FLIP-FLOPPING: IDEOLOGICAL ADJUSTMENT COSTS IN THE UNITED STATES SENATE

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Abstract

Using a long panel of roll call voting data, I find that "flip-flopping" senators face significant electoral costs when changing positions. In models of electoral competition, as the costs to candidates changing position approach zero, the equilibrium prediction is the convergence of platforms. Such convergence is at odds with empirical observation. Using a dynamic, structural model of candidate positioning, I identify the nature of the costs associated with changing position that may result in such non-convergence.

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I INTRODUCTION

Models of electoral competition often follow Downs (1957) and allow candidates to freely adjust their positions in the issue space to capture the majority of voters. The result, in a two-candidate election with a single dimensional policy space and single peaked preferences, is both candidates adopting the position of the median voter. Such convergence is rarely observed and is potentially at odds with the party polarization cited by the media and academics (e.g., Poole & Rosenthal (1991)). A possible source of the non-convergence of positions is candidate reputation (see, for example, Bernhardt & Ingberman (1985), Enelow & Munger (1993), and Kartik & McAfee (2007)). That is, candidates may find it costly to change positions in the issue space because it affects the voter's perceptions of the candidate's credibility or character. Indeed, if media reports can be believed, recent presidential hopefuls John Kerry and Mitt Romney can attest to the electoral costs of changing positions to attract voters. Despite the large amount of press given to flip-flopping candidates,

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there have been few empirical tests of the electoral costs candidates face when changing position. Tomz & Houweling (2009) study voter perceptions of changes in candidate positions and find that voters dislike such changes both because of the uncertainty they introduce into perceptions of future policy positions and because an intrinsic negative reaction to the change. Still no researchers focus on the nature of these costs and the resulting effects on electoral equilibria. For example, do candidates face large fixed costs to changing position that would imply flip-flopping is an important behavior?

The following study analyzes the nature of the electoral costs senators face when adjusting their ideological position. Using over 50 years of roll call voting scores from the United States Senate, I estimate the deep parameters of a dynamic, structural model of candidate positioning. The dynamics are important in this context because voter's utility depends upon both current and past positions of candidates, creating a dynamic linkage in the candidates optimization problem. Using a simulated method of moments (SMM) methodology, I identify the nature of ideological adjustment costs in the U.S. Senate. That is, I find the primitive parameters describing the objective functions of voters and candidates by matching moments characterizing the ideological positions of senators and election outcomes to the same moments from model simulations.

Understanding the electoral cost associated with a candidate's change in position is important for a number of reasons. First, by finding large costs to adjusting position, one calls into question the empirical validity of the median voter model and the policy predictions based upon it. This is because costs to changing position will pose a barrier to policy convergence in political equilibria. Second, knowing the nature of these costs is important for understanding the role of candidate credibility and reputation in electoral outcomes. For example, if a large part of the costs senators face are fixed costs, we would expect to see more "flip-flopping" senators. That is, senators who hold a position for long periods of time, but who make relatively large changes in position to move back towards the median voter when they do make a change. On the other hand, if the costs senators face are increasing with the size of their change in position (e.g., quadratic), we would expect to see more "wishy-washy" senators. These senators would change position more often when they deviate from the preferences of the median voter, but with only small moves. Knowing the nature of the costs to changing position is important for predicting electoral equilibria and will shed light on which theoretical models of electoral competition are most appealing on empirical grounds. These size and nature of these electoral costs will tell us whether the cost to flip-flopping is fixed or a function of the distance the candidate moves in the issue space. It will also show whether several small changes or one larger change is the better strategy for a candidate who wishes to change his platform.

The results suggest economically and statistically significant costs of changing position. Further, models that best fit the data are those with both convex and non-convex costs to changing position. That is, the data show senators who are not "flip-floppers" (which would imply a model with only fixed costs), but who change positions slowly. The standard Downsian model, and the convergence property of many median voter models of political equilibrium, are found to be inconsistent with the data on the ideological positioning of U.S. senators. The theoretical models found to be most consistent with the data are those where voters have both uncertainty about the future positions (as in Enelow & Munger (1993)) of candidates and care about candidate character (as in Kartik & McAfee (2007)). The implication is that voters penalize any change in position, but that electoral penalties are increasing in the size of the change.

I.I Previous Literature and Motivation

Models predicting non-convergence of policy platforms in two candidate elections with a single policy dimension come in several flavors. Alesina (1988) presents a model where politicians care about policy in addition to the rents from office and cannot commit to policy platforms. This creates a principal agent problem between the representatives and the voters. While the candidate would like to promise the median voter's preferred position to win the election, such a promise may not be credible and therefore candidate platforms will not converge. A second type of model in which the equilibrium may have non-convergence relies upon uncertainty by the voters about the policy to be implemented when the candidate takes office. The policy in office may differ from the announced policy because of the preferences of the politician (as in Alesina (1988)), because of future events, or because the candidate is unsure about his own preferred position. Enelow & Munger (1993), Bernhardt & Ingberman (1985), Ingberman (1989), and Banks (1990) all describe models with such uncertainty and derive the equilibrium conditions of electoral competition. Models of Kartik & McAfee (2007), Callander (2008), and Callander & Wilkie (2007) adopt a combination of the previous two types of models. Some candidates are policy motivated and others are purely office motivated. However, voters are uncertain about the type of the candidates. Candidates may also have some attribute such as "character" that is valuable to the voters, beyond the policy choice of the candidates. The uncertainty about type of the candidates causes announced positions to become signals of a politicians type, leading to non-convergence of platforms. Most closely related to the present work is the model of candidate flip-flopping between primary and general elections in Hummel (2010). This model proposes that voters prefer the valence properties of candidates who do not flip-flop (similar to that in Kartik & McAfee (2007)). The resulting equilibrium then includes cases where candidates in a general election do not fully converge in their policy platforms.

Each model of non-convergence implies something about the adjustment costs faced by candidates. That is, about the electoral costs associated with changes in position. For example, Enelow & Munger (1993) derive the expected utility of the voters when electing a particular candidate and show that the expected utility is decreasing in the size of the change in the candidates' policy platforms. Bernhardt & Ingberman (1985) and Ingberman (1989) find similar results using slightly different assumptions. The models of Banks (1990), Callander (2008), and Callander & Wilkie (2007), and Kartik & McAfee (2007) do not include past position as a state variable, but are only focused on positioning in a one-shot election where candidates may face a personal cost to misrepresenting their position. However, in a dynamic framework, signaling of one's motivation is done both through one's current choice of position, and through the dynamics of one's position. Whether the costs to adjusting position in dynamic versions of these models are convex, as in Enelow & Munger (1993), or non-convex (as might result from separating equilibria in a signaling game), depends upon the form of the personal costs to candidates for misrepresenting their position. The goal of this study is to empirically identify the form of the electoral costs candidates actually face.

Empirical models of candidate positioning related to the analysis in the following sections include the work of Glazer & Robbins (1993), Ansolabehere, Snyder Jr. & Stewart III (2001), Levitt (1996), Bronars & Lott Jr. (1997), Poole (2003), and Poole & Rosenthal (1997). The evidence that politicians make large movements in position due to changes in voter preferences is mixed. Glazer & Robbins (1993) find the ideological preferences of voters have a substantial effect on the ideological positions of their Representatives. Using the Conservative Coalition interest group's scores to identify the ideological position of Congressman, they find the voters exert much control over the position of their Congressman and deviations from the voters position are small, even for senior congressman. Ansolabehere, Snyder Jr. & Stewart III (2001) use the National Political Awareness test to identify the positions of both incumbents and challengers in over 100 years of House elections. They find much of a candidate's ideology is explained by his party, and in contrast to Glazer & Robbins (1993), find little of a candidate's ideological position is determined by local conditions. Levitt (1996) finds senators place the most weight on their own ideological preferences, with the remainder of their ideological stance being approximately equally determined by the preferences of their constituents and their party. However, changes the alignment between voter preferences and senatorial voting records over a senator's career are not explicitly examined by Levitt (1996). Poole (2003) finds little variation in a Congressman's position over his career when using his Nominate scores to define ideological positions. This paper will extend these analyses by further documenting how candidate positions change with changes in the preferences of the voters and estimating the impact of these changes in position on electoral outcomes.

Poole & Rosenthal (1997) find the vast majority of the variation in roll call voting records can be accounted for by a single dimension, the liberal-conservative spectrum. For example, how one votes on school-vouchers correlates very highly with how one votes on tax reform and welfare programs. Poole & Rosenthal (1997) have found this single dimension is able to explain the majority of roll call voting patterns, especially after the passage of the Civil Rights Act of 1964. In fact, they find over 90% of roll call vote choice can now be explained by the single dimension, liberal-conservative spectrum. These results and the theoretical models described above motivate my use of such a single dimension in the empirical analysis done here.

