Senate Coalitions

An Agent-Based Model

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1 Introduction

For my senior honors thesis, I developed an expected utility-based model of legislative coalitions to predict the effects of different rules surrounding the filibuster and cloture on the U.S. Senate. In my model, senators join proponent, opponent, or obstructionist coalitions based on the expected benefits and costs they would accrue in those coalitions. The choices of individual senators combine to form coalitions that are able to pass or kill bills in the Senate. This concept—of individual decisions combining to form group effects—makes my model a natural fit to translate to an agent-based representation.

Using an agent-based representation of my original model, I produce behaviors that better match the real-life Senate than my equation-based model would predict. This improvement represents an exciting discovery for a broad swath of political science models that suffer from similar predictive failures in their equation-based forms.

2 Background

The U.S. Congress as a whole, and the Senate more specifically, are naturally the subject of numerous formal models in political science. A foundational model in this area is pivotal politics theory (Krehbiel, 1998). In pivotal politics theory, legislators get utility from bills based on how bills move policy toward their *ideal point* policy preferences. In my model, I use DW-NOMINATE scores from Voteview (Lewis et al., 2024) to measure these ideal points. In order for a bill to pass, the bill must move policy towards the ideal points of a majority of senators (and a three-fifths supermajority if a bill is filibustered). Pivotal politics and its conception of policy benefits are fundamental components of my agent-based model.

One of the defining features of the modern Senate is the filibuster and the cloture rule. Over time, the Senate's longstanding norms respecting senators' right to debate have evolved into the filibuster as we know it today: a tool of obstruction used by united minority parties against nearly all bills in the Senate (Jentleson, 2022). The filibuster is now so strong that it has created a "60-vote Senate," in which almost every bill requires a supermajority to pass (Koger, 2010). Wawro & Schickler (2006) explained the impact of the Senate's original 1917 cloture rule by modeling the incentives of legislative entrepreneurs before and after the introduction of the rule. This model is the foundation of my equation-based model (Feinleib, 2024). Both of these models are explained further in Section 3. Koger (2010) responded to Wawro and Schickler by focusing more heavily on the costs of legislative obstruction (and the costs to the majority of withstanding it). Koger also presented a different model of the filibuster that is more explicitly based on game theory. My model incorporates Koger's focus on costs into Wawro and Schickler's original model.

Another theoretical building-block of my model is the role of cosponsorship in the lawmaking process. Cosponsorship signals a strong commitment to support a bill: senators who cosponsor a bill almost never vote against it (Bernhard & Sulkin, 2013). Harbridge-Yong et al. (2023) use cosponsor relationships to measure the level of bipartisanship in Congress. They introduce two measures of senators' bipartisanship that are included in my model:

- *Percent bipartisan cosponsors attracted (PBCA):* the average percentage of cosponsors that come from the opposite party on bills sponsored by a senator.
- *Percent bipartisan cosponsorships offered (PBCO):* the percentage of a senator's cosponsorships that go to bills sponsored by members of the opposite party.

Finally, my model aims to address a major outstanding puzzle in models on Congress. Many formal models, especially those based on pivotal politics, predict that bills will tend to pass with *minimal majorities*, that is, the smallest amount of support required by the rules of the Senate and House (three-fifths and one-half, respectively). The equation-based model in my thesis is one such model. However, these minimal majorities are relatively rare, empirically (Groseclose & Snyder, 1996; Uslaner, 1975). Relatedly, even as the parties have become more polarized over the past few decades (Desilver, 2022), the level of bipartisanship in bills that pass Congress has remained steady (Curry & Lee, 2019). An agent-based representation of my model, due to its heterogeneous treatment of individual members, has the potential to solve these issues with equation-based pivotal politics models.

3 The Underlying Model

The Senate Coalitions model is an agent-based representation of the equation-based model of legislative coalitions by Feinleib (2024), which is in turn an expansion of Wawro and Schickler's

(2006) model of legislative entrepreneurship under cloture. Thus, understanding these models is essential for understanding many elements of the agent-based model. I will now proceed to describe those models, naturally borrowing heavily from the original papers.

As emphasized by Koger (2010), the key factors in senators' decision-making during legislative fights are the relative costs and benefits of the different strategies available to them in such fights. Thus, to predict the outcomes of legislative battles, I compare the relative utilities of bill proponents and obstructionists under various rules environments.

