One Thing at a Time: Efficient Agendas in Multi-Issue Bargaining*

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Abstract: This paper analyses sequential agendas in multi-issue bargaining. A bilateral two-issue alternating offer model with complete information and players with opposing ranking of the issues is studied. The model assumes issues to be linked such that the implementation of any result requires all issues to be settled. The analysis shows that if offers are restricted to single-issues, then the agenda which emerges endogenously leads only exceptionally to inefficient outcomes, i.e. if bargaining frictions are sufficiently low and preferences are sufficiently similar. Moreover, by adopting an ex ante perspective, it is shown that full exploitation of inter-issue tradeoffs can be guaranteed only if issues are discussed one at a time. As a consequence, it is primarily the sequential agenda which generates ex ante efficient outcomes. *Journal of Economic Literature* Classification Number: C72.

Keywords: Multi-issue bargaining; Complete information; Agenda

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1 Introduction

Negotiation is a process that helps parties decide how to divide the fruits of cooperation. Often it is the case that multiple issues are at stake: political parties negotiating over a coalition agreement, two companies bargaining over the exact conditions of their joint-venture, or a labour union and a company trying to find an agreement on wages and working hours.

Multi-issue bargaining models frequently assume that the disagreement on one issue does not threaten the possible benefit from other issues so that the result from bargaining over one issue is unaffected by the other (In and Serrano, 2003, 2004; Inderst, 2000; Chen, 2006). Issues are not linked and can be *implemented separately*. On the other hand, there might be several issues which are linked in such way that they are essential for cooperation. Here the overall agreement depends on the successful settlement of these linked issues. Consequently, these issues can only be *implemented jointly*. For example, assume the success of the union-employer negotiation requires that both issues, wages and working hours are settled. In this case the agreed wage can not be implemented until an agreement on the working hours is achieved (and vice versa).

On the basis of Rubinstein's (1982) alternating offer model, this paper analyses a bargaining situation with two issues which are both essential to an overall agreement. In this sense, it continues the work of Fershtman (1990) and Weinberger (2000). However, in contrast to the assumption of separate implementation, joint implementation generally allows players to make compromises. In Raiffa's (1982, p. 142) words: "the art of compromise centers on the willingness to give up something in order to get something else in return". Because each issue might threaten a player's benefit from several issues, negotiations over linked issues allows the opponent to give up something without the fear that he will not get something in return. Hence, joint implementation allows players to focus on *one thing at a time* without losing the ability to make mutual beneficial compromises between the issues, i.e. *inter-issue tradeoffs*. These tradeoffs are impossible when issues can be implemented separately and are negotiated issue-by-issue.

A main task of this paper is to analyze the efficiency of different bargaining agendas. By *bargaining agenda* I mean the sequence in which the issues are discussed. The agenda is *simultaneous* if all issues at stake are negotiated in a bundle, it is *sequential* if negotiation takes place issue-by-issue. Moreover, the agenda is *exogenous* if the sequence of issues is prescribed while it is *endogenous* if not.

It is well-known that if offers are unrestricted, players chose to make bundle-offers over all issues and the simultaneous agenda emerges (Fershtman, 1990; In and Serrano, 2003; Inderst, 2000). From Fershtman (1990) we further learn that a restriction to single-issue offers may lead to inefficient outcomes; in his approach this occurs when players have opposing preferences and the first issue on the agenda is the one less preferred by the first-mover. In Fershtman's setting the first-mover prefers this inefficient sequence to the sequence which sets his preferred issue first such that the endogenous sequential agenda generally leads to an inefficient outcome. In this paper I show that this result strongly relies on the structure of moves which is assumed. By following the alternating offer structure more literally the results are contrasting: players nearly always prefer the agenda such that their preferred issue is negotiated first.[1] In this case the outcome is always efficient. In my approach the inefficient sequence emerges endogenously only when players are relatively patient and their preferences are relatively similar.

By adopting an ex ante perspective – a perspective prior to the selection of the first-mover – I propose the notion of ex ante efficiency as in Chen (2006). Assuming that players are uncertain about the sequence of moves, i.e. whether they are first or second-mover, their incentives fundamentally change. The preferred agenda of a player who is aware that he moves first is the one in which he can *capture* the maximal value, and this is always the simultaneous agenda. But as uncertainty increases, his interest in *creating* value increases. As a result we can ask the following questions:

> From an ex ante perspective: a) Which agenda maximizes a player's expected payoff? b) Which agenda maximizes efficiency? c) Does an agenda exist which maximizes both players expected payoffs simultaneously?

We will see that a player's expected payoff increases in his preference for one issue. This results from the fact that with increasing differences in the preferences the possibility to make inter-issue tradeoffs increases. It will further become clear that players can can exploit the tradeoffs to a higher extent in the sequential agenda.

[1] In Fershtman (1990) the proposer on each of the issues is selected randomly. We assume a random selection of the proposer only once for the first issue to be negotiated. Thereafter the offer structure is strictly alternating.

As as result, I will show that the sequential agenda is always ex ante beneficial for both players if preferences are sufficiently different or first mover probabilities are sufficiently similar. To get this straight, this result shows us that a sequential agenda may expand the ex ante reachable bargaining space and thereby increase the ex ante efficiency.

Classifying the literature on multi-issue bargaining, we find that the assumption made on the implementation of issues is of major importance: it influences the structure and the result of the game most profoundly. This explains why the results derived with separate implementation are far more general.[2] Fershtman (1990) assumes joint implementation and shows (in addition to the inefficiency result mentioned above), that the agenda does not influence efficiency but does influence the distribution of payoffs if players' preferences are identical. In a similar framework Weinberger (2000) shows that inefficient equilibria result when partial acceptance of bundle offers is allowed. Consequently, she finds that package bargaining tends to improve efficiency.[3]

This paper is organized as follows. In section 2, I will present a formal model and discuss equilibria for the simultaneous and sequential agenda. In section 3, I will introduce the ex ante perspective and derive the ex ante efficient agenda. In Section 4, I conclude with a discussion of the results. Proofs are provided in an appendix.

[2] The early works of Bac and Raff (1996) and Busch and Horstmann (1997) discuss the influence of unilateral incomplete information on the agenda setting. Working in a complete information setting, Busch and Horstmann (1997) analyse the influence of different types of bargaining frictions (1997b) and of different agendas (1999). Working with arbitrary sets of issues, In and Serrano (2003) generalise the result of Inderst (2000) and show for a larger class of utility functions that simultaneous offers form the unique SPE. In and Serrano (2004) analyse the endogenous agenda when offers are restricted to single-issues. Their model suffers from multiple equilibria when bargaining frictions become small. Chen (2006) tackles this problem and shows that a unique SPE agenda exists if the alternating offer structure is interpreted slightly different. Flamini (2007) finds a way to overcome the multiple equilibria by introducing a small unit of time in between the bargaining stages.

[3] Lang and Rosenthal (2001) show under the assumption of unrestricted offers, that there are SPE in which players offer only on subsets instead of on the whole bundle of issues. This result is surprising but it depends strongly on the nonconcavity assumption. Applying the Nash solution, Horstmann et al. (2005) and Harstad (2001) compare joint with separate implementation in a two-issue bargaining game. Both find that only joint implementation generally allows for inter-issue tradeoffs and is therefore preferable.

2 Multi-Issue Bargaining with Joint Implementation

2.1 The Model

Consider a game of complete information in which two players, A and B, bargain over drafting a contract for the arrangement of two issues or *pies*, X and Y. Each issue is assumed to be of size 1, desirable and infinitely divisible. Players' evaluations of the issues differ, precisely, their evaluation is exactly the reverse.

