Proportionality versus Perfectness:

Experiments in Majoritarian Bargaining*

Daniel Diermeier
IBM Professor of Regulation and Competitive Practice
Department of Managerial Economics and Decision Sciences (MEDS)
Kellogg School of Management,
Northwestern University,
Evanston, IL 60208-2009
Email:d-diermeier@kellogg.northwestern.edu

Rebecca Morton
Professor of Politics
Department of Politics
New York University
726 Broadway, Room 748
New York, NY 10003-6806

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Abstract

We investigate the predictive success of the Baron-Ferejohn model of legislative bargaining in laboratory environments. In particular, we use a finite period bargaining game under weighted majority rule where a fixed payoff is divided between three players. In each period one of the players is chosen according to a known rule to make a proposed allocation of a fixed sum among the three players. The proposal is then voted on, and if rejected, another proposer is selected until a proposal is accepted or the final period is reached. We find that our subjects' behavior is not predicted well by the Baron-Ferejohn model. The model predicts hardly better than a coin flip which coalition partner is selected by the chosen proposer, and proposers allocate more money to other players than predicted. In a significant minority of coalitions the sum is allocated equally across all three players. A sizable number of proposals are rejected in the first proposal periods and subjects who vote to reject a proposal on average receive a higher payoff from the new proposal. An alternative explanation of coalition bargaining outcomes based on a proportionality rule is consistent with behavior in one of our treatments, but is unsuccessful in the others. We find, however, that a simple equal sharing rule yields point predictions that can account for _ to _ of all accepted proposals.

Introduction

The Baron-Ferejohn model (hereafter BF) of legislative bargaining (Baron and Ferejohn 1989a) is one of the most widely used formal frameworks in the study of legislative politics. Variants of the model have been used in the study of legislative voting rules (Baron and Ferejohn 1989a), committee power (1989b), pork-barrel programs (Baron 1991a), government formation (Baron 1989, 1991b, Baron and Ferejohn 1989a), multi-party elections (Banks and Austen-Smith 1988, Baron 1991b), and inter-chamber bargaining (Diermeier and Myerson 1994). A general analysis of the Baron-Ferejohn framework was recently presented in Banks and Duggan (2000, 2003)

The BF model is based on the earlier bilateral alternating bargaining models of Stahl (1972), Krelle (1976) and Rubinstein (1982). The standard approach in these models is to assume that two actors must reach agreement on an outcome and if they fail to do so the outcome will be some fixed event. Typically, the actors are assumed to be dividing a fixed sum (or pie) between themselves and if they fail to reach an agreement all receive a pay-off of zero. Players alternate in making offers to each other and acceptance of an offer ends the game.[1]

The BF model adapts the Rubinstein model to the type of bargaining process that can occur in legislatures by extending the number of actors and incorporating a voting rule to determine when a proposal is accepted. In all variants of the BF model a proposer is selected according to a known rule. She then proposes a policy or an allocation of benefits to a group of voters. According to a given voting rule the proposal is either accepted or rejected. If the proposal is accepted, the game ends and all actors receive pay-offs as specified by the accepted proposal. Otherwise, another proposer is selected etc.[2] This process continues until a proposal is accepted or the game ends. In many applications the game is potentially of infinite duration. That is, it can only end if a proposal is accepted.

[1] See e.g. Osborne and Rubinstein (1990) for more detail.

[2] A variant of this set-up allows (nested) amendments to a proposal before it is voted on. This is the case of an open amendment rule (Baron and Ferejohn 1989a).

Consider a simple version of the model where there are three political parties with no party having a majority of the votes in the legislature. The BF model predicts that the party with proposal power will propose a minimal winning coalition consisting of herself and one other member, leaving the third party with a zero payoff. As in the Rubinstein model the proposing party will give its proposed coalition partner just the amount necessary to secure an acceptance. This amount (or continuation value) equals the coalition partner's expected payoff if the proposal was rejected and the bargaining continued. Proposals are thus always accepted in the first round. Note that the proposing party will always choose as its coalition partner the party with the lowest continuation value. The division of spoils will in general be highly unequal, especially if the parties are very impatient.

The BF model is attractive for the study of legislative politics, especially when the political issues have important distributive consequences for the representatives' constituencies. It is well known that simple majority voting games over redistribution lack a core. The BF model provides a useful alternative. The model explicitly formalizes the bargaining process, and provides both point and comparative statics predictions about the effects of different institutions on bargaining behavior and outcomes. This allows researchers to analyze how different legislative institutions and rules may affect political behavior and outcomes.

However, the usefulness of the Baron-Ferejohn model for the study of legislatures depends on how well it explains actual bargaining behavior in political environments. Recent experimental work on simpler two-person bargaining games has shown that such bargaining models' predictions may fail to be supported in the laboratory. For example, a number of experimental studies have examined the "ultimatum game" in which one player makes a proposal on the division of a fixed amount of money and the other player must either accept or reject; with rejection implying a zero payoff for both. In experiments on ultimatum games proposers should take (almost) all of the money, yet the divisions are far more equal than predicted. Moreover, if proposers offer less than certain amount[3], the other player frequently rejects the offer (even if it is a significant amount of money) and receives a payoff of zero. Experiments on bargaining games with a series of alternating offers result in similar outcomes. Proposers offer more money than suggested by their subgame-perfect strategy and bargaining partners consistently reject offers and forgo higher payoffs (e.g. Davis and Holt 1993, Forsythe et al. 1994, Gueth et al. 1982, Ochs and Roth 1989, Roth 1995). [4]

Many explanations have been suggested for this anomaly. One of the first hypotheses suggested concerns flaws in the experimental design. Early bargaining experiments were criticized for their lack of anonymity between the players (e.g. Hoffman and Spitzer 1982). Hoffmann et al. (1991) suggested that a similar effect might be due to the fact that the subjects' identities are known to the experimenter. Using an elaborate experimental design Bolton and Zwick (1992) show that there is no evidence that the presence of an experimenter inhibits subjects in ultimatum, dictator or impunity games.[5]

Another hypothesis suggests that players are behaving altruistically or trying to follow a fairness norm. This would imply that players are motivated by other factors than their monetary payoffs even under experimental conditions that guarantee anonymity between players. Forsythe, Horowitz, Savin, and Sefton (1994) investigated this hypothesis by comparing ultimatum and dictator games. The dictator game differs from the ultimatum game in that the proposing player proposes a division between the two players and the other player cannot reject the proposal. In ultimatum games almost 60% of the offers observed propose an equal division of pay-offs. While there is still a significant percentage of equal divisions in dictator games (less than 20%) the modal division is the subgame perfect allocation where the proposer keeps the entire pay-off.

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[3] This amount varies from culture to culture. In experiments conducted by Roth et al. (1991) the modal offer varied between 40% of the pay-off in Jerusalem, Israel and 50% in Pittsburgh.

[4] See Roth (1995) pages 253-292 and Davis and Holt (1993) pages 241-274 for reviews of this literature.

[5] In impunity games, like in dictator games, the proposer’s allocation to himself is unaffected by the other player’s acceptance or rejection but the other player’s acceptance or rejection determines whether that player receives her allocation.

This result suggest that while some of the subjects are primarily motivated by notions of fairness, the high percentage of equal divisions in ultimatum games cannot be attributed to a simple desire to be fair. Bolton and Zwick (1996) find a similar relationship between divisions in ultimatum games versus impunity games. In impunity games, as in dictator games, divisions are significantly less fair than in ultimatum games.

Another suggested explanation concerns the equilibrium concept used (Forsythe et. al. 1994). In ultimatum games players did not choose subgame perfect strategies, but play was consistent with Nash equilibria. This suggests a connection to other experiments where subgame perfect equilibria are not observed in the laboratory. The most noteworthy example is the centipede game (McKelvey and Palfrey 1992). However, subgame perfect equilibria are supported in other non-trivial extensive form games. Prasnikar and Roth (1989, 1992) consider a sequential model called the "best shot" public good provision game. In this game, first a player proposes a quantity of a public good that he will provide and then a second player (after being told the quantity proposed by the first player) proposes a quantity that she will provide, with the quantity of public good provided being the maximum of the two. Both players are charged for the quantity that he or she proposes to provide but only paid a redemption value based on the quantity actually provided. The perfect equilibrium prediction is for the first player to propose to provide a zero quantity, the second player proposes a positive quantity, and the bulk of the profits are then earned by the first player. Although this prediction appears to have similar unfair consequences and the potential for error and learning as in the ultimatum and other bargaining games, Prasnikar and Roth find that this prediction is supported in laboratory experiments. They suggest that the differences between the two settings are due to off the equilibrium path differences in the best shot game as compared with the ultimatum and other bargaining games.[6]

The BF bargaining game is similar to these bargaining games in the sense that proposers are expected to offer their coalition partner her continuation value. In the last period of a finite game, this continuation value is zero, as in the ultimatum game. Hence the non-proposing coalition partner in the last period of the BF model is like the second player in an ultimatum game. The relationship between the proposer and non-coalition member in the last period, however, is also similar to the dictator game, since the votes of the non-coalition members are not necessary to pass a proposal.

The similarity between the two-person sequential bargaining games and the BF games allows us to build on the experimental evidence and methodological expertise accumulated in the years of laboratory research with two-person bargaining. The only other experimental attempt to directly test the BF approach is McKelvey (1991). McKelvey uses a three-voter, three alternative stochastic version of the BF model that mimics Baron and Ferejohn (1989a) for the closed rule case. This game has many subgame-perfect equilibria. In this case it is customary to focus on the (usually) unique stationary equilibria. Stationarity rules out any dependence of the agents' strategies on the history of play and thus avoids the multi-equilibrium problem generated by a Folk-Theorem. McKelvey concludes that the stationary solution to his game at best modestly explains the data. Proposers usually offer too much and these proposals are accepted with too high a probability.

In contrast to McKelvey we use a finite game under weighted majority rule where a fixed payoff is divided among three actors.[7] This has methodological advantages. First, we avoid the problem of implementing (potentially) infinite games in finite time. Second, our model has a unique subgame perfect equilibrium. This provides a unique model prediction without assuming the much stronger stationarity requirement. This is important, given that McKelvey suggests that subjects may try to coordinate on a non-stationary equilibrium that might explain the data. We can thus test the BF model in isolation, not the model *with* an additional equilibrium refinement. Fourth, the subgame-perfect equilibrium involves no randomization. This avoids one of the main

[6] Roth and Erev (1994) have recently proposed a simple learning rule to address this issue.
[7] Baron and Ferejohn (1989a) discuss this case in a footnote.

problems is testing the BF approach.[8] If randomization occurs in equilibrium, one needs a large number of observations to detect a significant difference between predicted and observed frequencies (McKelvey 1991). Fifth, the weighted majority game allows us to test a rich set of comparative statics, not just its point predictions. Comparative statics analyses are of particular interest in testing game-theoretic models, since few game theorists would maintain that the assumptions of a game-theoretic model literally apply to a particular decision problem. Indeed, the failure of experimental or field data to precisely correspond to the point predictions of a model such as the exact equilibrium allocation of monetary pay-offs may not be too damaging to a model as long as the qualitative predictions of the model are confirmed.[9]

The next section formally introduces our version of the BF model. Section three discusses experimental design and predictions. Section four discusses our experimental results and compares our analysis to other experimental evidence on similar bargaining games. In Section five and six we discuss alternative explanations of our empirical findings. The last section discusses the implications of our results for bargaining models in general and legislative bargaining models in particular.

The Baron-Ferejohn Model

We consider the following version of the BF model. Assume a set N of n players, indexed by $i = 1, \ldots, n$ with a distribution $v = (v(1),\ldots, v(n))$ of votes per player. We also assume that $\sum_{i \in N} v(i)$ is odd. Assume further that there is a fixed transferable payoff $x(N)$ to be distributed among the players. Let $x(i)$ be the payoff assigned to i. We assume that $x(i) \geq 0$ and $\sum_{i=1}^{n} x(i) = x(N)$.