3.1 The Benefits for Proponents

The first element of my equation-based model is the benefits for bill proponents. This component comes directly from Wawro and Schickler (2006), who model the expected benefits of bill proponents under the Senate cloture rule. This model, which I refer to as $\mathrm{WS_K}$,[1] focuses on a legislative entrepreneur (LE) who receives benefits from passing their bills. The LE may add legislators to a coalition supporting their bill, which increases the probability that their proposal passes. However, growing the coalition decreases the benefits of passing the bill, as the LE may have to make compromises or share credit to gain additional support. Thus, legislative entrepreneurs face a trade-off when forming their proponent coalition.

The $\mathrm{WS_K}$ model is based on the following fundamentals:

- η: The size of the supporting coalition, as a proportion.

[1] K stands for cloture because C refers to costs in my model. Wawro and Schickler also present a model without a cloture rule (labeled WS in Feinleib (2024)). I am skipping that model for brevity.

- η is restricted to $\eta \in [.5, 1]$, as any bill must have at least majority support to pass. [2]

- π: The probability the bill passes, which is a function of η:

$$\pi(\alpha) = \left(\frac{\eta - .5}{.5}\right)^{\alpha}$$

  - α is a parameter indicating how much each additional coalition member contributes to the probability of passage. In effect, this parameter controls the steepness of the π curve. A higher value of α means that it takes more legislators in the supporting coalition to reach the same probability of passing a bill.
    * $\alpha \in (0, 1]$, so that as α increases toward 1, each additional legislator in the supporting coalition has a larger impact on the probability of passage.
  - π is strictly increasing in η. Note that when $\eta = .50$, $\pi = 0$ (i.e., you need at least a minimum majority to pass a bill), and when $\eta = 1$, $\pi = 1$ (i.e., a bill with unanimous support is guaranteed to pass).

- B: The benefits to the LE of passing their bill, which is also a function of η. The benefits to the LE diminish as they add more supporters, as the LE may have to make compromises on the policy content of the bill or share credit with a larger group of supporters.

$$B = \frac{1 - \eta}{.5}$$

  - That is, B linearly decreases from 1 to 0 as η increases over $(0.5, 1]$.

[2] For simplicity, $\mathrm{WS_K}$ ignores the case of a tie. In my agent-based model, I require bills to have strictly more than 50 votes to pass.

– Also, $\mathrm{WS_K}$ sets $B = 0$ if the proposal doesn't pass.

- EB: The expected benefits for the LE, which is simply the probability of passage multiplied by the benefits of passage:

$$EB = \pi B$$

Since π is an increasing function in η, and B is a decreasing function in η, there is an inherent tradeoff in forming an optimally sized coalition.

Finally, $\mathrm{WS_K}$ represents the Senate cloture rule as an increase in the passage probability when the supporting coalition clears the cloture threshold, K (which is 0.60 under the Senate's current rules). When η crosses K, the probability function switches from $\pi(\alpha)$ to $\pi(\alpha^*)$, with $\alpha^* < \alpha$, which scales up the probability.

Under $\mathrm{WS_K}$, the expected benefits are:

$$EB_K = \begin{cases} \pi(\alpha)B & \text{if } \eta < K \\ \\ \pi(\alpha^*)B & \text{if } \eta \geq K \end{cases}$$

Figure 1 below illustrates how the expected benefits to the LE vary with the size of the supporting coalition. The plots on the left show a Senate without a cloture rule, and those on the right show a Senate with a cloture rule. Wawro & Schickler (2006, p. 217) found that an α around 0.25 best fit the Senate of the late-19th and early-20th centuries, when the original cloture rule was introduced. The plot shows how a cloture rule created a sharp increase in benefits at the 60-vote threshold. Thus, the $\mathrm{WS_K}$ model predicts that legislative entrepreneurs will seek supporting coalitions just large enough to clear the cloture threshold.