I adopt the Rubinstein (1982) alternating offers bargaining model. Specifically, the procedure is as follows: In the first period a first mover is selected randomly and announces an offer to his opponent. Generally, this offer may contain either one proposal for the division of one issue or a menu of two proposals, each for a division of one issue. I will consider these cases separately and refer to the former as *sequential agenda* and to the letter as *simultaneous agenda*. An offer can be accepted or rejected only as a whole; partial acceptance is not possible. If an offer on a set of issues is accepted by the recipient, this set is assumed to be settled. Renegotiation of settled issues is excluded. No matter whether the recipient accepts or rejects the offer he will be the next proposer if an unsettled issue remains. *Joint implementation* is assumed. Hence, issues are linked such that players obtain any utility only if an agreement on both issues is found. This implies that a disagreement on one issue threatens the entire negotiation. The game starts in period zero. Only a rejection of an offer causes a bargaining friction and leads to a delay of one time period t. Time is assumed to be valuable such that each player prefers an early settlement. The game has no predetermined number of rounds and the outcome of (permanent) disagreement is zero for both players. The game ends when both issues are settled.

Given an agreement on both issues after period t, the partition is such that player A receives share x of issue X and share y of Y. Players' utilities are

$$u_A = (\alpha \cdot x + (1-\alpha)y)\,\delta^t, \qquad u_B = ((1-\alpha)(1-x) + \alpha(1-y))\,\delta^t$$

where δ is the constant rate of time preference and is equal for both players, with $0 \leq \delta < 1$. It is further assumed that $1/2 < \alpha < 1$, i.e. player A evaluates a share of X and B a share of Y higher than an equal share of the alternative issue.

2.2 The Simultaneous Agenda Equilibrium

Given a simultaneous agenda, the offer of the first mover contains a proposal on how to divide each of the two issues. The second-mover may accept or reject the offer only as a whole. In this case there is a unique SPE which always gives the first mover all of his preferred issue and, depending on α and δ, some share of his less preferred issue. Independently of the sequence of moves, the utility in equilibrium is $\frac{\alpha}{\alpha+\delta-\alpha\delta}$ for the first and $\frac{\alpha\delta}{\alpha+\delta-\alpha\delta}$ for the second-mover respectively. The proof is provided in appendix I. It comes as no surprise that in equilibrium the second-mover's utility takes the value of the discounted first-mover utility as this result coincides with Rubinstein (1982) for symmetric players. The intersection points of the continuous and dashed rays in Figure 1 illustrate the bargaining solution for values of α and δ.

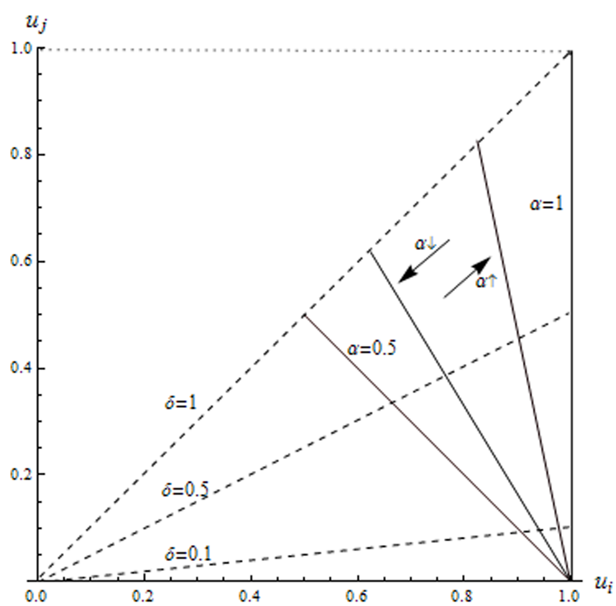

Figure 1: First (u_i with $i \in (A, B)$) and second-mover (u_j with $j \neq i$ and $j \in (A, B)$) payoffs given a simultaneous agenda

As can be expected, decreasing δ increases the first-mover's payoff (u_i) while it decreases the second-mover's payoff (u_j). For all evaluations α, if patience reaches zero $(\delta = 0)$ the game naturally converges to the ultimatum game; and if $\delta \to 1$ then it converges to the symmetric Nash solution. Note that for $\alpha = 0.5$, $u_i + u_j = 1$. For all $\delta > 0$, both payoffs increase in α. Hence, a higher discrepancy in the evaluation of the issues expands the bargaining frontier. This is due to the fact that opposing evaluations allow players to make *explicit inter-issue tradeoffs*. Figure 1 shows that the inter-issue tradeoffs diminish when bargaining frictions increase and vanish if $\delta \to 0$.

2.3 The Sequential Agenda Equilibrium

Unlike in the equilibrium of the simultaneous agenda, the determination of the equilibrium for the sequential agenda requires consideration of two cases: players who are restricted to single-issue offers either offer firstly on their preferred issue (*Case I*) or may prefer to offer on their less preferred issue (*Case II*). It will be shown that for every bargaining situation (i.e. every combination of α and δ) for both players one of these strategies is strictly preferable to the other.[4] Further, for all bargaining situations the preferred strategy is represented by a unique SPE in which both players accept their one-issue offers immediately.

Case I: Assume a sequential agenda such that the players are restricted to make offers on one issue at a time. Next, assume the agenda is set exogenously such that players offer solely on their preferred issue. In this case we can state:

Proposition 1. (sequential exogenous agenda) *For all δ and α, there is a unique SPE in which holds: each player receives his higher evaluated issue entirely, the bargaining solution is always on the efficiency frontier and the first (second) mover payoff is always smaller (higher) compared to the simultaneous structure.*

Proof (Sketch):[5] The second-mover will accept to give away all of his less preferred issue because he foresees that in return he can demand and receive all of his preferred issue. As the issues are only implementable if both issues are settled –

[4] Note that the payoff of the first and second mover is generally independent of the type of player (*A* or *B*), as both types are symmetric except that their evaluation of the issues is exactly reverse. Hence, for any given δ and α each player who is about to offer faces the same situation. So for example, if it is optimal for one player to offer on his preferred issue first, then the same holds for the other player. This property substantially simplifies the analysis as for any proposer's offer, the corresponding reservation value of the responder can be calculated (rather easily). Without this assumption, a calculation of the sequential endogenous agenda equilibrium analysis is far more difficult or may even be impossible to carry out as reservation values have to be calculated for any possibly evolving sequence of responses. Here only two cases have to be considered: either both players prefer to offer on their preferred or on their less preferred issue first.

