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Pork Versus Public Goods: An Experimental Study of Public Good Provision Within a Legislative Bargaining

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Key Words: Legislative Bargaining; Public Goods; Efficiency; Reference Point
JEL Classification: C7, D72, C92, C52

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

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Abstract

We experimentally investigate a recent model of legislators' incentives to produce particularistic and collective goods from a fixed budget. Depending on the relative value legislators' place on private versus public goods, the experiment confirms that accepted proposals consist of only private good allocations to minimum winning coalitions or, for higher values of the public good, allocations where the private good is only allocated (and in small proportions) to the proposer. Within the mixed public and private good region, the share of the budget devoted to the public good is decreasing as the relative value of the public good decreases, which is consistent with intuition and decision theoretic arguments, but is inconsistent with the stationary subgame perfect equilibrium prediction for this region.

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

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1 Introduction

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 its division in particularistic goods.[1] Lizzeri and Persico (2001) capture some of the tradeoffs between public versus private goods in party platforms, but assume that legislators produce either only public goods or exclusively redistributive goods, and that elected politicians can commit to produce one or the other before the election. Volden and Wiseman (2006) 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.[2]

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 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 coalition formation is confirmed (see Frechette, Kagel and Morelli, 2005a – FKMa from here on – and the references cited therein). 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 public goods (their greed for private goods) changes? With respect to this last question, there are competing forces pushing in different directions:

[1] 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 tradeoffs resulting from the fact that private and public good spending are alternative uses of *the same* fixed budget.

[2] Leblanc, Snyder and Tripathi (2000) and Battaglini and Coate (2006) also contain interesting predictions about legislative bargaining on multi-policy decision making. We focus on the Volden and Wiseman paper 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.

when the relative value of the public good decreases there is a reduction of the total value of the shares to be allocated as well as a change in the *marginal rate of substitution* between private and public goods, with these income and substitution effects pushing in different directions in terms of the incentives proposers face for allocating the fixed budget between public and private goods.

The present experiment also provides a contribution to the public goods literature, representing as it does the first experimental investigation of public good provision within a legislative bargaining framework. Most of the experimental work dealing with public goods does so within the framework of a voluntary contribution mechanism (vcm) where a set of subjects decides between allocating a fixed endowment between the public good or their own private allocation, with the latter being a dominant strategy (see Ledyard, 1995 for a review of the literature).[3] Considerable efforts have also been devoted to studying this same set-up when a threshold or provision point exists, in which case the structure is similar to the game of chicken rather than a prisoner's dilemma (Ledyard, 1995). The game within a legislative bargaining framework is neither a prisoner's dilemma nor chicken, and is arguably a more natural environment in which to investigate public good provision.[4]

The experiment also has implications for the growing other regarding preference literature in economics, as there are efficiency and equity implications associated with the predicted equilibrium outcomes. For example, in the region where the public good is valued very little relative to private shares, the model predicts a minimum winning coalition providing private goods to its members, even though a pure public good allocation would provide a larger total payoff and provide everyone the same level of benefits. This puts to the test notions of a "taste for efficiency" (see, for example, Charness and Rabin, 2002 and Engelmann and Strobel, 2004).

The Volden and Wiseman (2006) model extends the Baron-Ferejohn (1989) alternating-

[3] Often these games have a corner solution so that any mistakes made necessarily involve providing positive levels of the public good. This is not the case here for the mixed region of public and private good provision, and in the pure public good region where there is a dominant strategy to provide the public good, in which case mistakes involve *under* provision of the public good.

[4] The central tension in a vcm is the free riding problem, whereas in a committee (as in our environment) there is no free-riding problem since the proposer can always offer the most efficient allocation. It is also clear that chicken type coordination problems cannot arise in committee decision making. However, depending on the legislators preferences for the public good, the proposer can sometimes be better off not proposing the efficient allocation.

offer model of majoritarian bargaining to a legislature determining how to allocate a fixed budget between public goods that benefit each legislator's district and 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).[5] Legislators utility functions attach value to the public and private goods, with weights being the same across all legislators.

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 prediction with only private goods provided (within a minimum winning coalition). The model predicts, somewhat counterintuitively, that for intermediate values of the weight of the public good in legislators' utility functions (henceforth the mixed region), the public good provision level increases when the legislators care more about particularistic goods. This is because the proposer should use the standard subgame perfect equilibrium logic by offering a public good amount *on* the "participation constraint" of responders, and the latter would be violated if the proposer didn't increase the public good quantity when its value goes down. This comparative static prediction is quite important for comparative politics and for our understanding of economic policy making in different systems: it is well known that when legislators are elected with Single Member District plurality or majority rule, they should care more about their performance for their district compared to legislators elected with national lists, like in many European countries. The non-monotonic comparative static prediction of the model would then suggest that, in contrast with our intuition, single member district systems will induce legislators to produce *more* public goods than Proportional Representation systems. Empirical research with field data supports the fact that single member districts produce *less* public goods (more pork) compared to PR systems (see e.g. Persson and Tabellini 2006). But these results are clouded by the fact that the data for single member districts is dominated by the United States, which has a host of potentially confounding, idiosyncratic,

[5] The discounting is designed to capture delay costs, including the fact that legislators may not be reelected to enjoy the fruits of their labor.

factors associated with it. Our experimental investigation of the comparative static prediction of the Volden-Wiseman (2006) model within the mixed region provides another way of looking at this issue, one that is free from these (potential) confounding factors.