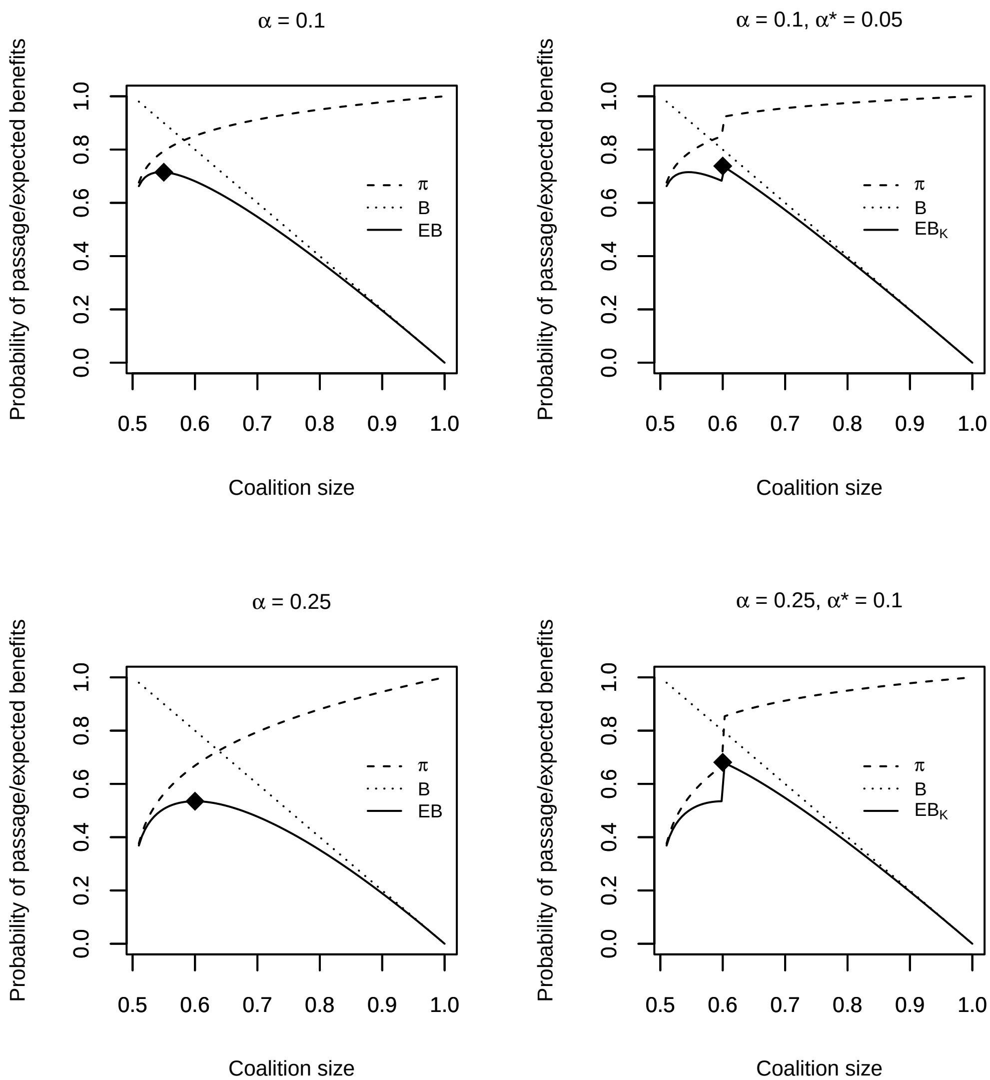

Figure 1: Proponents' expected benefits without (left) and with (right) a cloture rule

3.2 The Benefits for Obstructionists

In a legislative debate, the opponents are the remaining senators who do not support a bill. However, not all these opponents are willing to engage in active obstruction to prevent a bill from coming to a vote. These obstructionists are a subset of the bill opponents. As the opponents are a group with size $1-\eta$, I label the size of the obstructionist faction $\omega \in [0, 1-\eta]$.

Similar to bill proponents, the obstructionists receive benefits if they successfully kill a bill. These blocking benefits represent the obstructionists' preference for the status quo over the new policy proposal (the opposite of the proponents' policy benefits). They also may receive position-taking benefits for the act of obstruction regardless of the bill's outcome. By committing effort to actively obstruct a bill, obstructionists publicly demonstrate the strength of their policy commitments, which may improve their reputation with voters (Gibbs, 2023). Thus, the expected benefits of obstruction are:

$$EB_{obst} = (1-\pi)\beta_{block} + \beta_{position}$$

where β_{block} and $\beta_{position}$ represent the obstructionists' benefits for blocking a bill and their position-taking benefits, respectively. These terms are measured relative to the proponents' benefits B, which are fixed to a maximum of 1.