[5] For more details see appendix II.

meaning that an disagreement on an unsettled issue threatens players' benefit from the settled issue – the second-mover is secured against exploitation. Assume that player A is first mover and proposes a division $(x_A^I, 1 - x_A^I)$ on his preferred issue X in stage I.[6] After rejection or acceptance of his offer, it is up to B to offer A a share of Y. Note that the stage II agreement depends on the stage I division as a decision to reject would also discount the partitions of the stage I solution. That is, the stage II equilibrium is a reaction function of the stage I solution. Assume that A's proposal in stage I was accepted such that now B's stage II offer $(y_B^{II}, 1 - y_B^{II})$ has to fulfill:

$$\alpha x_A^I + (1-\alpha) y_B^{II} \;\geq\; \delta \left[\alpha x_A^I + (1-\alpha) y_A^{II} \right],$$

while A's counteroffer after a rejection would be restricted by:

$$(1-\alpha)(1-x_A^I) + \alpha(1-y_A^{II}) \;\geq\; \delta \left[(1-\alpha)(1-x_A^I) + \alpha(1-y_B^{II}) \right].$$

Solving these conditions for y_B^{II} makes consideration of different cases necessary. This results from the fact that X and Y are bounded by 0 and 1. Calculating A's possible payoff r_A from both issues as a function of his share x_I from his stage I offer, we obtain:

$$r_A(x^I) = \begin{cases} \frac{\delta - x\delta - \alpha\delta + 2x\alpha\delta}{\alpha + \alpha\delta} & , for\, x \geq k \wedge x < l \\ \alpha x & , for\, x \geq k \wedge x \geq l \\ \delta(1 - \alpha + \alpha x) & , for\, x < k \wedge x < m \\ \alpha x & , for\, x < k \wedge x \geq m \end{cases}$$

with

$$k = \frac{(1-\alpha)(1-\alpha-\alpha\delta)}{1-\alpha(2-\alpha-\alpha\delta)},\; l = \frac{\delta - \alpha\delta}{\alpha^2(1+\delta) - 2\alpha\delta + \delta},\; m = \frac{\delta - \alpha\delta}{\alpha - \alpha\delta}$$

while $r_A(x^I)$ is increasing in x^I over all cases and for all $x \in [0,1]$. Note that for the case that B rejects, his possible payoff would be $\delta r_B(y^I)$ which is decreasing in y^I for all $y \in [0,1]$. The calculation of the borders k, l and m and the derivation of the reaction function r_A is provided in Appendix II. Given these payoff functions, we can see that both players will try to maximize their overall payoff by maximizing their share of their preferred issue. For A's stage I offer on X the following conditions

[6] Note that each issue will be negotiated in a separate stage. This does not imply, that stage II necessarily begins in period t=1, but rather immediately after the settlement of the first issue. So, for example, if the first offer of stage I is accepted right away, no friction occurs and the negotiation of stage II continuous in t=0.

must hold:

$$(1-\alpha)(1-x_A^I)+\alpha(1-y_B^{II}) \geqq \delta\left[\alpha(1-y_B^I)+(1-\alpha)(1-x_A^{II})\right]$$

$$(1-\alpha)y_B^I+\alpha x_A^{II} \geqq \delta[\alpha x_A^I+(1-\alpha)y_B^{II}]\,.$$

If we check for the proposers payoff maximizing offer ($x_A^I = 1, y_B^I = 0$), we find that the stage *II* reactions for all $\alpha \in (0.5, 1)$ and all $\delta \in [0, 1)$ are $y_B^{II}(x^I = 1) = 0$ and $x_A^{II}(y^I = 0) = 1$ (see Appendix II). Inserting these reactions in the above stage *I* conditions, we have:

$$(x_A^I =)\, 1 \leq \frac{1-\alpha\delta}{1-\alpha} \quad \textit{and} \quad (y_B^I =)\, 0 \geq \frac{\alpha\delta-\alpha}{1-\alpha}\,.$$

Both conditions hold for all $\alpha \in (0.5, 1)$ and all $\delta \in [0, 1)$. According to this result, the first-mover (player *A*) will demand and receive all his preferred issue. Then *B* as first-mover in stage *II* will take advantage of *A*'s impatience and can successfully claim the other issue entirely. The first (second) mover payoff is thus of value α and is always lower (higher) than his corresponding payoff $\frac{\alpha}{\alpha+\delta-\alpha\delta}$ ($\frac{\alpha\delta}{\alpha+\delta-\alpha\delta}$) in the simultaneous agenda game. For the case that players are infinitely patient ($\delta \to 1$), the result of the game converges to the simultaneous agenda equilibrium. It is obvious that this result is the *unique* SPE of the given sequential bargaining game and is on the corresponding efficiency frontier.□

The above result shows that players' payoffs in equilibrium are independent of the common discount factor but are sensitive to changes in the evaluation of the issues. As before, a higher discrepancy in the evaluations allows for higher tradeoffs. But in contrast to the simultaneous offer game, where inter-issue tradeoffs are an explicit part of the proposal, the sequential agenda forces the players to consider possible tradeoffs in an implicit way. Note, that two properties are crucial for the existence of *implicit inter-issue tradeoffs*. Firstly, the sequential agenda reduces the bargaining power of the first proposer. Secondly, joint implementation allows the responder to forego the first issue without any worry, as this very sacrifice increases the impatience of his opponent in stage *II* and thereby enlarges his share of the second issue.

Case II. As before, the agenda is sequential such that players are restricted to offer on one issue at a time. But now assume that in contrast to *Case I*, the agenda is endogenous. This leads us to the following question: when is it optimal for the proposer *not* to offer on his preferred issue first? The following proposition gives the answers.

Proposition 2. (sequential endogenous agenda) *If players are sufficiently patient* ($\delta \gtrapprox 0.82$) *and preferences are sufficiently similar* ($\alpha \lessapprox 0.65$) *it may be that in the unique SPE of the sequential endogenous agenda game, players offer on their less preferred issue first. In this case a first-mover advantage exists, the result is never on the efficient bargaining frontier and the first mover's payoff is always smaller compared to the simultaneous agenda.*

Proof. Appendix III. [7]

The results contained in proposition 2 are illustrated in Figures 2, 3 and 4 and discussed in the following. The dark region θ in Figure 2 illustrates the combinations of α and δ for which the first mover offers on his preferred issue as his payoff ($\bar{u}_1^*$) by doing so exceeds α (recall: in *Case I* $\bar{u}_1^* = \bar{u}_2^* = \alpha$). [8]

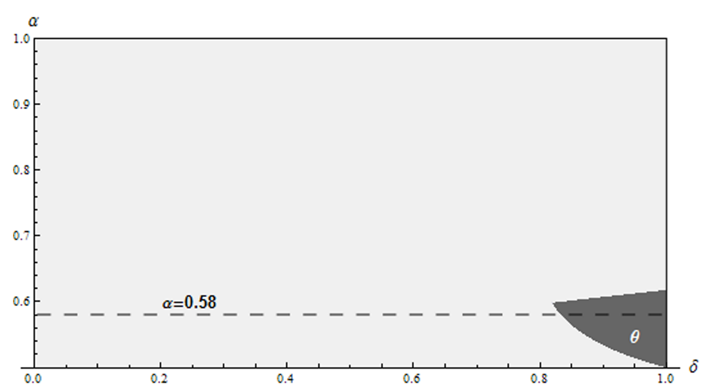

Figure 2: Region θ - values of α and δ for which the first-mover prefers to offer on his less preferred issue.

It is obvious that the inefficient agenda emerges only exceptionally; specifically if preferences are sufficiently similar and bargaining frictions are sufficiently small.

[7] A sketch of this proof is omitted here as it basically follows the proof of proposition 1.

[8] Region θ is defined by the following two conditions $\delta > \frac{\alpha^2}{3\alpha-1-\alpha^2}$ (12) and $\delta > \frac{2\alpha-1}{\alpha(1-\alpha)}$ (15). The derivation of these conditions are provided in Appendix III.