To the best of my knowledge, no empirical work presents an explicit, dynamic model of candidate positioning. The construction of a quantitative, dynamic model of candidate positioning is one of the major contributions of this work. However, the model and estimation used here owes much to work in dynamic economics, such as work by Cooper & Haltiwanger (2006). Cooper & Haltiwanger (2006) study the nature of costs to manufacturing plants when adjusting their stock of physical capital. The analysis here draws heavily on their methods and characterization of adjustment costs. One can see a similarity between a plant's choice of physical capital for next period based on current and expected productivity shocks and a candidate's choice of position, which is based on the current and expected preferences of the voters. Further, one can see how the nature of adjustment costs shape behavior in a similar manner in both contexts. Fixed costs associated with the investment of physical capital can generate the well-documented patterns of lumpy investment policies. In the same way, non-convexities in the electoral costs to changes in position can lead to candidates who make large jumps in position (i.e., flip-flop). Thus, many of the modeling and identification tools of dynamic economics can be applied to questions in dynamic political economy.

The remainder of the paper is organized as follows: Section II outlines the theoretical model of candidate positioning in a dynamic environment. Section III describes the data and Section IV discusses the reduced form evidence for a model in which senators face costs to changing position. Section V presents the econometric methodology and discusses identification. Section VI presents the baseline results and Section VII presents extensions of the baseline models. Section VIII concludes.

II A DYNAMIC MODEL OF CANDIDATE POSITIONING

The model of candidate positioning, which I describe formally below, has the following basic elements. Voters have single-peaked preferences over policy outcomes in a one-dimensional space. Voter's may also penalize candidates for changes in position in this one-dimensional space. These penalties may be because of signals of character derived from these changes or because of increases in uncertainty over future positions the candidate will take if elected. Both voters and candidates are forward looking and candidates make decisions with an infinite horizon. Finally, voters derive utility from a time-varying candidate characteristic orthogonal to the candidate's ideology.

Each election features two candidates. As in Downs (1957), candidates only care about the rents from holding office and not policy positions per se. Thus, they choose their positions to maximize the probability of obtaining office. Given the voter's preferences, however, candidates must take into account their past positions when choosing their current platform.

II.I <u>Model of Voters</u>

Let a voter's preferred position and identity be θ. Candidates and voters have common knowledge of θ, a point in a one dimensional policy space. Call this space "ideology".

Voters select the candidate in the current election to maximize their expected utility, a function of the policy the candidate puts into place once in office. Further, assume the demographics of the district change over time. That is, the distribution of θ, and in particular the median θ, θ^m, will evolve. Thus θ^m_t may not equal θ^m_{t+1}. Note, while the distribution of θ changes, this does not mean each of the voters' preferred points change, only that there are changes in the composition of individuals that make up the senators' constituencies.

Assume the voter's utility is quadratic so the expected utility of θ voting for candidate i, who takes position x_i in the one dimensional policy space, is:

$$Eu(i,\theta) = E(-(x_i^{'} - \theta)^2) - C(x_i, x_{i,-1}) + \xi_i, \tag{II.1}$$

where a prime denotes a one period ahead variable and the subscript -1 denotes the value from one period prior. The variable ξ_i is a random component to the voters' utility, which is distributed i.i.d. and is unobserved by the candidates at the time of their platform choices. This can represent some surge of popularity during the election that is orthogonal to the popularity of the platform and is often called "valence" in the political science literature.

The function $C(x_i, x_{i,-1})$ is the "cost of adjustment". In a sense, it is a punishment by the voters for a candidate's change in position. One may parameterize this function in several ways, according the model of electoral competition one believes to be correct. I discuss the specification of this function and the corresponding models of electoral competition in the following subsection.

The state variables for the voter's problem are the voter's preferred point, θ, the current positions of the candidates, x_i, the past positions of the candidates, $x_{i,-1}$, and the transitory shock to the candidates' electoral chances, ξ_i.

II.II Ideological Adjustment Costs

The adjustment cost function that politicians face is represented by a penalty function in the voter's utility. The shape of this reduced form function depends upon the theoretical model of voter preferences and electoral competition assumed. I outline three general cases below, relating each to the relevant political economy models and discussing their implications for the behavior of candidates.

II.II.1 Zero Costs of Adjustment

If changing position has no effect on a candidate's electoral prospects, then we are in the stylized Downsian world. In this case, the cost to any candidate i of moving from position $x_{i,-1}$ in the prior period to x_i in the current period is given by $C(x_i, x_{i,-1}) = 0$. Under this parametrization, candidates will always align themselves with the current position of the median voter, regardless of their past position.

II.II.2 Convex Costs of Adjustment

Bernhardt & Ingberman (1985), Ingberman (1989), and Enelow & Munger (1993) derive equilibria of electoral competition when voters are uncertain about the policies of candidates. The voters may be unsure the candidate will deliver on their campaign promises for a number of reasons. Writing the expected utility of voting for candidate i:

$$Eu(i, \theta) = E(-(x_i^{'} - \theta)^2) + \xi_i \tag{II.2}$$

One can pass through the expectations operator, perform some algebraic manipulation and find:

$$Eu(i,\theta) = -(E(x_i^{'}) - \theta)^2) - \sigma_{x_i}^2 + \xi_i, \tag{II.3}$$

where, costs to changing position result from increasing uncertainty regarding future positions. These costs are given by $\sigma_{x_i}^2$, the variance in the expected future positions of candidates. Given risk averse voters, as uncertainty about the future policies of the candidates increases, expected utility decreases. It is natural for voters to use the past record of candidates when updating their expectations about the candidate. In Enelow & Munger (1993), a change in position by the the politician increases the uncertainty of the voters and does so in a quadratic manner. Uncertainty increases at a rate proportional to the squared difference between the politicians past and current positions. This result is captured in the following specification of adjustment costs:

$$\sigma_x^2 = C(x_i, x_{i,-1}) = \frac{\gamma}{2}(x_i - x_{i,-1})^2 \tag{II.4}$$

Facing the convex adjustment costs of Equation II.4, senators will not be especially responsive to changes in the preferences of their constituents. While candidates will want to align themselves with the voters, the costs of changing position increase quickly as one makes larger moves. Such costs force senators to change position only in small increments. Senators will be "wishy-washy", making slight moves in any direction as the voters' preferred points in the ideological space change, but rarely making large jumps in their ideological position.

In addition to the quadratic case, I also consider a model where the costs of adjustment are linear. Such costs are consistent with the models of Bernhardt & Ingberman (1985) and Ingberman (1989), who allow the uncertainty of voters to be any function that is increasing the size of the deviations of candidates from their past record. These costs take the following form:

$$\sigma_x^2 = C(x_i, x_{i,-1}) = \kappa(|x_i - x_{i,-1}|) \tag{II.5}$$

II.II.3 Non-convex Costs of Adjustment

Still other models of candidate positioning assume the costs of adjusting one's position are related to the signaling of character. That is, voters derive utility from both the ideological stance of the politician and from the "character" of the politician. Kartik & McAfee (2007) and Callander & Wilkie (2007) describe models with just such a mechanism. In a dynamic version of these models, there may be a non-linear relationship between the size of one's change in position and the penalty one pays for the change. If one either has character or does not (as in Kartik & McAfee (2007)), holding one's ground signals good character and any change in position signals one has no character. In a separating equilibrium, no character types will reveal themselves by changing position. Since character is valuable, these candidates will face a lower probability of election than candidates who have the same platform, but signal having character. I model the dynamic signaling of character with a fixed cost to adjusting position. The adjustment cost function for candidate i is thus:

$$C^{NC}(x_i, x_{i,-1}) = 0, \tag{II.6}$$

where C^{NC} is the cost function when one does not change position ($x_i = x_{i,-1}$). And:

$$C^{C}(x_i, x_{i,-1}) = F, \tag{II.7}$$

where C^C is the cost function when one changes position and F is the fixed cost to changing position. Candidates facing fixed costs to changing position will change positions only when they are further away from the voters than a certain threshold, as determined by F. Senators facing fixed costs to adjustment will hold positions for a long period of time, but make larger changes than those in the convex models when they do change. In other words, these candidates flip-flop.

II.III Candidates and Electoral Competition: Static Model

To illustrate the nature of political competition in the presence of adjustment costs, let me begin with a one-period version of the model. The one-period model unfolds in the following order. Challengers are drawn from a population of potential challengers. The incumbent and challenger simultaneously determine their platforms, x_i. The candidates' records from the previous period, $x_{i,-1}$ and their current platform choice influences the voters' expectations about the candidates' positions in the following term, $E(x_i^{'})$, and determine the cost of adjustment associated with any changes in position, $C(x_i, x_{i,-1})$. After current positions have been determined, the election is held and the winner realized.

Politicians care only about the rents from office and not their policy positions per se. Therefore, they chose a position to maximize the utility of the median voter and thereby maximize the probability of getting elected.

