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**A NOTE ON MULTI-ISSUE TWO-SIDED
BARGAINING: BILATERAL PROCEDURES**

By Chaim Fershtman

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A Note on Multi-Issue Two-Sided Bargaining: Bilateral Procedures *

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April, 1998

Abstract: This note considers a two-sided multi-issue bargaining problem in which players that belong to the same "side" may have conflicting priorities regarding the different negotiated issues. The note examines different bilateral bargaining procedures and show the different equilibrium settlement that they yield. In particular the note examines the possibility that group heterogeneity (conflicting priorities) may be exploited in order to gain a better settlement. The different potential outcomes that are implied by the different procedures explains why we often observe such intense negotiation over bargaining procedures. Moreover, the players' choice of preferred procedure do not necessarily coincide with their "side" affiliation.

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A Note on Multi-Issue Two-Sided Bargaining: Bilateral Procedures

Introduction

On October 30, 1991, the peace talks between Israel and the Arab countries finally began in Madrid. In preparing the peace talks a great deal of time was devoted to the discussion of procedures. Some parties preferred simultaneous negotiation on all the outstanding issues while others preferred *issue-by-issue* bargaining, in which bargaining between the relevant parties begins on one issue and then continues, on to the next issue with other parties¹. The intense discussion about the talks' procedures indicates that the negotiators expected that the procedures themselves may affect their strategic positions in the negotiations and, consequently, the final outcome. It should be noted that the Israeli-Arab negotiations have a unique structure that make them different from standard bargaining problem.² Specifically, each of the several issues under negotiation needs to be negotiated between different countries, and each country has specific preferences with respect to the settlement to be reached by the other countries. Moreover, even though the Arab countries share a common interest (on most of the issues), each country has its own preferences regarding the relative importance of each issue. Thus, one country may find issue A (such as the final status of Jerusalem) to be more important and therefore is willing to compromise on issue B. While another country finds

¹Ultimately, the issue-by-issue procedure was implemented with negotiations between the Israelis and the Palestinians which were the first one to be inaugurated. The procedural dilemma still exists regarding other issues and parties. For example, Israel prefers to negotiate a settlement in Lebanon before discussing the Golan heights while Syria prefers to link the two issues together.

²Although, as we shall see, there are many bargaining problems that have the same specific structure.

issue B (for example, the future of the Golan heights) of greater importance and thus is willing to compromise on issue A as long as it gets a good deal on issue B. The question is, of course, who benefits from such conflicting priorities and whether the different priorities can be exploited by one of the "sides" to his own advantage.

The above multi-issue conflicting priority bargaining problem is also common in daily life. Consider, for example, a couple shopping for a new dining room table. Both husband and wife prefer high quality and low price. Their preferences may differ, however, on the relative importance of each attribute. One might place a larger emphasis on price while the other might view quality as the more important attribute. The couple needs to bargain with the furniture salesperson on both the quality and the price. In such a situation several bilateral bargaining procedures are available. It is possible for the wife (or the husband) to represent the couple and negotiate both the quality and the price. Or, the husband might negotiate the price and, after resolving this issue, the wife may negotiate the quality (knowing the agreed upon price). One can also reverse the order of negotiations letting quality be negotiated first between the wife and the salesperson. Another possibility is simultaneous bargaining, in which each person negotiates simultaneously and independently on one of the issues³. The main question is, of course, the effect of the buyers' conflicting priorities on the outcome of the different bargaining procedures. In particular, will the buyers be better off if only one of them shops with the a-priori consent of the other or will they be better off shopping together or can they use the issue-by-issue procedure for their advantage?

The main objective of this note is to study the different bilateral bargaining procedures and

³ Assuming that the store owner has several sales personnel who can conduct a simultaneous bargaining on the different issues.

the relationship between group heterogeneity (i.e., conflicting priorities) and group performance in the bargaining game. We therefore study a two-issue bargaining problem with a single player on one side and two players on the other. The two players have a common interest with respect to the two issues. But for one of them the first issue is more important while for the second, it is the second issue. Each of the players on the second side is entitled to negotiate on only one specific issue (which is assumed to be the issue of greater importance to her). This note examines three possible bilateral procedures to be employed in this bargaining problem: (i) simultaneous bargaining in which the relevant players, simultaneously and independently, negotiate the two issues, (ii) sequential *issue-by-issue* negotiation in which one of the issues is negotiated first (by the relevant two players) and, after its resolution, the second issue is negotiated by the relevant players, and (iii) negotiation by a representative player in which one of the players takes on the role of a representative agent and negotiates all the outstanding issues.

