

# Pork Versus Public Goods: An Experimental Study of Public Good Provision Within a Legislative Bargaining Framework\*

Guillaume R. Fréchette<sup>†</sup>

New York University

Department of Economics and CESS

John H. Kagel

Ohio State University

Department of Economics

Massimo Morelli

Columbia University

Departments of Economics and Political Science

May 2, 2009

---

\*This research was partially supported by: National Science Foundation Grants No. 0213312, 0519205, 0519045 and 0721111; the Mershon Center at The Ohio State University, and the Center for Experimental Social Science and the C.V. Starr Center at New York University. We thank Alan Wiseman, Johanna Goertz, Pedro Dal Bó, participants at the Séminaire Matuszewski at Université Laval (Québec 2007) and at the Citibank Workshop in Economic Theory at Brown University (Providence 2007), Society for Economic Design 5th Conference on Economic Design (Ann Arbor 2008), Social Dilemmas Conference (Tallahassee 2008), Experimental and Behavioral Conference (Santa Barbara 2008), Allied Social Science Associations Annual Meeting (New Orleans 2008), CIRANO conference on Individual Decisions and Political Process (Montreal, Canada, 2008) for useful comments and Kirill Chernomaz for developing the software employed in conducting the experiment along with helping to run the sessions. The software was developed using zTree (Fischbacher 2006). Any opinions, findings, and conclusions or recommendations in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation or the other funding agencies.

<sup>†</sup>Corresponding Author. Department of Economics, 19 West Fourth Street, 6th Floor, New York, NY 10012-1119; Tel. (212) 992-8683; frechette@nyu.edu.

## **Abstract**

We experimentally investigate a recent model in which legislators allocate a fixed budget between public goods and particularistic goods. Our results are consistent with many of the qualitative implications of the model: Public good provision varies monotonically across regions in the direction predicted. There is near exclusive public good provision in the pure public good region, and in the pure private good region the predominant tendency is for minimum winning coalitions with little public goods provided. However, in the “mixed region” in which both collective and particularistic goods are provided, the share of the budget devoted to the public good decreases as the relative value of the public good decreases, which is inconsistent with the theory. This can be rationalized as a best response of proposers to how subjects voted.

Key-words: Legislative Bargaining, Public Goods, Efficiency.

JEL classification: C7, D72, C92, C52.

# 1 Introduction

One of the most important questions in economics and political science is understanding how any collective body makes decisions, and, in particular, under what conditions we can expect an efficient provision of public goods by such collective bodies. Public good provision is a key aspect of what governments and legislatures do, with governments and legislatures typically being the most important suppliers of public goods. Even in countries where the government is not the most important supplier of public goods like health care and education, it is often the sole supplier of some key public goods such as defense and law enforcement. However, collective decision making bodies are far from being “benevolent unitary actors.” Rather their members are constantly trading off the virtues of the public goods under consideration against the attractiveness of spending the money on particularistic goods (pork) benefiting themselves individually or their districts.<sup>1</sup> Theoretical and experimental methods can help clarify this trade-off, with our goal in this paper being to identify and characterize the *behavioral patterns* of a collective body facing these types of choices.

Most of the experimental literature on public good provision has focussed on voluntary contribution mechanisms, or provision point mechanisms, in which individual agents decide between allocating their personal endowment to their own private use or to benefit the group as a whole. Both of these mechanisms have a very different structure from the one legislators face in bargaining over budget allocations, as public goods (both level and scope) have to be determined by some collective-choice procedure, and there always are particularistic goods available as alternative ways to use the budget. Thus, we need to turn to a reasonably appropriate model that explicitly considers the political process by which public goods are provided to capture the competing forces at work in political institutions.

For the most part, legislative bargaining theory has focused either on distributive politics or on policy decisions. Only recently have there been major efforts to model legislators’ incentives to provide public goods when the alternative use of the budget is to provide

---

<sup>1</sup>Particularistic goods here can be local public goods in the sense that they primarily yield benefits within the district the legislator represents. In this sense public goods refer to more global public goods which are enjoyed by all districts.

particularistic goods.<sup>2</sup> Volden and Wiseman (2005)<sup>3</sup> provide a benchmark model for our experimental analysis, since they model a bargaining game where legislators can agree on any division of the budget between particularistic and collective good spending.<sup>4</sup>

Previous experimental work on legislative bargaining has focused on purely distributive settings. The motivation behind these experiments has been to investigate the ability of the (stationary) subgame perfect equilibrium (henceforth SSPE) outcome to characterize allocations compared to alternative models used to characterize these settings, to measure the bargaining power of the agenda setter, and to determine whether or not Riker's minimum-winning-coalition view of bargaining is confirmed (see for instance McKelvey 1991; Fréchette, Kagel and Lehrer 2003 (henceforth FKL); Diermeier and Morton 2004; Diermeier and Gailmard 2004; Fréchette, Kagel and Morelli, 2005c (henceforth FKM(2005c))).<sup>5</sup>

Adding the possibility of proposing different combinations of private and public goods introduces a number of interesting new behavioral questions: Given that public good offers are by definition to everyone, will agents be biased (relative to the theory) in favor of the public good provision out of equity, efficiency or some other considerations? Can the possibility of public goods increase proposer power in some situations? What happens to the proposed combinations of private and public goods when the relative value legislators place on private goods changes?

The Volden and Wiseman (2005) model extends the Baron-Ferejohn (1989, henceforth BF) alternating-offer model of majoritarian bargaining to a legislature determining how to allocate a fixed budget between public goods that benefit all legislators' districts and

---

<sup>2</sup>There is a line of research incorporating collective and particularistic elements (e. g., Austen-Smith and Banks 1988, Crombez 1996, Banks and Duggan 2000, Baron and Diermeier 2001, Jackson and Moselle 2002, Morelli 1999, Goertz 2006), but those models do not capture the explicit trade-offs resulting from the fact that private and public good spending are alternative uses of *the same* fixed budget.

<sup>3</sup>Henceforth VW. For a list of variables, acronyms, and terms used with specific meaning, see the glossary in the appendix.

<sup>4</sup>Lizzeri and Persico (2001) capture some of the trade-offs between public and private goods in party platforms. Leblanc, Snyder and Tripathi (2000) and Battaglini and Coate (2006) also contain interesting predictions about legislative bargaining when deciding on multiple policy issues. We focus on the Volden and Wiseman model because it explicitly deals with the comparative statics we are interested in, namely the changes in bargaining behavior as legislators' utility from pork relative to common interest policies varies.

<sup>5</sup>There are many more recent experimental investigations of models related to the model of Baron and Ferejohn; some closely related ones are Kagel, Sung, and Winter 2005; Diermeier and Gailmard 2006; Battaglini and Palfrey 2007; Drouvelis, Montero, and Sefton 2007.

particularistic goods that benefit an individual district. In its closed-rule, infinite-horizon form, someone is picked at random to make a proposal, then the others simultaneously vote yes or no on it. If the majority rejects the proposal then a new proposer is chosen at random, with the process repeating until an allocation is determined (with discounting on the size of the budget).<sup>6</sup> Legislators utility functions attach value to the public and private goods, with weights being the same across all legislators. This utility function and the weight associated with the value of public versus particularistic goods can be thought of as a reduced form expression incorporating the impact of the electoral system; e.g., in systems where a politician’s survival is determined more by what happens locally, then the weight put on public goods will be smaller than when their survival depends more on what happens nationally.

In our experiment we vary these weights across treatment conditions in order to produce (1) a situation in which there is a unique equilibrium in which only public goods are provided (a dominant strategy for all players), (2) a mixed region in which both public and private goods are provided and (3) a region with a unique equilibrium with only private goods provided (within a minimum winning coalition; henceforth MWC). The model predicts, somewhat counterintuitively, that for intermediate values of the public good (the "mixed region"), the level of public goods provided *increases* when legislators care more about particularistic goods. This is because the proposer, in using the standard subgame perfect equilibrium logic, needs to offer a public good amount *on* the “participation constraint” of responders, which would be violated if the proposer didn’t increase the budget share of the public good when its value decreases.

