Towards a Complex Adaptive Congress

Robi Ragan and Gregory Robinson

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Abstract

In this paper we argue that scholars of Congress should move past the static, game theoretic, single dimensional models that currently dominate studies of the U.S. Congress. The policy making process in the U.S. Congress is a dynamic system that includes dynamics, heterogeneous agents, non-linear interactions, adaptation, positive and negative feedback and externalities. As such, the development of policy should be modeled as a complex adaptive system using agent based modeling. First, to demonstrate that an agent based approach is compatible with existing analytical approaches three of the leading analytical models of Congress are replicated using an agent based approach. Next we demonstrate the gains that can be made using the agent based approach by providing the first formalized model of Aldrich and Rohde's "Conditional Party Government" theory.

The use of complexity science and agent based models has been growing within social science in general and specifically within political science. The tools of complexity have been used to examine a wide range of social science issues; collective action (Schelling 1978), elections (Kollman, Miller & Page 1992), political economy (Kollman, Miller & Page 2003), macroeconomics (Sargent 1993), and international relations (Cederman 2003). As of yet,

though, there has been little application of the tools of complexity science to issues associated with American political institutions. This paper advocates taking a complex adaptive systems approach to modeling the United States Congress. Traditionally, formal models of Congress have used a static, single dimensional and game theoretic approach to modeling policy formation. We believe that there are gains to be made by using an agent based, complex adaptive approach.

Systems with dynamics, heterogeneous agents, non-linear interactions, adaptation, positive and negative feedback, and externalities are prime candidates for an application of the complex adaptive systems approach. The Congressional policy making system has many of these characteristics. In order to illustrate the analytical leverage of using the complex systems approach, we first build a set of agent based models which computationally replicate three of the most prominent models of congressional policy making: the distributive/committee model (Shepsle & Weingast 1987) (Weingast & Marshall 1988), the partisan model (Cox & McCubbins 2005), and the pivotal politics model (Krehbiel 1998). Next, we seek to replicate the intuition of the Conditional Party Government (CPG) model of Aldrich and Rohde (2000) in our agent based framework. The CPG model has never been fully formalized. We feel that this is due to the limitations of axiomatic mathematical models. In CPG, members of congress are constantly balancing their policy goals against their electoral goals. They do this within a macropolitical environment which determines if the "conditions" of conditional party government are met. The interplay between the determinants of the "conditions", and members' often countervailing goals culminates in a system with feedback loops and non-linear interactions. Further, members are not homogeneous in the electoral environment they face. A model that deals with each of these moving parts in a meaningful way is likely to be mathematically intractable. [1] We argue that omitting parts

[1]Even introducing these moving parts still leaves us, potentially, with a model which does not capture the full complexity of the CPG argument.

of the CPG argument in order to make formalization easier would lead to a mischaracterization of CPG, since the complexity of the interactions are a fundamental part of the model. Fortunately, a generative agent based model can handle these interactions easily. Without the need to simplify in order to achieve equilibrium or mathematical tractability we are able to make meaningful progress toward rigorously modeling the theory of Conditional Party Government.

The paper proceeds as follows. First, we lay out the elements and procedures of each of the models. Next are short summaries of the ways in which the models differ with special attention being paid to the complexities inherent in the CPG model. The results of each of the models are then presented and interpreted. The agent based models seem to replicate the findings of the game theoretic models very well. The results are not as good when we turn to the complex world of CPG. This is more than likely due to the difficulty of capturing a complicated theory like CPG with so many moving parts in a formalized setting. So we see this part of the paper as a first step (baby step) toward eventually "growing" CPG in an agent based model.

1 The Agent Based Models

First we will discuss the elements that most of the models have in common.

1.1 Common Elements

Space

All of the models assume a single dimensional policy space. The space is continuous and spans from 0 (no redistribution) to 100 (all income is redistributed).

Agents

Each member of Congress is assumed to have have a symmetric and single peaked utility

function. This implies that members have a single ideal point in the policy space which represents the policy position that maximizes their utility function. Members prefer policies lying closer to their ideal point to those lying farther from it.

Model

A unicameral legislature is used for each of the models. In each model, the status quo is initially set at zero. A member is chosen to propose a new policy based on the particulars of the given model. A vote is taken, and, if the proposal defeats the status quo, it becomes the new status quo. This process continues until 1,000 ticks have passed.