As with proponents, the probability and benefits of success for obstructionists depend on the size of the obstructionist faction. Both forms of benefits for the obstructionists are shared among all the members of the obstructionist faction. Thus, the benefits for each individual obstructionist are:

$$\beta_{block} = \left(\frac{.5 - \omega}{.5}\right) \sum \beta_{block} \qquad \beta_{position} = \left(\frac{.5 - \omega}{.5}\right) \sum \beta_{position}$$

where $\sum \beta_{block}$ and $\sum \beta_{position}$ are the total benefits of obstruction shared among the obstructionists. For each β, if there is a single obstructionist, then that member alone accrues the entire benefit. If $\omega = 0.50$ (i.e., the obstructionists make up half the chamber), then obstruction produces no benefits, as in that case, the bill opponents already have enough votes to block a bill without any additional obstruction.

3.3 The Costs for Proponents and Obstructionists

In order to provide a full accounting of the expected utility for bill proponents and obstructionists, we must also consider the costs each side faces. According to Koger's (2010) analysis of Senate filibustering, the primary factor in these costs is time. Time represents a cost to senators in two forms: the consumption of the finite floor time available during a legislative session and the opportunity costs related to other activities senators could be doing, such as campaigning and fundraising.

The costs associated with passing or obstructing a bill depend heavily on the rules and procedures of the Senate. As the Senate's rules surrounding filibustering and cloture have evolved, so too has the amount of time it takes to debate and vote on a bill. In a legislative fight, each faction i faces a time cost C_i of engaging in the fight. The costs to members of the proponent, opponent, and obstructionist factions are denoted as C_{prop}, C_{opp}, and C_{obst}, respectively. The time cost C_i of considering a bill can be broken down into the following components, such that

$C_i = C_{i,t} + C_{i,d} + C_{i,v}$:

- $C_{i,t}$: The cost of the consumption of floor time.
- $C_{i,d}$: The cost of physical attendance and debate time.
- $C_{i,v}$: The cost of voting time.

These costs may be different for each faction. For example, in a talking filibuster, the obstructionists face heavy debate costs from having to continuously speak, while the proponents and opponents just have to wait around (i.e., $C_{obst,d} > C_{prop,d}$ and $C_{obst,d} > C_{opp,d}$). Different rules around filibustering and cloture would change the amount of time the Senate spends on each bill. Given a specific set of rules, the amount of time spent on a bill and its cost also depend on the sizes of the proponent and obstructionist factions.

For demonstration, consider the costs of considering bills under the current rules with a few different mixes of proponents and obstructionists:

1. All senators support a bill ($\eta = 1$). The proponents can pass the bill by unanimous consent and spend no floor time, resulting in $C = 0$ for all factions.
2. A non-unanimous majority of senators supports a bill, but none of the opponents are willing to actively obstruct it ($\eta \in (0.5, 1),\ \omega = 0$). In order to pass the bill, the proponents must spend some floor time for debate and a single passage vote. Since there are no obstructionists, the opponents are submitting to a passage vote without forcing a cloture vote. This results in a small C for the proponents.
3. A filibuster-proof majority of senators supports a bill, and at least one senator obstructs a bill ($\eta \in [0.6, 1),\ \omega > 0$). In this case, proponents may either spend floor time on holding a cloture vote, or wait for the obstructionist to debate until they submit to a final passage

vote. The second option is rare in the modern Senate because of the high cost in floor time, but it is still an available strategy (Koger, 2010). For the obstructionists, debate would be even more costly, although they face no additional costs in the case of a cloture vote.

4. The supporting coalition is smaller than the cloture threshold, and at least one senator obstructs a bill ($\eta \in (0.5, 0.6),\ \omega > 0$). Proponents would fail a cloture vote, so their only option for passing a bill is waiting out the obstructionists. Again, this is extremely costly in floor time ($C_{prop,t}$). Accordingly, senators rarely employ this strategy in the modern Senate. This is why it is nearly impossible to pass a bill with fewer than 60 supporters in today's climate.

Different rules environments would allow for different strategies and different costs.