Our main experimental results can be summarized as follows: First, the public good provision level varies monotonically with the relative value of private versus public good 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 mixed region two types of allocations predominate, ones with *only* public goods or ones with both public and private goods, with the latter allocated exclusively to the proposer (i.e., equilibrium type allocations). Thus, the overall allocation of public goods within the mixed region is substantially higher than the theory predicts, both because of the all public good allocations and the fact that the amount of money proposers take for themselves is substantially smaller than predicted. Further, even conditioning on equilibrium type allocations within the mixed region (i.e., ignoring the all public good offers) the level of public good provision decreases as the value of private goods in players' utility functions increases.

Our data supports a decision theoretic/behavioral explanation for why the experimental outcome deviates from the theory's prediction in the mixed region. There is clear evidence of a *reference point effect* as legislators' decisions to accept or reject an offer seem to depend on how the offer compares with the best alternative offer they could have gotten, which, in the mixed region, is the all-public-good offer. As such when the relative value of the public good decreases, the value of the best alternative offer decreases as well. Given this lower reference point, proposers can expect legislators to be willing to accept slightly worse offers, which permits them to take a larger share of the budget for themselves in terms of particularistic goods. Within the mixed region, these relatively greedier proposals are in fact accepted with essentially the same frequency by responders as the more generous offers when greater weight is placed on the public good.

The excessive provision of public goods within the mixed region is consistent with the public goods literature, which shows relatively large positive levels of public good provision in voluntary provision games. Some of the mechanisms identified in the public goods literature behind over provision involve mistakes, learning and repeated play elements, as the level of public good provision decreases over time. Other mechanisms relate to "warm glow" effects,

as a residual supply of public goods typically remains near the end of sessions (Ledyard, 1995). Our data also suggests some element of mistakes and/or learning over time as the oversupply of public goods in the mixed region decreases with experience. However, there is still substantial oversupply of public goods at sessions end. While one might be tempted to attribute this oversupply to warm glow effects, the very high frequency of minimum winning coalitions in the region where the theory predicts only private goods suggests otherwise or, at a minimum, that these warm glow effects do not extend to the players getting zero payoffs. Rather, the results are consistent with the fact that both here and in other legislative bargaining experiments, proposers are unable to achieve anything approaching the large shares that the stationary subgame perfect equilibrium outcome predicts, as such proposals are routinely rejected (see e.g. FKMa, FKMb and the references cited therein). As such the extra money that proposers are unable to take for themselves naturally flows to the public good. The larger share allocated to public goods increases the probability that the proposal will be accepted, while typically providing the proposer with a greater (albeit smaller than predicted) payoff to themselves.

The plan of the paper is as follows: Section 2 outlines the Volden-Wiseman (2006) 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 Model

In this section we describe the model of Volden and Wiseman (2006), in the form that we will directly test in the laboratory.

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 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

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

where $\alpha \in [0, 1]$ is the relative weight of private goods in the utility function and q represents

the absolute value (or return) of spending a dollar in public good production.[6] 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 δ. The status quo is no division of the budget. The bargaining game is therefore 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.

The model predicts that, fixing q, for low values of α only the public good will be supplied, as it is a dominant strategy to do so. At the other extreme, for high values of α only the private goods will be offered, in which case only a minimum winning coalition (MWC) receives positive shares. For intermediate values of α 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

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

The upper bound on the mixed region is given by

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

In the mixed region, as α 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 (α). Thus, starting with low values for the private good (low values of α) the private good share for the proposer is first zero, then once α reaches α_{CM} it jumps up and then decreases within the mixed region, only to jump up again when the value of α becomes so high that no public good is offered anymore. Finally, when α is so high that only private goods are offered, the share going to the proposer as α varies is predicted to remain constant.

The intuition behind the comparative static result just described for the mixed region is as follows: when α goes up the payoff for the responders goes down if the offer is the same as

[6] The weight placed on private goods, α, can vary across legislators, which introduces a number of interesting possibilities that lie beyond the scope of the present paper.

the one before α changed; hence, the proposer increases y in order to partially compensate for this, as this is needed for the proposal to be accepted. The offer of any proposer in equilibrium is always predicted to be "just enough" to get the responders to accept it. Thus the comparative static result just described is determined by the effect of a change in α on the responders' "participation constraint".[7]

If we believe instead that the proposers don't try (or are unable) to make the offer that makes responders just indifferent as in the stationary subgame perfect equilibrium (SSPE), then the main effect of a change in α is likely to be its perceived impact on the proposer's payoff conditional on acceptance. Taking this idea to its extreme, one alternative hypothesis is that when α goes up in the mixed region, the proposer will take *more* for himself, because this has a direct, and relatively large, effect on his payoff conditional on acceptance, whereas the effect on the probability of acceptance is of second order importance (or perceived to be small). We will qualify and clarify this hypothesis in section 4. But for now let us anticipate that the probability of acceptance won't change much even if the proposer skims more pork when α goes up is related to the fact that responders reference point – namely the value of the best alternative offer – goes down when α increases.