Our main experimental results can be summarized as follows: First, the level of public goods provided varies monotonically with the relative value of private versus public goods in the utility function, not only across regions but also within the mixed region. Within the pure private goods region, the predominant tendency is for minimum winning coalitions with no public goods. Within the pure public good region, the vast majority of offers are all public good. Within the mixed region there are a multiplicity of types of allocations, but over time, behavior slowly converges toward allocations with both public and private goods, with the latter allocated exclusively to the proposer (i.e., equilibrium type allocations).<sup>7</sup> In the mixed

---

<sup>6</sup>The discounting is designed to capture delay costs, including the fact that legislators may not be reelected to enjoy the fruits of their labor.

<sup>7</sup>Throughout the paper we will use the terminology “equilibrium type” proposal to mean a proposal that

region, the overall allocation of public goods is substantially higher than the theory predicts, both because of all-public-good offers and the fact that the amount of money proposers take for themselves in equilibrium type offers is substantially smaller than predicted. The share of resources allocated to the public good is inconsistent with the comparative statics of the stationary subgame perfect equilibrium prediction within the mixed region, regardless of whether we look at all proposals or only equilibrium type proposals.

Our experiment also has implications for the public goods literature as it analyzes an entirely different framework for public good provision compared to voluntary contribution and provision point mechanisms that are typically investigated. Our results are similar in some dimensions to VCM and provision point experiments (e. g., the level of public good provision is higher than predicted throughout most of the mixed region). However, there are some major differences: Given the marginal per capita return (MPCR) of a contribution to the public good within the mixed region, public goods provision is substantially higher than reported in VCM games and *increasing* over time (as opposed to the decreasing pattern typical of VCM games). These differences reflect differences in equilibrium predictions between the legislative bargaining game and VCM games, as well as the constraints placed on particularistic goods provision within a legislative bargaining framework. The experiment also has implications for the “other regarding preference literature” that has grown up around bilateral bargaining games in the economics literature (i.e., concern for others’ income that goes beyond the usual assumption that only own income matters). These implications are discussed in the concluding section of the paper.

The plan of the paper is as follows: Section 2 outlines the Volden-Wiseman (2005) model that serves as our benchmark. Sections 3 and 4 give the experimental design and the results, respectively. Summary and concluding remarks are reported in Section 5.

## 2 Benchmark Model and Related Hypotheses

In this section we describe the model of Volden and Wiseman (2005).

Consider a legislature of  $N$  politicians, representing different legislative districts, who have to make a collective decision on how to allocate a fixed budget between a public good allocated strictly positive amounts of particularistic goods to the predicted number of subjects although not necessarily at the predicted level.

and private goods (pork barrel projects). Let  $N$  be an odd number. Denoting by  $y$  the share of the budget allocated to the public good and by  $x$  the  $N$ -dimensional vector of private good shares allocated to the  $N$  legislators ( $y + \sum_{i=1}^N x_i \leq 1$ ), the utility function of each legislator is given by<sup>8</sup>

$$U_i(x, y) = \alpha x_i + (1 - \alpha)yq$$

where  $\alpha \in [0, 1]$  is the relative weight of private goods in the utility function<sup>9</sup> and  $q$  represents the absolute value (or return) of spending a dollar in public good production.<sup>10</sup> Each legislator has the same probability of being selected by Nature as the proposer of a division of the (unitary) budget. If at least  $(N - 1)/2$  responders accept the proposal the budget is divided according to the proposal. If the majority rejects, another random proposer is selected, and the budget shrinks using the discount factor  $\delta$ . The status quo is no budget allocation. The bargaining game is a straightforward extension of the (closed rule) infinite horizon bargaining game of Baron and Ferejohn (1989) to a budget division involving two dimensions - public and particularistic goods. The solution concept is stationary subgame perfection (SSPE).

The model predicts that, fixing  $q$ , for low values of  $\alpha$  only public goods will be supplied as it is a dominant strategy to do so. At the other extreme, for high values of  $\alpha$  only private goods will be supplied, in which case only members of a minimum winning coalition (MWC) receive positive shares. For intermediate values of  $\alpha$  the public good is supplied and the proposer takes some private benefits for himself, but does not offer private benefits to anyone else. The lower bound on the mixed region is given by

$$\alpha_{CM} = \frac{q}{1 + q}.$$

---

<sup>8</sup>The expression here corresponds to the corrected expression provided by Volden and Wiseman in their errata corripge for their utility function. See [http://psweb.sbs.ohio-state.edu/faculty/awiseman/VW\\_APSR\\_final.pdf](http://psweb.sbs.ohio-state.edu/faculty/awiseman/VW_APSR_final.pdf).

<sup>9</sup>Volden and Wiseman (2006) develop a slightly different model where  $\alpha$  is not constrained to take on values between 0 and 1, and legislators' utilities are defined as  $\alpha x_i + qy$ . This specification does not qualitatively effect the equilibria, nor does it affect the comparative statics predictions that we experimentally examine in this paper. We prefer to test the model in its (2005) formulation because we want to vary the "relative" value of private and public goods (by varying  $\alpha$  across treatments) without scaling total utility up or down.

<sup>10</sup>The weight placed on private goods,  $\alpha$ , can vary across legislators, which introduces a number of interesting possibilities that lie beyond the scope of the present paper.

The upper bound on the mixed region is given by

$$\alpha_{MP} = \frac{q(N+1)}{2+q(N+1)}.$$

If  $\alpha \leq q/(1+q)$  it is a dominant strategy to offer only public goods as particularistic have a lower marginal utility than the public good. If  $\alpha \in (\alpha_{CM}, \alpha_{MP}]$ , a proposer has no incentive to deviate and offer all public goods even though such a proposal would surely be approved. The proposer prefers the mixed outcome to the all public goods outcome since he is better off taking a share of the budget for himself while still getting his proposal passed.

In the mixed region, as  $\alpha$  increases, the proposer *decreases* the share of the budget he takes for himself in terms of private benefits. In other words, the theory predicts a *non monotonic* relationship between the supply of the public good and the value legislators place on private goods ( $\alpha$ ). Thus, starting with low values for the private good (low values of  $\alpha$ ) the private good share for the proposer is first zero, then once  $\alpha$  reaches  $\alpha_{CM}$  it jumps up and then decreases within the mixed region, only to jump up again when the value of  $\alpha$  becomes so high that no public good is offered anymore. Finally, when  $\alpha$  is so high that only private goods are offered, the share going to the proposer remains constant for further increases in  $\alpha$ .

### 3 Experimental Design

Each experimental session used a legislature/committee comprised of  $N = 5$  subjects, with the value of the public good  $q = 0.7$  and the discount factor  $\delta = 0.8$  constant for all treatments. Thus the range for the mixed region is given by  $[\alpha_{CM}, \alpha_{MP}] = [0.412, 0.677]$ . The different values of  $\alpha$  used in experimental treatments were 0.3, 0.45, 0.55, 0.65 and 0.75.  $N$  and  $\delta$  were selected to correspond to values used in previous experimental studies of the BF game. Given those parameters,  $q$  was selected to provide a reasonably wide mixed region.