This stands in contrast to Fershtman (1990) where a sequential endogenous agenda always leads to inefficient outcomes.[9] Figure 3 plots the equilibrium payoffs of the first and second-mover for $\alpha = 0.58$, while figure 4 shows the division of both issues in the SPE for $\alpha = 0.58$ and A being first-mover.[10]

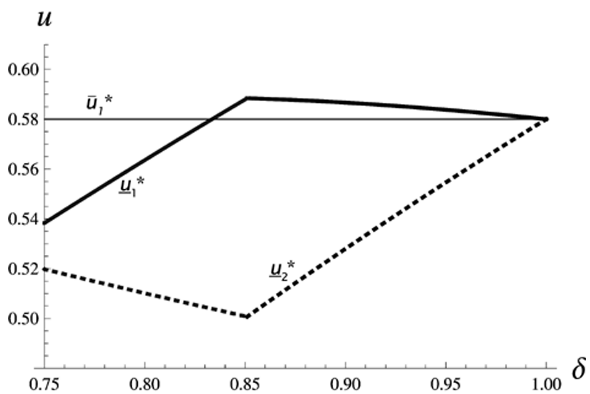

Figure 3: First and second mover payoffs for $\alpha = 0.58$

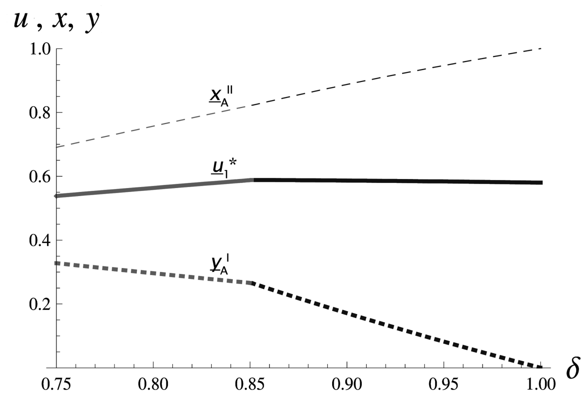

Figure 4: Division of issues in stage I and II for $\alpha = 0.58$

From Figure 3 we learn that the payoff ($\underline{u}_1^*$) of the first-mover for $\delta > 0.84$ is not only higher than the second-mover's payoff ($\underline{u}_2^*$) but also higher than α. In addition, we can see in Figure 3 that the summed payoffs of both players ($\underline{u}_1^* + \underline{u}_2^*$) is smaller than the summed payoff when players offer on their more important issue first ($\overline{u}_1^* + \overline{u}_2^* = 2\alpha$).[11] Furthermore, the plot for $\alpha = 0.58$ in Figure 4 shows us that each of the players receives at least a little share of both issues. This means that each player receives a share of an issue which is more important to his rival. Consequently the initial bargaining result is not on the efficiency frontier as renegotiation could lead to a higher payoff for both players. All observations derived from Figure 3 and 4 hold for the entire region θ.

The assumption of joint implementation implies that player's impatience con-

[9] In Fershtman (1990) players are uncertain about the sequence of moves (if they are proposer or responder) for the bargaining procedure on the second issue while they bargain on the first. Hence, players are ex ante uncertain about the division of the second issue and expect some average. As a result the first mover advantage for the first issue is comparably smaller such that each player prefers to bargain firstly on the issue he prefers less.

[10] The value $\alpha = 0.58$ has been chosen solely for explanatory reasons. For any other value in θ the picture is similar but less illustrative.

[11] Note the following: If the game is θ, then for $\underline{u}_1^*$ and $\underline{u}_2^*$ the following holds: the sum of both player's payoffs is always smaller, the first mover's payoff is always smaller and the second mover's payoff may be larger or smaller compared to the respective payoffs from the simultaneous agenda.

cerns both, the shares of the settled issue as well as the (expected) shares of the issue to be settled. Therefore common sense might tell us that the proposer of the last stage can exploit the common impatience at best. However, this line of thought is deceptive. Actually it is the proposer of the first stage who can set the course such that his opponent acts in his favor. The following example helps us to elucidate this point.

Example 1. Assume A moves first, $\delta = 0.9$ and $\alpha = 0.58$ as in Figure 4. The game is in θ and it is optimal for A to offer on his less preferred issue Y. In the unique SPE, player B accepts a share of $1 - y_A^I = 0.829$ of Y in stage I (see the lower dashed line in Figure 4). Given his large share of his higher evaluated issue, B is impatient regarding an implementation and cannot avoid to give away $x_B^{II} = 0.888$, an even larger share of X in stage II (see the higher located dashed line). Adding up we have $u_A^* = 0.586\ (> \alpha)$ and $u_B^* = 0.528$. However, note that neither in stage I nor in stage II B can escape from this equilibrium path. A rejection in stage I is excluded by the fact that $u_B^* = \delta u_A^*$, such that any deviation of B in stage I would not increase his payoff. Moreover, once having followed this path to stage II, B finds himself in a relatively powerless position: his minor interest in stage II issue combined with his impatience regarding an implementation of his large share from stage I would force him to accept any potential counter-offer from his opponent A – as a consequence his own offer has to set A at least indifferent.

3 The Ex Ante Efficient Agenda

Given a restriction to single-issue offers, we have seen that in most cases players offer on their preferred issue first. The simultaneous agenda gives strictly higher utility to the first mover than any of the sequential agendas. Hence, if offers are unrestricted the simultaneous agenda would emerge. This is also the standard result in literature (see In and Serrano, 2003; Inderst, 2000; Fershtman, 1990). However, do these results still hold if we take an perspective ex ante to the choice of the first-mover?[12] Note that even though the result of the simultaneous agenda is always on the efficiency frontier, this efficiency is only relative with respect to the agenda. Put simply, the joint payoff under the sequential agenda is always higher than under the

[12] A somehow constitutional perspective in which players - under a veil of ignorance - discuss about the agenda.

simultaneous agenda as long as the game is not in θ. Or in other words, the restriction to endogenous single-issue offers expands the efficiency frontier and yields the *ex ante efficient* allocation. The following example illustrates this.

Example 2. Assume that players are completely impatient ($\delta = 0$) and have a strong preference for one issue ($\alpha = 0.83$). If offers are unrestricted, the first-mover would always chose to offer on the bundle and receive both issues entirely: the payoff is 1 for the first and 0 for the second-mover. Now assume that players are uncertain who will be the first-mover; i.e. nature's choice falls on each player with probability one half. In the unrestricted case, the expected utility of each player is 0.5. In contrast, if offers are restricted to single issues and the game is not in θ, both players expected payoff is $\alpha = 0.83$. In this example, an exogenous restriction of the bargaining agenda to single-issue-offers meets the ex ante interest of both players even though it does not meet the interest of the first-mover once he is selected. To generalize this result it can now be stated:

Proposition 3. *If $p \in [0,1]$ is the probability for player A to be the first-mover, then for all games not in θ the sequential agenda yields*
(i) for all $p \in [0,1]$ higher joint payoffs and consequently a higher ex ante efficiency
(ii) for each of both players a higher ex ante expected payoff if $p \in (1-\alpha, \alpha)$
in comparison to the simultaneous agenda.

