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# Behavioral Identification in Coalitional Bargaining: An Experimental Analysis of Demand Bargaining and Alternating Offers*

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**Abstract**

We compare alternating-offer and demand bargaining models of the legislative bargaining process. These two approaches make very different predictions in terms of both *ex-ante* and *ex-post* distribution of payoffs, as well as about the role of the order of play. Experiments show that actual bargaining behavior is not as sensitive to the different bargaining rules as the theoretical predictions. We compare our results to studies attempting to distinguish between these two approaches using field data. We find strong similarities between the experimental data and the field data regardless of whether the experiments employ alternating-offer or demand-bargaining protocols. This *behavioral identification* problem suggests that it is impossible to derive, just from payoff data, what bargaining rules are being used in coalitional bargaining outside the laboratory.

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# 1 Introduction

Most group decisions require the consent of the majority of group members. When the issue is how to divide a fixed amount of resources among the group members, the core of the game is empty, since we can always find a majority of group members who would object to any given distributive proposal on the table. When the core is empty, voting and bargaining theories focus on the different predictions that could derive from the different "institutional" rules observed in reality (positive approach) or conceivable (normative approach) for such bargaining situations. These issues are especially relevant in distributive politics (e.g., committee and congressional decisions about pork barrel projects) and government formation in parliamentary democracies, but are also important problems in corporations. An additional complication, especially in government formation bargaining problems and in corporate governance, is the potential heterogeneity of bargaining power across group members. A strand of the cooperative game theory literature has focused on weighted majority games, and more recently there have been various attempts to study such games with noncooperative bargaining models. The theoretical predictions of these noncooperative bargaining models are very sensitive to variations in the rules of the game, and the equilibrium solution(s) may well require an unrealistic degree of rationality on the part of agents. Hence one wonders whether the actual behavior of bargaining agents is as sensitive to changing the rules of the game as the theory predicts. We report an experiment analyzing two very different kinds of bargaining games advocated in the literature, which can shed some light on these issues.

The classic Rubinstein (1982) bargaining model of how two agents can agree to split a dollar can be interpreted in two equivalent ways: the first mover can be either thought of as making an *offer* to the other agent, or as making a *demand* of a share, leaving to the other agent the choice between accepting the residual or disagreeing. In both cases the decision of the second mover depends on the discount factor, on whether the repeated game is finite or infinitely repeated, and on other institutional features, but not on the interpretation of whether the proposal was a demand or an offer. However, as soon as there is a group with at least three members, as in legislative or committee bargaining, offers and demands are no longer equivalent. If the proposer is making a specific distributive offer, the other players' decision is basically a *voting* decision on the specific offer; on the other hand, if the first mover is only making her own demand on the total amount of resources, the subsequent movers have also to decide what demand to make, and hence the asymmetry between movers is reduced. In reality, one can think of situations where the offer interpretation of the bargaining process seems more appropriate, and of situations where the opposite is true.[1] Although most real world bargaining processes are much less structured and richer than both of these extreme theoretical idealizations, there have been a number of empirical studies employing field data which make comparisons between them (Warwick and Druckman, 2001; Ansolabehere et al., 2003). The present paper is the first experimental work on this topic.

The alternating-offer model of majoritarian bargaining most used in political economy literature is Baron and Ferejohn (1989). In its closed-rule infinitely-repeated form, someone is picked at random to make a proposal, then the others simultaneously vote yes or no. If the majority rejects the proposal then a new proposer is chosen at random with the process repeating until an allocation is determined (with or without discounting, and with various types of randomization protocols). If the probability of recognition for each group member after any rejection is proportional to her relative bargaining power, then the ex-ante distribution of expected payoffs is proportional to the distribution of bargaining power, and coincides with the nucleolus of the game (see Montero, 2001). However, the ex-post distribution of equilibrium payoffs, by which we mean the equilibrium distribution of payoffs after a first proposer has been picked by nature, displays a very high proposer advantage.[2]

On the opposite extreme "demand" side of the spectrum of bargaining models, players sequentially make demands, and after each demand the next mover is randomly selected among those who have not yet made a demand, again with proportional recognition probability. This process continues until every player has made a demand or until some player has closed a majority coalition by demanding the residual part of the cake, the rest of which was demanded by the previous movers in the majority coalition. If no majority coalition with a feasible set of demands

[1]When the relevant players are committee members or individual congressmen, it is often the case that at some point (perhaps after a long discussion) someone makes a complete proposal and the others simply vote yes or no. On the other hand, when the relevant players are party leaders, like in the government formation process in European parliamentary systems, the formateur always has multiple consultations with the other party leaders about their individual demands for ministerial payoffs, and the final proposal is only a formal step, with the agreement being already reached at the demand stage.

[2]The fact that the agenda setter's power predicted by the Baron-Ferejohn's model is perhaps excessive was first discussed in Harrington (1990).

emerges after all players have made a demand, a new first demander is randomly selected, all the previous demands are void, and the game proceeds (with or without discounting) until a compatible set of demands is made by a majority coalition. This model makes a unique prediction for homogeneous weighted majority games – a prediction of proportionality between the relative payoff shares in the majority coalition and their relative "real" voting weights – which corresponds to the unique solution in the Demand Bargaining Set (see Morelli and Montero, 2003).[3, 4] That is, unlike the Baron and Ferejohn game, the ex-post distribution of payoffs within the majority coalition is always proportional to the relative bargaining power among the members of the majority coalition itself, without any first mover advantage.

The experiments reported here test for the internal validity of the demand bargaining and Baron-Ferejohn models both in terms of their point predictions and their comparative static predictions. All games involve bargaining groups of five subjects, a majority rule, and no shrinking of the pie over time. We address the comparative static predictions of the two models by first comparing a game in which all players have equal voting power (the Equal Weight game) to one in which one player controls three votes while four others control one vote each (the Apex game). We find that there are important behavioral regularities across games, which make them much more similar in outcomes than predicted by theory. For both bargaining game forms one-vote players receive a small extra benefit from moving first (formateur power) whereas the ex-post share to an Apex formateur is typically at (or even below) the demand bargaining prediction. To verify that such a lack of formateur power for Apex player derives from an "equity consideration" effect, we add a third treatment, where the only change is that the Apex subject takes home only 1/3 of the share obtained by the Apex player in the game. The two types of Apex treatments have exactly the same theoretical predictions for all bargaining rules, but the experimental results display a substantial equity correction effect, so that the Apex player in the third treatment exhibits some formateur power.

[3]The demand bargaining set is a selection of the Zhou bargaining set characterized by the requirement that counter-objections are acceptable only if they use the same demand vector of the original allocation proposal. The reason for this requirement is that any allocation proposal can always be represented by a pair, a demand vector and a coalition structure; a necessary condition for a vector of demands, one for each player, to be "stable" is that any objection to the proposal can be countered by another coalition that still refers to the original demand vector.

[4]The first attempts of a noncooperative demand bargaining approach can be found in Selten (1992), Winter (1994a, 1994b) and Morelli (1999).

The question of external validity is addressed by running regressions similar to those performed with field data and comparing the experimental results to the field data. There are a number of remarkable similarities between the experiments and the field data, regardless of whether the data underlying the regressions is for the demand bargaining or the Baron-Ferejohn game. Further, it is impossible, when looking at the experimental data, to clearly distinguish between the two games using the criteria commonly employed with the field data. Given the behavioral similarities that emerge in the lab between bargaining protocols, and the similarities between the lab and field data, the implication is that in the field data it will be impossible to distinguish between the two bargaining models solely on the basis of payoff data. This *behavioral identification* problem can be simply explained as follows: Even though the specifications used in the empirical studies are well identified with respect to the behavior implied by the theory, the parameters of interest are not identified with respect to the behavior actually observed. To address this behavioral identification problem, one would need to observe the actual institutional structure of the underlying game, not just the behavioral outcomes.

As already noted, prior research comparing the demand bargaining approach to the Baron-Ferejohn approach to legislative bargaining has been limited to field data: analyzing power in coalition governments (portfolios a party holds) in relation to the number of votes a party controls (seats in parliament). Warwick and Druckman (2001), following up on the earlier work of Browne and Franklin (1973) and Browne and Frendreis (1980), find a proportional relationship between portfolios held and the share of votes contributed to the winning coalition for most specifications.[5] However, Ansolabehere et al. (2003) analyze a similar data set and find evidence of proposer power (which supports the predictions of the Baron-Ferejohn model) even without controlling for portfolio salience. The main difference in approach is that Ansolabehere et al. use voting weights rather than seat shares as the independent variable.[6] There have been numerous other studies investigating

[5]Warwick and Druckman (2001) improve on the methodology of Browne and Franklin (1973) and Browne and Frendreis (1980) by controlling for the importance of the portfolios each party receives. They obviously find formateur power as soon as one attributes a large enough power weight to the prime minister seat, and they later verify (Warwick and Druckman 2003) that the difference between the power of the prime minister and that of any other minister in reality is as large as that needed to obtain a formateur advantage in the regressions.

[6]That is, they use real as opposed to nominal bargaining power (see Frechette, Kagel, and Morelli, 2003). Their data set also includes a few more years and two additional countries compared to Warwick and Druckman (2001).

the many implications of the Baron-Ferejohn model using field data, but with no comparisons to the demand bargaining approach, nor with any clear benchmark as to what the Baron-Ferejohn model predicts.[7]

Experimental studies of the Baron-Ferejohn model have been quite limited (McKelvey, 1991; Frechette, Kagel and Lehrer, 2003; Diermier and Morton, 2000; Frechette, Kagel and Morelli, 2003), with all of them focusing on games in which agents have equal real voting weights. Thus, the present paper is the first to directly compare the Baron-Ferejohn and demand bargaining approaches within an experimental framework, as well as the first to investigate the Apex game within the Baron-Ferejohn framework. There have, of course, been several earlier experimental studies of the Apex game within the framework of cooperative game theory (see, for example, Selten and Schuster, 1968 and Horowitz and Rapoport, 1974). We compare our experimental results to these earlier studies in the concluding section of the paper.

The paper is organized as follows: Section 2 outlines the theoretical implications of the demand bargaining and Baron-Ferejohn models for the games implemented in the laboratory. Section 3 characterizes the experimental design and procedures. The experimental results are reported in Section 4. Section 5 compares regressions based on the experimental results to compatible regressions using field data. Section 6 summarizes our main findings and relates the results to earlier studies of the Apex game and to "fairness" issues derived from the experimental literature on bilateral bargaining games in economics.

## 2 Alternate Offers vs. Demand Bargaining: Theoretical Predictions

The alternating-offer model uses the closed-rule infinitely repeated bargaining model of Baron and Ferejohn (henceforth BF);[8] The demand bargaining model (hereafter

[7]For example, data from US legislative districts shows a positive association between the level of federal government spending in a district and the districts represented on the committee responsible for the expenditures in question (Ferejohn, 1974, Atlas et al, 1995, Knight, 2002). However, this is a far cry from strict support for the theory which commonly calls for a highly uneven distribution of ex-post benefits between proposers and coalition members, for which the investigator typically has no well defined reference point.

[8]Frechette, Kagel and Lehrer (2003) also study the open-rule model. Here the focus is on the closed-rule model because it is the one that has been compared with demand bargaining on field data, and because the closed rule provides a more radical benchmark in terms of the ex post

DB) uses a slight modification of Morelli (1999).[9] The two models are presented in turn, displaying the specific predictions for the simple games on which we do experiments. Proofs are relegated to the appendix.