Given this structure, consider the case of elections where there is not stochastic term in the voter's utility so that:

$$Eu(i,\theta) = E(-(x_i^{'} - \theta)^2) - C(x_i, x_{i,-1}) \tag{II.8}$$

In this case, one can solve for the position of the candidate that maximizes the each voter's utility. Call this $x_i^*(x_{i,-1}, \theta)$, where i identifies the candidate (incumbent or challenger) and θ identifies the voter. Using the first order condition of the voter's utility function, one can solve for the optimal ideology for each candidate i and voter θ.[1] This ideology will solve the following equation:

$$2E\left[\frac{\partial x_i^{'}}{\partial x_i^*}(x_i^{'} - \theta)\right] = -\frac{\partial C(x_i^*, x_{i,-1})}{\partial x_i^*} \tag{II.9}$$

The second derivative of II.8 is given by:

$$\frac{\partial^2 Eu(i,\theta)}{\partial^2 x_i} = -2E\left[\frac{\partial^2 x_i^{'}}{\partial^2 x_i^*}(x_i^{'} - \theta)\right] - 2E\frac{\partial x_i^{'}}{\partial x_i} - \frac{\partial^2 C(x_i^*, x_{i,-1})}{\partial^2 x_i^*} \tag{II.10}$$

[1] Of course, the first order condition is the necessary condition for optimization only in the cases where the cost function is differentiable.

Note that for the zero cost, quadratic cost, and linear cost functions proposed above, $\frac{\partial^2 C(x_i^*, x_{i,-1})}{\partial^2 x_i^*} \geq 0$. Under the assumption that $x_i^{'}$ is not decreasing in x_i and the assumptions that $\frac{\partial^2 x_i^{'}}{\partial^2 x_i^*} \leq 0$ if $\theta > x_i$ and $\frac{\partial^2 x_i^{'}}{\partial^2 x_i^*} \geq 0$ if $\theta < x_i$, then this second derivative is negative.[2] Therefore, preferences of the voters are convex and single-peaked.

With single peaked preferences, deterministic voting, majority rule, and two candidates, the optimal position for candidate i is given by $median(x_i^*(x_{i,-1}, \theta))$. From Equation II.9, it is clear that $x_i^*(x_{i,-1}, \theta)$ is an increasing function of θ. Thus, $median(x_i^*(x_{i,-1}, \theta)) = x_i^*(x_{i,-1}, \theta^m)$, where θ^m is the preferred point of the median voter. In the case of no adjustment costs, expectations might take the form: $E(x_i^{'}) = x_i$ and thus the optimal position is to locate at the median. For models with costs to adjusting position, the optimal location for candidate i will be a function of both the median voter's preferred point and their past position and parameterization of the cost of adjustment function. As $x_{i,-1}$ is further from θ, the right hand side of Equation II.9 becomes more negative. For equality to hold, the expected distance (an function of the candidate's current position) on the left hand side must increase. In deterministic elections, with a cost of adjusting position, the outcome is predetermined so long as the expectations of future position functions, $E(x_i^{'})$, is the same for both candidates. That is, both candidates move towards the median, but may not converge on the median because of the costs to changing position. In this case, it is the candidate whose past position was closest to the voters who wins the election.

As Equation II.1 highlights, voters' utility may also be a function of a valence term that affects voter utility, but is unobserved by the econometrician. Under the assumption that valence is distributed i.i.d., is additively separable in the voters' utility function, and is unobserved by the candidate when choosing his current platform, then the optimal location of a candidate will still remain a function of the ideal point of the median voter and the candidate's own past position. However, the election outcome will not be predetermined, but will be stochastic. Thus, the candidate will be positioning himself to maximize the probability of winning the election, which, given the assumptions on the valence term, is a

[2] The first of these three assumptions says that increases in ideology in the current period are not expected lower ideology when in office. The second and third have to do with how the expected ideology when in office changes as the current period's position changes. Specifically, that movements toward the voter in the current prior have diminishing effects on the expected position next period and that movements away from the voter in the current period have increasing effects on the expected position next period.

function of his location relative to the median voter and the size of his position change to get there. In particular, assuming assuming ξ_i is distributed i.i.d., Type 1 Extreme Value and is additively separable in the utility function, the politician's expected probability of victory can be written using the logit formula:

$$P(i\ wins|x_i, x_{i,-1}, x_j, x_{j,-1}, \theta^m) = \frac{exp(Eu_i(x_i, x_{i,-1}, \theta^m)}{\sum_{i=1}^{2} exp(Eu_i(x_i, x_{i,-1}, \theta^m))} \tag{II.11}$$

The probability that candidate i wins is thus decreasing in his distance from the median voter (as median voter utility decreases with this distance) and decreasing in the size of the change in position (as voter utility falls as the size of this change increases).

II.IV Candidates and Electoral Competition: Dynamic Model

Extending the static model into a dynamic context, it is easiest to formulate the problem recursively. As before, candidates care only about the rents to office, and not policy. Candidates are forward looking into an infinite time horizon. Therefore, candidate i, who has tenure t, chooses x_i to maximize:

$$V_i(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m) = R+(1-\delta_t)\beta P(x_i, t, x_{i,-1}, x_j, x_{j,-1}, \theta^m) E_{\theta^{m'}, x_j^{'}|\theta^m} V_i(x_i, t+1, x_j^{'}, x_j, \theta^{m'}) \tag{II.12}$$

The value of rents, given by R, are unimportant other than they must be positive to motivate candidates to run. The continuation value of winning the election is discounted by the probability of winning, $P(\cdot)$, the candidates' rate of time preference, β, and the probability of retirement, δ_t.

The formulation of the senator's problem will differ under non-convex costs of adjusting position. Recall that with the fixed cost of adjustment function, the cost to the candidate in the case of no adjustment was C^{NC} and the cost incurred in the cast of any adjustment was C^C. Call the associated probabilities of re-election $P^{NC}(x_{i,-1}, x_j, x_{j,-1}, \theta^m)$ and $P^C(x_i, x_{i,-1}, x_j, x_{j,-1}, \theta^m)$, respectively. In the case of such non-convex costs of adjustment, one can write the dynamic programming problem of the senator as:

$$V(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m) = max[V^{NC}(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m), V^C(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m)] \tag{II.13}$$

Where

$$V^{NC}(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m) = R + (1-\delta)\beta P^{NC}(x_{i,-1}, x_j, x_{j,-1}, \theta^m) E_{\theta^m, x_j^{'}} V(x_{i,-1}, t+1, x_j^{'}, x_j, \theta^{m'}) \tag{II.14}$$

and

$$V^C(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m) = R + (1-\delta)\beta P^C(x_i, x_{i,-1}, x_j, x_{j,-1}, \theta^m) E_{\theta^m, x_j^{'}} V(x_i, t+1, x_j^{'}, x_j, \theta^{m'}) \tag{II.15}$$

Candidates choose a position to maximize the probability of getting elected and obtaining rents from office. The probability of winning is highest if they get as close to possible (bearing in mind the costs of adjustment) to the median voter in each period. Let the optimal decision rule for the candidates' choice of ideological position be given by the function $g(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m)$. The model thus unfolds in the following order:

$election, t = 0$ $\quad$ $election, t = 1$

$x_{i,-1} = g(x_{i,-2}, t, x_{j,-1}, x_{j,-2}, \theta^m_{-1})$ $\quad$ $x_i = g(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m)$ $\quad$ $x_i^{'} = g(x_i, t, x_j^{'}, x_{j,}, \theta^{m'})$

With candidate i choosing position x_i given knowledge of the other candidate's current and past positions and the position of the median voter in the election at time $t = 1$. The candidates' current and past positions, $x_i, x_j, x_{i,-1}$, and $x_{j,-1}$ enter into the voter's expected utility function for the election at $t = 1$.

II.V Rational Expectations Equilibrium

Definition 1. A Rational Expectations Recursive Political Equilibrium consists of functions $V(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m)$, and $g(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m)$ such that for all i:

- Given $x_{i,-1}$, t, x_j, $x_{j,-1}$, and θ^m, $V(x_{i,-1}, t, x_j, x_{j,-1})$ and $g(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m)$ solve the candidate's problem.

- Given $g(x_{i,-1}, t, x_j, x_{j,-1}, \theta^m)$, the voters choose the candidate who maximizes their expected utility.

- Voter's have rational expectations: $E(x_i^{'}) = \int_{\theta^{m'}} \int_{x_j^{'}} g(x_i, x_j^{'}, x_j, \theta^{m'}) dx_j^{'} d\theta^{m'}$

The above are standard conditions for the equilibrium of a repeated, two candidate electoral game. The value functions and policy functions are such that they solve the candidates' problems. The voters select the candidate that maximizes their utility and hold beliefs about the candidates' policy functions that are consistent with the actions of these candidates.

III DATA

Estimation of the model of candidate positioning requires data on the ideological positions of senators and their constituents, observations of senators' retirement decisions, and data on election outcomes. The data on Senate retirements and election outcomes is straight forward to collect. These data come from Stewart III & Woon (2006) (retirements), the ICPSR Congressional Biography Data Series (retirements), and the Federal Election Commission (election results) and I omit a detailed discussion of these data sources. The data on ideology requires a more thorough description.