Our comparison of the different bargaining procedures indicates that they indeed yield different equilibrium agreements on the two issues. There are, for example, circumstances in which some of the players prefer the issue-by-issue procedure over a procedure in which they can play the role of the representative agent and negotiate both issues. In such a case the players exploit their different priorities to get a larger share of the two pies. The different potential outcomes that are implied by the different procedures explains why we often observe such intense negotiation over bargaining procedures. Moreover, the players' choice of preferred procedure do not necessarily coincide with their "side" affiliation. In such a case a coalition of players that belong to the two "sides" may try to impose a certain procedure on the rest of the players.

In this note we concentrate only on bilateral bargaining procedures. Our setup indeed consists

of only two "sides" to the negotiations but each side may consist of several players with different preferences. This structure implies the existence of another important class of bargaining procedures, that is, the class of multilateral procedures. While multilateral procedures are beyond the scope of this note, it is important to note that even when players negotiate over one sole issue, the outcome of multilateral bargaining is sensitive to the procedure used. The procedure needs to specify the acceptance rule (whether all the players must accept the offer or is it sufficient for a majority to accept it), the procedure needs to specify who is entitled to make an offer, what is the order in which the players respond to an offer, etc. (e.g., Krishna and Serrano (1996), Merlo and Wilson (1995), Winter (1997)).⁴

The problem of multi-issue bargaining can also be raised when there are only two players. Again, the outcome of such bargaining may differ according to the procedure adopted. Players may choose to bargain on all the issues simultaneously or to negotiate the issues sequentially, according to a pre-arranged order. The importance of the agenda (the order of issues which are discussed) in such multi-issue two-players bargaining has been already discussed in the literature (e.g. Fershtman (1990) and Herrero (1989)).⁵

2. The Model.

Consider the following "two-sided" bargaining problem. The first side consists of one player,

⁴ Note that Rubinstein's result (1982) on the uniqueness of the perfect equilibrium outcome cannot be extended to the n-player bargaining problem. (see the example by Shaked in Sutton (1986), as well as Osborne and Rubinstein (1990) for a discussion on three-player bargaining).

⁵ The two players case is equivalent to the bargaining problem in which on each side of the bargaining players have the same preferences. In such a case, the issue of conflicting priorities and group heterogeneity cannot be discussed.

hereinafter player a, while the second "side" consists of two players, players b1 and b2. The players bargain over two issues. We model an issue as an interval $[0,1]$ (or as a pie of size 1). An outcome of the bargaining is $(x, t_1; y, t_2)$ such that x and y are divisions of the two pies, and t_i is the period in which the division of pie i is implemented.

We say that players b1 and b2 have a *common interest with respect to the first issue* when for every $x' > x$ and every y and t $(x', t_1; y, t_2) \succ_{b1} (x, t_1; y, t_2)$ if and only if $(x', t_1; y, t_2) \succ_{b2} (x, t_1; y, t_2)$. We say that players i and j have a *common interest* when they have common interest with respect to *all* the issues under negotiation. Players may clearly have common interests without having the same preferences. One player may put a greater weight on the first issue while the other may view the second issue as more important; hence, such players have *conflicting priorities*. We further assume that players are impatient; such that $0 < \delta < 1$ is a common and given rate of time preferences.

