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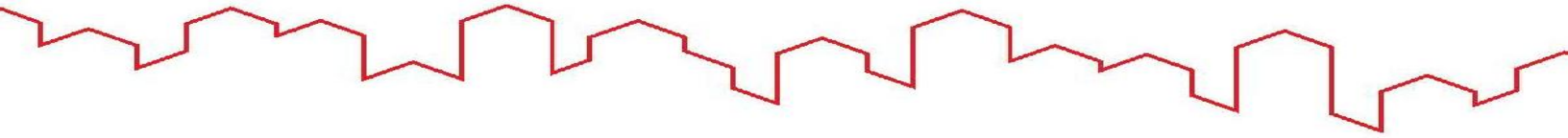

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Coalition Formation in a Legislative Voting Game

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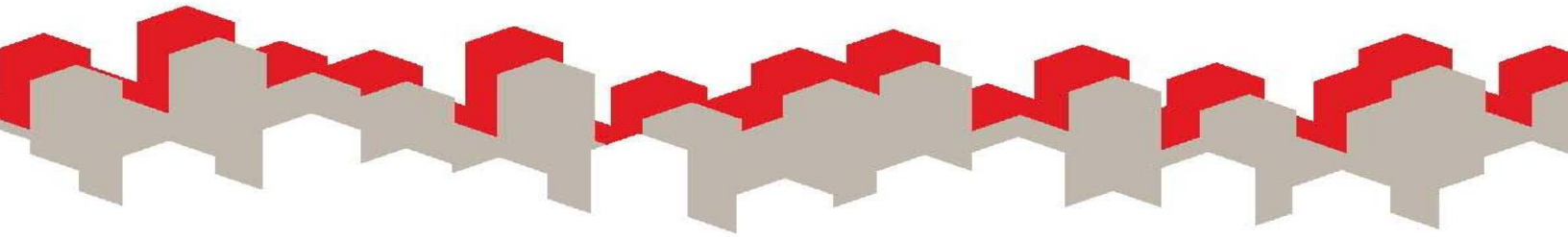

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Coalition Formation in a Legislative Voting Game[*]

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8/9/2011

Abstract

We experimentally investigate the Jackson-Moselle (2002) model where legislators bargain over policy proposals and the allocation of private goods. Key comparative static predictions of the model hold as policy proposals shift in the predicted direction with private goods, with the variance in policy outcomes increasing as well. Private goods increase total welfare even after accounting for their cost and help secure legislative compromise. Coalition formations are better characterized by an efficient equal split between coalition partners than the stationary subgame perfect equilibrium prediction.

Key words: legislative bargaining, policy decisions, private goods, experiment

JEL classification: C7, D72, C92, C52

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Legislative bargaining typically consists of dealing with policy proposals (e.g., the location of a public good/public bad, the extent to which gay/lesbian couples should have the same partner rights as heterosexual couples) along with purely distributive (private good) allocations. The present paper experimentally investigates the Jackson-Moselle (2002) model of legislative bargaining over policy issues in conjunction with purely distributive issues. The model simplifies the bargaining process to one in which legislators are bargaining over a single policy issue ranging over a single dimension, possibly representing familiar distinctions between liberal and conservative (or left and right of center) policy positions, and the distribution of private goods across legislative constituencies. Legislators are assumed to have single peaked preferences over the policy issue with differential "costs" to deviating from these preferences. In contrast, legislators' have uniform preferences over distributive goods with each legislator preferring larger amounts for his constituency. One of the key elements of the bargaining process is the usefulness of the distributive element (aka "pork") as an instrument for legislative compromise. Further, within the model there is the possibility that the introduction of the distributive element can increase total welfare as measured by the total value of legislators' payoffs, even after accounting for the cost of the private goods. We investigate these predictions along with a number of the model's predictions regarding coalition formation and proposer power.

The present paper adds to the growing experimental literature on legislative bargaining in games with a fixed extensive form (McKelvey, 1991; Diermeier and Morton, 2005; Fréchette, Kagel and Morelli, 2005a, b, in press). In these studies players are typically bargaining over strictly private goods, or over public and private goods but with homogenous preferences for the public good. The single exception to this that we are aware of is Christiansen (2010) where bargaining is over public and private goods with different blocks of legislators having heterogeneous preferences over the funding level for the public good. In contrast the present study analyzes how the availability of private goods affects the nature of policy proposals adopted, and is, in principle, capable of dealing with a wide range of policy proposals from public good allocations to more broadly defined public policy issuess. All of these experiments, as well as ours, take place within the Baron-Ferejohn (1989) extensive form for modeling multilateral bargaining.

Our experiment focuses on the comparative static predictions of the model with and without the presence of distributive goods for forging legislative compromise. We employ the simplest possible setting with three legislators with single peaked preferences over the location of a public good.[1] The experimental treatment that the body of the paper reports on is one in which the total value of legislators' equilibrium payoffs remains constant between bargaining over the public good only and bargaining over the public good in conjunction with particularistic goods after subtracting out the cost of the private goods. Key aggregate comparative static predictions of the model are satisfied in that the introduction of private goods shifts the average location of the public good significantly from near the median legislator's preferred outcome to a location that is closer to the preferred outcome of the extreme legislator who cares the most for the public good, as well as increasing the variance in the location of the public good across bargaining rounds.