Subjects were told that they had to decide how to divide 50 “francs” between “... two types of allocations: (i) allocations to individual voters or (ii) allocations to the group of voters as a whole (called the group allocation).” They were told the payoff in francs allocated to the group as a whole as well as the payoff in dollars and that those were a function of “...francs allocated to you as an individual as well as your share of the group allocation.” Everything was computerized with subjects screens automatically calculating the conversion

$\alpha$	Budget Share		Payoffs		Efficiency
	Public Good	Private Allocation	Proposer	Responders	
0.3	1	0	\$24.50	\$24.50 <sup>a</sup>	1.000
0.45	0.483	0.517	\$20.93	\$9.30 <sup>a</sup>	0.604
0.55	0.583	0.417	\$20.65	\$9.18 <sup>a</sup>	0.728
0.65	0.680	0.320	\$18.74	\$8.33 <sup>a</sup>	0.850
0.75	0	0.68	\$25.50	\$6.00 <sup>b</sup>	0.857

$\alpha$  = weight placed on private goods in members utility function.

<sup>a</sup> Given to all responders.

<sup>b</sup> Given to coalition partners within a minimum winning coalition.

Table 1: Theoretical Predictions

rate from the group allocation to individual payoffs, as well as the dollar payoffs for any proposed allocation.<sup>11</sup>

Table 1 gives the equilibrium predictions for each value of  $\alpha$ . The share of the budget devoted to the public good is reported as well as the share going to the proposer, along with payoffs (listed in dollars). Note that except for the case of pure private goods ( $\alpha = 0.75$ ), shares to responders represent only payoffs from the public good. In the pure private goods case, shares are allocated only to members of the minimum winning coalition (MWC). Table 1 also shows the efficiency levels predicted under the SSPE. In all cases efficiency is maximized when  $y = 1$  as this provides maximum total money payoffs. Efficiency is measured as the ratio of the difference in the sum of the utilities (monetary payoffs) in equilibrium and the sum of the utilities when  $y = 1$ .

Between 10 and 20 subjects were recruited for each experimental session, so that there would be a minimum of 2 bargaining rounds conducted simultaneously in each session and a maximum of 4.<sup>12</sup> After each bargaining round, subjects were randomly re-matched. Subject numbers also changed randomly between bargaining rounds (but not between the stages

<sup>11</sup>[http://homepages.nyu.edu/~gf35/print/fkm\\_pg\\_online\\_appendix.pdf](http://homepages.nyu.edu/~gf35/print/fkm_pg_online_appendix.pdf) provides sample instructions and screen shots.

<sup>12</sup>Our intention was to have a minimum of 15 subjects in each session, but in some cases enough extras showed up to be able to run four bargaining groups. Two sessions fell short of the desired 15 subjects and were conducted with 10 subjects each (see Table 2 below). There are no discernible differences between sessions as a consequence of the number of subjects present.

within a given bargaining round).

Procedures for each bargaining round were as follows: First all subjects entered a proposal on how to allocate the 50 francs. Then one proposal was picked randomly to be the standing proposal. This proposal was posted on subjects' screens giving the amounts in francs allocated to each subject along with the dollar shares implied by the given allocation as determined by the utility function  $U_i(x, y)$  along with the value of  $\alpha$  in effect for that treatment.<sup>13</sup> 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 (hence initiating a new stage of the same bargaining round). Complete voting results were posted on subjects' screens, giving the dollar amount allocated by subject number along with the francs allocated to the public good, whether that subject voted for or against the proposal, and whether the proposal passed or not.<sup>14</sup>

A total of 15 sessions, all with inexperienced subjects, were conducted. Table 2 lists the values of  $\alpha$  along with the number of subjects in each session. Sessions 1-13 all employed 12 bargaining rounds, with one of the rounds, selected at random, to be paid off on.<sup>15</sup> Sessions 14 and 15 employed a cross-over design with an initial set of 12 bargaining rounds with values of  $\alpha$  equal to 0.45 and 0.55, respectively. These were followed by another 8 bargaining rounds in which the value of  $\alpha$  was changed from 0.45 to 0.55 in session 14 and from 0.55 to 0.45 in session 15.<sup>16</sup> These cross-over sessions were conducted as the between session results with  $\alpha = 0.45$  and .55 failed to show the predicted increase in the budget share allocated to the public good. This design was employed to enable us to use own subject control to test this sensitive comparative static prediction of the model, and to provide subjects with the most

---

<sup>13</sup>For example, in the  $\alpha = 0.55$  treatment, if a proposal allocated 40 francs to the public good, and the remaining 10 francs to the proposer, subjects would see the implied dollar allocations (\$12.60 for responders, \$18.10 for the proposer) on their screens for all players along with the allocations in francs.

<sup>14</sup>Screens also displayed the proposed shares and votes for the last three bargaining rounds as 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.

<sup>15</sup>These cash bargaining rounds were preceded by a bargaining round in which subjects were "walked through" the various contingencies resulting from, for example, accepting or rejecting offers.

<sup>16</sup>These crossovers were announced after completion of the initial set of bargaining rounds, and were completed well within the time frame subjects were recruited for. Upon completion of the entire session, as single round was randomly selected for payment from the first set of bargaining rounds as well as from the second set.

Treatments (value of $\alpha$ )	Session	Number of Subjects	Final Payment in \$		
			Min	Max	Average
0.3	1	10	27.60	30.40	29.30
	2	15	32.50	32.50	32.50
	3	15	31.10	32.50	32.09
0.45	4	15	25.40	27.60	26.61
	5	20	21.50	27.30	25.00
0.55	6	20	19.10	26.10	21.48
	7	25	20.70	25.00	23.03
0.65	8	20	8.00	22.70	15.61
	9	15	15.40	25.60	18.20
	10	20	8.00	28.40	15.60
0.75	11	15	8.90	20.20	15.73
	12	20	8.40	22.30	15.56
	13	15	8.00	26.80	15.18
0.45 to 0.55	14	10	39.30	45.40	42
0.55 to 0.45	15	15	37.40	44.20	40.81

Table 2: Experimental Sessions

striking contrast in terms of their own payoffs for the predicted increase (decrease) in public good allocation following the increase (decrease) in  $\alpha$  that the theory predicts. In both of these sessions, subjects were paid on the basis of one random draw from each of the two sets of bargaining rounds. However, these draws were only made *after* both sets of bargaining rounds had been completed, while the planned change in the value of  $\alpha$ , along with the extra 8 bargaining rounds, was only announced at the end of the first set of 12 bargaining rounds.<sup>17</sup>

Subjects were recruited through e-mail solicitations from students enrolled in economics classes at The Ohio State University. This resulted in recruiting a broad cross-section of undergraduate students. All subjects received a participation fee of \$8 along with whatever monetary allocation they obtained from the randomly selected bargaining round(s). Sessions lasted between an hour and fifteen minutes and an hour and forty five minutes. Table 2 gives the minimum, maximum, and average earnings including the show-up fee for each session.

This design generates four central questions to be investigated with respect to the predictions of the model. (1) Do negotiations stop immediately (as predicted)? (2) Are proposals of “equilibrium type”? (3) Do we observe the predicted relation between  $\alpha$  and  $y$ ? (4) Do proposers exploit their power as predicted?

The rest of the paper will be organized as follows. First, the performance of the SSPE predictions of the model will be evaluated in terms of the four questions noted above. These results will be organized by first presenting evidence dealing with the question at hand followed by a summary of the evidence in the form of a “Conclusion.” Second, the main deviations from the theory identified in the mixed public and private good region will be explored further. Finally, we discuss the present results in relationship to results from other legislative bargaining experiments as well as their implications for the public goods literature and the other regarding preference literature.

---

<sup>17</sup>That is, instructions for the first 12 bargaining rounds were in all respects the same as the instructions for the corresponding sessions without the change in the value of  $\alpha$ .