1.2 Distributive Model

In the distributive model, the congressional committee with jurisdiction over the policy area has considerable influence over the policy outcome. In Weingast & Marshall (1988), three assumptions about the committee system are made: 1) A committee has a specific subset of policy issues over which it has jurisdiction, 2) Committees possess the monopoly right to make proposals, and 3) The committee's proposal must gain a majority of votes against the status quo to become the new policy. The distributive model also gives a veto to the committee over any new policy. This happens at the conference committee stage

A member's ideal point is assumed to represent the interest of their district. Political parties have little role in this model and do not change the decisions of the members. A committee is built by randomly drawing from the members of each party, and the committee is assembled with a numerical advantage for the majority party[2] [3]. The member with agenda setting power in this model is the median member of the committee. Whenever a proposal from the floor defeats the status quo, the median member of the committee is allowed to

[2]This conforms to **?** and Groseclose (1994), who find that members of committees are not outliers with respect to the House as a whole.

[3]In order to create some variation between the models the ideal points assigned to members for this model result in the left party controlling the committee. For the party model the right party is the majority.

choose between the winning proposal and the previous status quo.

1.3 Party Cartel Model

In the party model, the majority party has considerable influence over the policy outcome. They gain this influence by their monopoly power over which proposals are allowed to be considered. Looked at differently, majority party power manifests itself as the ability to prevent status quos from being targeted for change. This is known as "negative agenda control". The majority shapes the legislative agenda such that a proposal that would make it worse off is never allowed consideration.

In this model, each member is assigned to a political party based on their ideal point. The member who proposes the status quo policy for change is always the median member of the majority party.

1.4 Pivot Model

In the pivotal politics model, there are pivotal actors who have a strong influence on the policy outcome. These actors owe their importance to existing institutional rules. In the Senate, the filibuster allows a minority of Senators (2/5ths) to effectively block any proposal from being voted on. The President can veto any proposal that defeats the status quo in both the House and Senate. However, in each chamber, if a super-majority of members (2/3rds) in both chambers agree, they may override the president's veto.

Following Krehbiel (1998), we use a unicameral legislature in this model. A president is created with an ideal point on the the policy space. Whenever a proposal from the floor defeats the status quo, the member occupying the "filibuster pivot" chooses between the winning proposal and the previous status quo. If the filibuster pivot approves the proposal, it goes on to the president. The president then chooses between the proposal (signs) and the

status quo (vetoes). If the president vetoes the proposal, then it returns to the Congress, and the member occupying the veto pivot is allowed to choose between the proposal and the status quo.

1.5 Conditional Party Government Model

Much could be written of the predictions of policy outcomes under the conditional party government (CPG) model, but to use Shepsles (1986) terminology, in capturing CPG we must address both institutional equilibria *and* equilibrium institutions. If, as we suggest, party leaders are endowed with resources sufficient to twist arms in their caucus/conference, the question remains why self-interested party members would accept policy losses created by that arm twisting, even if those losses are relative rather than absolute. Meaningful congressional parties imply bias in outcomes, and bias in outcomes implies that someone in the party is voting on the basis of something other than their induced preference at some stage of the legislative process (rules votes, amendments, final passage, etc).

The preference-based argument which establishes the conditions of CPG is at the heart of the difficulty in reaching an analytic solution of CPG, and to test predictions thereof. As Krehbiel (1993) argues, intraparty homogeneity and interparty heterogeneity can produce more extreme outcomes, apparently in favor of the majority party, without any true party effects. While Cox and McCubbins (2005) posit a relatively weak majority party with party effects occurring at the procedural stage, the various iterations of CPG (Rohde 1991; Aldrich 1995; Aldrich and Rohde 2000) suggest the possibility of a stronger majority party that can twist arms at the amendment and final passage stages of the legislative process. The difficulty in their narrative is that it becomes more difficult to distinguish true party effects from preference effects as the conditions become more clearly met. Further difficulties are created by the commonly used measures of preferences, which are based on roll call behavior, which presumably already contains agenda influence (or lack thereof). Trying to empirically

establish the conditions of CPG at in any given Congress or congressional era is therefore rather difficult. Beyond the empirical problems, the feedback loops implied by the CPG argument introduce potentially intractable theoretical complexity. While certain 'moving parts' of the CPG argument could be held constant, the insights of the argument (and its crucial differences from other models of Congress) risk being lost in doing so.