### 2.1 The Baron-Ferejohn model

Let $n$ be an odd number of agents, $n = 5$ in the experiments. In the Equal Weight game, where each agent has one vote, at least three players have to agree on how to split a fixed amount of resources (money). One player is selected at random to make a proposal on how to divide the money, with this proposal voted up or down with no room for amendment. If a majority votes in favor of the proposed distribution, then the proposal is binding. If the proposal fails then a new proposer is picked at random, and the process repeats itself until a proposal is passed. Thus, at the proposal and voting stage each agent has to keep in mind that if the proposal doesn't pass they will be recognized as the proposer in the next stage with probability $1/n$. In our implementation the cake does not shrink if the proposal does not pass so that $1/n$ is also the continuation expected equilibrium payoff after a rejection. The unique Stationary Subgame Perfect Equilibrium (SSPE) outcome gives $3/5$ of the money to the proposer and $1/5$ to each of two other agents who were proposed their reservation continuation payoff, and the proposal is accepted. The remaining two agents receive zero of course.

Consider now what happens if four of the players have one vote but the fifth player (called the Apex player) has three votes. This is a game with heterogeneous bargaining power, since the Apex player only needs one other player to form a minimal winning coalition. Assume that the recognition probability is proportional, i.e., that after any rejected proposal the Apex player is recognized as the new proposer with probability $3/7$, and every other player with probability $1/7$.[10] In this game the SSPE prediction is as follows: if the first mover is the Apex player, then a minimum winning coalition (MWC) with two players forms, and the Apex receives $6/7$ of the cake; if the first mover is not the Apex player, then the first mover receives $4/7$, and the residual goes to the Apex with probability $1/4$ and is divided equally among the

distribution of benefits than the open rule.

[9]The modified model is easier to implement in the lab, but has similar equilibrium predictions to the original one.

[10]This proportional recognition probability assumption is not crucial for the special games studied in this paper (see Montero, 2002). However, the proportional recognition probability assumption is the only one consistent with ex-ante proportional payoffs in general (see Montero, 2001).

three one-vote players (henceforth called "base" players) with probability 3/4. In other words, each of the base players, when proposing, invites the Apex player into the coalition with probability 1/4 and forms a four-person coalition with the other base players with probability 3/4. Hence, the predicted frequency with which the Apex player appears in an equilibrium MWC is $\frac{4}{7}$. [11]

### 2.2 The Demand Bargaining model

Rather than assuming that the first mover makes a proposal to be voted up or down, in the DB approach the first mover, who is chosen randomly, makes a demand of a share of the fixed amount of resources.[12] Next, a second mover is selected randomly from the other four, and makes a second demand. If the first two movers can constitute a MWC and their demands do not exceed the total amount of resources, then the two players will establish a majority coalition, and the next randomized mover(s) can only demand the residual resources, if any. If the first two movers do not have enough votes to constitute a MWC and/or the first two demands exceed the fixed amount of resources, then a third mover is selected (randomly among the remaining three players) and makes a third demand. The game may not reach the fifth mover, because as soon as a subset of the players that constitute a majority coalition have made compatible demands exhausting the money, the game ends. But if, after all players have moved once, no set of compatible demands exists in any potential majority coalition, then all demands are voided and the game starts again. The game can go on indefinitely, like the BF game.[13] We assume, consistent with the assumptions made in the BF model, that the probability of recognition is always proportional to the relative weight of the players who do not yet have a valid (i.e., not voided) demand on the bargaining table.

For the Equal Weight game the unique subgame perfect equilibrium (SPE) out-

[11] With this probability mixture when the small player is indifferent, the continuation payoff of the Apex player is indeed $\frac{3}{7}$, since it is $\frac{3}{7}\frac{6}{7} + \frac{4}{7}\frac{1}{4}\frac{3}{7}$. The mixture $\frac{3}{4}/\frac{1}{4}$ is the unique symmetric equilibrium, guaranteeing that $\frac{3}{7}$ and $\frac{1}{7}$ are the respective continuation payoffs for Apex and base players respectively. Of course there could also be asymmetric equilibrium mixtures, but all with the same properties in terms of ex-ante payoff predictions and frequencies of coalitions. Thus, asymmetric equilibria are ignored here.

[12] Here think of a party leader who says what her party would want in order to participate in a government coalition, but does not propose what the other potential coalition members get.

[13] It is possible to show that the equilibrium outcome of the DB model does not depend on whether the game is finite or not, nor does it depend on the discount factor (see Morelli,1999, for this point).

come of the DB model gives 1/3 of the cake to each of the first three movers who form a MWC. In the Apex game the unique SPE gives the Apex player 3/4 unless she moves last, and gives a base player 1/4 when she ends up in the MWC with the Apex player. If the Apex player moves last, the MWC is made up of all base players each receiving 1/4 of the money.[14] Since the Apex player is in the MWC unless she moves last, the frequency with which the Apex player belongs to the MWC is roughly 97% ($1 - \frac{4}{7}\frac{3}{6}\frac{2}{5}\frac{1}{4}$). Hence the ex-ante payoff for the Apex player is almost 73% of the money (and the ex-ante payoff for a base player is slightly more than $\frac{1}{16}$).

### 2.3 Differences and similarities

The BF and DB models have a number of factors in common as well as a number of major differences. For both models, subgame perfection predicts that money will be allocated in the first stage, only MWCs will be formed (with non-coalition members receiving zero payoffs), and the Apex player will receive substantially larger shares than the base players, or than players shares in the Equal Weight game. The differences concern the distribution of ex-ante and ex-post payoffs, as well as the likelihood of observing one or the other type of MWC:

- **Ex-post**: The first mover always has a strong favorable position in the BF model. This makes the ex-post predictions of the BF model far from proportional, whereas the ex-post payoff distribution using the DB model is always proportional to the relative weights in the MWC that is formed. Thus, when all players have equal voting power, the ex-post payoff for the proposer is 60% of the pie in the BF model versus 33.3% for the first (and all other) movers in the DB game. In the Apex games, when the Apex player is the first mover, her predicted payoff is 85.7% in the BF game compared to 75% in the DB game. Further, conditional on being included as a member of the winning coalition, the share for the Apex player drops to 42.9% when the base player is the proposer in the BF game, whereas the Apex player's share remains fixed at 75% any time she is included in the winning coalition in the DB game.

- **Ex-ante**: In the BF game the ex-ante payoff for the Apex player is 3/7,

[14] More precisely, a base player receives 1/4 if one of the following four events occur: (1) she is first, (2) she is second after the Apex, (3) she moves right before the Apex, and (4) when the Apex moves last. Otherwise she receives 0. See the appendix.

| | Base Formateur | Partner | Apex Formateur | Partner |
|---|---|---|---|---|
| Equal Weight | | | | |
| BF | 0.6 | 0.2 | NA | NA |
| DB | 0.333 | 0.333 | NA | NA |
| Apex | | | | |
| BF | 0.571 | 0.429 [a] | 0.857 | 0.143 |
| DB | 0.25 | 0.75 [a] | 0.75 | 0.25 |

[a] Share for an Apex partner. To be divided in three equal parts in the case of all base players.

Table 1: Predicted Shares

which coincides with the continuation payoff after a proposal is rejected; on the other hand, in the DB game the Apex player is ex-ante almost sure to receive 3/4 of the money, so that her expected payoff is almost 73% of the money. Correspondingly, the ex-ante payoff for the small players is 1/7 in the BF game and less than half than that in the DB game.

- Finally the Apex player is predicted to be a member of the minimal winning coalition substantially more often in the DB game than in the BF game (97% vs. 57%, given the proportional recognition probabilities employed).

Table 1 summarizes the predictions of the two models. Regarding allocation of shares, the emphasis in the analysis is on the ex post distribution, in part because of the field data we will compare our results to, and in part because these predictions are more extreme and less easily satisfied than the ex ante distribution of payoffs.

## 3 Experimental Design

In each bargaining round five subjects divided $60 between five voting blocks, with one subject representing each voting block. Our initial experimental design employed two treatment conditions for each of the DB and BF games: the Equal Weight game and the Apex game. After seeing the results from these two treatments, a third treatment was implemented, referred to as the $\text{Apex}_{1/3}$ treatment in which the Apex player receives 1/3 of the Apex player's payoff rather than the full payment. The motivation for this treatment will become clear in the process of

| Treatment | Experience Level | Number of Subjects | |
| --- | --- | --- | --- |
| | | BF | DB |
| Control | Inexperienced | 30 | 30 |
| | Experienced | 15 | 15 |
| Apex | Inexperienced | 30 | 30 |
| | Experienced | 15 | 10 |

Table 2: Number of Subjects per Treatment

reporting the results for the two initial treatments, and will be discussed in detail at the appropriate point in the text.

Either 10 or 15 subjects were recruited for each experimental session, so that there would be either 2 or 3 bargaining rounds conducted simultaneously in each session. In the Apex sessions subjects weights, which were selected randomly during the dry run, remained fixed throughout the experimental session.[15] Subjects were assigned to each "legislative" cohort randomly in each bargaining round, subject to the restriction that in the Apex sessions each voting block contained a single Apex player. Subject numbers also changed randomly between bargaining rounds (but not between the various stages of a given bargaining round). Feedback from voting outcomes was limited to the legislative cohort a subject was assigned to.

In the BF treatments, the procedures of each bargaining round were as follows: First all subjects entered a proposal allocating the $60. Then one proposal was randomly selected to be the standing proposal. This proposal was posted on subjects' screens giving the amounts allocated to each voting block, by subject number, along with the number of votes controlled by that subject. Proposals were voted up or down, with no opportunity for amendment. If a simple majority accepted the proposal the payoff was implemented and the bargaining round ended. If the proposal was rejected, the process repeated itself. Complete voting results were posted on subjects' screens, giving the amount allocated by subject number (along with the number of votes that subject controlled in the Apex games), whether that subject voted for or against the proposal, and whether the proposal passed or not.[16] Recog-

[15]There is an obvious tradeoff here between having a larger sample of subjects in the role of the Apex player versus the possible effect of changing roles on speed of adjustment to equilibrium play and/or possible reciprocity considerations. This is an important technical issue that should be explored as part of any continuing research in this area.

[16]Screens also displayed the proposed shares and votes for the last three bargaining rounds as

nition probabilities for proposals to be voted on equaled the ratio of the number of votes controlled to the total number of votes.

In the DB sessions procedures were as follows: First, all subjects entered a demand for their desired share of the $60. Then one demand was randomly selected to represent the first demand and was posted on all subjects' screens. This process repeated itself up to the point that a player could close the bargaining round without violating the budget constraint. At that point the player who could close the bargaining round was given the option to close it or to continue the process. In those cases where the player closing the bargaining round could include different subsets of players in the coalition, there was an option as to who to include. Further, in case a bargaining round was closed without exhausting the budget constraint, and there were still players whose demands had yet to be recognized, these players were permitted to make demands on the residual.[17] In case all players had made their demands without anyone closing, the process repeated itself. If a player closed the bargaining round, the final allocation was binding. The complete set of demands for each stage of a bargaining round were posted on subjects screens, giving the amount demanded by subject number. Once a bargaining round closed, screens reported the demands of those included in the winning coalition. In the Apex games the number of votes each subject controlled was reported, along with these demands. The order in which subjects were called on to make their demands was determined by the ratio of number of votes controlled to the total number of votes for those players who had yet to be selected.

Subjects were recruited through e-mail solicitations and posters spread around the Ohio State University campus. For each treatment, there were two inexperienced subject sessions and one experienced subject session. Experienced subjects all had prior experience with exactly the same treatment they were recruited back for.[18] A total of 11 bargaining rounds were held in each inexperienced subject session, 1 dry run and 10 for cash, with one of the cash bargaining rounds selected at random to

well as the proposed shares and votes for up to the past three stages of the current bargaining round. Other general information such as the number of votes required for a proposal to be accepted were also displayed. Screen shots, along with instructions, are provided at the web site http://www.econ.ohio-state.edu/kagel/Apexinstructions1.pdf.