When α is below α_{CM} proposers have a dominant strategy to allocate all of the fixed budget to the public good. For example, consider the case of $\alpha = 0.3$ with $q = 0.7$ (the parameter values employed in our all public goods treatment). An extra \$1 allocated to the private good yields 30¢ to the proposer while the extra \$1 allocated to the public good yields 49¢ to the proposer, so that public goods increase the proposer's payoff relative to private goods while also increasing the probability of acceptance. Now consider $\alpha = .45$ and $\alpha = .55$ which pretty much span the mixed region given our other parameter values. With $\alpha = .45$ an extra \$1 of the budget allocated to private goods yields 45¢ to the proposer versus 39¢ if the extra \$1 was allocated to the public good, an extra 6¢. With $\alpha = .55$ an extra \$1 allocated to private goods yields 55¢ to the proposer versus 32¢ if allocated to the public good, an extra 23¢. In both cases the extra \$1 allocated to the private good increases the probability of rejection. However, it yields a substantially higher return for the proposer with $\alpha = .55$. If proposers' subjective beliefs regarding the increased risk of rejection are small enough at the margin, the increased return may justify the increased

[7] The theoretical prediction that the equilibrium public good offer y is decreasing in q comes from the same effect on the acceptance threshold.

private allocation.[8] And if responders use the reference point effect postulated above to evaluate offers, these perceptions will be satisfied. In contrast, the alternating offer theory suggests the opposite because in that theory the proposer computes the continuation value and substitutes away from the private good in order to make the responders no worse off following the reduced return on the public good, as this is necessary to avoid having the offer rejected.

3 Experimental Design

Each experimental session used a legislature/committee comprised of $N = 5$ subjects, with the value of the public good always $q = 0.7$, and the discount factor $\delta = 0.8$. Thus the range for the mixed region is given by $[\alpha_{CM}, \alpha_{MP}) = [0.41176, 0.59036)$. The different values of α used in experimental treatments were 0.3, 0.45, 0.55, and 0.75.

Subjects were told that they had to decide how to divide 50 tokens (or "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 was 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 rate from the group allocation to individual payoffs, as well as the dollar payoffs for any proposed allocation (see Appendix B for a sample instructions and screen shots).

Table 1 gives the equilibrium predictions for each value of α used in the experiment. The share of tokens devoted to the public good is reported along with the share going to the proposer. Dollar payoffs convert these shares into players' payoffs with the last two columns representing shares to responders. Note that except for the case of pure private goods $\alpha = .75$), shares to responders represent only payoffs from the public good. For the case of pure private goods we consider a minimum winning coalition (MWC).

Between 10 and 20 subjects were recruited for each experimental session, so that there would be a minimum 2 bargaining rounds conducted simultaneously in each session and a

[8] Further, what we do know from previous legislative bargaining experiments with all private goods is that responders will tolerate some difference in earnings between themselves and proposers, although nothing approaching what the SSPE predicts. The bilateral bargaining literature shows the same (see, Roth, 1995, for a review of the literature).

α	Budget Share		Payoffs	
	Public Good	Private Allocation	Proposer	Responders
0.3	1	0	\$24.50	\$24.50[a]
0.45	0.483	0.517	\$20.95	\$9.30[a]
0.55	0.583	0.417	\$20.65	\$9.20[a]
0.75	0	0.68	\$25.50	\$6.00[b]

α = weight placed on private goods in members utility function.

[a] Given to all responders.

[b] Given to coalition partners within a minimum winning coalition.

Table 1: Theoretical Predictions

maximum of 4.[9] After each bargaining round, subjects were randomly re-matched in groups. Subject numbers also changed randomly between bargaining rounds (but not between the stages 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. 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.[10]

A total of 8 sessions, all with inexperienced subjects, were conducted. Table 2 lists the values of α along with the number of subjects in each session. Sessions 1-6 all employed 12

[9] Our intention was to have a minimum of 15 subjects in each session, but if enough extras showed up to be able to run four bargaining groups we were prepared to do so. Two sessions fell short of the desired 15 subjects and so were conducted with 10 subjects each (see Table 2 below).

[10] 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.

Treatments (value of α)	Session	Number of Subjects
0.3	1	10
	2	15
0.45	3	15
0.55	4	15
0.75	5	20
	6	20
0.45 to 0.55	7	10
0.55 to 0.45	8	15

Table 2: Experimental Sessions

bargaining rounds, with one of the rounds, selected at random, to be paid off on.[11] Sessions 7 and 8 employed a cross-over design with an initial set of 12 bargaining rounds with values of α equal to .45 and .55, respectively. These were followed by another 8 bargaining rounds in which the value of α was changed from .45 to .55 in session 7 and from .55 to .45 in session 8. These cross-over sessions were conducted as the between session results with $\alpha = .45$ and .55 failed to show the predicted increase in the share of francs 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 striking contrast in terms of their own payoffs for the failure to increase (decrease) the public good allocation following the increase (decrease) in α 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 α, along with the extra 8 bargaining rounds, was only announced at the end of the first set of 12 bargaining rounds.[12]

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 undergraduates and an occasional graduate student. All subjects received a participation

[11] 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.

[12] 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 α.

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.

