstmann (1997) show that the impact of the agenda persists when agreements can be sequentially implemented and not only once all issues have been resigned as in Fershtman (1990). The result depends on the relative valuation on the two issues. A player prefers a sequential procedure in which its highly valued issue is negotiated over first while it prefers a simultaneous procedure when its highly valued issue is bargained over last. Focusing only on sequential procedures, Flamini (2004) shows that the relative valuation of the two cakes between players matters but also the urgency/difficulty of an issue in the sense that a failure of the negotiation on that issue may lead to a breakdown in the negotiation for the second one.

A second generation of papers considers an endogenous agenda where players are free to make an offer about any subset of issues (Inderst, 2000; In and Serrano, 2004). Inderst (2000) considers bilateral bargaining over a set of issues in which players can bargain sequentially over a partition of the set of issues into subsets or simultaneously over all issues. When issues are mutually beneficial for the two players, the bargain ends with simultaneous agreement. The agreement is immediate and exploits the trade-offs in the marginal rates of substitutions between the issues. However, when there is at least one controversial issue, yielding a positive payoff for one player but a negative for the other, multiple equilibria can arise. In and Serrano (2004) show that when players are forced to negotiate one issue at a time, their inability to exploit trade-offs among issues yields a multiplicity of equilibrium agreements. With incomplete information, several papers have shown that sequential negotiation can be used to signal bargaining power, making the

agenda endogenous (Bac and Raff, 1996; Bush and Horstmann, 1999, 2002). In Bush and Horstmann (2002), the value of the surplus of one issue called the "easy" issue is known to both players while the value of the surplus of the so-called "hard" issue is private information for one player. Results show that the easy issue is bargained over first when agreements are implemented once they are signed. When the implementation of agreements is simultaneous, the hard issue is bargained over first. However both players prefer sequential implementation.

Multilateral bargaining models deal with the division of one cake among n players. It is well-known that this division raises some theoretical problems since the Rubinstein result on the uniqueness of the subgame perfect equilibrium outcome cannot be extended to three or more players when unanimity is required. To avoid the multiplicity of equilibria, Krishna and Serrano (1996) introduce an exit rule asserting that after a proposal has been made to all the players, any player can accept the offered share, leave the negotiation table with the awarded share and let the remaining players continue to bargain over the rest of the cake. A new division of the surplus is then offered until agreement is reached. In that way bargaining occurs in sequence and the uniqueness of the outcome is restored. Suh and Wen (2006) also emphasize sequential negotiation through bilateral bargaining rounds, in which their aim is to find protocols giving the Nash solution. However the question of how to share one cake among several players in the presence of a dominant player who ultimately decides whether the surplus will be created has received little attention.² Cai (2000, 2003) considers a bargaining framework in which the dominant player bargains in a bilateral manner with all the other passive players according the following rule. In each round, the dominant player bargains with one passive player; if an agreement is reached, the passive player leaves the game with a binding share while in case of disagreement, he/she is moved to the end of the queue. Then the bargaining process moves to the next round with a new passive player until the emergence of a global agreement with all the passive players ensuring that the project will be implemented. In common with this approach, we have a bargaining framework with a dominant player who is dependent on agreeing with all other players before a surplus can be created and shared. We allow the dominant player to divide the opponents into groups that he then bargains sequentially

²Clark & Perea (2007) consider dominant player bargaining between three agents where the focus is on sequential bargaining.

with, but all within-group bargaining occurs simultaneously. At one extreme we have completely sequential bargaining with one player at a time, and at the other a simultaneous framework where all deals are bargained over simultaneously. We characterize the equilibrium shares that will result from each potential constellation of opponents, and show that the dominant player secures the highest share from the completely simultaneous framework. Further, we show that each of the dominant firm's opponents would prefer to be in a group that negotiates early in any sequential process, and that the most preferred position of such a player is to negotiate with the dominant player alone in the first round, and then to see the dominant player negotiate with all remaining players simultaneously in round two.

Section two presents the basic model, and section three presents the possible negotiation processes and solves for the equilibrium shares and expected payoffs that result from each of these. Brief conclusions are offered in section 4.