[17]These residual demands were recognized in random order. If the first of these demands did not exhaust the budget constraint, the process was repeated until the residual was exhausted and/or all demands were satisfied. Any demand exceeding the residual was counted as a zero demand.

[18]All subjects were invited back for experienced subject sessions. In case more than 15 subjects showed up for a session, subjects to be sent home were randomly determined.

| | Frequency bargaining ends in stage 1 | | Frequency of MWC | |
|---|---|---|---|---|
| Equal Weight | BF | DB | BF | DB |
| Inexperienced | 61.7% (1.7) [5] | 96.7% (1.0) [2] | 76.6% | 82.5% |
| Experienced | 50.0% (1.6) [3] | 96.7% (1.0) [1] | 94.2% | 87.6% |
| Apex | | | | |
| Inexperienced | 57.9% (1.9) [12] | 93.3% (1.1) [2] | 63.1% | 77.3% |
| Experienced | 76.7% (1.4) [7] | 95.0% (1.1) [2] | 73.4% | 100.0% |

Table 3: Frequency of bargaining rounds that end in stage 1 and of minimum winning coalitions. Average [maximum] number of stages in parenthesis [square bracquets]

be paid off on.[19] In addition, each subject received a participation fee of $8.

# 4 Experimental Results

Results will be presented as a series of conclusions. The conclusions that concern exclusively the final allocations will have FA in parenthesis at the beginning. Otherwise, the analysis will be based on all observations, including proposals and demands that were rejected and that failed to be recognized. If a conclusion is limited to minimal winning coalitions, it will have MWC in parentheses. As a convention, the term formateur will be used to refer to the proposer in the BF treatments and the subject who made the first demand in the final allocation in the DB treatments.

## 4.1 Demands and Proposals in the Equal Weight and Apex Treatments

The first two columns of Table 3 show the frequency with which bargaining rounds end in stage 1. The average number of stages per bargaining round are shown in parentheses next to these percentages, and the maximum number in brackets next to this. A majority of bargaining rounds end in stage 1 for both BF and DB, but this happens much more frequently under DB. However, what is missing from these

[19]The dry run was eliminated in the experienced subject sessions. Inexperienced subject sessions lasted approximately 1.5 hours; experienced subject sessions approximately 1 hour as summary instructions were employed and subjects were familiar with the task. Although each bargaining round could potentially last very (infinitely) long, there was never any need for the experimenter to intervene to insure completing a session well within the time frame (up to 2 hours) subjects were recruited for.

statistics is that for DB, within a bargaining round, it often required more than the minimal number of steps (demands) to achieve an allocation. For example, in the Equal Weight treatment, 45.0% (33.4%) of all bargaining rounds required more than three steps to close for inexperienced (experienced) subjects.[20] The typical reason for these extra steps is that one of the early players demanded too much, so that player was passed over (and received a zero share as a consequence). In the Equal Weight treatment, for example, with inexperienced subjects, the average demand for subjects excluded from the final allocation when four steps were necessary was a 0.542 share, compared to an average share of 0.292 for those included in the winning coalition.[21]

**Conclusion 1** *Over* 50.0% *of all allocations were completed in stage 1 for both BF and DB, with substantially more allocations completed in stage 1 under the DB game. However, far from all of the DB bargaining rounds ended in the minimal number of steps, contrary to the theory's prediction.*

The last two columns of Table 3 report the frequency of MWCs across treatments. These percentages are consistently well above the 50% mark, and tend to be somewhat higher under DB than under BF. At the other extreme very few bargaining rounds end with everyone getting a share of the pie. Non-MWCs in the DB treatments consist almost exclusively of cases where a subject closed the bargaining round but left money over for later movers. In the Equal Weight version of the DB game the amount of money left over in these cases averaged \$8.15 (\$7.27) per bargaining round for inexperienced (experienced) subjects. By way of contrast, non-MWCs in the BF game left over an average of \$13.85 (\$12.07) per bargaining round for the redundant coalition partners (defined as those excess players receiving the lowest shares).

**Conclusion 2** *The majority of proposals were for MWCs with somewhat higher frequencies of MWCs in DB than in BF.*

[20]Of those requiring more than three steps, 26.7% (26.7%) were achieved in four steps, with the remaining 18.3% (6.7%) requiring five steps for inexperienced (experienced) subjects. The number of bargaining rounds ending in the minimal number of steps was a little higher in the Apex treatments, with 28.3% (20.0%) of the bargaining rounds requiring more than the minimal number of steps for inexperienced (experienced) subjects.

[21]Shares for those included are less than 1/3 due to those elections providing benefits to more than a MWC. For bargaining rounds lasting five steps the corresponding shares were 0.457 for those excluded versus 0.330 for those included.

| Equal Weight | Baron-Ferejohn 1 Vote Formateur | Partner | Apex Formateur | Partner |
|---|---|---|---|---|
| Inexperienced | 0.399 [.600] | 0.305$^b$ [.200] | | |
| Experienced | 0.402 [.600] | 0.299$^b$ [.200] | | |
| Apex – Inexperienced. | | | | |
| Apex Included | 0.469 [.571] | 0.530$^a$ [.429] | 0.721 [.857] | 0.279 [.143] |
| Apex Excluded | 0.319 [.571] | 0.236$^b$ [.143] | | |
| Apex – Experienced | | | | |
| Apex Included | 0.519 [.571] | 0.481$^a$ [.429] | 0.667 [.857] | 0.333 [.143] |
| Apex Excluded | 0.333 [.571] | 0.222$^b$ [.143] | | |

*a.* Apex payoff.

*b.* Highest share among coalition partners when all base players.

Table 4: Allocations passed for Minimum Winning Coalitions [predicted values in brackets]

| Equal Weight | Demand Bargaining 1 Vote Formateur | Partner | Apex Formateur | Partner |
|---|---|---|---|---|
| Inexperienced | 0.337 [.333] | 0.364$^b$ [.333] | | |
| Experienced | 0.346 [.333] | 0.348$^b$ [.333] | | |
| Apex | | | | |
| Inexperienced | 0.358 [.250] | 0.642$^a$ [.750] | 0.636 [.750] | 0.364 [.250] |
| Experienced | 0.350 [.250] | 0.650$^a$ [.750] | 0.811 [.750] | 0.189 [.250] |

*a.* Apex payoff.

*b.* Highest share among coalition partners when all base players.

Table 5: Allocations passed for Minimum Winning Coalitions [predicted values in brackets]

One of the key differences between the DB and BF models relates to the ex post distribution of benefits within MWCs. This is also the key factor used to distinguish between the two models with field data. Tables 4 and 5 report shares to coalition partners for accepted MWCs. Predicted shares are reported in brackets next to average realized shares. The tables distinguish between coalitions in which the formateur is a base player and those with an Apex formateur. Further, for the BF sessions we distinguish between MWCs involving the Apex player and those with base players only. (For DB sessions there are no MWCs involving all base players.) For coalitions with all base players, partner's share reports the average of the *largest* share allocated to *any* coalition partner.

There are a number of clear patterns in the data:

1. About base players:

    (a) In the BF sessions base players have clear proposer power: In all cases their shares are above the number of votes they bring to the MWC. However, with the exception of base formateurs who form a coalition with the Apex player, they never achieve anything close to the extreme proposer power the BF model predicts.

    (b) In the DB sessions, base players have a first-mover advantage, as they consistently average more than their predicted share when going first.

    (c) The first-mover advantage is consistently greater for base players in BF than in DB games, as the theory predicts. However, the differences are not nearly as large as the theory predicts.

2. About the Apex player:

    (a) In the BF games, Apex players *lack* proposer power as their average shares are below 0.750 for both inexperienced and experienced players.

    (b) Inexperienced Apex players in DB games obtain average shares below the predicted level, although experienced players do a bit better than predicted.

    (c) Thus, Apex players obtain similar shares when they are first movers under the two bargaining protocols. And these shares are much closer to those predicted under DB.

3. About frequencies:

   (a) In BF games base players earn substantially more as formateurs when partnering with the Apex player than when partnering with other base players (increased shares of 31% and 60% for inexperienced and experienced players respectively). Hence, not surprisingly, base players form MWCs with Apex players 70.4% (73.5%) of the time for inexperienced (experienced) players, compared to the predicted rate of 25%.

   (b) In DB games base players partner with Apex players 100% of the time in MWCs, which is not unexpected given the recognition protocol employed. Indeed, there were only 4 bargaining rounds (for inexperienced subjects and none for experienced subjects) where the Apex player had not been selected by the fourth step in the demand process, and in all of these cases the fourth base player failed to close the coalition, either because they could not do so and stay within the budget constraint or because the residual share was too small to be acceptable.

**Conclusion 3** *(FA, MWC) Base formateurs have a clear first-mover advantage in both BF and DB games. Further, although these base formateurs did not take nearly as much as predicted in the BF games, they had a stronger first-mover advantage under BF compared to DB, as the theory predicts. In contrast, Apex formateurs had little (if any) proposer power in both BF and DB treatments. In general, with respect to formateur power, behavior is much more similar between BF and DB games than the theory predicts.*

Two remarks are in order here: First, the proposer power in the DB game for base players could result from a number of factors. For example, in the Equal Weight game, one can imagine that later movers would be willing to accept a somewhat smaller share than predicted out of fear of being shut out of the winning coalition and willingness to pay a small price to guard against this. The latter, in turn could result from (1) risk aversion, which is not analyzed in the theory, (2) players own inability to follow the backward induction argument underlying the SPE, or (3) lack of confidence in others being able to follow the logic underlying the SPE. Regardless of the basis for the behavior, from the shares reported in Table 5, it is clear that the individual cost of accepting lower shares was relatively small, with the lowest share member of these coalitions averaging \$2.90 (\$1.46) less than predicted as inexperienced (experienced) subjects. These arguments are much less convincing when looking at Apex players, since Apex players are always almost sure to be included in the winning coalition. In spite of this, Apex partners were taking substantially smaller shares then predicted ($6.48 and $6.24 less, on average, for inexperienced and experienced players respectively). As the next section shows, it appears that equity considerations underlay the deviations in the case of the Apex player.

Second, the limited formateur's power in the BF games, compared to the predicted outcome, rests squarely on the fact that base players were almost certainly rejecting shares approaching the SSPE prediction in these games, so that offering the SSPE share did not maximize expected income. This is discussed in detail in Section 4.3 below, where voting behavior is analyzed.

### 4.2 Proposals and Demands in the $\text{Apex}_{1/3}$ Treatment

The general inability of the Apex player to enjoy a first-mover advantage (often actually experience a first-mover *disadvantage*), in conjunction with the much higher than predicted frequency of base formateurs partnering with the Apex player in the BF games, is strikingly at odds with the BF theory. One does not need to look very far for a candidate explanation of these deviations. The extensive experimental literature on bilateral bargaining games (see Roth, 1995, for a survey) indicates that players are likely to be motivated, in part, by minimum equity considerations regarding their own payoffs.[22] These equity considerations work in opposition to the greater bargaining power the Apex player has, since the Apex player, when included in a winning coalition, takes home a much larger share of the cake than base players do. That is, other things equal, it is much easier to satisfy any minimum equity considerations for Apex players compared to base players.[23] One way to neutralize these equity considerations across players is to limit the "take-home" pay of the Apex player to 1/3 of the Apex player's share – as if the Apex subject were just a representative player for a three-member party, with equal payoff division inside the party. This way the ex-ante payoff of the Apex player is equalized to that of the base players, thereby largely restoring equity between player types. For both the BF and DB games this change in the take-home pay for the Apex player has no impact on the subgame perfect equilibrium predictions. The $\text{Apex}_{1/3}$ treatment also acts as a stand-in for the fact that in real legislative settings payoffs must be

[22] The studies of legislative bargaining games (McKelvey, 1991; Frechette, Kagel and Lehrer, 2003; Frechette, Kagel and Morelli, 2003) indicate similar factors at work there as well.