The total value of players' payoffs increases modestly, but significantly, with the introduction of distributive goods after accounting for their cost. At a more micro level most, but far from all, players with extreme locational preferences effectively use distributive goods to move the location of the public good in favor of their preferred position when acting as proposers. However, the more subtle prediction regarding coalition formation in which the median legislator forms a coalition with the legislator with a more extreme locational preference to theirs fails in favor of the player with a closer locational preference. In common with the other legislative bargaining experiments employing Baron-Ferejohn bargaining procedures (i) the majority of proposals are passed without delay, but unlike the theory in a significant minority of cases there are delays, and (ii) although there is proposer power, payoffs *within* winning coalitions are far more equal than predicted under the stationary subgame perfect equilibrium (SSPE) outcome.

The outline of the paper is as follows: Section 1 outlines the predictions of the model. Section 2 describes the experimental procedures, with Section 3 reporting the experimental results. Section 4 concludes with a brief summary of the results and their similarities and differences with other legislative bargaining experiments. There is a rather long appendix to the paper reporting the motivation for, as well as outcomes, of a second set of experimental

[1] There is no distinction within the model between legislators bargaining over ideological issues or a public good issue. As such to simplify matters from here on out we discuss bargaining over a public good issue.

treatment conditions in which the introduction of private goods is predicted to increase the total value of legislators' payoffs after accounting for the cost of the public good. These results are relegated to an appendix as (i) the main results are quite similar to those reported in the text, but (ii) the predictions of the model along with the data analysis are complicated by the presence of a mixed strategy equilibrium, although there will be some brief discussion of them at the end of Section 3. Readers with particular interests in legislative bargaining models of the sort studied here are encouraged to read the appendix.

The Legislative Bargaining Model

The legislative bargaining model is based on Jackson and Moselle (2002; hereafter JM). There are n legislators where $n \geq 3$ is an odd number. A decision is a vector $(y, x_i,\ldots,x_n)$ consisting of a public good decision y and a distributive decision $x_i, \ldots,x_n$. The set of feasible public decisions is [0, Y] where $Y \in [0, 100]$ and the set of private allocations are such that $x_i \geq 0$ for each i with $\sum x_i \leq X$ where $X \geq 0$. When Y = 0, the model simplifies to that of Baron and Ferejohn (1989) with the X consisting of the total amount of purely private goods to be distributed among legislative districts. At the other extreme, when $X = 0$ the model reduces to a median voter game with the Y capturing the public good decision.

Each legislator i has preferences over decisions that depend only on Y and x_i, his or her share of the private good. Legislator i's utility function $u_i(y, x_i)$ is nonnegative, continuous, and strictly increasing in x_i for every $y \in Y$. Preferences over the public good are separable from the distributive decision for each i and u_i is single peaked in y, noted as y_i^*.

The legislative game consists of a potentially infinite number of stages. At the beginning of each stage a legislator is recognized at random to make a proposal with probability p_i where $\sum p_i = 1$, with the recognition probabilities the same in each stage. The legislator recognized proposes a decision $(y, x_i,\ldots,x_n)$ which is then voted on. If a majority votes in favor of the decision, the game ends and the decision is binding. Otherwise the game proceeds to the next stage with probability δ and the process repeats itself. For the case where $\delta = 1$ a default decision is specified. Although it is conceivable that the default would matter, Jackson and Moselle prove that this is not the case.

Each legislator observes all the actions that precede any action decided on. The full set of Nash equilibria for this game is large, with some equilibria involving complex, contingent strategies. The equilibrium that researchers typically focus on is the stationary subgame perfect

equilibrium (SSPE) where the history of past play in a bargaining round does not affect strategies chosen, which we focus on as well.

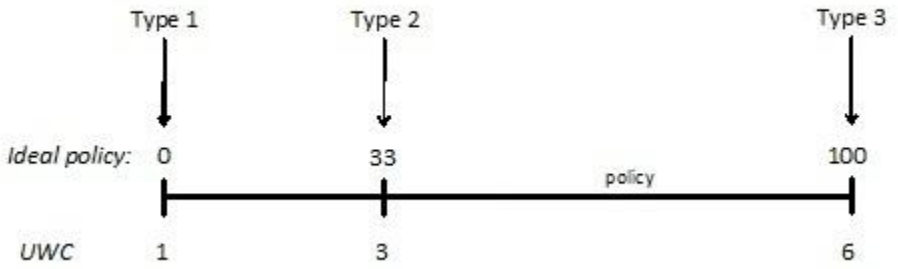
In games where $X = 0$ and $\delta = 1$, the preferred point of the median legislator, y_{med}^* ,is proposed and eventually approved with probability 1 in any SSPE. The intuition here is that a proposal that is not at the median legislator's ideal point will not win approval since the median legislator and the legislator to the other side of the proposed y can wait and do better.

In games where $X > 0$ and $Y > 0$ there is a positive probability that a proposal wins approval with a coalition that excludes the median legislator. That is, there is a positive probability that a proposal wins approval which includes members of a disjoint coalition. The next section characterizes the possible SSPE for these cases under our experimental treatment conditions.

Experimental Design and Procedures

Each bargaining group consisted of three legislators with ideal points for the public good distributed on the line interval [0, 100]. The three legislators, designated T1, T2, T3, had ideal locations for the public good at points 0, 33, and 100, respectively, with the cost for each integer deviation from a player's ideal point of 1, 3, and 6 for T1, T2, and T3, respectively. This setup is summarized in Figure 1.

Figure 1



UWC = unit cost to each player for policy outcome deviating from their ideal point.

All payoffs and costs were characterized in terms of experimental currency units (ECUs), which were converted into dollars at fixed conversion rate. Each player was endowed with 600 ECUs with returns to the public good location (R) calculated as follows:

$$R_i = 600 - UWC_i * \left| y_i^* - y_{prop} \right|$$

where y_i* is Ti's ideal point, y_{prop} is the proposed location, UWC_i is Ti's unit cost to deviating from their ideal point. With public and private goods the value of any private goods allocated to Ti would simply be added to R_i.