2 The model

The model that we use here is an extension of the framework in Clark and Perea (2007). There are $n + 1$ players, all of which are essential in creating a surplus. We consider a two stage model in which negotiations take place at stage 1 over the division of the surplus *if* it is created at stage 2. Stage 2 analyses the creation of the surplus. Inputs from all of the players are essential in creating the surplus, but suppose player 0 takes on the job of coordinating its creation. Then at stage 1, player 0 seeks to obtain binding agreements on surplus division with the n other, identical players; based on these contingent agreements, player 0 must then decide whether it is profitable to create the surplus and share it accordingly. Fix the size of the surplus at $B > 0$. At the start of stage 2, the cost of creating the surplus is made known as the result of a draw from a uniform distribution on $[0, T]$ where T is a known positive parameter. Let x be the realized cost. Player 0 then creates the surplus as long as the share of the surplus it receives at least covers the cost of its creation.³

³The model of surplus creation used here depicts Coase's (1960) famous example of the negotiations between a railroad company and a group of farmers. In order to create the surplus, the railroad is dependent on securing an agreement with each farmer; however, in pursuing the largest possible share of the surplus, each farmer is mindful of the fact that

Given shares s_1 and s_2 from the first stage, 0 will create the surplus as long as

$$\left(1 - \sum_{i=1}^n s_i\right) B \geq x$$

Seen from stage 1, the probability that the surplus gets created is then

$$P = \Pr\left(\left(1 - \sum_{i=1}^n s_i\right) B \geq x\right) = \frac{(1 - \sum_{i=1}^n s_i) B}{T}$$

At stage 1, none of the players know whether the surplus will be created or not. Then the expected profit of players $j = 1, 2, \dots, n$ and 0 seen from stage 1 are

$$\begin{aligned}\pi_j^* &= P s_j B = \frac{(1 - \sum_{i=1}^n s_i) s_j B^2}{T}, \quad j = 1, 2, \dots, n \\ \pi_0^* &= P \left(1 - \sum_{i=1}^n s_i\right) B = \frac{(1 - \sum_{i=1}^n s_i)^2 B^2}{T}\end{aligned}$$

Normalizing $B^2/T = 1$, writing $s_0 = 1 - \sum_{i=1}^n s_i$, $\mathbf{s} = (s_0, s_1, \dots, s_n)$ and defining $1 \geq \delta > 0$ to be the common discount factor, the expected profit of 0 and each rival obtained at time t can be rewritten as

$$\begin{aligned}\pi_0^*(\mathbf{s}, t) &= \delta^t (s_0)^2 = \delta^t \left(1 - \sum_{i=1}^n s_i\right)^2 \\ \pi_j^*(\mathbf{s}, t) &= \delta^t s_0 s_j = \delta^t \left(1 - \sum_{i=1}^n s_i\right) s_j\end{aligned}\tag{1}$$

3 The negotiation process

In the negotiation, let us assume that the players other than 0 are divided into m groups consisting of k_a players in each group so that $\sum_{a=1}^m k_a = n$. No restriction is made about the number of players in each group other than this summing up condition. Within each group, player 0 makes offers to group

the project must be profitable enough for the railroad to want to instigate the project that creates the surplus. Hence each farmer wants to increase his share at the expense of the other farmers, not the railroad.

members simultaneously. Each group is negotiated with in turn, and we can assume without loss of generality that the order is increasing in group index; group 1 negotiates first, then group 2, with group m entering the negotiation last. Hence we can identify some special cases, in particular when $m = 1$ we have fully simultaneous negotiation, and when $k_a = 1$, $a = 1, \dots, m$ we have fully sequential negotiation one player at a time. Each negotiation is assumed to be a Rubinstein alternating offers setup in which player 0 makes the first offer to the players with which it is bargaining. After the initial offer, the other players can accept or make a counteroffer in the next period. The process continues into the potentially infinite future until agreement is reached. Only when agreement is reached with all players does the game proceed to stage 2 to determine whether the surplus will be created.