Let $u_a(x, t_1, y, t_2)$ be the preferences of player a defined over all possible settlements of the two issues, and let us assume the following additive preferences:

$$u_a(x, t_1, y, t_2) \equiv \delta^{t_1}(1 - x) + \delta^{t_2}(1 - y) \quad (1)$$

The preferences of players b1 and b2, denoted by $u_{b1}(x, t_1, y, t_2)$ and $u_{b2}(x, t_1, y, t_2)$ respectively, are assumed to be

$$u_{b1}(x, t_1, y, t_2) \equiv \delta^{t_1}\alpha x + \delta^{t_2}y; \quad u_{b2}(x, t_1, y, t_2) \equiv \delta^{t_1}x + \delta^{t_2}\beta y \quad (2)$$

where $\alpha, \beta > 1$. We restrict our discussion to situations in which δ is sufficiently close to one such that $\delta\alpha > 1$ and $\delta\beta > 1$.

Given the above preferences, any partition (x, y) can have the following interpretation: the

second "side" (players b1 and b2) get x percent of the first pie and y percent of the second pie while player a gets the remaining parts of the two pies. Under such preferences, players b1 and b2 have a common interest - they both prefer a large x and y - but they have conflicting priorities. Player b1 places greater emphasis on the first issue while the player b2 values the second more.

For the above bargaining problem we consider three possible bargaining procedures. In the first one, there are independent and simultaneous negotiations between players a and b1 (on the partition of the first pie) and between players a and b2 (on the partition of the second pie).⁶ In the second procedure, the bargaining is done sequentially. Players a and b1 start to negotiate on the partition of the first pie; only after they reach an agreement, does the second session begin, in which players a and b2 negotiate the second issue (the order might also be reversed). We refer to such a procedure as an *issue-by-issue* procedure. The third bargaining procedure is negotiation by a representative agent. In such a procedure, one of the players represents the two players and negotiates with player a on both issues.⁷

In considering the three bargaining procedures we adopt the alternating offers bargaining mechanism (see Rubinstein (1982)), and assume, for convenience, that it is player a who is the first proposer in all the procedures.

⁶ We assume that, as in the Israeli-Arab negotiations, a player does not mean a person and therefore it is possible for player a to conduct simultaneous talks with players b1 and b2.

⁷ One can also imagine a bargaining procedure in which a representative agent and player a negotiate both issues but that this negotiation has an issue-by-issue agenda. In such issue-by-issue bargaining, the order in which the issues are discussed may be important, as was pointed out by Fershtman (1990) and Herrero (1989).

3. Division under different bargaining procedures

When player a negotiates simultaneously and independently with players b_1 and b_2 , no interdependence exists between the bargaining on the two issues. Applying the standard sequential bargaining solution yields that the equilibrium division of the two pies is $(\delta/(1+\delta), \delta/(1+\delta))$ and that agreement is immediately obtained. Letting $\delta \rightarrow 1$, the equilibrium division is $(1/2, 1/2)$, such that both pies are equally divided between the two sides. In such a case the different priorities of players b_1 and b_2 , i.e., the preference parameters α and β , do not affect the outcome of the bargaining.

When players use an issue-by-issue bargaining procedure, the timing of the implementation of the agreements plays an important role and may clearly affect the equilibrium outcome. One possibility is for implementation to be carried out immediately after each agreement is reached. In such a case, after players a and b_1 agree on the division of the first pie, the agreement is immediately implemented and only then do players a and b_2 begin to negotiate the second issue. When an agreement is reached on the second issue, it is immediately implemented as well. The second possible implementation rule dictates that implementation of *all* the agreements is initiated at the end of the two stages of negotiation and after *all* the issues are resolved.

Under our assumed additive utility functions, when the bargaining procedure entails immediate implementation, the agreement on the first issue has no effect on the bargaining over the second issue. It follows that the equilibrium division of the two pies in such a case is $(1/2, 1/2)$, which is identical to the simultaneous bargaining case.⁸ When the implementation of the agreements

⁸This interdependence holds only because of our assumption of additive utility functions. In the general case, the outcome of the negotiations on the first issue affects the players' utility function in the negotiations on the second issue and consequently affects the final equilibrium agreement.

on both issues is done at the end of the two stages of negotiations, the agreement on the first issue affects the bargaining on the second issue as any delay in reaching an agreement on the second issue postpones implementation of the first agreement and thus imposes an additional cost on both players. These costs of delay are affected by the different relative importance of the two pies for the players. When negotiating the first issue, players a and b are clearly aware of this effect and take it into account in their negotiations on the first issue. Because an issue-by-issue procedure with immediate implementation is equivalent (under our assumptions) to the simultaneous procedure, we will not consider this case. Therefore, in the following, when referring to the issue-by-issue procedure we mean a procedure in which implementation occurs at the conclusion of the negotiations on both pies.