A between groups design was employed with baseline sessions for each treatment consisting of games with $X = 0$, with $X = 100$ for games with public and private goods. The SSPE outcome in the baseline sessions is for the public good location to be at 33 with zero variance. With private goods the expected location of the public good is 49.7 with a variance of 740.7. Expected total payoffs are 1365 with $X = 0$ and 1465 with private payments, for no net change in total payoffs after subtracting out $X = 100$, the total value of the private goods. The SSPE consists of a pure strategy equilibrium, with the public good location and private good allocation as a function of the proposer's type reported in the Table 1.

Table 1
Public Good Location and Private Good Allocations as a Function of Proposer's Type
(under the SSPE)

	Proposer		
	T1	T2	T3
Location	16.67	49.67	83
Private Good Allocation	All to T1	All to T2	All to T1
Proposer's Payoff	684	650	498

$\delta = 1$

Experimental sessions consisted of 15 bargaining rounds with between 12 and 15 subjects recruited for each session. Subjects' designation as a T1, T2 or T3 were fixed at the start of each session and remained the same throughout. New bargaining groups were formed after each bargaining round with one round, selected at random, to be paid off on at the end of the session. Each bargaining round continued until all groups had achieved an allocation.[2] Experimental sessions typically lasted for between an hour and an hour and a half. Software for conducting the experiments was programmed using zTree (Fishbacker, 2007).

[2] The software was designed to permit up to 15 stages of bargaining before the program moved onto a new bargaining round. All bargaining rounds ended well before 15 stages reported on in the text. Subjects were not told that had a bargaining round gone beyond 15 stages, the software would move on to a new bargaining round, with any payments resulting from that round (should it be randomly selected) coming from another randomly selected bargaining round that reached agreement.

Instructions were read out loud with each subject having a copy to follow along with. The public good issue was characterized using the metaphor of a bus stop location, with each player having a preferred point for the location of the bus stop and a per unit walking cost in case the location differed from their ideal point.[3] The key programming task was to make sure subjects were aware of the opportunity cost for deviations from their ideal points. This was done through a computer graphic showing the proposed location being voted on along with the deviation from a given player's ideal point along with the total walking cost.[4]

Each experimental session started with an initial dry run in which subjects were walked through the computer interface to understand the rules of the game and the software when a proposed allocation was rejected and when it was accepted. Sessions with private goods began with two dry runs with no cash. Subjects were told "Please treat the dry runs seriously as the experience should help you when we start to play for cash." As noted, all sessions had 15 rounds that could determine cash payments. In each stage of each bargaining round all players made proposed allocations after which one was selected at random to be voted on.

Subjects were recruited via e-mail solicitation from the 5000 or so undergraduates enrolled in economics classes for the quarter in which sessions were conducted, as well as the previous quarter. All subjects had no prior experience with the game in question or other multilateral bargaining experiments. Each subject was paid a $6 show up fee along with whatever their earnings were from the bargaining selected for payment with ECUs converted to dollars at 1 ECU = 3 cents. Earnings averaged between $20-22 per person including the $6 show up fee.

Three sessions of the public good only (baseline) treatment were conducted along with three sessions of the public and private good treatment, with a total of 42 and 39 subjects in the baseline and private goods treatments, respectively. Results will be summarized periodically in the form of a number of Conclusions.

Experimental Results

Unless otherwise stated, in what follows we report outcomes for rounds 7-15, after subjects have gained some experience with the structure of the game as well as the software.

[3] A full set of instructions can be found at http://www.econ.ohio-state.edu/kagel/CGK_leg_barg/instructions.pdf
[4] See Figure 1 of the Instructions appendix.

Results are reasonably similar, but with somewhat more noise if including all periods. The analysis begins with aggregate outcomes.

3.1 Aggregate Outcomes: Table 2 shows a significant shift in the location of the public good in response to the introduction of private goods. This is true using a t-test treating each bargaining round as an independent observation ($p < 0.01$) or a Mann-Whitney test using session level averages as the unit of observation ($p < 0.05$). The variance around the mean value of the public good also increases significantly.[5] Note that even though with only public goods the variance is much greater than predicted under the SSPE (it should be zero), the mean location of the public good is quite close to what is predicted (38.8 versus 33). Further, with public and private goods the mean location of the public good is essentially at the level predicted (49.78), with the variance quite close to its predicted value as well (858.5 versus 740.7).

Table 2
Aggregate Outcomes

Location (standard errors)		Percentage of Proposals Accepted in Stage 1		Total Payoffs [predicted]	
No Private	With Private	No Private	With Private	No Private	With Private
38.8 (20.3)	49.8 (29.3)	63.3%	76.9%	1350 [1365]	1483 [1465]

Proposals are far from always being accepted in stage 1, which is contrary to the SSPE. But rejection rates are comparable to what has been reported in other Barron-Ferejohn type divide the dollar bargaining experiments.[6] With only public goods T1s and T3s offer locations that are typically quite far away from 33, with a number of these offers being accepted. With private goods, as will be shown below, winning coalitions are formed and proposals passed that differ from the SSPE on a number of dimensions. Finally, stage 1 acceptance rates are

[5] Unless otherwise stated, all statistical tests reported in the text are significant under a Mann-Whitney test at the 5% level using session level data and at the 1% level using a t-test treating each bargaining round as an independent observation.