Proof.
(i) Outside of θ both players' payoff under the sequential structure is α, hence players' joint payoff is 2α. For the simultaneous structure the first and second-mover payoffs are $\frac{\alpha}{\alpha+\delta-\alpha\delta}$ and $\frac{\alpha\delta}{\alpha+\delta-\alpha\delta}$, respectively. The joint payoff in the simultaneous structure is $\frac{\alpha+\alpha\delta}{\alpha+\delta-\alpha\delta}$ and always lower than 2α.
(ii) Notice that A's ex ante expected utility in the simultaneous case is $Eu_A = p\frac{\alpha}{\alpha+\delta-\alpha\delta} + (1-p)\frac{\alpha\delta}{\alpha+\delta-\alpha\delta}$ (for B: $Eu_B = (1-p)\frac{\alpha}{\alpha+\delta-\alpha\delta} + p\frac{\alpha\delta}{\alpha+\delta-\alpha\delta}$) which is always smaller than α as long $p < \alpha$ (for B: $(1-p) < \alpha$).$\Box$

Note that part (ii) of the proposition answers questions a) and c) from the introduction: the sequential agenda maximises each player's expected payoff as long as neither of them has a probability higher α to be the first mover. Part (i) answers question b): the sequential structure maximises ex-ante efficiency.

Figure 5 illustrates players' expected utility from bargaining with a simultaneous agenda as subject to δ and p for $\alpha = 0.8$. For example, given $\delta = p = 0.5$ (point E) both players expect a payoff $Eu_A = Eu_B = 0.\bar{6}$.

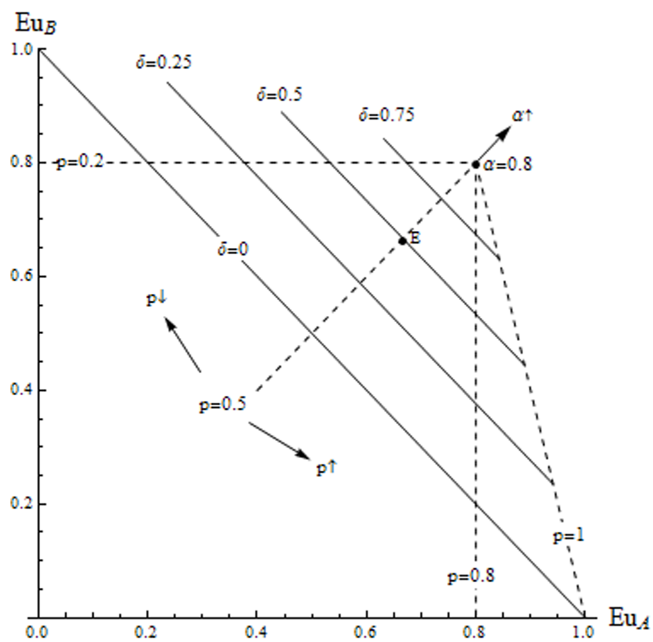

Figure 5: Simultaneous agenda expected payoffs subject to p and δ for $\alpha = 0.8$.

From section 3.2. we know that α expands the bargaining frontier and both players' payoffs increase ceteris paribus if α increases. If δ approaches 1, both issues will be split by maximizing the overall utility and a player's utility equals his expected utility α (in this case 0.8) independently of p. This naturally coincides with the cooperative division of the Nash Bargaining Solution. However, the more impatient the players are, the more asymmetric is the bargaining power and the more unequal players' payoffs. Moreover, the bargaining space shrinks in δ, because players' ability to make inter issue tradeoffs diminishes. Hence, if ex ante uncertainty comes into play the expected utility of each player also decreases in δ ceteris paribus. Figure 5 now shows us that a player's expected utility, independent of δ, exceeds the value of α only if the first-mover probability p (for B (1-p)) exceeds α. Thus, we can conclude that the presence of frictions in multi-issue bargaining a simultaneous (unrestricted) agenda imposes not only a high ex ante risk on each player, but may also lower the bargaining frontier and thereby reduce player's ex ante expected utility.

4 Conclusions

This paper explored the importance of the bargaining agenda from two perspectives. Firstly, does a certain agenda create an efficient outcome? Secondly, by applying the ex ante perspective, how efficient is this outcome compared to those from other agendas? The insights are new and provide novel arguments for the sequential agenda: negotiating one issue at a time only seldom leads to inefficiency and it is almost always ex-ante efficient. Admittedly, the results are anything but general – however, the essential results are likely to prevail in less restricted settings.

By adopting an ex ante perspective it became obvious that a sequential agenda allows for *implicit inter-issue tradeoffs* if joint implementation is assumed. We learned that in this case players fully exploit the inter-issue tradeoffs independently of the bargaining frictions present. In contrast, we saw that the simultaneous agenda only allows for full exploitation of tradeoffs if no frictions are present and that tradeoffs decrease when frictions rise. Similarly, for separate implementation we know from Chen (2006) that the sequential agenda only allows for full exploitation of tradeoffs if bargaining frictions are maximal and that tradeoffs decrease if frictions decrease. We can thus conclude that linking issues (joint implementation) and restricting offers to single-issues (sequential agenda) makes inter-issue tradeoffs generally achievable to a higher extent and thus expands the bargaining frontier. Under these settings, the outcome of our non-cooperative bargaining game equals the (ex-ante) efficient outcome of the cooperative (Nash-) Solution. This insight is a strong result itself and a valid argument against a rejection of the sequential structure (see Fershtman, 1990; Weinberger, 2000; In and Serrano, 2004; Raiffa, 1982).

Nevertheless we have also seen that a sequential structure may cause inefficiency. If the first mover offers on his less preferred issue first, then both players receive a share of the issue preferred by their opponent. Like Fershtman (1990) we find that for this agenda the result is clearly not on the bargaining frontier. But in contrast to Fershtman, under our assumptions this inefficient sequential agenda is a rather exceptional result: it emerges endogenously only if players are sufficiently patient and their preferences are not too opposing. For most bargaining situations the emerging endogenous agenda has players offering on their preferred issue first and the result is efficient. This result clearly weakens the inefficiency result of Fershtman (1990) and is a second argument in favor of bargaining *one thing at a time*.

We have further seen that the restriction of the agenda has distributional effects.

Payoffs in the sequential structure are nearly always independent of the sequence of moves which removes risk. Ex post, the restriction to single-issue offers is always unpleasant for the first-mover and throughout beneficial for the second-mover. Ex ante, the effect is always beneficial for both if the achievable inter-issue tradeoffs are comparably higher than any player's first-mover advantage. From this perspective, the simultaneous structure leads the proposer to exploit his relative advantage and to *capture value* while the sequential structure leads both players to exploit possible inter-issue tradeoffs and thus to *create value*.

5 Appendices

Appendix I (simultaneous agenda)

[Not necessarily for publication]

Assume A is the first-mover. His offer maximizes his utility $u_A = \alpha x + (1 - \alpha)y$ under the condition that the second-mover B accepts. As players have equal discount factors and following Rubinstein (1982), B will always accept if $u_B \geq \delta u_A$. Thus, in the unique SPE the following has to hold $u_B = (1-\alpha)(1-x) + \alpha(1-y) = [\alpha x + (1-\alpha)y]\delta = \delta u_A$.
By rearranging we obtain:

$$x = \frac{1 - y(\alpha(1-\delta) + \delta)}{1 - \alpha(1-\alpha)}\ .$$

Note that x, which is A's share of issue X exceeds one if $y < k$ with $k = \frac{\alpha(1-\delta)}{\alpha+\delta-\alpha\delta}$, . Remember that X is bounded by 0 and 1, therefore for all $y < k$ the share x is set to 1. We can express A's payoff depending on y, α and δ :

$$u_A(y, \alpha, \delta) = \begin{cases} \alpha \frac{1-y(\alpha(1-\delta)+\delta)}{1-\alpha(1-\alpha)} + (1-\alpha)y, & if\ y > k \\ \alpha + (1-\alpha)y & if\ y \leq k \end{cases}.$$

