

# Gamson's Law versus Non-Cooperative Bargaining Theory\*

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## Abstract

We compare Gamson's Law, a popular empirical model of legislative bargaining, with two non-cooperative bargaining models in three player divide the dollar games in which no player has enough votes to form a winning coalition on their own. Both of the game theoretic models better organize the comparative static data resulting from changes in nominal bargaining power than does Gamson's Law. We also identify deviations from the point predictions of the non-cooperative bargaining models. Namely, proposer power is not nearly as strong as predicted under the Baron-Ferejohn model, and a significant number of bargaining rounds tend to take more than two steps under demand bargaining and more than one stage under Baron-Ferejohn, counter to the models' predictions. Regressions using the experimental data provide results similar to the field data, but fail to do so once one accounts for predictions regarding coalition composition under Gamson's Law.

Key words: legislative bargaining, Gamson's Law, Baron-Ferejohn, demand bargaining, nominal bargaining power.

JEL classification: C7, D72, C92, C52.

Legislative bargaining is part and parcel of the process for allocating public resources in democracies. The bargaining process not only affects who gets what, but can lead to the adoption of socially inefficient programs. A full characterization of the bargaining process would, of necessity, be quite complicated. As such, models of the bargaining process must abstract from a number of features of reality. Nonetheless, modeling is central to understanding the bargaining process, as it focuses on the central forces at work and the key variables impacting on bargaining outcomes.

Gamson's Law (Gamson, 1961) is a popular empirical model of the legislative bargaining process. Gamson's Law is not based on any explicit game theoretic formulation of the legislative bargaining process, but rather owes its importance in the literature to the strong empirical regularity reporting proportionality between cabinet posts and votes contributed to the ruling coalition in parliamentary democracies (Browne and Franklin, 1973; Browne and Frendreis, 1980; Warwick and Druckman, 2001, 2003). One of the great appeals of Gamson's Law is its intuitive nature and the parsimony it offers, as it is independent of the game form underlying the legislative bargaining process.

The present paper reports a series of experiments examining the comparative static predictions of Gamson's Law using two popular non-cooperative legislative bargaining models; the Baron-Ferejohn (1989) alternating-offer legislative bargaining model and Morelli's (1999) demand bargaining model. We look at three player divide the dollar games in which no player has enough votes to form a winning coalition on its own. In the closed-rule form of the Baron-Ferejohn

model, someone is picked at random to make a proposal, then the others simultaneously vote it up or down. 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). In demand bargaining, players sequentially make demands 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 mover(s) in the forming coalition. If no majority coalition with a feasible set of demands emerges after all players have made a demand, all previous demands are voided, and the game proceeds (with or without discounting) until a compatible set of demands is made by a majority coalition.

With three voting blocks,<sup>1</sup> none of which has a majority by itself, each voting block, regardless of the number of votes it controls, has equal *real* bargaining power in both of the non-cooperative bargaining models under consideration, since under majority rule, passage of an allocation *always* requires a coalition of two out of three voting blocks. As such, changes in the number of votes a block controls that do *not* result in any party achieving an outright majority (referred to as changes in nominal bargaining power) have no effect on the ex-post equilibrium distribution of benefits among coalition partners.<sup>2</sup> In contrast,

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<sup>1</sup>A voting block is a group of votes that cannot be separated. In our context, a subject with 2 votes for instance is a voting block of 2 votes.

<sup>2</sup>With three voting blocks the only way to change real bargaining power would be to provide one party with enough votes to pass legislation on its own. With more voting blocks, changes

according to Gamson's Law there is no distinction between real and nominal bargaining power. This is clear from Gamson's own writings as well as the empirical analysis of coalition governments supporting Gamson's Law.<sup>3</sup>

The three party case provides the basis for a number of contrasting predictions between Gamson's Law and demand bargaining, and between Gamson's Law and the Baron-Ferejohn model, as well as between the Baron-Ferejohn model and demand bargaining. With equal proposal recognition probabilities the Baron Ferejohn model predicts that ex ante shares of the voting blocks will be equal, while the ex post shares will give  $2/3$  to the proposer and the remaining  $1/3$  to the coalition partner, regardless of the number of votes each party controls. In demand bargaining, the ex ante shares of the voting blocks will be equal, while ex post the model predicts a 50-50 split of the benefits between the two-player coalition partners, regardless of the number of votes a party controls. In contrast, in Gamson's Law the ex post shares of the voting blocks forming the minimum winning coalition will be proportional to the number of votes they contribute to the coalition. Further, the formateur of the winning coalition will in the number of votes a block controls may change real bargaining power if they determine a change in the set of minimal winning coalitions each player can belong to (see Morelli, 1999; and Schofield and Laver, 1985). Demand bargaining predictions coincide with Gamson's Law (1961) for games where the fraction of votes controlled by each player corresponds to his fraction of votes in the minimum integer representation of the game, but deviate systematically from Gamson's Law otherwise.

<sup>3</sup>See Gamson (1961), p. 567 "Convention" 2, and Browne and Franklin (1973, p.457). Browne and Franklin, as well as Warwick and Druckman, make no distinction between real and nominal bargaining power.

always partner with the least expensive potential coalition partner, i.e., the remaining voting block with the fewest number of votes.

This establishes a number of contrasting predictions that form the basis for the comparative static tests of these competing models reported here. For example, consider the case where each voting block has an equal number of votes. In this case both Gamson's Law and demand bargaining predict minimum winning coalitions in which the coalition partners share benefits equally. In contrast, under the stationary subgame perfect equilibrium refinement used to establish unique predictions under Baron-Ferejohn, the formateur is predicted to take  $2/3$  of the benefits with the coalition partner getting the remaining  $1/3^{\text{rd}}$ . Now consider the case where voting blocks have unequal numbers: For example, two of the voting blocks each have two votes and the third block has one vote. Now, Gamson's Law predicts that the one-vote block will always be in the coalition, receiving a  $1/3$  share, while the two-vote block will receive a  $2/3$  share, regardless of which voting block is selected to form the coalition. In contrast, demand bargaining continues to predict a 50-50 split between coalition members. Further, when the two-vote block establishes the order in which demands will be made, the formateur is indifferent between having the one-vote or two-vote block go second since, in equilibrium, both will accept the 50-50 split. Finally, Baron-Ferejohn continues to predict a  $2/3$ ,  $1/3$  split, with the  $2/3$  going to the formateur regardless of the number of votes she controls. We elaborate on these and other predictions below.

There are several previous experimental studies of the legislative bargaining

process. McKelvey (1991) was the first person to investigate the Baron-Ferejohn model. He did so under closed amendment rule procedures with three voters choosing between three or four predetermined allocations (resulting in a mixed strategy equilibrium), and with a discount rate of 0.95. There are no comparisons of his results with Gamson's Law or demand bargaining, although he does report that the formateur's share was substantially smaller than predicted, hence closer to a proportional distribution of benefits than the Baron-Ferejohn model would predict. Diermeier and Morton (2003) investigate the Baron-Ferejohn model focusing on varying recognition probabilities and on the share of votes that each elector controls under closed rule procedures, in an environment with a finite number of bargaining rounds (5) and three voting blocks.<sup>4</sup> Their results are consistent with ours, namely they report that coalition member shares are more equal than predicted under Baron-Ferejohn, and that a majority of, but not all, allocations are for minimal winning coalitions. Fréchette, Kagel and Lehrer (2003) study the impact of closed versus open amendment rules on legislative outcomes in a Baron-Ferejohn game with an infinite horizon and a shrinking pie. They find support for the qualitative implications of the Baron-Ferejohn model; namely greater proposer power under closed compared to open amendment rules, but with serious deviations from the point predictions of the model. Fréchette, Kagel, and Morelli (2004a) compare a demand bargaining game with

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<sup>4</sup>With finite repetitions and proportional proposal recognition probabilities continuation values vary with each stage of the game. As a result both coalition composition and coalition partners' shares vary with each stage of the game. In the infinite horizon version of the Baron-Ferejohn game we implement coalition composition and partners' shares remain constant.

the alternating offer game with five voting blocks in both equal weight games and in games where one voting block had disproportionate *real* voting power (an Apex game). Both games employ an infinite time horizon, with no discounting of payoffs for failure to reach agreement in a given bargaining round. They find that behavior is much more similar between the two models than either theory predicts. One important consequence of this is that regressions like those employed in analyzing the field data, but using their experimental data, cannot clearly distinguish between the models using the criteria commonly employed when evaluating the field data.

Results from these experiments provide some evidence which could be interpreted in favor of Gamson's Law. The tests of the Baron-Ferejohn alternating-offer model consistently show some proposer power, but not nearly as much power as the theory predicts, so that bargainers shares are frequently close to the proportionate shares predicted under Gamson's Law. Further, the tests of demand bargaining reported in FKM (2004a) also show that bargaining shares are reasonably close to proportionate. However, these results provide far from conclusive support for Gamson's Law since, with the exception of Diermeier and Morton (2003), there are no direct tests of the critical implications of Gamson's Law; i.e., that changes in nominal bargaining power, holding real bargaining power constant, will impact bargaining shares as Gamson's Law predicts, and that the voting block with the weakest nominal bargaining power will always be included in the winning coalition.