[6] For example in the three person divide the dollar games reported in Fréchette et al. (2005a) in which players had equal bargaining weight and equal probability of being the proposer, 65-67% of all bargaining rounds ended in stage 1 for inexperienced subjects.

significantly higher with private goods present than without, consistent with the notion that legislative compromise is easier with private payoffs available to grease the wheels.[7]

Total payoffs are somewhat lower than predicted absent private goods, and somewhat higher than predicted with private goods present. The net effect is a statistically significant increase in total payoffs with private goods present after subtracting out the cost of the private goods (an increase in total payoffs of 133 versus the predicted increase of 100). As such, the introduction of private goods, aka "pork", is in this case at least welfare enhancing in terms of increasing total payoffs. Note, this is not to say that the presence of private goods will always be welfare enhancing as this depends critically on the relative values of the public good for different constituencies as well as how the distribution of private goods affects the policy chosen. But the present results demonstrate that there clearly are cases where "pork" is welfare enhancing.

Conclusion 1: Aggregate outcomes are qualitatively similar to those predicted in that (i) the mean outcome for the public good shifts significantly in the direction predicted with private goods present, and (ii) the variance around the mean location of the public good is significantly greater with private goods available. Introducing private goods increases total welfare above and beyond the cost of the private goods, with stage 1 acceptance rates increasing as well.

Behavior by Types: Table 3 shows the average stage 1 proposed location for the public good by player type for games with no private goods, along with the "pass rate" – the percentage of type Ti's proposals voted on that were passed. Accepted proposals are included regardless of the stage in which they were accepted. Payoffs from accepted proposals for different types are shown in the right hand most columns of Table 3 along with predicted payoffs, so that reading across a row gives outcomes for a given proposer type: For example, T1s' average proposed location for the public good in stage 1 was 26.8, with an average location for accepted proposals of 29.0. These accepted locations resulted in average payoffs to T1 of 571, to T2 of 561 and to T3 of 174. The bottom row, average overall payoff, gives payoffs by type averaged across all accepted allocations.

[7] In the wake of recent debt ceiling crisis in the United States, a number of pundits noted that the decision by Congress to ban earmarks deprived the Speaker of the House of Representatives an important tool for getting members of his caucus to support proposed solutions to the crisis.

Table 3
Proposed Public Good Location by Player Type: Public Good Only Treatment
(standard error of the mean in parentheses)[a]

Proposer's Type	Location		Pass Rate[b]	Average Payoffs for Accepted Proposals[c] [predicted]		
	Proposed in stage 1	Accepted		T1	T2	T3
T1	26.8 (3.6)	29.0 (4.3)	50.0%	**571** **[567]**	561 [600]	174 [198]
T2	33.9 (3.5)	33.2 (3.6)	62.2%	567 [567]	**575** **[600]**	199 [198]
T3	67.6 (4.0)	61.5 (4.8)	38.3%	539 [567]	515 [600]	**369** **[198]**
			Average Overall Payoffs	561.2 (1.8) [567]	555.4 (4.0) [600]	233.0 (10.9) [198]

[a] Using subject averages as the unit of observation.
[b] Percent of Ti's proposals voted on that were passed.
[c] Proposers' payoffs in **bold**.

Looking at the proposed location for the public good it is quite clear that except for T2s, proposers typically propose something closer to their ideal location than the predicted location of 33. Further, there are very few stage 1 proposals by T1s and T3s that are really close to 33: For T1s 10.7% of all stage 1 proposals are in the interval [30, 35] with 0.0% of all T3s' proposals in this interval. Differences between proposed stage 1 locations and accepted locations are relatively small for both T1s and T3s but consistently shift towards the median player's ideal location. Contrary to the SSPE, at there is at least modest proposer power present for all three types in that each of them obtains their highest average payoff when proposing. In this respect T3s have the strongest proposer power, which is only partially offset by their much lower acceptance rates compared to T1s and T2s.[8] To rank relative proposer power we calculate expected payoffs to the different types in their role as proposers.[9] Accounting for the frequency with which their proposals were rejected, payoffs to T3s as proposers averaged 144% of what is

[8] Fréchette, Kagel, and Morelli (2005b, in press) also identify proposer power where it is not predicted under the SSPE in legislative bargaining games.
[9] The expected payoff is a proposer's average payoff for accepted allocations multiplied by the acceptance rate plus their empirically determined continuation value of the game multiplied by the rejection rate.

predicted under the SSPE compared to 100% and 95% for T1s and T2s, respectively.[10] T1s wind up with essentially the same average overall payoffs as T2s as they get a little more than predicted on average as proposers, and T2s have a higher unit cost to the deviations from their ideal point.

Proposals typically pass with what essentially amount to minimum winning coalitions (MWCs) as the average number of votes in favor of winning proposals (in addition to the proposer's vote) averaged 1.2 votes, with minimal variation across proposer types. Winning coalitions are what one would expect based on players' self-interest with T2s most often voting in favor of T1s proposals (87%), T1s typically siding with T2s (74%) and T2s typically siding with T3s (65%).

Conclusion 2: The relatively large variance around the predicted location of 33 with public goods results from T1s and T3s proposing locations closer to their ideal points with many of these proposals accepted. MWCs tend to form based on voters' self-interest, with the vast majority of proposals passing with one other vote in addition to the proposer.