We assume a finite multi-period sequential bargaining game with the following structure. At the beginning of each period a proposer is selected among the players according to a time-invariant

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[8] This is true in all periods except for the last, which is off the equilibrium path.

selection rule. We denote the probability that player i is selected by $p(i)$. Thus, we assume that $p(i) \geq 0$ and $\sum_{i=1}^{n} p(i) = 1$. Let j be the chosen proposer. Then j's proposal is a vector $x_j(x_j(1),\ldots,x_j(n))$ again with $x_j(i) \geq 0$ and $\sum_{i=1}^{n} x_j(i) = x(N)$. A proposal is accepted if and only if it receives a majority of the votes. If a proposal is accepted, the game ends and each player's payoff is determined by the accepted proposal. If not, the game moves to the next period where again a proposer is selected according to $p = (p(1),\ldots,p(n))$. This process continues until either a proposal is accepted or the last period T is reached. If no proposal is accepted in the last period, every player receives a payoff of $x(i) = 0$. In the parlance of BF we thus consider a finite sequential bargaining game with a weighted majority voting rule, random recognition, and a closed amendment rule. The solution concept is subgame-perfection.[10]

For a given recognition rule we can then solve the game as follows: in the last period T the unique subgame-perfect equilibrium is for the proposer to keep the entire dollar. Given perfection such a proposal will be accepted for sure.[11] Note that in the last period a rejection will give each player a payoff of zero. Call this each player i's *continuation value* for period t: w_j^T. In general, a continuation value equal a player's expected utility if the proposal fails and subsequent play is consistent with subgame-perfect equilibrium. So, in period T we have for all i: $w_j^T = 0$.

The key to analyzing the BF model is to note that this insight generalizes to each period: in equilibrium a proposer will always make an offer to the non-proposer k with the lowest

[9] We address this issue more expansively in our discussion of the experimental analysis.

[10] Since we use a finite game there is no technical reason to discount future payoffs. Moreover, discounting would lead to less sharp predictions.

[11] To see, why note that the proposer j has a strictly dominant strategy to vote for his proposal. The other two voters are indifferent. So, suppose they randomize, then j could randomly choose one of the non-proposers, say i, and propose an ε-amount to i. Then i will accept this proposal for sure. But this cannot be equilibrium since j would prefer to reduce ε to zero. Hence in any perfect equilibrium at least one non-proposer has to accept the proposal for sure.

continuation value (the "cheapest" non-proposer). In particular, the proposer will offer *k* exactly her continuation value.[12] Such a proposal is expected to pass for sure.

Consider a three player version of the game with players *i*, *j* and *k* with $x(N) = 1$. For each *t* let w_i^t be the largest continuation value, w_j^t the second biggest, and w_k^t the smallest in period *t*. We can then recursively calculate the continuation value for period $t - 1$ according to the following formulae.

$$w_j^{t-1} = p(i)(1 - w_k^t)$$

$$w_j^{t-1} = p(j)(1 - w_k^t) + p(k)w_j^t)$$

$$w_k^{t-1} = p(k)(1 - w_j^t) + (1 - p(k))w_k^t) .$$

The intuition underlying these calculations is straightforward. Player *i* has the highest continuation value. Hence he will only be included in a coalition if he himself is the proposer. In this case he will offer *k*, the player with the smallest continuation value, exactly w_k^t and keep the rest of $x(N)$ for himself. This event occurs with probability $p(i)$. A similar argument works for *j* in that player *j* will, if the proposer, also offer *k* exactly w_k^t and keep the rest of $x(N)$ for herself. But in contrast to *i*, *j* will also be included in the coalition if *k* is the chosen proposer, since for *k*, a coalition with *j* is the cheaper of the two potential coalition members. In this case *j* will receive exactly her reservation value. Because *k* has the lowest continuation value, she will always be included in the coalition, either as a proposer, in which she receives $1 - w_k^t$ or by being offered her continuation value by either *i* or *j*.

Note that *i*'s continuation value decreases in the next period, while *k*'s always increases (the direction of w_j^t is in general undetermined). This implies that the order of continuation values may change from period to period. Each player may be the cheapest player in some period. This leads to abrupt changes in the predicted probability of being included in a coalition

[12] If there are more than one "cheapest" player the proposer will randomize.

from period to period. The BF model thus leads to sharp predictions both about which coalitions will form and what the equilibrium offers will be. Both the expected coalitional composition and the equilibrium offers in general differ for different recognition probabilities and number of remaining periods.

Experimental Design

We conducted three treatments at the University of Iowa using a large (400 plus) subject pool of undergraduate and MBA students recruited from the Colleges of Business and Liberal Arts. The treatments were conducted via a computer network on terminals. Subjects were separated by dividers and given experiment specific ID numbers. Subjects were given copies of the instructions and the instructions were read aloud. All questions were answered in public. Subjects were also given a short quiz on the instructions to ensure that they understood the experiment. A sample copy of the instructions is contained in the appendix. Subjects were also provided with personal history forms to record the events that occurred in each bargaining period in which they participated.

The treatments used twelve subjects each, giving a total of 36. In each treatment, the subjects were randomly assigned to three member groups. Within each three person group, the subjects were then randomly assigned a vote total and a color: Blue, Green, or Orange. The color assigned to a subject was the label for that subject for that bargaining period and bargaining group. Thus, subjects' identities were anonymous.

In each treatment we assume that the total number of votes is 99 and that 50 votes are needed to pass a proposal. In treatment 1, the three vote totals assigned were 34, 33, and 32. That is, one player was assigned 34 votes, a second 33, and a third 32. These assignments were made independently of the color assignments. In treatment 2 the three vote totals assigned were 49, 33, and 17 and in treatment 3, the three vote totals assigned were 46, 44, and 9. Subjects were told both their own color and vote total and also the colors and vote totals of the other members of their group but not the identity (ID numbers or names) of the other members.

In each proposal period, one of the group members was selected to make a proposal using known probabilities. Initially, the probability of being selected as a proposer was based on the percentage of votes assigned to the subject. That is, $p(i) = \frac{v(i)}{\sum_{i=1}^{n} v(i)}$. In treatment 1 this roughly corresponds to recognition probabilities of $p \approx \left(\frac{1}{3},\frac{1}{3},\frac{1}{3}\right)$. In treatment 2 $p \approx \left(\frac{1}{2},\frac{1}{3},\frac{1}{6}\right)$ and in treatment 3 we have $p \approx \left(\frac{4.5}{10},\frac{4.5}{10},\frac{1}{10}\right)$.

Subjects selected to make a proposal were told to allocate \$45 (in integers) among the three members of their group (including themselves). They were told that they could allocate any integer amounts as long as the total sum allocated did not exceed \$45. The proposal was then revealed to the three members of the proposer's group and the proposer was identified by her color assignment in the group. All group members then voted all of their votes either yes or no on the proposal. A proposal was considered accepted if the proposal received 50 or more yes votes. Thus, in all treatments, any coalition of two subjects voting yes was sufficient for a proposal to be passed. If the proposal was accepted, the bargaining game was considered over for the group. Group members were told the outcome of the vote and how each group member votes (by color assignment).

In the treatments, subjects were given five proposal periods. That is, if the fifth proposal was rejected by a group, then all members of the group were given \$0 payoff. The treatments differed in vote shares and recognition probabilities. After each group had either accepted a proposal or gone through the maximum number of proposal periods and rejected the final proposal, the subjects were randomly re-assigned to three member groups again. Subjects were also randomly re-assigned vote totals and colors to minimize repeated game effects. To control for income effects, one bargaining period was chosen at random for payment.[13] There were 18 bargaining periods in each treatment, thus there were 18 x 4 x 3 = 216 bargaining groups.

As discussed above, the BF theory provides precise predictions of the allocations that will occur in the three experimental treatments. These predictions fall into different categories. The first two pertain to initial proposing behavior. They indicate the types of coalitions proposed and the precise division of pay-offs in a proposal. We expect that a coalition will form between the chosen proposer and the subject of the remaining group members with the lower continuation value. For the three treatments the predictions can be summarized in the following table:[14]

[Table 1 here]

Second, the BF model provides precise predictions concerning the allocations offered to the coalition members. A coalition partner is expected to be offered a payoff equal to her continuation value. Hence in the first proposal period of treatment 1, if player b is chosen to make a proposal, she is expected to propose that player a receive \$11, keep \$34 for herself, and allocate \$0 for player c. The predictions are summarized in Table 2.

[Table 2 here]

Notice that the coalitions, as well as the allocations, vary with the treatments. For example, when player b is chosen to make a proposal in the first proposal period in treatments 2 and 3 she is expected to form a coalition with player c instead of a. And while player c is expected to always choose player a as a coalition partner in treatment 1 she is expected to offer a lower allocation than in treatments 2 or 3.

Third, we expect that the subjects will vote for a proposal if and only if it provides them with an allocation greater than or equal to their continuation values. Thus, for example, in the

[13] All subjects were paid an additional \$7.00 minimum show-up fee.

[14] Note that since we required the subjects to make proposed allocations in integer amounts, the continuation values are calculated for each period as the next highest integer over the expected value to a player for continuing the game to the next proposal period. As a consequence, even though in treatments 2 and 3 there are significant differences in vote shares, the proposed allocations are very similar. Moreover, in treatment 1 players b and c have the same continuation value because of the effect of the rounding.

first proposal period of treatment 1, we would expect subjects of type a will only vote for proposals that offer them \$11 or more.

As in all empirical analyses of experiments we generally would not expect to observe the exact allocations in the BF model, even in the controlled laboratory environment. It is well known that some learning may take place in early periods, as subjects become more familiar with the bargaining game and the computer experimental environment. Subjects may make random errors in calculation throughout the experiment. It is thus important not only to consider point predictions, but also to consider general qualitative predictions and comparative statics analyses.

Experimental Results

Coalition Types. The first important finding concerns minimum winning coalitions. In all three treatments we find a large number of proposal that allocate money to all players ("grand coalitions"). In treatment 1 these are 40% of all allocations, in treatment 2, 41.6% of all allocations, in treatment 3, 30.5% of all allocations.

This finding may suggest some concern for fairness or altruistic preferences among the subjects. But such a conclusion would be premature. Most of the grand coalition proposals, for instance, do not allocate money equally. Only 15% in treatment 1, 11% in treatment 2 and 3 of all proposals allocate \$15 to each subject. This is far less than the percentages of equal allocations reported for the ultimatum game and even less than for the dictator game (Forsythe et al. 1994). To put it differently, what could be considered fair in the BF model is far less obvious than in 2-person bargaining games. It may apply to coalitional composition or to the allocation of pay-offs within a coalition or both.

However, even if we restrict attention to minimal wining coalition proposals only, the BF model explains little of the observed variations. In treatment 1, 51% of the minimal winning coalition proposals are predicted by the BF model, in treatment 2, 55%, and in treatment 3, 46%.

If we assume that a chosen proposer will always include himself in a proposed coalition, the BF-model does not predict better than a coin flip.

As an obvious alternative to the B-F model one may consider the following "naïve" proposal rule: "always propose to remaining player with the lowest number of votes". We call these coalitions "simple minimal winning". Such a rule successfully predicts 42% of minimal winning coalition proposals in treatment 1, 74% in treatment 2, and 44% in treatment 3. Sometimes, however, BF and the naïve proposal rule predict the same coalition. In treatment 2, for instance, both predict the same coalition, except if c is chosen as the proposer. If only compare the cases where the two rules differ, the BF model predicts 43% of all cases correctly, the naïve rule 57%.

One may suspect that the number of grand coalitions declines over time as subject become more experienced over time. Figure 1, however, suggests that this is not the case.

[Figure 1 here]

We find that the percentage of coalitions correctly predicted by the BF model increases in the early bargaining periods, but this increase is also accompanied by an increase in the simple minimal winning coalitions. Two player proposals also increase with bargaining period. These increases seem to occur early, by the fifth bargaining period. The percent of grand fair coalitions varies but does not increase or decrease significantly with bargaining period. This finding is similar to the persistence of equal distributions in the two-person bargaining models (Ochs and Roth 1989).

Proposal Power. Analyzing the observed proposed allocations yields a similar result. In the following figures we can see that proposers almost always allocate less money to themselves than predicted by the BF model.

[Figures 2-10 about here]

Note also than in all nine cases some proposers allocate a positive payoff to all players (these allocations are in the interior of the simplices).