Claim 1: The *issue-by-issue* bilateral bargaining procedure (when the first issue is negotiated first), letting $\delta \rightarrow 1$, yields the following (subgame perfect) equilibrium division of the two pies:

$$(x^*, y^*) = \left(\frac{2\beta^2(\alpha - 1)}{(2\alpha\beta - 1 - \beta)(\beta - 1)}, \frac{\alpha\beta^2 - 3\alpha\beta + \beta + 1}{(2\alpha\beta - 1 - \beta)(\beta - 1)} \right) \quad \text{when } \alpha \leq \frac{\beta^2 + 1}{2\beta}. \quad (3)$$

For relatively large values of α we get

$$(x^*, y^*) = \left(1, \frac{\beta - 1}{2\beta} \right) \quad \text{when } \alpha > \frac{1 + \beta^2}{2\beta}. \quad (4)$$

In both cases agreements are immediately reached with no delays.

Proof: We will analyze this bargaining procedure in the standard way by considering first the bargaining on the second pie (given a certain partition of the first pie) and then proceed backward to

the bargaining of the first issue.

Given a partition x of the first pie, player a wishes to maximize $\delta[(1-x) + (1-y)]$ where y is a partition of the second pie and t is the period in which agreement on the second pie is reached. Player b2, on the other hand, maximizes $\delta[x + \beta y]$. An equilibrium for the second stage of bargaining is a pair of functions $y_a(x)$ and $y_{b2}(x)$ such that player a offers the partition $y_a(x)$ and accepts any offer that is at least as good as $y_{b2}(x)$, while player b2 offers the partition $y_{b2}(x)$ and accepts any offer that is at least as good as $y_a(x)$. Specifically, $y_{b2}(x)$ is the maximum portion of the second pie such that $(1-x) + (1-y_{b2}(x)) \geq \delta(1 - y_a(x) + (1-x))$; while $y_a(x)$ is the minimum portion of the second pie such that $x + \beta y_a(x) \geq \delta(x + \beta y_{b2}(x))$. Solving these characteristic equations yields the following (subgame perfect) equilibrium partition offers for the second pie bargaining:

For large values of x such that $x > \beta(1-\delta)/(\delta+\beta)$, we get

$$y_a(x) = \frac{\delta\beta(2-x)-x}{\beta(1+\delta)} \quad , \quad y_{b2}(x) = \frac{\beta(2-x)-\delta x}{\beta(1+\delta)} \quad (5)$$

For low values of x , such that $x \leq \beta(1-\delta)/(\delta+\beta)$,

$$y_a(x) = \frac{\delta x + \delta\beta - x}{\beta} \quad , \quad y_{b2}(x) = 1 \quad (6)$$

Given our assumption that it is player a who makes the first offer, the equilibrium division of the second pie is given by $y_a(x)$ as specified by (5) and (6).⁹

⁹ Note that $y_a(x)$ decreases with x and increases with β . A lower x makes player a relatively more impatient, which results in a lower equilibrium share from the second pie. A larger β implies that player b2 values the second pie more; therefore, the agreed-upon share of the first pie has a smaller effect on his impatience. Indeed note that when $x=0$, the size of β has no effect on the equilibrium partition of the second pie. In such a case, the equilibrium division is such that player b2 (and also b1) get all of the second pie.