The present paper begins with a review of results from an earlier paper of



ours, Fréchet, Kagel and Morelli (2004b), that directly compares the Baron-Ferejohn alternating-offer model's predictions with Gamson's Law. We then go on to report, in detail, a new experiment that extends this work in two directions: First, we conduct comparable direct tests of Gamson's Law but within the institutional framework of demand bargaining. This tests the implication that Gamson's Law will hold regardless of the institutional context. Second, we introduce an important new manipulation whose structure is closer in spirit to how bargaining shares would be distributed *within* a given voting block in field settings. Under this setup, equity considerations that appear to play an important role in limiting the extent of proposer power in the experimental tests of the Baron-Ferejohn model should, if anything, bias outcomes in favor of Gamson's Law. Based on the review of our earlier paper (FKM, 2004b) and the results of the present experiment we conclude that results from games in which bargainers have equal nominal and real bargaining power exhibit a high degree of proportionality, consistent with Gamson's Law. However, when nominal bargaining power varies, holding real bargaining power constant, the bargaining shares continue to exhibit proportionality to the real weights, consistent with the game theoretic bargaining models and inconsistent with Gamson's Law. Further, coalition composition does not consistently move to strongly favor voting blocks with weak nominal bargaining power as Gamson's Law predicts. These results imply that even in the equal nominal weights case the quasi-proportional outcomes may be driven by some behavioral component that has no direct relationship with Gamson's Law. We go on to identify this missing behavioral

factor.

The plan of the paper is as follows. Section 1 reviews results from our earlier paper comparing Gamson’s law with Baron-Ferejohn model. Section 2 provides a detailed report of the new experiment comparing Gamson’s Law with demand bargaining, along with a test for the impact of discounting of payoffs on outcomes in demand bargaining. The latter is important since discounting is predicted to have no impact in demand bargaining, but plays an important role on bargaining outcomes in the Baron-Ferejohn model. Section 3 directly compares the results of the demand bargaining experiment with results from our earlier Baron-Ferejohn experiment. The concluding section summarizes our main results and relates them to previous results reported in the literature.

## 1 Baron-Ferejohn versus Gamson’s Law

### 1.1 Experimental design and treatments

In our earlier experiment (FKM, 2004b) we compared Gamson’s Law (hereafter GL) with the alternating-offer bargaining model proposed by Baron and Ferejohn (1989) (hereafter BF) in a three player game.<sup>5</sup> In the baseline, equal weight (EW) treatment, each of three subjects controlled 33 votes which had to be cast as a block in determining how to allocate \$30 between the three bargainers.<sup>6</sup>

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<sup>5</sup>The terminology used in this paper differs from that used in FKMb. Each session was composed of 10 bargaining rounds (elections in FKMb) each of which might include multiple stages (rounds in FKMb).

<sup>6</sup>Here, think of a party leader who represents the wishes of his coalition members, while the method by which these wishes are determined is left completely unspecified, subject to

Each of the three voting blocks had equal recognition probability, so that their proposals were equally likely to be recognized and voted on under closed amendment rule procedures (no opportunity to amend the proposal). Proposals were voted up or down by majority rule. If the proposal was accepted, the allocation was binding. If it was rejected, the process was repeated until an allocation was achieved, with *no* shrinkage in the amount of money to be allocated. Under the stationary subgame perfect equilibrium (SSPE) refinement required to get a point prediction, the BF model predicts a proposer (or formateur) share of  $2/3$  of the pie (\$20), with the coalition partner receiving the remaining  $1/3$  (\$10) share.<sup>7</sup> In contrast GL predicts an equal split between the formateur and the coalition partner. Note that both predict a minimum winning coalition (MWC). Further, GL is silent regarding how many stages there will be in any given bargaining round to form a MWC, while BF predicts that it will be achieved in the first stage of a bargaining round.

We contrasted outcomes under this baseline treatment with two other treatments. The most relevant, and closest in flavor to the unequal weight treatments employed in the new demand bargaining experiments reported here, was as follows: Two of the three voting blocks controlled 45 votes with the third block controlling 9, with proportional recognition rules (i.e., the 45-vote blocks each had a  $45/99$  chance of their proposed allocation being recognized). Under the SSPE refinement the BF model continues to predict  $2/3$  share to the formateur (regardless of which voting block's proposal is recognized) and a  $1/3$  share to the constraint of strict party discipline.

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<sup>7</sup>There are, of course, many other Nash equilibria to this game.

the coalition partner. In contrast, under GL, the 45-vote block should obtain a 45/54 (83.3%) share (its seat contribution to the MWC) with the 9-vote block getting the remaining share of 9/54 (16.7%). Further, GL predicts that a formateur with 45 votes will *always* include the 9-vote block as their coalition partner: “...where the total payoff is held constant, he [a player choosing a coalition] will favor the *cheapest winning coalition*.” (Gamson, 1961, p. 376, italics in original, bracketed terms added.) In contrast, assuming symmetry, the BF model implies that the 45-vote blocks will employ a mixed strategy including the 9-vote block as their coalition partner 90% of the time.<sup>8</sup> We will refer to this treatment as the BFUWFP (for the Baron-Ferejohn game with unequal weights and full payment of each block’s share to the subject *representing* the voting block) or simply as the UW treatment, when it does not cause confusion.<sup>9</sup>

Inexperienced experimental sessions employed between 12 and 15 subjects so that there were between 4 and 5 three person groups bargaining at one time. Each experimental session consisted of 10 bargaining rounds with subjects randomly assigned to new bargaining groups in each round. One of the 10 rounds was selected, at random, at the end of the experiment to be paid off on. Subjects received the allocation achieved in this bargaining round plus an \$8 participation fee. In the UW treatment, subjects roles as 45 vote block representatives were

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<sup>8</sup>See FKM, 2004b, for details regarding these predictions. Here the difference in inclusion probability of the smallest voting block between GL and BF is not striking, but below it will be clear that this inclusion probability issue yields a significant tool to contrast GL with the two bargaining models.

<sup>9</sup>This is referred to as the UWUS treatment in FKM (2004b).

fixed throughout the session. Following two inexperienced subject sessions, all subjects from a given treatment were invited back for an experienced subject session. Between 12 and 18 subjects participated in these experienced subject sessions.

## 1.2 Experimental results and discussion

Table 1 shows shares obtained by the formateur and coalition partner's for all coalitions and for MWCs. For coalitions in which all three bidders got a share of the pie, partner's share is computed as the average share of the coalition partner getting the largest share. By way of background to evaluating these results, MWCs were found in 61% (77%) of all bargaining rounds for inexperienced (experienced) subjects in the EW treatment, and for 73% (84%) of all bargaining rounds for inexperienced (experienced) subjects in the UW treatment.<sup>10</sup>

[Table 1 approximately here]

Looking at all coalitions, inexperienced subjects in the EW treatment achieve just under a 50% share of the pie, but nevertheless get a significantly larger share than the highest average partner's share.<sup>11</sup> Formateur shares in this case increase to 55% for experienced subjects. Looking at MWCs, formateur shares are 55% for both inexperienced and experienced subjects. While these figures are still well below the 67% predicted under BF, and are indeed closer to the percentages predicted under GL, the shares are significantly higher than

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<sup>10</sup>Information on the average number of stages required to complete a bargaining round will be reported in Section 3, where we directly compare BF with demand bargaining.

<sup>11</sup> $p = 0.01$  using a Mann-Whitney test with subject averages as the unit of observation.

partner's share in both cases.<sup>12</sup>

Results for the UW treatment clearly indicate that it is not GL that is responsible for the close to proportionate share under the EW treatment, as 45-vote formateurs obtain much the same average share as formateurs in the EW treatment, nothing close to the 83.3% shares predicted under GL.<sup>13</sup> Shares given by 45-vote formateurs to 45 vs 9-vote partners are essentially the same as well, with the exception of the MWC case for inexperienced bargainers. This is indicative of no differential treatment of 45- vs 9-vote blocks by 45-vote formateurs, along with inclusion of 45-vote blocks as partners, neither of which should happen according to a strict interpretation of GL.

The UW treatment does see 9-vote blocks included as coalition partners more often than 45-vote blocks: 74% vs 51% ( $p < .05$ , one-tailed sign test) for inexperienced subjects and 77% vs 47% ( $p < .01$ , one-tailed sign test) for experienced subjects.<sup>14</sup> Further, for experienced subjects we cannot reject a

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<sup>12</sup> $p < .01$  using a Mann-Whitney test with subject averages as the unit of observation, for both inexperienced and experienced subjects.