We can confirm this finding using a series of difference in means tests. The observed mean allocations are never within one standard deviation of the predicted allocation and rarely within two standard deviations. Our subjects do not exploit their proposal power as predicted by the BF model.

[Table 3 here]

As we discussed above, the BF model predicts that proposals will be accepted in the first proposal period if and only if the proposal is at least as high as a player's continuation value. Since there are so few allocations at or below a respondent's continuation value we can only investigate voting behavior where proposals exceed the continuation value. The BF models predict that all such proposals will be accepted. Yet, a significant percentage of first period proposals above the continuation value are rejected (from 19% in treatment 2 to 27% in treatment 1), and in some cases, groups go through a number of rejection before reaching agreement.

Our findings are consistent with some of the findings from the literature on two-person sequential bargaining games.[15] Proposers choose to allocate less to themselves than predicted by the theory and rejections occur at significant rates even if proposals exceed a respondend's continuation value. However, in contrast to two-person games, where previous research has indicated a tendency for players to receive lower payoffs after a rejection, we find that subjects who voted against a proposal and the proposal was rejected on average received a higher payoff from the subsequent proposal and that subjects who voted for a proposal which was rejected on average received a lower payoff. Table 4 presents the mean increase in allocation from the subsequent allocation for subjects across treatments when proposals are rejected.

[Table 4 here]

Gamson's Law in the Lab - An Alternative Explanation of Majoritarian Bargaining

Given the poor fit of experimental data and BF model we need to consider alternative explanations for the observed pay-off distributions. A very simple alternative is a *Proportionality Rule* for allocations within coalitions. The Proportionality Rule (PR) states that the distribution of benefits within a government is proportional to relative vote shares in a coalition. This alternative explanation is particularly attractive because it is consistent with one of the most striking empirical regularities in comparative politics: the proportional division of portfolios among the parties of a governing coalition.

The original formulation of this proposition is due to Gamson (1961). Subsequent research (e.g. Browne and Franklin 1973, Browne and Fendreis 1980, Schofield and Laver 1985, Laver and Schofield 1990) has confirmed this conjecture to an extent that one can justifiably call it *Gamson's Law*.[16] Gamson's Law, however, is not the only instance of proportional distributions of legislative offices. Other examples include the proportional assignments to committees in the United States Congress,[17] the distribution of committee chairs in parliamentary democracies, or the allocation of time in debates (e.g. Loewenberg et al. 1985).

The Proportionality Rule states that the benefits are divided within coalitions by party vote shares. Let $C \subseteq N$ with $C \neq \emptyset$ be a coalition of players. For every C let

$v(C) := \sum_{i \in C} v(i)$ be the weight assigned to coalition C. Then the Proportionality Rule states that

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[15] See Roth (1995) pages 304-323.

[16] At least two amendments suggested in the subsequent literature, however, ought to be mentioned. Browne and Fendreis (1980) found a tendency of small parties to be overrepresented (by about one portfolio). Laver and Schofield (1990) report that while cooperative bargaining models like the "bargaining set" (see Osborne and Rubinstein 1990) are outperformed by the simple Proportionality Rule, in some countries predictions derived from the bargaining set are slightly more accurate. Nevertheless, the basic empirical support for Gamson's Law is impressive. In a simple regression model Browne and Fendreis (1980), for instance, compared the actual number of portfolios Y to a party's seat share X. Perfect proportionality would imply a regression equation of $Y = b_0 + b_1 X$ where $b_0 = 0$, and $b_1 = 1$. The estimated coefficients for Browne and Fendreis were $Y = 0.97 + 0.83X$ with $R^2 = 0.93$.

[17] As in the case of portfolio distributions there are small deviations from proportionality. In some committees such as the House Committee on Rules the members of the majority party are over-represented.

$$\frac{x(i)}{x(N)} = \frac{v(i)}{v(C)} \quad \text{or}$$

$$x(i) \quad \frac{v(i)}{v(C)}.$$

Note that PR does not have any implications on the size of *C*, or the timing of coalition formation. That is, it only predicts the division of payoffs conditional on there being an agreement.

It is important to distinguish between PR as a predictive device in a majoritarian bargaining situation and its application to a specific empirical domain such as the distribution of cabinet portfolios. That is, Gamson's Law follows as an application of PR to the case of government formation. To draw this inference one would need additional applications such that each player *i* represents a political party, *v*(*i*) corresponds to party *i*'s seat share in the chamber that elects the government and C refers to a governing coalition etc. Finally, it is assumed that *x*(*N*) is the number of cabinet portfolios and *x*(*i*) the number of portfolio's assigned to party *i*. In our context we are *not* testing any specific application such as Gamson's Law, but the usefulness of PR in generic bargaining situations.

It is evident that from a theoretical point of view the BF model is superior to PR. It has a well-defined behavioral motivation, a clear solution concept (stationary subgame perfect Nash equilibrium), and provides a coherent framework to analyze a variety of issues in legislative politics. Moreover, it has a richer set of empirical implications since it not only predicts allocations, but also which coalitions will form.

It is important to note that the Proportionality Rule can be sustained as a Nash equilibrium, albeit not a subgame-perfect one. To see why, note that the non-proposing voters can adopt the following voting strategy: reject every proposal unless it confirms to the Proportionality Rule. Given this voting strategy, the proposer's best response is to allocate payoffs proportionally. However, many other (non-proportional) pay-off allocations can be sustained as Nash equilibria in this way. PR thus could be interpreted as a focal point in majoritarian bargaining games.[18]

We can summarize the PR's predicted allocations in the following table. It will be useful to use the measure r_{ij} := (allocation to i)/(allocation to j). Recall that PR does not rule out coalitions that are not minimal winning coalitions. Yet, if grand coalitions occur, the expected allocations to vary across treatments with only treatment 1 expected to result in grand coalitions with equal allocations.

[Table 5 here]

In contrast to BF, which predicts initial proposals, PR applies to accepted coalitions only. In the case of treatment 1 PR performs reasonably well in predicting accepted allocations.

[Figure 11 here]

However, this is not the case in treatments 2 and 3.

[Figure 12 and 13 here]

Here, the accepted allocations are consistently more egalitarian than expected. We can confirm this result by conducting simple difference in means tests, which are summarized in the following table.[19]

[Table 6 here]

A Simple Equal Sharing Rule

Neither the Baron-Ferejohn model, nor the Proportionality Rule was very successful in explaining our subjects' behavior. A closer inspection of the distribution of 2-player accepted proposals in treatment 1-3, however, reveals a surprisingly clear pattern.

[Table 7 here]

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[18] As the reader will note, these Nash equilibria are in general sustained by non-credible threats, since they require voters to reject allocations greater than their expected post-rejection payoffs, a strategy that is ruled out by subgame-perfectness.

In all three treatments there is little or no proposer effect. Rather, the mean allocations are close to an equal split of the $45 between the two coalition members no matter which players compose the coalition. The good fit of PR in treatment 1 thus can be attributed to the fact that for an equal vote distribution PR also predicts equal allocations. But if proposers expect to share the benefits equally, they are indifferent on which coalition to pick, which may explain the apparent randomness in the choice of coalition partner.

We may inspect this regularity in more detail by assessing the ability to the equal sharing rule to yield accurate point predictions. Consider the following histograms for the three treatments.

[Figures 14-16 here]

We can see that between roughly _ and _ of all accepted proposals allocate either $22 or $23 to the proposer.[20] Recall that proposers are constrained to make integer proposals. Thus, they cannot split the $45 exactly into equal halves, but have to either propose either $22 or $23 to the coalition partner.

Equal sharing may also explain the occurrence of some peculiar three player coalitions, where two players receive $22 each and the third player receives $1. In treatment 1 about 42% of all three player coalitions are such “pittance coalitions”, in treatment 3 25%, while there are no pittance coalitions in treatment 2, which exhibits by far the highest percentage of equal sharing allocations. Since the total payoff ($45) cannot be allocated equally in a two-player coalition, players appear to “discard” $1 (i.e. allocating it to the third player) rather than proposing an unequal allocation, even if the allocations differ only by a single dollar!

Applying the equal sharing rule to three-player coalitions predicts fair coalitions. In treatment 1, 42% of all accepted three-player coalitions are fair, in treatment 2, 28%, in treatment

[19] The large standard errors in treatment 1 and 3 for the case of 3-player coalitions are due to “pittance coalitions” where two players each receive $22 and one player receives $1. See also below.
[20] These percentages are of the same magnitude as the number of equal allocations in ultimatum games.

3, 33%. If we eliminate pittance coalitions from the set of accepted three-player coalitions the percentages are 73% in treatment 1, 28% in treatment 2, and 44% in treatment 3.

Discussion

The subject's behavior in our experiment is not predicted well by the Baron-Ferejohn model. Rather, a simple equal sharing rule where subjects share the available amount equally among the coalition members is highly consistent with the data. While this may suggest some intrinsic fairness motivation of our subjects, such a conclusion would be premature. As we discussed above, equal sharing may also serve as a simple focal point. Finally, subjects may be overwhelmed by the complexity of the experiment and rely on simple rules of thumb. We discuss each of these possibilities in turn.

Fairness. The equal sharing rule and large number of three player coalitions seems to suggest that players are motivated by other factors than monetary rewards even under experimental conditions that guarantee anonymity (both with respect to other players and the experimenter). While there is ample evidence that in some experiments players do exhibit behavior that suggests that they are following certain fairness norms, our results indicate that the precise nature of these norms is far from obvious. In our experiment, for instance, we saw that almost half of all first round proposals allocated money to all three players, but only 11% to 15% allocate $15 to all subjects. Moreover, while the suggested equal sharing may be consistent with some notion of fairness, such "fairness" would be restricted to the chosen coalition. The excluded player receives a pay-off of zero.[21] Interestingly, players did not consider different vote shares to be important reference points for deciding the allocation. That is, a proportionality rule based on vote share did not explain the data well. any explanation of Gamson's Law that is based on some "proportionality norm" is not supported in our experiment.

[21] This is consistent with the findings of Gueth and van Damme (1998) who add a dummy player to the standard ultimatum game who receives a zero pay-off, if the game is played sufficiently often. Fairness norms may also depend on the context. Hoffmann et al. (1994), for instance, show that in ultimatum games the percentage of equal distributions decreases if the right to propose is not allocated randomly, but earned, e.g. through a prior test or contest. For recent theoretical accounts of equity, reciprocity, and spitefulness see Levine (1996) as well as Bolton and Ockenfels (2000) and Fehr and Schmidt (1999).

Alternatively one may suspect that the occurrence of fair coalitions may be due to a small number of players that persistently propose fair allocations. “Selfish” proposers, for example, then should strategically adapt their strategies to the presence of voters with fairness concerns. However, while it is true in our experiments that some individuals are more likely to propose egalitarian allocations, there is not a single player in our sample who *always* exhibits this kind of behavior. Rather even players who predominantly propose fair allocations occasionally propose two-player coalitions.

Conventions and Focal Points. An alternative explanation may be based on the rejection of perfectness as useful equilibrium concept.[22] In this case there are many Nash equilibria and the question is why players coordinate so frequently on the one that splits the pay-off equally. One way to address this question is to interpret the equal distribution as a focal point or a convention (Schelling 1960). But what would rationalize an equal sharing rule? One approach would be to use solutions concepts from cooperative game theory. The equal sharing rule is, for instance, consistent with the Aumann-Myerson value (Aumann and Myerson 1988) in games with endogenous coalition structures. In such games players first non-cooperatively form links between each other (in our case choose a coalition) and then allocate pay-offs within linked sets using the Shapley value. Alternatively, one may use the Stable Aspiration Set (Morelli 1997) which is consistent with the equal sharing rule for 2-player coalitions, but cannot account for the occurrence of three player coalitions.

[22] Another possible explanation of our findings could rely on the fact that our subjects make non-trivial errors in their proposing and voting choices. If the possibility of errors is common knowledge among the players, then Nash Equilibrium is not the appropriate solution concept. Rather we would have to solve for Bayesian or Quantal Response Equilbria (McKelvey and Palfrey 1995). The latter approach has the advantage of usually identifying a unique equilbrium.