## 4 Results

### 4.1 Testing the Theory

Most bargaining rounds had only 1 stage. More specifically, 86% of bargaining rounds ended in stage 1, 13% in stage 2, and 1% in stages greater than 2 (with 5 being the maximum number of stages in any bargaining round). These numbers are essentially unaffected when looking at rounds 10 and above when subjects would have had more experience with the game.<sup>18</sup> Further, there were minimal differences in time to agreement across treatments, with treatments where more all public goods offers were made leading to slightly faster agreements (reflective of the fact that all public good allocations usually received unanimous approval).<sup>19</sup>

**Conclusion 1** *The vast majority of bargaining rounds ends in stage 1 as the theory predicts, with only 1% of all bargaining rounds extending beyond stage 2.*

The number of subjects who were offered strictly positive amounts of private goods is reported in Table 3. Looking at all rounds, the modal offer yields private benefits to as many subjects as the equilibrium predicts with  $\alpha = 0.30, 0.55$  and  $0.75$ . The two notable exceptions are  $\alpha = 0.45$  and  $0.65$ , at either end of the mixed region, with too many all public proposals with  $\alpha = 0.45$  and too many MWC type offers with  $\alpha = 0.65$ . Equilibrium type offers are more frequent for all treatments in rounds 10 and above, indicative of within session learning in all cases.<sup>20</sup> These changes are sufficiently strong that for rounds 10 and above the modal offer is an equilibrium type offer for  $\alpha = 0.65$ , and equilibrium type offers have increased from 32% to 40% for  $\alpha = 0.45$ .

---

<sup>18</sup>Given that most of the data is in stage 1, the data analysis that follows uses stage 1 data only, unless noted otherwise. This is done for convenience, as it makes comparisons simpler since we do not have to worry about the effect of discounting on payoffs.

<sup>19</sup>For  $\alpha = 0.3$ , the average number of rounds to agreement was 1.05 versus 1.27 for  $\alpha = 0.65$ , with the other averages inbetween these two values. A Kruskal-Wallis test rejects the null of equality across all  $\alpha$ , but one cannot reject the null that  $\alpha = 0.3$  and  $0.45$  are the same, while  $\alpha = 0.55, 0.65$ , and  $0.75$  are the same.

<sup>20</sup>For the cross-over sessions we include data for all 8 bargaining rounds after the change in  $\alpha$  when characterizing experienced play (periods 10 and above). We do so on the grounds that subjects are already quite familiar with the structure of the game. Results for experienced play are robust to limiting the data to the last 3 bargaining periods before and after the crossover.

Number of Subjects Offered Private Allocations						
	0	1	2	3	4	5
$\alpha = 0.3$	<b>0.80</b>	0.01	0.00	0.07	0.02	0.10
$\alpha = 0.45$	0.54	<b>0.32</b>	0.01	0.05	0.01	0.07
$\alpha = 0.55$	0.28	<b>0.43</b>	0.01	0.13	0.04	0.11
$\alpha = 0.65$	0.09	<b>0.27</b>	0.00	0.44	0.03	0.17
$\alpha = 0.75$	0.06	0.03	0.00	<b>0.62</b>	0.05	0.25
Rounds 10 and Above						
$\alpha = 0.3$	<b>0.82</b>	0.02	0.00	0.08	0.02	0.08
$\alpha = 0.45$	0.53	<b>0.40</b>	0.01	0.02	0.00	0.04
$\alpha = 0.55$	0.28	<b>0.57</b>	0.01	0.08	0.02	0.04
$\alpha = 0.65$	0.06	<b>0.41</b>	0.01	0.39	0.01	0.12
$\alpha = 0.75$	0.09	0.01	0.00	<b>0.73</b>	0.02	0.15

**Equilibrium Type** Offers are in Bold.

Table 3: Frequencies With Which Different Numbers of Subjects Were Allocated Private Benefits: All Offers (including those not voted on)

	All Proposals		Equilibrium Type Proposals		SSPE
	All Rounds	Rounds > 9	All Rounds	Rounds > 9	
$\alpha = 0.3$	0.929	0.961	1.000	1.000	1.000
$\alpha = 0.45$	0.905	0.934	0.860	0.871	0.483
$\alpha = 0.55$	0.802	0.858	0.843	0.847	0.583
$\alpha = 0.65$	0.450	0.569	0.777	0.762	0.680
$\alpha = 0.75$	0.148	0.114	0.049	0.026	0.000

Table 4: Average Proposed Provision of Public Good

The  $\alpha = 0.3$  condition reveals some inefficiencies as 20% of all proposals involve some private goods. However, these misallocations are relatively small in magnitude, as the average share of francs allocated to the public good with  $\alpha = 0.3$  was 91.4% calculated over all rounds, and 95.3% for rounds 10 and above (see below). Finally, in round 12, these allocations of particularistic goods represent just 2% of the budget.<sup>21</sup>

**Conclusion 2** *Looking at all rounds, the modal offer yields private benefits to as many subjects as the theory predicts with the exception of  $\alpha = 0.45$  and  $\alpha = 0.65$ , with too many all public good offers in the first case and too many players receiving private goods in the second case. There is learning/adjustment going on within sessions in that equilibrium type offers are more common in later bargaining rounds for all values of  $\alpha$ .*

Table 4 gives the average proposed share of francs allocated to the public good by treatment for all proposals and for equilibrium type proposals.<sup>22</sup> It also shows the SSPE prediction. Public good allocations are only slightly smaller, on average, when going from  $\alpha = 0.3$  to  $\alpha = 0.45$ . However, the distributions are statistically different between these two treatments (rank sum test, p-value  $< 0.1$  for all rounds and  $< 0.05$  for rounds 10 and above).<sup>23</sup> All of the other pairwise comparisons of the distribution of public good allocations between treatments are statistically significant at the 1% level or better. In

<sup>21</sup> The appendix contains a table equivalent to Table 3 except that it only includes *accepted* offers. The relative frequencies are very similar to those shown in Table 3.

<sup>22</sup> Average accepted shares are quite similar to proposed shares, see Table 9 in the appendix.

<sup>23</sup> Throughout the paper averages, frequencies, and other descriptive statistics use all the relevant data whereas statistical tests average all the observations for a given subject first, and use the subject average as the unit of observation, except when regressions are estimated.

particular, there is a statistically significant *decrease* in the budget share devoted to public goods going from  $\alpha = 0.45$  to  $\alpha = 0.55$  and then to  $\alpha = 0.65$ , *contrary* to what the theory predicts.<sup>24</sup> This difference, although relatively small going from  $\alpha = 0.45$  to  $\alpha = 0.55$  is quite robust. For example suppose that we drop all the subjects who always propose only public goods with  $\alpha = 0.45$  on the grounds that they are simply miscalibrated, which biases the average allocation against what the theory predicts.<sup>25</sup> Then looking at the cross-over sessions, using own subject differences as the unit of observation, the average share of the budget allocated to the public good for all proposals for all rounds is 0.88 with  $\alpha = 0.45$  versus 0.78 with  $\alpha = 0.55$ , and 0.89 versus 0.83 in rounds 10 and above, with both these differences statistically significant at the 5% level. Going from  $\alpha = 0.55$  to  $\alpha = 0.65$ , the decrease in the budget share going to public goods is quite dramatic, in large measure because of the large number of proposals allocating private goods to three players instead of one. Finally, note the small share allocated to the public good with  $\alpha = 0.75$ , close in size to the misallocation (but in the opposite direction) as in the all public good region ( $\alpha = 0.3$ ).

Within the mixed region, the average proposed share of francs allocated to the public good, conditional on the proposal being an equilibrium type offer also decreases throughout. This contradicts one of the key comparative static predictions of the model.