4 Results

Most bargaining rounds had only 1 stage. More specifically, 89% of bargaining rounds ended in stage 1, 10% in stage 2, and 1% in stage 3. The number of rounds ending in stage 1 increased to 92% for the rounds 10 and above.[13]

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 included in proposals is reported in Table 3. For 3 of the 4 values of α the modal offer yields private benefits to as many subjects as the equilibrium predicts. The exception is for $\alpha = .45$ where the modal proposal involves all public goods. Similarly with $\alpha = .55$, there is a large cluster of all public good offers: 35% of all such proposals versus 40% where the proposer takes something extra for himself with all public goods to others (equilibrium type offers). Thus, in both cases there are way too many allocations of the more efficient, all public goods, option. However, when private benefits were provided in addition to the public good, the frequency with which the proposer only allocated benefits to himself clearly dominates. Further, experience tends to move behavior closer to the predicted outcome for all values of α as there are more equilibrium type proposals after round 9 for all treatments: 36% after versus 30% before round 9 for $\alpha = .45$ and 52% after versus 52% before round 9 with $\alpha = .55$.[14]

Two other factors are worth noting in Table 3. First the frequency of MWCs in the $\alpha = 0.75$ treatment is very similar to results from prior experiments on multilateral bargaining with only particularistic goods. For instance FKM (2005a) report between 61%

[13] Given that most of the data is in stage 1, the data analysis that follows uses stage 1 data only except if 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.

[14] For the cross-over sessions we include data for all 8 bargaining rounds after the change in α 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
$\alpha = 0.3$	**0.74**	0.01	0.00	0.07	0.03	0.15
$\alpha = 0.45$	0.55	**0.30**	0.01	0.04	0.01	0.09
$\alpha = 0.55$	0.35	**0.40**	0.01	0.10	0.04	0.11
$\alpha = 0.75$	0.03	0.00	0.00	**0.65**	0.05	0.26
Rounds 10 and Above						
$\alpha = 0.3$	**0.75**	0.03	0.00	0.08	0.03	0.12
$\alpha = 0.45$	0.56	**0.36**	0.01	0.02	0.00	0.05
$\alpha = 0.55$	0.35	**0.52**	0.01	0.06	0.02	0.05
$\alpha = 0.75$	0.06	0.01	0.00	**0.74**	0.02	0.17

Equilibrium Type Offers are in Bold.

Table 3: Frequencies With Which Different Numbers of Subjects Were Allocated Private Benefits

and 90% MWCs, depending on the treatment, with committees/legislatures of 3 subjects, and FKM (2005b) report between 63% and 83% MWCs, depending on the treatment, with committees/legislatures of 5 subjects.

Second, the $\alpha = 0.3$ condition reveals some inefficiencies in choices as 26% of all proposals involve some private goods. In this treatment, not only is this not equilibrium behavior, it is dominated by all public good allocations. However, as we will see below, these misallocations are relatively small in magnitude as the average share of tokens allocated to the public good in this treatment was 91.4% calculated over all rounds, and 95.3% for rounds 10 and above. The appendix contains a table for the number of subjects offered private allocations for *accepted* offers. The relative frequencies are very similar to those shown in Table 3.

Conclusion 2 *The modal offer yields private benefits to as many subjects as the theory predicts for 3 out of 4 values of* α*. The exception is for* $\alpha = 0.45$ *where the modal offer involves all public goods. There is a much higher frequency of all public good offers than the theory predicts in the mixed public and private goods region. But when private benefits are offered in this region, they typically go only to the proposer as the theory predicts.*

	All Rounds	Rounds > 9
$\alpha = 0.3$	0.914	0.953
$\alpha = 0.45$	0.914	0.937
$\alpha = 0.55$	0.829	0.866
$\alpha = 0.75$	0.104	0.078

Table 4: Average Proposed Provision of Public Good

Table 4 gives the average proposed share of francs allocated to the public good by treatment.[15] Averaged over all bargaining rounds, almost the same allocations are made to the public good with $\alpha = 0.3$ as with $\alpha = 0.45$. Further, although average public good shares are larger with $\alpha = 0.3$ for later bargaining rounds (10 and above), the difference is not statistically significant using a rank sum test with subject averages as the unit of observation. All of the other differences in average public good shares are statistically significant. In particular there is a statistically significant *decrease* in the allocation to public goods with $\alpha = 0.55$ versus $\alpha = 0.45$, contrary to what the theory predicts.[16] This difference, although relatively small 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.[17] Then looking at the cross-over sessions, 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 using subject averages as the unit of observation.

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 0.101 to 0.135 for $\alpha = .45$ versus $\alpha = .55$ (p-value < 0.05 for the ranksum test excluding observations

[15] Average accepted shares are quite similar to proposed shares.

[16] This is established two ways, both using subject averages as the unit of observation. 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.