Based on our experimental data we cannot decide between these alternative accounts. However, one could easily design experiments with more than three players that would separate, e.g. the Aumann-Myerson value from the Stable Aspiration Set and both from a fairness norm.

Cognitive Limitations and Leaning. A final interpretation of our results is that subjects did not sufficiently understand the incentives in the game. Hence, they relied on simple "rules of thumb" that serve them well outside the laboratory. One experimental strategy that would alleviate this problem is to have a computer calculate each subject's reservation value and then make this information available to subjects. However, experiments that have used this technique find that subjects rarely use this information even if it is easily available (e.g. Camerer 2003). Another possibility is to investigate the presence of learning by subjects as they gain experience with the experiment. However, similar to previous multi-stage bargaining experiments (e.g. Ochs and Roth 1989), we find no evidence of learning effects in our data. It is, of course, possible, that the game is of sufficient cognitive complexity that even multiple rounds of play will not provide sufficiently diverse feed-back for subjects to learn. Note, however, that even if the cognitive complexity hypothesis is correct, our finding of equal sharing rules may be important, because most real bargaining or voting situations are highly complex and thus actors may indeed rely on simple sharing rules as cognitive short-cuts. Thus, we should investigate how robust equal sharing rules are in environments that easy to understand.

Conclusion

Our laboratory experiments of the Baron-Ferejohn model of sequential majoritarian bargaining indicate that the model has little success in predicting our subjects' behavior. Grand coalitions occur at a significant rate and proposers are not more likely to include coalition partners with lower continuation values. In addition, proposers fail to sufficiently exploit their proposal power and allocate too much money to their coalition partners. Voting behavior also differs from the behavior of the Baron-Ferejohn model. About a quarter of proposals are rejected although a majority of players is offered more than their continuation value. A simple proportionality rule based on Gamson's Law of cabinet formations predicts reasonably well as long as the expected allocations are not too unequal. For unequal allocations the fit is poor.

The best account of the subjects' behavior is provided by a simple sharing rule where the proposer chooses any winning coalition and then distributes the pay-off equally among the coalition members. This finding is consistent with various explanations: (i) players incorporate additional fairness concerns in their voting and proposing behavior, (ii) the equal sharing rule may constitute a focal point in majoritarian bargaining games, or (iii) it may be the consequence of using a simple rule of thumb in a complex decision environment.

Appendix: Experiment Instructions

Experiment ID#_________

This experiment is part of a study of decision making. The Graduate School of Business at Stanford University and the College of Liberal Arts at the University of Iowa have provided funds for this research. The instructions are simple and, if you are careful you can generally expect to make a substantial amount of money, which will be paid to you **IN CASH** at the end of the experiment.

One important rule of this experiment is that once we begin, no one is allowed to talk or communicate in anyway to anyone else. Anyone that does talk or communicate to someone else will lose his or her right to payment.

After we finish the instructions, we will pass out a "quiz" that you will take on the experiment. We will go over the quiz after you complete it. The reason for having a quiz is to make sure that you understand how the experiment works. So please pay close attention as we go over the instructions.

What determines how much you will be paid? The amount of your payment depends partly on your decisions, partly on the decisions of others, and partly on chance. The payoffs in the experiment are not necessarily fair, and we cannot guarantee that you will earn any specified amount beyond a minimum of $7.00 that everyone will at least receive. However, if you are careful you can generally expect to make a substantial amount of money. The experiment consists of a series of group decision-making periods in which you will participate with others in deciding how to divide $45.00. At the end of the experiment, one of the decision making periods you participated in will be chosen at random, and you will be paid in cash what you earned in that period plus the $7.00 minimum. That is, suppose that the experiment runs for 3 periods. Suppose also, that in period 1 you earned $25.00, in period 2 you earned $45.00, and in period 3 you earned $0.00. One of these periods will be randomly selected by the computer as your payment period. Note that each has a chance of being drawn with a probability of 1/3. If period 1 is drawn you will be paid $25.00 + $7.00 = $32.00 for the experiment, if period 2 is drawn you will be paid $45.00 + $7.00 = $52.00 for the experiment. But if period 3 is drawn you will be paid the minimum payment of $7.00.

What materials do you have for the experiment? You have four types of handouts. First you have a copy of these instructions which you can look at anytime during the experiment. You will see your ID# for the experiment at the top of these instructions. The second item you have is two copies of a Consent Form on the experiment that you must sign in our presence and you should take a copy home. The third item you have is your receipt for payment in the experiment. Do not fill in the receipt; at the end of the experiment we will tell you how to fill in the receipt.

The last handout is a set of personal history forms, one form for each decision-making period. During the experiment you may want to make a record of the events of the experiment. The personal history forms are like scratch sheets that you can use to write on during the experiment, take notes to yourself, etc. Please note that the forms are optional but that they will be turned in at the end of the experiment.

How does the experiment work? This experiment is conducted using the network and your individual computer terminals. As noted above, the experiment will take place in a series of decision-making periods. Each decision-making period will have the following structure:

1. All subjects are randomly assigned to groups of three participants. Thus, if there are 24 subjects, there will be 8 groups of three subjects. The groups will be numbered 1 through the total number of groups (with 24 subjects the groups are numbered 1 through 8).

2. Each group member in each group will be randomly assigned a color, either Blue, Green, or Orange. Note that only one member of each group will be assigned Blue, only one will be assigned Green, and only one will be assigned Orange. Each group member will also be randomly given a number of votes, either 34, 33, or 32. Note that only one member of each group will have 34 votes, one will have 33 votes, and one will have 32 votes.

3. Each group will decide how to divide $45.00.

4. You will be randomly re-assigned to new three member groups and again randomly assigned a vote total and color. Then all the groups will decide again how to divide $45.00. We will continue this procedure until the end of the experiment.

That is the basic structure of the experiment. Now I will explain how it works in more detail:

How do you find out your group assignment, color, and vote total? Your computer terminal will tell you this information. When you first sat down for the experiment, your computer screen had the following information:

Login: (number no more than 2 digits):

My assistant or I entered your experiment ID# from the first page of your instructions on your desk and pressed ENTER.

Now your computer screen shows the following information:

You have logged in. Enter C to continue. The setup will take a few minutes.

After we finish the instructions I will make an announcement on when to press "C." After you press "C" the computer screen will ask you to press either "1" to proceed or "9" to quit. DO NOT PRESS "9" UNTIL I TELL YOU THAT THE EXPERIMENT IS OVER.

When you press "1" your computer terminal "calls" the "center."

The center will send you the information on your color and vote total assignments as described above when you press "1." Your computer will then display the following information:

This is PERIOD# y PROPOSAL PERIOD# z

You are color BLUE You have xx votes GREEN has xx votes ORANGE has xx votes

If you want, you can enter the information from the computer as to your color and vote total on your personal history form for that decision-making period.

In general, when the "center" is ready to send you information, this information will appear on your screen when you press "1." If you see information on the screen, you should note it down on your personal history form and then press "1" again so that your computer terminal is ready to receive more information from the "center." Each time you press "1" your computer calls the center for information.

If the center is not ready to send you information, the center will send you the following message when your press "1":

error: center not ready. Try again later.

This means that there is no new information to send you. The computer again asks you to press "1" to proceed or "9" to quit. DO NOT PRESS "9" UNTIL THE END OF THE EXPERIMENT. You should press "1" again, and continue to press "1" until the center sends you information.

What happens after you find out your group assignment, color, and vote total? Each group will decide how they wish to divide $45.

How will each group decide? Each decision-making period is divided up into a series of proposal periods. In each proposal period, one member of each group will be selected to make a proposal on how to divide the $45. The computer will pick which group member will make the proposal based on the vote totals that have been assigned. That is, the three vote totals, 34, 33, and 32 add up to 99. The probability or likelihood that a group member will be picked is the member's vote total divided by 99.

For example, if you are assigned 34, then the probability that the computer will pick you to make a proposal will be 34/99 or approximately 34.34%. That is, if the computer were to draw for a proposer 100 times, it would probably pick you 34 times. The probability that the computer will pick you if you are assigned 33 will be 33/99 or approximately 33.33% (out of 100 draws the computer would probably pick you 33 times) and the probability that the computer will pick you if you are assigned 32 will be 32/99 or approximately 32.32% (out of 100 draws the computer would probably pick you 32 times).

If you are the group member selected to make a proposal your screen will also show the following information when everyone finds out their colors and vote totals:

This is the x-th proposal in this period
Choose an allocation for each Group Member:

The total must be <= $45
BLUE's allocation:

A cursor will appear next to the words "BLUE's allocation:" First you will enter in the amount of dollars of the $45 you wish to allocate to the member with the color Blue, then you press ENTER. You do not need to enter the dollar sign ($). Also you must enter the amount in dollars (e.g. either $10 or $11, not $10.xx). You can enter any number in whole dollars from $0 to $45.

The computer will next ask how much you wish to allocate to Green. You will enter the amount you wish to allocate to the member with the color Green, then you press ENTER. Again, you can enter any amount in whole dollars from $0 to $45.

Then the computer will ask for how much you wish to allocate to Orange. You will enter the amount you wish to allocate to the member with the color Orange, then you press ENTER. Again, you can enter any amount from $0 to $45.

While you can enter any amount from $0 to $45 for each group member, the SUM of the amounts cannot be greater than $45 total.

If the total sum of your allocations is greater than $45, the computer will automatically reject your allocation and send you a message. For example, suppose that you allocate $20 to each group member. Then the sum you have allocated is $60. If this happens, then the computer will send you the following message underneath the proposal box:

Your proposal is invalid
The sum of your allocation is > $45:
Please reallocate so that the sum <= $45. Press c to continue

If you receive this message you should press "c" and then re-enter allocations for each group member as before, but make sure that the total sum of allocations is not more than $45.

IMPORTANT -- YOU CAN ONLY ALLOCATE THE MONEY IN WHOLE DOLLARS. THE COMPUTER WILL NOT ALLOW YOU TO ALLOCATE THE MONEY IN CENTS. FOR EXAMPLE, YOU CANNOT ALLOCATE AMOUNTS LIKE $4.25 OR $7.89. YOU MUST ENTER AMOUNTS LIKE $4 OR $8.

Once you have submitted a proposal that is valid the computer will then ask you to confirm your proposal with by pressing "Y" to confirm your proposal or "N" to change your proposal. Make sure that you press "Y" and not "y" or "N" and not "n."

Note -- IF YOU PRESS "y" AND NOT "Y" OR "n" AND NOT "N" YOUR VOTE WILL BE RECORDED WRONGLY BY THE COMPUTER. IT IS VERY IMPORTANT THAT YOU USE THE SHIFT KEY IN VOTING.

You will see the following on your computer screen:

Press "Y" to confirm your proposal

Press "N" to change your proposal

If you press "N" the computer will move the curser back to Blue's allocation and you will be able to make changes in the allocations that you have made.

If you press "Y" the computer will tell you that your proposal has been sent out to the center and will ask you to press "c" to continue.

Once you or another chosen group member has submitted a proposal, the computer network will send out the proposal to all the group members. The proposal will appear on all three-group members' computer screens. All three-group members (including the person making the proposal) will be asked to vote over the proposal. You can enter "Y" to vote yes to accept the proposal or "N" to vote no to reject the proposal. Your computer screen will look like this:

Green's Proposal is:

Blue's allocation is $xx
Green's allocation is $xx
Orange's allocation is $xx

Please record this information on your Personal History Form
This is the x-th proposal

Now it is time for you to vote

Press "Y" to vote yes
Press "N" to vote no
Your vote:

IMPORTANT: When a group member votes yes, all of his or her votes are assigned as yes votes. When a group member votes no, all of his or her votes are assigned as no votes. You cannot divide up your votes.

After everyone votes, the outcome will be reported to you on your computer screen. For a proposal to be accepted it must receive more than 50% of the total votes. Remember that each group member has been assigned a vote total; either 34, 33, or 32 votes. Therefore the total number of votes are 99. For a proposal to be accepted it must receive more than 49.5 votes, or 50 votes or more. If a proposal receives at least 50 yes votes, the proposal will be considered accepted by the group and the computer screen will show the following:

The proposal has been accepted

Blue voted yes with xx yes votes
Green voted yes with xx yes votes
Orange voted no with xx no votes

Please record this information on your personal history form

In a few minutes you will be re-assigned to a new voting group

If the proposal does not receive at least 50 yes votes it will be considered rejected by the group and your computer screen will show the following box:.