Table 4
Accepted Proposals in Games with Private Goods: Location, Private Good Allocations and Payoffs
(standard error of the mean in parentheses)[a]

	Location	Private good to			Pass Rate[b]	Average Payoffs for Accepted Proposals[c] [predicted payoffs]		
Proposer's Type		T1	T2	T3		T1	T2	T3
T1	36.4 (4.9)	63.1 (4.8)	35.5 (4.8)	1.4 (1.3)	81.0%	**626.7 [684]**	596.2 [550]	219.8 [98]
T2	34.0 (3.5)	48.4 (4.5)	44.1 (3.1)	7.6 (4.3)	79.6%	614.4 [550]	**620.1 [650]**	211.3 [298]
T3	88.2 (3.0)	71.2 (12.8)	21.7 (11.3)	7.2 (4.7)	61.4%	582.9 [617]	456.0 [450]	**536.6 [498]**
					Average Overall Payoffs	613.2 (2.9) [616.4]	566.1 (8.3) [549.6]	303.5 (16.5) [298.0]

[a] Using subject averages as the unit of observation.
[b] Brackets show the percent of Ti's proposals voted on that were passed.
[c] Proposers' payoffs in **bold**.

[10] Note that T2s' predicted payoff (600) is the maximum payoff possible in the game while T3s' predicted payoff is substantially below this. As a result, T3s have much more room for improving on their predicted payoff. .

Table 4 is the counterpart to Table 3 for games with private goods. Space considerations limit us to reporting average accepted public good locations along with the corresponding private good allocations.[11] Pass rates are substantially higher than absent private goods, particularly for T1s and T3s, consistent with the fundamental idea that private goods help to achieve compromise on policy issues. Although the theory is silent on this point, since all proposals are accepted under the SSPE, it is clear that private goods help to promote compromise. Conditional on their proposal being accepted, all three types have proposer power in the sense that they obtain at least modestly higher payoffs when proposing than when they are not proposing. Using expected payoffs to rank relative proposer power, T3s have the least power relative to what is predicted as their expected payoff is 89.7% of their predicted payoff under the SSPE, with T1s and T2s getting 91.2% and 96.3% of their predicted payoffs, respectively.

Table 4 in conjunction with voting patterns for accepted proposals provide clear evidence as to the types of coalitions formed with private payoffs available. First, proposals rarely pass with more than the vote of the proposer and one other player, even less often than with public goods (averaging 1.05 votes in addition to the proposer). As predicted T3s are largely forming coalitions with T1s (92% of the time), allocating most of the private goods to them and with a proposed public good location that is reasonably close to the predicted location of 83. The advantage to T3s of using private goods to try and get a more favorable public good location for themselves was reasonably obvious with 8 out of 13 T3s essentially allocating all the private goods to T1s (over 99 ECUs on average).[12] The remainder of T3s kept either a significant portion of private goods for themselves and/or allocated a significant portion to T2s.[13] T2s primarily formed coalitions with T1s (88% of the time), with only 3 out of 13 proposing an average location greater than 36, compared to 4 proposing average locations less than 30.[14] The SSPE prediction that T2s will form coalitions with T3s is reasonably subtle as it essentially rests

[11] Average stage 1 proposals, which are reasonably close to accepted proposals, are available on request.
[12] Proposed allocations are calculated over all stage 1 proposals for bargaining rounds 7-15.
[13] Three out of 13 kept more than 1 ECU on average for themselves (averaging 77.8, 33.1, and 23.2 ECUs respectively), with 4 offering larger private good allocations to T2s than to T1s (averaging 77.8, 55.6, 38.3 and 8.9 ECUs respectively; 2 out of these 4 were among the three keeping more than 1 ECU on average for themselves).
[14] Of those proposing allocations greater than 36, one proposed locations in the 80s in the last 4 bargaining rounds generating a close to equal split among all three players, one might have still been learning proposing in the 30s over the last 6 bargaining rounds, with the third showing no consistency proposing in the range 21-85 over bargaining rounds 7-15.

on the fact that T1s can demand relatively large payoffs unless T2s form coalitions with T3s. However, this winds up not to be the case, as the near equal splits T2s offer T1s are readily accepted, with T2s earning approximately what they would have gotten under the SSPE, while also having the highest average frequency with which their proposals were accepted. T1s primarily formed coalitions with T2s (78% of the time), with 9 out of 13 T1s' average stage one proposals yielding payoffs that were within 20 ECUs between T1s and T2s, along with sharply lower payoffs for T3s (350 more to themselves than to T3).[15]

Conclusion 3: All proposers' acceptance rates are substantially higher with private goods available to "grease the wheels," consistent with the fundamental notion that private goods help to achieve compromise. Comparing actual to expected payoffs, T2s have the greatest proposer power relative to what the SSPE predicts, followed by T1s and T3s. T3s largely form coalitions with T1s, as predicted. However, T2s form winning coalitions with T1s, contrary to what the SSPE predicts.

Table 5
Voting Probits with Private Goods Available
(Rounds 7-15)

T1	Vote =	-21.7	+ 0.036 T2	+ 0.033 T3	+ 0.004 T2T3	+ 0.006 T3T2
		(8.29)[a]	(0.013)[a]	(0.011)[a]	(0.004)	(0.006)
T2	Vote =	-20.6	+ 0.035 T1	+ 0.040 T3	+ 0.002 T1T3	- 0.002 T3T1
		(8.01)[a]	(0.013)[a]	(0.017)[b]	(0.004)	(0.012)
T3	Vote =	10.33	+ 0.001 T1	+ 0.005 T2	- 0.020 T1T2	- 0.022 T2T1
		(9.17)	(0.005)	(0.005)	(0.014)	(0.014)

[a] Significantly different from 0 at better than the 0.01 level, two-tailed test.
[b] Significantly different from 0 at better than the 0.05 level, two-tailed test.