[23] This would, of course, not be true if equity considerations co-varied with player power.

| | Frequency bargaining ends in stage 1 | | Frequency of MWC | |
|---|---|---|---|---|
| $\text{Apex}_{1/3}$ | BF | DB | BF | DB |
| Inexperienced | 71.7% (1.8) [12] | 72.6% (1.4) [6] | 73.3% | 93.6% |
| Experienced | 80.0% (1.3) [4] | 100.0% (1.0) [1] | 79.5% | 86.6% |

Table 6: Frequency of bargaining rounds that end in stage 1and MWCs. Average [maximum] number of stages in parentheses [square brackets].

shared between coalition partners constituting the Apex voting block.

Procedures were essentially the same for the $\text{Apex}_{1/3}$ treatment as for the other treatments, with two inexperienced, and one experienced, subject sessions running for both BF and DB.[24] The only modification in the screen layouts was to report the nominal share allocated to the Apex player along with the amount of money that player would actually receive.

For both DB and BF sessions the vast majority of games ended in stage 1 and involved MWCs, with no systematic differences, on these dimensions, compared to the earlier Apex sessions.

1. Even though according to the theory there should be no difference whatsoever between the Apex game and the $\text{Apex}_{1/3}$ game, there are systematic behavioral effects from the reduction of the take-home pay of Apex players:
    (a) Under both BF and DB, Apex players now obtain a very small advantage as formateurs, as opposed to a disadvantage in the Apex treatment.
    (b) Apex players require a much larger nominal share of the pie when invited into MWCs by base players in the BF game and when closing coalitions in the DB game.
    (c) Base formateurs in the BF game now invite the Apex player into MWCs much less often than in the Apex game, averaging 39.0% (42.0%) for inexperienced (experienced) subjects, as opposed to 70.4% (73.5%) in the Apex treatment.
2. While other characteristics remain the same as in the Apex game:

[24]Fifteen subjects each in the inexperienced subject sessions and the experienced BF session, and ten subjects in the experienced DB session.

| | $\text{Apex}_{1/3}$ Treatment | | | |
|---|---|---|---|---|
| *Baron-Ferejohn* | Base Formateur | Apex Partner | Apex Formateur | Base Partner |
| Inexperienced | 0.283 [.571] | 0.717 [.429] | 0.775 [.857] | 0.225 [.143] |
| Experienced | 0.267 [.571] | 0.733 [.429] | 0.761 [.857] | 0.239 [.143] |
| *Demand Bargaining* | | | | |
| Inexperienced | 0.290 [.250] | 0.710 [.750] | 0.779 [.750] | 0.221 [.250] |
| Experienced | 0.238 [.250] | 0.763 [.750] | 0.829 [.750] | 0.171 [.250] |

Table 7: Allocations Passed for MWCs

(a) There is essentially no impact on the shares base formateurs are able to obtain when forming a coalition with all base players.[25]

(b) Base formateurs in both the BF game and the DB game (for inexperienced players in the latter case) display some small formateur advantage.

To decompose the benefits associated with being the Apex player, compare the Apex player's shares in Table 7 with those reported in Tables 4 and 5. Since the difference between the average share of an Apex player in the Apex treatment and the average share of a base player in the equal weight treatment is the net result of the (positive) bargaining power effect and the (negative) equity consideration effect, we normalize the difference between the average share the Apex player obtained in the $\text{Apex}_{1/3}$ game and the average share of the base player in the Equal Weight treatment as 100% of the increase associated with being the Apex player, after correcting for equity considerations. For inexperienced players in the BF games, with the Apex player as formateur, 69.8% of the increase can be attributed to the increase in voting power, with the remaining 30.2% attributed to the "equity" correction. The percentages change somewhat for the Apex player as coalition partner, with 57.7% of the increase due to increased voting power, and the remaining 42.2% due to the equity correction.[26] The corresponding percentages of voting power effect for the DB games are 69.2% as first mover and 77.6% as second mover closing the coalition. Thus:

**Conclusion 4** *(FA, MWC) In both DB and BF games voting power accounts for*

[25] Average shares for allocations passed of 0.282 (0.242) and 0.260 (0.250) for inexperienced and experienced players respectively (with highest coalition partner's share in parentheses).

[26] The baseline in this case, and in the DB calculations, is the highest average share among coalition partners.

*roughly $\frac{2}{3}$ of the difference between the average share of Apex formateurs in the Apex$_{1/3}$ treatment and the average share of a base player in the equal weight treatment, the remaining third being represented by an equity consideration adjustment. For Apex partners, the equity consideration effect is twice as large in BF games as in DB games.*

### 4.3 Voting Patterns

In the BF game voting is explicit, as each proposal that is recognized is voted up or down by everyone. For DB games any time a player has a chance to close a coalition she is in effect voting for or against a given allocation. For example, take the Equal Weight treatment and suppose that the first two players have each demanded a 0.4 share of the pie. Then the third player can close the coalition by accepting a 0.2 share, or she can demand a larger share, so that in effect closing (not closing) the coalition is a vote in favor of (against) a 0.2 share. Of course, there are far fewer "votes" in the DB game than in the BF game, but there are sufficient numbers of observations to clearly identify voting patterns.[27]

Figures 1, 2, and 3 summarize votes, by shares offered for both DB and BF games pooling over experience levels in all cases, and distinguishing between base and Apex players in the Apex games.[28] As the figures illustrate, the probability of acceptance increases with share in all cases. Looking at base players in the BF games, offers of \$12 in the Equal Weight treatment and \$8.57 in the Apex treatment should be accepted according to the SSPE, but have little, if any, chance of being accepted in practice. Predicted voting patterns are also violated for base players in the DB games. In this case shares between \$15 and \$20 should always be rejected in the Equal Weight treatment and always accepted in the Apex and Apex$_{1/3}$ treatments. This does not happen: In all cases only a small percentage of \$18 (and above) shares are consistently rejected, and a large proportion of \$13-\$20 shares are accepted. Apex players in BF games essentially reject all shares below \$24, and accept most shares at or above \$28, which is quite close to their predicted cut off point of \$25.71 under the SSPE. In contrast, Apex players in DB games accept between 70-80% of all allocations greater than or equal to \$28, which is well below their SPE cutoff point.

[27]The maximum share the subject can request to form a minimal winning coalition is used in all cases.

[28]These figures exclude the votes of proposers in BF sessions.

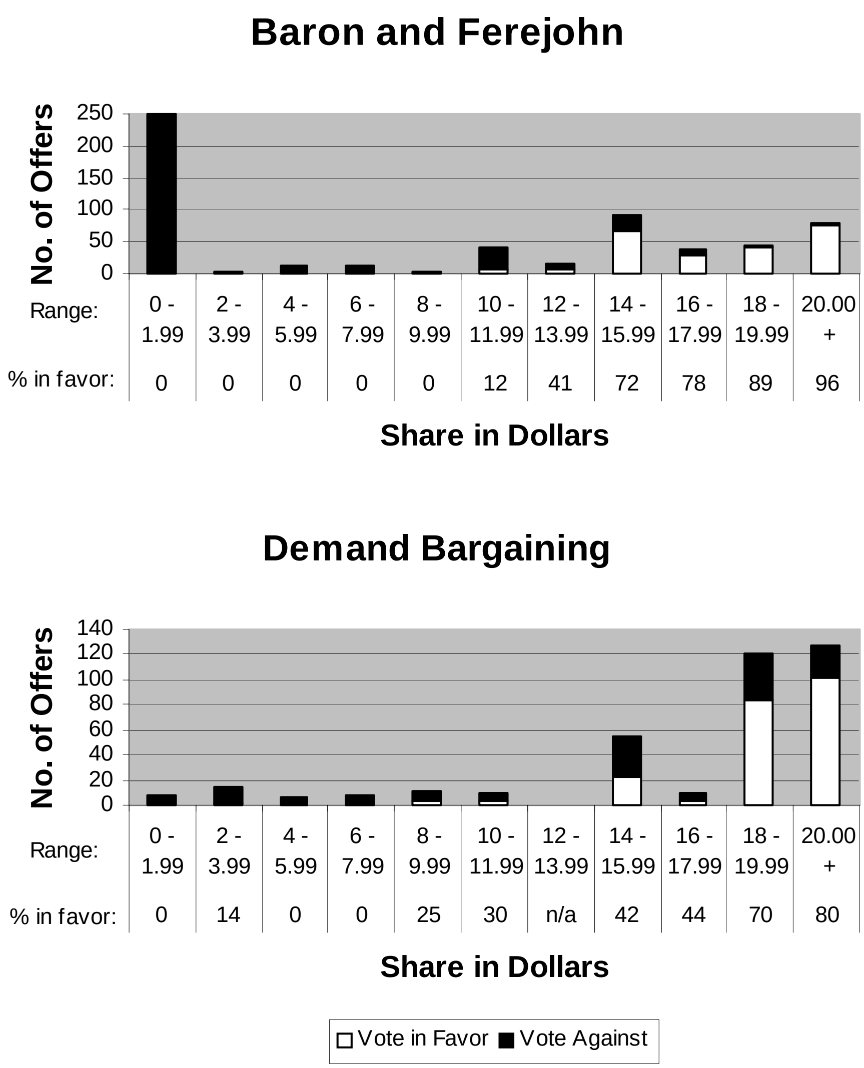


Figure 1: Equal Weight: Votes by Shares (represented in dollar amounts)

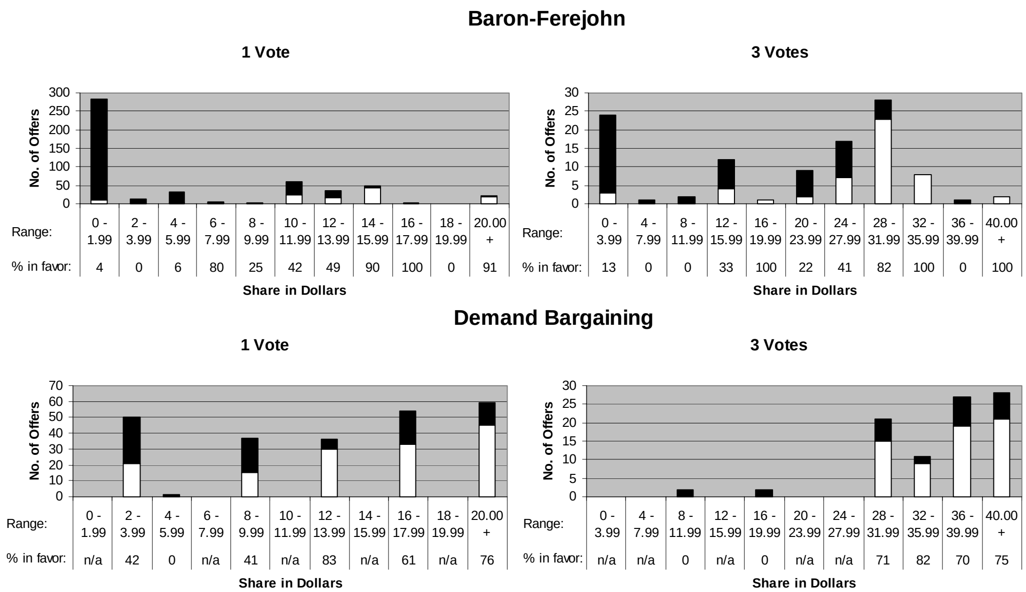


Figure 2: Apex: Votes by Shares (represented in dollar amounts)

