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Coalition formation in multilateral negotiations with a potential for logrolling: An experimental analysis of negotiators' cognition processes

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Coalition formation in multilateral negotiations with a potential for logrolling: an experimental analysis of negotiators' cognition processes

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Coalition formation in multilateral negotiations with a potential for logrolling: an experimental analysis of negotiators' cognition processes

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Abstract:

In the present study we analyse the topic of coalition formation in multi-issue multilateral negotiations under different voting rules when there is the opportunity of logrolling. We have carried out 3 experiments and compare our findings with the standard public choice theory predictions. In the first experiment we have shown that in a situation of 3-issues and 3-parties negotiations with majority rule, most of the subjects behave in a satisficing, not in a optimizing, way. They are found to be subject to a "Zone of Agreement Bias" (ZAB) which induces them to form suboptimal coalitions and to choose Pareto-dominated agreements. Moreover, we find that the cycling problem predicted by public choice theory in most cases does not arise. In experiment 2 we have shown that the adoption of the unanimity, instead of the majority, rule reduced the suboptimizing effect of the ZAB, and produced a much higher rate of optimal agreements. Experiment 3 shows that the results obtained in experiments 1 and 2 hold even when the level of complexity of the negotiation problem increases. To this aim we considered a situation of four-issues and four-parties negotiations under both the majority and the unanimity rule.

JEL-Classification: D 72, C 91, C 92

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1. Introduction

The purpose of this study is to analyse multilateral negotiations that offer a potential for logrolling[2] by means of laboratory experiments. Logrolling in negotiation research refers to one of the main techniques used in integrative negotiation. The latter is defined in opposition to distributive negotiation in that it emphasises the importance of joint problem solving. In particular we will analyse *how negotiators' cognition* affects the process of coalition formation and the level of efficiency of the agreements under different voting rules. The topic we are dealing with lies in the intersect of the disciplinary areas of negotiation research and public choice theory. Logrolling, indeed, has been treated in both areas, but with different approaches and methodologies, which in our opinion can be integrated. *Negotiation research* (see Section 2 below), on the one hand, is more empirically based, in that it makes a wider use of direct observation and of experimentation, and stresses the importance of taking into account negotiators' cognitive processes. Most of the work, however, which has been done so far exclusively deals with bilateral negotiation. How coalition formation in multilateral negotiation situations under different voting rules works has been left open to question. *Public choice research* (see Section 3), on the other hand, treats the topic of multilateral negotiation, coalition formation, and voting rules, but is mainly of a purely theoretical nature and is built on the assumption of negotiators' perfect rationality. Our objective is simultaneously to draw from and to integrate both perspectives and to provide experimental data on certain cognitive aspects that affect the process of coalition formation and the efficiency of the agreements in multilateral negotiations.

2. Logrolling in negotiation research

The focus of our analysis lies on integrative negotiations which are characterized by joint problem solving. One of the main instruments used in the analysis of integrative negotiations is the technique of logrolling. "Many negotiations provide opportunities for integrative agreements in which the parties maximise their outcomes, or achieve greater resources, without competing with the other party in a direct win-lose fashion [as it happens in distributive negotiations]" (Thompson and Hastie, 1990a). Integrative analysis, rather than seeing a process that works from fixed points of

[2] The word logrolling is metaphorically employed in the economic literature to indicate a reciprocal exchange of favors. It has assumed this meaning because of the habit in use among the woodcutters to help each other when they have to transport logs. The rolling of a log indeed requires the cooperation of at least two people.

discord to a common point of convergence, stresses the need to create new solutions by manipulating the involved subjects' conceptualizations of the problem through a process of inventive and cooperative problem solving, so as to reconcile the interests of all parties and reach joint benefits, or attain "win-win" goals (Pruitt, 1986; Putnam, 1990; Brett et al., 1990; Fisher and Ury, 1991; Brett, 2000). The different parties are likely to have different interests, priorities, and resources, and these asymmetries frequently produce cross-cutting cleavages among actors and opportunities for tradeoffs among issues which could be positively exploited. Simple concession-convergence bargaining becomes virtually impossible since there is no single dimension along which parties can converge.

A growing branch of integrative analysis focuses on precise mechanisms for identifying the best tradeoffs among the parties' interests, and thereby insuring optimality to the outcome (Zartman, 1999). To be sure, this doesn't mean that the distributive component of bargaining is completely eliminated from the negotiation process, but simply that the parties "can cooperate in order to change the pie that they eventually will have to divide" (Raiffa, 1982).

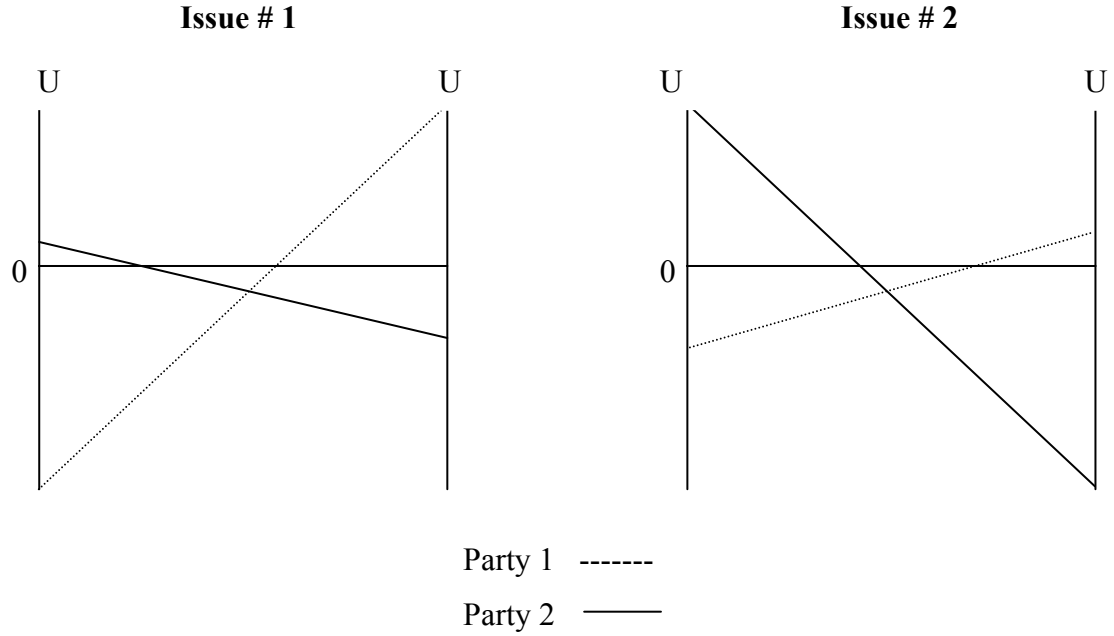
In contrast the technique of logrolling consists in redefining the issues by aggregating them into interlocking issues. Sub-issues are linked together "to create package agreements out of components that would be nonnegotiable if treated separately" (Hopmann, 1996). This approach involves identifying and prioritising interests, and creating tradeoffs in which parties concede on low-priority interests in order to receive satisfaction of high-priority interests (Brett et al., 1990).

The idea of logrolling is represented in Fig.2.1. On both issues the bargaining spaces of the parties don't overlap, since the preference curves intersect below the line of neutrality or indifference. In a situation of distributive bargaining this would create a stalemate on both issues. However, if we consider that party 1 has stronger interests about issue 2 and is more neutral on issue 1, and party 2 has stronger interest on issue 1 and is more neutral on issue 2, a solution can be found by agreeing to let party 1 win on issue 2, and party 2 win on issue 1. If party 1's gains on issue 2 exceed its losses on issue 1, and party 2's gains on issue 1 exceed its losses on issue 2, then both parties will still find the overall agreement beneficial (for a more precise description of the solutions to this negotiation problem see Fig. 2.4)

Note that in order for logrolling to take place, and thus to achieve Pareto-optimal outcomes, the parties should possess the cognitive capabilities required to represent and analyse the whole space of the negotiation problem. From the traditional point of view of rational-choice theory, which underlies most economic models, the problem of understanding the complexity of a problem would not exist since the parties are considered to be able to construct complete and objective representations of reality. In the rational-choice approach the agents are assumed to possess perfect

knowledge of the whole set of alternatives available to achieve their goals, and of the consequences that would flow from each of them. Furthermore, they are assumed to have a well defined and stable structure of preferences over alternatives, to be driven by the maximisation motive, to be endowed with unlimited computational ability, and to choose the tactics most likely to produce an optimal realisation of their goals. Under these assumptions the parties would always be able to recognise and take mutually advantage of the integrative potential of negotiations.

Figure 2.1 – Issue aggregation –



The utility curves of party 1 and 2 intersect below the horizontal line of indifference, thus the two parties don't have a Zone of Agreement on neither issue. By aggregating the two issues (party 1 wins on issue 2 and party 2 wins on issue 1), however, the two parties can both reach a beneficial agreement (for a more precise description of the solutions to this negotiation problem see Fig. 2.4)

A large amount of empirical research (see for example Simon, 1982; Ho and Weigelt, 1996; Schotter et al., 1994; Selten, 1997; Legrenzi and Girotto, 1996; Zhang and Norman, 1994; Johnson-Laird, 1990; Ripps, 1994; Evans and Over, 1996; Tversky and Kahneman, 1986;), nevertheless, has demonstrated that individuals don't actually behave in such a perfectly rational way. When a complex problem situation arises, individuals are not able, because of their limited computational abilities, to develop an objective and complete representation of the problem; rather, they construct a subjective, simplified, partial, and sometimes even idiosyncratic, mental model of the situation, and then use this mental model to make projections and predictions about the future. As problem representations are generally prior to the generation of solutions, poor decision making and biases

may not derive from the way preferences and alternatives are handled, but rather from the assumptions that underlie the generation, evaluation, revision, and selection among those preferences and alternatives.