<sup>13</sup>Results for 9-vote formateurs go in a different direction, but there are only 9 accepted allocations for inexperienced 9-vote formateurs. In the UW<sub>ES</sub> treatment described below, for which we have many more observations, 9-vote formateurs take a larger share than they give to coalition partners: For accepted MWCs a .52 share to self versus a .48 share to their coalition partner, for both inexperienced and experienced subjects.

<sup>14</sup>These percentages sum to greater than one because of supermajorities. To avoid repeated measures problems these averages are calculated using subject averages as the unit of observation. These do not coincide with the population averages because some subjects play more rounds than others. A sign test is performed to establish if the percentage of offers to 9-vote blocks is the same as to 45-vote blocks.

null hypothesis that 9-vote blocks are given money 9 times more often than 45-vote blocks as the BF model predicts (p-value  $> 0.1$  using a sign test on subject averages as the unit of observation). Although this failure to reject the null hypothesis could be due to a combination of small sample size and the low power of the sign test, there is sufficient power to reject the null hypothesis that both types are equally likely to be invited into a coalition.

It is of some value to compare the results from the UW treatment with a second-unequal nominal voting weight treatment implemented in FKM (2004b), the difference being that in this second treatment each voting block's proposals were recognized with equal probability, just as in the EW treatment (call this treatment  $UW_{ES}$ ). What this does is to change the prediction for the BF model regarding the frequency with which 9-vote blocks will be invited into the MWC from 90% to being independent of voting block size. In contrast, GL continues to predict exclusive reliance by 45-vote blocks on 9-vote blocks as coalition partners. For inexperienced bargainers in the  $UW_{ES}$  treatment, 45-vote blocks offer shares to 9-vote blocks slightly more often than to 45-vote blocks (64% versus 56%), with the percentages for experienced bargainers being quite similar (61% for 9-vote blocks versus 45% for 45-vote blocks).<sup>15</sup> Neither of these differences is statistically significant at conventional levels. Thus, the comparative static effects on this score favor BF over GL.

What is the explanation for the failure of formateurs in BF games to achieve

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<sup>15</sup>Again, these data are for all accepted coalitions including supermajorities so that the percentages sum to greater than 100%.

anything approaching the SSPE prediction regarding proposer's share? Calculations reported in FKM (2004b) show that this rests squarely on coalition partners voting patterns, which yield sufficiently high rejections for proposals at or near the SSPE that the expected value of a proposal is maximized by offering shares close to those actually offered. This result parallels results from the extensive experimental literature on bilateral bargaining games which show, for example, that offers much below 50% in the ultimatum game are rejected with sufficiently high probability that it does not pay in an expected value sense to make such offers (see Roth, 1995, for a review of the literature).

In short, according to the subgame perfect equilibrium prediction, if players only care about their own income, they should accept minimal offers, but they do not. This has generated an extensive literature on other regarding preferences, or "fairness" issues, in economics. The analysis of voting patterns in the BF game adds somewhat to our understanding of other regarding preferences found in these bilateral bargaining games: Subjects vote for or against a proposal depend only on their own share of the pie, with essentially no consideration for payoffs for the least well off and for proposer's share (FKM, 2004b).<sup>16</sup>

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<sup>16</sup>Unless allocations become much more extreme than in this setup, in which case there is some evidence that they also care about the proposer's share, see FKL and FKM (2004a) on this point.



## 2 Demand Bargaining versus Gamson's Law

In demand bargaining (hereafter DB) each voting block makes a demand for their share of the fixed amount of resources, along with the order in which other voting blocks will be permitted to make their demands.<sup>17</sup> Next, the second voting block specified to make a demand makes her demand. If the first two demanders 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 remaining demanders can only demand the residual resources, if any. If the first two demanders do not have enough votes to constitute a MWC, and/or the first two demands exceed the fixed amount of resources, then the voting block specified to make the third demand is selected to make the third demand. The game may not reach the third voting block since 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. Further, 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 that may apply to payoffs should an allocation not be achieved in the first stage of the bargaining process (Morelli, 1999).

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<sup>17</sup>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.

In the case of three voting blocks, none of which by itself has a majority of votes, the unique subgame perfect equilibrium (SPE) outcome of the DB model gives  $1/2$  of the cake to each of the first two movers who form a MWC, regardless of the number of votes each voting block controls (and no stationarity refinement is necessary). Further, in selecting the order in which subsequent demands are to be made, players are indifferent to the number of votes in each voting block. In contrast, under GL shares to players who form the MWC will be equal to the proportion of votes that voting block contributes to the MWC. Further, in selecting the order in which subsequent demands are to be made, players will always pick the voting block with the least number of votes to move second, as this insures the maximum payoff for the first demander (i.e., constitutes the cheapest MWC).

## 2.1 Experimental design

In each bargaining round three subjects divided \$50 between three voting blocks, with *one* subject representing each voting block. (The larger amount of money employed here compared to FKM (2004b) was in anticipation of the UWPP treatment to be described below.) Procedures within a bargaining round were as follows: First, each subject representing a voting block entered the amount of money (out of the \$50) they demanded for their voting block, along with the order in which other voting blocks would be permitted to make their demands. One of these initial proposals was randomly selected, with the probability of selection equal to the proportion of the total number of votes that block con-

trolled. This demand, along with the order in which demands were to be made, was posted on subjects' screens. Then the voting block designated to go second according to the proposal selected entered her demand. If those two first demands were less than or equal to \$50, then the second demander was offered the opportunity to close the coalition, in which case the demands were binding.<sup>18</sup> If the first two demands summed to greater than \$50, or the second demander chose not to close the coalition, then the subject representing the voting block selected to move third in the initial proposal was permitted to demand the amount of money she required to join the coalition (all subjects could observe all selected demands to that point on their computer screens). If after this third demand, any two demands summed to \$50 or less, then the third demander was offered the option to close the coalition, in which case the demands were binding.<sup>19</sup> If the third demander chose not to close the coalition, or there was no possible majority coalition that satisfied the budget constraint, then all demands were erased and the process started over again (*after* applying the discount rate, if there was one). Thus, there are potentially an infinite number of stages to each bargaining round. Each stage had a maximum of three steps (three possible demands made), with DB predicting that each round would end in the first stage and require only two steps. To summarize: Each bargaining

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<sup>18</sup>In those cases where demands summed to less than \$50, the third voting block was given the opportunity to claim the residual.

<sup>19</sup>In those cases where the third demander could form two possible coalitions, she was offered the choice of who to include in the coalition. In this case if the demands selected summed to less than \$50, the unclaimed balance was not allocated. This case clearly represents out-of-equilibrium play.

round had potentially multiple stages, and each stage had either 2 or 3 steps.

The three experimental treatments employed are reported in Table 2 along with the predictions from DB and GL. In the equal weight (EW) treatment each voting block controlled one vote. In the unequal weight, full payment treatment (UWFP) two of the voting blocks each controlled two votes, while the third block controlled a single vote.<sup>20</sup> Further, each subject representing a voting block received the full payment allocated to that block. Thus, this treatment corresponds to the UW treatment for BF games reported in the previous section. The unequal weight, partial payment treatment (UWPP) was the same as the UWFP treatment except that subject payments were divided by the number of votes in their block; i.e., “take-home” pay for subjects representing the two vote blocks were half the payment allocated to their block.

The motivation for the UWPP treatment was two-fold: First, in field settings one would expect payoffs to be shared between members of a voting block, so that this treatment acts as a stand-in for this case, albeit for the special case of equal sharing between block members. Second, and more importantly for present purposes, equity considerations, which are known to play a significant role in bargaining games, favor DB in the UWFP treatment, as any claim that the 2-vote block has to a larger share is offset by the fact that a single player receives the full amount of that larger share. In contrast, in the UWPP treatment this is not the case. In this treatment equity considerations call for the

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<sup>20</sup>Hence, in the EW treatment each voting block had a 1/3 chance of being the first demander, while in the UW treatments each of the two vote blocks had a 2/5 chance of being the first demander.

2-vote block to receive double the payoff of the 1-vote block, which coincides with GL. In fact, one might argue that the proportional payoffs predicted under GL derive from these equity considerations, both in Gamson’s original formulation and in field settings. Hence, the UWPP treatment gives GL its best shot, while the UWFP treatment gives DB its best shot. In this framework, the EW treatment serves as a baseline against which to evaluate the outcomes in the other two treatments.<sup>21</sup>

**[Table 2 approximately here]**

To minimize the possibility of repeated play effects, we recruited between 15 and 18 subjects per session, conducting between 5 and 6 bargaining rounds simultaneously. Subjects were assigned to each “legislative” cohort randomly in each round, subject to the restriction that in the UW sessions each legislative group contained two 2-vote blocks and one 1-vote block. Subject numbers also changed randomly between bargaining rounds (but not between stages of a given round). The number of votes in each subject’s voting block was selected randomly at the start of each session and remained fixed throughout the session. Feedback was limited to a subject’s legislative cohort. This feedback consisted of the selected demands and the proposed order of play, along with who was included in the final coalition and what their payoffs were.<sup>22</sup>

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<sup>21</sup>We should add that these factors were brought to our attention by a referee of the earlier FKM (2004b) paper.