The CPG model differs from the previous models in several ways. In CPG, members of congress face both an electoral motivation and a policy motivation. In order to include this tension in the model we create a population of voters who elect the members to congress. Each district consists of 10,000 voters who are drawn randomly from a uniform [0:100] distribution. Within each district voters are assigned to a party based on their ideal point (if a voter's ideal point is ¡50 she is assigned to the L party and vice versa). Each party then nominates a candidate at its respective median within the district. These two candidates then face each other in a general election where all district voters vote for the candidate closer to their ideal point. Once a member is elected he is sent to the Congress with the members from all other districts. The member retains the median of the *primary constituency* as their ideal point (not the median of the district). Once in Congress the member follows a rule where she always votes her (induced) ideal point unless it could cause absolute policy loss for the median of her district. In doing so, the member is balancing the electoral and policy incentives that influence roll call votes.

Within the Congress the procedures modeled are more complex than in the previous models. In order to allow party control to get stronger as the conditions are met and weaker when they are not we use a two stage rule for policy proposals. In the first stage the members decide whether or not to adopt the "special rule". The entire floor first evaluates the status quo policy against the median of the majority party caucus. If the status quo prevails then it remains the policy. If the median of the majority party prevails then there is a second stage where the entire floor evaluates the median of the majority versus an alternative proposal

at the median of the chamber.

After the vote is taken one-third of the members must return to their district to face reelection. However, while they were gone there have been shifts in the electorate. Their has been migration of voters in and out of the district. Also, some voters have changed their policy preference. This is operationalized by a random shock to the population of voters. The member is renominated by their party and the out-party in the district nominates a new challenger at the median of their party. The general election happens and the incumbent will be defeated if more than half the voters prefer the challenger to her. Once the general elections are over then the members return to Congress and the policy making procedure repeats itself. This model is allowed to run for 50 time periods (each representing a Congress).

2 Results

2.1 Distributive Model

The agents in the replicated version of the distributive model produce the same policy outcome as predicted by the game theoretic model. The results can be seen in Figure (1). The policy that prevails is a 57.9 policy outcome. This is also the ideal point of the median member of the committee.

The model was run again this time as a series of static models running the ideal point of the median of the majority party against all possible status quos. The results are displayed in Figure (2).

The results confirm that the agent based system is producing outcomes that correspond with the original game theoretic model. Let the policy outcome be $x(co_m, c_m)$, where $co_m \equiv$ the ideal point of the median member of the relevant committee, and $c_m \equiv$ the median member of the chamber. There are four distinct regions of status quos on the policy space graph.