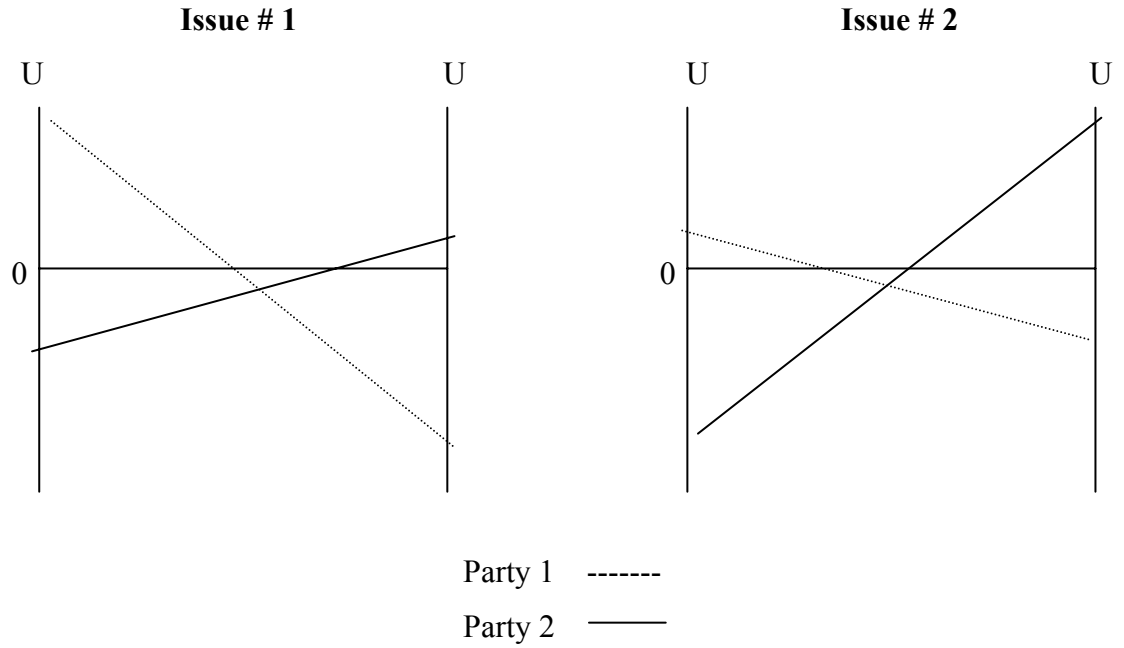
Research on negotiation has begun to focus attention on the study of how negotiators define and perceive a negotiation game. (Bazerman, 1983 and 1985; Hammond et al., 1975; Carroll and Payne, 1991; Thompson and Hastie, 1990 b). Experimental evidence has demonstrated that negotiators use various presumptions or simplifying strategies to interpret the situation and to construct a response. As will be explained in more detail in the following, the more complex and ill-structured is the negotiation problem, the more biased is the negotiators' representations.

Bazerman (1983) suggested that negotiators' mental models are subjected to the "fixed-pie bias". They perceive negotiation as a purely distributive, or competitive, game in which there is a fixed pie of resources to be divided up among the parties, and better outcomes for one party can be obtained only at the expenses of another party. Bazerman (1985) found that in a negotiation task with integrative potential individuals concentrate first on competitive issues and it takes them significant experience to overcome the fixed pie bias and recognize the integrative potential of the situation.

Hammond et al. (1975) suggest that negotiators frequently have poor and inaccurate perceptions of their opponents' importance weights for multi-issue conflicts. "The fixed pie assumption actually may derive from the presumption that the other party has the same concerns regarding the relative importance of the issues, thus eliminating the possibility for mutually-beneficial trades" (Carroll and Payne, 1991). This presumption is due to a social perception bias known as "false consensus effect". It refers to the tendency of people to overestimate the proportion of other people who have interests similar to their own (Ross et al., 1977), and in negotiation this might result in distributive, win-lose perceptions of the task (Thompson and Hastie, 1990 b).

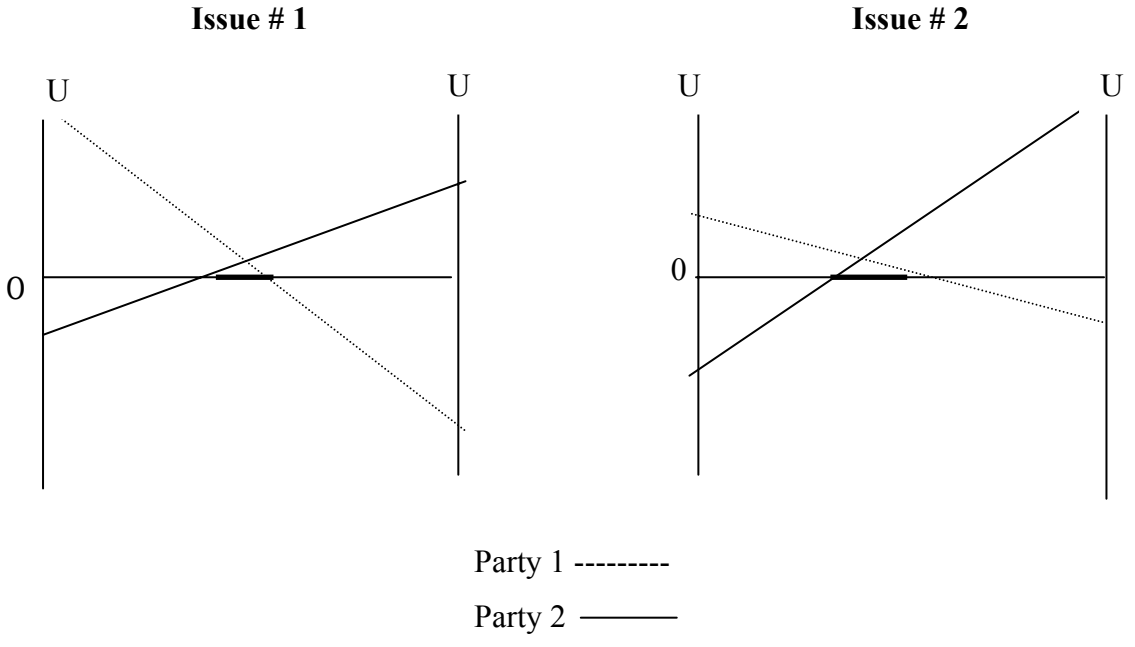
Reina (2003) has shown that, besides the fixed pie bias, there exists an additional factor which explains the suboptimality observed in integrative negotiation. This factor is represented by a "Zone of Agreement bias" (ZAB) which is due to the fact that negotiators behave in a satisficing, and not optimizing, way. In other words, negotiators explore only a limited part of the negotiation problem's space, and, as soon as they are able to find a suboptimal agreement, they stop searching for the optimal solution and remain blocked in the suboptimal one. Reina compared negotiators' behavior under two different treatments (A and B). Treatment A is the one described in Fig.2.2, in which the bargaining spaces of the two negotiators don't overlap in neither issue. Treatment B is the one described in Fig.2.3, in which the bargaining spaces of the two negotiators overlap in both issues. In Fig. 2.4 and 2.5 are represented the spaces of all possible couples of agreements on issues

Figure 2.2 – Treatment A –



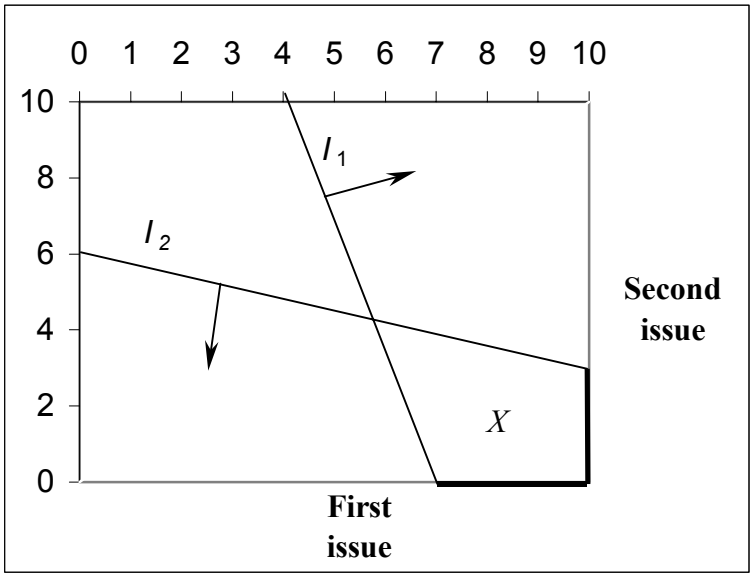
The abscissas of the two graphs represent the values of issue 1 and 2 respectively. The two parties don't have a Zone of Agreement on neither issue.

Figure 2.3 – Treatment B –



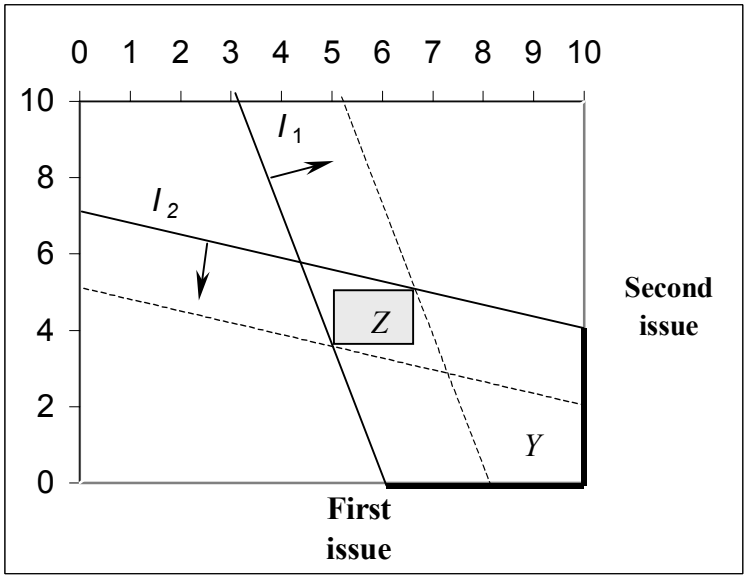
The abscissas of the two graphs represent the values of issue 1 and 2 respectively. The two parties have a Zone of Agreement (the bold line) on both issues.

Figure 2.4 – Solutions under treatment A –



Here is represented the space of all possible couples of agreements on issues 1 and 2 under treatment A. The region *X* contains all the possible agreements in which both players obtain a positive total payoff through logrolling, and the bold line is its Pareto frontier.

Figure 2.5 – Solutions under treatment B –



Here is represented the space of all possible agreements on issues one and two under treatment B. The region *Z* contains those agreements in which both players obtain a positive payoff on each issue singularly. Any agreement in the area *Y* Pareto dominates any other agreement inside *Z*.

1 and 2 respectively under treatment A and B. Along the line I_1 in Fig. 2.4 we can find all the joint agreements inducing a total payoff of zero for player one; the arrow indicates the hemiplane containing agreements with a total payoff greater than zero. Similarly along I_2 we can find all the joint agreements inducing a total payoff of zero for player two; the arrow indicates the hemiplane containing agreements with a total payoff greater than zero. The region *X* contains all the possible agreements in which both players obtain a positive total payoff, and the bold line represents the Pareto frontier of such region. As we already know, under treatment A there are no joint agreements in which both players obtain a positive payoff on both issues. Region *X* represents then the bargaining space which emerges when the two issues are aggregated (through the logrolling mechanism).

In Fig. 2.5 lines and arrows have the same meaning as in figure 2.4 but now we can also observe a new region (the box denoted by *Z*) which is delimited by the two Zones of Agreement of the two issues (the bold lines in Fig.2.3), and contains those agreements in which both players obtain a positive payoff on each issue singularly (and of course a positive total payoff). It is worth noting that any agreement in the area *Y* Pareto dominates any other agreement inside *Z*.