<sup>22</sup>Screens also displayed the outcomes (demands by coalition members and who was included) for the last three bargaining rounds as well as the demands for up to the three most recent stages of the current round. Other general information such as the discount rate, the number of votes required for a proposal to be accepted, etc. were also displayed. Instructions

Subjects were recruited via email solicitations sent to students taking economics undergraduate classes during the quarter the experiment was conducted in, along with those students registered for economics classes in the previous quarter, at the Ohio State University. This gives a population base of close to 10,000 students to draw from, with a wide variety of undergraduate majors.<sup>23</sup> For each treatment, there were two inexperienced subject sessions and one experienced subject session. Each inexperienced subject session had 11 bargaining rounds, with the first one consisting of a “walk-through” during which we directed subjects actions so that they would become familiar with the entire set of options open to them.<sup>24</sup> This was followed by 10 bargaining rounds played for cash, with one of the cash rounds selected at random to be paid off according to the allocation in that round.<sup>25</sup> In addition, each subject received a participation fee of \$8.

Subjects were told that sessions would last approximately 1.5-2.0 hours. None of the sessions required intervention by the experimenters to end within this time frame, with most sessions ending within 1.5 hours, including time for

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are at the web site

<http://www.econ.ohio-state.edu/kagel/DB3.insts.pdf>

<sup>23</sup>Introductory economics classes, which serve as the bulk of this population base, are a social science elective for a wide range of majors.

<sup>24</sup>During the walk-through subjects were free to make whatever demands they wished but were directed to either close the coalition, or keep it open, so that they could see the full set of options open to them (see the instructions posted on the web site noted above). The walk-through was eliminated in the experienced subject sessions.

<sup>25</sup>In one session there was a crash after round 5. The experiment was re-started for 10 new rounds. We use these last 10 rounds in the data analysis.

the instructions and the walk-through.

## 2.2 Results for $\delta = 1$ treatments

We report our results in a series of conclusions, either preceded by, or followed by, the evidence supporting the conclusion reached.

**Conclusion 1** *The vast majority of bargaining rounds end without delay, in stage 1, as DB predicts, with 72% or more of the experienced subject bargaining rounds ending in the minimal number of steps.*

[Table 3 approximately here]

Table 3 reports the percentage of bargaining rounds that ended in stage 1, the percentage of bargaining outcomes that closed in two steps (as DB predicts), and the percentage of MWCs. The percent of bargaining rounds ending in stage 1 is relatively high, averaging some 85% (97%) for the 3 treatments combined for inexperienced (experienced) subjects. Averaging over all treatments, the average number of stages goes from 1.19 for inexperienced subjects to 1.03 for experienced subjects, with the average increasing for all three treatments as subjects gain experience. Further, the number of stages never exceeds 2 for experienced players.

The percentage of bargaining rounds that closed in 2 steps, averaged over all stages of all bargaining rounds and over all treatments, goes from 55% for inexperienced players to 77% for experienced subjects. It also increases, with experience, over all three treatments. Note that both in terms of the number of rounds ending in stage 1, and the number of stages ending in two steps,

these percentages decrease in going from EW to UWFP to UWPP treatments, suggesting greater levels of disagreement across the three treatments.

**Conclusion 2** *The majority of the coalitions formed are minimal winning coalitions (MWCs).*

On average, 89% of the final allocations in a bargaining round for inexperienced subjects consisted of MWCs, with this number increasing to 97% for experienced players. Table 3 breaks these numbers out by treatment. Thus, on average, in 89% (97%) of the final allocations for inexperienced (experienced) subjects, one player received no money.

In looking at the allocation of shares between voting blocks we ask the following questions: First, do allocations move in the direction predicted by Gamson's Law (a smaller share for the 1-vote player) in the UWFP and/or the UWPP treatments? If shares move in favor of the 1-vote player, are they closer to the shares predicted under GL or under DB? (The dividing line here is a share of 42% or \$20.80.)<sup>26</sup> When we look at the percentage of 1-vote players receiving shares at or below 42% (\$20.80), how do these numbers compare to the percentage of players in MWCs for the EW treatment getting comparable shares (which outcomes cannot be attributed to GL)? In what follows we look at average aggregate shares as well as individual subject data.

**[Table 4 approximately here]**

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<sup>26</sup>Note, this split also accounts for the fact that  $1/3$  does not divide into \$50 evenly, so it covers the focal point split of \$20 for 1-vote players versus \$40 for 2-vote players.



Table 4 reports average demands in accepted MWC for subjects “in the money” broken down by treatment, and number of votes controlled.<sup>27</sup> If two adjacent numbers in a row (1 vs 2 votes) are in bold, it means they are statistically different at the 10% level using a Mann-Whitney test.

Shares for inexperienced players in the UWFP treatment deviate from the DB prediction, but *not* in the direction that GL predicts, as 1-vote players demanded, and got, slightly larger shares than those with two votes. However, this difference, which is trivial in magnitude, disappears with experience. On the other hand, in the UWPP treatment, 2-vote players demanded, and got, significantly larger shares than those with one vote, and this difference, although diminished in magnitude, was not eliminated for experienced subjects. However, average shares for 1-vote players under UWPP were just at the dividing line between GL and DB (42%) and closer to the DB prediction for experienced subjects.

Looking at individual subjects, under the UWFP treatment 14% (13%) of 1-vote players in MWCs got shares that were closer to the GL prediction than to DB for inexperienced (experienced) players. These percentages jump up in the

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<sup>27</sup>For EW these have to be 0.5 by definition unless some money is leftover, which was the case here. (In this case resulting from MWCs made up of 2nd and 3rd movers, so that the little money leftover could not be claimed.) The fact that the numbers for subjects with 1 and 2 votes do not always sum to 1 for UWFP and UWPP is normal. For example imagine that the data set consists of two coalitions, one where 2 subjects with 2 votes each requested 0.5, and one where a subject with 2 votes requested 0.6 while a subject with 1 vote requested 0.4. Then the average requests for subjects with 2 votes would be 0.5333 and for subjects with 1 vote it would be 0.4.

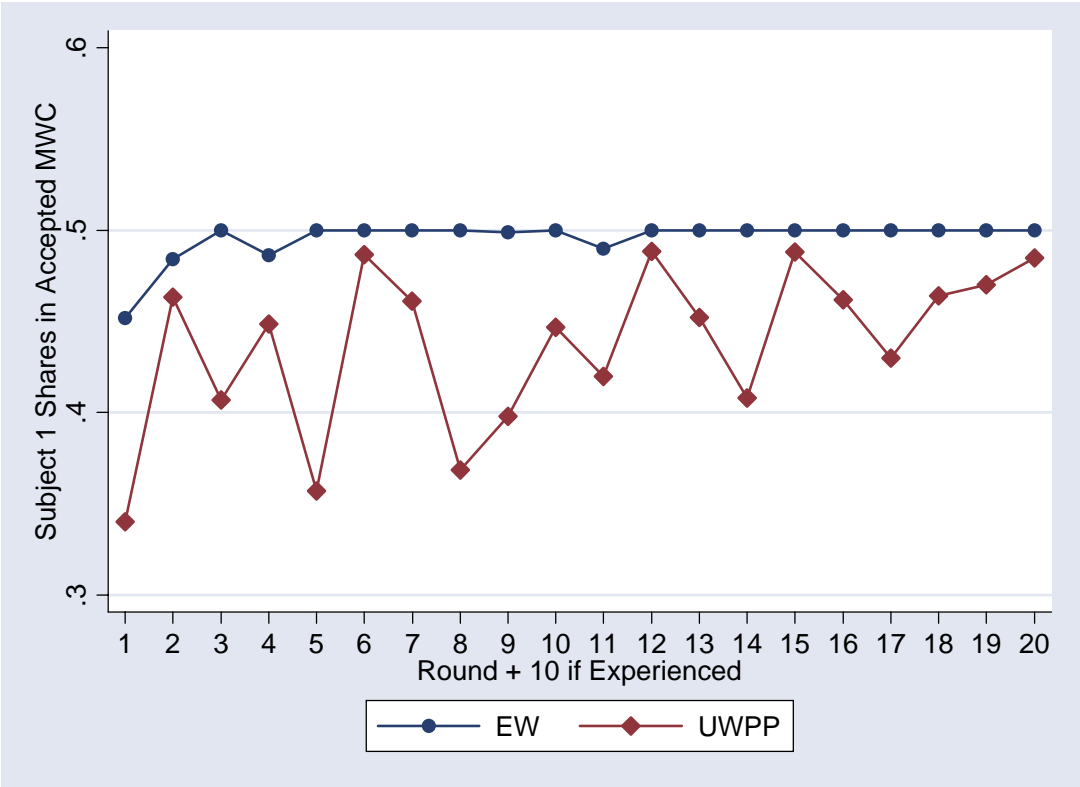


Figure 1: Evolution of Average Shares to Subjects With 1 Vote

UWPP treatment, particularly for inexperienced subjects, averaging 55% (27%) for inexperienced (experienced) subjects. The sharp drop in the frequency of 1-vote allocations favoring GL for experienced players is symptomatic of a more or less continuous reduction in the frequency with which 1-vote player's shares favor GL as illustrated in Figure 1 (where for comparative purposes we also report shares for the EW treatment). As can be seen, there is a significant amount of learning going on over time, with 1-vote player shares converging close to shares in the EW treatment for experienced players. Note that one vote player shares remain significantly below shares in the EW treatment even at the end. But this is largely due to the negligible variation in shares under the EW treatment as there is little mean difference between treatments over the last several bargaining rounds.

