Coalition Formation and Selectorate Theory: An Experiment - Appendix

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Appendix

Experimental Setup

To test the effect of domestic political structure on selection into conflict and the mobilization of resources once a conflict is underway, I present a game that captures the underlying dynamics of a lengthy interstate war. Group leaders decide whether or not to fight a war or accept a settlement. If war occurs, leaders set their effort level. Furthermore, there can be up to three rounds of conflict, allowing leaders to adjust their effort level as a lengthy war unfolds. Leaders then stand for reselection under. By random assignment into groups, this set-up tests the effect of domestic political institutions on war selection and war effort. The game is stated more formally below.

The game has two groups, each consisting of n members attempting to capture a prize of value p. One member of each group is randomly selected as the leader and given a budget of points, b_1 and b_2, respectively, while the other group members are assigned to be citizens.

The game begins with a proposal to split p according to the formula $\pi = \frac{b_1}{b_1+b_2}$, where π is the portion of the prize offered to the leader of group 1 and $1-\pi$ is the portion of the

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prize offered to the leader of group 2. Leaders and citizens are informed that rejecting the proposal will result in a war that could last up to three rounds. If both leaders accept the proposal, the leaders receive a payoff for their group of $(\pi * p + b_1, (1-\pi) * p + b_2)$, the conflict phase is skipped, and they move on to the internal distribution phase described below.

If at least one leader rejects the proposal, the leaders play the first stage of a 3-stage Colonel Blotto game to determine which group receives the prize p. A Blotto game was selected to represent the international conflict because of its long history of representing the placement of troops or regiments during wars (Golman and Page, 2009). Blotto games capture the strategic difficulties of allocating resources while also favoring players that have more resources available (or the willingness to use more resources in the case of the non-zero sum Blotto game presented here). Thus, a Blotto game that unfolds over time and in which leaders keep resources not spent on war seems ideal to test how regime type influences war effort.

Each stage of the Blotto game consists of three battlefields and the leader that places more points on a battlefield wins that battlefield. In case of a tie, a half-win is awarded to both. The points placed on battlefields are subtracted from the leaders' budgets regardless of who wins that battlefield, making the battlefields all-pay auctions. Given that there are nine battlefields over the course of the three stages, the leader that wins five battlefields is awarded p.

After the first stage of the Blotto game, which represents the initial battles of a war, a new proposal to divide p is offered to the leaders that is updated based on each leader's remaining budget of points and remaining wins needed to capture all of p according to the formula:

$\pi' = \frac{b_1' * (\frac{r_2}{r_1+r_2})}{b_1' * (\frac{r_2}{r_1+r_2}) + b_2' * (\frac{r_1}{r_1+r_2})})$,

where π' is the updated portion of the prize offered to the leader of group 1, b_1' and b_2' are the remaining budgets for leaders 1 and 2, respectively, and r_1 and r_2 are the remaining wins

needed to capture all of p for leaders 1 and 2, respectively. This formula makes higher offers to leaders who have gained a battlefield advantage by winning early battles and to leaders who have more remaining military power, in the form of points. In this way, the formula balances battles won and power remaining and represents a break in the fighting for negotiation. Leaders and citizens in both groups see the offer and the effort already put forth by both leaders and are informed of the remaining budget of both groups. If both leaders accept the updated offer, the leaders receive a payoff for their group of $(\pi' * p + b'_1, (1 - \pi') * p + b'_2)$ and the game moves on to the internal distribution phase described below.

If at least one leader rejects this proposal, they proceed to the second stage of the Blotto game, which represents an extension of the war, and allocate points over the second set of three battlefields. After the second stage, a new proposal is generated according to a similar formula, but again updated based on the remaining budgets and wins needed to reach five for each leader. This new proposal again represents a break in the war for negotiations. If both leaders accept the proposal, the leaders receive a payoff for their group of $(\pi'' * p + b''_1, (1 - \pi'') * p + b''_2)$, where π'' is the updated percentage offered to leader 1, and b''_1 and b''_2 are the remaining budgets of the leaders after the second stage. The game then moves on to the internal distribution phase described below.

If at least one leader rejects the third proposal, the leaders play the final stage of the Blotto game, which represents the end of a lengthy war. After the third stage, the winning leader is awarded p in addition to her remaining budget, while the losing leader is left with only her remaining budget. If the number of wins is even after the third stage, each leader is awarded $.5p$.