The rate of suboptimal agreements has been higher when negotiators had a Zone of Agreement (treatment B). In this case indeed, the possibility to find an agreement on the two issues separately, prevented negotiators from exploring the space of more efficient agreements achievable through the aggregation of the two issues. Negotiators remained blocked in the suboptimal agreements falling within the Zone of Agreement of each issue, and didn't consider the Pareto optimal ones falling outside of it. Negotiators under treatment A, in contrast, not being able to find a suboptimal 'separate' solution, were induced to consider the two issues jointly and to find an optimal agreement.

3. Logrolling in the public choice approach

In the public choice literature logrolling refers to the exchange of votes within decision making committees and in particular within legislatures. A logrolling situation is normally defined in the following way (Stratman, 1997):

let (x,y) and (z,w) be pairs of mutually exclusive issues. If voters preferences in relation to each pair are separable and each voter votes sincerely, a logrolling situation exists if

xPy and zPw, but ywPxz,

where P represents the social preference as determined by the voting rule employed. In a pairwise vote x defeats y and z defeats w. But, if all issues are voted contemporaneously, the pair yw can defeat, through a vote-trading agreement (logrolling), the pair xz.
Stratmann illustrates logrolling with the example reported in Table 3.1.

Tab. 3.1 – Example of logrolling

	Issues	
Voters	**A**	**B**
1	5	-1
2	-1	5
3	-1	-1

In this example voters 1, 2, and 3 vote separately with majority rule for the passage of each issue A and B. The numbers in the cells represent the payoff of each voter for the passage of each issue. The table represents the payoffs for each voter on each issue. If everyone voted sincerely (i.e. stated honestly his preference - pass or not pass - for each single issue), neither issue A nor issue B would pass. However voters 1 and 2 have an incentive to make an agreement in which voter 1 accepts to vote for B in exchange for voter 2 voting for A. In the presence of this votes-trade, which implies a misrepresentation of preferences, both issues pass. In this particular example, the total utility is increased by 3 units for each issue, and society is better off overall.
Early studies by political scientists often report vote trading in their descriptions of legislative behavior. Mayhew (1966) has studied the House of Representatives in the United States from 1948 to 1962. He considered votes concerning farm, city, labor, and western issues. In that period of time, most representatives from the Democratic party showed a tendency to vote in ways benefiting special interests. Examining the constituency benefiting from various types of legislation, Mayhew argued that legislation benefiting farm, labor, and western interests could not have passed if every legislator had voted sincerely. Mayhew observed that Democrats representing various special interests supported each other on four different types of issue. Stratmann (1992) identifies logrolling statistically among agricultural interests on amendments to the 1985 farm bill. Among the findings

are that representatives from tobacco districts traded votes with legislators representing other agricultural commodity interests, specifically sugar and peanut farmers. Further evidence of logrolling taking place within legislatures is provided by Froman (1967), Jackson (1974), Kau and Rubin (1979), Stratmann (1995).

In the example reported in Table 3.1 we saw that through logrolling the society is better off overall. Nevertheless, we have to note that, by replacing the –1's by –3's, there is still an incentive for voters 1 and 2 to trade votes, but in this case society is worse off overall by –1 for each issue. Logrolling indeed, can produce externalities with utility losses on nontraders, and, depending on the entity of these losses, the community as a whole can be better or worse off. In the first case logrolling can be interpreted as a positive sum game; in the second as a negative sum game. The fact that vote-trading can be on net welfare enhancing as well as welfare reducing, has raised a controversy surrounding the optimality of logrolling. Early discussions on the topic go back at least to Bentley (1907), and the whole century has seen authors and arguments in favour of as well as against logrolling (Buchanan and Tullock, 1962; Coleman, 1966a,b; Mueller, 1967 and 1973; Wilson, 1969; Koford, 1982).

One of the arguments against logrolling is related to the problem of cyclical majorities. The public choice literature (Mueller, 1989) has shown that some of the negative impacts of vote-trading stem from the possibility to form potentially unstable coalitions and majorities. Using the example in Table 3.1 it is possible to illustrate how logrolling is linked to cyclical majorities. In Table 3.1 there exist four possible combinations of issue pairs: (A,B), (-A,B), (A,-B), (-A,-B), where –A and –B means that issue A and B respectively do not pass. Let's suppose that voters 1 and 2 make an agreement to let the issue pair (A,B) pass. Now voter 3 has an incentive to propose an agreement to voter 1 for the passage of the issue pair (A,-B). This combination makes both voters 1 and 3 better off. At this point voter 2 has an incentive to propose an agreement to voter 3 in order to let none of the issues pass (-A,-B). From here the cycle starts all over again with the issue pair (A,B).

Bernholz (1973) has demonstrated first that the existence of a logrolling situation implies intransitive social preferences, and second that the existence of a transitive social preference ordering implies the absence of a logrolling situation. The only situation in which logrolling is certain not to create the potential for a cycle is when a unanimity rule is employed. The possibility of cycling through logrolling indeed may have severe implications for the stability of the political system. If coalitions are inherently unstable the outcome of the political process might indeed be suboptimal.

4. Integrating the negotiation and public choice perspectives: an experimental study on multilateral integrative negotiation

As noted earlier, most of the public choice research on logrolling and coalition formation is of a purely theoretical nature and particularly is based on the assumption that individuals behave in a perfectly rational way. That means that even in very complex situations they are always able to recognise the optimal voting strategy and to form the best coalition which allows them to maximize their gains. Nevertheless, empirical research on negotiation has demonstrated that the perfect rationality assumption is often violated by individuals. As we mentioned in Section 2 Reina (2003) has shown that in a situation of two-issue bilateral bargaining with a potential for logrolling negotiators are often subjected to a "Zone of Agreement bias" (ZAB), i.e. they reach suboptimal agreements because they remain locked in their Zone of Agreement without exploring the Pareto-dominant solutions falling outside of it.

In the present study we will address the problem of logrolling and of the ZAB in a situation of multi-issue multilateral bargaining. We want to analyse to what extent negotiators are actually able to form an optimal coalition and reach an optimal agreement in a situation of three-issue and three-parties negotiation with a potential for logrolling. Our focus will be on testing the hypothesis that in certain situations the ZAB might induce negotiators to form suboptimal coalitions which lead to Pareto-dominated agreements, and that the cycling problem predicted by the public choice theory might not exist (experiment 1). Moreover we will analyse the effects produced by voting rules (majority or unanimity) (experiment 2) and by the degree of complexity of the negotiation problem on the ZAB and on the level of optimality of agreements (experiment 3).

Consider the situation described in Fig. 4.1.1. Three negotiators, A, B, and C have to negotiate on three issues 1, 2, and 3 and to make decisions employing a simple majority rule. In each graph the horizontal axis represents the value of the issue to be negotiated and the vertical axis represents the utility values of the involved negotiators. The three curves represent the utility functions of the three negotiators. The curves have been constructed so that on issue 1 (2, 3) negotiators A and B (C and A, B and C, respectively) share a Zone of Agreement, and negotiator C (B, A), which has the highest interest on issue 1 (2, 3), doesn't share any Zone of Agreement with the other two negotiators. In this situation there are three types of possible solutions to the negotiation problem:

1) **Non-integrative suboptimal solution:** if the three issues were negotiated separately, negotiators A and B would form a coalition and find an agreement within their Zone of Agreement on issue 1, and the same would happen for negotiators A and C on issue 2, and for B an C on issue 3.

This way each negotiator would win on his two low-priority issues and lose on his high priority issue (if the players choose this solution and make an equitable agreement in this particular example, each of them wins about 9 points). There is also the possibility that the negotiators don't find any agreement on one or more issues; in this case the negotiators get 0 points for each issue on which they disagree, and the solution would be non-integrative and suboptimal as well.

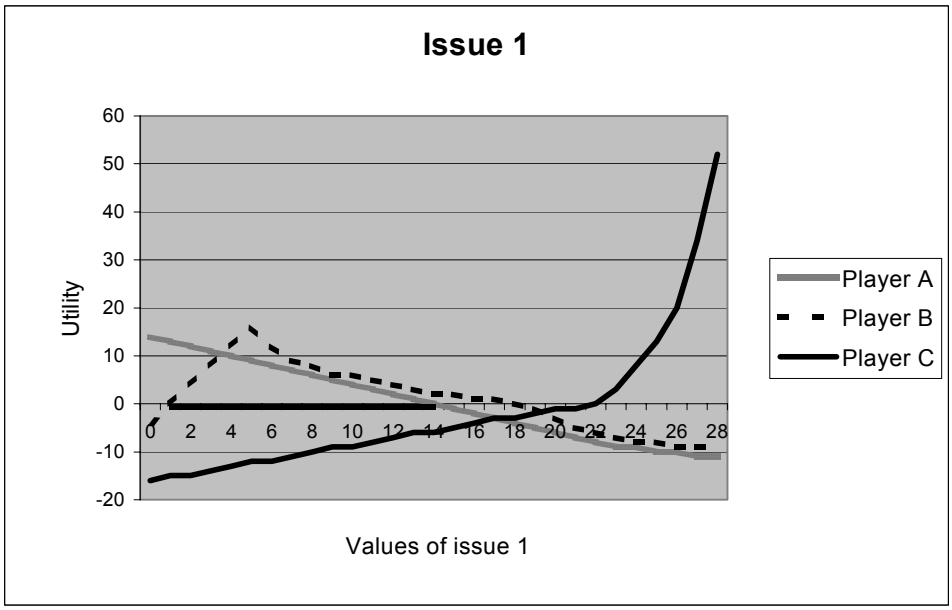
2) **Integrative Pareto optimal solution:** the negotiation of the three issues together could lead negotiators to a Pareto-dominant (in comparison to solution 1) outcome. The three parties indeed have different interest intensities on the three issues, and they could engage in a logroll in which each party accepts to lose on his two low-priority issues in exchange for a win on his high-priority issue (in our example, the parties might decide to let C win on issue 1, B on issue 2, and A on issue 3). The utility curves have been constructed in such a way that, if the negotiators choose this solution and make an equitable agreement, the payoff for each negotiator would be between three and four times greater than with solution 1 (i.e. 32 points).