**Conclusion 3** *In the UWPP treatment, final allocations to the 1-vote players are approximately the same as to the 2-vote players, consistent with DB predictions. In the UWPP treatment, final allocations to 1-vote players are less than those to 2-vote players, consistent with GL. However, average shares of 1-vote players are closer to those predicted by DB for experienced subjects in the UWPP treatment as well, and there are **no** allocations closer to GL than to DB over the last five bargaining rounds for experienced subjects in this treatment.*

[Table 5 approximately here]

Table 5 lists the percentage of SPE demands by treatment.<sup>28</sup> It also gives the percentage of SPE demands for half the pie in step 1, the percentage of SPE demands in the last stage of a bargaining round, and the percentage of bargaining rounds that end in step 2 of stage 1 with both players demanding one half. A few aspects of these results stand out.<sup>29</sup> First, experienced subjects consistently exhibit a greater frequency of SPE outcomes in all four categories than inexperienced players. Second, there are more SPE demands in EW than in UWFP, and more in UWFP than in UWPP. The increased frequency of SPE outcomes is a more or less continuous progression in all three treatments. Figure 2 illustrates this point, as it plots the frequency of SPE demands over time. In all three treatments there is a clear upward trend, with the frequency approaching 100% over the last three bargaining rounds for experienced subjects in the EW treatment.

**Conclusion 4** *A non-negligible number of demands are subgame perfect in all three treatments. The frequency of subgame perfect demands is growing over time in all three treatments as well.*

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<sup>28</sup>The data in this table consists of all demands, whether accepted or not.

<sup>29</sup>Even though in equilibrium all requests should be for half the pie and every bargaining round should end in step 2 of stage 1, conditional on previous requests not being on the equilibrium path, one should not request  $\frac{1}{2}$ . If the first requested share,  $r_1$ , is less than  $\frac{1}{2}$ , then the second request should be  $1 - r_1$ . If it is more than  $\frac{1}{2}$ , then the second request should be  $\min\left\{r_1, 1 - \frac{\delta}{3}\right\} - \varepsilon$  where  $\delta$  is the discount factor and  $\varepsilon \rightarrow 0$ . The latter follows because the continuation value for the third player, in case of not closing the coalition, is  $\frac{\delta}{3}$ , so that he should accept any share greater than  $\frac{\delta}{3}$ .

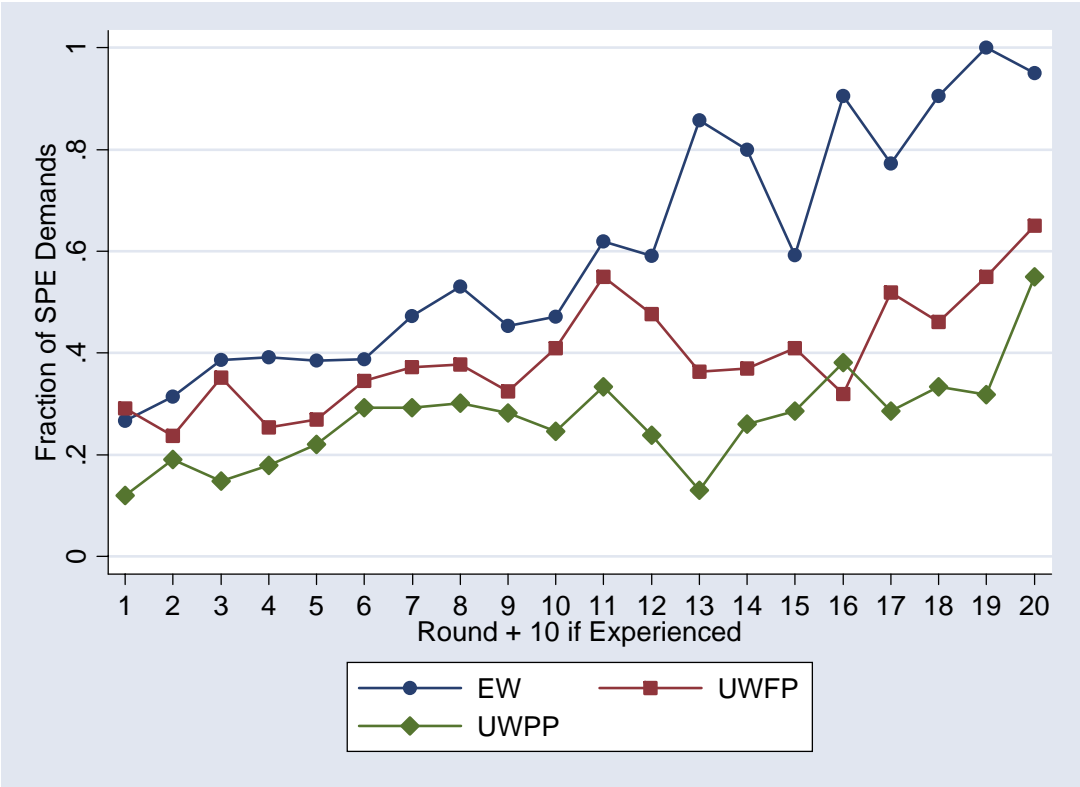


Figure 2: Evolution of the Frequency of SPE Demands by Treatment

**Conclusion 5** *1-vote players are invited to move second by 2-vote players more often than they invite other 2-vote players in the UWPP treatment. Further, 2-vote players end up partnering significantly more often with 1-vote players in MWCs than with other 2-vote players, for experienced subjects in both the UWFP and UWPP treatments. However, these frequencies are well below the 100% level predicted under GL.*

[Table 6 approximately here]

GL predicts that 2-vote players should always form the winning coalitions with 1-vote players. To achieve this 2-vote players must invite 1-vote players to move second. DB on the other hand predicts no preference for 1-vote players over other 2-vote player in terms of the order in which demands will be made. Table 6 gives the fraction of times 2-vote players *invite* 1-vote players to go second in step 1. Although the fraction is greater than .50 for both inexperienced and experienced players in the UWFP treatment, using individual subjects as the unit of observation, these differences are not significantly different from 0.5 (p-value of one-sided sign test  $> 0.1$ ).<sup>30</sup> In the UWPP treatment 1-vote players are invited to move second significantly more often than other 2-vote players for both inexperienced ( $p < .10$ ) and experienced ( $p < .01$ ) players, but the average frequency is nowhere near the 100% level predicted under GL.

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<sup>30</sup>Averages for individual subjects serve as the unit of observation here; i.e. we calculate the frequency with which each individual subject with two votes picks a 1-vote player to go second as opposed to a fellow 2-vote player. We then see if this happens more often than the other way around over the population of 2-vote players.

The average frequency with which 1-vote players are *included* as members of the MWCs is greater than .50 in all cases. These differences achieve statistical significance, at conventional levels, for both UWFP and UWPP treatments for experienced subjects only ( $p < .10$  for UWFP;  $p < .05$ , UWPP).<sup>31</sup> Here too, of course, the percentages are not anywhere close to the 100% predicted under GL.

### 2.3 Relationship of results to field data

GL has gained support through analysis of ministry allocations in coalition government starting with Browne and Franklin (1973). Empirical studies of GL's performance typically include as a regressor the share of ministries in the coalition government controlled by each party (Browne and Franklin, 1973; Browne and Frendreis, 1980; Schofield and Laver, 1985; Laver and Schofield, 1990; and Warwick and Druckman, 2001).<sup>32</sup> The three player treatments considered here, for which the minimum integer representation is  $(1, 1, 1)$ , allow us to nest the

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<sup>31</sup>In this case we use bargaining round as the unit of observation. There is a minor puzzle here in that while bargaining shares for one-vote blocks are converging to an equal share over time, the two-vote block's are inviting the one-vote blocks into the coalition with increased frequency. We are left to conjecture that with one-vote blocks getting nearly equal shares in MWCs, there is little to choose from in terms of inviting one- or two-vote blocks to move second. As a result subjects may be using efficiency as a tie-breaking rule since one-vote blocks get to take home the full share allocated to them (see, for example, Charness and Rabin, 2002).

<sup>32</sup>Several recent empirical studies have compared GL with the BF model of legislative bargaining (see Ansolabahere, Snyder, Strauss, and Ting (2003) and Warwick and Druckman (2003)).

predictions of DB and GL in a simple specification.<sup>33</sup> In what follows we do this for our experimental data. FKM (2004a) and FKM (2004b) also look into the relation between those experimental data sets and regressions used on field data. Those papers however employ specifications used with field data instead of proposing a new approach as is done here.