Data on the ideological position of senators and voters come from the Americans for Democratic Action (ADA) interest group ratings of roll call votes. Each year, the ADA select a subset (20 votes) of the year's roll call votes and rate each Congressman on a scale of 0 to 100. A score of 0 means the Congressman voted against the ADA's position on every roll call vote and 100 means the Congressman voted for the ADA's position on every roll call vote. Thus a score of 0 indicates the the Congressman is very conservative and a score of 100 indicates the Congressman is very liberal, as defined by the ADA. The sample period is 1947-2006.[3]

Adjustments are made to these scores to allow them to be comparable across time and chambers. These adjustments are described in Groseclose, Levitt & Snyder (1999). Such adjustments to the raw ADA scores are necessary because the issues voted on vary over time and across chambers and so the raw scores are not directly comparable. The adjustments are used to allow the ADA scores to shift and stretch across time and chambers. Thus converting raw scores to adjusted scores is similar to converting temperature from Fahrenheit to Celsius. The adjusted scores are not bounded between 0 and 100. Table 1 presents summary statistics for the adjusted and nominal ADA scores, separating out the scores for each major party. These data are available for the entire 1947-2007 period from Anderson & Habel (2008).

Table 1: ADA Scores

Variable	Mean	Std. Dev
Adjusted ADA Score	37.774	31.605
Democrats, Adjusted ADA Score	56.535	26.337
Republican, Adjusted ADA Score	15.463	21.108
Nominal ADA Score	46.238	34.458
Democrats, Nominal ADA Score	67.011	28.446
Republicans, Nominal ADA Score	21.535	22.666

There are several advantages to ADA scores over other measures of ideology, such as the Nominate scores of Keith Poole and Howard Rosenthal. First, ADA scores have a clear definition (i.e. position on the liberal-conservative spectrum, as defined by the ADA). Second, due to the work of Groseclose, Levitt & Snyder (1999), they are comparable over time and across chambers.[4] Third, they are reported at a higher frequency.[5]

The mean of the ADA scores of the state's House delegation are used as a proxy for the ideological position of each state's voters. This follows the work of Levitt (1996), who uses the same proxy for the preferences of each state's voters.[6] If House members face adjustment

[3]Data from 1947-1959, 1962, and 1964 are constructed by Tim Groseclose based on the ADA's methodology and list of key votes for 1947-1959. The ADA did not publish scores for this time period.

[4]D-Nominate scores are comparable over time, but not across chambers. They are also constructed in such a way as to constrain the ideological position of a Congressman to change in a linear fashion.

[5]ADA scores are reported annually, whereas Nominate scores are reported only for each Congress.

[6]The median ideological position of the House delegation gives similar results.

costs similar to those faced by Senator's then this proxy variable will bias the estimates of the adjustment costs faced by Senators. The result will be a downward bias on the size of the adjustment costs estimated. The reasoning is as follows. If House members face positive adjustment costs, then their positions (and thus my proxy for voter preferences) will move less than one point for each one point change in the preferences of the median voters. Senators will respond to the true voter preferences. Thus by using the positions of House members as a proxy for voter preferences, it will look as those Senators move closer to the positions of voters than they in fact do. Since the model is in part identified through the assumption that adjustment costs are the frictions preventing Senators from moving close to the positions of the median voter, the result will be downward biased adjustment cost parameter estimates.

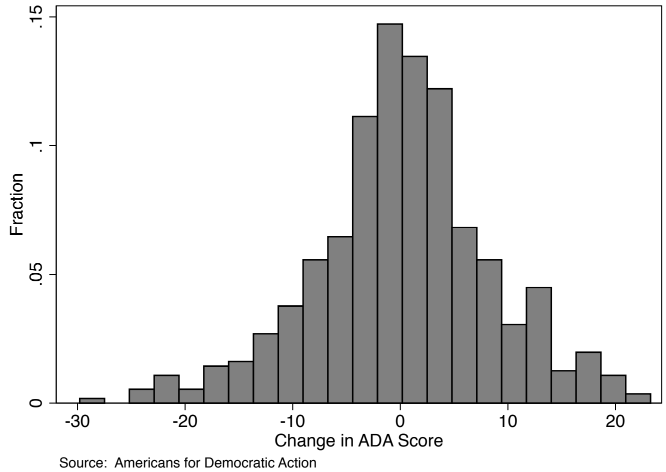
Because the ADA scores are based on such a small number of votes, there may be much year to year variation due to the votes the ADA considers each year. To mitigate this noise, I define a model period as a term in the senate and average the scores across the period. I do not calculate scores for senators who did not receive a score in two or more years of the six year term, ensuring the ideological position of each senator is based on at least 80 votes. This leaves me with 960 senator-term observations over the sample period of 1947-2006. Included in this sample are 400 different senators. Of these 137 serve only one term, 104 serve two terms, 77 serve three terms, 48 serve four terms, and 34 serve five or more terms during the sample period. From the sample, I am able to observe 557 potential changes in position.

Table 2: Summary Statistics

Variable	
Mean years observe Senator	10.387
Mean size of change	0.219
Mean of abs value of change	6.215
Serial correlation of changes	-0.098
Serial correlation of abs value of changes	0.263
Correlation of changes in voter and senator	0.056
Correlation of voter ideology and senator ideology	0.551
Fraction of jumps ($\geq$ 20 point change)	0.025

Summary statistics for the ADA data are presented in Table 2. Figure 1 displays a histogram of the distribution of ideological changes,$(x - x_{-1})$ and shows a distribution with

Figure 1: Distribution of Changes in Position by Senators



a mass toward zero. This figure is important for thinking about whether those costs are convex or non-convex. Convex costs would suggest most movements would be small and there would be a positive correlation between the movements. Indeed, the mass towards zero supports this. Over 11% of the changes are less than one point on the ADA scale and over 20% are less than 2 points on the scale. Non-convex costs would suggest a long right tail (i.e. many senators making big jumps), which is not evident from Figure 1. Of all changes in position, the moves larger than 20 points on the ADA scale account for about 7% of the total change in position. These "jumps" constitute 2.5% of the observations.

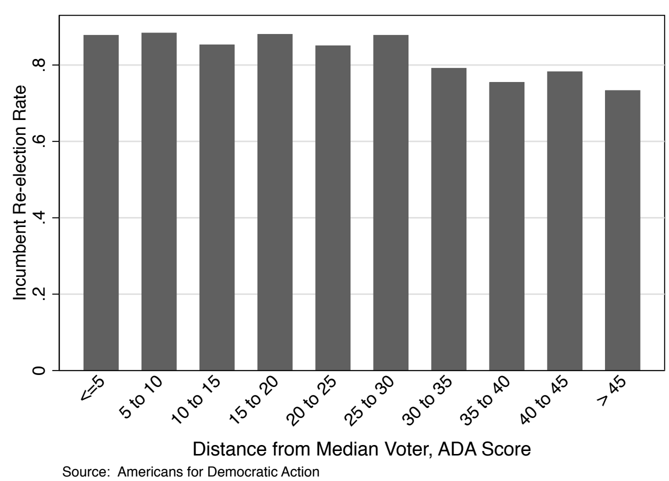
If costs were zero, then one would expect a high correlation between changes in voter ideology and changes in senator ideology and also a high correlation between the observed ideology of senators and voters. The correlation of changes in Table 2 is low, at 0.06 and the correlation of observed ideologies is 0.551. With zero cost of adjusting position both of these correlations would be 1.00.

IV EVIDENCE OF IDEOLOGICAL ADJUSTMENT COSTS

IV.I Non-parametric Evidence

The distance between the position of the senators and the voters as measured by the ADA scores has a clear effect on electoral outcomes. As a measure of electoral outcomes, I employ incumbent re-election rates. These are analogous to the electoral probabilities for incumbents derived from the model. Note that the theoretical model predicts that, on average, the candidates who position themselves closer to the median voter will fare better, but not necessarily win the election, given the stochastic valence term. The unconditional correlation between a senators' re-election rate and his distance from the voters is -0.119. Figure 2 plots how incumbent re-election rates decline as distance from the voter increases. This relationship negative, as one might expect.

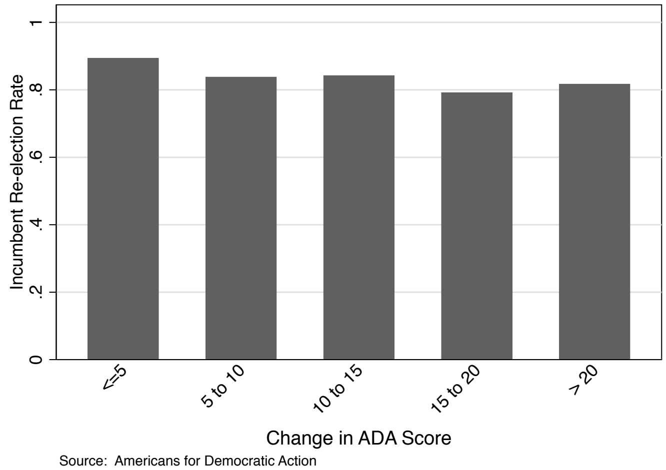
Figure 2: Ideological Distance and Incumbent Re-election Rates



Changing position also negatively effects one's electoral prospects. The unconditional correlation between the incumbent re-election rates and the absolute value of his change in position is -0.115. Figure 3 shows how incumbent re-election rates decline as changes in position become larger.