3.4 Comparing the Expected Utility of the Two Factions

To predict the outcome of legislative battles, I compare the total expected utility of the members of the proponent and obstructionist factions. Since each member of the proponent and obstructionist factions receives expected benefits EB_i and costs C_i, the following expressions give the aggregate expected utility for each faction:

$$\sum EU_{prop} = \eta \cdot (EB_{prop} - C_{prop})$$
$$\sum EU_{obst} = \omega \cdot (EB_{obst} - C_{obst})$$

In this model, it is important to sum the benefits and costs among the members of each faction because those benefits and costs are shared. As a faction grows, even though an individual senator's benefits and costs decrease, the total benefits and costs increase with the size of a faction.

If each faction receives expected utility $\sum EU_i$ from playing their respective strategy (that is, by representing a proponent or obstructionist faction), then the side with the greater (positive) expected utility will be more willing to engage in the legislative fight.[3] This utility-based method to predict the winner of a legislative fight is possible because senators have the ability to ensure a win at great cost (proponents by changing the rules or forcing the obstructionists to continuously debate, and obstructionists by being willing to continuously debate) if they evaluate that winning the fight produces enough benefits.

At first glance, this rule to predict winners using expected utility may appear rigid, as if either the proponents or obstructionists are doomed from the start of a legislative fight. How does this rule explain the negotiation process that is so critical for proponents to grow the coalition to pass a bill, or for obstructionists to kill it? The answer is that the expected utility of these two factions constantly varies as the factions grow and shrink and they change their cost-benefit calculations. As the coalitions and the political environment change, and more and more time passes, the expected-utility winner may shift. This change over time is what makes the expected-utility system dynamic.

4 An Agent-Based Representation

The Senate Coalitions ABM is a agent-based representation of the equation-based model described above. While the agent-based model does not fully reproduce all the elements of the

[3] If a faction receives negative expected utility, then they would simply surrender the fight.

equation-based model, its behavior resembles the expected behavior of the equation-based model and that of the real-life Senate. I will now explain the rules of the Senate Coalitions model.

4.1 Setup

The most substantive portion of the `SETUP` procedure is the initialization of senators. Senators are created using data from Harbridge-Yong et al. (2023) on the 114th Congress (2015–16). The following senator properties come from this data: first name, last name, home state, DW-NOMINATE 1st-dimension estimate, DW-NOMINATE 2nd-dimension estimate, party, average number of cosponsors on sponsored bills, PBCA, and PBCO. Senators' locations in the view are based on their DW-NOMINATE coordinates, and they are colored by party (blue for Democrats, red for Republicans, and yellow for independents). Senators from the most common party are labeled as majority-party senators. All senators are placed in an empty coalition. The `SETUP` procedure also clears previous model state, resets the tick counter, and resets the metrics that are used in the monitors and plots in the interface.

4.2 Go

The `GO` procedure runs through the introduction and consideration of a bill. Unlike in most NetLogo models, the `GO` procedure does not last just one tick. Instead, each of the below sub-procedures, each of which represents one step in the legislative process, increments the tick counter. This design gives the model a richer conception of the time it takes to consider a bill.

4.2.1 Creating a Bill

The `PLACE-BILL` procedure creates a new bill. First, it creates a status quo policy at a random point in DW-NOMINATE policy space. Then it creates a bill at another random point in policy space. Thus, the bills that are introduced are totally random and independent of the policy preferences of all senators. Bills that make little political sense are introduced, but these reliably fail.

The new bill is initialized with no sponsor or cosponsors. The new bill adopts the just-created status quo as its `squo-policy`, and creates an arrow-shaped link from that status quo. The new bill becomes the active bill.

The tick counter is incremented, and the `active-time` of the bill is set to 1.

4.2.2 Attracting a Sponsor and Cosponsors

This step occurs in the `GET-SPONSOR-AND-COSPONSORS` procedure.

Sponsor

All bills in the Senate must be introduced by a sponsoring senator. It is reasonable to assume that senators introduce bills that align with their policy preferences. Thus, the bill selects the senator with the greatest benefits from its policy movement to be the sponsor. The bill creates a green link with its sponsor, and the sponsor permanently becomes a proponent of this bill.