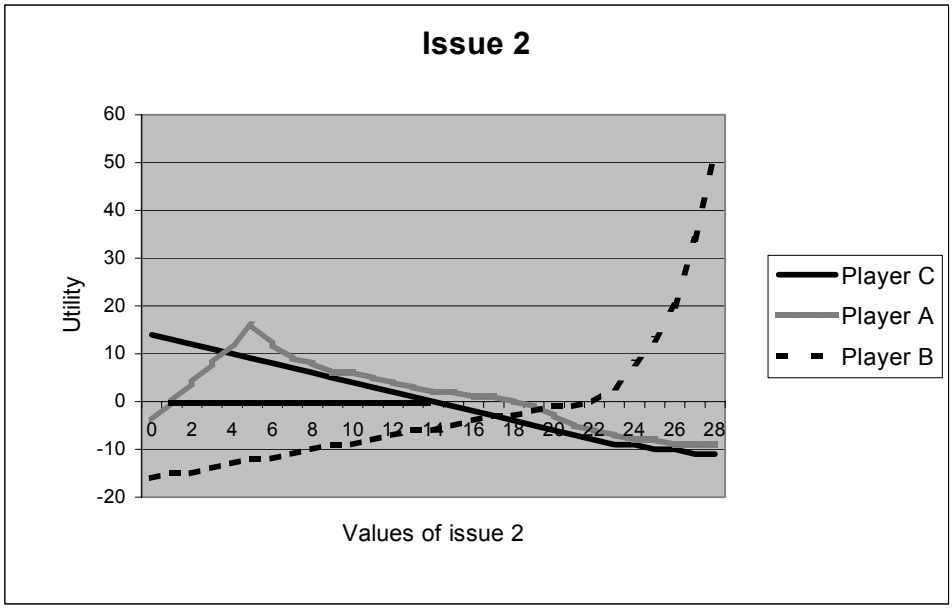
3) **Integrative individually optimal solution:** two negotiators could form a coalition and exclude the third negotiator. The two members of the coalition could make an integrative agreement in which each one wins on his own high priority issue and on the high priority issue of the third negotiator (if the two coalition members make an equitable agreement, they get about 51 points each while the excluded negotiator loses about 34 points). This solution would be optimal for the two coalition members, but surely would not be Pareto-optimal. This solution, moreover, would imply a cycling problem because all coalitions A-B, B-C, and C-A would be equally likely.

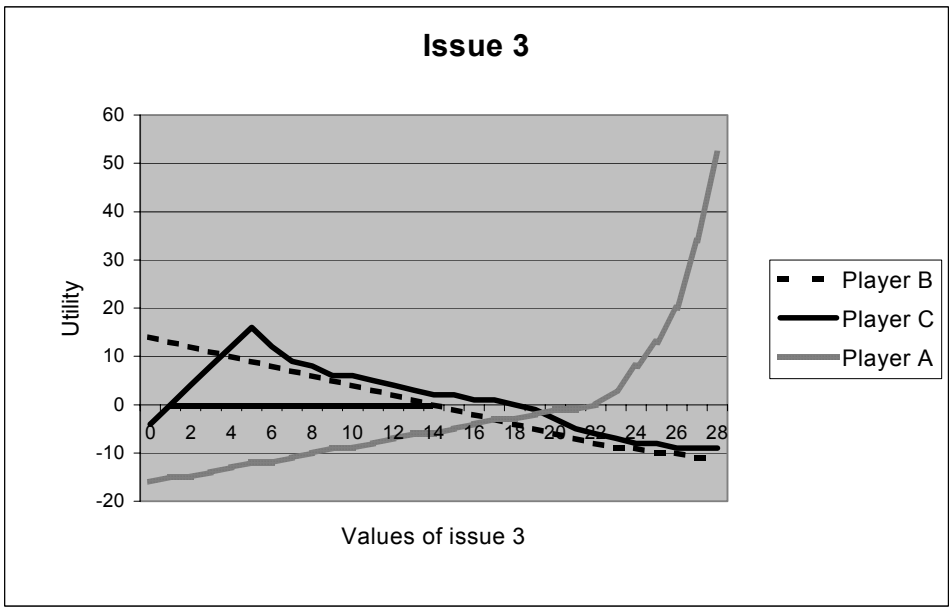
Fig. 4.1.1

3 issues and 3 parties logrolling

On each issue two negotiators out of three share a zone of agreement (the bold line on the abscissa), and the third negotiator excluded from the zone of agreement is the one with the highest interest on the issue.







5. Experiment 1

The aim of this experiment is to test the hypothesis that first in a situation like the one described in Fig. 4.1.1 the negotiators might form, because of the ZAB, suboptimal coalitions that lead to Pareto-dominated agreements, and that second no cycle might arise. The existence of a Zone of Agreement for two parties on each issue might induce negotiators to behave in a satisficing, and not optimizing, way; i.e. negotiators look for a solution within the Zone of Agreement, and as soon as they find it they stop their search for a better agreement, and do not explore the space of Pareto-dominant solutions falling outside the Zone of Agreement. This way the parties would choose the non-integrative suboptimal solution (solution 1, see the Section 4): they would negotiate on each issue separately and form suboptimal winning coalitions (A and B on issue1, A and C on issue 2, B and C on issue 3). In this case no cycle should be observed.

5.1 Experimental design

The experiment has been run with 39 undergraduate students from the Faculty of Economics of the University of Trento, Italy. Subjects were asked to take part in an experiment aimed at analysing negotiation behavior. They were randomly divided in groups of three. Each group was asked to negotiate on three different issues. Each subject was given a sheet with three Tables (for the Tables see Appendix B) representing her incentive in the negotiation about the three issues respectively. The first column of each Table contained numbers from 0 to 28, representing the possible agreements on an issue, and the second column contained the points associated to each agreement (the values in the Tables corresponded to the utility functions of Fig. 4.1.1, with the only difference that the abscissa values of the second issue have been inverted, i.e. from 28 to 0, instead from 0 to 28; this was done in order to prevent the subjects from realizing that they had the same utility functions on the three issues respectively). Subjects were requested to negotiate with their counterpart on one number from 0 to 28 in the first Table, one number in the second Table, and one in the third Table in such a way to maximise their own total number of points (for the precise instructions see Appendix A). The decision on each issue was to be taken with a majority rule of two out of three. Each player, including the one excluded from the winning coalition, was assigned the points corresponding to the number chosen by the coalition members.

Negotiation was carried out face to face and subjects were allowed to speak freely[3]. The only restriction was that they could not show their sheet with the tables to their counterparts. They had a maximum of 15 minutes to reach an agreement on the three numbers. If they didn't find an agreement on one of the three numbers they got 0 points for that number.

As an incentive the subjects were paid a show-up fee (3 €) plus an amount of money dependent on their performance in the experiment, i.e. directly proportional to the number of points they obtained (0,25 € for each point). At the beginning subjects were automatically assigned 15 points.

5.2 Theoretical predictions

According to public choice theory and to the assumption of perfect rationality of individuals, the prediction for this experiment is that negotiators will choose solution 3 (see Section 4), i.e. two negotiators will form a coalition so that each coalition member wins on his own high-priority issue and on the high priority issue of the third negotiator who gets excluded from the coalition (i.e. each group should choose the number 28 on two issues, and a number within the interval 1-14, which corresponds to the Zone of Agreement, on the third issue). Since all coalitions A-B, A-C, and B-C are equally likely a cycling problem should arise.

If negotiators are perfectly rational but also have a concern for equity, the theoretical prediction is that they will choose the Pareto-optimal solution (solution 2), i.e. they will form an extended coalition of three, in which each negotiator wins only on his own high-priority issue (i.e. each group should choose the number 28 on each issue). In this case no cycling problem arises.

In contrast, our theoretical prediction, based on the assumption of bounded rationality of individuals, is that the ZAB will induce part of the negotiators to choose solution 1, even though it is Pareto-dominated by solution 2. Negotiators A and B, B and C, and A and C in this case would form a coalition on issue 1, 2, and 3, respectively (i. e. each agreement would fall within the interval 1-14), and no cycle should be observed.

[3] In some experiments the fact that the players interact face to face and are allowed to speak freely with one another might influence the results in that it introduces a problem of fairness (the topic of fairness in bargaining games is a very vast one and would require a whole paper in order to be treated in an exhausting way. Since this was not our main objective, we remand the reader to Kagel and Roth (1995) where a very nice and complete review can be found of experimental research on fairness in bargaining games). However we think that in our experiment this was not the case because an eventual concern of the players for fairness could cause, at most, a shift of choices from solution 3 to solution 2 (which are both optimal), but not from solution 2 or 3 to solution 1.

5.3 Results

In Table 5.4.1 and Fig.5.4.1 the results of the experiment are represented. The agreements on the second issue are reported in terms of the original scale, i.e. from 0 to 28.

Groups 1, 4, 6, 7, 8, 9, 10, 12, 13 (69%) have made agreements on the three issues, which fall within the Zone of Agreement, i.e. the interval 1-14 (solution 1).

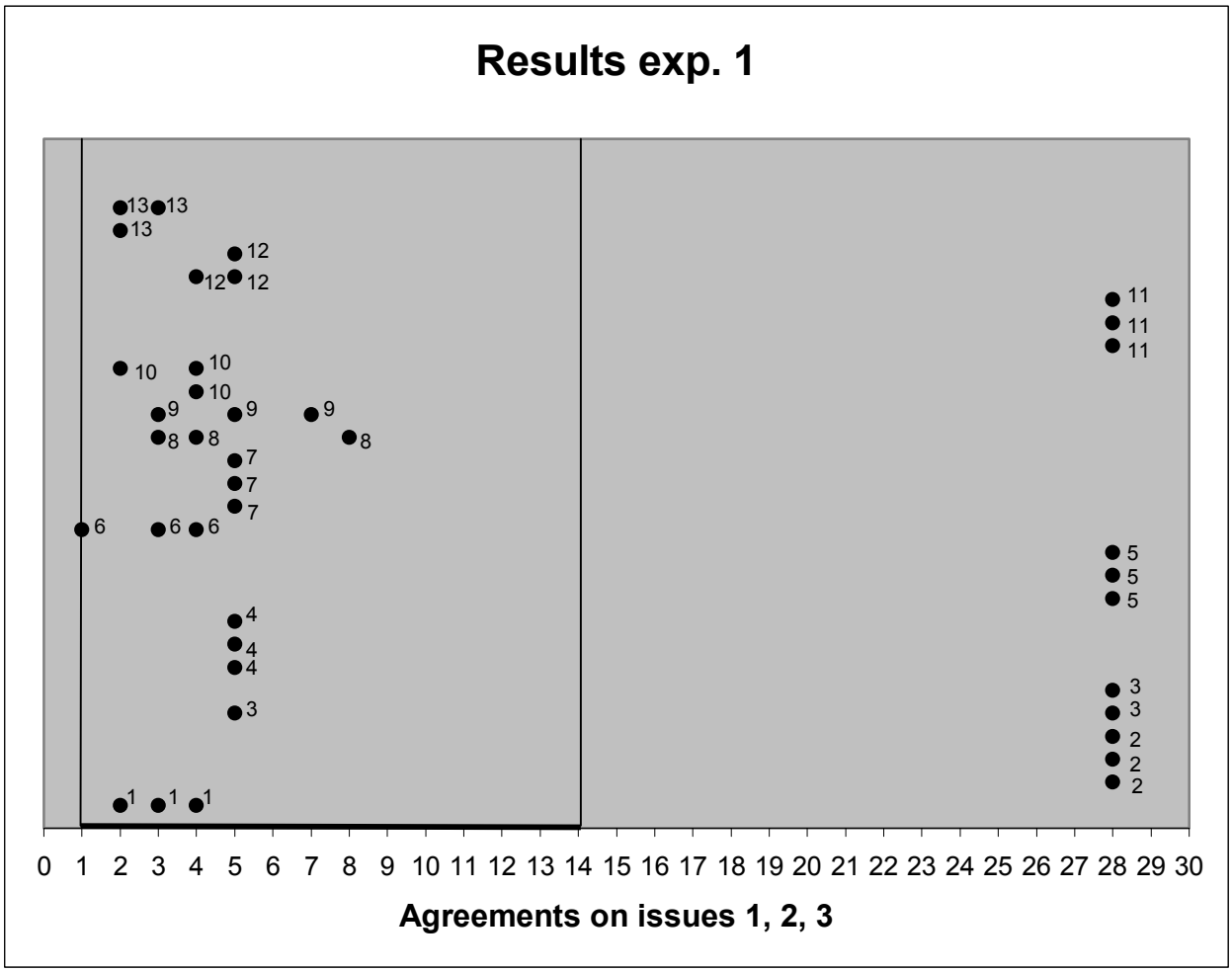
Groups 2, 5, 11 (23%) have made agreements on the three issues outside the Zone of Agreement, in particular at point 28 (solution 2).