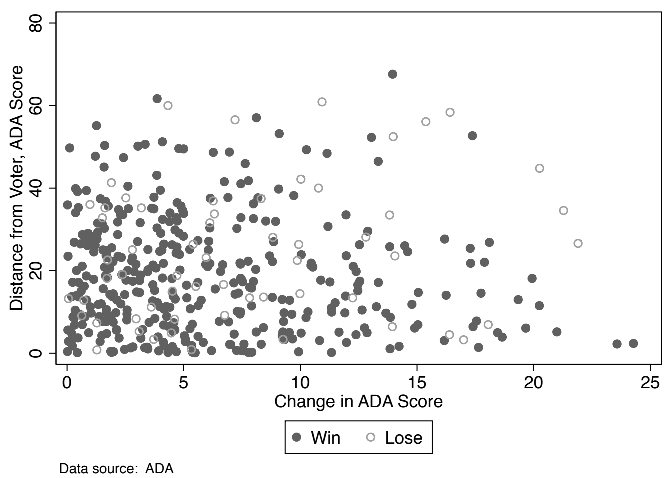
Finally, Figure 4 plots incumbent electoral outcomes over changes and distance. Solid dots are incumbent victories and the open circles are defeats. Incumbents win the vast ma-

Figure 3: Changes in Ideology and Incumbent Re-election Rates



jority of elections, but those that they lose are disproportionately those where the incumbent is positioned far from the voters preferences or makes a large change in position.

Figure 4: Incumbent Wins and Loses by Ideological Distance and Changes in Ideology



IV.II Reduced-Form Evidence

The unconditional correlation between incumbent re-election rates and the size of a candidate's change in position may biased downward because those who change position are likely to be those whose ideological position is far from the voters' preferred point. To correct for this, I estimate a logit model of incumbent re-election rates and control for ideological distance, changes in ideology, changes in state economic conditions, candidate seniority, and national and state trends in party popularity. Tufte (1975) and Erikson (1990) find support for the role of economic conditions in the outcomes of Congressional elections and prompt me to control for changes in state income. Alesina & Rosenthal (1989) find controlling for national sways in opinion are important, therefore I include fixed effects for the interaction of the candidate's party and the year of the election.

Table 3: Effects of Changes in Ideology on Incumbent Re-election Rates, Logit Model

Variable:	(1)	(2)	(3)
Ideological Distance	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)
Abs(Change in Ideology)	-0.078*		-0.085
	(0.038)		(0.122)
Square of Change in Ideology		-0.004*	0.000
		(0.002)	(0.006)
Seniority	0.204	0.201	0.205
	(0.187)	(0.182)	(0.188)
% Change in State Income	2.931	2.829	2.939
	(3.154)	(3.188)	(3.151)
Year*Party Effects	Yes	Yes	Yes
Model χ-squared	51.568	53.116	51.724
Obs	262	262	262

[a] $*p < 0.05$, $**p < 0.01$, $***p < 0.001$
[b] Standard errors in parentheses below parameter estimates.

Table 3 reports the results of the logit model estimation. Ideological distance is defined as the square of the distance between the voters and the senator, $(\theta^m - x)^2$. Changes in ideology are measured in two ways. First, by the absolute value of the change, $|x_i - x_{i,-1}|$. Second, by the square of the change in position, $(x_i - x_{i,-1})^2$. The coefficients on distance from the voters and changes in positions have the expected (negative) sign in all specifications. Changes in state income are positively related to a candidate's electoral prospects, which is anticipated, as all candidates included in the regressions are incumbents. In fact, they are all incumbents with at least two terms of tenure, which is needed to calculate changes in position. The effect of seniority is positive, but statistically insignificant at standard significance levels. However, Gowrisankaran, Mitchell & Moro (2008) and others show that after the "sophomore surge", the returns to being an incumbent are small.

While the coefficients on a change in ideology are of only marginal statistical significance, the signs consistent with the theoretical model - changes in position negatively affect the incumbents success in any model. When evaluated at the sample means, a 10 point change in ideology results in a decrease incumbent re-election rates of between 1.5 to 3.7 percentage points, which is economically meaningful. In fact, in model (1), a change in position of 6.22 ADA points (the average size of a change in position) is equivalent to a candidate being about 20 ADA points further away from the voters, in terms of the effects on incumbent re-election rates. To put this in perspective, the difference between the average positions of Senators Al Gore, Jr. and Ted Kennedy, moderate and very liberal senators, respectively, is about 18 points on the ADA scale.

There is potential for bias in the coefficients on ideological distance and changes in position. This bias comes from two sources. First, if running in an election is costly, those who run are likely to be those who anticipate winning. Thus, those with a past voting record closer to the ideal position of the voters and who do not have to make large changes in position will run for office, while those who are far from the voters and would have to make large changes do not run. Not controlling for the endogenous selection of candidates into re-election bids biases the estimated relationship between changing position and electoral success in a downward direction. Second, among those who run, those changing position are going to be those who are more likely to lose the election; those with a voting record far from the voters and who face a strong candidate. Evidence of such behavior can be found in Somer-Topcu (2009), who documents parties changing position in response to weak election outcomes. The effect of failing to account for the endogenous relationship between changes in position and re-election rates results in a upward bias of the estimated relationship between the two variables.

To control for selection and the endogeneity of changes in position, I estimate a model of candidate positioning in a more direct fashion. This has the further advantage of controlling for the position of challengers. By not controlling for the position of challengers, I am biasing the estimates of the effects of changing position. For example, imagine a case where the challenger takes a position very near the median voter and has a record that is close to the median as well. In such a case, the incumbent will likely have to move close to the median also, but he will face a low probability of winning given the proximity of the challenger to the position of the median voter. In this case, large changes in position come in cases when the incumbent has a relatively low probability of victory. Thus the estimates of the electoral costs to changing position may be biased upward. Estimating a structural model allows me to control for these sources of endogeneity by explicitly including them in the optimization problems of the agents. That is, when the model is simulated these endogenous relationships are a part of the simulated behavior, allowing for unbiased estimates of the deep parameters of the model. In the next section, I discuss the structural estimation of a model of candidate positioning when changing position is costly.

V STRUCTURAL ESTIMATION

V.I Estimable Model

In order to estimate the dynamic model described in Section II, one needs data on the past records of both candidates, the current positions taken by both candidates, and the preferred position of the median voter. I use ADA scores to proxy for the current and past positions of those who have served in the Senate. A candidate's voting record during his term in office serves as his platform for the election at the end of that term. No available data allow me to observe the past positions of first term senators or the past or the current position taken by those who have never served in the Senate. Because of this limitation, I assume a distribution for the positions of challengers and the costs of adjustment associated with these positions. The model of challengers is reduced form, but consistent with both an incumbency advantage (as in Bernhardt & Ingberman (1985)) and with the model of candidate positioning described above. This simplification captures much of the richness of the model from Section II, while allowing one to estimate the underlying parameters of the model in the absence of data on challenger positions.

Specifically, the challenger's current position, x_C, and the costs associated with this position, C_C, are drawn from a bivariate normal distribution with mean μ and covariance

Σ_C. These assumptions imply the expected utility of electing a challenger is:

$$Eu(C,\theta) = -(E(x_C^{'}) - \theta^m)^2 - C_C + \xi_C \tag{V.1}$$

The function $E(x_C^{'})$ is a function of the current position of the challenger, x_C, which the econometrician cannot observe since there is no available voting record for the challenger. Therefore, I model the challenger's current position as a random draw with $x_C \sim N(\mu_{x_C}, \sigma_{x_C})$. In addition, because I do not want to assume challengers and incumbents face the same costs to changing position, the costs of adjustment, C_C, associated with the challenger and his position are also stochastic; $C_C \sim N(\mu_C, \sigma_C)$.[7] Allowing for a correlation between one's current position and the costs of changing position is natural, as one might expect there to be more uncertainty if a candidate adopts a more centrist position because he may be playing to the voters (see Enelow & Hinich (1981), Kartik & McAfee (2007)). Let ρ_{C,x_C} be the correlation between the challenger's current position and the costs associated with that position.

Alternatively, one could assume the challengers' cost of adjustment function. Knowing the form of this cost of adjustment function, one need only draw the past position of the challenger. Given the cost function and the position of the incumbent, the challenger's equilibrium decision rule will omit his optimal ideological position. However, one is not able to identify both the parameters of the cost function for challengers and the distribution of their past positions. Thus, I assume a parametrization of the stochastic processes summarizing the best response function of the challengers and their costs of adjusting position. These can be summarized through the draw of their current position and the challenger cost function, which represents the cost to moving to their current position (a function of their current and past positions, neither of which are observable in the data).