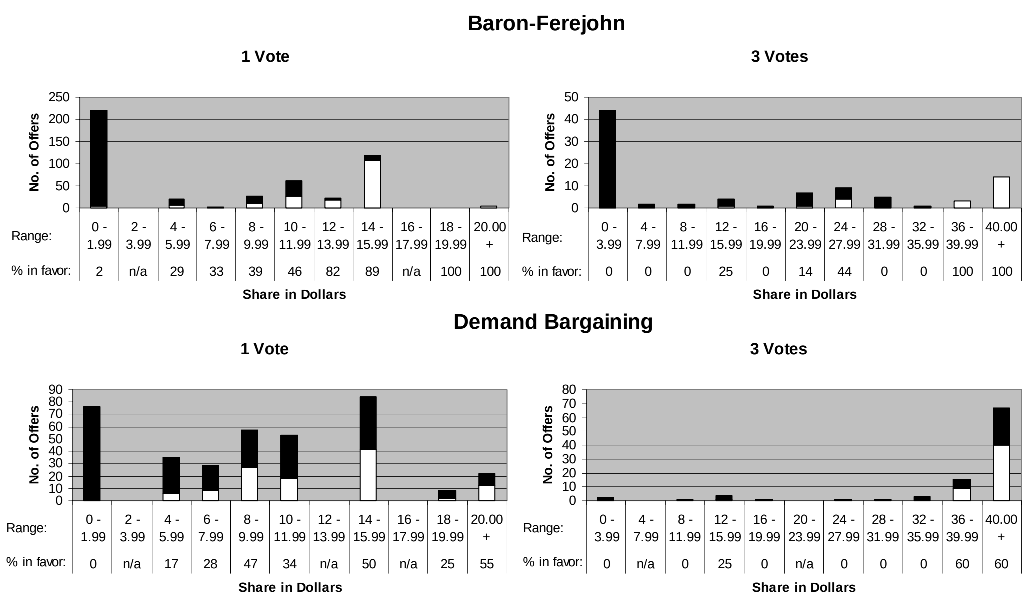


Figure 3: Apex$_{1/3}$: Votes by Shares (represented in dollar amounts)

A more nuanced look at voting patterns is obtained through random effect probits.[29] An initial set of probits were run to determine the sensitivity of votes to factors other than own share. The specification for BF sessions was:

$$vote_{it} = I\left\{\beta_0 + \beta_1 bS_{it} + \beta_2 aS_{it} + \beta_3 PS_{it} + \beta_4 D^2_{it} + \beta_5 D^3_{it} + \beta_6 D^4_{it} + \alpha_i + \nu_{it} \geq 0\right\} \tag{1}$$

where $I\{\cdot\}$ is an indicator function that takes value 1 if the left hand side of the inequality inside the brackets is greater than or equal to zero and 0 otherwise. Explanatory variables include own share ($S_{it}$), the share the proposer takes (PS), and dummy variables $D^j, j = 2, 3, 4$, taking value one if the proposal on the floor included $j$ members.[30] The dummy variable $a$ takes value one for Apex players, and the dummy $b$ takes value one for base players. From this general specification one can derive the special case of the regression for the Equal Weight treatment by dropping $\beta_1 aS_{it}$.

In all the regressions own share is the key determinant of voting for or against a proposal. The dummy variables $D^j, j = 2, 3, 4$, fail to achieve statistical significance at anything approaching conventional levels for any of the data sets, indicating the following: (i) subjects had little, if any, concern for *other* subjects getting zero shares as long as their own share was large enough; (ii) there were no systematic differences in acceptance thresholds in cases where the money is divided between two, three, four, or five subjects. The variable $PS$ achieved statistical significance in the Apex treatments but not in the Equal Weight treatment.[31] Given all this, the simpler specification reported for the BF sessions is:

$$vote_{it} = I\left\{\beta_0 + \beta_1 aS_{it} + \beta_2 bS_{it} + \beta_3 PS_{it} + \alpha_i + \nu_{it} \geq 0\right\} \tag{2}$$

For DB sessions, recall that only the data about the movers who had the possibility to close a majority coalition are considered votes. The initial set of probits involved the following specification:

$$vote_{it} = I\left\{\beta_0 + \beta_1 aS_{it} + \beta_2 bS_{it} + \beta_3 HS_{it} + \alpha_i + \nu_{it} \geq 0\right\} \tag{3}$$

where $HS$ is the highest share in the previous requests among the requests forming

[29] The probits employ a one way subject error component.

[30] The excluded cathegory is the one where funds were distributed to all five voters.

[31] These results are robust to specifications in which the $PS$ variable was permitted to take on different values for base versus Apex proposers.

| | Equal Weight | | Apex | | Apex$_{1/3}$ | |
|---|---|---|---|---|---|---|
| | Inexp | Exp | Inexp | Exp | Inexp | Exp |
| S. - 1 vote | 19.988*** | 25.023*** | 11.875*** | 26.630*** | 15.950*** | 25.507*** |
| | (2.640) | (5.883) | (1.349) | (9.327) | (1.544) | (5.882) |
| S. – Apex | NA | NA | 6.466*** | 16.028*** | 5.224*** | 9.956*** |
| | | | (1.122) | (5.951) | (0.897) | (3.065) |
| PS | -1.051 | -1.286 | -1.336** | -5.790** | 0.51 | -0.132 |
| | (1.027) | (2.129) | (0.535) | (2.491) | (0.494) | (1.024) |
| Constant | -4.033*** | -5.166*** | -1.710*** | -0.792 | -2.783*** | -3.685*** |
| | (0.709) | (1.769) | (0.381) | (1.633) | (0.417) | (0.995) |
| $\rho$ | 0.307*** | 0.256 | 0.544*** | 0.781*** | 0.271*** | 0.561*** |
| IP – 1 vote | 0.223 | 0.229 | 0.200 | 0.143 | 0.159 | 0.147 |
| | ($13.39) | ($13.74) | ($11.98) | ($8.57) | ($9.54) | ($8.81) |
| IP – Apex | NA | NA | 0.367 | 0.239 | 0.485 | 0.376 |
| | | | ($21.99) | ($14.32) | ($29.11) | ($22.56) |
| Obs. | 404 | 192 | 444 | 168 | 420 | 152 |

Table 8: Voting Patterns in Baron-Ferejohn

the cheapest potential coalition.[32] The $HS$ variable is meant to mirror what $PS$ captures in the BF probits. There is no equivalent for the number of subjects included in the distribution in this case. However, the $HS$ variable failed to achieve statistical significance at anything approaching conventional levels and/or had an incorrect sign (in one case $\beta_3 < 0$), so that the specification reported excludes $HS$.[33] As with the BF sessions, own share is statistically significant for all of the data sets for which there are a reasonable number of observations.

Table 8 reports the regression results for the BF sessions, along with estimates of $\rho$ defined as $\frac{\sigma_\alpha^2}{\sigma_\alpha^2+1}$ where $\sigma_\alpha^2$ is the variance of the subject specific random effects. As such $\rho$ measures the extent of the individual subject effects, or the dispersion in the likelihood of acceptance across individual subjects.[34] From the coefficient estimates, using the mean value of $PS$ for the treatment in question, we compute

[32]For instance, in the Equal Weight condition, if there were three requests prior to yours, 0.5, 0.4, and 0.3, $HS$ would equal 0.4.

[33]The results reported are robust to alternative specifications in which the $HS$ variable was permitted to take on different values for Apex and base proposers.

[34]$\rho$ has a minimum value of 0 (no individual subject effects) and a maximum value of 1 (all the variance is explained by individual subject effects).

the share that the *average* voter requires just to be indifferent between accepting or rejecting a proposed allocation. These indifference points in both shares and dollars are reported at the bottom of the table. Our focus is on the indifference points for inexperienced voters (as these coefficient estimates are substantially more reliable, especially in the Apex treatments because of the limited number of observations for experienced subjects). For base players indifference points are essentially the same between the Equal Weight and the Apex treatment, around \$13.50, slightly above the \$12 cutoff under the SSPE. This drops rather sharply under the Apex$_{1/3}$ treatment to \$8.94, which is not much above the SSPE share of \$8.57. Similarly, the indifference point for the average Apex player jumps from \$21.82 to \$29.87 in going from the Apex to the Apex$_{1/3}$ treatment, bracketing the \$25.71 predicted under the SSPE. The reduced demands of the base players and the increased demands of the Apex players in the Apex$_{1/3}$ treatment were what was anticipated when implementing this treatment, as Apex players require a larger nominal payoff to compensate for the fact that they are only getting a 1/3 share of the Apex "block's" payoff. Although this should not happen according to the theory, it is consistent with the notion that subjects have some lower bound on payoffs that they are willing to accept independent of continuation values (and/or they do not compute continuation values). At the same time, the large difference in cut-off values between Apex and base players makes it clear that subjects respond to the presence of bargaining power asymmetries.

¿From the voting regressions we can compute the share formateurs should offer to maximize their expected return and compare this with the shares actually offered and their expected return had they played according to the SSPE. These shares are consistently well above the indifference points reported in Table 8, as the latter are based on average responses. In contrast, the formateur must cope with the dispersion in minimal thresholds across subjects, so that offers equal to the average indifference point have only a 50% chance of being accepted. Taking the dispersion in thresholds into account, in the Equal Weight treatment a share of 0.293 (\$17.57) to each coalition partner maximizes the formateurs' expected return at \$21.80.[35] In contrast, had the formateur played according to the SSPE, the expected return

[35]These are obtained using the formula Expected value $= \left(\Pr \frac{(1-\text{Share to Self})}{2}\right)^2 \times (\text{Share to Self}) + \left(1 - \left(\Pr \frac{(1-\text{Share to Self})}{2}\right)^2\right) \times (\text{Continuation Value})$ where $\Pr(s)$ is the estimated probability that a share of $s$ is accepted using the random effects probits. The continuation value is approximated by the average payoff.

| | Equal Weight | | Apex | | Apex$_{1/3}$ | |
|---|---|---|---|---|---|---|
| | Inexp | Exp | Inexp | Exp | Inexp | Exp |
| S. - 1 vote | 5.343*** | 17.447*** | 3.611*** | 30.382 | 6.305*** | 12.580*** |
| | (0.798) | (3.931) | (0.791) | (18.865) | (0.999) | (4.559) |
| S. - Apex | | | 3.259*** | 4.866* | 3.132*** | 3.098** |
| | | | (0.794) | (2.519) | (0.626) | (1.480) |
| Constant | -1.483*** | -4.504*** (1.183) | -1.124*** | -2.675* | -1.843*** | -1.659** |
| | (0.275) | | (0.341) | (1.600) | (0.277) | (0.813) |
| $\rho$ | 0.150*** | 0.583*** | 0.415*** | 0.000 | 0.426*** | 0.408*** |
| IP – 1 vote | 0.277 | 0.258 | 0.311 | 0.088 | 0.292 | 0.132 |
| | ($16.65) | ($15.49) | ($18.67) | ($5.28) | ($17.54) | ($7.91) |
| IP – Apex | NA | NA | 0.345 | 0.550 | 0.588 | 0.535 |
| | | | ($20.69) | ($32.98) | ($35.31) | ($32.13) |
| Obs. | 254 | 115 | 241 | 87 | 390 | 69 |

Table 9: Voting Patterns in Demand Bargaining

would have been only $14.01. The much lower expected return for the SSPE reflects the much higher probability of at least one of the coalition partners rejecting the SSPE share. Similar calculations for the Apex treatments shows that the Apex player would maximize expected return by offering shares of 0.283 ($16.97) and 0.232 ($13.92) for the Apex and Apex$_{1/3}$ treatments, respectively, yielding expected returns of $38.66 and $43.83.[36] This compares to expected returns of $34.18 and $39.73 if offering the SSPE share. Base players would maximize expected returns by offering shares of 0.495 and 0.515 to the Apex player under the Apex and Apex$_{1/3}$ treatments, yielding expected returns of $23.71 and $19.45, compared to expected returns of $23.09 and $18.74 for offering the SSPE share. With the exception of the base player's income maximizing share for the Apex$_{1/3}$ treatment, all of these shares are reasonably close to the average shares reported in Table 4.