Group 3 (8%) has made an agreement at point 28 on two issues, and at point 5 on one issue (solution 3).

Tab 5.4.1 – Results experiment 1

Group	Agreement on the 1st issue	Agreement on the 2nd issue	Agreement on the 3rd issue
1	4	3	2
2	28	0	28
3	5	0	28
4	5	5	5
5	28	0	28
6	1	3	4
7	5	5	5
8	3	4	8
9	7	3	5
10	4	4	2
11	28	0	28
12	5	4	5
13	2	2	3

Fig. 5.4.1



The diagram represents all the agreements (the black points) that the groups made on the three issues. Each group is identified by a number which appears on the side of each agreement point. For each group three agreements on the three issues are depicted respectively. The bold line from 1 to 14 on the abscissa represents the Zone of Agreement of the three issues.

5.4 Discussion

The results of the experiment have confirmed our initial hypothesis in that a great majority of the subjects (69%) behaved in a way which is inconsistent with the public choice predictions, but consistent with the ZAB prediction. 69% of the subjects indeed, adopted a satisficing behaviour; as soon as two negotiators out of three were able to find a suboptimal agreement within their Zone of Agreement on each issue separately (solution 1), the search process for an optimal solution (outside the Zone of Agreement) was interrupted. Only 31% of the subjects have been able to find an

optimal agreement (23 % chose solution 2, and 8 % solution 3) by exploring the space of solutions falling outside the Zone of Agreement[4].

Moreover, for all the groups (92%) who chose solution 1 and 2 there arose no cycling problem; in the case of solution 1, on each issue a stable coalition agreement was made between the two subjects who shared a Zone of Agreement. In the case of solution 2, a stable coalition agreement of all three group members was made.

6. Experiment 2

The aim of experiment 2 is to examine the effect that different voting rules can have on the ZAB and on the optimality of the agreements. We consider the same negotiation problem of experiment 1 and observe what happens when a unanimity rule, instead of a majority rule, is employed. Our hypothesis is that, in a situation like the one described in Fig. 4.1.1, the adoption of a unanimity rule instead of a majority rule might eliminate the effect of the ZAB "trap". With a unanimity rule, indeed, the parties don't have the possibility to negotiate the three issues separately, because on each issue there would be the veto of at least one party. This way negotiators might be induced to explore the space of solutions falling outside the Zone of Agreement, and eventually to find an optimal agreement.

It is worth noting that, under unanimity rule, solution 1 is an integrative solution, because each negotiator must accept to lose on one issue in order to win on the remaining two. Nevertheless it remains a suboptimal solution (it is Pareto-dominated by solution 2) because each negotiator loses on his high-priority issue and wins on his two low-priority issues. Under unanimity rule the only case of non-integrative suboptimal solution is that in which the negotiators try to negotiate on each issue separately, and don't come to any agreement because on each issue there's the veto of one player. Solution 2, moreover is the only (Pareto) optimal solution, because solution 3 is not viable under unanimity rule.

[4] It could be argued that most subjects found a suboptimal agreement within their Zone of Agreement because they have been subject to a sort of median position salience bias (the zone of agreement occupied a central position in the values' interval of each issue) and not to the ZAB. We think, nevertheless that this was not the case: the most salient values of each player (were she could win the maximum number of points) were located at the extremes of the values' scale for 2 issues out of 3; it was only through the negotiation process that players were induced by their counterparts to take into consideration the values within the Zone of Agreement.

6.1 Experimental design

The experiment has been carried out with 21 undergraduate students of the Faculty of Economics of the University of Trento. The design was exactly the same as in experiment 1, with the exception that decisions had to be made with the unanimity, instead of majority, rule.

6.2 Theoretical predictions

Our theoretical prediction is that, in comparison to experiment 1 where a majority rule was employed, under unanimity rule the effect of the ZAB should be reduced, and a greater number of optimal agreements (in correspondence of number 28) should be observed.

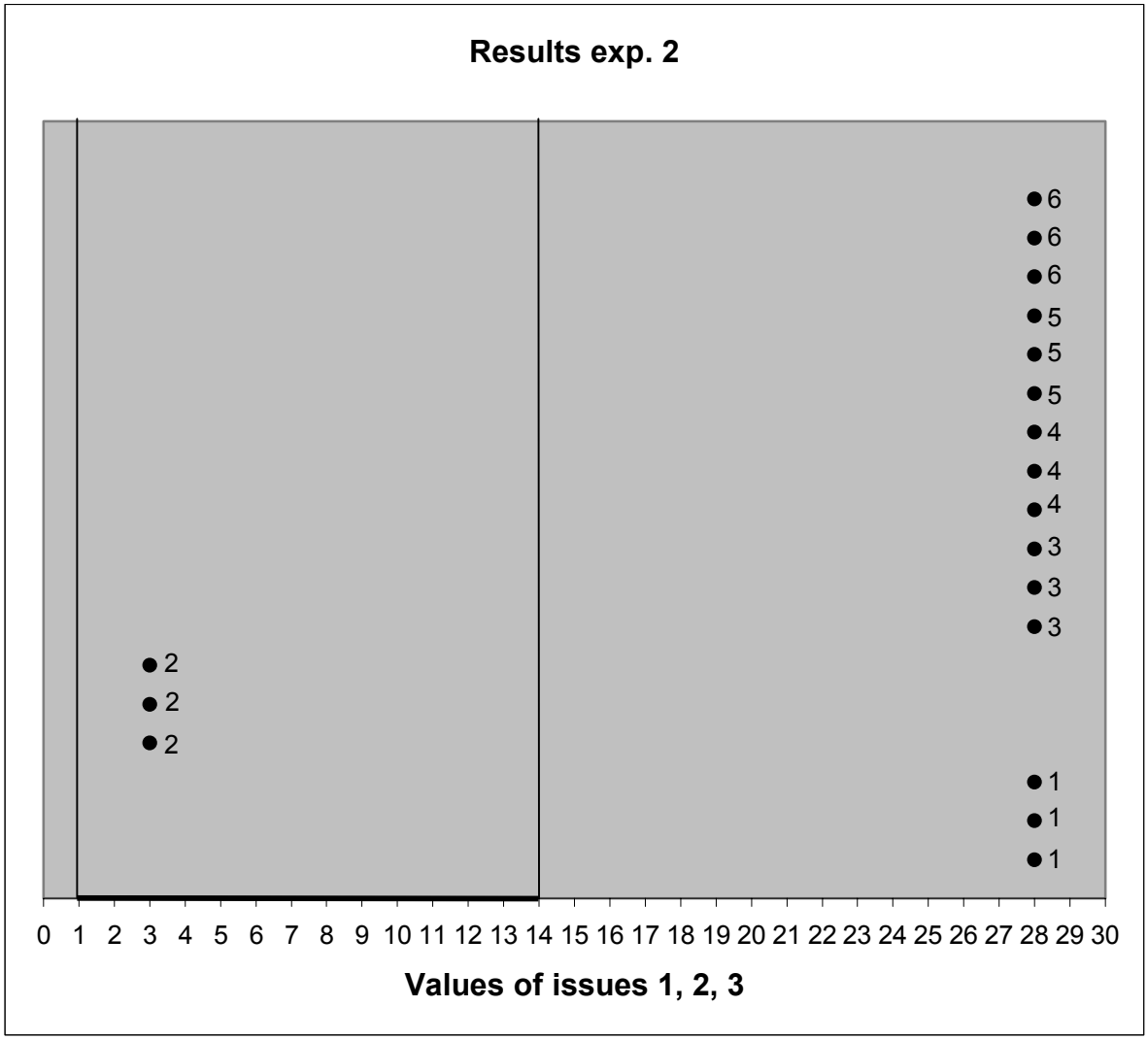
6.3 Results

The results of the experiment have been represented in Tab.6.4.1 and Fig.6.4.1.
Groups 1, 4, 5, 6, 7 (72%) have made agreements on the three issues outside the Zone of Agreement, in particular at point 28 (solution 2).
Group 2 (14%) has made agreements on the three issues, which fall within the Zone of Agreement, i.e. within the interval 1-14 (solution 1).
Group 3 (14%) didn't find any agreement at all.