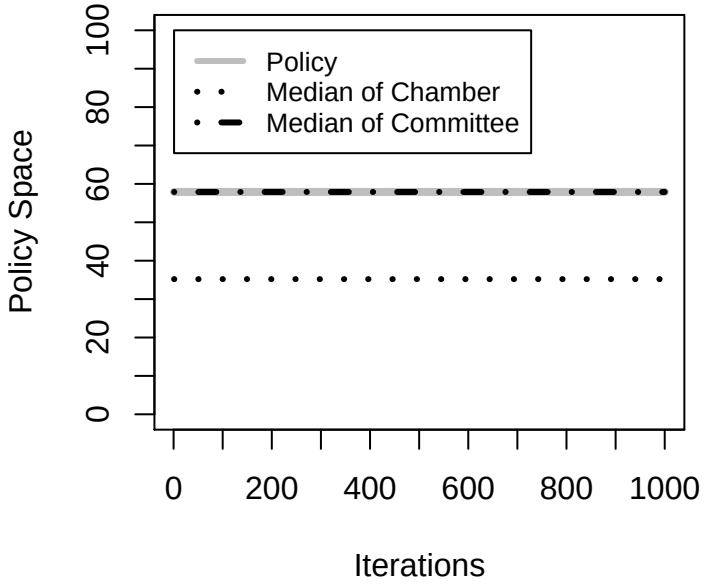


Figure 1: Distributive Model Results

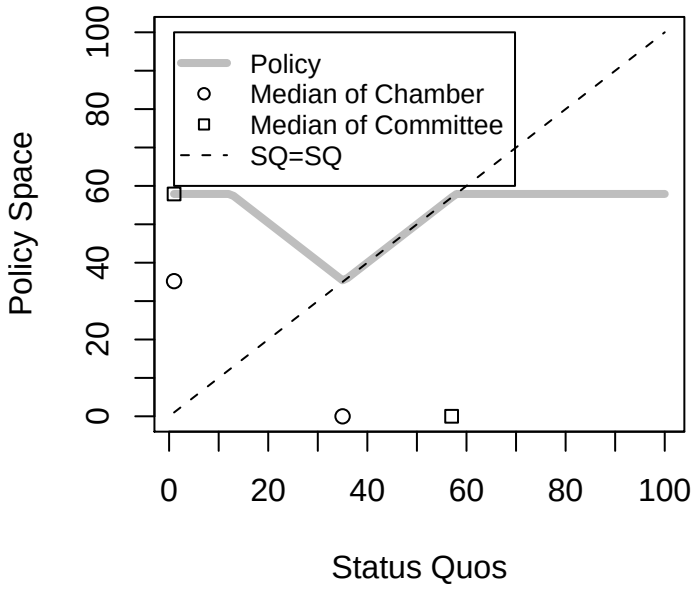


Figure 2: Distributive Model Across Status Quos

$$x = \begin{cases} p_m, & SQ < 2c_m - co_m \\ 2c_m - s, & 2c_m - co_m < SQ < c_m \\ SQ, & c_m < SQ < co_m \\ p_m, & co_m < SQ \end{cases}$$

The first is the region representing all status quos to the left of a point at $2c_m - c_o$. This point is important because any status quo falling to the left of it has so little redistribution that the median of the chamber can propose his or her own ideal point (no matter what that policy outcome is), and it will defeat the status quo and become the policy outcome. The next region is the range of status quos falling between the critical value $(2c_m - co_m)$ discussed above and the ideal point of the chamber median. Within this region, the median of the committee would prefer a higher level of redistribution than is realized, but is unable to move the policy any closer towards his or her ideal point because they would not be able to convince enough members to vote for more redistribution. The third region is the set of status quos lying to the right of the chamber median's ideal point and to the left of the ideal point of the median of the relevant committee. In this region, the median of the committee can not move the policy outcome higher than the status quo level. The majority median cannot propose his or her own ideal point, because there are not enough members who prefer it to the status quo. Intervals of the policy space , such as this one, where the status quo defeats any alternative that the agenda setter would be willing to offer are called gridlock intervals. The fourth region is the region where the status quo is so extreme compared to the status quo that the median of the committee is always able to defeat it with his or her ideal point.

2.2 Party Cartel Model

The agent based version of the party cartel model replicates the predictions of the game theoretic model. The results can be seen in Figure (3). The policy outcome is 25.6, corresponding to the ideal point of the median member of the majority party (right party).

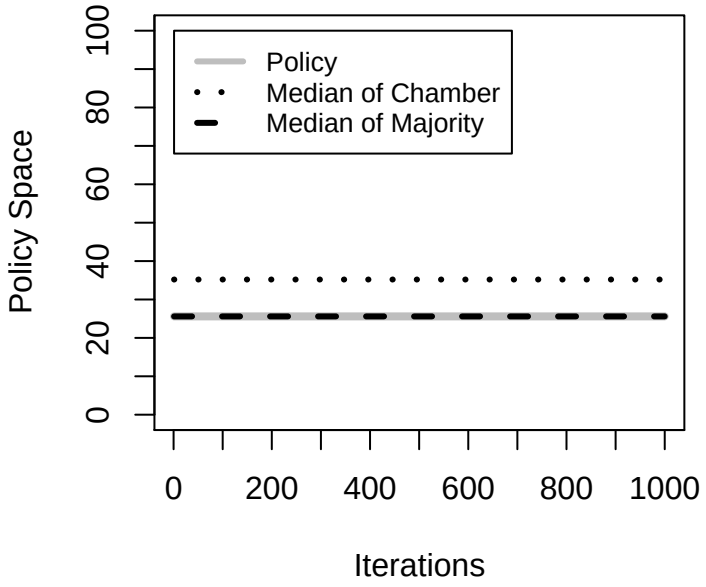


Figure 3: Party Cartel Model Results

As with the distributive model, the model was run against all possible status quos. The results are displayed in Figure (4).