> The proposal has been rejected
>
> Blue voted no with xx no votes
> Green voted yes with xx yes votes
> Orange voted no with xx no votes
>
> Please record this information on your personal history form
>
> In a few minutes one of your group will be selected to make a new proposal

If the first proposal is accepted, then you and the other members of your group are now ready to move on to the next period in the experiment. If the first proposal is rejected, the computer will again choose a group member to make a second proposal. This group member will be selected using the same probabilities as above and the group will participate in a second proposal period. If the second proposal is accepted, then you and the other members of your group are then ready to move on to the next period. If the second proposal is rejected, the computer will again choose a group member to make a third proposal and the group will participate in a third proposal period. Again, if the third proposal is accepted, your group is ready to move on and if it is rejected, the computer will again choose a group member to make a fourth proposal and the group will participate in a fourth proposal period. You will be allowed to go through at most **FIVE** proposals. If your group advances to a fifth proposal period and it is rejected, all members of your group will receive ZERO dollars for that period of the experiment.

IF YOUR GROUP HAS REJECTED A FIFTH AND FINAL PROPOSAL, THE COMPUTER SCREEN WILL SHOW THE FOLLOWING:

> The proposal has been rejected
>
> Blue voted no with xx no votes
> Green voted yes with xx yes votes
> Orange voted no with xx no votes
>
> Please record this information on your personal history form
>
> This was the fifth and last proposal, so the payoff for this period for all is $0

After all groups have either accepted proposals or not accepted proposals but gone through five rejected proposals in the first period, you will be randomly re-assigned to new three member groups and again randomly assigned a vote total and color. Then all the groups will again go through the decision-making period. We will continue this procedure until the end of the experiment.

Again, what determines how much you are paid in the experiment? At the end of the experiment, one of your decision making periods is drawn randomly by the computer and you will be paid the amount of money you earned in that decision making period plus the minimum payment of $7.00. Thus, one (and only one) of these periods will be used to determine your payment for the experiment. At the end of the experiment your computer will tell you which period was used to calculate your payoff and how much your payment is. You should add $7.00 to this amount and put this amount on your receipt at the time. You will be paid in cash this amount at the end of the experiment.

FINAL NOTE: The experiment works by your computer "calling" the center for information. When you press "1" you call the center. If the center has information for you, it will appear on your screen and you should write it down on your personal history form. You may also be asked to either make a proposal or vote on a proposal. You should follow the instructions on the screen. After writing down the information and following the instructions as required, you should again press "1" to call the center and continue to press "1" until you receive additional information.

We are now ready to conduct a quiz on these instructions. Any questions before the quiz?

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Table 1

Coalition Composition Predicted by Baron/Ferejohn Model

	Treatment 1	**Treatment 2**	**Treatment 3**
Vote Allocation	(34,33,32)	(49,33,17)	(46,44,9)
Recognition Probability*	(0.34,0.33,0.32)	(0.49,0.33,0.17)	(0.46,0.44,0.09)
Predicted Coalitions (T=5)	a->{a,b} or {a,c} b->{a,b} c->{a,c}	a->{a,c} b->{b,c} c->{a,c}	a->{a,c} b->{b,c} c->{a,c}

*These values are rounded.

Table 2: Coalition Allocation Predicted by Baron-Ferejohn Model
r_{ij} = (i's allocation)/(j's allocation)

	Treatments		
	1	2	3
	Recognition Probabilities		
a	0.34	0.49	0.46
b	0.33	0.33	0.44
c	0.32	0.17	0.09
	Proposer = a		
a	$27	$34	$34
b	$18*	$0	$0
c	$18*	$11	$11
	Proposer = b		
A	$11	$0	$0
B	$34	$34	$34
C	$0	$11	$11
	Proposer = c		
A	$11	$16	$17
B	$0	$0	$0
C	$34	$29	$28

*In treatment 1 player a will randomize between coalition partners b and c (whose continuation values are both $18).

Table 3

Mean Allocation to Proposer in First Period*

	Treatments		
	1	2	3
	Recognition Probabilities		
a	0.34	0.49	0.46
b	0.33	0.33	0.44
c	0.32	0.17	0.09
	Proposer = a		
Predicted allocation to a	27.00	34.00	34.00
Observed allocation to a	21.68	20.9	24.2
	(3.8)	(4.8)	(5.13)
	Proposer = b		
Predicted allocation to b	34.00	34.00	34.00
Observed allocation to b	22.2	22.7	23.1
	(4.4)	(7.9)	(4.8)
	Proposer = c		
Predicted allocation to c	34.00	29.00	28.00
Observed allocation to c	21.8	19.4	20.5
	(3.6)	(5.7)	(2.5)

*Standard Deviations in Parenthesis

Table 4

Mean Gain from Subsequent Proposals when Proposal is Rejected
(standard deviations in parentheses)

	Increase in a's Allocation	Increase in b's Allocation	Increase in c's Allocation
Voted "no"	$6.34 (13.05) 59 obs.	$5.36 (11.83) 58 obs.	$3.26 (13.80) 74 obs.
Voted "yes"	-$4.95 (10.62) 46 obs.	-$8.09 (12.84) 47 obs.	-$10.29 (9.63) 31 obs.

Table 5

Allocation Predictions from the Proportionality Rule
(allocation for a, allocation for b, allocation for c)
r_{ij} = (i's allocation)/(j's allocation) in two player coalitions

	Treatments		
Coalitions	1	2	3
(a,b)	(\$23, \$22, \$0) r_{ab} = 1.05	(\$27.00, \$18.00, \$0) r_{ab} = 1.5	(\$23, \$22, \$0) r_{ab} = 1.05
(a,c)	(\$23, \$0, \$22) r_{ac} = 1.05	(\$33, \$0, \$12) r_{ac} = 2.75	(\$38, 0, \$7) r_{ac} = 5.43
(b,c)	(\$0, \$23, \$22) r_{bc} = 1.05	(\$0, \$30, \$15) r_{bc} = 2.00	(\$0, \$37, \$8) r_{bc} = 5.43
(a,b,c)	(\$15, \$15, \$15) r_{ab} = 1.0	(\$23, \$15, \$7) r_{ab} = 1.53	(\$20, \$20, \$5) r_{ab} = 1.0

Table 6: Mean Allocation Ratios for Accepted Two Player Coalitions in First Proposal Periods
(standard deviations in parentheses)

	Treatment 1	Treatment 2	Treatment 3
Predicted r_{ab} for {a,b}-coalition	1.05	1.5	1.05
Observed r_{ab} for {a,b}-coalition	1.06	1.1	1.23
	(0.29)	(0.14)	(0.41)
Predicted r_{ac} for {a,c}-coalition	1.05	2.75	5.43
Observed r_{ac} for {a,c}-coalition	1.04	1.06	1.3
	(0.18)	(0.11)	(0.38)
Predicted r_{bc} for {b,c}-coalition	1.05	2.0	5.43
Observed r_{bc} for {b,c}-coalition	1.06	1.1	1.31
	(0.17)	(0.26)	(0.28)
Predicted r_{ab} for {a,b,c}-coalition	1.0	1.53	1.0
Observed r_{ab} for {a,b,c}-coalition	3.6.	1.0	3.13.
	(6.96)	(0.63)	(5.9)

Table 7: Mean Proposer Allocations for Accepted Two Player Coalitions
(standard deviations in brackets)

		Treatment 1		Treatment 2		Treatment 3	
		Proposer 1	Proposer 2	Proposer 1	Proposer 2	Proposer 1	Proposer 2
Coalition	{a,b}	23.8 (2.9) n=9	23.3 (1.6) n=7	24 (1.3) n=7	23 (0) n=2	25.1 (3.4) n=7	22.7 (0.6) n=3
	{a,c}	23.5 (1.6) n=6	22.6 (2.3) n=9	23.7 (1.0) n=12	2.8 (0.4) n=6	25.3 (3.1) n=13	22 (0) n=2
	{b,c}	23.3 (1.5) n=10	22.6 (2.5) n=5	24 (2.8) n=7	22.2 (1.5) n=10	25.5 (2.4) n=19	21 (1.2) n=4