Tab 6.4.1 – Results experiment 2

Group	Agreement on the 1st issue	Agreement on the 2nd issue	Agreement on the 3rd issue
1	28	28	28
2	3	3	3
3	/	/	/
4	28	28	28
5	28	28	28
6	28	28	28
7	28	28	28

Fig. 6.4.1



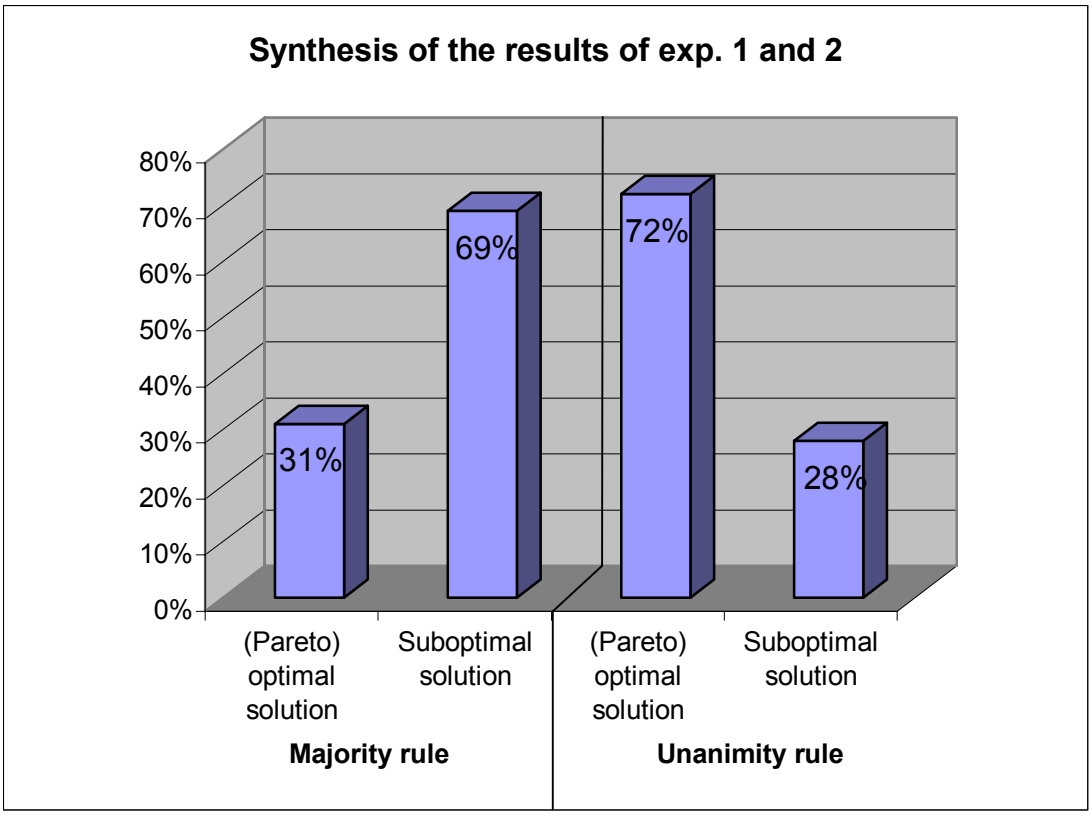
The diagram represents all the agreements (the black points) that the groups made on the three issues. Each group is identified by a number which appears on the side of each agreement point. For each group three agreements on the three issues are depicted, respectively. The bold line from 1 to 14 on the abscissa represents the Zone of Agreement of the three issues.

6.4 Discussion

The results of experiment 2 have confirmed our initial hypothesis; under unanimity rule the effect of the ZAB has been considerably lower. The subjects have been induced to explore the space of solutions falling outside the Zone of Agreement, and 72% of them (in contrast to only 31% under majority rule) has been able to find the optimal solution in correspondence of the number 28. Only 28% of the subjects (69% under majority rule) found a suboptimal solution (14%) or didn't find any solution at all (14%).

For a synthesis of the results of experiments 1 and 2, and a comparison between the effects of the majority and the unanimity rule, see Fig.6.5.1.

Fig. 6.5.1



The (Pareto) optimal solution refers to both solutions 2 and 3, while the suboptimal solution refers to solution 1.

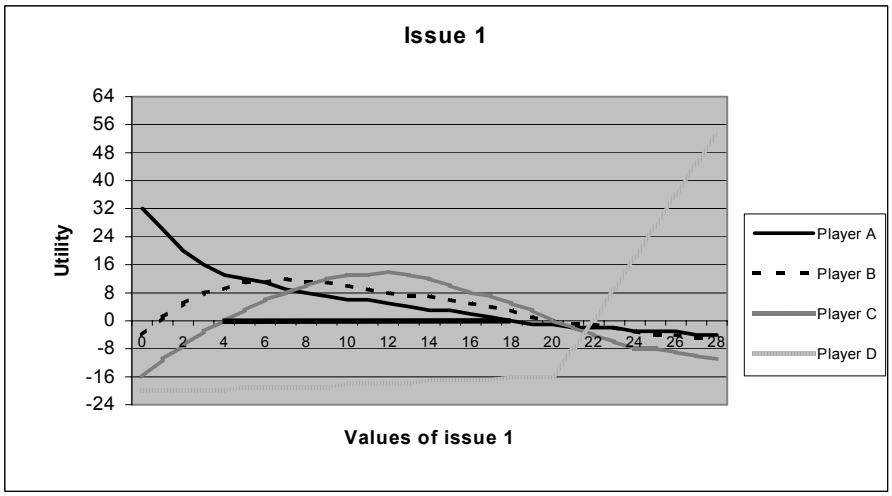
7. Experiment 3

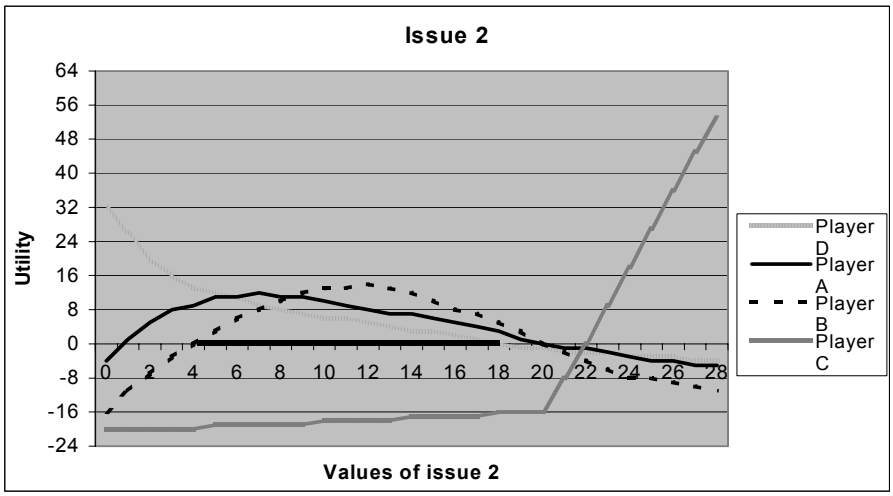
In the previous experiment we have shown that the unanimity rule, in comparison to the majority rule, induced a larger number of negotiators to find (Pareto) optimal agreements. It is interesting now to test whether these results are dependent on the number of parties and issues involved in the negotiation increases, or not. An increase in the number of parties and issues, indeed, could result in a higher level of complexity of the negotiation problem and therefore, under the unanimity rule, the negotiators might not be able to find any agreement at all. In this case therefore a majority rule, even if yielding suboptimal agreements, would be preferable.

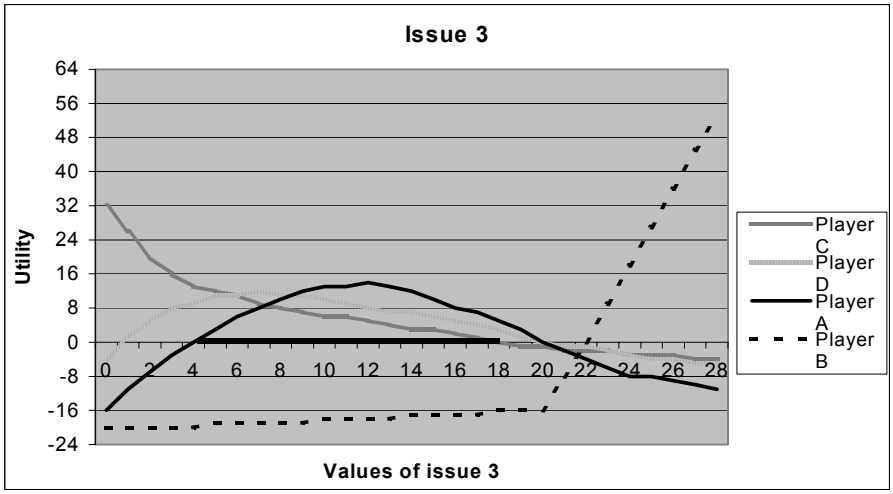
Let's consider the situation depicted in Fig. 7.1.1. Here we have four parties that have to negotiate on four issues. Each party has one high-priority issue and three low-priority issues. On each issue three out of four negotiators share a Zone of Agreement.

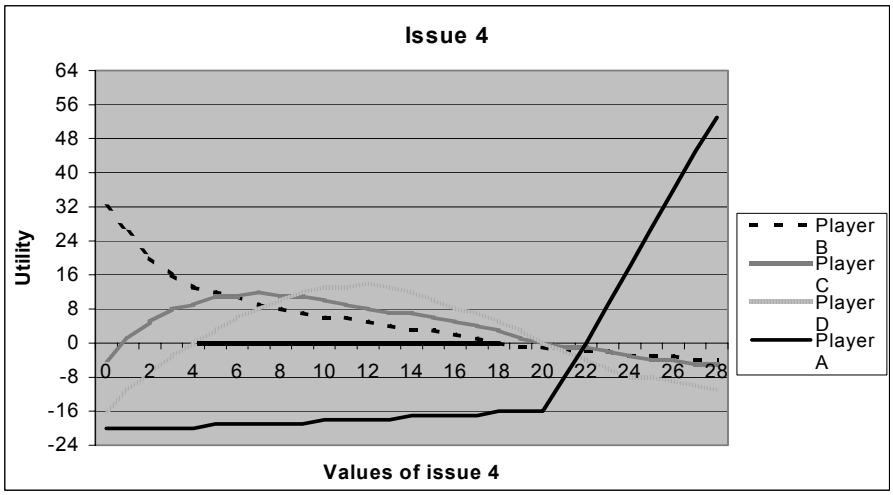
Fig. 7.1.1 -
4 issues and 4 parties logrolling

On each issue three out of four negotiators share a zone of agreement (the bold line on the abscissa), and the fourth negotiator excluded from the zone of agreement is the one with the highest interest on the issue.









The negotiator excluded from the Zone of Agreement is always the one with the highest interest on that issue. The utility curves have been constructed in such a way that the solutions to this negotiation problem under the majority and the unanimity rule, respectively, are conceptually the same as in experiments 1 and 2.

7.1 Experimental design

The experiment has been carried out with 48 undergraduate students of the Faculty of Economics of the University of Trento. 24 subjects were assigned to the treatment with the majority rule, and 24 to the treatment with the unanimity rule. In each treatment subjects were randomly divided in groups of four and asked to negotiate on four issues. The experimental design was exactly the same as for experiments 1 and 2, with the only difference that the values in the tables corresponded to the utility functions of Fig. 7.1.1 (the abscissa values of the second and fourth issues have been inverted, i.e. from 28 to 0 instead of 0 to 28) and that, under majority rule, decisions had to be taken with a majority of 3 out of 4 negotiators.