The results confirm that the agent based system is producing outcomes as expected. Let $p_m \equiv$ the ideal point of the median of the majority party, and $c_m \equiv$ the median member of the chamber. There are four distinct regions on the graph.

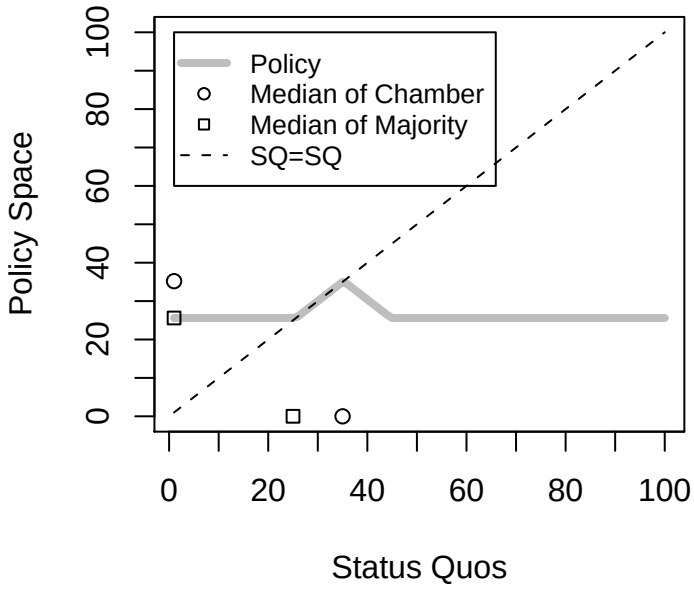


Figure 4: Party Cartel Model Across Status Quos

$$x = \begin{cases} p_m, & SQ < p_m \\ \text{SQ}, & p_m < SQ < c_m \\ 2c_m - s, & c_m < SQ < 2c_m - p_m \\ p_m, & 2c_m - p_m < SQ \end{cases}$$

The first is the region representing all status quos below the ideal point of the median of the majority party. In this region, the median of the majority party sees his or her ideal level of redistribution become policy. The second region is the range of status quos falling between the median of the majority party and the ideal point of the chamber median. Within this region, the median of the majority party would prefer a lower level of redistribution[4] than is realized. However, the party median is unable to move the policy from the status quo towards his or her ideal point because more members prefer the status quo to the median of the majority party's ideal point. This is another instance of a gridlock interval. The third region is the set of status quos which lie to the right of the chamber median's ideal point and to the left of the point at $2c_m - p_m$. In this region, the median of the majority party can begin to propose policies that a majority of the members prefer to the status quo. The majority median cannot propose his or her own ideal point because there are not enough members who prefer it to the status quo. However, the majority median can propose a policy outcome which they strictly prefer to the status quo and that the chamber median just barely prefers to the status quo. The fourth region is the region in which the status quo is so extreme that the median on the majority party can again get over half the members to vote for the majority median's ideal point over the status quo.

[4]The analysis is similar when the left party is the majority party. The only difference is that in the corresponding interval the left party would prefer more redistribution.

2.3 Pivot Model

As with the previous two models, in the pivotal politics model, the agent based model replicates the predictions of the game theoretic model. The results of the model can be seen in Figure (5). The policy outcome is 35.2, and this corresponds to the ideal point of the median member of the chamber.