A few preliminary comments are in order before describing the exact specification employed. First, data for one player, or party, must be dropped for each bargaining round or coalition government observation. The simplest way to see this is to think of a MWC where all the money is exhausted. In this case, the share of one subject, or political party, is one minus the share of the other coalition member. Hence, failure to drop the data for one of the players in a MWC would introduce correlation in the error term, which violates the standard assumptions of OLS. The subject/party we choose to drop will be that of the formateur. Note, the correlation in the error term resulting from the failure to drop the data from one party is an unrecognized problem in all the regressions using field data reported in the literature that we are aware of.

Second, ever since Browne and Franklin's (1973), the traditional GL specification has used as an explanatory variable the share of ministries in the coalition government controlled by each party (what we will refer to as the weak version of GL, or WGL). However, this only operationalizes one part of Gamson's argument, totally neglecting the second part that the formateur "will favor the *cheapest winning coalition*." To operationalize this we employ the *conditional*

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<sup>33</sup>This specification also nests the BF model for the three player case.



*seat ratio* as the explanatory variable, conditional on being part of the cheapest MWC; i.e., if the party (subject) is predicted by GL to be included in the winning coalition the *conditional seat ratio* is equal to the share of seats (votes) in the winning coalition and zero otherwise (the strong version of GL: SGL). For example, in our design with 5 votes, if the formateur has two votes and forms a coalition with a 1-vote player, the 1-vote players *conditional seat ratio* will be  $\frac{1}{3}$ , but if he forms a coalition with a 2-vote player then the 2-vote player is assigned a *conditional seat ratio* of 0.

This yields the following specification

$$y_i = c + \beta (\text{conditional seat ratio}_i) + \varepsilon_i$$

where  $y_i$  is the share of the pie (weighted fraction of ministries) for each subject (political party)  $i$  who is not a formateur in a given bargaining round (year),  $c$  is the estimate for the constant, and  $\varepsilon_i$  is an error term. We will assume that  $\varepsilon_i$  has the usual properties for OLS estimation to be consistent.<sup>34</sup> Under this specification GL predicts that  $c = 0$  and  $\beta = 1$ , and DB predicts that  $c = 1/2$  and  $\beta = 0$ . That is, DB is unaffected by the changes in conditional seat ratio since voting blocks, regardless of whether they control 1 or 2 votes have the same real voting power and should receive half the pie, as opposed to GL where

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<sup>34</sup>For instance we neglect any intra subject/party correlation across time which is standard in field studies. However, we correct the standard errors to account for potential correlation within a group/government as in Ansolabahere, Snyder, Strauss, and Ting (2003) and FKM (2004a).

pie share varies with the number of votes a party brings to the coalition.<sup>35</sup>

[Table 7 approximately here]

Estimates for the experimental data, pooling treatments EW with  $\delta = 1$  and UWPP are reported in Table 7.<sup>36</sup> The estimates reported in columns (1) - (2) use the conditional seat ratio as the explanatory variable over all bargaining rounds (column 1) and over the last three bargaining rounds for experienced subjects (column 2). We are clearly able to reject the point predictions of both models over the full data set. However, note that the data are clearly closer to the predictions of DB than to SGL as the coefficient value for the constant is twice that of the conditional seat share. Remarkably enough, over the last three bargaining rounds, we are *unable* to reject a null hypothesis based on the point predictions of the DB model.<sup>37</sup> This is not strictly an artifact of the smaller sample size, as witness the estimates in column (3) using data from the first inexperienced bargaining round (to obtain a similar sample size), where we can reject the point predictions of all three models at better than the 5% level.

Specification (4), which employs the usual seat share measure, shows the effect of neglecting the coalition composition aspect of GL. Although we can

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<sup>35</sup>The BF model predicts that  $c = 1/3$  and  $\beta = 0$ , as with no discounting (and no opportunity to amend proposed allocations), the formateur will get 2/3 of the pie.

<sup>36</sup>Estimates for the specifications reported in Table 7 using the EWFP treatment instead of the EWPP treatment are reported in the appendix. The qualitative results are the same as those reported here.

<sup>37</sup>Remarkable in the sense that point predictions of models are rarely satisfied in experimental data. Hence, our emphasis on comparative static predictions or the relative size of the coefficient values.

still reject WGL's point predictions (intercept of zero and seat share value of 1.0), and the seat share coefficient is well below 1.0, qualitatively the results now clearly favor GL over DB as the coefficient value for seat share is now more than twice that of the constant. In addition to ignoring the coalition composition element of GL, the better fit achieved here results in part from the ability of this looser specification to capture those bargaining outcomes that result in winning coalitions that include all three parties. The easiest way to see this last point is to think of the traditional specification employed for the field data that would include all parties in the coalition government. In this case, if we observe a coalition with all three players, even though GL predicts that only two should be in the coalition, the seat shares sum to one in this looser GL specification, thereby readily accommodating the data. On the other hand, the way BF and DB are operationalized (using bargaining power), bargaining power sums to 1.5, which is bound to result in a poorer fit.

**Conclusion 6** *Regressions similar to those employed with field data, but which account for **both** the share prediction and the coalition composition prediction of GL, clearly favor DB over GL in the experimental data. However, more traditional regression specifications used to test GL, which ignore the coalition composition prediction of GL, favor GL over DB. We argue that the former specification is the more appropriate one for distinguishing between the two models.*

## 2.4 Results for $\delta < 1$ treatments

DB predicts no effects from discounting in equilibrium. This stands in marked contrast to predictions of alternating-offer legislative bargaining models (for example, Baron and Ferejohn, 1989), where a shrinking pie enhances proposer power. The  $\delta < 1$  treatments were implemented to test this prediction. We conjectured that there could be two possible behavioral effects of discounting between stages: (1) it might introduce (or enhance) a first mover (formateur) advantage and (2) it might result in more bargaining rounds ending in stage 1 and/or ending in two steps. These conjectures are based on the idea that with a shrinking pie, it might be easier to bully subsequent players into accepting smaller shares, as a shrinking pie can induce third players to accept less in cases where the first demander asks for a share greater than  $1/2$ .<sup>38</sup> We employed two different discount rates:  $\delta = .8$  and  $.5$ , with one session of inexperienced subjects in both cases.

[Table 8 approximately here]

Table 8 reports these results, where we reproduce the earlier results for the case of  $\delta = 1$ . The percentage of bargaining rounds ending in stage 1 is virtually identical across treatments, averaging 94% for both  $\delta = 0.8$  and  $\delta = 0.5$ , compared to 93% with  $\delta = 1$ .<sup>39</sup> There is some variation in the frequency

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<sup>38</sup>Recall footnote 29. Of course, the first mover does not benefit from this out-of-equilibrium play as he/she is cut of the winning coalition, which is what prevents such an outcome in the equilibrium behavior of DB.

<sup>39</sup>None of these are statistically different (all p-values  $> 0.1$ ) using a test of proportions. Similarly, the average number of stages needed to reach agreement is not statistically different

of bargaining rounds ending in two-steps, but only treatments 0.8 and 0.5 are statistically different from each other ( $p < .05$ , two-sided Mann-Whitney test). Notice that as  $\delta$  decreases, the number of rounds finishing in 2 steps decreases. However, at best this effect is marginally significant: An ANOVA rejects the null hypothesis (at the 10% level) that as  $\delta$  decreases the number of steps increases, while the p-value for the (non-parametric) Kruskal-Wallis test is 0.10. The vast majority of bargaining rounds end with MWCs, averaging 86% for  $\delta = 1$ , 90% for  $\delta = 0.8$ , and 93% for  $\delta = 0.5$ . Only treatments  $\delta = 1$  and  $\delta = 0.5$  are statistically different from each other ( $p < .05$  using a test of proportions; the other two comparisons have p-values above 0.1).<sup>40</sup>

The step 1 demands are averaged over all such demands. These are quite close to 0.50 in all cases, and they differ significantly from .50 only in the  $\delta = 0.8$  treatment with a p-value of 0.01 (two-sided Mann-Whitney test on subject averages  $> 0.1$  in the other cases). In that treatment, this is a persistent effect although it finally vanishes (not statistically different past period 8).

First movers share in MWCs is defined as the share demanded by the first demander in a MWC (whether this be the first player actually making a demand in that stage or the second player, in those cases where the first demander was not included in the MWC). Here too the average shares are very close to .50, 

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 (all p-values  $> 0.1$  using a two-sided Mann-Whitney test).

<sup>40</sup> All of the statistical tests reported in this paragraph treat each observation as independent. Clearly, this may not be the case since they involve repeated observations of the same subjects, so that there might be some positive correlation in outcomes across bargaining rounds. The net effect of this is that we are likely to reject a null hypothesis of no difference more often than is warranted.

with none significantly different from .50 (p-values of two-sided sign test on subject averages  $> 0.1$ ).