The flip side of this is that if we look at the share of the private good that proposers allocate to themselves, conditional on equilibrium type allocations (public goods with only private goods to themselves), the average private share for accepted offers goes from 0.111 with  $\alpha = 0.45$  to 0.135 for  $\alpha = 0.55$  to 0.181 for  $\alpha = 0.65$ , contrary to what the theory predicts (differences statistically significant at the 1% level using a Kruskal-Wallis test).<sup>26</sup> This holds for the cross-over sessions as well. Although these differences decrease slightly over time (looking at bargaining rounds 10 and higher, budget shares proposers allocate to themselves, conditional on equilibrium type allocations, are 0.119, 0.145, and 0.177) they

---

<sup>24</sup>This is established two ways. One way is using the ranksum test for all rounds except those after round 12. The other is using the Wilcoxon matched-pairs signed-ranks test using data from the cross-over sessions. In both cases we can reject a null hypothesis of no difference in favor of a smaller allocation with  $\alpha = 0.55$  at the 0.01 level or better.

<sup>25</sup>This accounts for 9 out of 25 subjects for all rounds and 11 out of 25 subjects for rounds 10 or higher in the cross-over sessions.

<sup>26</sup>Data from period 13 on in the cross-over sessions are not included since the analysis is based on subject data averages which are probably not independent for a given subject before and after cross-over.

$\alpha$		Budget Share		Payoffs	
		Public Good	Private Allocation	Proposer	Responders*
0.3	SSPE	1	0	\$24.50	\$24.50
	Average All	0.973	0.009	\$23.96	\$23.90
	Avg. Eq. Type	1	0	\$24.50	\$24.50
0.45	SSPE	0.483	0.517	\$20.93	\$9.30
	Average All	0.929	0.049	\$18.99	\$18.01
	Avg. Eq. Type	0.884	0.111	\$19.51	\$17.04
0.55	SSPE	0.583	0.417	\$20.65	\$9.18
	Average All	0.886	0.080	\$16.15	\$14.19
	Avg. Eq. Type	0.868	0.127	\$17.17	\$13.70
0.65	SSPE	0.680	0.320	\$18.74	\$8.33
	Average All	0.548	0.223	\$13.95	\$8.58
	Avg. Eq. Type	0.798	0.187	\$15.86	\$9.90
0.75	SSPE	0	0.68	\$25.50	\$3.00
	Average All	0.179	0.319	\$13.53	\$6.27
	Avg. Eq. Type	0.045	0.396	\$15.25	\$5.63

SSPE = predicted under the stationary subgame perfect equilibrium.

Average All = averages for all accepted offers.

Avg. Eq. Type = averages for equilibrium type offers.

\* Average over all 4 responders even when less than 4 subjects are allocated strictly positive amounts.

Table 5: Theoretical Predictions and Observed Averages for Accepted Offers

are still in the wrong direction relative to what the theory predicts (the p-value of the Kruskal-Wallis test is now only significant at the 10% level).

**Conclusion 3** *Public good provision decreases monotonically as  $\alpha$  increases, contrary to the model's prediction within the mixed public and private region going from  $\alpha = 0.45$  to  $\alpha = 0.55$  and 0.65. This is true whether one includes all proposals, or if one conditions on equilibrium type proposals.*

Table 5 gives the SSPE prediction in terms of public versus particularistic good allocations, as well as the payoffs to the proposer and responder. It also reports the average for

all accepted offers, and the average conditional on the accepted offer being an equilibrium type allocation.<sup>27</sup> Note that in the case of  $\alpha = 0.75$ , since the equilibrium calls for a MWC, responders payoffs must be multiplied by 2 to know how much coalition partners within the MWC are being offered.

Focusing on proposer power, the average payoff difference between proposers and responders is \$0.06, \$0.98, \$1.96, \$5.37, and \$7.26 for the  $\alpha$  equal to 0.3, 0.45, 0.55, 0.65, and 0.75 treatments respectively. Conditioning on the offer being an equilibrium type offer, the differences are \$2.47, \$3.47, and \$5.96 for  $\alpha$  equal to 0.45, 0.55 and 0.65 treatments, and \$3.99 *within* the MWC for  $\alpha = 0.75$ . Other than for all proposals with  $\alpha = 0.3$ , the higher payoffs of proposers are all statistically significant ( $p < 0.01$  Wilcoxon matched-pairs signed-ranks test), with proposer power increasing as  $\alpha$  increases. However, the higher payoffs represent only a fraction of what proposers are predicted to take for themselves: 21%, 30%, 33%, and 31% of what they are predicted to make with  $\alpha$  equal to 0.45, 0.55, 0.65, and 0.75, respectively (percentages are for the equilibrium type offers).

**Conclusion 4** *Proposers exploit their power by taking greater shares than responders in every treatment where they are predicted to do so. However, the level of proposer power is significantly less than what is predicted under the SSPE.*

To summarize, the theory performs well on many dimensions. First, subjects almost always agree on a division in round 1 as predicted. Second, there is some proposer power in both the mixed region and in the all private goods region, and this increases as  $\alpha$  increases. Third, the share of the budget allocated to public goods decreases going from  $\alpha = 0.3$  to  $\alpha = 0.45$  and from  $\alpha = 0.65$  to  $\alpha = 0.75$ . There are however four main deviations from the theory. First, the extent to which proposer power is exercised is far from what is predicted in the SSPE. Second, in the  $\alpha = 0.45$  treatment the modal offer is an all public goods offer. Third, in the  $\alpha = 0.65$  treatment the modal offer in the last three rounds consists of an equilibrium type offer, but this is not the case when all rounds are considered. Fourth,

---

<sup>27</sup>Up to this point, tables used all the data with the equivalent table restricting attention to accepted offers in the Appendix. The advantage of using all offers is mainly increased sample size (as well as the fact that conclusions are not materially affected using only accepted offers). The reason for the change of focus here to only accepted offer is that proposer power (which is what this table is used to study) is only relevant to the extent that it can be exercised. If proposers ask for a lot, but their offers are rejected, then they do not have proposer power.

the fraction of resources allocated to public goods decreases as  $\alpha$  increases within the mixed region.

In the next section we focus on these differences from equilibrium predictions within the mixed region. Of particular interest is the fact that the fraction of resources allocated to public goods decreases as  $\alpha$  increases as this contradicts one of the key comparative static predictions of the model. Experience with experimental outcomes has taught us, and most of the profession, that the main gravitational forces inherent in any given model will often be at play even though the point predictions of the model are not satisfied. However, breakdowns in comparative static predictions of equilibrium models are rarer, and suggestive of more fundamental deficiencies in the model, so that we take them much more seriously.

## 4.2 Deviations from Equilibrium Predictions in the Mixed Region

This section elaborates on the main factors we believe underlie the paucity of equilibrium type proposals with  $\alpha = 0.45$  and  $0.65$ , as well as the failure of public good allocations to increase within the mixed region. First, for all values of  $\alpha$  within the mixed region players' first impulse is *not* to provide equilibrium type allocations. This is shown in Table 6 which reports proposals in the first bargaining round of each treatment: These average 12% of all proposals in the mixed region, which is substantially less than the round one frequency of equilibrium type proposals for  $\alpha = 0.30$  or  $0.75$ . Further, as shown in Figure 1, there are steady increases in the frequency of equilibrium type allocations for all values of  $\alpha$  within the mixed region, which, arguably, at least for  $\alpha = 0.55$  or  $0.65$ , would ultimately result in frequencies of equilibrium type allocations like those reported for  $\alpha = 0.30$  and  $0.75$  as subjects gained more experience. In this context, one reason why the frequency of equilibrium type allocations in rounds 10 and above within the mixed region are less than those found with  $\alpha = 0.30$  or  $0.75$  is that they have far more ground to make up compared to these other treatments.