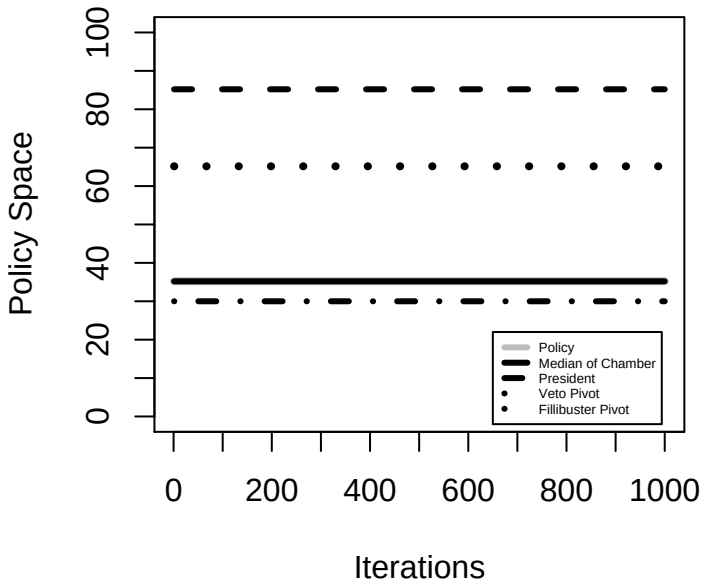


Figure 5: Pivot Model Results

As before, we run the model on all possible status quos in the policy space. The results are displayed in Figure (6).

The results further confirm that the agent based system is producing outcomes in line with the game theoretic model. Let v represent the ideal point of the member at the veto pivot and let f represent the ideal point of the member who occupies the filibuster pivot. There are five distinct regions on the graph.

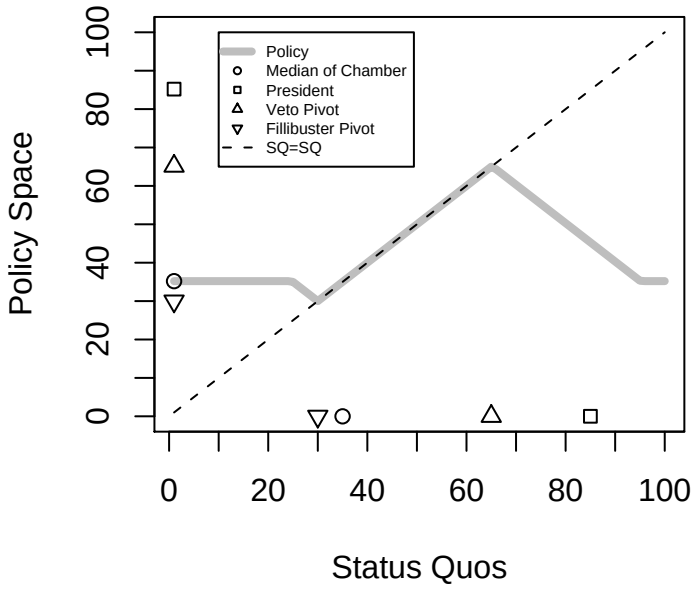


Figure 6: Pivot Model Across Status Quos

$$x = \begin{cases} c_m, & SQ < 2f - c_m \\ 2f - s, & 2f - p_m < SQ < c_m \\ SQ, & f < SQ < v \\ 2v - s, & v < SQ < 2v - c_m \\ c_m, & 2v - c_m < SQ \end{cases}$$

For all status quos below the critical value of $2f - c_m$ the chamber median is able to run his or her on ideal point against it and win. The next region is the area above the critical value and below the filibuster pivot's ideal point. In this area, the chamber median is no longer able to enact his or her ideal point. The filibuster pivot would filibuster that policy outcome. The chamber median is able to instead offer a proposal that is much closer to his or her ideal and that the filibuster pivot barely prefers to the status quo. The next region is another gridlock interval. Between the ideal points of the filibuster pivot and the veto pivot, the status quo prevails. The chamber median is unable to move the policy outcome any closer to his or her ideal. The fourth region is the set of status quos between the ideal point of the veto pivot and another critical value ($2v - p_m$). In this interval, the chamber median cannot get his or her ideal point but they can get closer than the status quo by offering the member a choice between the status quo and a level of redistribution at 2v-s. The final region is the region in which the status quo is so extreme that the chamber median can easily get over half the members to vote for the majority median's ideal point over the status quo.

2.4 Conditional Party Government Model

In order to look both the progression of the policy over time as well as the possible influence of the initial status quo. The 50 period model was run 100 times each with a different initial status quo. The results are graphed in Figure (7), what they show is that under this very

highly polarized Congresses that the model generates there is little deviation from the wishes of the majority party (for almost every Congress formed in the model the left party was in the majority).