Table 9 reports the regression results for the DB sessions along with the implied share that the *average* voter requires to be indifferent between closing or not closing the coalition. With the exception of the Apex player in the Apex treatment, indifference points are larger in DB than BF for comparable treatments, as the theory

[36]In this case the formula used is Expected value = Pr (1 − Share to Self) × (Share to Self) + (1 − Pr (1 − Share to Self)) × (Continuation Value) where the continuation value is approximated by the average payoff of Apex players.

predicts. However, these differences are not nearly as large as predicted. The indifference point for Apex players in the Apex treatment is only slightly higher than for base players, but is considerably higher in the $\text{Apex}_{1/3}$ treatment. This should not happen according to the theory, but is again consistent with the notion that subjects have some lower bound on payoffs that they are willing to accept, so that the cut in the Apex player's "take-home" pay has this effect. Finally, the indifference point for the Apex player in the Apex treatment is surprisingly close to that of the base players, even though the Apex player was almost certain to be included in any winning coalition.

**Conclusion 5** *Own share of the benefits was the key factor affecting voting for or against a proposed allocation, with essentially no concern for players left out of MWCs when deciding how to vote.*

**Conclusion 6** *Average shares required to vote favorably on a proposed allocation were consistently larger under DB than BF, as the theory predicts. But these differences were not nearly as large as predicted. Apex players in the* $Apex_{1/3}$ *treatment required substantially larger shares than in the Apex treatment, consistent with the notion that subjects have some lower bound on payoffs they are willing to accept. Acceptance thresholds were, however, sensitive to strategic considerations as witness the large differences in average acceptance thresholds between base players and Apex players in the BF treatment.*

Finally, note that the sharp increase (decrease) in the indifference point for Apex (base) players in going from the Apex to the $\text{Apex}_{1/3}$ treatments is accompanied by virtually no change in the average number of steps required to complete a bargaining round. This suggests some sense of shared social norms regarding minimum acceptable shares, as otherwise we would expect these changes to generate considerably more disagreements (hence more steps to complete a bargaining round) in the $\text{Apex}_{1/3}$ treatment.

## 5 Comparisons with Field Data

A key arena for distinguishing between demand based and offer based models of legislative bargaining with field data has involved analyzing the share of cabinet posts held within coalition governments in parliamentary democracies as a function of parties' relative voting strength. The two most recent efforts along these lines have been explicitly designed to distinguish between demand based and offer based bargaining models using Morelli (1999) and Baron-Ferejohn (1989) as their respective reference points (see Warwick and Druckman, 2001, and Ansolabehere et al., 2003).

Warwick and Druckman, and the studies preceding theirs (e.g., Browne and Frendreis, 1980) measure a party's voting strength in terms of the share of legislative seats each party contributes to the winning coalition (as opposed to the share of seats each party in the winning coalition has in the legislature as a whole). These studies consistently find that a party's share of cabinet posts is linearly related to its share of legislative seats within the coalition government, and that there is little or no advantage to being the formateur. (Warwick and Druckman find a significant formateur effect *after* weighting cabinet posts according to their importance, with significant importance given to the prime minister's seat). Given the linear relationship and the general absence of a formateur effect these studies conclude in favor of the DB approach.

Ansolabehere et al. re-analyze the Warwick and Druckman data employing a measure of a party's voting-weight within the legislature, not their share of seats within the winning coalition, as the primary regressor.[37] Seat shares do not generally equal voting-weight shares, and voting-weight shares constitute the key factor underlying legislative bargaining power. Ansolabehere et al. also develop a framework for nesting the DB and BF approaches, and estimate the model using both voting-weight shares and shares of seats within the governing coalition. They conclude that the data favors the BF model as they find a statistically significant formateur effect both with and without weighting the prime minister's (PM's) portfolio more than other portfolios, and the coefficient value for voting-weight shares is close to 1.0. They note, however, that the estimated formateur effect is significantly *lower* than predicted under BF – one third of the predicted value for the unweighted data, and one half of the predicted value when weighting the PM's portfolio.

The analogue to these approaches for the experimental data is to use the share of benefits obtained by a subject as the dependent variable in the regression, and to use either the share of votes that a subject contributes to the winning coalition, or its

[37]They also add two additional countries and several more years of data, but the analysis makes it clear that this has no material effect on the differences between their results and those reported in Warwick and Druckman.

| | Baron-Ferejohn Games | | Demand Bargaining Games | | Warwick and Druchman[a] | |
|---|---|---|---|---|---|---|
| Specification 1 | Inexp. | Exp. | Inexp. | Exp. | Unweighted | Weighted |
| Share of Votes | 0.94*** | 0.90*** | 0.93*** | 1.01*** | 0.915*** | |
| | (0.02) | (0.03) | (0.02) | (0.02) | (0.01) | |
| $R^2$ | 0.91 | 0.87 | 0.88 | 0.95 | - | |
| Specification 2 | | | | | | |
| Share of Votes | 0.83*** | 0.77*** | 0.90*** | 0.91*** | 1.049*** | 0.859*** |
| | (0.02) | (0.03) | (0.02) | (0.03) | (0.02) | (0.02) |
| Form.*Share of Votes | 0.29*** | 0.44*** | 0 .08* | 0.18*** | -0.182*** | 0.135*** |
| | (0.03) | (0.05) | (0.04) | (0.04) | (0.02) | (0.02) |
| $R^2$ | 0.93 | 0.92 | 0.88 | 0.96 | - | - |
| No. Obs. | 345 | 171 | 348 | 137 | - | - |

[a] From Warwick and Druchman (2001)

* Significantly different from zero at the 10% level

*** Significantly different from zero at the 1% level

Table 10: Estimates of Payoff Shares as a Function of Vote Share in Winning Coalition (standard errors in parentheses)

| | Baron-Ferejohn Games | | Demand Bargaining Games | | Field Data[a] | |
|---|---|---|---|---|---|---|
| | Inexp. | Exp. | Inexp | Exp | Unweighted | PM weighted |
| Constant | 0.07*** | 0.13*** | 0.09*** | -0.07** | 0.07*** | 0.06*** |
| | (0.02) | (0.01) | (0.02) | (0.03) | (0.01) | (0.01) |
| Voting Weight | 0.99*** | 0.75*** | 1.01*** | 1.80*** | 01.12*** | 0.98*** |
| | (0.09) | (0.05) | (0.11) | (0.15) | (0.05) | (0.05) |
| Formateur | 0.14*** | 0.16*** | 0.08*** | 0.09*** | 0.15*** | 0.25*** |
| | (0.01) | (0.02) | (0.02) | (0.02) | (0.02) | (0.01) |
| $R^2$ | 0.54 | 0.61 | 0.39 | 0.78 | 0.72 | 0.82 |
| No. Obs. | 345 | 171 | 348 | 137 | 682 | 682 |

[a] From Ansolabehere et al (2003)

** Significantly different from zero at the 5% level

*** Significantly different from zero at the 1% level

Table 11: Estimates of Payoff Shares as a Function of Voting weights (clustered standard errors in parentheses)

voting-weight share, as the key explanatory variable.[38] As in the field data analysis, we use a dummy variable to test the importance of being a formateur. We pool the data from the Apex and Equal Weight treatments in the regressions reported. Similar results are obtained when pooling over the $\text{Apex}_{1/3}$ and the Equal Weight treatments (see Tables 13 and 14 reported in the appendix). Separate estimates are reported for the BF and DB games.

Table 10 reports the results of these regressions using the Warwick and Druckman specification, along with the estimated coefficient values reported from their study. The first thing to notice is that it is difficult to distinguish between DB and BF games based on the coefficient estimates reported. In both cases the coefficient values for share of votes are reasonably close to 1.0. Further, in both cases the formateur dummy is statistically significant, with the major difference being the substantially larger coefficient value for the BF games. Thus, one cannot decide between specifications based on the statistical significance of the formateur dummy, as tends to be done when analyzing the field data, or on the linear relationship between shares and "seats," as these characteristics are present in the experimental data for both BF and DB games. Finally, independent of whether or not the underlying game structure is BF or DB, our coefficient estimates are remarkably close to those reported in Warwick and Druckman, with the notable exception of the formateur dummy for their unweighted data.

Table 11 reports the regression results using the Ansolabehere et al. specification. Here too it is difficult to distinguish between BF and DB games based on the regressions results. In both cases, the constant (which, in theory, should be zero) is statistically significant, as it is in the field data. The coefficient values for voting-weight share are very close to 1.0 for inexperienced subjects in both DB and BF games as Ansolabehere et al. claim should be the case for BF games alone. The coefficients for the formateur dummy are statistically significant for both the DB and BF games, so that on this basis alone there is no way to distinguish between DB or BF type games as Ansolabehere et al. do. Finally, using Ansolabehere et al.'s regression specification, the estimated coefficient value for voting-weight share in conjunction with the average voting weight in the underlying data yield a predicted value for the

[38] Payoff shares are perfectly divisible, eliminating the "lumpiness" problem associated with using portfolios as the dependent variable in the regression. The field data also suffer from problems inevitably associated with attempts to weight the relative importance of different portfolios. Further, we can compute voting weight shares directly, whereas Ansolabehere et al. use an algorithm to compute these values from seats held.

formateur dummy, which they use to determine how short the predicted formateur effect is from the actual effect. Applying this procedure to our data, the predicted value for the formateur dummy is 0.415, compared to an estimated value in the BF games of 0.14 (0.16) for inexperienced (experienced) subjects. This yields the same ratio of actual to predicted effect (approximately 1/3) as reported in Ansolabehere et al. for the unweighted field data. Finally, viewed overall, there is little difference between the estimates using *either* of our data sets (BF or DB) for inexperienced subjects versus the field data reported in Ansolabehere et al.

The reasons for the difficulty in distinguishing between DB and BF games with the experimental data in these regressions is reasonably transparent: Although the two models make very different predictions regarding ex-post bargaining outcomes, realized differences in bargaining power are not nearly as large as predicted, while base players enjoy a first-mover advantage in both DB and BF games. Thus, behaviorally the two models are much closer to each other than one would predict, so that deciding between them on the basis of a linear relationship between voting shares and payoff shares, or the presence or absence of a statistically significant formateur effect, would appear to be doomed to failure.[39]

Table 12 makes this point absolutely clear. These regressions are based on the Apex and Equal Weight treatments, but instead of using actual behavior we use simulated subjects who behave according to the BF and DB models' predictions. The regression results under either the Warwick and Druckman or Ansolabehere et al. specifications clearly identify the nature of the game being played by the simulated subjects. For the BF games, the Warwick and Druckman specification yields a coefficient value for the interaction term between formateur and share of votes ($F_i$*Share of Votes) which is positive and very large relative to what is typically reported, indicating a strong formateur effect.[40] Similarly, for the BF games, the

[39]The one noticeable difference between the regressions in the text and those in the Appendix (which pool data from the $\text{Apex}_{1/3}$ treatment and the Equal Weight treatment) is a substantially larger coefficient value for voting weight, and a somewhat smaller formateur effect, in the latter for both BF and DB games. This reflects the loss in formateur power for base players in $\text{Apex}_{1/3}$ games compared to the Apex games. However, here too it is essentially impossible to distinguish between BF and DB games based on the coefficient values reported from the regressions.