Beside initial tendencies, voting patterns of responders place constraints on what kinds of proposals will be passed. In particular voting behavior limits the amount of proposer power that can be exercised. Table 7 shows this, where votes are regressed on own payoffs as well as payoffs to the proposer (votes of proposers are excluded from these regressions). Own payoff is significant in every treatment. However, for the mixed region the payoff to the proposer has a negative impact on the likelihood that a proposal will be accepted, which

Number of Subjects Offered Private Allocations						
	0	1	2	3	4	5
$\alpha = 0.3$	<b>0.68</b>	0.00	0.03	0.08	0.05	0.18
$\alpha = 0.45$	0.11	<b>0.11</b>	0.02	0.18	0.00	0.18
$\alpha = 0.55$	0.25	<b>0.18</b>	0.00	0.23	0.05	0.28
$\alpha = 0.65$	0.07	<b>0.07</b>	0.00	0.51	0.04	0.31
$\alpha = 0.75$	0.04	0.04	0.00	<b>0.38</b>	0.08	0.46

Table 6: Types of Proposals in Round 1

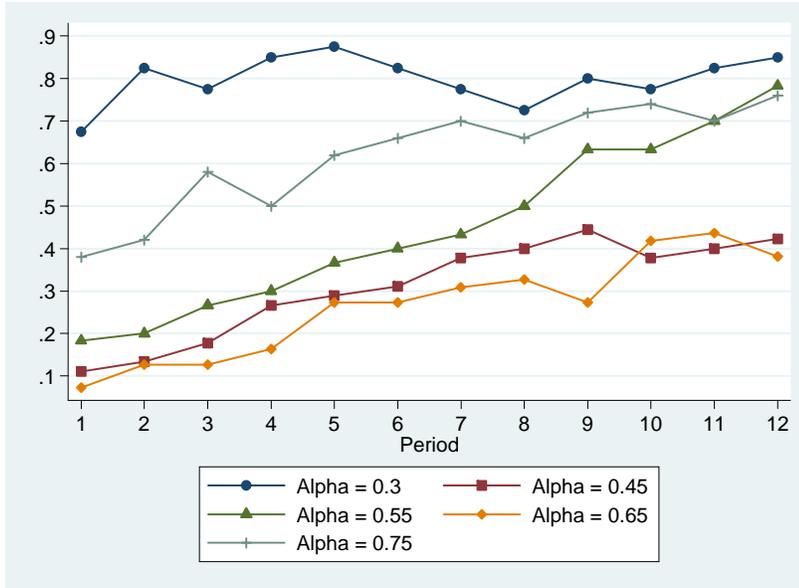


Figure 1: Fraction of Equilibrium Type Offers

	$\alpha = 0.3$	$\alpha = 0.45$	$\alpha = 0.55$	$\alpha = 0.65$	$\alpha = 0.75$
Own Payoff	16.03*** (5.57)	43.41*** (6.81)	27.95*** (2.56)	22.43*** (2.02)	20.99*** (1.89)
Payoff to the Proposer	-6.28 (5.68)	-20.16*** (4.46)	-7.75*** (1.60)	-6.49*** (1.57)	-0.54 (0.97)
Constant	-2.71*** (0.60)	-5.05 (1.47)	-3.81*** (0.51)	-1.54*** (0.54)	-2.55*** (0.41)
$\rho$	0.26 <sup>§§§</sup> (0.12)	0.69 <sup>§§§</sup> (0.11)	0.36 <sup>§§§</sup> (0.09)	0.27 <sup>§§§</sup> (0.09)	0.04 (0.09)
Observations	380	528	640	528	480
Number of subjects	40	60	70	55	50

Standard errors in parentheses

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

§ significant at 10%; §§ significant at 5%; §§§ significant at 1%

using a likelihood ratio test

Table 7: Random Effects probit Estimates of the Determinants of Vote

limits the ability of proposers to exploit their power. This is especially true for the  $\alpha = 0.45$  treatment.

These voting patterns impact the growth of, and the nature of, equilibrium type allocations within the mixed region. In particular, they go a long way to account for the fact that for  $\alpha = 0.45$ , all public good allocations grow faster than equilibrium type allocations (from 0.11 in round 1 to 0.53 in rounds 10 and above for all public good type allocations versus 0.11 to 0.40 for equilibrium type allocations). With  $\alpha = 0.45$  the average payoff to proposers for equilibrium type allocations that are passed averaged \$0.26 more than for an all public good allocation (\$19.51 versus \$19.25). This small increase in proposers' payoffs carries with it considerably greater risk of rejection, as 14% of equilibrium type allocations are rejected for  $\alpha = 0.45$  as opposed to *no* rejections of an all public good allocation. Thus, for  $\alpha = 0.45$ , there is little to be gained from an equilibrium type allocation compared to an all public good type allocation, with some risk of rejection with the resulting shrinkage in the budget. In contrast, with  $\alpha = 0.55$  proposers earned \$1.42 more than with the all public good allocation, a stronger incentive to provide equilibrium type proposals than with

$\alpha = 0.45$ , with essentially no difference in the likelihood of an equilibrium type proposal of this sort being rejected (14% rejection rate for  $\alpha = 0.45$  versus 13% for  $\alpha = 0.55$ ). (All public good allocations continued to be passed 100% of the time for  $\alpha = 0.55$ .)

For  $\alpha = 0.65$  the main rival in round one to an equilibrium type allocation is one in which there is a MWC with all private goods, albeit one with a reasonably large share of the budget allocated to public goods as well (averaging 24% of the budget in round one for these proposals). It takes proposers some time to figure out that they can get more on average from equilibrium type allocations than from MWC type allocations, while also having a better chance of their proposal being accepted: \$15.86 versus \$13.86, with 85% of equilibrium type allocations of this sort being passed compared to 75% of MWC type allocations passing.<sup>28</sup>

The evolution of equilibrium type proposals over time suggests that they would dominate for  $\alpha = 0.55$  and  $0.65$ , if not for  $\alpha = 0.45$ . However, the same cannot be said for the comparative static prediction that the share of budgets allocated to the public good will increase as  $\alpha$  increases in the mixed region since, even conditioning on equilibrium type offers, the level of public good provision is decreasing in the mixed region. So that unless these shares would change with experience, even with all equilibrium type allocations this comparative static prediction of the model would be violated.

The reduction in public good provision within the mixed region, conditional on equilibrium type offers, results from the fact that as  $\alpha$  increases, proposer power increases: Considering only equilibrium type proposals, proposers share as a fraction of total resources goes from 23.7%, 24.7%, to 30.6% for  $\alpha = 0.45, 0.55,$  and  $0.65$  respectively. And this is supported by how responders voted, as estimates from the voting regressions show that the share the median responder required to be indifferent between accepting or rejecting a proposal *decreases* systematically from \$15.17 to \$11.93 to \$8.66 as  $\alpha$  increases from 0.45 to 0.55 to 0.65. That is, increases in proposer power as  $\alpha$  increases, in conjunction with reductions in what constitutes acceptable equilibrium type offers, generates the reductions in the level of public good allocations within the mixed region. Thus, the reduction in public good provision within the mixed region is at least directionally consistent with best

---

<sup>28</sup>Average payoffs to proposers for proposals that passed are biased downward compared to payoffs for proposals that were voted on - but not by much. The latter averaged \$19.61, \$17.34, and \$16.47 for  $\alpha = 0.45, 0.55$  and  $0.65$  respectively compared to \$19.51, \$17.17 and \$15.86 for proposals that passed.

responding on the part of proposers.<sup>29</sup>

### 4.3 Discussion

In the case where  $\alpha = 0.75$  the results reported here are similar to results reported in previous experiments investigating the Baron-Ferejohn model. With  $\alpha = 0.75$  the theory calls for an all private goods allocation within a MWC, which is the modal outcome observed. There is some learning involved as the frequency of MWCs is increasing throughout a session. The frequency of MWCs is very similar to results from prior experiments on multilateral bargaining with only particularistic goods. For example, FKM (2005c) report between 61% and 90% MWCs, depending on the treatment, with committees/legislatures of 3 subjects, and FKM (2005a) report between 63% and 83% MWCs, depending on the treatment, with committees/legislatures of 5 subjects. here too the frequency of MWCs grows, more or less continuously, throughout a session. Within the MWC proposers obtain significantly more private goods than their coalition partners, which is qualitatively what the theory predicts, but they obtain much less than the SSPE predicts. The level of proposer power observed with  $\alpha = 0.75$  is close to what has been observed in previous legislative bargaining experiments with all particularistic goods. Here, proposer's take in an MWC is about 38% of the resources within a MWC while FKL and FKM (2005c) report proposers taking about 40% of the resources within a MWC under closed amendment rule procedures.<sup>30</sup>

Two additional results find a parallel in our earlier studies of the BF model. First, most bargaining rounds end in stage 1. That result has been observed in all of our prior experiments. Second, the fact that proposer's share, which is typically greater than shares offered to coalition partners, negatively affects voting has also been observed in one or more treatments in previous studies of the BF model (FKL, FKMa, FKLc).