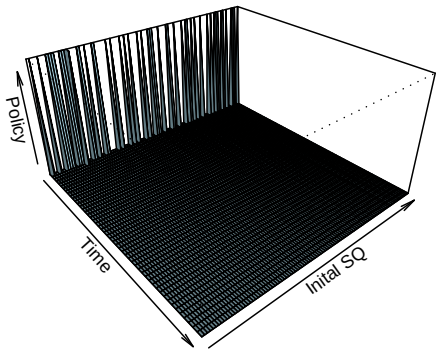
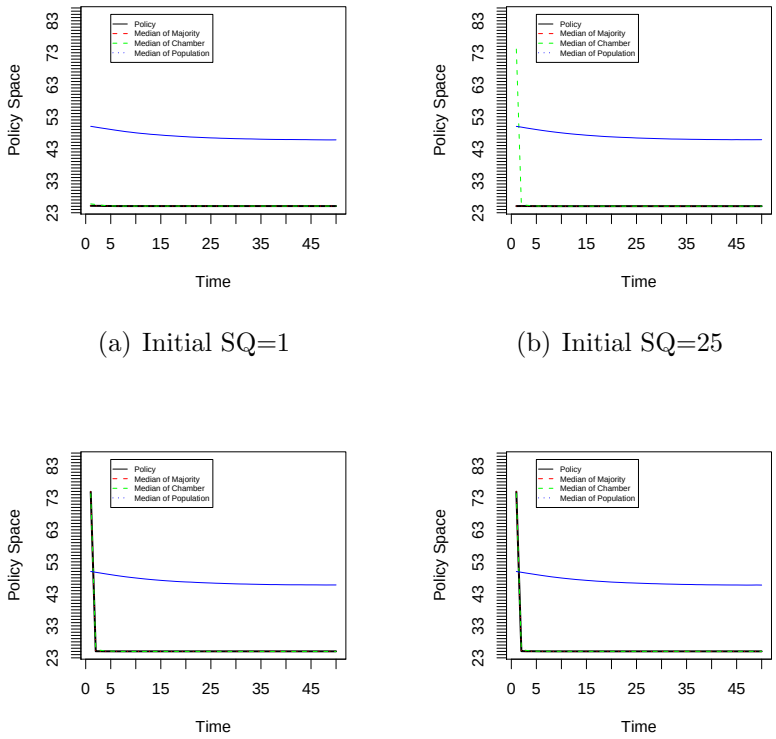


Figure 7: CPG Model Results

In order to better see the development of the policy over the run of the model, we take 4 cross sections at different initial status quos (Figure(8)). There is little development in the policy over the run of the model. The may be due to the relative stability of the electorate's preferences (the random shock each period was small), as well as the stark choice that voters faced when electing a representative. Most "Left Party" candidates had ideal points in the mid 20's while most Right Party Candidates had ideal points in the mid 70's. This made it difficult for a challenger to unseat an incumbent in the model. This virtual incumbency advantage led to a great deal of stability in the Congress. Further, the population of voters as a whole were moving slightly to the left (as reflected in the slight bend in the Median Voter line in each graph. This made any change in the policy impossible.



(a) Initial SQ=1

(b) Initial SQ=25

(c) Initial SQ=75

(d) Initial SQ=100

Figure 8: Policy Outcomes Across Time at Selected Initial Status Quos

3 Future Research

This paper is a part of a larger project seeking to develop a model of the policy making process using a fully integrated complex adaptive systems approach. Within that larger agenda, our current focus is on building upon our admittedly simple framework to more fully capture the complexities of the conditional party government argument. Our current framework includes a slightly more complex internal agenda, as well as recognizing the two-stage process of contemporary congressional elections. Extensions should include (but should not be limited to) adding committees to the legislative process (either as competitors to or as agents of the party), building constituent, party, and personal influences into members'

policy preferences, bringing more nuance to the party affiliation dynamics among voters *and* politicians, and building party and committee leadership choice and committee membership dynamics into the model. Other additions could include extending the model into at least two dimensions, and allowing for non-symmetric utility functions.

The narrative of conditional party government takes seriously the complexities of Congress, but it has been awaiting analytic tools that can deal adequately with that complexity. Despite the limitations of our current implementation, we think that agent based modeling shows great promise in formalizing what, in many ways, represents a unifying theory of congressional organization.

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