[40]Note that excluding the interaction term between $F_i$*Share of Votes, as was done in earlier studies (e.g., Browne and Franklin, 1973) gives the totally misleading impression that the data is generated by a DB type process, as the coefficient value for Share of Votes is not significantly different from 1.0, and is essentially the same value as when the data is actually generated by a DB process (see the first column under Demand Bargaining Data).

Ansolabehere et al. specification yields a formateur dummy that is large and positive, the coefficient value for voting weight is close to 1.0, and the implied value of the formateur based on the coefficient value for voting-weight, in conjunction with the average voting weight, is within a reasonably close neighborhood of the estimated value for the formateur dummy. In contrast, when the data are generated by subjects behaving in strict conformity with the DB model, the Warwick and Druckman specification correctly characterizes the process as the $F_i$*Share of Votes variable is not significantly different from zero, and the coefficient value for Share of Votes is just slightly above 1.0. In this case the Ansolabehere et al. specification clearly points to an absence of formateur power as, although the $F_i$ dummy is significantly different from zero (due to specification error), it is trivial in size. And the voting-weight variable is reasonably closer to 2.0, the predicted value under DB in their specification.[41] Thus, it is not the differences in the regression specifications that prevent distinguishing between DB and BF, but rather the fact that there is much more similarity in actual behavior as opposed to what the two theories predict.

**Conclusion 7** *Replicating regressions like those performed with field data for the experimental data, we are unable to clearly distinguish between BF and DB games, as a result of the similarities between the actual behaviors. Further, there are a number of striking similarities between the regression estimates from the experimental data and the field data. This suggests, among other things, that the relatively weak formateur power reported for BF games in the laboratory is very likely to be weak in the field data as well.*

## 6 Summary and Conclusions

This paper examines, experimentally, the predictions of the leading alternating-offer (Baron-Ferejohn, 1989) and demand bargaining (Morelli, 1999) approaches to legislative bargaining, in games where players have equal real voting power and in Apex games where one player has disproportionate (real) voting power. The models make distinctly different predictions regarding the ex post distribution of benefits

[41] Ansolabehere et al. claim to have a regression specification that nests DB and BF. The approximations in their model introduce some small specification errors, but these do not distract from clearly distinguishing between the DB and BF games for our simulated treatments. These approximations are likely to be significant for parliaments comprised of very few political parties with real voting power

| | Baron-Ferejohn Data | | | Demand Bargaining Data | | |
|---|---|---|---|---|---|---|
| | W. and D. | | Ans. et al. | W. and D. | | Ans. et al. |
| Share of Votes | 1.01*** | 0.64*** | | 1.09*** | 1.10*** | |
| | (0.05) | (0.06) | | (0.03) | (0.04) | |
| $F_i$*Share of Votes | | 0.77*** | | | -0.03 | |
| | | (0.09) | | | (0.07) | |
| Voting Weight | | | 1.020*** | | | 1.782*** |
| | | | (0.006) | | | (0.002) |
| $F_i$ | | | 0.414*** | | | 0.002*** |
| | | | (0.001) | | | (0.001) |
| Constant | | | -0.004*** | | | -0.018*** |
| | | | (0.001) | | | (0.001) |
| $R^2$ | 0.58 | 0.66 | 1.00 | 0.78 | 0.78 | 1.00 |
| No. Obs. | 316 | 316 | 316 | 304 | 304 | 304 |

*, **, *** Significantly different from zero at the 10%, 5%, and 1% level.

Table 12: Simulated Data (standard errors in parentheses)

between parties, with the BF model predicting a sharply skewed distribution in favor of the proposer and the DB approach predicting shares proportionate to real voting power. These different predictions have formed the basis for distinguishing between the two models using field data.

The experimental data show proposer power for base players in BF games, and show that benefits shift substantially in favor of the player with greater real voting power (the Apex player) in both DB and BF games, all of which are consistent with the models' predictions. However, the sharp differences in ex-post shares that the theory predicts between BF and DB games fail to materialize, as a result of formateurs' failure to obtain anything approaching the large shares predicted in the BF games. The latter can be directly attributed to the reluctance of players to take the small shares predicted under the SSPE in the BF games, which is consistent with the large body of experimental data from alternating-offer bilateral bargaining games (Roth, 1995). However, in this case it is not so much what the *average* base player is willing to accept that is responsible (as the average willingness to accept is reasonably close to the SSPE prediction). Rather, it is the between subject variation in what base players are willing to accept that is responsible, so that to maximize expected income formateurs need to offer substantially more than the SSPE share, or else face very high rejection rates.

Using the experimental data to conduct regressions similar to those reported with field data for distinguishing between BF and DB bargaining models, we are *unable* to distinguish between which game subjects are playing using the criteria typically applied with the field data. Further, there are a number of strong similarities between our regressions results and those reported with the field data. These results can be attributed to the fact that, contrary to the theory, there is a limited first-mover advantage in DB games, and proposer power is much more limited than predicted in the BF games. At a minimum these regression results suggest that it is likely to be very hard to distinguish between game forms using the field data in the way it has been done in the past. As a general methodological point, these results demonstrate the relevance of a closer interaction of experimental and field data analysis, in order to avoid drawing inference from specifications that are identified in the traditional sense but may not be *behaviorally* identified.

The regression results also suggest that the limited formateur power reported for the BF games in the laboratory closely parallels the field data, as the difference between predicted and realized formateur power is remarkably similar in both cases. This has significant implications for the external validity of our experimental results, and by extension, for the large body of results from the experimental literature on bilateral bargaining games.

There have been a number of earlier experimental studies of the Apex game, using a more or less free form of bargaining between players. These experiments were designed to assess the implications of various cooperative bargaining solutions. The two closest in spirit to our games are Selten and Schuster (1968) and Horowitz and Rapoport (1974).[42] Selten and Schuster employed free form communication with face-to-face bargaining, and permitted all possible coalitions to form. Horowitz and Rapoport limited communication to a small preselected set of messages without allowing players to hear or to see each other, and restricted outcomes to MWCs. The vast majority of games, 83.3% (10/12), involved MWCs in Selten and Schuster. Among MWCs the vast majority involved the Apex player in both cases: 80.0% (8/10) in Selten and Schuster and 91.7% (11/12) in Horowitz and Rapoport. [43] For

[42]Both used cash payments contingent on performance and 5 person Apex games. See Oliver (1980) for a summary of this and related earlier studies of the Apex game.

[43]For Horowitz and Rapoport we only consider games for which payoffs were the same for coalitions including the Apex player and all base player coalitions.

MWCs including the Apex player, base player shares averaged 0.435 in Selten and Schuster and 0.283 in Horowitz and Rapoport, as opposed to shares of 0.250 predicted under the leading cooperative bargaining models.[44] Further, in Horowitz and Rapoport there were minimal differences in shares achieved conditional on whether the base player or the Apex player was permitted to communicate first.[45] These results are similar to ours in the sense that (i) the overwhelming number of MWCs included the Apex player and (ii) the Apex player's average share of the pie failed to achieve the 75% mark, by a minimal amount in Horowitz and Rapoport and by a more substantial amount in Selten and Schuster.

The results of these multilateral bargaining experiments are both informed by, and have implications, for the growing literature on "other regarding" preferences in the economics literature. With respect to the latter we make three points.

First, note the simultaneous pattern of voters ignoring the zero payoffs to non-coalition partners when voting in the BF game, while the same voters, in a minority of cases, propose supermajorities as formateurs (and do the same as closers in the DB game, occasionally leaving relatively small amounts of money over for later players). While the supermajorities might be rationalized as mistakes on the part of proposers (or closers), they are persistent in the data, suggesting that they are not mistakes. This pattern of simultaneously ignoring zero payoffs for some players when voting, while proposing supermajorities is, however, consistent with Bolton, Katok and Zwick's (1998) notion of "I'm no saint": Proposers and closers are willing to give a little money away, but when faced with the prospect of a respectable allocation to themselves, and giving zero to non-coalition members, versus potentially being shut out of the money entirely (if they vote no), the expected cost of rejecting such proposals is just too high to pass up.

Second, methods for establishing asymmetric power in bilateral bargaining games are limited to setting up different outside options for players, different discount rates, or different risk preferences. These options have been subject to limited exploration (see Roth, 1995, for a review). In multilateral bargaining games, in addition to these options, it is most natural to consider differential voting weights, as in the Apex game. In doing so we can directly compare the effects of real changes in

[44]These were the main simple solution of von Neuman and Morgenstern (1947) and the competitive bargaining set (Horowitz, 1973).

[45]However, in Horowitz and Rapoport's Apex games with 4 subjects, there were substantial differences in shares achieved, with significantly larger average shares for the base player when base players were permitted to communicate first.

voting strength versus equity considerations or other regarding preferences. Results from the present experiment show that Apex players do exercise a fair amount of the power granted them, taking substantially larger shares for themselves than base players do in the Equal Weight games. It is true that equity considerations play a role here as indicated by the differences between the Apex and $\text{Apex}_{1/3}$ treatments, but voting weight accounts for about two-thirds of the gain to be had from an Apex treatment in which equity considerations have been corrected for (the $\text{Apex}_{1/3}$ treatment). Further, minimum acceptable payoffs are sensitive to these strategic considerations as well, as witness the sharp reduction in the indifference point for base players between the Apex and $\text{Apex}_{1/3}$ BF games. Thus, there are clearly both strategic factors and equity considerations guiding behavior in these games, with sometimes subtle interactions.

Third, other regarding preferences appear to play a smaller role in DB than in BF games. This shows up in two ways: (1) The amount of money left over after closing a coalition in DB is smaller, on average, than the amount of money given to redundant coalition partners in BF (a difference of about $5.00) and (2) the equity consideration effect identified through the $\text{Apex}_{1/3}$ treatment is about twice as large in BF games as in DB games. Two potential explanations for these difference come immediately to mind. One is that it could be a framing effect as in BF subjects must directly consider allocations to all players, whereas in DB they just choose a share for themselves. Thus, subjects are forced to think more directly about payoffs to other in BF. Alternatively, it is much harder to exercise other regarding preferences in DB; if as an early demander wants to leave money over for players likely to be shut out of the coalition, there is no assurance that these players will actually get the money as later demanders can simply take this excess for themselves. In contrast, in BF one is giving the excess directly to the redundant players. It remains to sort out between these two alternatives or others that come to mind.

There are a number of obvious and potentially important extensions to the present line of research. First, what is the impact of pre-proposal communication (cheap talk) that permits proposers to establish competition between potential coalition partners? This would seem to be part of any real world legislative bargaining process, and might well move proposer power closer to the BF predictions as it would enable formateurs to distinguish between coalition partners willing to accept smaller shares. What will be the impact of veto players on outcomes (see Winter, 1996 for predictions within the Baron-Ferejohn framework)? Is there a method for clearly distinguishing between the two bargaining models using field data, and what will these results show? These and a number of other interesting and important questions remain to be investigated.

# 7 Appendix: Proofs

No proof is necessary for the theoretical predictions of the BF model, since we just applied without modifications the original model. On the other hand, given that the DB model used here is different from the one in Morelli (1999),[46] new proofs are necessary for the DB apex game.