Cosponsors

The bill then proceeds to attract cosponsors. The cosponsorship-attraction process is based on the interaction of the bill's policy movement, the properties of the bill's sponsor, and the properties of the other 99 senators. First, the number of cosponsors (`n-cosponsors`) is randomly drawn from a Poisson distribution using the sponsor's average number of cosponsors on their bills.

Next, the 99 other senators calculate their "cosponsor likelihood" for the bill based on three factors. First, the senator calculates their policy benefits from the bill. Then, the senator multiplies those benefits by a "party factor" based on the interaction of their own party and the sponsor's party. The party factor is the product of the senator's frequency of offering cosponsorships to members of the sponsor's party (PBCO) and the sponsor's frequency of attracting cosponsorships from member's of the senator's party (PBCA). If either the senator or the sponsor is an Independent, both the PBCO and PBCA are treated as 50%. This calculation considers the varying behaviors of senators related to bipartisanship. Finally, a small bonus is added if the senator is from the same home state as the sponsor. It is common for senators from the same state to work together on legislation, and this bonus represents that.

Note that this "cosponsor likelihood" is not a proper 0–1 probability. It is a real number that may be positive or negative, and take on quite large magnitudes. These facts are not significant, though, as the cosponsor likelihood is simply used for ordering.

The bill sets its cosponsors agentset to be the `n-cosponsors` senators with the highest positive cosponsor likelihoods. If less than N-COSPONSORS senators have positive cosponsor likelihoods, the cosponsors will just be those senators with positive cosponsor likelihoods. The cosponsors create gray links with the sponsor, and the cosponsors permanently become proponents of the bill. This commitment to the bill is based on the reliable support of cosponsors in the real-life Congress (Bernhard & Sulkin, 2013).

The tick counter and the `active-time` of the bill are both incremented.

4.2.3 Building Initial Coalitions

The senators (besides the sponsor and cosponsors) find their initial coalition: either proponent or opponent, depending on whether they receive positive policy benefits from the bill.

The tick counter and the `active-time` of the bill are both incremented.

4.2.4 Playing It Out

The following substeps loop until the bill reaches an end state.

Advancing Coaltions

The senators (besides the sponsor and cosponsors) re-select their coalitions out of proponent, opponent, or obstructionist.

First, the senators calculate the expected utility they would receive from joining the proponent or obstructionist coalitions. Expected utility refers to expected benefits minus costs.

The expected benefits for proponents come from the formulas of the $\mathrm{WS_K}$ model in Section 3.1. One major difference, though, is that each senator receives their own policy benefits. That is,

$$B = \frac{1-\eta}{.5} * (\text{policy benefits})$$

This addition customizes the benefits of each proponent and deepens the meaning of the B parameter. Otherwise, the formula for proponent benefits is the same as the EB_K formula in Section 3.1, incorporating the `alpha`, `alpha-after-cloture`, and `cloture-threshold` parameters.

The expected benefits for obstructionists similarly consider each senator's individual policy preferences when computing the blocking benefits. Thus, the formula for β_{block} in this model is:

$$\beta_{block} = \left(\frac{.5 - \omega}{.5}\right) * (-\text{ policy benefits})$$

The position-taking benefits take the same sign as the blocking benefits (that is, the opposite sign of the policy benefits), and the base size is controlled by the `position-taking-benefits` slider. From there, the obstructionists' benefits are given by the formula for EB_{obst} in Section 3.2.

The costs are a combination of the costs of consuming floor time and the costs of debate time ($C_{i,t}$ and $C_{i,d}$ in the equation-based model). The cost of voting time is not considered in the agent-based model. The floor time costs depend on a senator's party. These costs are given by one-tenth of the bills `active-time` (rounded down) times the `majority-floor-time-costs` or `minority-floor-time-costs`, depending on the senator's party. The costs of debate time vary by coalition. The debate time costs are the product of the bill's `active-time` and the `prop-debate-costs` for proponents or the `obst-debate-costs` for obstructionists. Thus, the costs for all senators increase over time. This decreases the incentives to join the proponent or obstructionist coalition, pushing senators into a "default" of the opponent coalition in case of a stalemate.

Each senator (again, excluding the sponsor and cosponsors) joins the coalition with the higher (positive) expected utility between proponent or obstructionist. If neither of those have positive expected utility, the senator joins the opponent coalition, which is always defined to have zero utility.