Dependent variable is 1 if vote in favor of proposal; 0 otherwise.
Explanatory variables: Ti = payoff proposed by player Ti; TiTj = payoff proposed by Ti to Tj.

Table 5 reports random effect probits (with a subject random effect) for voting by the different player types with private goods available. The dependent variable is 1 for a yes vote; 0

[15] Average payoffs for these 9 were 626.7, 619.5, and 181.2 for T1, T2, and T3, respectively. The remaining 4 T1s were uniformly more generous to T3s than the SSPE prediction, while consistently taking less than predicted for themselves, with average proposed payoffs of 624.1, 526.4, and 333.8 to T1, T2, and T3 respectively.

otherwise. Rather than treat the public good location and private payoffs as separate explanatory variables we adopt a reduced form approach with own payoffs as right hand side variables distinguishing between who the proposer is (in case there is resentment towards different proposer types on account of unequal payoffs), as well as payoffs of proposers to other players (to account for possible other regarding preferences).[16] For example, the first probit reported is for how T1s' voted with the following RHS variables: T2s' proposed payoff to T1, T3s' proposed payoff to T1, T2s' proposed payoff to T3, and T3s' proposed payoff to T2. Preliminary probits with voting stage included as an explanatory variable failed to identify a significant stage effect ($p > 0.10$ in all cases) with little impact on the other coefficient values with stage removed, and are not reported here.

Own payoffs are positive and significantly different from zero at better than the 5% level in all cases. The sole exception to this is T3s' voting in response to own payoffs which, although positive, are not significant at conventional levels, which may reflect the infrequency with which T1s and T2s offered any sizable share to T3s. T1s and T2s are "color" blind when voting with respect to the proposer's type, as we cannot reject a null hypothesis of equal responsiveness to own share regardless of the proposer's type. None of the remaining variables in the probits achieve statistical significance at anything approaching conventional levels.

The probits can be used to calculate the expected payoff maximizing proposal for each type, as well as the expected payoff from the SSPE proposal, and the "efficient equal split" (the payoff maximizing proposal that equalizes payoffs to within 1 ECU between the proposer and one other coalition partner). These are reported in Table 6 along with the average expected return by types when proposing.[17,18] Several things stand out in the data. First, the payoff maximizing proposal is greater than the SSPE proposal in all cases. This is a result of the very

[16] This reduced form is justified here since players presumably have no particular attachment to the public good location here and treat location and private good benefits as perfect substitutes. Obviously in field settings the idea that these two are perfect substitutes is unlikely to be the case.

[17] The expected payoff of an offer depends on the probability one or both of the other players accept the proposal, the proposer's type, and the experimental continuation value for the game should the proposal be defeated. The latter is a type's average payoff in the game weighted by the frequency of acceptance for each type of proposer. The experimental continuation values are 613, 566, and 304 for T1, T2, and T3, respectively.

[18] For a T1 proposer the payoff maximizing proposal and the SSPE proposal, along with the expected returns from those proposals, assume that a T3 votes no on the proposal. The probits show that T3s are more likely to vote in favor of a proposal from a T1 when the payoff to T2 is lower, so that without this restriction it becomes optimal for a T1 proposer to propose Y=0 and PT1=100. However, it is highly doubtful that T3s would actually vote for proposals that give them a payoff of 0, or 98 under the SSPE, so that extrapolation of the probits in this case seems unreasonable. As such the calculations reported impose T3s not voting in favor of these offers.

unequal splits between coalition partners under the SSPE which generates relatively high rejection rates. Second, the efficient equal split also yields a higher expected payoff than the SSPE for all types, but a lower expected return than the payoff maximizing proposal (although not so much lower that proposers are giving up large sums of money). Third, for T2s both the payoff maximizing proposal and the efficient equal split involve partnering with T1s, not T3s, as the SSPE requires, yielding substantially higher payoffs than the SSPE in both cases. Finally, in terms of looking for an efficient equal split it is a relative no-brainer for T3s to partner with T1s rather than T2s as the best they could earn with T2s is 534 versus 600 with T1s, while also providing T1s with higher payoffs thereby promoting greater acceptance rates.[19]

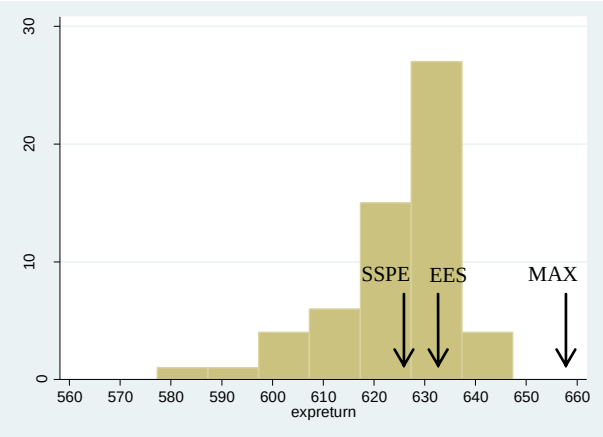
Table 6
Comparison of Expected Return to Proposer's Payoff Maximizing Proposal with Other Offers in Games with Private Goods
(standard error of the mean in parentheses)[a]

	Expected Return to Proposer from			
Proposer's Type	Payoff Maximizing Proposal	Efficient Equal Split[b]	SSPE	Average Expected Return
T1	658.7	633.7	624.7	625.5 (2.98)
T2	647.3	632.5	617.1	619.2 (5.50)
T3	524.1	523.7	485.9	465.3 (17.56)