**Proposition 1:** *Consider a 5-player apex DB game. (I) In every SPE outcome the base player(s) included in the equilibrium MWC receive 1/4 of the money; (II) In every SPE outcome the apex player receives 3/4 of the money iff she belongs to the equilibrium MWC; (III) The equilibrium MWC has four base players iff the apex player moves last; (IV) In all other cases the equilibrium winning coalition includes the apex player and a base player.*

*Proof.* Let $d_a \in [0,1]$ denote the demand made by the apex player, and $d_{b_i}$ the demand by base player $b_i$. Let the index $i$ be increasing in the order of play, i.e., $b_1$ is the first base player moving, then $b_2$, and so on. When player $b_i$'s turn to move comes, she is the $i$-th mover if the apex player has not moved yet, or the $i+1$-st mover if the apex has already moved. To compact notation, we say that player $b_i$ moves in position $i + I(r)$, where $I(r) = 1$ means that $a$ has moved before round $r$ and $I(r) = 0$ means that $a$ has not moved yet when round $r$ comes. The formal description of our proportional recognition probability assumption is as follows: for each step $r \in R \equiv \{1, 2, 3, 4\}$, $\Pr(m_r = a)$ (i.e., the prob. that the $r$-th mover is $a$) equals $(1 - I(r))\frac{3}{8-r}$. (The computation of the corresponding residual probabilities for the base players is left to the reader).

Denote by $W_j$ the set of coalitions $S$ such that $S \cup \{j\}$ is a winning coalition (at least 4 votes). A strategy of $a$ associates a demand $d_a$, plus a decision $S \in 2^{\{m_1,\dots,m_{r-1}\}} \cap W_a$ about whether to close a MWC (and which one) if feasible, to every combination of position and previous demands; a strategy of a base player associates a demand $d_{b_i}$, plus a decision $S \in 2^{\{m_1,\dots,m_{r-1}\}} \cap W_{b_i}$ about whether to close a MWC (and which one) if feasible, to every combination of position, previous demands, and weight of previous movers. In other words, a strategy of $a$ is a mapping from $R \times [0,1]^{R-1}$ into $[0,1] \times 2^{\{m_1,\dots,m_{R-1}\}} \cap W_a$, and a strategy for $b_i$ is a mapping from $R \times [0,1]^{i-1} \times [0,1]^{I(R)}$ into $[0,1] \times 2^{\{m_1,\dots,m_{R-1}\}} \cap W_{b_i}$. As in

[46] In the original model of DB the first randomized mover would choose the rest of the order of play, whereas here every new mover has to come from a new randomization.

Morelli (1999), the discount factor and the length of the game don't matter, so we can describe the candidate equilibrium strategy profile as if the game was over after the five players have made one demand each. For the moment, assume that the continuation equilibrium expected payoff for a base player if the five demands are voided is $u_b \leq \frac{1}{4}$. We will return to validate this hypothesis after completing the equilibrium analysis given this hypothesis.

Consider the following candidate strategy profile:

1. **Apex**:

   (a) $d_a = \frac{3}{4}$ if $a$ moves first;

   (b) If $a$ moves at some $r = 2, 3, 4$, $a$'s action is:

      i. If $\sum_{i=1}^{r-1} d_{b_i} \leq \frac{r-1}{4}$, then $(d_a = (1 - \min_{i<r} d_{b_i}), S = \{i\})$, where the chosen base player $i$ is $b_{r-1}$ if $d_{b_{r-1}} \leq d_{b_j}\ \forall j < r-1$;

      ii. If $\sum_{i=1}^{r-1} d_{b_i} > \frac{r-1}{4}$, then $d_a = \min\{(\frac{3}{4} + \sum_{i=1}^{r-1} d_{b_i} - \frac{r-1}{4}), (1 - u_b)\}$;

   (c) If the apex moves last (which means that the four base players have not found an agreement), she closes with the $b_i$ such that $d_{b_i}$ is less than or equal to the other demands (once again breaking indifference in favor of later movers) iff $1 - d_{b_i} \geq \frac{3}{4}\frac{67}{70}$, otherwise restart.

2. **Base**:

   (a) $d_{b_1} = \frac{1}{4}$ if the first mover is a base player;

   (b) If $b_i$ moves at $r = 2, 3$ with $I(r) = 0$, $b_i$'s action is $d_{b_i} = \min\left\{[\frac{1}{4} - \max\{0, (\sum_{i=1}^{r-1} d_{b_i} - \frac{r-1}{4})\}], \min_{j<i} d_{b_j}\right\}$;

   (c) If $m_4 = b_4$ (i.e., $I(4) = 0$), $b_4$'s demand is $\max\{1 - \sum_{i=1}^{3} d_{b_i}, \min_{i<4} d_{b_i}\}$ (implicitly closing the base MWC if the max is the first term and implicitly inviting the apex to join if the max is the second term).

   (d) If $b_i$ moves at $r = 2, 3, 4, 5$ with $m_{r-1} = a$, $b_i$'s action is:

      i. close with the apex (demanding the residual) if $d_a - \frac{3}{4} \leq \sum_{j=1}^{r-2} d_{b_j} - \frac{r-2}{4}$ and $1 - d_a \geq u_b$;

      ii. Demand $\max\{u_b, \frac{1}{4} - (\sum_{j=1}^{r-2} d_{b_j} - \frac{r-2}{4})\}$ otherwise.[47]

[47] In this case (ii), if $r = 5$ and the max is $u_b$, then it means that we have to restart; if the max is the other expression, it implicitly means that the MWC of all the base players is formed.

All the other potential nodes can be ignored.

To see that this strategy profile is an equilibrium, Let's check first that the proposed strategy of the apex is a perfect best response to the proposed strategy of base players. It is clear that when $m_1 = a$ any demand above $\frac{3}{4}$ would induce the other movers to exclude the apex, whereas demanding $\frac{3}{4}$ the apex is sure to be chosen right away, given that the second mover would have to demand strictly less than $\frac{1}{4}$ to be sure to be chosen by the subsequent movers against the apex. $a$'s action when she moves second, third, or fourth, is simply to close with the minimum previous demander if the sum of the previous demands is less than $\frac{r-1}{4}$, and make just a demand otherwise: this is a best response, taking into account what would be done by the subsequent mover. Finally, if the game reaches the node where the apex player moves last, it is clear that there is no incentive for the apex to close any coalition unless a base player made a demand low enough to guarantee $a$ at least $\frac{3}{4}\frac{67}{70}$, where $\frac{67}{70}$ is the probability that the apex will be moving in one of the first four positions in the next stage, and $\frac{3}{4}$ is the assumed payoff expectation conditional on being in the MWC. To complete the proof that the candidate profile described above is an equilibrium we now need to consider all the decision nodes where a base player moves. Note first that if $I(4) = 0$ and $m_4 = b_4$, then $d_{b_4} = \min_{i<4} d_{b_i}$ is the maximum demand $b_4$ can make if she wants to attract the apex. Hence $b_4$ chooses such a demand if it is greater than $1 - \sum_{i=1}^{3} d_{b_i}$. When $b_i$ moves at $r = 2, 3$ with $I(r) = 0$, the logic behind the action described above is simply that the best thing to do is to demand the same as the previous minimum demander, knowing that this way the apex would choose her if the apex moves next. Knowing this, if $m_1 = b_1$ any $d_{b_1} > \frac{1}{4}$ leads to be excluded, unless the apex will move last, which happens with very low probability.

If $m_1 = a$ uniqueness of the continuation equilibrium is clear: any $d_a > \frac{3}{4}$ cannot be part of any SPE, because $b_1$ can deviate demanding $\frac{1}{4}$, counting on the fact that perfection requires the subsequent movers to choose her over $a$ because of $d_a > \frac{3}{4}$. Given $d_a = \frac{3}{4}$, on the other hand, $b_1$ strictly prefers to close, because if she demands $\frac{1}{4}$ without closing the subsequent movers could eventually (one of them) close with the apex. The argument above about the case where $m_1 = b_1$ and $d_{b_1} > \frac{1}{4}$ is also enough to guarantee uniqueness. If $m_2 = a$, there cannot be any continuation equilibrium where she closes and demands $1 - d_{b_1}$, because she can demand $\frac{3}{4} + \epsilon$ and be sure, for $\epsilon$ small enough, that the subsequent mover will prefer to close with her rather than demanding something compatible with the demand of $b_1$. This implies that if $m_2 = a$ $b_1$ surely receives zero payoff if $d_{b_1} > \frac{1}{4}$. If $m_2 = b_2$, the latter will choose to follow the strategy described above, since that comes just from perfection. It is important to note that even though in principle the apex player is indifferent between closing with $b_1$ or $b_2$ if $d_{b_1} = d_{b_2}$, only closing with $b_2$ can be an equilibrium (otherwise $b_2$ could deviate with $\epsilon$ undercutting). Hence $b_2$ can demand $d_{b_2} = d_{b_1}$ being sure to be selected if $m_3 = a$. Hence the only possibility to receive $d_{b_1} > \frac{1}{4}$ for player $b_1$ is if the apex player is never selected until the end. But the apex player is chosen last only with probability $\frac{3}{70}$; hence the expected payoff share for $b_1$ if she demands $d_{b_1} > \frac{1}{4}$ is $\frac{3}{70} d_{b_1} \leq \frac{3}{70}$. By demanding $d_{b_1} = \frac{1}{4}$, on the other hand, $b_1$ can guarantee herself $\frac{1}{4}$ with probability $\frac{1}{2}$, i.e., with the probability that $m_2 = a$: in fact, if $m_2 = a$ the apex strictly prefers to close, since if she does not close the subsequent movers might choose the MWC of all base players, since they would be indifferent. This $\frac{1}{8}$ expected share (plus $\frac{1}{4}\frac{3}{70}$ if $a$ is last) dominates asking more than $\frac{1}{4}$. **QED.**

# 8 Appendix: Field Regressions Using the Apex$_{1/3}$ Data

| | Baron-Ferejohn Games | | Demand Bargaining Games | |
|---|---|---|---|---|
| Specification 1 | Inexp. | Exp. | Inexp. | Exp. |
| Share of Votes | 1.01*** | 1.00*** | 0.99*** | 1.03*** |
| | (0.01) | (0.01) | (0.02) | (0.02) |
| $R^2$ | 0.97 | 0.87 | 0.93 | 0.95 |
| Specification 2 | | | | |
| Share of Votes | 0.93*** | 0.93*** | 0.94*** | 0.98*** |
| | (0.01) | (0.01) | (0.02) | (0.03) |
| Form.*Share of Votes | 0.16*** | 0.18*** | 0.12*** | 0.10** |
| | (0.02) | (0.02) | (0.03) | (0.04) |
| $R^2$ | 0.97 | 0.98 | 0.93 | 0.95 |
| No. Obs. | 379 | 179 | 298 | 142 |

** Significantly different from zero at the 5% level

*** Significantly different from zero at the 1% level

Table 13: Estimates of Payoff Shares as a Function of Vote Share in Winning Coalition (standard errors in parentheses)

| | Baron-Ferejohn Games | | Demand Bargaining Games | |
|---|---|---|---|---|
| | Inexp. | Exp. | Inexp | Exp |
| Constant | -0.02 | -0.03** | -0.08*** | -0.10*** |
| | (0.02) | (0.01) | (0.02) | (0.04) |
| Voting Weight | 1.50*** | 1.60*** | 1.78*** | 1.97*** |
| | (0.08) | (0.08) | (0.09) | (0.15) |
| Formateur | 0.08*** | 0.09*** | 0.08*** | 0.05*** |
| | (0.01) | (0.01) | (0.02) | (0.02) |
| $R^2$ | 0.76 | 0.83 | 0.68 | 0.76 |
| No. Obs. | 379 | 179 | 298 | 142 |

** Significantly different from zero at the 5% level

*** Significantly different from zero at the 1% level

Table 14: Estimates of Payoff Shares as a Function of Voting - Weight Shares (clustered standard errors in parentheses)

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