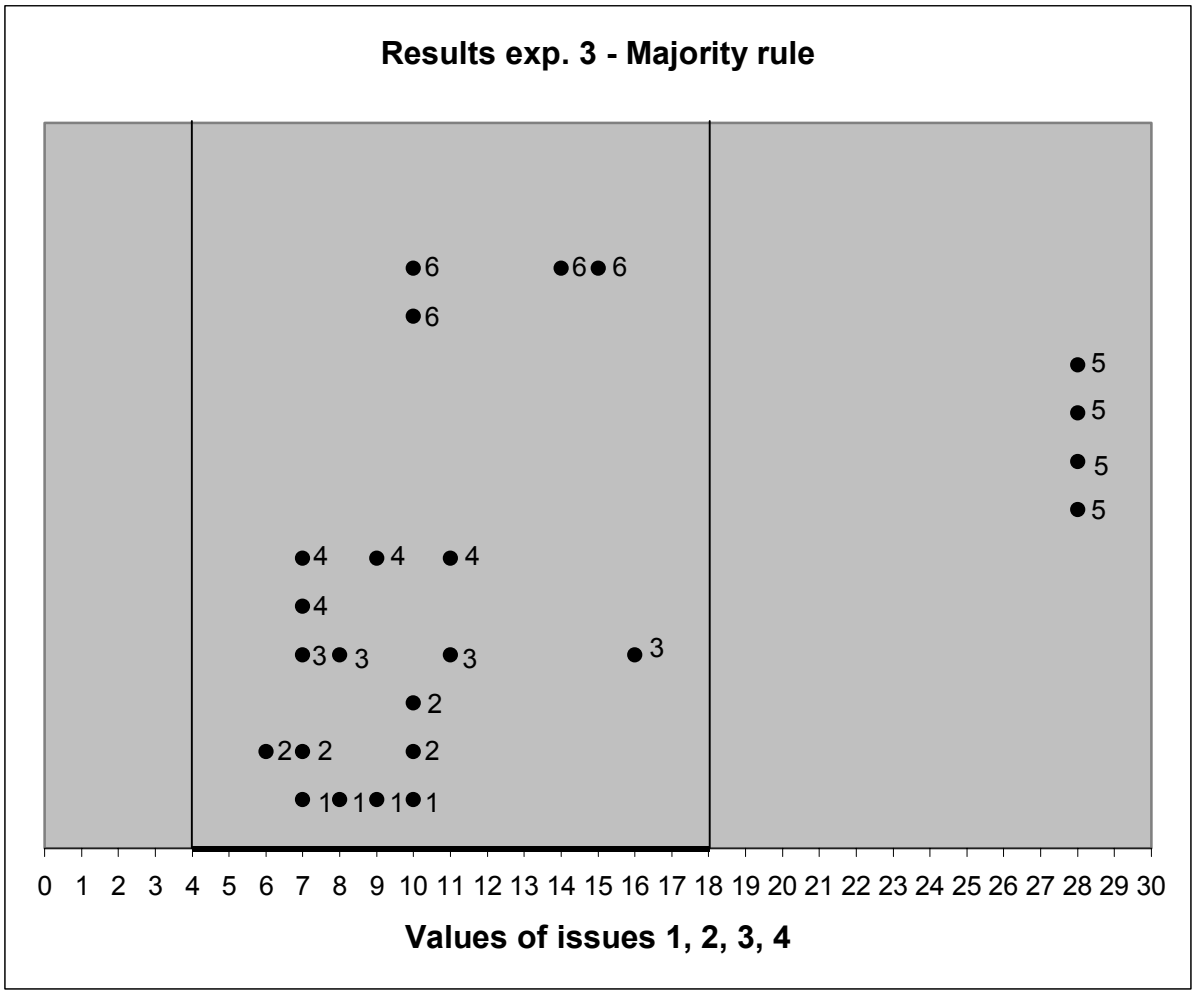
7.2 Results

Under the treatment with majority rule (see Table 7.3.1 and Fig. 7.3.1), groups 1, 2, 3, 4, 6 (83%) have made agreements on the four issues, which fall within the Zone of Agreement, i.e. within the interval 4-18 (solution 1).
Only group 5 (17%) has made agreements on the four issues outside the Zone of Agreement, in particular at point 28 (solution 2).

Tab. 7.3.1 – Results experiment 3 with majority rule

Group	Agreement on the 1st issue	Agreement on the 2nd issue	Agreement on the 3rd issue	Agreement on the 4th issue
1	8	7	9	10
2	6	10	10	7
3	8	16	11	7
4	7	11	7	9
5	28	28	28	28
6	15	10	14	10

Fig 7.3.1



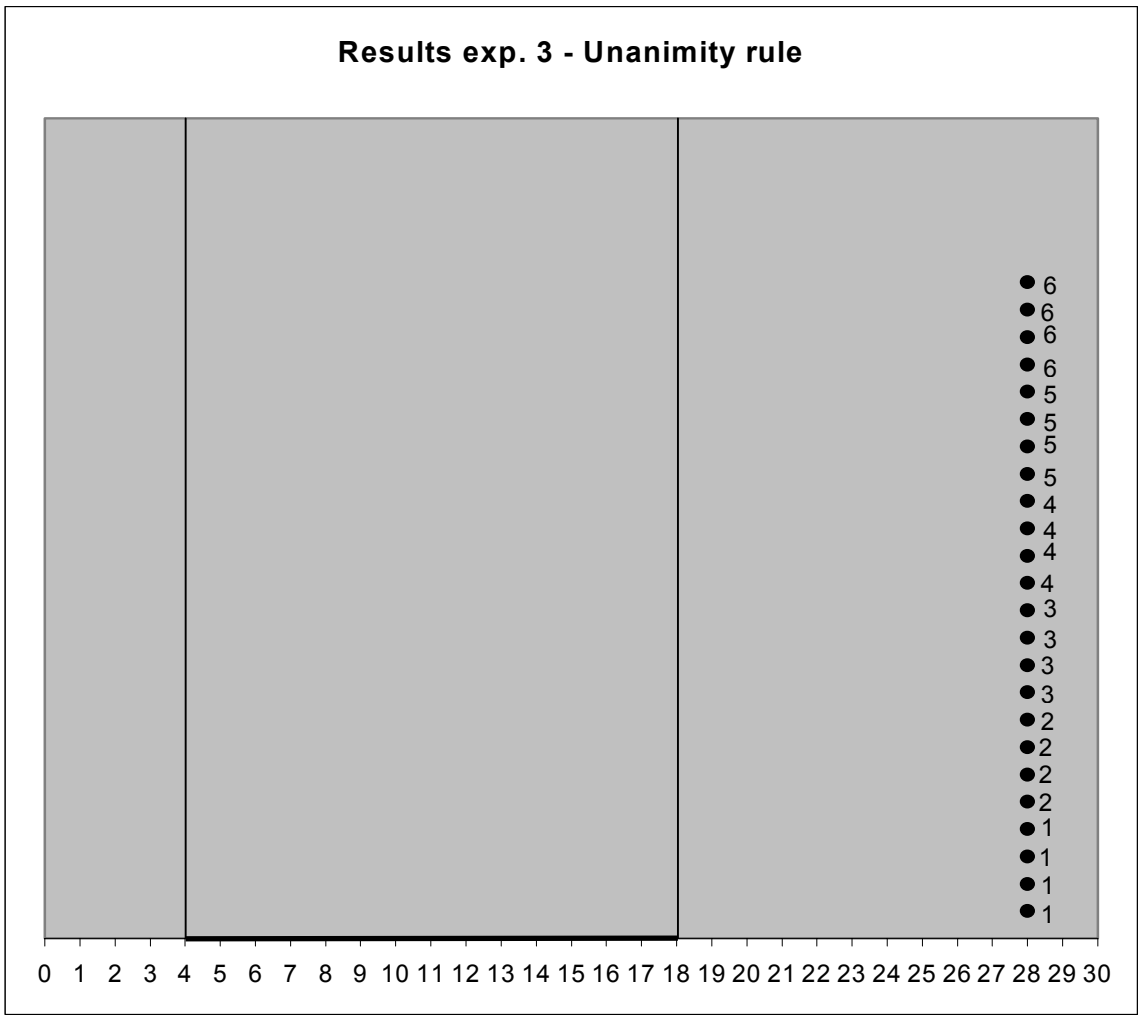
The diagram represents all the agreements (the black points) that the groups made on the four issues. Each group is identified by a number which appears on the side of each agreement point. For each group four agreements on the four issues are depicted, respectively. The bold line from 4 to 18 on the abscissa represents the Zone of Agreement of the four issues.

Under the treatment with unanimity rule (see Table 7.3.2 and Fig. 7.3.2), all groups (100%) have made agreements on the four issues outside the Zone of Agreement, in particular at point 28 (solution 2).

Tab. 7.3.2 - Results experiment 3 with unanimity rule

Group	Agreement on the 1st issue	Agreement on the 2nd issue	Agreement on the 3rd issue	Agreement on the 4th issue
1	28	28	28	28
2	28	28	28	28
3	28	28	28	28
4	28	28	28	28
5	28	28	28	28
6	28	28	28	28

Fig. 7.3.2



The diagram represents all the agreements (the black points) that the groups made on the four issues. Each group is identified by a number which appears on the side of each agreement point. For each group four agreements on the four issues are depicted, respectively. The bold line from 4 to 18 on the abscissa represents the Zone of Agreement of the four issues.

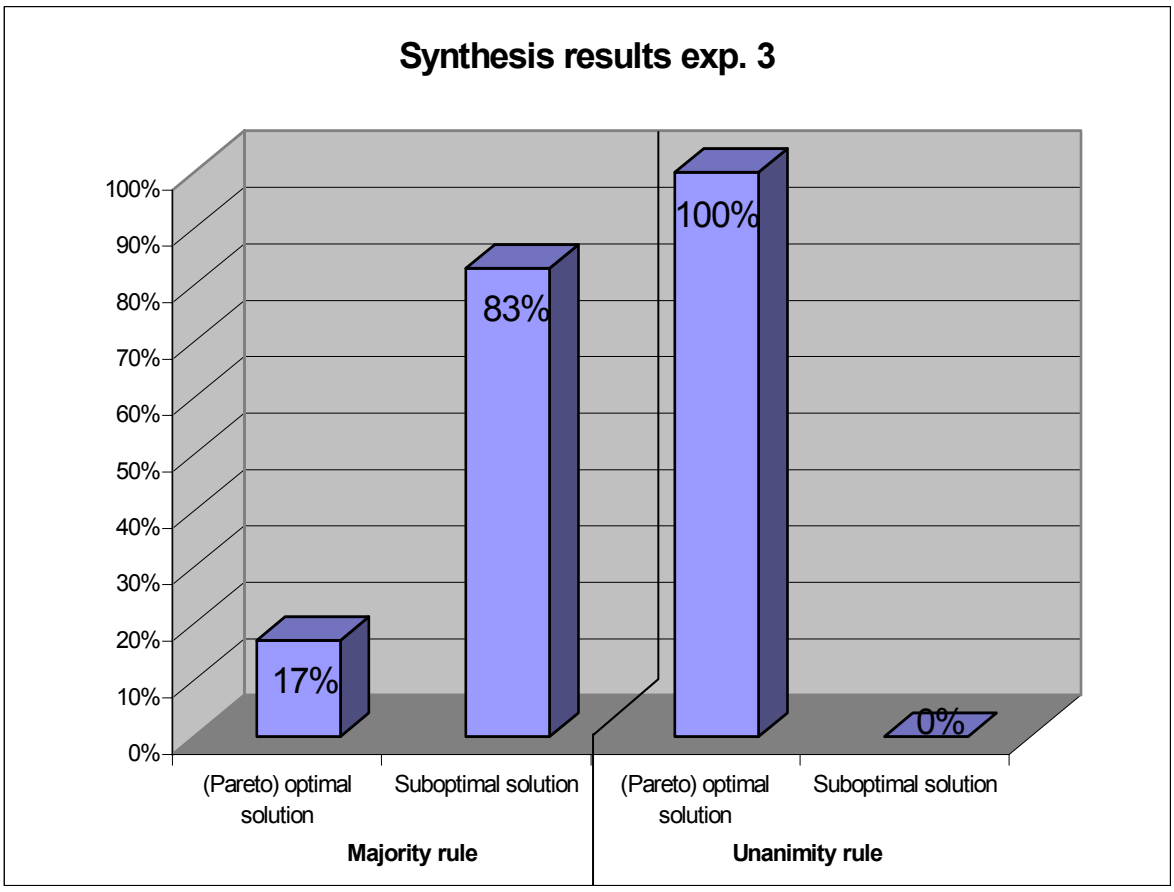
7.3 Discussion

The results of experiment 3 basically reflect the results of experiments 1 and 2. Under the majority rule the great majority of the subjects has been subjected to the ZAB and chose a suboptimal solution (solution 1).