Upon conclusion of the conflict phase, the leaders distribute points within their groups. The leaders can keep points for themselves, give them directly to individual group members, or invest them in a public good, in which those points are multiplied by pg, where $pg > 1$, and then distributed evenly to all members of the group. Group members know the initial

allocation of points to their leader, offers that were turned down by the leader, the number of points used each round of the war, the outcome of the war, and the final total of points held by the leader. After the distribution, the group members vote on retaining the leader for the next round. If the leader receives w_g votes, where g represents the group number and the number of votes needed can differ between groups, the leader is retained for the next round. If the leader does not receive the requisite number of votes, the leader's payoff for the round is set to 0 and a new leader is randomly selected from the other members of the group at the beginning of the next round.[A1] Leaders and citizens are both informed of w_g before the game begins.

Thus, the round payoffs for the citizens consist of any points given directly to that group member by the leader plus pg/n times the amount invested in public goods by the leader. The round payoffs for the leaders are the points kept by the leader plus pg/n times the amount invested in public goods by the leader if that leader is retained and 0 otherwise.

Experimental Parameters

The specific values of the parameters of the game used in the experiment are as follows: The value of the prize, p was set to 100 for all treatments. Each round, the initial budgets are randomly set to either 150 for both groups or 100 for one group and 200 for the other, with the more powerful group also being randomly determined each round. The value of the prize is equal to the round endowment of the weakest groups in order to ensure that all wars are "difficult" in that one leader cannot rationally overwhelm the other with force. Both sides can at least mobilize resources equal to the value of the prize.

When the leader invests points in the public good, those points are multiplied by 2.8 and then distributed evenly to all members of the group. This multiplier is common knowledge

[A1] While acknowledging Goemans (2008)'s finding on the post-tenure fate of leaders and how it differs by regime type, this rule is meant to induce the leader to be primarily concerned with retaining office, the key assumption of Selectorate Theory.

to all group members. After receiving their allocation of points, the citizens, all of whom are members of the selectorate, vote on whether to retain the leader from that round for the next round or not. The number of votes needed for reselection of the leader is $w = 1$ for small coalitions and $w = 3$ for large coalitions and citizens and leaders know their group type.[A2] Varying the number of votes needed to win reselection changes W/S in accordance with Selectorate Theory's assumptions about retaining office in an autocracy

Experimental Design: Inter-group phase

At the beginning of each round, the four leaders in the session were divided into pairs and played the conflict game. In three experimental sessions, there were two small coalition groups and two large coalition groups. To increase interactions between groups of similar regime types, one session consisted of three small coalition groups and one large coalition group, while one session consisted of three large coalition groups and one small coalition group.

The leaders and the citizens of both groups in the pairing were informed of both groups' regime types, their endowments for the round, and the initial offer to divide the prize.[A3] After each offer, the entire group was informed whether their leader and the other leader accepted the offer and if the conflict would continue or not. If the groups engaged in conflict, after each set of battles the leaders and citizens were informed of the remaining endowment for both groups as well as the number of battlefields won. After the conflict was settled, the group was informed whether it was settled by negotiation or fought to its conclusion.

[A2]The leader did not vote on her own reselection. Given that the leader had a dominate strategy to vote yes and that the computer lab only held 24 subjects, it made practical sense to set the group size to six so that four groups could participate concurrently.

[A3]In the experiment, autocratic regimes were referred to as groups of type A while democratic groups were referred to as type B.

Public versus Private Goods

The main text asserts that, given the setup of the game, large coalition leaders will rely on public goods and small coalition leaders will distribute private goods to one group member in equilibrium.

I start with the standard parameterization that the marginal per capita return on public good investment is less than one (that is, the public good multiplier divided by the groups size or $\gamma/6$ here). In this case, any individual gets a lower payoff from one point invested in public goods than one point of private goods.

Therefore, assuming a small coalition leader knows, or can learn, the reservation prices of the citizens, she can target the citizen with the lowest reservation price with private goods and giving nothing to the other citizens for a cost of r_1. If the leader deviates to using public goods, it will cost the leader $\frac{\gamma * x}{6} = r_1$ to reach r_1. Solving for the total cost, x, yields: $x = \frac{6 * r_1}{\gamma}$. However, the leader also recovers r_1 through benefiting from the public good.