[17] This accounts for 9 out of 25 subjects for all rounds and 11 out of 25 for rounds 10 or more in the cross-over sessions.

after the cross-over and p-value < 0.1 for the Wilcoxon matched-pairs signed-ranks test using data from the cross-over treatments).[18] This doesn't go away over time either: looking at bargaining rounds 10 and higher, shares are .11 and 0.15, so that the difference is even greater, and still in the wrong direction relative to what the theory predicts (p-value < 0.05 for the ranksum test excluding observations after the cross-over.[19]

Conclusion 3 *Public good provision is flat between the region where the theory predicts all public goods and the start of the mixed region, then decreases monotonically between regions after that. Notably, public good provision decreases* ***within*** *the mixed public and private region contrary to the model's prediction.*

Table 5 shows the returns on accepted offers of different types. The row labeled "Private Share to Proposer" shows the share of francs allocated to the proposer, and the row labeled "Public Share" shows the share of francs allocated to the public good. The row labeled "Payoff to Proposer" gives the dollar payoffs to the proposer for the different possible allocations. Thus, for example, with $\alpha = .75$ for accepted offers involving MWCs, the proposer averages \$15.64, \$6.89 more than with an all public good proposal, and \$4.60 more than the second most popular proposal - private benefits to all 5 subjects along with some public good. For $\alpha = 0.45$ proposers average 33¢ more for equilibrium type offers compared to the more popular all public good offer. In contrast, with $\alpha = 0.55$ equilibrium type offers yield \$1.47 more, on average, for proposers than an all public good proposal.

Table 6 gives the frequency with which each proposal type passes. For all values of α, proposals with all public goods *always* pass, and typically pass unanimously. In the mixed region, 91% and 90% of the equilibrium type offers were accepted with $\alpha = 0.45$ and 0.55, respectively. The high acceptance rates for equilibrium type offers in the mixed region provides little in the way of variation to determine if with equilibrium type offers proposers were taking shares at or near the limit of what they could get away with. However, the voting patterns reported on in more detail below suggest that this was indeed the case. Thus, the high rates of acceptance in the mixed region, as well as with $\alpha = 0.75$, suggest

[18] When using the ranksum test, observations after the cross-over are excluded since the data is averaged by subject and each subject faces different alphas before and after the cross-over. If instead we kep the data and averaged it seperately before and after, then the two observations would probably not be independent for a given subject.

[19] There aren't enough observations in this case to establish statistical significance with the Wilcoxon matched-pairs signed-ranks test using data from the cross-over treatments.

	Number of Subjects Offered Private Allocations:					
	0	1	2	3	4	5
$\alpha = 0.3$						
Private Share to Proposer	0.000	0.020		0.100	0.100	0.053
Public Share	1.000	0.980		0.720	0.800	0.733
Payoff to Proposer	\$24.50	\$24.31		\$19.14	\$21.10	\$18.77
$\alpha = 0.45$						
Private Share to Proposer	0.000	0.101		0.173	0.080	0.061
Public Share	1.000	0.899		0.645	0.800	0.839
Payoff to Proposer	\$19.25	\$19.58		\$16.32	\$17.20	\$17.53
$\alpha = 0.55$						
Private Share to Proposer	0.000	0.135	0.080	0.144	0.100	0.050
Public Share	1.000	0.857	0.900	0.668	0.700	0.822
Payoff to Proposer	\$15.75	\$17.22	\$16.38	\$1448	\$13.78	\$14.32
$\alpha = 0.75$						
Private Share to Proposer	0.000			0.408	0.270	0.250
Public Public	1.000			0.041	0.170	0.191
Payoff to Proposer	\$8.75			\$15.64	\$11.61	\$11.04

Private Share = share of budget allocated to the proposer.

Public Share = share of budget allocated to the public good.

Table 5: Approved Allocations

	Number of Subjects Offered Private Allocations					
Condition	0	1	2	3	4	5
$\alpha = 0.3$	1.0	0.5	n/a	1.0	1.0	0.5
	(48)	(2)	(0)	(3)	(1)	(6)
$\alpha = 0.45$	1.0	0.91	n/a	1.0	1.0	1.0
	(47)	(22)	(0)	(6)	(1)	(8)
$\alpha = 0.55$	1.0	0.9	0.5	0.64	0.33	0.5
	(34)	(40)	(2)	(11)	(3)	(10)
$\alpha = 0.75$	1.0	0	n/a	0.85	0.5	0.91
	(1)	(1)	(0)	(55)	(4)	(23)

Table 6: Frequency of Acceptance and Number of Such Proposals Voted On (with number reported in parentheses)

that selfish proposers had a pretty good idea of what was acceptable. Finally, we know from past legislative bargaining experiments that the shares predicted for coalition partners under the SSPE would have no chance of being passed.

With $\alpha = 0.75$ proposals which involve MWCs provide proposers, as well as their coalition partners, with substantially higher expected incomes than with all public goods: \$15.64 for proposers and \$10.70 on average for each of their coalition partners versus \$8.75 with all public goods in accepted proposals. Further, the average difference in payoffs between proposers and their coalition partners in a MWC is over \$4.00, well above the average difference in income between proposers and responders in the mixed region. This difference cannot, however, proxy for the threshold at which income differences would be rejected in the mixed region, since if you are a member of the MWC with $\alpha = 0.75$, to reject such an offer exposes you to the distinct possibility of obtaining a \$0 allocation in the next stage of the bargaining round as MWCs were proposed 65% overall (74% for rounds 10 and higher). In contrast, the high frequency of either all public good proposals, or equilibrium type offers, in the mixed region (85% and 75% with $\alpha = .45$ and .55, respectively) sharply restricts the probability of a zero allocation. Which may make subjects less tolerant of income differences in the mixed region. On the other hand, the subject with the lowest tolerance for income differences within a MWC can block it with $\alpha = 0.75$. This is not the case in the mixed region for equilibrium type offers, as they provide substantial shares to all four responders,