Denote by $s_{a,j}$ the share of player $j = 1, \dots, k_a$ in group $a = 1, \dots, m$. The sum that group a manages to secure is then $\sum_{i=1}^{k_a} s_{a,i} \equiv S_a$. Furthermore, let $S_{a,-j} = S_a - s_{a,j}$, the share of group a excluding that gained by j . The negotiation game is solved backwards for the subgame perfect equilibrium, starting with the negotiation between the members of group m and player 0. When the game has reached this stage, the total share left to be negotiated over is $1 - \sum_{a=1}^{m-1} S_a$, and in its bilateral negotiation with player 0 player j in group m takes the shares of its fellow group members as fixed. Denote the claim that player j makes for himself as $s_{m,j}^{(m,j)}$ and the offer made by player 0 to this player as $s_{m,j}^{(0)}$. When player 0 negotiates with such a player j in group m we get the following programme for accepted offers:

$$\begin{aligned} \left(1 - \sum_{a=1}^{m-1} S_a - S_{m,-j} - s_{m,j}^{(m,j)}\right)^2 &= \delta \left(1 - \sum_{a=1}^{m-1} S_a - S_{m,-j} - s_{m,j}^{(0)}\right)^2 & (2) \\ \left(1 - \sum_{a=1}^{m-1} S_a - S_{m,-j} - s_{m,j}^{(0)}\right) s_{m,j}^{(0)} &= \delta \left(1 - \sum_{a=1}^{m-1} S_a - S_{m,-j} - s_{m,j}^{(m,j)}\right) s_{m,j}^{(m,j)} & (3) \end{aligned}$$

Here (2) reflects the offer made by j such that player 0 is indifferent between accepting this and making a counteroffer, and (3) reflects the same indifference condition for player j .

Solving this system, given that player 0 makes the first offer yields for

$j = 1, \dots, k_m$

$$s_{m,j}^{(0)} = \frac{(\sqrt{\delta})^3}{(\sqrt{\delta} + 1)(\delta + 1)} \left(1 - \sum_{a=1}^{m-1} S_a - S_{m,-j} \right) \equiv \alpha \left(1 - \sum_{a=1}^{m-1} S_a - S_{m,-j} \right) \quad (4)$$

with agreement being reached immediately. Summing up the k_m offers in (4) gives

$$S_m = \frac{\alpha k_m}{1 + \alpha(k_m - 1)} \left(1 - \sum_{a=1}^{m-1} S_a \right) \quad (5)$$

Hence, the total amount captured by group m is a proportion of the surplus that is left after the first $m - 1$ group negotiations, with the factor of proportionality increasing in both the discount factor and the number of members in group m . Each member of group m will get the same offer so

$$\begin{aligned} s_{m,j} &= \frac{S_m}{k_m} = \frac{\alpha}{1 + \alpha(k_m - 1)} \left(1 - \sum_{a=1}^{m-1} S_a \right) \\ &= \frac{(\sqrt{\delta})^3}{\left(\delta + \sqrt{\delta} + k_m \delta^{\frac{3}{2}} + 1 \right)} \left(1 - \sum_{a=1}^{m-1} S_a \right), \quad j = 1, \dots, k_m \end{aligned}$$

where the proportion of the surplus gained by each member naturally decreases in k_m , and increases in δ . In the limit case as $\delta \rightarrow 1$, $s_{m,j} = \frac{1}{3+k_m} (1 - \sum_{a=1}^{m-1} S_a)$.

Now the negotiation with group $m - 1$ can be analyzed, given the results for the final bargaining round. The negotiating players take into account how their agreements affect the share that m gets in the next round through (5). In negotiating with group $m - 1$, the expected profit of player 0 can be written as

$$\begin{aligned} \pi_{0,m-1} &= \left(1 - \sum_{a=1}^{m-1} S_a - \frac{\alpha k_m}{1 + \alpha(k_m - 1)} \left(1 - \sum_{a=1}^{m-1} S_a \right) \right)^2 \\ &= \left(\frac{1 - \alpha}{1 + \alpha(k_m - 1)} \right)^2 \left(1 - \sum_{a=1}^{m-1} S_a \right)^2 \end{aligned} \quad (6)$$