Therefore, when $-r_1 = -\frac{6 * r_1}{\gamma} + r_1$ the leader is indifferent between public and private goods. Thus, the leader becomes indifferent when $\gamma = 3$. Therefore, for $\gamma = 2.8$ used in the experiment, a small coalition leader should prefer private goods.

Meanwhile, a leader of a large coalition needs three votes to ensure reselection. We can represent the three lowest reservation prices of the citizenry in ascending order as r_1, r_2, and r_3. If the leader relies on private goods, she will need to give out a total of $r_1 + r_2 + r_3$. Given that r_3 will be the critical citizen to satisfy, the formula $\frac{\gamma * x}{6} = r_3$ gives the minimum investment in public goods by the leader to reach r_3 when solved for x. Solving for x yields: $x = \frac{6 * r_3}{\gamma}$. However, the leader also recovers r_3 through benefiting from the public good.

Therefore, when $-r_1 - r_2 - r_3 = -\frac{6 * r_3}{\gamma} + r3$, the leader is indifferent between public goods and private goods in equilibrium. Rearranging, reveals the leader is indifferent when $\gamma = \frac{-6 * r_3}{-r_1 - r_2 - 2r_3}$. If all citizens are interchangeable, $r_1 = r_2 = r_3$, then when $\gamma > 1.5$, the leader will rely on public goods. When r_1 and r_2 approach 0, γ approaching 3 still causes

the leader to prefer public goods. Thus, the assertion that large coalition leaders will rely on public goods for the γ of 2.8 in this experiment stands even if two citizens have exceptionally low reservation prices.

Scatter Plots

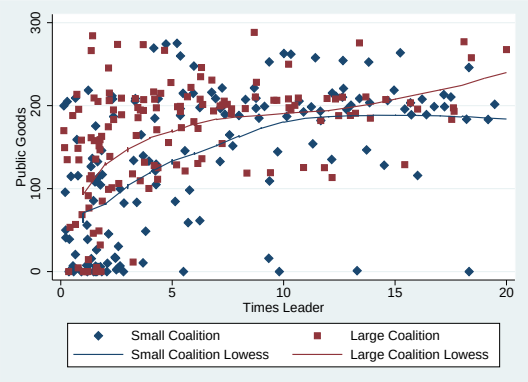

Figure 1: Scatter plot of leader investment in public goods by the number of rounds the leader has been in office with a separate lowess fit for small coalition leaders and large coalition leaders.

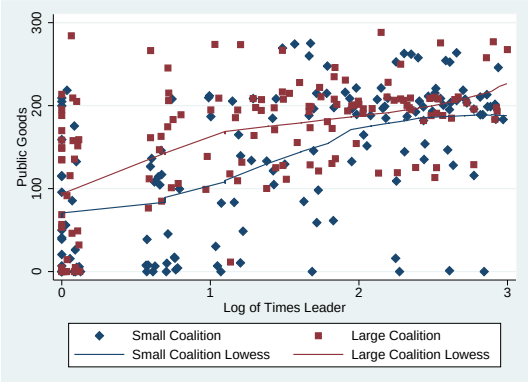

Figure 2: Scatter plot of leader investment in public goods by the log of the number of rounds the leader has been in office with a separate lowess fit for small coalition leaders and large coalition leaders.

Figures 1 and 2 present how leaders used public goods during their time in office. Figure 1 has the number of times the leader had been in office as the x-axis while Figure 2 uses the log of that number. The figures clearly show that leaders that have been in office longer behave differently than than leaders that have just entered office. Both small coalition and large coalition leaders that have been in office longer tend to use more public goods. On the log-scale presented in Figure 2, this increase is approximately linear and so the use of this variable in the regressions in the main body of the paper is appropriate.

Figures 3 and 4 present how leaders used private goods during their time in office. Figure 3 has the number of times the leader had been in office as the x-axis while Figure 4 uses

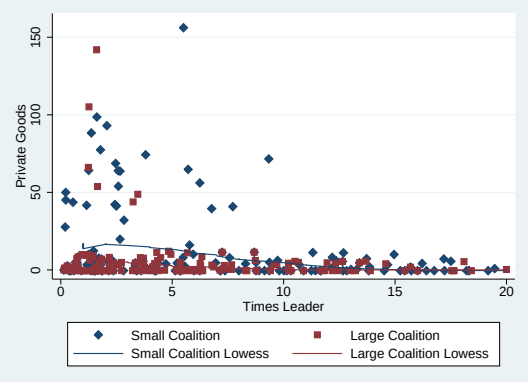

Figure 3: Scatter plot of leader use of private goods by the number of rounds the leader has been in office with a separate lowess fit for small coalition leaders and large coalition leaders.