Figure 1: Coalition Types by Bargaining Period

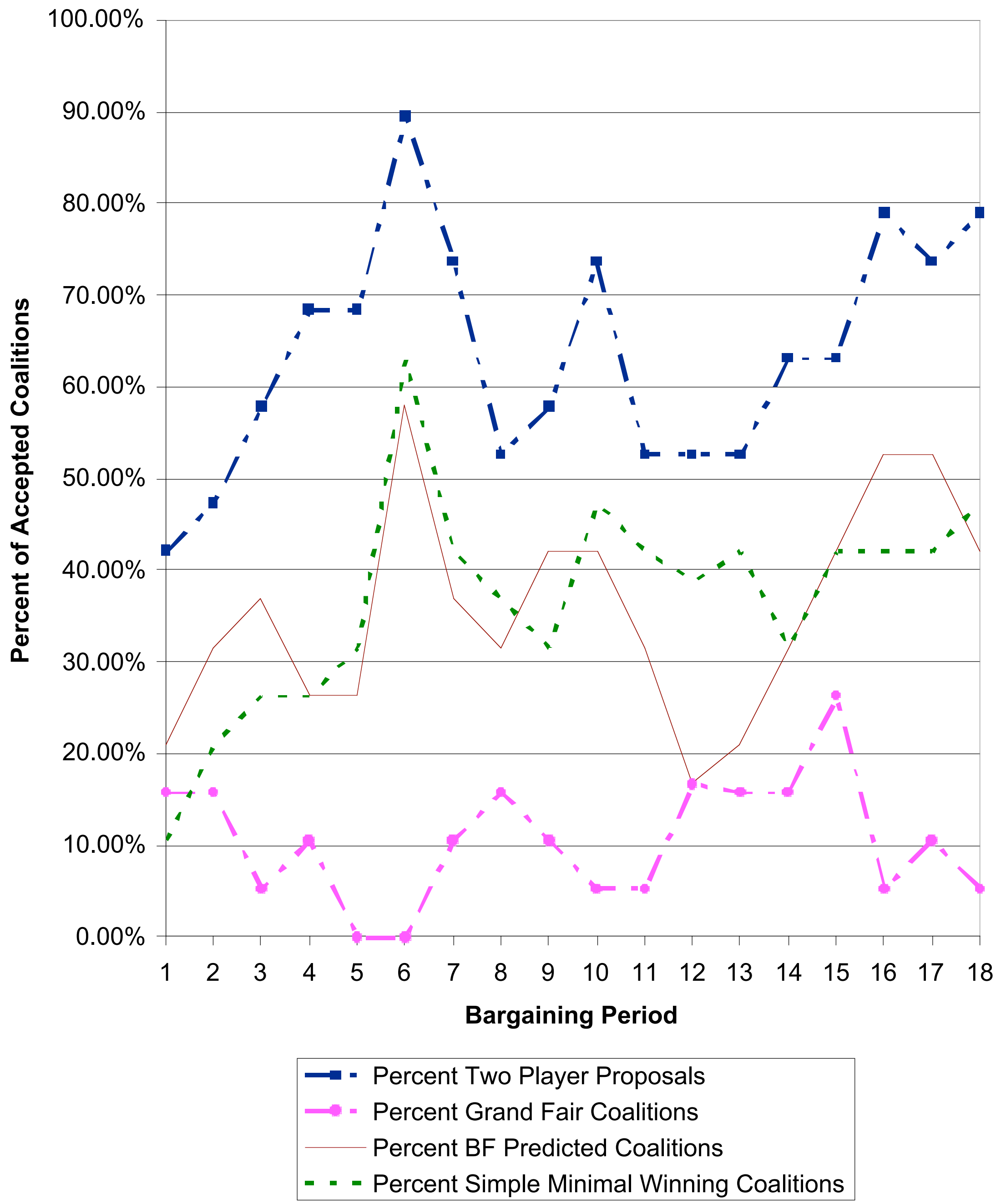


Figure 2: Treatment 1 - Proposer a

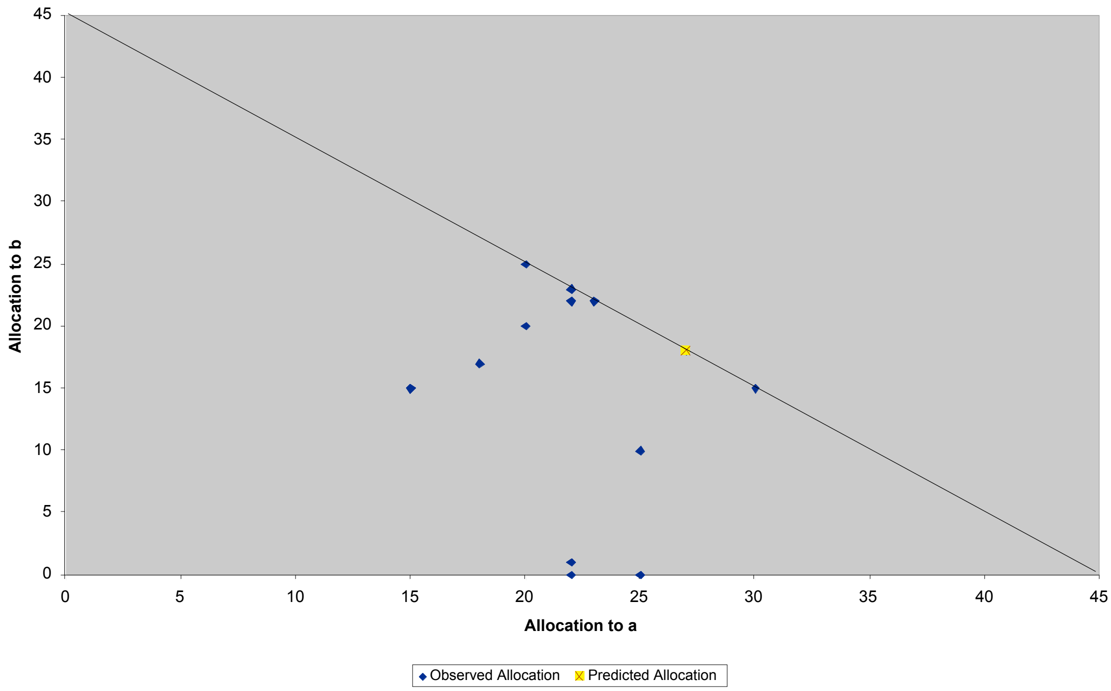


Figure 3: Treatment 1 - Proposer b

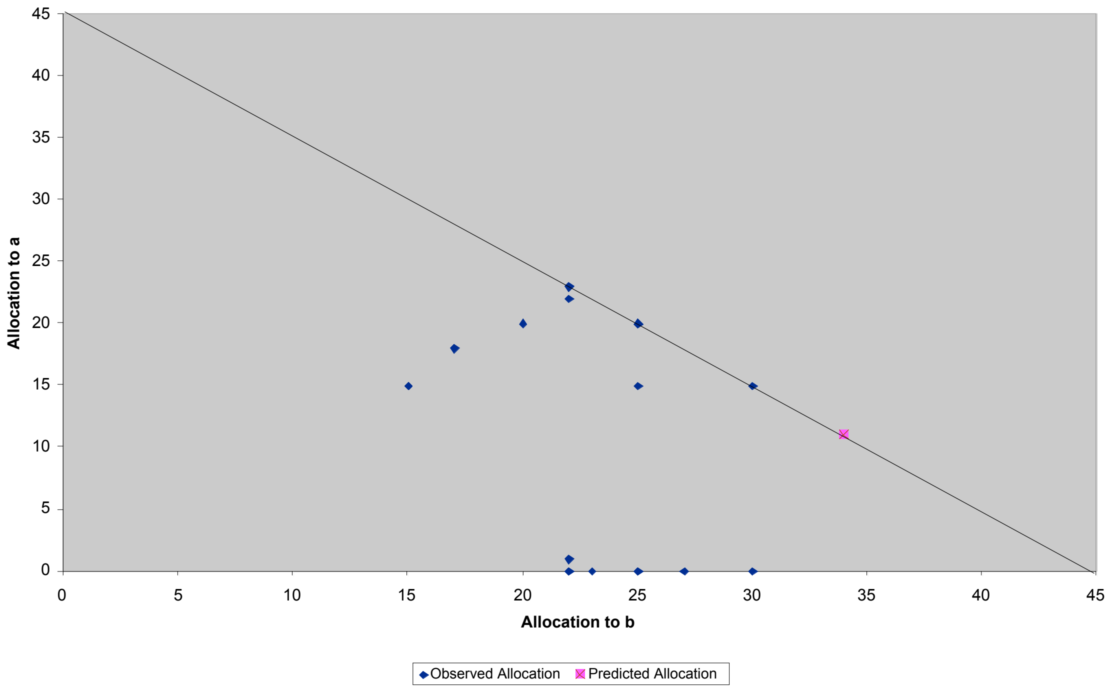


Figure 4: Treatment 1 - Proposer c

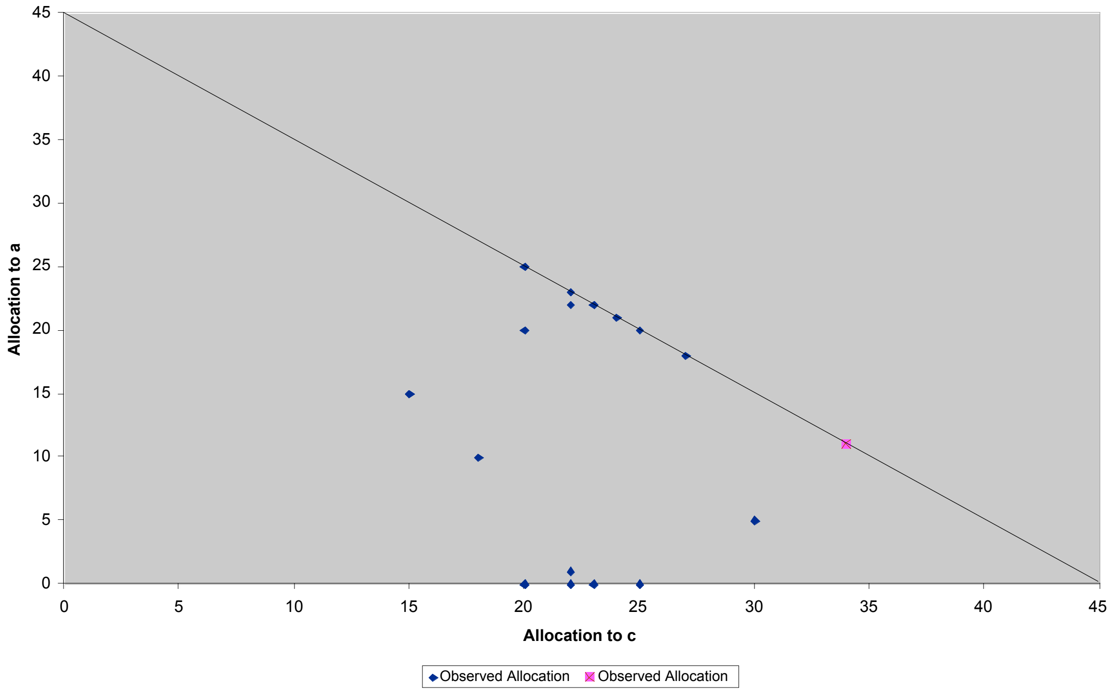


Figure 5: Treatment 2 - Proposer a

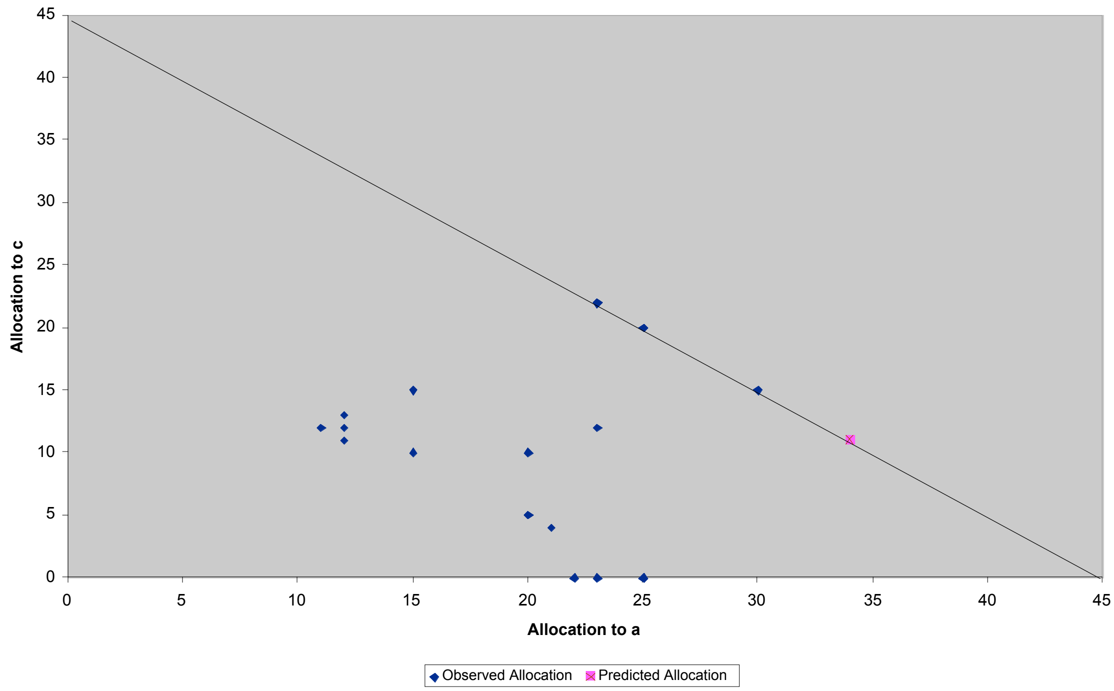


Figure 6: Treatment 2 - Proposer b