Attempting Passage

Once the coalitions are formed, the bill tests for whether it can pass, or if it has too little support to continue. These rules approximate the different strategies available to pass bills in the Senate. These rules are different than the expected-utility comparisons that occur in the equation-based model. Designing stopping conditions for the expected-utility system would take substantial additional work and introduce many new assumptions.

1. If the bill has fewer than 47 proponents, it fails.
2. If the bill has more than 90 proponents and obstructionists, it passes via unanimous consent.
3. If the bill has more than 50 proponents and fewer than `obsts-to-block-vote` obstructionists, it passes by a simple majority vote.
4. If the bill has at least `cloture-threshold` proponents, it passes using cloture.

If any of these stopping conditions apply, the corresponding counter is incremented, and the `active-time` is recorded. If the bill passes (conditions 2-4), the size of the proponent coalition and the percent of minority-party senators who are proponents are also recorded. These records are used in the histograms and monitors in the interface.

If none of these conditions apply, Step 4 (advancing coalitions and attempting passage) repeats.

4.2.5 Clearing the Bill

After a bill either passes or failed, the bill, status quo, and links are deleted, and all senators return to the empty coalition.

5 Experiment: The Effects of Different Cloture Thresholds

I performed a BehaviorSpace experiment to explore the effects of different cloture thresholds and obstruction costs (`obst_debate_costs`) on bill outcomes. I evaluated each parameter set on the following measures:

- mean passing coalition
- mean minority-party support

These measures correspond to the plots and monitors on the right-hand side of the interface.

I tested four cloture thresholds (51, 60, 67, and 100) and four levels of obstruction costs (0.01, 0.02, 0.05, 0.10). I performed 5 repetitions for each combination of cloture threshold and obstruction costs, resulting in 80 total runs. I measured the mean passing coalition and minority-party support after 2000 bills had been considered in each run. The values of the other parameters were as follows:

name	value
alpha	0.25
alpha_above_cloture	0.10
obsts_to_block_vote	3.00

name	value
dwnom1_emphasis	90.00
position_taking_benefits	1.00
majority_floor_time_costs	0.05
minority_floor_time_costs	0.01
prop_debate_costs	0.01

The plots below show the results of the BehaviorSpace experiment. Figure 2 shows the effect of obstructionist costs on passing coalitions at the different cloture thresholds. Average passing coalitions are highest for lower obstructionist costs. Also, lowering the cloture threshold from 67 to 60 to 51 lowers passing coalitions. These relationships suggest that when obstruction is easier (low-cost), and overcoming obstruction is harder (because of higher cloture thresholds), it takes more support to pass bills.

Figure 3 shows similar trends. This plot suggest that when it is harder to overcome obstruction, legislative entrepreneurs have to get more buy-in from minority-party senators to pass bills.

6 Discussion

The results of my BehaviorSpace have exciting implications for the puzzles I raised in Section 2. Using an agent-based representation, I was able to develop a pivotal politics-based model that did not predict minimal majorities or minority-party rolls. The behavior of this agent-based model is a better match than the predictions of equation-based models for the behavior of the real-life Senate. Crucially, these problems were solved while preserving the core elements of