As u_A is strictly increasing in y for all $y < k$ and strictly decreasing in y for all $y > k$, the SPE is unique and has A proposing a partition in which B receives nothing of issue X and 1-k of Y. B accepts this offer. The payoff of A and B reflect the general utility of the first (u_1) and second-mover (u_2) in the unique SPE of the simultaneous offer game:

$$u_A = u_1 = \alpha + (1-\alpha)\frac{\alpha(1-\delta)}{\alpha+\delta-\alpha\delta} = \frac{\alpha}{\alpha+\delta-\alpha\delta}$$

$$u_B = u_2 = \alpha(1 - \frac{\alpha(1-\delta)}{\alpha+\delta-\alpha\delta}) = \frac{\alpha\delta}{\alpha+\delta-\alpha\delta}$$

Appendix II (sequential exogenous agenda)

Proof of Proposition 1.[13] The structure of the proof is as follows. We assume that A is proposer in stage I and that B immediately accepts his offer how to divide issue X. In the first step (i) we derive the B's stage II SPE offer how to divide Y which is depending on stage I division of X. Using the stage II SPE we can now derive A's payoff as a reaction function depending on his share of issue X , which is step (ii). We find that A's payoff is strictly increasing in his share of X and we will show in the last step (iii) that in the SPE B accepts A's stage I proposal to keep the entire issue X for himself while B in turn receives all of his preferred issue Y in stage II.

(i) Assume that B accepted A's proposal $(x_A^I, 1-x_A^I)$ how to divide issue X in stage I. The stage II offer of B on Y $(y_B^{II}, 1-y_B^{II})$ will be accepted by A if the following holds:

$$\alpha x_A^I + (1-\alpha)y_B^{II} \;\geq\; \delta\left[\alpha x_A^I + (1-\alpha)y_A^{II}\right],$$

solving for y_B^{II}, the share B offers A of issue Y:

$$y_B^{II} \geq \frac{-\alpha x(1-\delta)}{1-\alpha} + \delta y_A^{II}\,. \tag{1}$$

If (1) does not hold and A rejects, his counteroffer finds B's acceptance if the following holds:

$$\delta[(1-\alpha)(1-x_A^I) + \alpha(1-y_A^{II})] \;\geq\; \delta^2\left[(1-\alpha)(1-x_A^I) + \alpha(1-y_B^{II})\right]\,.$$

[13] This proof completes the sketch in the main text. Further explication and intuition are provided in the main text.

Solving for y_A^{II}, we obtain the share A would offer himself:

$$y_A^{II} \leq \frac{(1 - x_A^I(1-\alpha))(1-\delta)}{\alpha} + \delta y_B^{II}. \tag{2}$$

When solving for the stage II offers, one should keep in mind that both issues are assumed to be of size 1, such that offered partitions are thus naturally restricted by 0 and 1. By inserting equation (1) in (2) we find that y_A^{II}, the partition Player A would demand for himself in the case of a counteroffer, is never below 0 but exceeds 1 always when

$$y_B^{II} > \frac{-1 + \alpha + \delta + x_A^I(1 - \alpha - \delta + \alpha\delta)}{\alpha\delta}, \tag{3}$$

such that y_A^{II} will be set equal 1 if (3) holds. Inserting (2) in (1) we obtain the minimal share which B has to offer A in stage II, this is B's SPE offer in stage II:

$$y_B^{II} = \frac{-x_A^I\alpha(1-\delta)}{1-\alpha} + \delta \tag{4}$$

if (3) holds and $0 \leq y_B^{II} \leq 1$, while it is

$$\begin{aligned} y_B^{II} &= \frac{-x_A^I\alpha(1-\delta)}{1-\alpha} + \delta\left(\frac{(1 - x_A^I(1-\alpha))(1-\delta)}{\alpha} + \delta y_B^{II}\right) \\ &= \frac{\alpha\delta - \delta + x_A^I(\alpha^2 + \delta - 2\alpha\delta + \alpha^2\delta)}{-(1-\alpha)\alpha(1+\delta)} \end{aligned} \tag{5}$$

if (3) does not hold and $0 \leq y_B^{II} \leq 1$, otherwise we have

$$y_B^{II} = 1 \text{ if } y_B^{II} > 1 \text{ and } y_B^{II} = 0 \text{ if } y_B^{II} < 0\,.$$

Note that y_B^{II} (A's share of Y in the stage II SPE of B's offer) is continuous and monotonically decreasing in x^I over all above cases. Therefore we can now state that (3) only holds as long as $x^I < \frac{(1-\alpha)(1-\alpha-\alpha\delta)}{1-\alpha(2-\alpha-\alpha\delta)} = k$. Checking for the natural boundaries (1 and 0) of y_B^{II} we find the following: if $x^I \geq k$ it holds that y_B^{II} is defined according to (5) and is never larger than 1 but is always smaller than 0 if $x^I \geq \frac{\delta(1-\alpha)}{\alpha^2(1+\delta)-\delta(2\alpha-1)} = l$. Further, if $x^I < k$, the SPE offer y_B^{II} is now defined according to (4) and is again never larger than 1 but is smaller than 0 for all $x^I \geq \frac{\delta(1-\alpha)}{\alpha(1-\delta)} = m$.

(ii) Given B's optimal offer in stage II we can now calculate A's expected payoff as a reaction function $r_A(x^I)$ depending on x^I and the bargaining situation (the values of α and δ):

$$r_A(x^I) = \begin{cases} \frac{\delta(1+2x^I\alpha - x^I - \alpha)}{\alpha+\alpha\delta} & , for\, x^I \geq k \wedge x^I < l \\ \alpha x^I & , for\, x^I \geq k \wedge x^I \geq l \\ \delta(1-\alpha+\alpha x^I) & , for\, x^I < k \wedge x^I < m \\ \alpha x^I & , for\, x^I < k \wedge x^I \geq m \end{cases} .$$

As described in the main text, r_A is increasing in x for all $\alpha \in (0.5, 1)$ and all $\delta \in [0, 1)$. In stage I, the share of X which would maximize A's payoff is thus $x^I = 1$.

(iii) We now check the stage I conditions for A's proposal to find B's acceptance. As we know, B accepts the proposal only if he cannot expect greater payoff by rejecting:

$$(1-\alpha)(1-x_A^I) + \alpha(1-y_B^{II}) \geqq \delta\left[\alpha(1-y_B^I) + (1-\alpha)(1-x_A^{II})\right]$$

$$(1-\alpha)y_B^I + \alpha x_A^{II} \geqq \delta[\alpha x_A^I + (1-\alpha)y_B^{II}] .$$

Now, assume that A's stage I partition is $x_A^I = 1$. It is then easy to show that for all α and δ the share A receives in the SPE of stage II is always $y_B^{II} = 0$: therefore note that firstly, if $k \leq 1$, then according to (5) the following has to hold: $\frac{\alpha(\alpha+\alpha\delta-\delta)}{-(1-\alpha)\alpha(1+\delta)} \leq 0$. This is generally true as the denominator is always negative while the nominator is positive for all α and δ in the defined range. Secondly, $k > 1$ never comes into play as k is never larger than 1. Inserting the values $x_A^I = 1$ and $y_B^{II} = 0$ in the above stage I conditions, we have:

$$(x_A^I =)\, 1 \leq \frac{1-\alpha\delta}{1-\alpha} \quad and \quad (y_B^I =)\, 0 \geq \frac{-\alpha(1-\delta)}{1-\alpha} .$$

Both conditions hold for all $\alpha \in (0.5, 1] \wedge \delta \in [0, 1)$. Hence, in the unique SPE the first mover (A) will demand all of his preferred issue (X) in stage I. The second mover (B) will accept this proposal and forego any share of his less preferred issue in stage I. As a consequence he can expect to receive his preferred issue Y entirely in stage II. Note that B would not reject A's proposal in stage I as he would then face the same situation A faced before. As this holds for all α and δ, under this sequential exogenous agenda each player receives his preferred issue entirely and each player's payoff is his evaluation of this issue: α. □

Appendix III (sequential endogenous agenda)

Proof of Proposition 2. From Proposition 1 we know that the first and the second mover's payoff is α if players offer on their preferred issue. We need to show that for all α and δ in the region θ there is an unique SPE in which the payoff of first mover is higher than α if he offers on his less preferred issue first.[14] Further we show that in this SPE players' joint payoff is strictly lower than 2α and therefore not on the bargaining frontier.