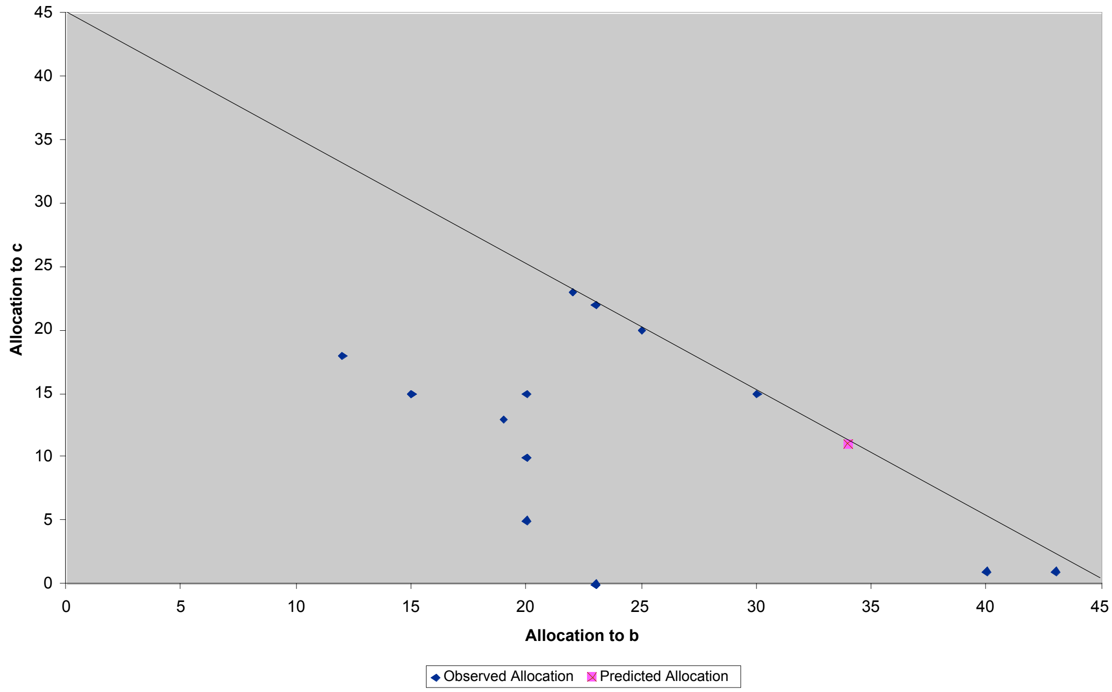


Figure 7: Treatment 2 - Proposer c

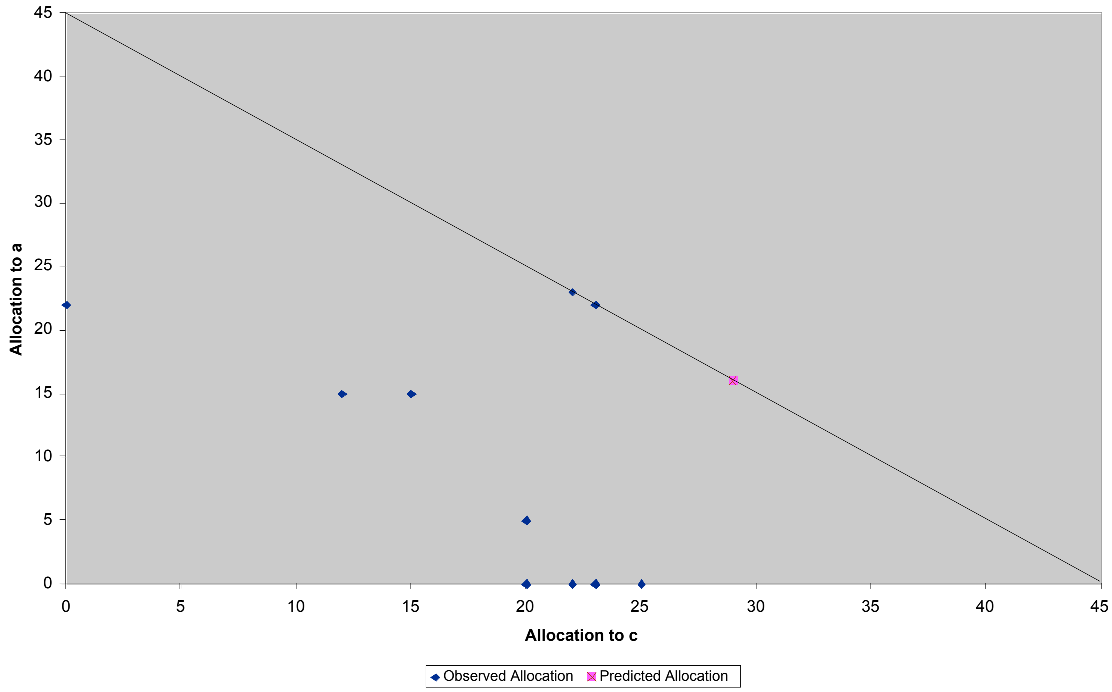
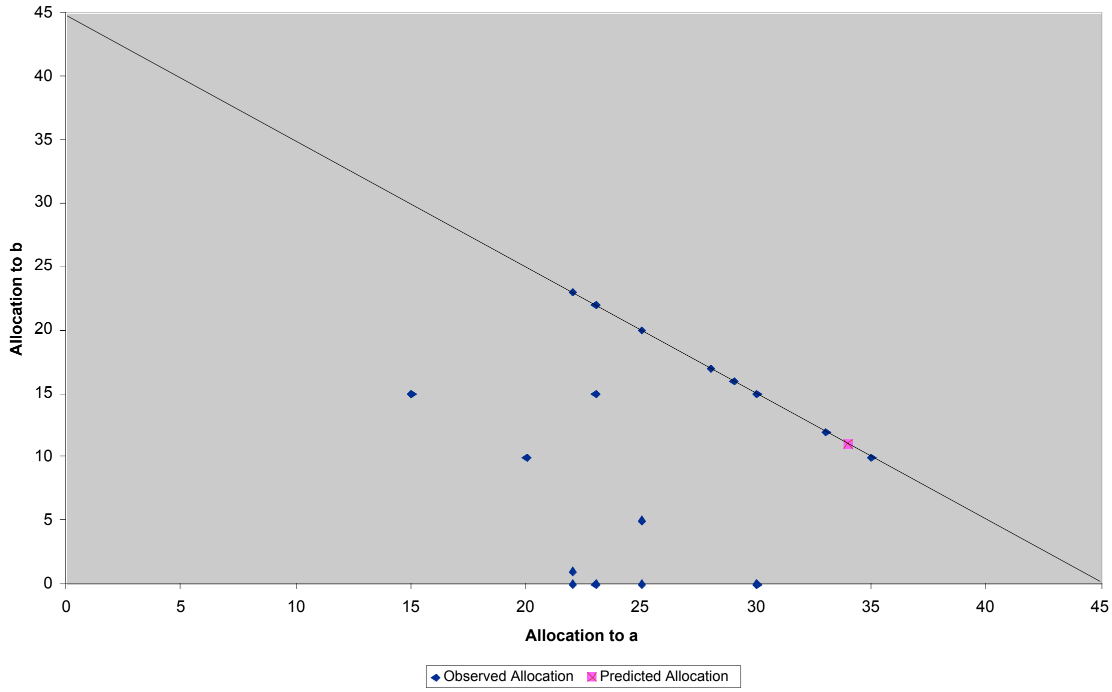


Figure 8: Treatment 3 - Proposer a



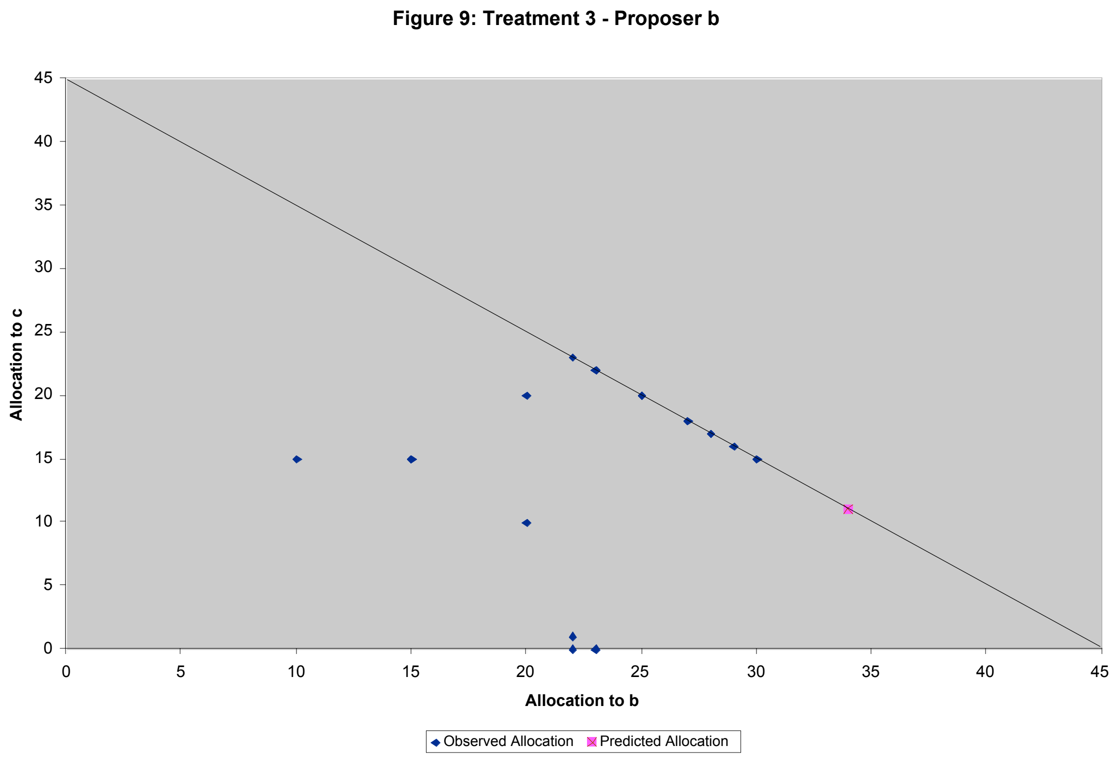
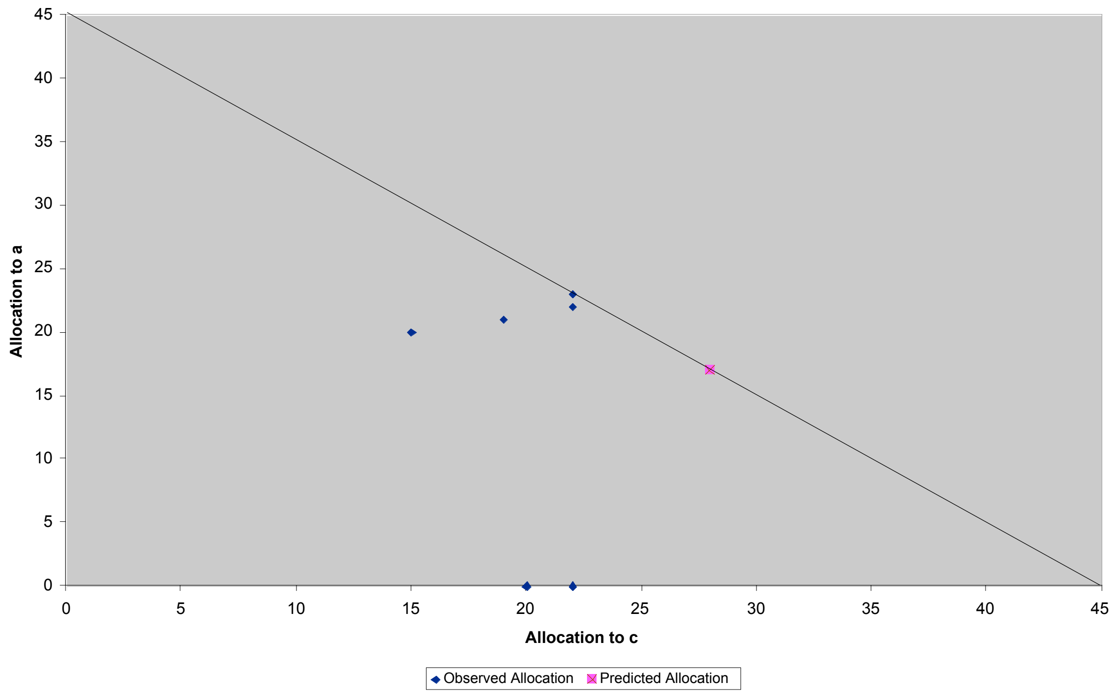


Figure 9: Treatment 3 - Proposer b
Allocation to c
Allocation to b
0
5
10
15
20
25
30
35
40
45
Observed Allocation
Predicted Allocation