Consider now the bargaining on the division of the first pie between players a and b1. In formulating their strategies both players take into account the effect of the agreed division of the first pie on the second stage bargaining between player a and player b2. Specifically, for a given settlement, x , in the negotiations on the first issue, the overall payoffs (from both issues) for player a is $R_a(x) \equiv 1 - x + 1 - y_a(x)$. This result consists of the direct benefit from the first pie, $1 - x$, and the expected share from the second pie, $1 - y_a(x)$. Similarly, the overall payoff of player b1 is $R_{b1}(x) \equiv \alpha x + y_a(x)$. In order for a pair of divisions (x_a, x_{b1}) to be an equilibrium, it must be that x_a (resp. x_{b1}) is the division offered by player a (resp. b1) and that player a (resp. b1) accepts any offer that gives him at least $R_a(x_{b1})$, (resp. $R_{b1}(x_a)$). At equilibrium, x_a is the smallest portion of the first pie that satisfies $R_{b1}(x_a) \geq \delta R_{b1}(x_{b1})$ and x_{b1} is the largest portion of the first pie that satisfies $R_a(x_{b1}) \geq \delta R_a(x_a)$. Solving these equations and letting $\delta \rightarrow 1$ yields the equilibrium division of the pies specified by equations (3) and (4). ■

We now turn to bargaining with a representative agent procedure in which players a and b1 (or b2) bargain on the partition of both pies. We assume, as before, an alternating offers bargaining game in which player a makes the first offer. An offer in such a case is (x_a, y_a) or (x_{b1}, y_{b1}) , which are suggested divisions of both pies.

Claim 2: When player b1 represents the second side in the bargaining on both issues then:

(i) The (subgame perfect) equilibrium division is :

$$(x^*, y^*) = \left(\frac{\alpha \delta + \delta - 2\delta^2}{\alpha - \delta^2}, 0 \right) \quad (7)$$

(ii) $(x^*, y^*) \rightarrow (1, 0)$ when $\delta \rightarrow 1$.

Proof. Let (x_a, y_a) and (x_{b1}, y_{b1}) be the equilibrium proposals of players a and b1, respectively. (x_a, y_a) is a division that maximizes player a's utility subject to its being acceptable to player b1, i.e., $\alpha x_a + y_a \geq \delta(\alpha x_{b1} + y_{b1})$. Similarly, (x_{b1}, y_{b1}) is a division that maximizes the utility of player b1 subject to its being acceptable to player a, i.e., $(1 - x_{b1}) + (1 - y_{b1}) \geq \delta(1 - x_a + 1 - y_a)$. Note that if $x_a < 1$ then it must be that $y_a = 0$. Otherwise player a can reduce y_a and increase x_a such that he will be better off and player b1 will be indifferent. Similarly, y_{b1} is positive only when $x_{b1} = 1$. A simple calculation indicates that at equilibrium, it must be that $x_a < 1$, which also implies that $y_a = 0$. Inserting these values in the above characteristic equations and solving them yields (7). Part (ii) follows immediately by taking the limit of (7) when $\delta \rightarrow 1$. ■

When player b1 bargains on the division of the two pies, letting $\delta \rightarrow 1$, the equilibrium division is such that players b1 and b2 get the first pie while player a gets the second pie. Note that in such a case, player a, given her preferences, gets $\frac{1}{2}$ of the overall pie (the case of both issues taken as a whole), player b1 gets the pie that she prefers, while player b2 gets no share of the second pie, which is the one that she prefers. Clearly, in such a case, players b1 and b2 both prefer to be the representative agent while player a is indifferent between the two.

4. Comparison of the different bargaining procedures.

The analysis in Section 3 indicates that the bargaining procedure itself may affect the division of the two pies. In this section we compare the equilibrium outcomes of the three suggested bilateral procedures. Our comparison will be carried out for the case of $\delta \rightarrow 1$.

Claim 3: Player a is indifferent between the simultaneous bargaining procedure and bargaining by a representative. Player b1 (similarly b2) prefers bargaining by a representative only if she is the representative agent. Otherwise, if player b2 is the representative agent, player b1 is better off with the simultaneous negotiation procedure.

Proof: Straightforward from the analysis in Section 3. ■

We next compare the simultaneous bargaining procedure with the issue-by-issue procedure in which the first issue is negotiated at the first session.

Claim 4:

- (i) Player a is always better off with the simultaneous bargaining procedure than with the issue-by-issue bargaining procedure.
- (ii) Player b1 is better off with the issue-by-issue negotiation procedure in which the first issue is negotiated first than with the simultaneous bargaining.
- (iii) When $\alpha \geq (1+\beta^2)/2\beta$, player b2 is indifferent between the simultaneous bargaining procedure and the issue-by-issue procedure in which the first issue is negotiated first. When $\alpha < (1+\beta^2)/2\beta$, player b2 prefers the issue-by-issue procedure to the simultaneous bargaining procedure.