Following Enelow & Munger (1993), voter expectations about future candidate positions take a specific functional form, although in this case voter expectations are assumed to be forward-looking. These expectations take the following form: $E(x_i^{'}) = \lambda x_i + (1-\lambda)E\theta^{m'}$, where $\lambda \in [0,1]$. That is, the expected position of the candidate next period is assumed to

[7] The incumbency advantage can thus be built into this general cost parameter.

be between where he positions himself today and and where the median voter will be one period hence. The expectations function is consistent with the theoretical model in Section II in that it is increasing in x_i. It also models voters as having expectations consistent with the fact that candidates change position to move closer to voters, but may not fully adjust in the presence of adjustment costs. In the results which follow, I fix λ at 0.5.[8] Positing a functional form for voter expectations of future candidate positions helps to pin down the voters' beliefs.

The utility and expectations of voters, the stochastic valence of candidates, the motivation of candidates, and the exogenous processes describing challengers put structure on the model. The parameters of this model are estimated using data on the positions taken by senators on the liberal-conservative spectrum defined by the ADA. The expected value of a candidate's policy next period is determined by expectations about the evolution of the median voter and decision rules of the candidates.

V.II Estimating Voter Preferences and Non-electoral Exit Probabilities

The decisions of the senators depend importantly upon retirement probabilities and the expectations of the future positions of voters. Retirement probabilities depend upon the tenure of the senator and help to define how future elections are discounted. On average, just under 10% of senators retire each term. The probability of retirement, δ_t, is found by calculating the empirical probability that a senator with a given level of tenure retires. That is, retirement decisions are not modeled as strategic choices, as in Merlo, Diermeier & Keane (2005). The assumption of exogenous probabilities of non-electoral exit is consistent with the evidence of Ansolabehere & Snyder (2004) who find no evidence that candidates for statewide office retire strategically. Gowrisankaran, Mitchell & Moro (2008) also propose that senator's retirement probabilities are non-strategic.[9]

Understanding the persistence and variability in the preferences of the voters are key

[8] Local variation in λ does not significantly affect the relative magnitudes of the effects of changing position versus changing distance from the voter on electoral outcomes.

[9] Note that the probability of winning is not a function of tenure, while retirement is. The evidence supports these assumptions. Dawes & Bacot (1998) and DeBacker (2011) find that the incumbency advantage is flat over tenure. Gowrisankaran, Mitchell & Moro (2008) even find evidence that tenure is disadvantageous in U.S. Senate election outcomes.

Table 4: Parameters

Parameter	Value	Source
β	0.960	4% Risk free rate
δ_t	0.08-0.28	Empirical prob retire
ρ	0.567	Estimated persistence of median voter position
σ_ϵ	10.380	Estimated std dev of shock to median position

components to the solution of the senators' dynamic programming problem. The bliss point of the decisive voter is unaffected by the positions of the senators and is assumed to follow and AR(1) process:

$$\theta_t^m = (1-\rho)\mu + \rho\theta_{t-1}^m + \epsilon_t \tag{V.2}$$

I assume $\epsilon \sim N(0, \sigma_\epsilon)$ and use the mean ADA score of the House delegation from the senator's state as a proxy for the preferences of the decisive voter, as done in Levitt (1996). The AR(1) process is estimated using a least squares approach where the mean of the autoregressive process is allowed to vary across states. I assume both ρ and σ_ϵ are constant across states and find them to be 0.567 and 10.380, respectively. The AR(1) process is then approximated by a first-order Markov process following the method of Tauchen (1986) to determine the transitions of the voters in the discretized state space of the computational model. Because the preferences of voters are exogenous to the choice of position by senators, it is not necessary to estimate the distribution of voter preferences within the structural model.

In addition to the exit probabilities and the law of motion for the median voter, I also set the values of several model parameters before the structural estimation stage. As noted by Rust (1987), it is difficult to estimate the rate of time preference in discrete choice dynamic programming problems. Therefore, I set the value of β to an annual value of 0.96, consistent with a 4% risk free interest rate.[10] The decision rules of senators depend upon the differences in ideology between the candidates and the median voter. Therefore, I assume the mean of the distribution of challenger ideology, μ_{x_C}, is the same as the mean from the distribution of the median voters' preferred points. For the following analysis, I

[10]Note that an increase in β results in candidates more heavily weighting the current election relative to future elections. This means that candidates are more likely to make larger moves, regardless of the form of adjustment costs. This is because candidates who are less patient place lower value on being closer to the voter (and paying less adjustment costs) in future elections.

also assume the correlation between the ideology of challengers and the adjustment costs of challengers, ρ_{C,x_C}, is zero.[11]

V.III Estimating Ideological Adjustment Costs

Using an indirect inference method, I estimate the following model parameters: μ_C, σ_C, σ_{x_C}, and the parameters describing the costs of adjustment function $C(x_i, x_{i,-1})$. These remaining parameters underlying the model of candidate positioning, $\Theta = (\mu_C, \sigma_C, \sigma_{x_C}, \gamma, \kappa, F)$, are identified through a simulated method of moments (SMM) estimation procedure as described in McFadden (1989). The SMM methodology has several advantages over alternative methods of estimation such as maximum likelihood. First, SMM is transparent. The moments I choose to match are well measured, clearly defined, and easily interpreted. Second, given the non-convex costs of adjustment, if one were to use MLE, the data would have to be measured very precisely in order to identify a "no change" in position. The data used here do not satisfy such a strict requirement.

The SMM procedure has the following algorithm. For a given vector of parameters, Θ, the dynamic programming problem (DPP) of the senator is solved. The solution to the DPP is a set of policy functions determining the senator's optimal choice of ideological position given his past position, the position of the challenger, the adjustment cost associated with the challenger's position, the current position of the voters, and the electoral shock ξ. These policy functions are used to simulate a panel of policy choices and electoral outcomes . A set of moments is calculated from the simulated panel. Call the vector of simulated moments $\Psi^s(\Theta)$.

The estimate $\hat{\Theta}$ is the vector of parameters that minimizes the weighted distance between $\Psi^s(\Theta)$ and the vector of moments from the data, Ψ^d. Formally, $\hat{\Theta}$ solves:

$$\pounds(\Theta) = \min_{\Theta}[\Psi^d - \Psi^s(\Theta)]' W [\Psi^d - \Psi^s(\Theta)], \tag{V.3}$$

[11] Without data on the positions of challengers, it is not possible to estimate this correlation. As a robustness check of the results, I estimate the model under alternative assumptions for the correlation between the distance between the position of the challenger and the median voter and the adjustment costs those challengers face. Changes to this assumption have very little impact on the fit of the model and result in no change to the model which best fits the data (a model with fixed and quadratic costs).

where W is the optimal weighting matrix, calculated as the inverse of the variance covariance matrix of the data moments, as described in Gourieroux, Monfort & Renault (1993). This weighting matrix is calculated by bootstrapping the data. Using the SMM procedure with the optimal weighting matrix ensures consistent and efficient estimates of Θ.

In the minimization routine, the vector Θ is updated using a simulated annealing algorithm (Goffe, Ferrier & Rogers (1994)). Such an algorithm is very effective at finding the global minimum in cases where the objective function is non-linear in its parameters, as in this case.

V.IV Moments and Identification

To estimate Θ, I choose to match the following moments: the fraction of jumps in position (a change in position of at least 20 points on the ADA scale), the serial correlation of changes in position, the re-election rate of incumbents, the correlation between re-election rates and the distance between a senator and voter's position, the correlation between the ideology of senators and voters, the correlation between the ideology of senators and voters for first term senators, and the standard deviation of positions for first term senators.[12] Table 5 summarizes the moments. While each of the moment is affected by all the parameters to some extent, I discuss next which moments contribute most to the identification of each parameter.

Table 5: Moments Used For Estimation

Moment	
Fraction of Jumps ($\geq$ 20 point change)	0.025
Serial Corr of Changes	0.263
Incumbent Re-election Rate	0.843
Correlation(win,distance)	-0.119
Correlation of voter and senator ideology	0.551
Correlation of voter and 1st term senator ideology	0.462
Freshman Re-election Rate	0.829

The fraction of jumps and the serial correlation in changes of position are most informative about the size and nature of the costs of adjustment. In the quadratic adjustment costs model, a larger value of γ implies fewer jumps. The fixed-cost model has more jumps

[12]Changing the value that defines a jump has little effect on the parameter estimates. A higher (lower) value for the definition only decreases (increases) the moment that is the fraction of jumps.

Table 6: Parameters

Parameter	Definition
μ_C	Mean of challenger adjustment costs
σ_C	Std. dev. of challenger adjustment costs
σ_{x_C}	Std. dev. of challenger position
κ	Coefficient in linear costs of changing position
γ	Coefficient in quadratic costs of changing position
F	Fixed cost of changing position

than the quadratic model, and the number of jumps increases as F decreases (for certain ranges of F).