	$\alpha = 0.3$	$\alpha = 0.45$	$\alpha = 0.55$	$\alpha = 0.75$
Own Payoff	62.33***	54.00***	56.21***	21.38***
	(22.46)	(19.02)	(10.08)	(2.05)
Public Allocation	-27.83**	-7.29	-4.57**	-0.415
	(12.03)	(6.89)	(2.050)	(0.459)
Payoff to the Proposer	12.02	-14.88*	-6.27*	-0.425
	(8.96)	(7.795)	(3.71)	(1.387)
Constant	-6.78***	-4.61*	-8.11***	-2.665***
	(2.17)	(2.68)	(1.61)	(0.587)
ρ	$0.235^{\S\S}$	$0.594^{\S\S\S}$	$0.488^{\S\S\S}$	0.000
	(0.134)	(0.117)	(0.114)	(0.000)
Observations	240	336	400	336
Number of subjects	25	40	45	35

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

only two of which need to vote yes for the proposal to pass. We will have more to say about what drives acceptances and rejections in the mixed region when we examine voting patterns below.

Conclusion 4 *All public good allocations are always approved for all values of α. The relatively higher frequency of equilibrium type allocations, as opposed to all public good allocations, with $\alpha = 0.55$ versus $\alpha = 0.45$ is associated with a relatively higher rate of return to proposers for equilibrium type allocations with $\alpha = 0.55$. Private good allocations with MWCs for $\alpha = 0.75$ yield substantially higher payoffs to proposers than any of the alternatives, while getting almost as high approval rates as providing all public goods or an all inclusive private allocation.*

Table 7 reports random effect probit estimates of voting patterns along with estimates of $\rho \equiv \frac{\sigma_\alpha^2}{\sigma_\alpha^2+1}$, where σ_α^2 is the variance of the subject specific random effects.[20] Votes of

[20] ρ measures the extent of the individual subject effects, or the dispersion in the likelihood of acceptance across individual subjects. ρ has a minimum value of 0 (no individual subject effects) and a maximum

proposers are excluded from the analysis. Explanatory variables include own payoff, how many francs were allocated to the public good (Public Allocation), and the dollar payoff to proposers. In theory, all that should matter is own payoff, which is statistically significant in all cases. Payoff to the proposer has a negative and marginally significant ($p < .10$) impact on votes for both value of α in the mixed region. The negative and statistically significant coefficient values for the public good variable with $\alpha = 0.3$ and $\alpha = 0.55$ is strange. The proximate cause for this result is multicollinearity between own payoffs and share allocated to the public good. The correlation between these two variables is 0.997 and 0.941 with $\alpha = 0.3$ and $\alpha = 0.55$, respectively, making it very difficult to separately identify the impact of either variable. Another indication of this is that dropping only the first 3 rounds is enough to make all regressors statistically insignificant in both cases. Furthermore, in both cases, if only Own Payoffs or Public Allocation are included, they have positive and statistically significant coefficient estimates (which are all statistically significant at the 10% level).

Although there are relatively few rejections for equilibrium type offers in the mixed region, we looked at the data more carefully to see if we could better identify the basis for these rejections and the failure of the comparative static prediction of the model in the mixed region. Focusing strictly on equilibrium type proposals - proposals in which the only private good allocation goes to the proposer with all public goods provided to responders - not surprisingly, when proposers provide a larger public good allocation, the proposal is more likely to be accepted. What is surprising is that responders' payoffs that seem, from the voting data, as if they would have received a large number of negative votes with $\alpha = .45$, sail through with minimal negative votes with $\alpha = .55$.

These data are reported in Table 8.[21] With $\alpha = .45$, proposals that give responders a payoff of \$16.55 or less received negative votes 46.4% of the time, leading to two rejected proposals out of the six made. In contrast, with $\alpha = .55$, it takes responders' shares of \$13.23 or less before the first proposal is rejected. And responders' shares greater than this (shares ranging between \$13.55 and \$14.18) receive negative votes on average 15.0% of the time. That is, responders' payoffs that would appear to have drawn negative votes of 50% or more with $\alpha = .45$ are rejected by responders 15% of the time with $\alpha = .55$. As such it is

value of 1 (all the variance is explained by individual subject effects).

[21] Table 8 excludes two outlier proposals where the proposer offered a private share to one person, but zero private share to themselves.