The proof is structured as follows. We assume that A is proposer in stage I and that B immediately accepts his offer how to divide issue Y. Remember that issue X is preferred by A while Y is preferred by B. In the first step (i) we derive the B's stage II SPE offer how to divide X which is depending on stage I division of Y. Using the stage II SPE we can now derive A's payoff as a reaction function depending on his share of issue Y , which is step (ii). We derive conditions on α, δ and A's stage I offer y_A^Isuch that his payoff exceeds α. In the next step (iii) we define the conditions under which B would accept such offer and show that for all combinations of α and δ within the region θ all conditions hold. In the last step (iv) we calculate the SPE offers and payoffs and conclude the proof.

(i) Assume player A is the first mover. In stage I, A proposes a division $(y_A^I, 1 - y_A^I)$ of issue Y. Again, the proof is by backward induction. Given B accepts the stage I proposal, then in stage II, B himself proposes a division $(x_B^{II}, 1 - x_B^{II})$ of issue X. Player A will accept this offer only if:

$$\alpha x_B^{II} + (1-\alpha) y_A^I \geq \delta[\alpha x_A^{II} + (1-\alpha) y_A^I] \,.$$

Solving for x_B^{II}, the minimal share B has to offer A of issue X is:

$$x_B^{II} \geq \delta x_A^{II} - \frac{(1-\alpha)(1-\delta) y_A^I}{\alpha} \,. \tag{6}$$

Given a rejection, $A's$ counteroffer would find acceptance if the following holds:

$$\delta[(1-\alpha)(1-x_A^{II}) + \alpha(1-y_A^I)] \;\geq\; \delta^2 \left[(1-\alpha)(1-x_B^{II}) + \alpha(1-y_A^I)\right] \,.$$

[14] The two conditions (12) and (15) which define θ are derived in this Appendix and plotted in Figure 2 and 6.

Solving for x_A^{II}, we obtain the share A would offer *himself*:

$$x_A^{II} \leq \delta x_B^{II} + \frac{1-\delta-\alpha(1-\delta)y_A^I}{1-\alpha}. \tag{7}$$

Inserting (6) into (7), it results that x_A^{II} is never smaller 0 but is equal or larger 1 if the following is true:

$$x_B^{II} \geq \frac{-\alpha+\delta+\alpha(1-\delta)y_A^I}{(1-\alpha)\delta}. \tag{8}$$

We can now calculate the condition for B's stage *II* SPE offer By inserting (7) into (6) we can now calculate the minimal share which B has to offer A in stage *II*, which is B's SPE offer in stage *II*:

$$x_B^{II} = \frac{\alpha\delta-(1-\alpha(2-\alpha-\alpha\delta))y_A^I}{(1-\alpha)\alpha(1+\delta)} \tag{9}$$

if (8) does not hold and $0 \leq x_B^{II} \leq 1$. The condition is

$$x_B^{II} = \delta - \frac{(1-\alpha)(1-\delta)y_A^I}{\alpha} \tag{10}$$

if (8) does hold and $0 \leq x_B^{II} \leq 1$. Otherwise for $x_B^{II} < 0$, set $x_B^{II} = 0$ and if $x_B^{II} > 1$, set $x_B^{II} = 1$.

Note that we now have B's stage *II* equilibrium offer as a function depending on α, δ and the solution of stage *I* $(y^I, 1-y^I)$. Note further that following (9) and (10), A's share of X is monotonically decreasing in y^I. Therefore it can be stated that (8) always holds if $y^I \leq \frac{\alpha(\alpha-(1-\alpha)\delta)}{\alpha^2+(1-\alpha)^2\delta} = \hat{k}$. Checking for the natural boundaries (0 and 1) of x_B^{II}, we obtain the following: for all partitions $y^I > k$ of stage *I*, it holds that x_B^{II} is defined as in (9) and is (for the relevant parameters) never greater than 1 but always smaller than 0 if $y^I > \frac{\alpha\delta}{1-\alpha(2-\alpha-\alpha\delta)} = \hat{l}$. For all partitions $y^I \leq k$ of stage *I*, x_B^{II} is defined as in (10) and is never greater than 1 but always smaller 0 if $y^I > \frac{\alpha\delta}{(1-\alpha)(1-\delta)} = \hat{m}$.

(ii) Given B's optimal offer in stage *II* we can now calculate A's expected payoff as a reaction function $r_A(y^I)$ depending on the stage division of issue Y and the values of α and δ):

$$r_A(y^I) = \alpha x_B^{II} + (1-\alpha)y^I = \begin{cases} \frac{(\alpha - y^I(2\alpha-1))\delta}{(1-\alpha)(1+\delta)} & , for\, y^I > \hat{k} \wedge y^I \leq \hat{l} \\ (1-\alpha)y^I & , for\, y^I > \hat{k} \wedge y^I > \hat{l} \\ \alpha\delta + (\delta - \alpha\delta)y^I & , for\, y^I \leq \hat{k} \wedge y^I \leq \hat{m} \\ (1-\alpha)y^I & , for\, y^I \leq \hat{k} \wedge y^I > \hat{m} \end{cases}$$

Note that $r_A(y^I)$ is a continuous function over all possible cases. Now, as $\alpha \in (0.5, 1] \wedge y^I \in [0, 1]$ we find that the following holds: $(1-\alpha)y^I < \alpha$. Consequently, A will not offer in these regions as his payoff is smaller than α, the payoff he expects by offering on his preferred issue first. Further, if both $y^I > \hat{k}$ and $y^I \leq \hat{l}$ hold, it is easy to see that A's payoff is monotonically decreasing in y^I and we can calculate that B's payoff is also decreasing in y^I : $(1-\alpha)(1-x_B^{II}) + \alpha(1-y^I)$, with x_B^{II} defined as in (9) we have:

$$r_B(y^I) = \frac{\alpha - y^I(2\alpha - 1)}{\alpha(1+\delta)}\, , for\, y^I > \hat{k} \wedge y^I \leq \hat{l}\, .$$

Consequently A would not propose y^I in this region as smaller y^I increase the payoff of both players. In contrast, if $y^I \leq \hat{k} \wedge y^I \leq \hat{m}$ we have $r_A(y^I)$ increasing and $r_B(y^I)$ decreasing in y^I. Moreover, $r_A(y^I) = \alpha\delta + \delta(1-\alpha)y^I$ is higher α always when $y^I > \frac{\alpha(1-\delta)}{(1-\alpha)\delta}$. Note that $y^I \leq \hat{m}$ always holds if $y^I \leq \hat{k} \wedge y^I > \frac{\alpha(1-\delta)}{(1-\alpha)\delta}$ hold. Further note that a share y^I which fulfills:

$$y^I \leq \hat{k} \ \wedge y^I > \frac{\alpha(1-\delta)}{(1-\alpha)\delta}\, , \tag{11}$$

only exist if α and δ are such that the following holds:

$$\frac{\alpha(1-\delta)}{(1-\alpha)\delta} < \hat{k} = \frac{\alpha(\alpha - (1-\alpha)\delta)}{\alpha^2 + (1-\alpha)^2\delta}\, ,$$

which in turn holds only if:

$$\delta > \frac{\alpha^2}{3\alpha - 1 - \alpha^2}\, . \tag{12}$$

Hence, only if (12) applies, then there can exist a first stage offer y^I which gives the first mover a payoff greater than α if he offers on his less preferred issue first. Consequently, for A's payoff to be greater than α, his stage I offer has to fulfill (11), be no greater than 1 nor smaller 0 *and* find the acceptance of B.