Proof: (i) In simultaneous negotiations player a gets $\frac{1}{2}$ of each pie; therefore, her final utility is $u_a=1$. From (3) and (4) it is evident that in issue-by-issue negotiations, $(1-x^*) + (1-y^*) < 1$ regardless of the preference parameters' values.

(ii) and (iii) can be proven by comparing (3) and (4) for the issue-by-issue procedure and the

equilibrium division of $(1/2, 1/2)$ for the simultaneous negotiation procedure. ■

We next compare issue-by-issue bargaining (having the first issue being negotiated first) with the negotiation by representation procedure, and letting w.l.g. player b1 be the representative agent.

Claim 5:

(i) Player a prefers the negotiation by a representative procedure to the issue-by-issue bargaining procedure regardless of the order in which the issues will be discussed and the identity of the representative agent.

(ii) When $\alpha > (1 + \beta^2)/2\beta$, both players b1 and b2 prefer the issue-by-issue procedure to the bargaining by representation in which player b1 negotiates both issues.

(iii) When $\alpha \leq (1 + \beta^2)/2\beta$, player b1 is better off when representing her side on both issues than with the issue-by-issue negotiation procedure while player b2 prefers issue-by-issue negotiations.

Proof: (i): Similar to the proof of Claim 4(i).

(ii) and (iii): Letting player b1 be the representative player yields an equilibrium division of $(1, 0)$. Comparing this outcome with (3) and (4), which are the equilibrium divisions under an issue-by-issue bargaining procedure, will complete the proof. ■

Claims 3-5 demonstrate the problem in reaching an agreement on the bargaining procedure. First note that there is not even one bilateral bargaining procedure that is dominated by another procedure and therefore there is no possibility to eliminate one of the procedures apriori. While intuition may suggest that a player is always better off representing her own side in negotiating of

both issues, Claim 4 indicates that this intuition is misleading. Player b1, for example, may prefer the issue-by-issue procedure in which the first issue is considered first (and when he does not participate in the negotiation on the second issue) to the procedure in which he negotiates both issues. In such a case, players b1 and b2 "exploit" their conflicting priorities to obtain a better settlement. A similar intuition applies to the comparison of the issue-by-issue procedure with the simultaneous negotiation procedure. Players b1 and b2 both prefer the issue-by-issue procedure, in which their different priorities are helpful in obtaining a better settlement.

The players' preferences among the possible procedures may also be affected by the order in which the issues are discussed in the issue-by-issue procedure.

Claim 6:

(i) Consider the case in which $\beta > (1+\alpha^2)/2\alpha$, $\alpha > (1+\beta^2)/2\beta$, yet $\alpha > \beta$. If the issue-by-issue procedure is used, player a is better off when the first issue is negotiated first, player b1 (resp. b2) is better off when the first (resp. the second) issue is negotiated first.

(ii) When $\beta < (1+\alpha^2)/2\alpha$ and $\alpha > (1+\beta^2)/2\beta$, player a is better off when the first issue is discussed first, whereas player b2 is better off when the bargaining begins with the second issue. If $2\alpha^2\beta + \alpha + \beta + 1 > 4\alpha\beta^2 + \alpha\beta$, player b1 prefers to start with the first issue; otherwise, player b1 is better off when the bargaining starts with the second issue.¹⁰

Proof: (i) When α and β satisfy the above conditions, we always find ourselves in the case specified by Equation (4). In such a case the equilibrium divisions of the two pies are $(1, (\beta-1)/2\beta)$ if the first issue is considered first and $((\alpha-1)/2\alpha, 1)$ if the second issue is discussed first. Player a's utility is

¹⁰ The cases in which $\beta > (1+\alpha^2)/2\alpha$ and $\alpha < (1+\beta^2)/2\beta$ is analogous.