$\alpha = 0.45$			$\alpha = 0.55$		
Responder's Payoff (in dollars)	Percent no Votes (raw data)	Percent Rejected (raw data)	Responder's Payoff (in dollars)	Percent No Votes (raw data)	Percent Rejected (raw data)
15.4	37.50% (3/8)	0.00% (0/2)	11.03	75.00% (3/4)	100% (1/1)
15.59	75.00% (3/4)	100% (1/1)	11.97	75.00% (6/8)	50.00% (1/2)
15.99	25.00% (2/8)	0.00% (0/2)	12.6	35.00% (14/40)	10.00% (1/10)
16.17	50.00% (2/4)	0.00% (0/1)	13.23	31.30% (5/16)	25.00% (1/4)
16.55	75.00% (3/4)	100% (0/1)	13.39	0.00% (0/4)	0.00% (0/1)
16.94	25.00% (1/4)	0.00% (0/1)	13.55	41.70% (5/12)	0.00% (0/3)
17.33	12.50% (3/24)	0.00% (0/6)	13.86	0.00% (0/8)	0.00% (0/2)
17.71	25.00% (1/4)	0.00% (0/1)	13.9	0.00% (0/4)	0.00% (0/1)
18.1	0.00% (0/8)	0.00% (0/2)	14.02	0.00% (0/4)	0.00% (0/1)
18.48	10.00% (2/20)	0.00% (0/5)	14.08	0.00% (0/12)	0.00% (0/3)
			14.18	17.50% (7/40)	0.00% (0/10)
19.25*	0.50% (1/192)	0.00% (0/45)	**15.75***	1.70% (3/172)	0.00% (0/43)

* Maximum possible responder's payoff - all public good allocation.

Table 8: Voting Patterns on Equilibrium Type Offers in Mixed Region

simply not credible to think of responders' votes as being strictly influenced by own payoffs, the key characteristic of the SSPE.

How does one account for these data? One explanation that immediately comes to mind is that subjects are employing a decision theoretic framework in which reference point effects play a prominent role. That is, responders' votes are strongly influenced by comparing their own payoff from a proposal relative to other proposals they had voted on, or could have possibly gotten, given the value of α. In this framework, an equilibrium type offer of \$14.00 or so would appear to be pretty good to responders with $\alpha = 0.55$, given that the best they could do, with an all public good allocation, was \$15.75, and there were a lot of these being offered. However, with $\alpha = 0.45$, a payoff of \$14.00 or so would not appear to be so favorable given that the best they could do with an all public good allocation is \$19.25, and there were a lot of these being offered as well. Note that there is ample precedent for such reference point effects in the decision theoretic literature, although most of these have been reported using hypothetical payoffs (Kahneman and Tversky, 1979; Shafir, Diamond, and Tversky, 1997).[22]

Given the data, there are, of course, plausible alternative explanations to the reference point effect offered above. Several alternative explanations come immediately to mind: (i) responders vote against offers that give them smaller shares than the all public good reference point out of relative income considerations, (ii) they vote against proposals that give them much less than the all public good allocation given the obvious inefficiency of such offers (i.e., subjects have a taste for efficiency; see for example Charness and Rabin, 2002; Englemann and Strobel, 2004), or (iii) the income inequality in conjunction with the inefficiency of equilibrium type offers signals a meanness that is offensive to responders (that is, intentions matter; see Charness and Levine, 2005). However, if (i) is a factor, it too is sensitive to the context in which the offer was made, as larger income differences between proposer and responders are tolerated with $\alpha = 0.75$ where rejection of a proposal by a member of the MWC opens up a high probability of getting a zero allocation in the next stage. Regarding (ii) or (iii), any taste for efficiency is, at a minimum, tempered by its cost relative to own income, since with $\alpha = 0.75$ there are very few offers for the more efficient all public good allocation, which would appear to be driven by the fact that within

[22] Also see Owens and Kagel (2007) who demonstrate a reference point effect within the framework of an interactive economic framework with real payoffs.

a MWC both proposers and responders can earn substantially more with an all private good allocation.

Conclusion 5 *Voting with respect to allocations is driven in large measure by own payoffs. However, there appear to be clear reference point effects impacting on responders' decisions to vote for or against a given offer as opposed to the "participation constraint" underlying the standard subgame perfect equilibrium argument. These reference point effects account for the failure of the theory with respect to its counter intuitive prediction of increased shares of the budget going to public goods as α increase. This reference point effect permits proposers to skim more pork for themselves as α increases in the mixed region.*

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.

The total amount of public goods provided remains flat, and in the neighborhood of 95%, going from the region where the model predicts exclusive provision of public goods to the beginning of the mixed public and private good region.[23] At the start of the mixed public and private region the *second* most popular allocation (30% of all proposals) consists of equilibrium type allocations where all of the particularistic type goods go to the proposer, with the *most* popular allocation (55% of all proposals) providing all public goods. Looking at behavior near the end of the mixed region, the level of public good provision drops, with the most popular choice consisting of equilibrium type proposals (52% of all allocations),

[23] All of the summary statistics provided here consist of more experienced subject behavior - periods 10 and above.

with the second most popular allocation consisting of all public goods (35% of all allocations). Thus, within the mixed region we find (i) when private goods are provided, in the large majority of cases they go exclusively to proposers as the theory predicts, (ii) there is excess provision of public goods relative to what the theory predicts because of the high frequency of all public good allocations, and the lower then predicted levels of private goods proposers' take with equilibrium type allocations, and (iii) the level of public good provision falls as the value of the public goods decreases, contrary to the model's predictions but consistent with a simple decision theoretic framework in which reference points (in terms of the best alternative outcome) impact on choices of responders.

In the region where only private good allocations are predicted, the most popular allocation consists of all private goods within a minimum winning coalition (two out of five subjects get nothing). Within the minimum winning coalition proposers obtain significantly more private goods than their coalition partners, which is what the theory predicts, but they obtain much less than the stationary subgame perfect equilibrium predicts. Both the frequency of minimum winning coalitions and the level of proposer power observed in this region is close to what has been observed in previous legislative bargaining experiments with all particularistic goods (Frechette, Kagel, and Morelli, 2005b).