Figure 10: Treatment 3 - Proposer c



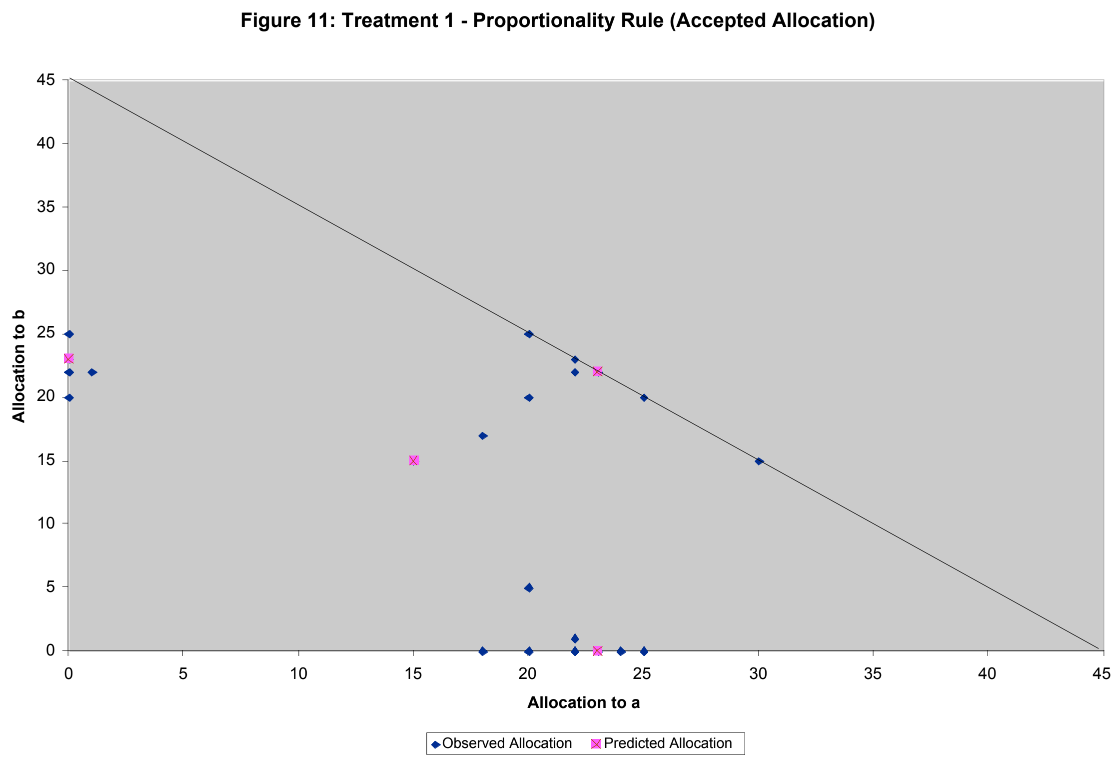


Figure 11: Treatment 1 - Proportionality Rule (Accepted Allocation)
45
40
35
30
25
20
15
10
5
0
0
5
10
15
20
25
30
35
40
45
Allocation to b
Allocation to a
Observed Allocation
Predicted Allocation

Figure 12: Treatment 2 - Proportionality Rule (Accepted Allocations)

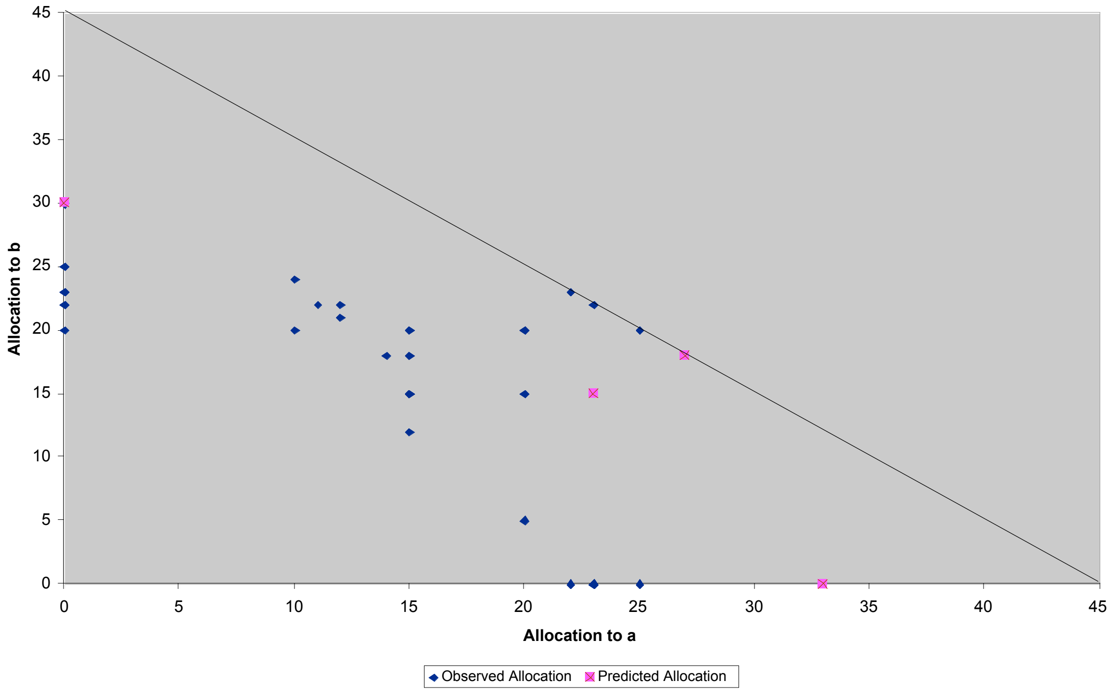


Figure 13: Treatment 3 - Proportionality Rule (Accepted Proposals)

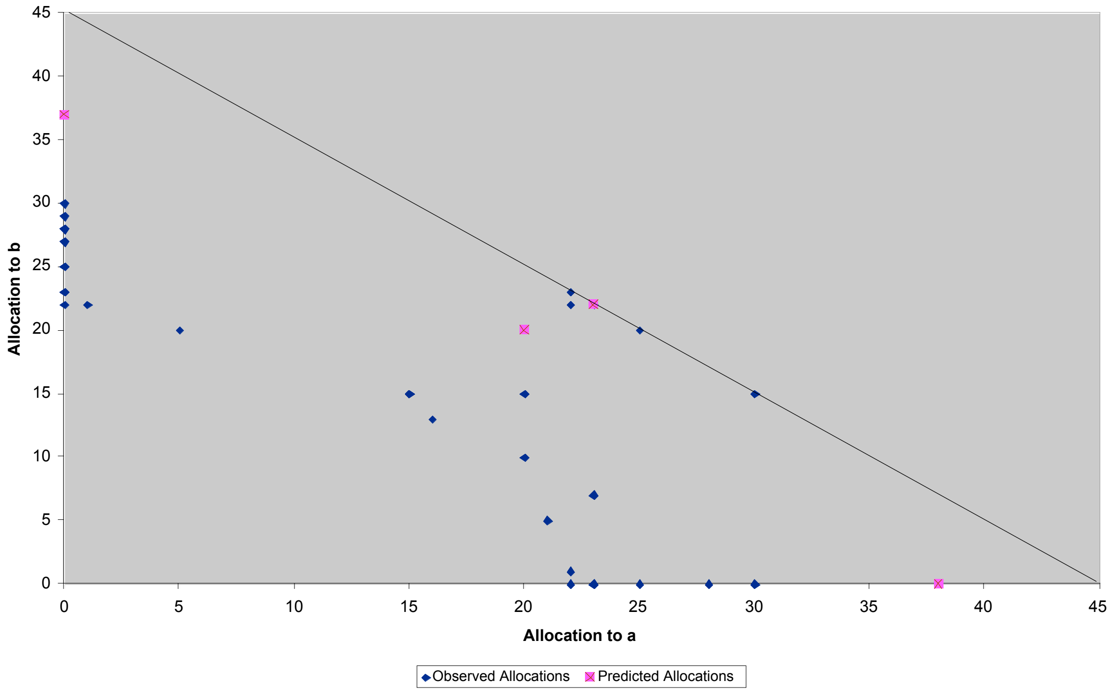


Figure 14: Accepted 2-Player Coalitions - Proposer Allocations
Treatment 1 (n=46)

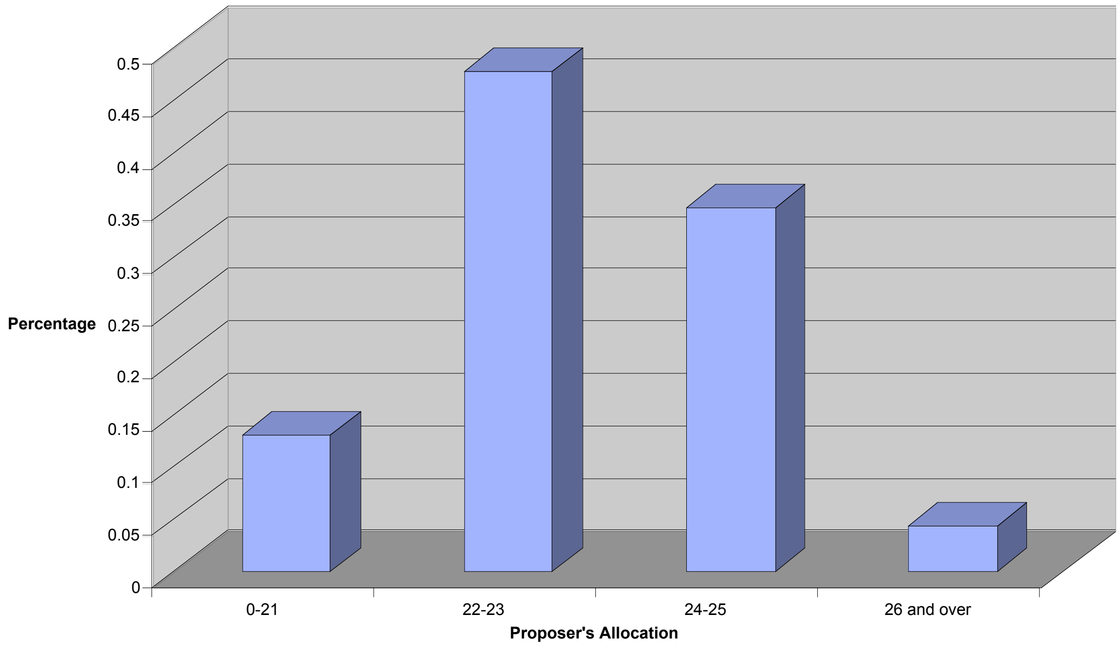


Figure 15: Accepted 2-Player Coalitions - Proposer Allocations
Treatment 2 (n=43)

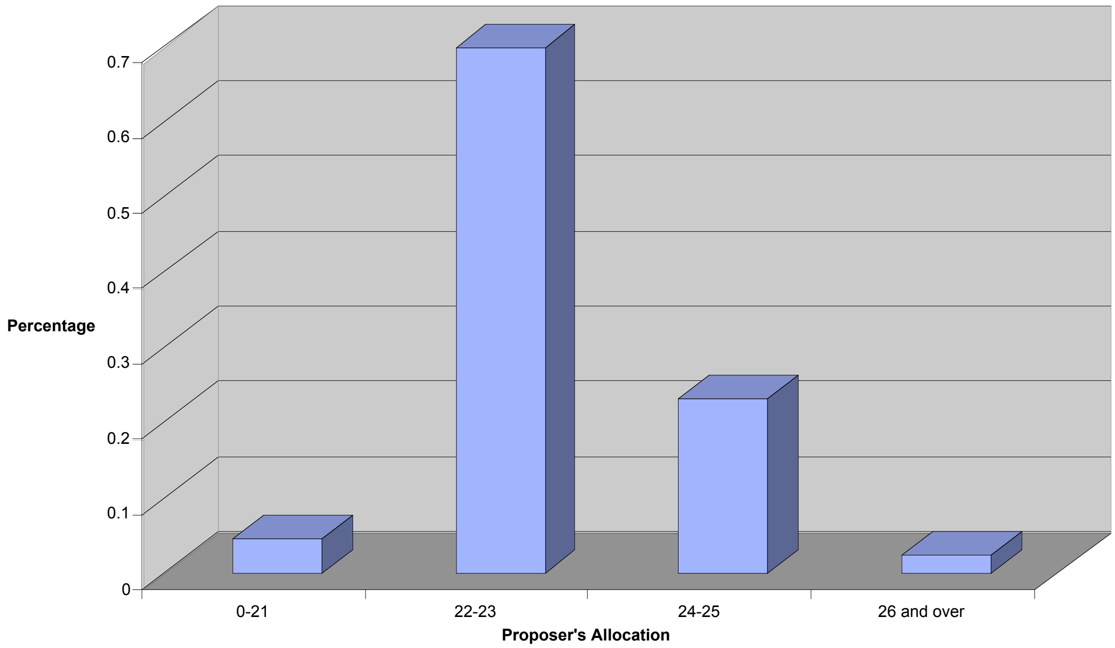


Figure 15: Accepted 2-Player Coalitions - Proposer Allocations
Treatment 3 (n=48)