The serial correlation is also informative about the nature of the costs of adjustment. With quadratic costs of adjustment, one will find a relatively high degree of serial correlation. This is because senators will not make large changes in position because the costs to changing position are increasing with the size of the change. With linear costs of adjustment, the marginal cost of a change in position does not depend upon the size of the change, so the changes will be larger and the serial correlation lower. When costs are independent of the size of one change, as in the fixed cost case, the serial correlation will be lowest. Facing fixed costs of adjustment, candidates will only change position when they are beyond a certain threshold from the voters and will make large changes in position in one term, with little activity at other times.

Re-election rates are determined by a number of the parameters, but they most directly help to pin down the mean adjustment costs faced by challengers, μ_C. Higher adjustment costs for challengers leads to a larger incumbency advantage and thus higher incumbency re-election rates.

The correlation of senator and voter ideology is significantly affected the size of the costs of adjustment and the the standard deviation in the positions of challengers, σ_{x_C}. To separate the standard deviation in the positions of challengers from the size of the costs of adjustment for incumbents, I include as a moment the correlation of senator and voter ideology for first term senators only. Holding adjustment costs constant, an increase in σ_{x_C} will result in a lower correlation between the positions of senators and the median voter. This will be stronger for more junior senators, who do not have a long period of time to adjust their positions.

Finally, the standard deviation of challenger adjustment costs, σ_C is identified by matching re-election rate of freshman senators. Freshman re-election rates provide identification of σ_C because increases (decreases) in σ_C decrease (increase) the correlation between the ideology of the median voter and the winning challenger's ideology. Because adjustment costs prevent freshman senators from moving far from the positions they had as challengers, the position they first campaigned on will directly impact their chances of re-election. A larger (smaller) σ_C will result in lower (higher) re-election rates for freshman senators.

VI RESULTS OF STRUCTURAL ESTIMATION

The structural model is estimated estimated using ADA data from 1947-2006. Table 7 presents the results of estimation, reporting the parameters of the cost function (with standard errors in parentheses), the values of the moments, and the minimum statistic. I estimate a baseline case with no adjustment costs as well as models with quadratic, linear, and fixed costs to adjustment and a combination model. The combination model combines the quadratic and fixed costs of adjustment. Such a model allows for both the role of uncertainty (as in Enelow & Munger (1993)) and character (as in Kartik & McAfee (2007)).

Using the minimum statistic as the criteria, the model with both quadratic and fixed costs to adjusting position does the best at capturing the relevant moments. It is able to come very close to five of the moments, and, in particular, does a much better job that other models in matching both the serial correlation of changes in position and the correlations between voter and senator ideology. The model with no costs of adjustment is clearly rejected by the data, with simulations showing senators being much too responsive to changes in voter ideology.

As in the reduced form estimation, one finds significant effects of changing position in the structural models. Any model with some cost of adjustment does much better at matching the relevant moments than does the model with no costs of adjustment. In the best fitting model, with both quadratic and fixed costs of adjustment, a change of 6.22 ADA points (an average size change) lessens a candidate's chances of victory by the same probability

Table 7: Results of Structural Estimation

Model:	No Cost	Linear	Quadratic	Fixed Cost	Fixed and Quad	Data
Parameters						
γ	0.000	0.000	3.049	0.000	2.760	-
	-	-	(1.269)	-	(0.791)	-
κ	0.000	13.945	0.000	0.000	0.000	-
	-	(0.894)	-	-	-	-
F	0.000	0.000	0.000	349.374	17.871	-
	-	-	-	(51.030)	(4.912)	-
Moments						
Frac Jumps	0.091	0.003	0.000	0.042	0.000	0.025
Serial Correlation	-0.222	0.103	0.363	-0.026	0.259	0.263
Re-elect Rate	0.852	0.842	0.847	0.831	0.842	0.843
Corr Ideo	1.000	0.546	0.570	0.448	0.554	0.551
Corr Win/Dist	0.000	-0.116	-0.117	-0.074	-0.085	-0.119
Corr Ideo, Freshman	1.000	0.502	0.416	0.418	0.436	0.462
Re-elect Rate, Freshman	0.852	0.832	0.832	0.832	0.833	0.829
$\pounds(\Theta)$	524.322	18.170	20.932	42.496	14.732	-

[a] Standard errors in parentheses below parameter estimates.

as being about five points further away from the voter along the ideological spectrum.[13] Five ADA points is about the average distance between senators John McCain and Bob Dole or between senators Joe Biden and Al Gore; which is to say that it is a noticeable, but slight difference in position. The relative electoral cost of a change in position resulting from structural estimation is smaller than the quantitative significance found in the reduced form models and may suggest that there is upward bias in the estimates of adjustment costs in the reduced form models. That is, because the reduced form models do not control for the endogeneity of changes in position to the competitiveness of the election they overestimate the size of adjustment costs as larger adjustments more often came in more competitive elections (i.e., those with lower incumbent re-election rates) .

The numerical example above is illustrative about the relative magnitude of the electoral effects of distance versus costs of changing position. But such an example does not tell us much about the optimal position of a candidate or convergence of policy positions in electoral equilibria. To further understand the effects of changes in position on electoral outcomes, consider Figure 5. This figure plots the incumbent's re-election probability as a function of the size of his change in position for three models: no cost, quadratic cost,

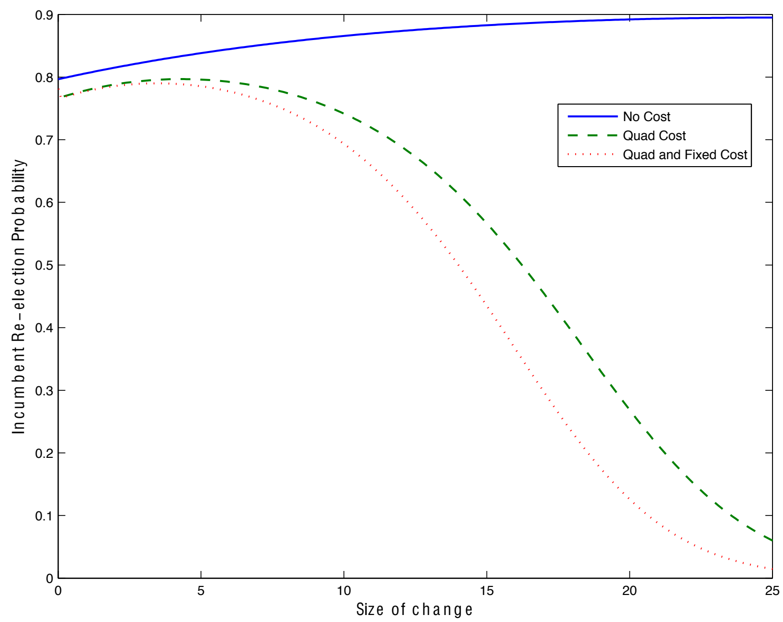
[13] This comparison was done using the model evaluated where the incumbent and challenger took positions the mean distance from the voters (24.5 ADA points) and where the challenger drew the mean challenger cost.

and the model with fixed and quadratic costs. In this numerical example, the incumbents past position is assumed to be 25 points away from the median voter (recall that the mean distance is 24.5). Thus a change of 25 points means that the incumbent aligns his position with that of the median voter. In addition, it is assumed that the challenger's position (x_C) is 20 points away from the voter and that the challenger's cost (C_C) is μ_C.[14] Without adjustment costs, the electoral probability is a strictly increasing function of the change; as the candidate moves closer to the median voter, this probability of election increases. Thus, the optimal position is to locate at the median voter's preferred point. With quadratic costs, there is a range of changes for which changing position increases electoral success. In particular, incumbent re-election rates are increases for changes between 0 and 4.2 ADA points. This shows the non-convergence of platforms in a model with adjustment costs. When choosing to maximize their chances of obtaining office, candidates must weigh the benefits of positioning themselves close to the voter with the electoral costs of changing position. In this case, a candidate whose past position is 25 points from the voter would optimally locate 20.8 points from the voter when faced with quadratic adjustment costs of the size estimated. The quadratic and fixed costs model has a similar curvature, but incur the fixed cost for any change. Thus, there is an immediate drop for any change in position. Following this, the re-election probability increases to its maximum at a change of 3.5 ADA points before declining. Thus, in this case, and with a past position 25 points from the median voter, the candidate's optimal position is one that is 21.5 points from the median voter.

Of the models with positive costs to adjustment, the worst fitting model is the model which posits only a fixed cost to adjusting position. In this model, any change in position, regardless of the size, is punished by voters and negatively affects a candidate's electoral prospects. Because of the large cost for any size change in position (any change incurs a cost equivalent to being about 20 points further way from the voters- more than the average distance between senators Al Gore and Ted Kennedy), the serial correlation of position changes and the correlation between the ideologies of senators and voters is much lower than in the data.