Similarly, the expected profit of member j of group $m - 1$ is

$$\begin{aligned}\pi_{m-1,j} &= \left(1 - \sum_{a=1}^{m-1} S_a - \frac{\alpha k_m}{1 + \alpha(k_m - 1)} \left(1 - \sum_{a=1}^{m-1} S_a\right)\right) s_{m-1,j} \\ &= \left(\frac{1 - \alpha}{1 + \alpha(k_m - 1)}\right) \left(1 - \sum_{a=1}^{m-1} S_a\right) s_{m-1,j}, \quad j = 1, \dots, k_{m-1}\end{aligned}\quad (7)$$

Setting up the Rubinstein conditions for this negotiation with the members of group $m - 1$ gives

$$\begin{aligned}\left(1 - \sum_{a=1}^{m-2} S_a - S_{m-1,-j} - s_{m-1,j}^{(m-1,j)}\right)^2 &= \delta \left(1 - \sum_{a=1}^{m-2} S_a - S_{m-1,-j} - s_{m-1,j}^{(0)}\right)^2 \\ \left(1 - \sum_{a=1}^{m-2} S_a - S_{m-1,-j} - s_{m-1,j}^{(0)}\right) s_{m-1,j}^{(0)} &= \delta \left(1 - \sum_{a=1}^{m-2} S_a - S_{m-1,-j} - s_{m-1,j}^{(m-1,j)}\right) s_{m-1,j}^{(m-1,j)}\end{aligned}\quad (8)$$

This programme is qualitatively identical to (2) and (3), and hence the shares and sum of shares of group $m - 1$ follow the same pattern as (4):

$$S_{m-1} = \frac{\alpha k_{m-1}}{1 + \alpha(k_{m-1} - 1)} \left(1 - \sum_{a=1}^{m-2} S_a\right) \quad (9)$$

$$s_{m-1,j} = \frac{S_{m-1}}{k_{m-1}} = \frac{\alpha}{1 + \alpha(k_{m-1} - 1)} \left(1 - \sum_{a=1}^{m-2} S_a\right) \quad (10)$$

Solving recursively gives the profit of the first group to negotiate as:

$$S_1 = \frac{\alpha k_1}{1 + \alpha(k_1 - 1)}$$

and hence

$$\begin{aligned}1 - S_1 &= \frac{1 - \alpha}{1 + \alpha(k_1 - 1)} \\ S_2 &= \frac{\alpha k_2}{1 + \alpha(k_2 - 1)} (1 - S_1) = \frac{\alpha k_2 (1 - \alpha)}{(1 + \alpha(k_1 - 1)) (1 + \alpha(k_2 - 1))}\end{aligned}$$

These calculations lead to the solution of the negotiation process that is summed up in the following proposition:

Proposition 1 *Suppose that player 0 negotiates with each group in ascending order, and that the negotiation within each group is simultaneous with 0 making the first offer in all cases. Define $\alpha = \frac{(\sqrt{\delta})^3}{(\sqrt{\delta}+1)(\delta+1)}$. Then the sum of shares, and individual shares gained by group $z = 1, 2, \dots, m$ is*

$$S_z = \frac{\alpha k_z (1 - \alpha)^{z-1}}{\prod_{a=1}^z (1 + \alpha(k_a - 1))} \quad (11)$$

$$s_{z,j} = \frac{S_z}{k_z} = \frac{\alpha(1 - \alpha)^{z-1}}{\prod_{a=1}^z (1 + \alpha(k_a - 1))}, \quad j = 1, 2, \dots, k_z \quad (12)$$

The total share gained by player 0 with corresponding expected profit is

$$s_0 = 1 - \sum_{a=1}^m S_a = \frac{(1 - \alpha)^m}{\prod_{a=1}^m (1 + \alpha(k_a - 1))} \quad (13)$$

$$\pi_0 = s_0^2 \quad (14)$$

Member j of group z has an expected profit of

$$\pi_{z,j} = s_0 s_{z,j} = \frac{\alpha(1 - \alpha)^{m+z-1}}{(\prod_{a=1}^m (1 + \alpha(k_a - 1))) (\prod_{a=1}^z (1 + \alpha(k_a - 1)))} \quad (15)$$