$(1+\beta)/2\beta$ when the first issue is negotiated in the first stage and $(1+\alpha)/2\alpha$ if the second issue is negotiated first. Thus $\alpha > \beta$ implies that player a is better off when the first issue is negotiated first. Comparing the utility of player b1 under the two alternatives yields that because $\alpha + (\beta-1)/2\beta > 1 + (\alpha-1)/2\alpha$, player b1 is better off when the first issue is negotiated first (a similar result holds for player b2).

(ii) When $\beta < (1+\alpha^2)/2\alpha$ and $\alpha > (1+\beta^2)/2\beta$, if players a and b1 negotiate the first issue in the first stage of negotiations, the equilibrium division will be $(1, (\beta-1)/2\beta)$, while if players a and b2 start the negotiations by bargaining on the second issue, the equilibrium division, according to Eq. (3), will be $\{2\alpha^2(\beta-1)/(2\alpha\beta-1-\alpha)(\alpha-1); (\alpha^2\beta-3\alpha\beta+\alpha+1)/(2\alpha\beta-1-\alpha)(\alpha-1)\}$. Comparing the utilities that such divisions yield for the different players will conclude the proof of (ii). ■

Numerical Example: In order to illustrate the above dilemma consider the example in which $\alpha=2$ and $\beta=3$. In such a case, when the players use an issue-by-issue procedure and the first pie is negotiated first, then by Claim 1 the equilibrium divisions of the two pies are $(1, 1/3)$. Similarly, when the order of negotiation is reversed and the second pie is negotiated first, the equilibrium division is $(1/4, 1)$. Under simultaneous bilateral bargaining, the equilibrium division is $(1/2, 1/2)$. Bargaining by a representation procedure yields the division $(1, 0)$ when player b1 is the representative agent (or $(0, 1)$ if player b2 is the representative agent).

Given the above options, player a clearly prefers either the simultaneous bargaining procedure or bargaining by representation. When an issue-by-issue procedure is used, player a prefers to start the negotiations with player b2, and only after an agreement on the second issue is reached to negotiate on the first issue. Player b1 (resp. Player b2), on the other hand, prefers the issue-by-issue

procedure in which the first (resp. second) issue is negotiated first. If this procedure is not feasible, player b1 (resp. Player b2) would prefer bargaining by representation if she is assigned to be the representative agent. Player b1's (resp. b2) third choice would be either simultaneous negotiations or issue-by-issue bargaining in which the second issue (resp. the first issue) is negotiated first. Player b1 (resp. b2) is worse off when player b2 (resp. b1) is assigned as the representative agent and negotiates both issues.

Concluding Remarks: Negotiating over bargaining procedures

Because the different bargaining procedures lead to different divisions of the two pies, players may disagree on the preferable procedure. This situation illustrates why players need to bargain over the bargaining procedure itself. In the preliminary negotiations over procedures, it is possible that an alliance of players that are on the same side of the negotiations and that have common interest, will be switched over so that one (or several) of them prefer the same procedure as does the player on the other side (player a in our case), against the wishes of some of their partners from the same side. This situation is described in Claim 5.

The bargaining over bargaining procedures itself may be viewed as a regular bargaining problem. However, if we will prohibit agreements that subscribe lotteries over procedures, we end up with a bargaining problem with a finite set of outcomes. In such a situation, even when there are only two players, the uniqueness of the subgame perfect equilibrium is not guaranteed (see van Damme, Selten and Winter (1990)). Moreover, given our specific structure of multi-player two-side bargaining, the outcome of the bargaining over procedures will again depend on the procedure of this bargaining: Are all the players required to agree on a procedure or is a majority sufficient, who

is entitled to suggest a procedure, etc. One can even envision a situation in which a subset of the players may start to negotiate on one of the issues without the agreement of the other players. This situation in fact occurred in the Israeli-Arab peace talks when the Israelis and the Palestinians began to negotiate against the wish of Syria. This situation may also occurs in our model when players a and b1 both prefer an issue-by-issue procedure in which the first issue is discussed first: they can start negotiating without the consent of player b2. In this case, even though players b1 and b2 have a common interest and are basically on the same "side", players a and b1 (or b2) may prefer the same procedure and have the ability to impose it on player b2 (or b1).

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