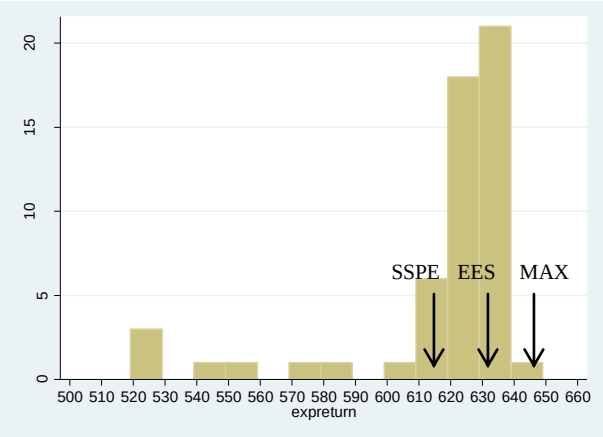
[a] Using subject averages as the unit of observation.
[b] The payoff maximizing proposal that equalizes payoffs (within 1 ECU) between the proposer and one other coalition partner. The efficient splits are:
T1 Proposer: Y=33, PT1=67, PT2=33, PT3=0
T2 Proposer: Y=33, PT1=66, PT2=34, PT3=0
T3 Proposer: Y=100, PT1=100, PT2=0, PT3=0,
where PTi = private goods to Ti.

[19] It's also a relative no-brainer for T2s to pursue efficient equal splits with T1 rather than T3s.

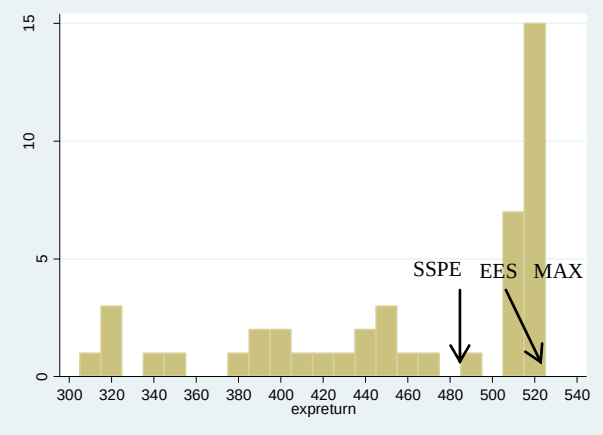
Figure 2
Histogram of Expected Payoffs to Proposer[a]



Type 1 Proposer



Type 2 Proposer



Type 3 Proposer

[a] Rounds 7-15 all proposals voted on.
Expected returns from SSPE, efficient equal split (EES), and the payoff maximizing proposal (Max) are noted in all cases.

Looking at average expected returns based on the data, all types earn less than the payoff maximizing offer, with T1s and T2s earning close to the efficient equal split, and T3s earning substantially less than the efficient equal split. Figure 2 provides histograms of each type's expected payoff from proposals voted on. For all types these are clustered around the efficient equal split. However, T3s have a long tail of proposals well below the efficient equal split which reflect low acceptance rates, so that on average they earn well below the efficient equal split. In a number of cases these proposals consist of T3s keeping some of the private goods for

themselves while also proposing locations close to their preferred point which have essentially no chance of passing. Even their equal split proposals have an expected passing rate of only 69%.

One question is why proposers (particularly T1s and T2s) fail to achieve the payoff maximizing outcome, going for the efficient equal split instead. We argue that the efficient equal split, or something very close to it, provides an obvious focal point with a very high probability of being accepted and with payoffs in this case that are reasonably close to maximum returns. In contrast, the expected payoff maximizing proposal requires more comprehensive information than players would be likely to have and would entail somewhat greater risk of rejection. Given the greater risk of rejection it is tempting to argue that, in going for the efficient equal split, T1s and T2s are risk averse. However, this explanation is not fully consistent with the data. For one thing, T1s' payoff maximizing offer yields 600 for T2s versus T2s' empirical continuation payoff of 566, with the probits indicating T2s would reject these offers 21% of the time. For another, the payoff maximizing offer for T2s yields 599 to T1s versus their empirical continuation value of 613, a trivial increase for a T1 to hold out for, but which the probits suggest is likely to happen 15% of the time. As such one would have to postulate that a sizable portion of T2s and even T1s are risk loving to rationalize these likely rejections. At the same time, there are no T1 or T2 proposals voted on that are at *their* payoff maximizing value, and only a handful much above the efficient equal split. This means there is a non-negligible level of risk loving on the part of some T1 and T2 voters who in turn are risk averse in the offers they make as proposers, a finding that casts serious doubt on risk aversion as the driving force for efficient equal split proposals.

Conclusion 4: With public and private goods both the payoff maximizing proposal and the efficient equal split offer higher expected returns than the SSPE for all types, with offers clustered at, or very close to, the efficient equal split. Risk aversion fails to provide a plausible explanation for favoring the efficient equal split over the payoff maximizing proposal as it requires subjects to be risk averse as proposers and risk loving as responders. We conjecture that the efficient equal split is attractive as a focal point with reasonably high expected own payoffs and a high probability of acceptance.

The experimental treatment reported on in the appendix has quite similar results to the one reported on here with the exception of the fact that the largest difference between the efficient equal split and the payoff maximizing proposal there is almost twice as large as the largest difference here (45 ECUs versus 25 ECUs). Thus there is substantially more incentive

for proposers (T2s in that case) to go with the payoff maximizing proposal as opposed to the efficient equal split. Forty two percent (42%) of T2s proposals in that treatment lie above the efficient equal split, which is almost twice as large as the maximum percentage of current proposals lying in that interval in the current treatment (12.1%, 24.1%, and 0.0% for T1s, T2s, and T3s, respectively). This will be discussed in more detail in the appendix.