**Conclusion 7** *The threat of a shrinking pie, should bargaining rounds not be completed in stage 1, has no systematic effect on outcomes, and any effect it has is small in magnitude. This is consistent with the DB prediction.*

### **3 Comparing Demand Bargaining with the Alternating Offer (Baron-Ferejohn) Bargaining Protocol**

This section compares DB outcomes with those from BF. The focus will be on EW games. The primary caveat in making these comparisons is the difference in pie size between the two experiments. But this seems too small to have any major effect on behavior, and FKM (2004a) report a series of five player bargaining games with the same pie size, which show much the same results as in the three-player games reported on here.

[Table 9 approximately here]

The first two columns of Table 9 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 bargaining rounds end in stage 1 much more frequently in

DB than in BF ( $p < .05$  using a Mann-Whitney test with session as the unit of observation and pooling across experience levels). However, as noted earlier for DB, within a bargaining round, it often required more than the minimal number of steps (demands) to achieve an allocation, with only 65% (80%) of all bargaining rounds ending in two steps, as DB predicts for inexperienced (experienced) bargainers. The typical reason for these extra steps was that one of the early players demanded too much, so that he was passed over (and received a zero share as a consequence); e.g., with inexperienced subjects, the average demand for subjects excluded from the final allocation in the EW treatment when three steps were necessary was a 0.58 share, compared to an average share of 0.49 for those included in the winning coalition.

The last two columns of Table 9 report the frequency of MWCs across treatments. These percentages are above the 50% in every session, and are substantially higher under DB than under BF.<sup>41</sup> Although the frequency of MWCs clearly tend to be higher under DB than BF, what the averages leave out is the more or less steady growth in the frequency of MWCs in the BF games (see Figure 3). Both these results, higher average MWCs in DB than BF, and growing frequency of MWCs in BF over time, replicate the results for five player EW and Apex games reported in FKM (2004a).

**[Table 10 approximately here]**

Table 10 compares average shares to proposers (first-movers), along with the

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<sup>41</sup> $p < .05$  using a Mann-Whitney test with session as the unit of observation and pooling across experience levels.

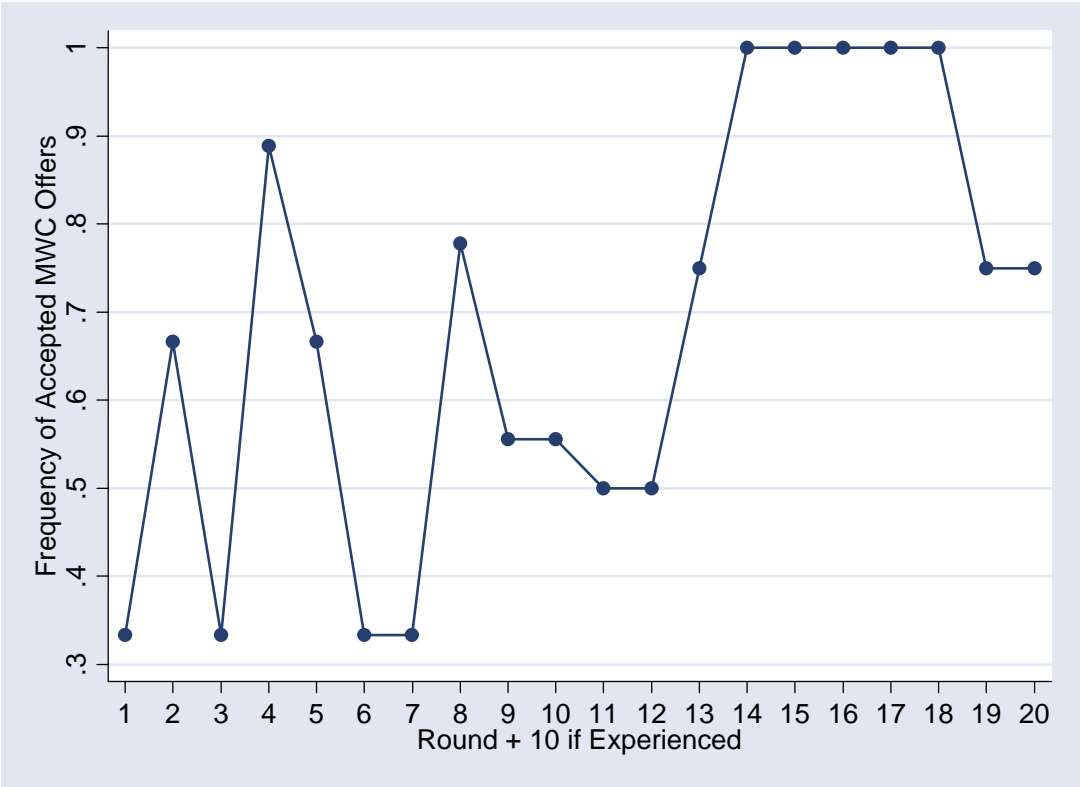


Figure 3: Evolution of Frequency of MWC Offers in BF EW Treatment



minimum and maximum shares, in BF versus DB for EW games for MWCs. In DB games first-movers get essentially half the pie, while in BF there is a clear (if much smaller than predicted) proposer advantage as formateurs consistently get 55% of the pie ( $p < .01$  for these differences using a Mann-Whitney test with subject averages as the unit of observation). These results are also similar to those reported for five-player EW games in the sense that there is significantly more proposer power in BF games than in DB games, as the theory predicts. Further, in terms of absolute dollar amounts, after adjusting for the pie size differences between the two experiments, the first mover advantage is a bit larger in the five-player games compared to three-player games: Formateurs gain \$1.50 more than they would with an equal split between coalition partners in the three-player games (with pie size \$30), versus gaining \$3.60 more than with an equal split in the five-player games (with a pie size of \$60). The latter is for inexperienced subjects, with an even larger increase (\$4.26) for experienced subjects. Finally, in the five-player games under the DB protocol, first movers have a small first-mover advantage, with average shares consistently greater than the share of votes they contribute to the MWC. We suspect that the increased shares obtained by formateurs (first-movers) in the five player games results from the relatively greater pressure players are under to accept smaller shares or possibly be completely excluded from the coalition should a MWC form without them. Finally, note that the minimum formateur share obtained under the BF protocol is at or above 50%, whereas it is below 50% under DB. This too attests to the stronger first mover advantage under BF compared to

DB procedures.

## 4 Summary and Conclusions

We compare the predictions of two leading non-cooperative bargaining models (Baron-Ferejohn, 1989; Morelli, 1999) with Gamson's Law (Gamson, 1961) in three player divide the dollar games in which no single player has enough votes to form a winning coalition on their own. The non-cooperative bargaining models make very different predictions from each other and from Gamson's Law under the different treatment conditions explored. Under all treatments, all three models imply minimum winning coalitions (MWCs). In equal weight games, where each voting block controls the same number of votes, the BF models predicts that the ex post distribution of shares will strongly favor the proposer, whereas both DB and GL predict equal shares between coalition partners. Changes in nominal voting weights without resulting in any of the three voting-blocks obtaining an outright majority should have no effect on the distribution of shares between coalition partners under both BF and DB, as these changes have no effect on real bargaining power. In contrast, GL predicts that coalition shares will reflect each voting block's relative contribution to the MWC. The models also make different predictions regarding coalition membership under proportional recognition probabilities, with GL predicting that the party with the fewest number of votes will always be invited into the winning coalition by the larger parties, DB predicting no preference for which party to include, and BF pre-

dicting (under our treatment conditions) a strong, but not exclusive, preference for the smallest voting block.

The paper first summarizes results from an earlier experiment comparing BF with GL. Results from the earlier experiment show some proposer power in EW games, but far from the power predicted in the BF model. On this evidence alone one would come down in favor of GL or DB as payoff shares are closer to proportional than to the disproportionate shares the BF model predicts. However, introducing treatments with unequal nominal voting weights, with no voting block having a majority by itself, fails to achieve the disproportionate shares that GL predicts, as well as anything approaching the exclusive inclusion of the smallest voting block into winning coalitions that GL predicts. As such, we argue that this rules out GL as an explanation for the smaller than predicted shares that formateurs obtain in the BF games. Rather, the explanation for these smaller than predicted shares appears to rest on the reluctance of subjects to accept anything approaching the subgame perfect equilibrium share predicted in the BF games. A result that is quite similar to results reported for bilateral bargaining game experiments.

We then go on to report in detail a new experiment comparing the predictions of GL with those of Morelli's (1999) demand bargaining model. We compare treatments in which each player controls an equal number of votes to ones in which each player controls a different number of votes (while still not being able to constitute a majority on their own). Within the latter we consider a treatment where the subject acting on behalf of each voting block takes home

the full amount of money allocated to that voting block, as well as one in which this player takes home a proportionate share of the money allocated to the voting block (as if the money has to be shared equally between members of the coalition that person represents). The same equity considerations used to explain the shortfall in proposer power in the BF game should promote GL over DB in this proportional payoff treatment.