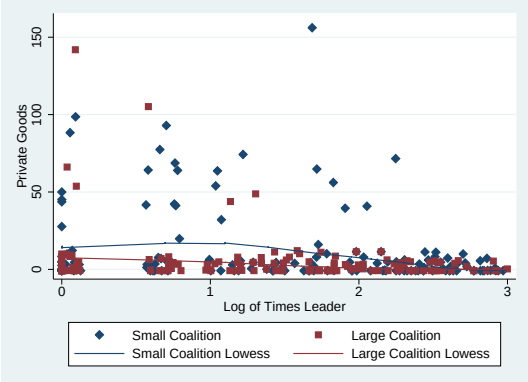

Figure 4: Scatter plot of leader use of private goods by the log of the number of rounds the leader has been in office with a separate lowess fit for small coalition leaders and large coalition leaders.

the log of that number. These figures show that leaders that used substantial amounts of private goods tended to be leaders in small coalition systems. The lowess fits show a small decrease over time, which on the log-scale presented in Figure 4, is approximately linear.

Figures 5 and 6 present scatter plots for the citizen round payoffs by the log of the number of rounds the leader has been in office in small coalition systems and large coalition systems, respectively. In Figure 5, as discussed in the main body of the paper, there is clear separation between citizens that previously voted in favor of the leader and those that did not, with those that supported the leader consistently receiving higher payoffs. This pattern holds until the highest values of the log of the number of rounds the leader has been in office, where two lines intersect. This intersection is consistent with Figures 1 and 1 and indicates that the small coalition leaders that remained in office the longest tended to more heavily rely on public goods.

Figure 6 shows that, consistent with the results in the main body of the paper, there is little to no separation between citizens that previous supported a leader and those that did not in large coalition systems. Taken together, Figures 5 and 6 show that supporting

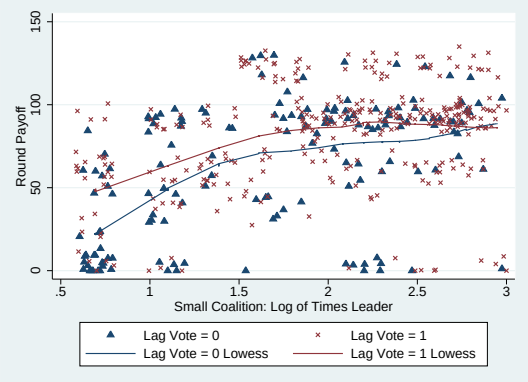

Figure 5: Scatter plot of citizen round payoffs in small coalition systems by the log of the number of rounds the leader has been in office with a separate lowess fit for citizens that voted in favor of and against the leader in the previous period.

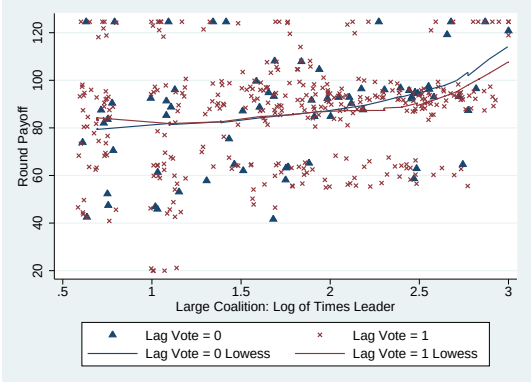

Figure 6: Scatter plot of citizen round payoffs in large coalition systems by the log of the number of rounds the leader has been in office with a separate lowess fit for citizens that voted in favor of and against the leader in the previous period.

a leader in previous rounds increased payoffs in small coalition systems but not in large coalition systems.

Experimental Instructions

Thank you for agreeing to participate in this experiment. You should now see a white welcome. As indicated on the consent form, participation in this experiment is voluntary. For the remainder of the experiment, please silence your cell phones. All choices and interaction will occur through your computer. Throughout the experiment talking, communicating, or signaling is prohibited and will result in a forfeiture of payment.