(iii) Player B will accept A's stage I offer only if a rejection does not yield him a greater payoff. As we assume an endogenous sequential agenda, this statement has to hold no matter if B's subsequent offer after a rejection would be on his preferred issue (Y) or his less preferred issue (X). Here the fact that the players' evaluation is exactly reverse helps us to put ourselves in the shoes of player B: we can deduce that player B faces the same situation as player A did before. Hence, what has been issue X for player A means issue Y for player B. Assume a bargaining situation in which (12) holds and A's offer fulfills (11), A expects a payoff greater α. Now, given player B rejects he would also offer on his less preferred issue (X) and expect the discounted payoff $\delta r_B(x^I) = \delta r_A(y^I) > \delta\alpha$. Consequently, if (12) holds, B will accept A's stage I offer if the following condition holds:

$$r_A(y^I) \geq \delta r_B(x^I) = \delta r_A(y^I). \tag{13}$$

By reformulating we obtain:

$$y^I \leq \frac{\alpha(1-\delta)(1+\alpha\delta)}{2\alpha - 1 + (1-\alpha)^2\delta + (1-\alpha)\alpha\delta^2} = \hat{n}. \tag{14}$$

From (11), $y^I > \frac{\alpha(1-\delta)}{(1-\alpha)\delta}$ has to hold, thus

$$\frac{\alpha(1-\delta)(1+\alpha\delta)}{2\alpha - 1 + (1-\alpha)^2\delta + (1-\alpha)\alpha\delta^2} > \frac{\alpha(1-\delta)}{(1-\alpha)\delta}.$$

This results in the condition

$$\delta > \frac{2\alpha - 1}{\alpha(1-\alpha)}. \tag{15}$$

A share y^I fulfilling (11) and (14) consequently exists if, and only if, α and δ fulfill (12) and (15). Note that in this case the values of $\hat{n}$, $\hat{k}$ and $\frac{\alpha(1-\delta)}{(1-\alpha)\delta}$ are always in the interval of 0 and 1. Figure 6 plots the boundaries of condition (12) as continuous line and condition (15) as dashed line. The region above both lines constitutes θ. In θ the first mover (here player A) expects a higher payoff from offering on his less preferred issue (here Y) first. Note that Figure 2 plots the inverse function.

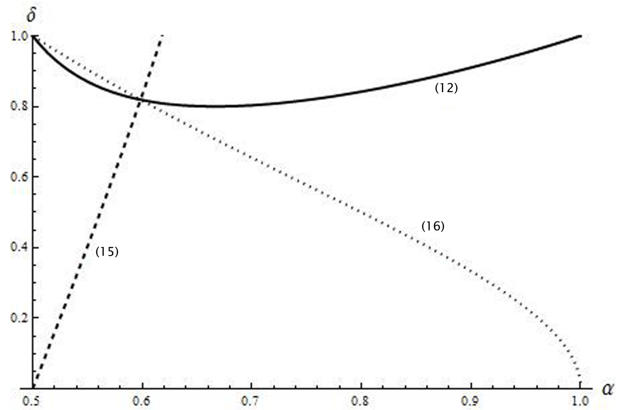

Figure 6: Plot of condition (12), (15) and (16).

(iv) Having defined region θ, we need to calculate the exact SPE stage I offer (y^I_A) and the corresponding payoffs. As we know that A's payoff is monotonically increasing in y^I we know A will chose the highest y^I fulfilling the three conditions $y^I \leq \hat{k}$, $y^I > \frac{\alpha(1-\delta)}{(1-\alpha)\delta}$, $y^I \leq \hat{n}$ of (11) and (14). Further we find that in θ, i.e. if (12) and (15) hold, the share $y^I = min(\hat{k}, \hat{n})$ is always greater $\frac{\alpha(1-\delta)}{(1-\alpha)\delta}$. Therefore, $y^I = min(\hat{k}, \hat{n})$ is the unique SPE offer of A, as no other offer in stage I (neither on X or Y) yields A a higher final payoff. Regarding $y^I = min(\hat{k}, \hat{n})$ it holds that $\hat{k}$ is smaller $\hat{n}$ if

$$\delta < \frac{\sqrt{1-\alpha}}{\sqrt{a}} . \tag{16}$$

Hence, A will demand the share $\hat{k}$ for himself if (16) holds and $\hat{n}$ otherwise. Condition (16) is depicted in Figure 6 as dotted line. For all α and δ above the continuous but below the dotted line, A's SPE offer is $y^I = \hat{k}$; while if α and δ are above the dotted and the dashed line, A's SPE offer is $y^I = \hat{n}$. Note that these two areas constitute region θ.

We can now calculate the SPE payoffs for A and B in θ :
Case (a): If (16) holds, A offers $y^I = \hat{k}$, B accepts and offers $x^{II}_B = \delta - \frac{(1-\alpha)(1-\delta)\hat{k}}{\alpha}$ (see (10)) to A in stage II. A in turn accepts such that we obtain the payoffs:

$$u_A = \alpha(\delta - \frac{(1-\alpha)(1-\delta)\hat{k}}{\alpha}) + (1-\alpha)\hat{k} = \frac{\alpha^2\delta}{\alpha^2 + (1-\alpha)^2\delta} \text{ and}$$

$$u_B = (1-\alpha)(1-\delta + \frac{(1-\alpha)(1-\delta)\hat{k}}{\alpha}) + \alpha(1-\hat{k}) = -\frac{-(1-\alpha)\alpha}{\alpha^2 + (1-\alpha)^2\delta} .$$

For α and δ in θ, A's payoff is always greater than the value α and the payoff of B is always smaller α.

Case (b): If (16) does not hold, A offers $y^I = \hat{n}$, B accepts and offers $x_B^{II} = \delta - \frac{(-1+\alpha)(-1+\delta)\hat{n}}{\alpha}$ to A in stage II. Again, A in turn accepts and in this case the payoffs are:

$$u_A = \alpha\delta + (\delta - \alpha\delta)\hat{n} = -\frac{\alpha^2\delta}{1 - 2\alpha + (1-\alpha)^2\delta - (1-\alpha)\alpha\delta^2} \text{ and}$$

$$u_B = -\frac{\alpha^2\delta^2}{1 - 2\alpha + (1-\alpha)^2\delta - (1-\alpha)\alpha\delta^2}\,.$$

Again, we find that u_A is always greater α and u_B is always smaller α. [15] □

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[15] Figure 2 illustrates these payoffs for $\alpha = 0.58$ where the increasing part of the first mover payoff reflects Case (*a*) and the decreasing part reflects Case (*b*).

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