Summary and Discussion

We report results from a legislative bargaining experiment based on Jackson and Moselle's (2002) model in which players bargain over a single policy along with the distribution of private goods across legislative constituencies. We compare play in a baseline treatment with only public goods to play in games with private goods available to help secure compromise. We report a number of outcomes each of which are discussed below.

In the implementation reported on here, total welfare (total payoffs) is predicted to remain constant between treatments. However, contrary to this, total welfare increased with private goods available after accounting for the cost of the private goods, and this occurred uniformly across experimental sessions.[20] Hence, not only did private goods (aka pork) grease the wheels in terms of securing more timely passage of proposed allocations, they also improved total welfare. This is not to say this will always happen but that private goods (pork) need not always be bad. Additional reservations need to be added to this result in any effort to extend it beyond the lab. In the experiment private goods (aka pork) are delivered directly to agents, whereas in field settings private goods allocated to legislative districts can take the form of inefficient local public goods; e.g., the bridge to nowhere in Alaska. This tends to dilute the benefits obtained from the private good, thereby offsetting, to some extent at least, whatever welfare gains that might result from private goods.[21]

Regarding total welfare levels reported versus those predicted, total payoffs were less than predicted in the public good only treatment and greater than predicted with private goods present. The reasons for these deviations can be found in the asymmetric payoffs for deviations from the average public good location in conjunction with the variability in outcomes across different bargaining rounds. The welfare maximizing outcome for the location of the public good is 100, so it always increases total welfare to move policy to the right of the predicted

[20] Further, as in the parallel treatment reported in the Appendix, welfare increased more than predicted with public and private goods compared to only public goods.

[21] We are grateful to Guillaume Fréchette for pointing this out.

outcome. However, given the costs to deviating, all rightward movements of policy are not equal. The marginal benefit of a rightward shift when the public good location is less than 33 is four times the marginal benefit than when its greater than 33 (8 versus 2) as the shift helps both the T2 and T3 players in the first case and helps only the T3 play in the second case. This explains why welfare falls in the public good only treatment even though the average public good location is to the right of 33 (38.8): 53% of accepted proposals lie below 33 with an average location of 23.8, while 40% of proposals lie above 33 with an average of location of 60.5. Because of these asymmetric welfare effects around 33, policies passed to the right of 33 do not occur often enough and/or are not sufficiently to the right of 33 for welfare to reach the predicted outcome.

This asymmetry in welfare effects for deviations from the predicted public good location also explains why welfare is greater than predicted in the private good treatment (and greater than in the public good treatment) even though the average accepted policy outcome is almost identical to the average predicted policy. With private goods the average location for the public good with T1s as proposers is 36.4 (with minimal variance around this outcome) versus the predicted location of 16-17, with this difference generating a strong positive welfare effect. So while T2s average policy location is 34 versus the predicted location of 49-50, it does not usually go below 33 (and when it does, not by very much), so that given the asymmetry in payoffs this has a smaller negative impact on total payoffs than the positive effect of the rightward shift in location generated by T1s. Finally, T3 proposers' average accepted policy location is a bit above the predicted level (88.2 versus 83), which also provides a modest bump to overall welfare.

The public good only treatment achieved, on average, close to the predicted public good location but with a relatively large variance around that location as opposed to the zero variance predicted. This large variance was generated by T1s and T3s consistently proposing a public good location more favorable to their own payoffs than to the median voter, with substantial numbers of these proposals being accepted. Further, as already noted, acceptances were not due to odd coalitions in which T3s voted in favor of T1s proposals that favor T1s, or vice versa. Two points are worth discussing with respect to this result. First, there are a series of earlier experiments dealing with public good/locational issues similar to the present study (see Palfrey, 2006 for a survey of the relevant research), but done in a very different context and with quite different outcomes. These earlier studies typically involved unstructured, face-to-face,

bargaining using Robert's rules of order, designed to investigate the drawing power of the core. A fair summary of these results is that the core represents a fairly good predictor under a number of conditions, but when the core is present and differs from the "fair" outcome where *all* players receive decent positive payoffs, the fair outcome attracts more attention than the core (Eavey and Miller, 1984). Although we find "fair" outcomes within what are effectively MWCs (e.g., much more equal splits between T1s and T2s than predicted) there is typically little concern for the third player, with T3s achieving distinctly lower average payoffs than T1s and T2s in the public good treatment. The factors most likely responsible for this difference from the earlier research are (i) the much more structured nature of the bargaining process under the Baron-Ferejohn rules employed here which tends to promote MWCs and (ii) the fact that bargaining is done anonymously here which tends to promote more unequal splits (see, for example, Roth, 1995).[22]

Second, the fact that the median player (T2) is willing to accept public good locations that deviate from T2's ideal point suggests some impatience. Impatience in legislative bargaining acts like an implicit discount, and serves to enhance proposer power. But this cannot by itself explain deviations from the SSPE in games with public and private goods, since outcomes there tend to involve more equal splits than predicted under the SSPE. Rather, as in the divide the dollar games, the equal splits within what are essentially MWCs in the present context seem to be driven by the focal nature of the efficient equal split in conjunction with the fact that responders within the MWC are very unlikely to accept anything approaching the much more unequal outcomes the SSPE predicts.

[22] MWCs emerge immediately and grow rapidly in divided the dollar versions of the legislative bargaining game under Baron-Ferejohn rules, which completely shut out one or more players from positive payoffs (see, for example, Fréchette et al., 2005a, b).

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