Our results have several implications for the legislative bargaining literature. First, the fact that as the weight legislators place on private goods increases, the share of particularistic goods provided within the mixed region increases, supports the intuition, as well as the empirical literature, that single member districts tend to produce more pork than do legislators elected from national lists. This support for the empirical literature comes without the confounding factors associated with comparing outcomes between nation states with their different cultures, histories, and other potential confounding factors. Second, the reduction in the supply of public goods as the weight placed on private goods (α) increases within the mixed region directly contradicts the comparative static prediction of the Volden-Wiseman model under the SSPE refinement, the standard refinement for games of this sort. Although tests of the underlying Barron-Ferejohn (1989) model with only private goods have shown that proposers fail to obtain anything approaching the large shares that the SSPE predicts, the comparative static predictions of the model have largely been satisfied (FKMa). The present results involve a much more damaging blow to the underlying logic of the model (and the SSPE refinement used to reach it) than proposers failure to obtain anything ap-

proaching the large shares predicted. This counter-intuitive comparative static prediction of the model rests squarely on the notion that agents have solved, or act as if they have solved, the backward induction problem underlying the SSPE, establishing a participation constraint that must be satisfied for them to vote in favor of a proposed allocation. However, the data suggests that subjects have not done this. Rather they seem to employ a decision theoretic framework comparing the shares offered to the best they can hope to get given the reduced value of the public good when α increases, thereby accepting smaller shares for higher values of α. The question that remains, which goes well beyond the scope of the present paper, is what kind of alternative solution concept accurately characterizes the full data set from games of this sort?

Our experimental results also have implications for the growing economics literature on other regarding preferences and the public goods literature. In particular, although the over provision of public goods in the mixed region is consistent with what is typically reported in voluntary provision experiments, to the extent that "warm glow" effects - the good feeling subjects get for helping others - often postulated to explain over provision in the public goods literature underlies both cases, it clearly does not extend to those subjects receiving zero benefits in the all private goods region. Thus, the data suggest that, at a minimum, the mechanism behind over provision of public goods in the mixed region is more complicated than simple warm glow effects, and that the latter has only a small, or perhaps no, part in the over provision of public goods found here. Rather, the mechanism underlying over provision of public goods here would appear to involve the inability of proposers to take anything approaching the stationary subgame perfect allocation the theory predicts, as a result of which the extra money proposers are unable to take for themselves naturally flows to the public good, which also increases the probability that their proposal (with some private goods for themselves) will be accepted.

In the region where the model predicts only private goods, subjects had the opportunity to provide a perfectly egalitarian distribution that was also a more efficient allocation (in the sense of providing more total benefits) than the minimum winning coalitions obtained, by making an all public good allocation. Nevertheless, all public good allocations only accounted for 3% of all proposals, even though such proposals were almost certain to be passed. Rather subjects opted overwhelmingly for minimum winning coalitions 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 along with maximin preferences (a taste for maximizing the benefits for the least well off) (see, for example, Englemann and Strobel, 2004 and Charness and Rabin, 2002). There are several obvious differences between the present experiment and these other experiments: namely the present experiment involves bargaining and these other studies involve simple dictator type allocations, in which the proposers' benefits are not impacted, or minimally impacted, by opting for a more efficient allocation, or maximizing the benefits of the least well off. Further, unlike the legislative bargaining experiments with particularistic goods in which this same pattern occurs, the results here cannot be rationalized on the grounds that subjects are primarily responding to the observed "selfishness" of others in the sample population. This argument simply does not apply here as the all public goods option is available from the beginning, but never achieves much traction.

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A Additional Results

	Number of Subjects Offered Private Allocations					
	0	1	2	3	4	5
$\alpha = 0.3$	**0.86**	0.02	0.00	0.05	0.2	0.05
$\alpha = 0.45$	0.57	**0.24**	0.00	0.07	0.01	0.10
$\alpha = 0.55$	0.40	**0.43**	0.01	0.08	0.01	0.06
$\alpha = 0.75$	0.01	0.00	0.00	**0.66**	0.03	0.30
	Rounds 10 and Above					
$\alpha = 0.3$	**0.80**	0.07	0.00	0.07	0.00	0.07
$\alpha = 0.45$	0.62	**0.27**	0.00	0.03	0.00	0.08
$\alpha = 0.55$	0.30	**0.64**	0.00	0.03	0.00	0.03
$\alpha = 0.75$	0.06	0.00	0.00	**0.67**	0.00	0.28

Equilibrium Type Offers are in Bold.

Table 9: Frequency With Which Subjects are Allocated Private Benefits in Accepted Proposals

	All Rounds	Rounds >9
$\alpha = 0.3$	0.959	0.973
$\alpha = 0.45$	0.932	0.960
$\alpha = 0.55$	0.899	0.890
$\alpha = 0.75$	0.092	0.072

Table 10: Average Provision of Public Good for Accepted Proposals

B Instructions and Screen Shots

Availaible in an online appendix at http://homepages.nyu.edu/~gf35/print/fkm_pg_online_appendix.pdf.