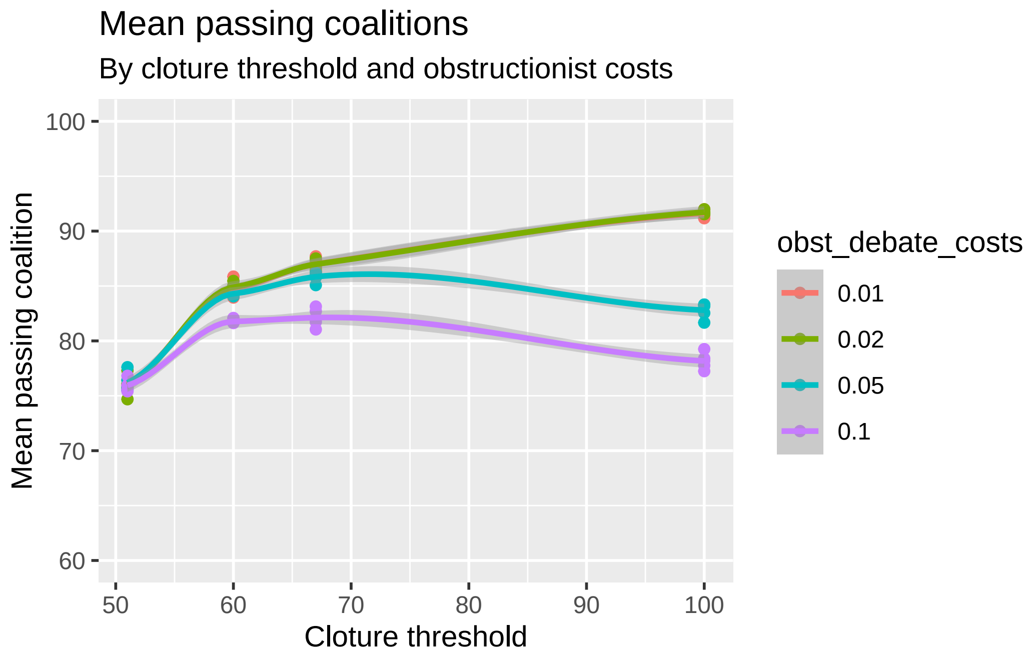

Figure 2: Results of BehaviorSpace experiment: Passing coalitions

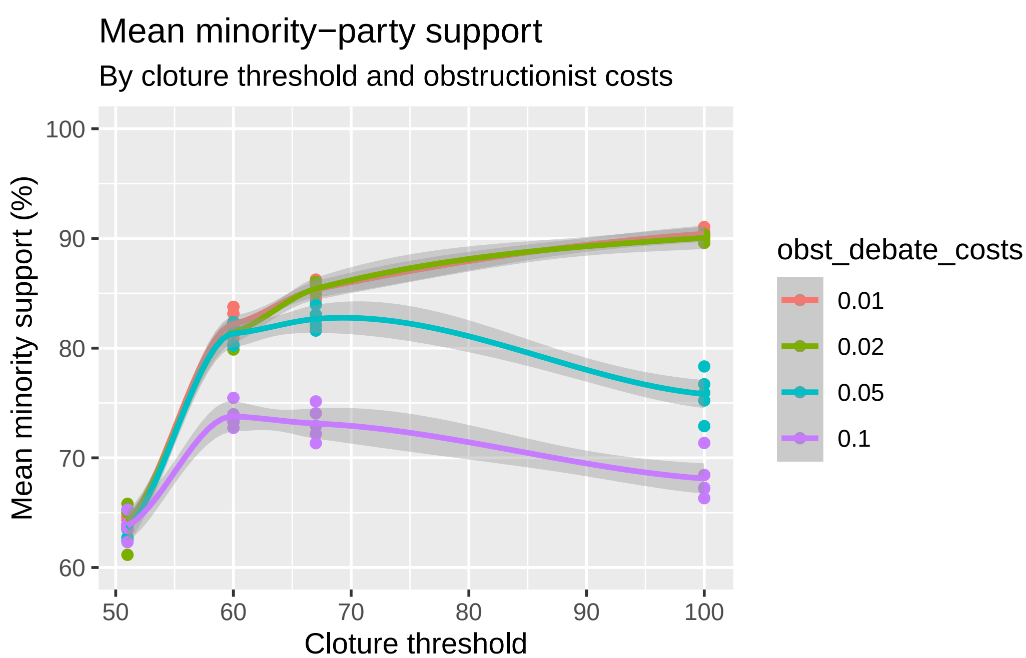

Figure 3: Results of BehaviorSpace experiment: Minority-party support

my original equation-based model. Converting traditional models to use agent-based representations may therefore represent a powerful methodological tool for analyzing Congress. I find this result surprising. It is not intuitive from the rules of the model why an agent-based approach would produce different results from the equation-based predictions. This, of course, is the beauty of agent-based modeling.

7 Software Credits

This agent-based model was built in the NetLogo programming language (Wilensky, 1999). The model uses the NetLogo CSV extension (*CSV Extension*, 2015/2024), and borrows code for that extension from the CSV Example model in the NetLogo Models Library (Wilensky, n.d.). Data used in the model comes from Harbridge-Yong et al. (2023) and the Legislative Effectiveness Scores project (Volden & Wiseman, 2023). This data was retrieved using the `filibustr` R package (Feinleib, 2023/2024).

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