The results in Proposition 1 show how the shares and expected payoffs are affected by the number of groups and the distribution of the members between groups. These expressions can then be analyzed for their comparative static effects. Consider first the share (and the expected profit) obtained by player 0. Suppose the number of groups is kept fixed at m . Then the effect of the distribution of players among the groups affects only the denominator in (13), and this denominator expression is minimized by placing one player in all but one of the m groups, with the remaining $n - (m - 1)$ in the last group. Which group it is that gets the most members is irrelevant for the expected share (profit) of player 0. This is the distribution of players among m groups that maximizes the share of player 0; denote this by $\hat{s}_0(m) = \frac{(1-\alpha)^m}{(1+\alpha(n-m))}$. Given this distribution, suppose that one of the groups consisting of a single player is taken away by placing this player in the largest group. The change in expected share for player 0 is then

$$\begin{aligned} \hat{s}_0(m-1) - \hat{s}_0(m) &= \frac{(1 - \alpha)^{m-1}}{(1 + \alpha(n - (m - 1)))} - \frac{(1 - \alpha)^m}{(1 + \alpha(n - m))} \quad (16) \\ &= \frac{\alpha^2 (1 - \alpha)^{m-1} (n + 1 - m)}{(1 + \alpha(n - (m - 1))) (1 + \alpha(n - m))} > 0 \end{aligned}$$

where the sign follows directly from the fact that $n \geq m$. This leads directly to the following result:

Proposition 2 *Suppose that player 0 can freely choose the number of groups and their composition before the negotiation process commences. Then player 0 will choose $m = 1$ and $k_1 = n$, leading to maximal share $\bar{s}_0 = \frac{(1-\alpha)}{(1+\alpha(n-1))}$.*

Hence, the dominant player secures the largest share for itself (and thus the largest payoff) by having a purely simultaneous negotiation process in which all deals are negotiated at the same time. Even though the effect of future bargains is neutralized in the sequential negotiation process (see (8)), the each sequential deal is made over the size of the surplus that remains after all previous steps in the sequence have been agreed. In the simultaneous negotiation, this effect is not present since all players take actions that assume the unknown shares of the opponents as fixed.

The maximal share that 0 can obtain is increasing in the discount factor, reaching its maximum in the limit case $\delta \rightarrow 1$ at $\frac{3}{n+3}$.

To get the largest private share possible (and largest private expected payoff), each of the n other players would prefer to be in a group that negotiates early in any sequential process, as is easily verified by comparing successive values of $s_{z,j}$ from (12). Which group gets the largest total share cannot be determined unambiguously, however.

Proposition 3 *With m groups, player $j = 1, \dots, n$ would prefer to be a member of the first group to enter negotiations.*

Suppose now that there are m groups and that one of the players (in group z) other than 0 can decide the distribution of players among these. Maximizing the profit of this player requires making the denominator in (15) as small as possible. We have already seen that the first part of this expression is minimized by putting one player in each group and then the remaining $n - (m - 1)$ in the last group. Whereas player 0 did not have a preference for which of the groups is largest, we see from the second term in the denominator of (15) is minimized by putting one player in each group up to and including z and then putting the remaining players in following groups. Hence, player j in z would like the same distribution of the mass of players as 0 but wants to negotiate before the large group. Proposition 3 demonstrates that player j would want to be in the first group ($z = 1$). Thus,

with a fixed number of groups, the maximal payoff achieved by j in group 1 is $\widehat{\pi}_{1,j}(m) = \frac{\alpha}{1-\alpha} \frac{(1-\alpha)^m}{(1+\alpha(n-m))} = \frac{\alpha}{1-\alpha} \widehat{s}_0(m)$. Since this expression is proportional to the maximal share that 0 can achieve with a fixed number of groups, so is the calculation in (16). Then player j prefers a smaller number of negotiating groups. Then there are two candidate structures for maximizing the payoff of one of the players: either to negotiate first alone, and to have a single large group with all other players negotiate simultaneously in second place, or completely simultaneous negotiation. Call the expected payoffs to j from these structures $\pi_{1,j}(m=2)$ and $\pi_{1,j}(m=1)$. Then using (15) we get

$$\pi_{1,j}(m=2) - \pi_{1,j}(m=1) = \frac{\alpha^2(1-\alpha)(n-1)(1-\alpha^2(n-1) + \alpha(n-3))}{(\alpha(n-2) + 1)(\alpha(n-1) + 1)^2} > 0$$