The mixed region, where both public and private goods are provided, is relatively narrow within the theory. It appears that it is even narrower behaviorally, as (i) the modal choice just coming out of the all public goods region ( $\alpha = .45$ ) is still all public goods (with

---

<sup>29</sup>Using estimates from the voting regressions to predict the probability of a proposal being accepted, and computing the offer that maximizes the proposers expected payoff (= payoff if accepted \* probability of acceptance + 0.8\*average payoff (with the second term approximating the continuation value of the game)), the expected value maximizing share of the budget going to public goods is 0.89, 0.84. and 0.68 for  $\alpha = 0.45, 0.55$ , and 0.65 respectively.

<sup>30</sup>FKL involved legislatures of 5 members with  $\delta = 0.8$  whereas FKM(2005c) used  $\delta = 1$ .

equilibrium type allocations coming in a close second) and (ii) MWCs with all private goods dominate proposals early on in the neighborhood ( $\alpha = .65$ ) of the mixed region close to the all private goods region. With respect to point (ii) however, learning is such that in later bargaining rounds equilibrium type proposals constitute the modal offer, with these proposals continuing to grow. In some sense it's not terribly surprising that the mixed region is narrower than predicted as at the extremes equilibrium type allocations are not quite so clear cut unless subjects are doing the sorts of detailed calculations that the theory implies. Also note that under the constraints of having five players and  $\delta = 0.8$  (parameter values that were selected in order to make the underlying bargaining structure close to our earlier experiments with all particularistic goods), we selected  $q$  (the return on the public good) to make the mixed region as large as possible.

With respect to the one qualitative violation of the comparative static predictions of the theory, that within the mixed region public good allocations are decreasing rather than increasing, this holds regardless of whether or not we include all proposals (passed or otherwise) or only equilibrium type proposals (passed or otherwise). This indicates that the main gravitational forces predicted to be at play within the theory, are substantially weaker than predicted or not present at all. More than likely this has to do with the fact that subjects are not performing the complicated backward induction calculations underlying the theory, but instead relying on some sort of rule of thumb. Exactly what this might be, a rule (or rules) that get so much of the qualitative predictions of the model right, and gets this one wrong, remains to be discovered. And for those concerned with external validity, we leave it to the reader's judgement (and future empirical work) as to whether one might expect "better" behavior from active politicians or in other intended applications of the model.

Our results have implications for the other regarding preference literature in economics. First, the abundance of MWC proposals with  $\alpha = 0.75$  (also reported in previous experiments with only particularistic goods) indicates that subjects do not have a taste for maximizing the benefits for the least well off as some have argued (Charness and Rabin, 2002; Englemann and Strobel, 2004).<sup>31</sup> Second, in the region where the model predicts only private goods, an all public goods allocation would have provided a perfectly egalitarian

---

<sup>31</sup>Further, with respect to games with only particularistic goods Montero (2007) shows that the standard models of other regarding preferences (e.g., Fehr-Schmidt, 1999) predict that proposer would exhibit even more proposer power than if subjects didn't have other regarding preferences, and this is in clear contradiction with the data in this experiment and previous experiments as well.

distribution that was also a more efficient allocation (in the sense of providing more total benefits) than an MWC with all private goods. Nevertheless, all public good allocations only accounted for 6% of all proposals overall, even though such proposals were almost certain to be passed. Rather subjects opted overwhelmingly for MWCs which provided greater benefits to the members of the coalition than they could have gotten with an all public good allocation. These results are inconsistent with recent suggestions from the other regarding preferences literature that subjects have a taste for efficiency (see, for example, Charness and Rabin, 2002). The primary difference between the present experiment and these other experiments is that the present experiment involves bargaining and these other studies involved simple dictator games. The clear suggestion from a number of dictator game experiments is that the results are not robust to small perturbations in the game, no less in the results transferring to bargaining environments.

Our results have connections to VCM type public goods games. Even though there are radical differences in the structure between the present game and VCM games, they do have in common a well defined marginal per capita return (MPCR) for public good allocations that provides a basis for comparing across games. There are several major, relevant characteristics to VCM games with moderate numbers of players: (i) public good contributions typically start rather high and then trail off over time but rarely are reduced to zero, (ii) the starting level of public goods contributions is often surprisingly high but rarely exceeds 50% of the total possible contributions to begin with, and (iii) the level of public goods contributions is a decreasing function of the MPCR (see Ledyard, 1995 for a survey of the public goods literature). With respect to the first and second characteristics, sometimes our data matches it, other times it does not. Take, for example, the  $\alpha = 0.55$  treatment which has an MPCR of 0.57, close to the 0.50 value often employed in VCM games. Here, the level of public good provision averages slightly over 80% of the maximum possible contribution and is *increasing* over time rather than decreasing (86% of the maximum possible in the last several rounds), consistent with characteristics (i) and (ii) above (see, for example, Croson, 1996).<sup>32</sup> In contrast, with  $\alpha = 0.75$ , we have an MPCR of 0.23 which is close to the 0.30 level others have used (see, for example, Isaac and Walker, 1988). In this case our results are much closer to those reported for VCM games as public good

---

<sup>32</sup>Croson's (1996) strangers treatment, which is what ours amounts to, has an initial contribution rate of just over 40%.

contributions are decreasing throughout the session, and start out with public good levels that are reasonably similar in the two cases (a little over 20% overall in our case versus a little over 30% in Isaac and Walker with four players). Characteristic (iii), decreasing public goods levels with the MPCR decreasing, is common to both cases, and provides one candidate explanation for the reduced public goods contributions in the mixed region, as subjects react in a "natural" way to the reduced value of the public good. Of course, the overwhelming difference between the present game and VCM games, particularly in cases such as  $\alpha = 0.55$  where the results are very different, is that in our case large public good provision is an equilibrium outcome, whereas in the VCM game its a dominated strategy (assuming players only care about own income).

## 5 Conclusions

We investigated a simple model of public goods provision within a legislative bargaining framework. In the model, legislators/committee members have preferences over public and private goods that they must decide between under a fixed budget constraint. (Taxes required to support the budget are exogenous to the model.) Our experimental treatment conditions focus on varying the weight subjects place on public versus private goods, spanning the range of predicted outcomes from all public goods, to mixed public and private goods, to exclusively private goods. We put special emphasis on the mixed region with its counterintuitive prediction that public good provision will increase as the value of the public good decreases. The model also predicts that in the mixed region, private goods will be allocated only to the proposer, the expression of proposer power within the mixed region.

Many of the qualitative predictions of the model find support: Bargaining typically ends in round 1, there is proposer power in all treatments (albeit, less than predicted), equilibrium type allocations tend to dominate throughout, and where they do not within the mixed region, they are growing over time. The one major qualitative failure of the model is that public good allocations decrease within the mixed region, rather than increase as the theory predicts. More than likely this has to do with the fact that subjects are not performing the complicated backward induction calculations underlying the theory, but instead relying on some sort of rule of thumb. Exactly what these might be, that get so much of the qualitative predictions of the model right, and gets this one wrong, remains to

be discovered.