The experiment will proceed as follows: you will be randomly assigned into groups of 6 and one member of your group will be randomly selected as the leader.

This experiment is a simulation of international conflict. At the beginning of each round, your leader will be randomly paired with the leader of another group. Both leaders will be given 150 points or one leader will be given 200 points and the other 100 points. This

allocation is random and the amount of points received by each leader is known to all players in both groups, as is the type of both groups (explained below).

Then, the international crisis begins. The conflict is over how the two groups will divide a 100 point prize and begins with an offer to split the prize according the percentage of points received by each leader (either 50-50 or 67-33). If both leaders accept this offer, the crisis ends and the points are added to the leaders' totals. If at least one leader rejects this offer, a war begins.

To win the war, a leader must win 5 of 9 battles. However, only three battles are fought at a time and the war can be terminated before all 9 battles are fought. The leaders allocate points across the first three battlefields and the leader that places more points on a given battlefield wins that battle. In case of a tie, both leaders are awarded a half-win. Any points placed on a battlefield are considered used and subtracted from your leader's initial allocation of point regardless of whether the leader won that battlefield or not.

After the first three battles, the leaders receive a second offer to end the crisis. The second offer takes into account the number of wins in the first three battles as well as the number of remaining points each leader has. If both leaders accept this offer, the conflict ends and the points are added to their totals. If at least one leader rejects this offer, the war continues. If the war continues, the leaders place points on the second three battlefields.

After the second three battles, a final offer is made that takes into account the total number of wins so far and the remaining points of each leader. If this offer is accepted, the conflict ends and the points are added to their totals. If at least one leader rejects this offer, the war continues. If the war continues, the leaders place points on the final three battlefields. The leader who won at least 5 battles is awarded the 100 point prize. If both leaders won 4.5 battles, they split the 100 points evenly.

Next, the leader decides how to allocate those points within the leader's own group. These points include any points initially allocated but not used in battle, plus any points

from a negotiated settlement or won in the war. The leader can give all the points to one player or divide them among any number of players. Finally, the leader can take some points and invest them in a such a way that they are multiplied by 2.8 and then distributed evenly among all players.

For example, if the leader had 100 points, he could put 10 points in the multiplier fund and keep 90 for himself. The 28 points would be multiplied by 2.8, become 28 points, and then 4.7 points would be given to each group member while the leader receives 94.7 points.

After the leader allocates the points, the group members will vote on whether to retain or replace the leader for the next round. There are two types of groups. In groups of Type A, the leader only needs 1 vote to retain office while in groups of Type B, the leader needs 3 votes to retain office. Individuals' votes are made public to the entire group and the leader does not vote (a -1 will appear next to the leader's player number to indicate the leader did not vote). If the leader does not earn enough votes to be retained for the next round, the leader's point total for that round is set to 0 and a new leader is randomly selected from the other five group members at the beginning of the next round.

Throughout the experiment, groups and player numbers remain the same.

You will be offered at least 10 dollars for your participation. Additional monetary compensation will be based on the sum of points you earned in two randomly chosen rounds in the experiment. For every 10 points earned in those two rounds, you will earn $.30. If you withdraw before the end of the study, you will receive no payment: you will be offered a minimum of 10 dollars only if you complete the study.

References

Belot, M., L. Miller and R. Duch. 2010. "Who should be called to the lab?" *Working Paper* .

Fischbacher, U. 2007. "z-Tree: Zurich toolbox for ready-made economic experiments." *Experimental Economics* 10(2):171–178.

Goemans, Hein E. 2008. "Which way out? The manner and consequences of losing office." *Journal of Conflict Resolution* 52(6):771–794.

Golman, Russell and Scott E Page. 2009. "General Blotto: games of allocative strategic mismatch." *Public Choice* 138(3-4):279–299.

Hafner-Burton, Emilie M, Brad L LeVeck, David G Victor and James H Fowler. 2012. "Decision Maker Preferences for International Legal Cooperation." *International Organization* 68(4):845–876.

Mintz, A., S.B. Redd and A. Vedlitz. 2006. "Can we generalize from student experiments to the real world in political science, military affairs, and international relations?" *Journal of Conflict Resolution* 50(5):757–776.

Morton, R. B. and K.C. Williams. 2010. *Experimental Political Science and the study of causality*. Cambridge Univ Pr.