The sign of this expression is readily determined since the only ambiguous term is $(1 - \alpha^2(n-1) + \alpha(n-3))$. Given the definition of α , we have that $\frac{1}{4} \geq \alpha \geq 0$, so that this expression is increasing in n , and is positive at $n=1$. Hence we have determined the following result:

Proposition 4 *Player $j = 1, \dots, n$ prefers a negotiation structure in which it negotiates alone with player 0 in the first round, followed by simultaneous negotiation between 0 and all of the remaining players in round two.*

This result reflects the fact that simultaneous negotiation secures a high share for player 0, making it more likely that the surplus will be created, and that there is a first-mover advantage for any player that can make the first bargain with 0 since the others are bargaining over the remaining surplus.

4 Summary and conclusion

This paper considers the effect that the order of negotiation can have on the creation of the surplus that is bargained over. In situations where a dominant player can create a surplus if it is sufficiently profitable, different groupings of negotiation partners will affect the share that each group can achieve; the order of the groups' negotiation also plays a prominent role here. When faced with n rivals, we have examined the equilibrium of an alternating offers bargaining model, and the shares that arise for any constellation of grouping of the rival partners. Suppose that the dominant player is the railroad company in the Coase example; then this firm will negotiate with each

farmer individually. On the other hand, one can imagine that the dominant player is a firm which is attempting to produce a new product that combines fragmented intellectual property. Then it may need to negotiate with some groups of firms that own the rights to different patent groups.

We solve for the unique equilibrium for an arbitrary constellation of players, and then conduct comparative static analysis to uncover which negotiation structure each would prefer. The dominant player prefers to negotiate with all partners simultaneously, but each of the partners would prefer to secure its share first in negotiations with the dominant player and then see all rival partners participate in a simultaneous bargain over the remaining cake.

5 References

Bac, M. and Raff, H. (1996). "Issue-by-Issue Negotiations: The role of Information and Time Preference", *Games and Economic Behavior*, 13, pp. 125-168.

Barneji, A. (2002). "Sequencing strategically: wage negotiations under oligopoly", *International Journal of Industrial Organization*, 20, pp. 1037-1058.

Bush, L.A. and Horstmann, I. (1997). "Bargaining Frictions, bargaining Procedures and Implied Cost in Multiple-Issue Bargaining", *Economica*, 64, pp.669-80.

Bush, L.A. and Horstmann, I. (2002). "The Game of Negotiations: Ordering Issues and Implementing Agreements", *Games and Economic Behavior*, 41, pp.169-91.

Cai, H. (2000). Delay in multilateral bargaining under complete information, *Journal of Economic Theory*, 93, 260-276.

Cai, H. (2003). Inefficient Markov perfect equilibria in multilateral bargaining, *Economic Theory*, 22, 583-606.

Clark, D.J. and Pereau, J-C. (2007) Passing the buck in sequential negotiation, mimeo.

Coase, R. H. (1960). The problem of social cost, *The Journal of Law and Economics*, 3, 1-44.

Flamini, F. (2007). "First things first? The agenda formation problem for multi-issue committees", *Journal of Economic Behavior & Organization*, 63, pp. 138-157.

Horn, H. and Wolinsky, A. (1988). "Bilateral monopolies and incentives for merger", *Rand Journal of Economics*, 19(3), pp. 408-419.

In, Y. and Serrano, R. (2004). "Agenda restrictions in multi-issue bargaining", *Journal of Economic Behavior & Organization*, 53, pp.385-399.

Inderst, R. (2000). "Multi-issue Bargaining with Endogenous Agenda", *Games and Economic Behavior*, 30, pp. 64-82.

Marshall, R.C. and Merlo, A. (2004). "Pattern Bargaining", *International Economic Review*, 45(1), pp. 239-255.

Rubinstein, A. (1982). Perfect equilibrium in a bargaining model, *Econometrica* 50, 97-109.

Suh, S-C. and Wen, Q. (2006). Multi-agent bilateral bargaining and the Nash bargaining solution, *Journal of Mathematical Economics*, 42, 61-73.