## References

- Austen-Smith, D. and Banks, J. S.: 1988, Social choice theory, game theory, and positive political theory, *Annual Review of Political Science* **1**, 259–287.
- Banks, J. S. and Duggan, J.: 2000, A bargaining model of collective choice, *American Political Science Review* **94**(1), 73–88.
- Baron, D. P. and Diermeier, D.: 2001, Elections, governments, and parliaments under proportional representation, *Quarterly Journal of Economics* **116**(3), 933–967.
- Baron, D. P. and Ferejohn, J. A.: 1989, Bargaining in legislatures, *American Political Science Review* **83**(4), 1181–1206.
- Battaglini, M. and Coate, S.: 2006, A dynamic theory of public spending, taxation and debt. mimeo.
- Charness, G. and Rabin, M.: 2002, Understanding social preferences with simple tests, *The Quarterly Journal of Economics* **117**(3), 817–869.
- Crombez, C.: 1996, Minority governments, minimal winning coalitions and surplus majorities in parliamentary systems, *European Journal of Political Research* **29**(1), 1–29.
- Croson, R.: 1996, Partners and strangers revisited, *Economics Letters* **53**, 25–32.
- Diermeier, D. and Gailmard, S.: 2006, Self-interest, inequality, and entitlement in majoritarian decision-making, *Quarterly Journal of Political Science* **1**, 327–350.
- Diermeier, D. and Morton, R.: 2004. “Proportionality versus Perfectness: Experiments in Majoritarian Bargaining” in *Social Choice and Strategic Behavior: Essays in the Honor of Jeffrey S. Banks*, ed. by David Austen-Smith and John Duggan. Berlin: Springer. Forthcoming.
- Drouvelis, M., Montero, M. and Sefton, M.: 2007, The paradox of new members: Strategic foundations and experimental evidence. CeDEx Discussion Paper.

- Engelmann, D. and Strobel, M.: 2004, Inequality aversion, efficiency and maximin preferences in simple distribution experiments.
- Fehr, E. and Schmidt, K. M.: 1999, A theory of fairness, competition and cooperation, *Quarterly Journal of Economics* **114**(3), 817–868.
- Fischbacher, U.: 2006, z-tree: Zurich toolbox for readymade economic experiments, *Experimental Economics* . forthcoming.
- Fréchette, G. R., Kagel, J. H. and Lehrer, S. F.: 2003, Bargaining in legislatures: An experimental investigation of open versus closed amendment rules, *American Political Science Review* **97**(2), 221–232.
- Fréchette, G. R., Kagel, J. H. and Morelli, M.: 2005a, Behavioral identification in coalitional bargaining: An experimental analysis of demand bargaining and alternating offers, *Econometrica* **73**(6), 1893–1938.
- Fréchette, G. R., Kagel, J. H. and Morelli, M.: 2005b, Nominal bargaining power, selection protocol and discounting in legislative bargaining, *Journal of Public Economics* **89**(8), 1497–1517.
- Goertz, J. M. M.: 2006, Sequential demands in multi-issue legislative bargaining. mimeo.
- Harrington, J. E.: 1990, The power of a proposal maker in a model of endogenous agenda formation, *Public Choice* **64**(1), 1–20.
- Isaac, M. and Walker, J. M.: 1988, Group size effects in public goods provision: The voluntary contributions mechanism, *The Quarterly Journal of Economics* **103**(1), 179–199.
- Jackson, M. and Moselle, B.: 2002, Coalition and party formation in a legislative voting game, *Journal of Economic Theory* **103**, 49–87.
- Kahneman, D. and Tversky, A.: 1979, Prospect theory: An analysis of decision under risk, *Econometrica* **47**, 263–92.
- Leblanc, W., Snyder, J. and Tripathi, M.: 2000, Majority-rule bargaining and the under provision of public investment goods, *Journal of Public Economics* **75**(1), 21–47.

- Ledyard, J. O.: 1995. "Public Goods" in *Handbook of Experimental Economics*, ed. by John H. Kagel and Alvin E. Roth. Princeton: Princeton University Press, 111-194.
- Lizzeri, A. and Persico, N.: 2001, The provision of public goods under alternative electoral incentives, *American Economic Review* .
- McKelvey, R. D.: 1991. "An Experimental Test of a Stochastic Game Model of Committee Bargaining" in *Contemporary Laboratory Research in Political Economy*, ed. by Thomas R. Palfrey. Ann Arbor: University of Michigan Press.
- Montero, M.: 2006, Inequity aversion may increase inequity, *Economic Journal* . Forthcoming.
- Morelli, M.: 1999, Demand competition and policy compromise in legislative bargaining, *American Political Science Review* **93**, 809–820.
- Owens, M. F. and Kagel, J. H.: 2007, Minimum wage restrictions and employee effort in labor markets with gift exchange present. mimeo.
- Persson, T. and Tabellini, G.: 2006. "Electoral systems and economic policy" in *Handbook of Political Economy*, ed. Weingast, B. and D. Wittman. Oxford.
- Roth, A. E.: 1995. "Bargaining Experiments" in *Handbook of Experimental Economics*, ed. by John H. Kagel and Alvin E. Roth. Princeton: Princeton University Press, 253-348.
- Shafir, E., Diamond, P. and Tversky, A.: 1997, Money illusion, *The Quarterly Journal of Economics* **112**, 341–374.
- Volden, C. and Wiseman, A. E.: 2005, Bargaining in legislatures over particularistic and collective goods. Paper Presented at the 76th Annual Meetings of the Southern Political Science Association, January 5-9, New Orleans, Louisiana.
- Volden, C. and Wiseman, A. E.: 2006, Bargaining in legislatures over particularistic and collective goods, *American Political Science Review* **101**(1), 79–92.

## A Additional Results

	Number of Subjects Offered Private Allocations					
	0	1	2	3	4	5
$\alpha = 0.3$	<b>0.88</b>	0.01	0.00	0.05	0.01	0.04
$\alpha = 0.45$	0.55	<b>0.30</b>	0.00	0.07	0.02	0.07
$\alpha = 0.55$	0.34	<b>0.45</b>	0.02	0.11	0.01	0.08
$\alpha = 0.65$	0.15	<b>0.28</b>	0.00	0.46	0.03	0.08
$\alpha = 0.75$	0.08	0.04	0.00	<b>0.59</b>	0.04	0.25
	Rounds 10 and Above					
$\alpha = 0.3$	<b>0.88</b>	0.04	0.00	0.04	0.00	0.04
$\alpha = 0.45$	0.53	<b>0.38</b>	0.00	0.02	0.00	0.06
$\alpha = 0.55$	0.24	<b>0.66</b>	0.00	0.07	0.00	0.02
$\alpha = 0.65$	0.14	<b>0.43</b>	0.00	0.33	0.00	0.10
$\alpha = 0.75$	0.15	0.00	0.00	<b>0.57</b>	0.04	0.23

Equilibrium Type Offers are in Bold.

Table 8: Frequency With Which Subjects are Allocated Private Benefits in Accepted Proposals

	All Proposals		Equilibrium Type Proposals		SSPE
	All Rounds	Rounds > 9	All Rounds	Rounds > 9	
$\alpha = 0.3$	0.9725	0.9833	1.0000	1.0000	1.000
$\alpha = 0.45$	0.9290	0.9452	0.8838	0.8812	0.483
$\alpha = 0.55$	0.8862	0.8925	0.8680	0.8723	0.583
$\alpha = 0.65$	0.5484	0.7143	0.7976	0.8333	0.680
$\alpha = 0.75$	0.1788	0.1929	0.0447	0.0587	0.000

Table 9: Average Provision of Public Good for Accepted Proposals