Our results show that GL has some drawing power in the proportionate payoff treatment, especially early on for inexperienced subjects, but that payoff shares gradually approach the 50-50 split predicted under DB. Further, the small voting block is not invited into winning coalitions as often as predicted under GL. Why do “equity” considerations appear to play a smaller role here than they do in the BF games? First, it's clear there is a strong learning process in the data as the small voting block asserts its bargaining power over time. It would be worthwhile to explore one or more of the learning models (e.g., Roth and Erev, 1995 or Camerer and Ho, 1999) used to explain the failure of proposer power in bilateral bargaining games to better understand this factor.<sup>42</sup> Second, it has always been clear in the bilateral bargaining game (and related economic) literature that gave rise to the other regarding preference literature that strategic and equity considerations *both* play a role in bargaining outcomes. Evidence for this is contained in the BF game results themselves, as they show consistent formateur power but not as much as the SSPE solution would predict.

GL performs very poorly both under the BF bargaining protocol and under

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<sup>42</sup>For an example of this using the FKL data see Fréchet, 2004.

the DB protocol in terms of its ability to organize the comparative static outcomes of the various treatment conditions implemented. Our research indicates a number of reasons for the continued success of GL in organizing the empirical data on portfolio allocations within coalition governments, which provides the strongest empirical support for GL. First, in our five-player legislative bargaining game experiment (FKM, 2004a), we explore the ability to distinguish between the DB bargaining protocol (which, under the treatment conditions employed, yields the same predictions regarding coalition shares as GL) from the BF protocol using regression specifications usually employed to distinguish between the two bargaining protocols using field data. These regressions show that the experimental data *cannot* identify the data generating process using the criteria commonly employed with the field data, and yield striking similarities to regression coefficients found in the field data, regardless of the underlying bargaining game. Our interpretation of these regression results is that, to the extent that either the DB or BF bargaining models faithfully characterizes the bargaining process underlying the composition of coalition governments, the behavioral similarities found in the laboratory are present in the field as well. Second, the regressions reported here providing a nested specification for comparing DB with GL for three player games show that when accounting for *both* the share predictions of GL and its implications for coalition composition, DB provides a far better fit to the data than does GL. However, ignoring the coalition composition prediction of GL (which results in the models' no longer being nested), shows that WGL provides a better fit to the data than DB. The reason

for this is that this much looser specification captures those bargaining outcomes that result in supermajorities, which are strictly ruled out under DB. Thus, if the primary goal is to obtain the best fit to the data, the traditional way of fitting GL to the data, ignoring its implications for coalition composition, will work better than DB as it has, in effect, more degrees of freedom. This result highlights the importance of accounting for the coalition composition implications of GL when evaluating its fit to the data, both in the lab and in field settings.

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This Column Gives the no. of Votes for the Proposer	All		MWC	
	Form.	(Highest) Non-Form.	Form.	(Highest) Non-Form.
<b>EW: Inexperienced</b>				
<b>33</b>	0.49	0.43	0.55	0.45
<b>EW: Experienced</b>				
<b>33</b>	0.55	0.44	0.55	0.45
<b>UW: Inexperienced</b>				
<b>9</b>	0.46	0.52	0.47	0.53
<b>45</b>	0.53	0.41	0.58	0.42
<b>45 gives to 9</b>		0.37		0.39
<b>45 gives to 45</b>		0.38		0.48
<b>UW: Experienced</b>				
<b>9</b>	0.45	0.52	0.46	0.54
<b>45</b>	0.54	0.42	0.57	0.43
<b>45 gives to 9</b>		0.38		0.42
<b>45 gives to 45</b>		0.37		0.43

Table 1: Shares by Position and Weight in BF

Treatment	Number of subjects	Predicted Share for first mover			Ex-Ante Inclusion Probability	
		Weight:	1	2	1	2
Equal weights (EW)	36 inexp.,	Demand-Barg.	.50	n/a	.66	n/a
	15 exp.	Gamson's Law	.50	n/a	.66	n/a
Unequal weight, full payoff (UWFP)	33 inexp.,	Demand-Barg.	.50	.50	.66	.66
	15 exp.	Gamson's Law	.33	.66	1	.50
Unequal weight, proportional payoff (UWPP)	33 inexp.,	Demand-Barg.	.50	.50	.66	.66
	15 exp.	Gamson's Law	.33	.66	1	.50

Table 2: Experimental Treatment Conditions and Predictions

End in:	Inexperienced			Experienced		
	Stage 1	2 Steps	MWC	Stage 1	2 Steps	MWC
EW	93%	65%	86%	98%	80%	100%
UWFP	85%	52%	90%	92%	78%	92%
UWPP	75%	46%	93%	100%	72%	100%

Table 3: Percentage of Elections Ending in Stage 1, in a total of 2 steps and of MWCs

Votes	Inexperienced		Experienced	
	1	2	1	2
EW	0.49	n/a	0.50	n/a
UWFP	<b>0.51</b>	<b>0.47</b>	0.49	0.50
UWPP	<b>0.42</b>	<b>0.54</b>	<b>0.46</b>	<b>0.52</b>

Table 4: Average Demands in Final MWCs

	EW		UWFP		UWPP	
	Inexp.	Exp.	Inexp.	Exp.	Inexp.	Exp.
SPE demands	41%	79%	32%	46%	22%	31%
Step 1 SPE demands	41%	80%	31%	41%	18%	25%
SPE demands in final stage	47%	85%	40%	52%	32%	37%
SPE allocations	34%	76%	22%	36%	16%	26%

Table 5: SPE Demands

	Inexperienced		Experienced	
	Invited 2 <sup>nd</sup>	In MWC	Invited 2 <sup>nd</sup>	In MWC
UWFP	0.53	0.56	0.61	0.65
UWPP	0.55	0.56	0.72	0.67

Table 6: Fraction of Stages Where the Subject with 1 Vote is Invited Second and Fraction of Final Stages Where he is in the Winning Coalition (conditional on MWC)

	All Rounds	Last 3 Rounds	First Round	All Rounds
	(1)	(2)	(3)	(4)
Conditional Seat Ratio	0.155**	0.171**	-0.002	
	(0.043)	(0.076)	(0.132)	
Constant	0.388***	0.418***	0.420***	0.180***
	(0.021)	(0.037)	(0.052)	(0.029)
Seat Share				0.582***
				(0.058)
No. Obs.	350	30	27	350
P-values of Joint Hypothesis				
DB	0.000***	0.100	0.039**	0.000***
GL <sup>§</sup>	0.000***	0.000***	0.000***	0.000***

Clustered standard errors in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

<sup>§</sup> SGL for specifications 1, 2, and 3; WGL for specification 4.

Table 7: Regression Estimates on Experimental Data



	EW (Inexperienced)				
	End in:		MWC	Step 1 Demands	First Mover's Share in Accepted MWC's
	Stage 1	2 Steps			
$\delta = 1$	93%	65%	86%	0.53	0.49
$\delta = 0.8$	94%	78%	98%	0.52	0.51
$\delta = 0.5$	94%	56%	92%	0.52	0.49

Table 8: Effects of Discounting of Payoffs in Equal Weight (EW) Treatment

Equal Weight	Frequency bargaining ends in stage 1		Frequency of MWC	
	BF	DB	BF	DB
Inexperienced	65.0% (1.6) [6]	93.3% (1.1) [3]	60.8%	85.8%
Experienced	76.7% (1.2) [2]	98.0% (1.0) [2]	77.8%	100.0%

Table 9: Frequency of bargaining rounds that end in stage 1 and of minimum winning coalitions. Average [maximum] number of stages in parenthesis [square brackets]

	<b>DB</b>			<b>BF</b>		
	Min	<b>Mean</b>	Max	Min	<b>Mean</b>	Max
<b>Inexperienced</b>	0.10	<b>0.49</b>	0.90	0.50	<b>0.55</b>	0.70
<b>Experienced</b>	0.40	<b>0.50</b>	0.60	0.50	<b>0.55</b>	0.67

Table 10: Average Share to the Proposer in Accepted MWC

## A Additional Estimation Results

	All Stages	Last 3 Stages	First Stage	All Stages
	(1b)	(2b)	(3b)	(4b)
Conditional Seat Ratio	0.051	-0.040**	0.161	
	(0.045)	(0.016)	(0.175)	
Constant	0.440***	0.526***	0.320***	0.318***
	(0.020)	(0.009)	(0.072)	(0.032)
Seat Share				0.314***
				(0.063)
No. Obs.	362	30	29	362
P-values of Joint Hypothesis				
DB	0.000***	0.017**	0.001***	0.000***
GL <sup>§</sup>	0.000***	0.000***	0.000***	0.000***

Clustered standard errors in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%

§ SGL for specifications 1, 2, and 3; WGL for specification 4.

Table 11: Regression Estimates on Experimental Data (EW and UWFP)