Under the unanimity rule, notwithstanding the increased level of complexity of the negotiation problem (in comparison to experiment 2), the subjects have been induced to search for a solution outside the Zone of Agreement, and all of them have been able to find the Pareto-optimal solution (solution 2).

For a synthesis of the results of experiment 3, and a comparison between the majority and the unanimity rule, see Fig.7.4.1

Fig. 7.4.1



The (Pareto) optimal solution refers to both solutions 2 and 3, while the suboptimal solution refers to solution 1.

8. Conclusions

In the present study we have analysed the issue of coalition formation with a potential of logrolling under different voting rules in multi-issue multilateral negotiations. We have adopted the experimental method in order to gather empirical data on this topic which in the public choice literature so far has been treated only in a theoretical way.

The aim of our *experiment 1* has been to analyse to what extent negotiators are actually able (as would be predicted from the public choice theory) to form an optimal coalition and to reach an optimal agreement in a situation of a three-issue and three-parties negotiation with a potential for logrolling. In particular we tested the hypothesis that in certain situations the ZAB (Zone of Agreement Bias) might induce negotiators to form suboptimal coalitions which lead to Pareto-dominated agreements, and that the cycling problem predicted by the public choice theory might not exist.

The results of our first experiment have confirmed our initial hypothesis that a great majority of the subjects behaved in a way which is inconsistent with the public choice predictions, but consistent with the ZAB prediction. Most of the subjects adopted a satisficing behaviour; as soon as two negotiators out of three were able to find a suboptimal agreement within their Zone of Agreement on each issue separately, the search process for an optimal solution (outside the Zone of Agreement) was interrupted. Moreover, in almost all groups there arose no cycling problem.

The aim of *experiment 2* has been to examine the effects that different voting rules may have on the ZAB and on the optimality of the agreements. We considered the same negotiation problem as in experiment 1, and tested the hypothesis that the adoption of a unanimity rule, instead of a majority rule, might eliminate the effect of the ZAB. The results of experiment 2 have confirmed our initial hypothesis: under the unanimity rule the effect of the ZAB has been considerably lower. With the unanimity rule, however, the parties haven't had the possibility to negotiate the three issues separately, because on each issue there was the veto of at least one party. This way most of the negotiators have been induced to explore the space of solutions falling outside the Zone of Agreement, and to find an optimal agreement.

In *experiment 3* we have tested whether the results obtained with experiments 1 and 2 even hold when the level of complexity of the negotiation problem increases. To this aim we considered the situation of four-issues and four parties negotiations under both the majority and the unanimity rule.

The results of experiment 3 basically reflect the results of experiments 1 and 2. Under the majority rule the great majority of the subjects has been subject to the ZAB and chose a suboptimal solution. Under the unanimity rule, notwithstanding the increased level of complexity of the negotiation

problem, the subjects have been induced to search for a solution outside the Zone of Agreement, and all of them have been able to find the Pareto-optimal solution.

As a consequence the results from our three experiments provide empirical data on multilateral negotiations which put into question the validity of some predictions of the public choice theory, and in particular of the perfect rationality assumption. We are, however, well aware of the fact that these results just hold for the specific situations (Figures 4.1.1 and 7.1.1) we took into consideration. An interesting line for future research could be to analyse the effects of a change in the utility curves, in the incentive structure, or in the negotiation modalities (simultaneous vs. sequential exchange of offers) of the negotiation task. Moreover it could be interesting to study the learning processes of negotiators through the iteration of the negotiation game.

Appendix A

Instructions of experiment 1 (2 and 3)*

Introduction

You are about to participate in an experimental study on decision-making and negotiation. The experiment will last about half an hour. The instructions of the experiment are simple, and if you follow them carefully, you may win an amount of money directly proportional to your performance in the experiment plus a show-up fee of 3 €.
You will be randomly matched with 2 other participants, and your scope is to win as many points as you can. The amount of money you will be paid will be directly proportional to the total number of points you will score in the experiment. For each point you will get 0,25 €. At the beginning you will be assigned 15 points.

What to do?

Each participant will choose an envelope (A, B, or C) containing a record sheet and a sheet with 3 tables. Please, write your name on the record sheet.
Each of the three tables is made of two columns: in the left column you have a scale of numbers from 0 to 28. In the right column you have the number of points associated with each number in the left column. The tables of the other players are different from yours. Your tables and the points you get for each number of the left column is not known to the other player. Please, keep your tables secret.
You have to negotiate with the other players in order to choose a number in the left column of each table, so as to maximize your own total number of points. For a number to be chosen it suffices that a majority of two players out of three agree on the number. Each player (the one excluded from the majority as well) will be assigned the points corresponding to the number chosen in each table. In case of disagreement each player will get 0 points The total number of points you will gain will be the sum of the points you get from the agreement in each table.
You can negotiate following the order you prefer, i.e. you can start the negotiation with the any table, and you don't have to conclude the negotiation on one table before switching to the next one. It is only important that you and the two other players negotiate on the same tables at the same time (for instance, you can all start negotiating on the second table)

During the negotiations you can speak freely with the other players (if you want, you can communicate information about your points) but you can not show them your tables.
You have about 15 minutes to complete the negotiations on the three tables.

* In experiment 2 the instructions were the same as in experiment 1, with the only difference that it was required that all negotiators agreed on one number in order for that number to be chosen.
In experiment 3 the instructions for the majority and unanimity rule treatments were the same as in experiment 1 and 2 respectively, with the only difference that the groups were made of four negotiators and that decisions under the majority rule had to be taken with a majority of three out of four negotiators.

Appendix B

Tables used in experiments 1 and 2

The tables correspond to the utility curves depicted in Fig.4.1.1. Each player received the same three tables, but in a different order so that for player A issue 1 corresponded to Table 1, issue 2 to Table 2, and issue 3 to Table 3; for player B Table 2 corresponded to issue 1, Table 3 to issue 2, and Table 1 to issue 3; for player C Table 3 corresponded to issue 1, Table 1 to issue 2, and Table 2 to issue 3.
In the experiment the numbers of the second issue have been inverted for each player, i.e. from 28 to 0 instead of 0 to 28; this was done in order to prevent the subjects from realizing that they had the same utility functions.

TABLE 1	
Number	**Points**
0	14
1	13
2	12
3	11
4	10
5	9
6	8
7	7
8	6
9	5
10	4
11	3
12	2
13	1
14	0
15	-1
16	-2
17	-3
18	-4
19	-5
20	-6
21	-7
22	-8
23	-9
24	-9
25	-10
26	-10
27	-11
28	-11
Disagree	0

TABLE 2	
Number	**Points**
0	-4
1	0
2	4
3	8
4	12
5	16
6	12
7	9
8	8
9	6
10	6
11	5
12	4
13	3
14	2
15	2
16	1
17	1
18	0
19	-1
20	-3
21	-5
22	-6
23	-7
24	-8
25	-8
26	-9
27	-9
28	-9
Disagree	0

TABLE 3	
Number	**Points**
0	-16
1	-15
2	-15
3	-14
4	-13
5	-12
6	-12
7	-11
8	-10
9	-9
10	-9
11	-8
12	-7
13	-6
14	-6
15	-5
16	-4
17	-3
18	-3
19	-2
20	-1
21	-1
22	0
23	3
24	8
25	13
26	20
27	34
28	52
Disagree	0

Appendix C

Tables used in experiment 3

The tables correspond to the utility curves depicted in Fig.7.1.1. Each player received the same four tables but in a different order, so that for player A issue 1 corresponded to Table 1, issue 2 to Table 2, issue 3 to Table 3, and issue 4 to Table 4; for player B Table 2 corresponded to issue 1, Table 3 to issue 2, Table 4 to issue 3, and Table 1 to issue 4; for player C Table 3 corresponded to issue 1, Table 4 to issue 2, Table 1 to issue 3, and Table 2 to issue 4.

In the experiment the numbers of the second and fourth issue have been inverted, i.e. from 28 to 0 instead of 0 to 28; this was done in order to prevent the subjects from realizing that they had the same utility functions.

TABLE 1	
Number	**Points**
0	32
1	26
2	20
3	16
4	13
5	12
6	11
7	9
8	8
9	7
10	6
11	6
12	5
13	4
14	3
15	3
16	2
17	1
18	0
19	-1
20	-1
21	-2
22	-2
23	-2
24	-3
25	-3
26	-3
27	-4
28	-4
Disagree	0

TABLE 2	
Number	**Points**
0	-4
1	1
2	5
3	8
4	9
5	11
6	11
7	12
8	11
9	11
10	10
11	9
12	8
13	7
14	7
15	6
16	5
17	4
18	3
19	1
20	0
21	-1
22	-1
23	-2
24	-3
25	-4
26	-4
27	-5
28	-5
Disagree	0

TABLE 3	
Number	**Points**
0	-16
1	-11
2	-7
3	-3
4	0
5	3
6	6
7	8
8	10
9	12
10	13
11	13
12	14
13	13
14	12
15	10
16	8
17	7
18	5
19	3
20	0
21	-2
22	-4
23	-6
24	-8
25	-8
26	-9
27	-10
28	-11
Disagree	0

TABLE 4	
Number	**Points**
0	-20
1	-20
2	-20
3	-20
4	-20
5	-19
6	-19
7	-19
8	-19
9	-19
10	-18
11	-18
12	-18
13	-18
14	-17
15	-17
16	-17
17	-17
18	-16
19	-16
20	-16
21	-8
22	0
23	9
24	18
25	27
26	36
27	45
28	53
Disagree	0

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