[14] μ_C was estimated 248.087 in the model with quadratic and fixed costs of adjustment.

Figure 5: Incumbent Electoral Probabilities by Model



Still, any model with a positive cost to adjusting one's position fits the data much better than the zero cost model. Senators move towards the voters, but, because of costs of adjustment, do not align themselves perfectly with the voters. Models where costs to changing position increase with the size of the change are the most consistent with the data. The best fitting model has both variable cost and fixed cost components, suggesting signaling through persistent ideological stances is an important empirical phenomena. This result is consistent with the survey evidence of Tomz & Houweling (2009), who show voters dislike changes in position both because of the change itself and because of the increased uncertainty this provides regarding future positions of the candidate. Such preferences map well into the fixed and variable cost models I present above, and it is these models that best fit the data on electoral outcomes.

VII EXTENSIONS

I now discuss several relevant extensions to the baseline models and estimation in order to show the robustness of the results. In particular, I consider variations in the cost function, the voter's utility over policy positions, the measurement of ideology, and sample selection, in that order.

VII.I Voter Threshold for Position Changes

It may be the case that voters are not well informed about the present and/or past positions of the candidate and thus can't accurately identify small changes in position. Or voters may simply not penalize small changes. Alternatively, there may be noise in the data that prevent the econometrician from accurately identifying small changes. Thus, it is of interest to consider a model where costs are incurred only for changes above a certain threshold. To determine what a reasonable threshold is, I turn to the data, and in particular the correlation between the size of the incumbent's change in position and his re-election probability. For all changes, this correlation is -0.11. For changes smaller than five points on the ADA scale, the correlation is 0.01. For those smaller than ten points it is -0.07. And it is -0.12 for changes larger than ten points on the ADA scale. Thus, a threshold of five ADA points is a reasonable threshold, as a simple correlation suggests there may be little electoral cost to such small changes.

To see if a threshold model does a better at describing the data, I estimate a model with fixed and quadratic adjustment costs, but with no electoral cost incurred for changes smaller than the threshold of five ADA points. The model is estimated using the same moments and methodology as in Section VI. The minimum statistic found through estimation is 18.285. The model fits the data well, but not quite as well as the model where costs are incurred on all changes. Estimates of both the quadratic cost and fixed cost parameters are larger than in the baseline model, with $\gamma = 11.236$ and $F = 34.833$. What this means is that while changes of smaller than five ADA points incur no electoral cost, larger changes are found to omit larger costs than in the baseline model. For example, a change of mean size (6.22 points) results in a decrease in electoral probability equal to the candidate having a position 15 points further from the median voter.[15]

[15] This comparison was done using the model evaluated where the incumbent and challenger took positions the mean distance from the voters (24.5 ADA points) and where the challenger drew the mean challenger cost.

VII.II Distance from the Voter

As with any discrete choice dynamic programming problem, the model is non-parametrically unidentified (see Magnac & Thesmar (2002)). That is, given the subjective discount factor β, there is an equivalence class containing infinitely many utility functions that can all rationalize any particular decision rule. Because only differences in voters' utility between different candidates affect the election probabilities, the overall scale of the utility function is irrelevant and unidentified. However, changes other than those to the scale of the utility function may matter. The previous subsection discussed an extension to the cost of adjustment function. Here, I consider a variation in the measure of distance between the voter and candidate. In particular, I use the absolute value of the distance between the candidate and the voter (as opposed to the square of the distance).

Changing the distance measure only affects the calculation of one moment; the correlation between winning and distance. In fact, this moment remains the same (-0.119) under both parameterizations. The estimation yields a slightly worse fit than under the square of the distance parameterization (a minimum statistic of 38.848 vs. 14.732). Because of the change in distance measure, one can't tell much by directly comparing the parameter estimates of the cost function to those from the baseline estimation. Instead, I again draw upon the comparison between the effects of a mean-sized change in position and an increase in distance from the voter on the electoral probabilities to give a sense of how important changes in position are relative to distance. In the linear distance model, a change of 6.22 ADA points results in a decrease in electoral probability equal to the candidate positioning himself nine points further from the median voter.[16] In the linear distance model, the marginal cost of positioning further from the voter is not increasing, the relative importance of adjustment costs decreases. That is, if voter utility is linear, and not quadratic, in the distance between the candidate's position and the voter's preferred point, candidates are going to be less likely incur the adjustment cost to move closer to the voter.

[16]This comparison was done using the model evaluated where the incumbent and challenger take positions the mean distance from the voters (24.5 ADA points) and where the challenger drew the mean challenger cost.

VII.III Scaling ADA Scores

As a further robustness check, let's consider a change in the scale of the ADA scores themselves. In particular, I use the natural logarithm of the ADA scores so that distances and changes will be measured in percentage terms. Such an interpretation of the ADA scores may make sense if the ADA seeks to use their scores highlight differences amongst the more liberal members of congress. Recall that an ADA score of 100 represents someone who agreed with the ADA on each roll call vote. If the role call votes are selected in a way that highlights differences among the more liberal members of congress (those scoring closer to 100), then a distance of 10 points near the top of the scale (say the difference between an ADA score of 80 and 90) may not represent the same difference in ideology as a distance of 10 points near the bottom of the scale (say the difference between an ADA score of 10 and 20) when viewed by the voter. In particular, if the ADA is trying to highlight the difference between liberal members of Congresss, then the difference between scores of 80 and 90 might be small by the point of the view of the voter, while the difference between 10 and 20 would be large. Using the natural log will help to correct this, as differences near the bottom of the scale will be larger in percentage terms than differences near the top of the scale. Indeed, Brunell, Koetzle, Dinardo, Grofman & Feld (1999) find evidence of just such a pattern in interest group rating scores. Brunell et al. (1999) find that liberal groups like the ADA focus more on differentiating liberal members, while lumping conservatives together at the bottom, despite significant variation in their ideologies. Therefore, it's important see how robust the results are to an alternative scaling of the ADA scores.

Table 8 shows the moments from the data using the logarithm of ADA scores. The model is able to fit the data well; the minimum statistic is almost as low as in the baseline case. The parameter estimates for the cost function are not directly comparable to the baseline case, but a numerical example will highlight the relative magnitude of the effect of changing position in this model. I evaluate the model where the incumbent and challenger take positions the mean distance from the voter and where the challenger draws the mean challenger cost, the median voter has a position of 50, and the challenger is positioned to the right (ADA score below) the median voter. In this case, a change of 6.22 ADA points affects the incumbent's re-election probability by the same amount as if the incumbent were nine points further from the voter and made no change in position. If the candidate is positioned the mean distance to the right of the voter (ADA score above the voter's), then a 6.22 change in position affects the probability of re-election by the same amount as 25 point increase in the distance between the voter and the senator. Because of the log scale, a single ADA point change when ideology is more conservative is more costly than a single point change when ideology is more liberal.

Table 8: Log ADA Scale, Data and Model Moments

	Data	Model
Frac Jumps	0.025	0.000
Serial Correlation	0.442	0.398
Re-elect Rate	0.843	0.836
Corr Ideo	0.459	0.413
Corr Win/Dist	-0.067	0.001
Corr Ideo, Freshman	0.357	0.266
Re-elect Rate, Freshman	0.829	0.836
$\pounds(\Theta)$	-	16.698

VII.IV Close Elections

One might suppose that electoral costs vary between states that strongly favor a particular party and those that are swing states. For example, it may be the case that flip-flopping is punished more in more partisan states since a candidates' biggest hurdle to re-election is the party primary and the median voter who is relevant is further from the center. To test this, I calculate the data moments used to estimate the models in the previous section, but do so only for elections where the winning candidate has between 45 and 55 percent of the vote share. I then estimate the model with quadratic and fixed costs using the methodology described above to find the parameters that best match the model moments to those from the data. The data and model moments, as well as minimum statistic are presented in Table 9.[17] The model fits the data very well. What is important to note is that the serial correlation is much lower in close elections than in the sample of all elections. The correlation between voter and senator ideologies is also lower, as are incumbent re-election

[17]The estimate for the quadratic cost parameter is 0.461 and the fixed cost parameter is 200.97.

rates. The lower correlation between voter and senator ideology suggests that adjustment costs are actually higher in close elections, although this result could also be due to selection effects. That is, candidates in close elections are in close elections because they happened to win office despite being positioned far from the median voter. However, two other moments highlight the importance of adjustment costs in these close elections. First, close elections have lower correlation between distance and the incumbent's re-election rate. The correlation may be lower because adjustment costs are relatively more important in these elections. Second, the low serial correlation in position changes suggests that incumbents face large costs to changing position. And, in particular, it suggests that they face larger fixed costs to changing position. It is such fixed costs that result in a low serial correlation of position changes as candidates find it optimal to make larger position changes at one time rather than small position changes each term. This implies that candidates in close elections will be more likely to be flip-floppers than to be wishy-washy candidates. This is consistent with the observation that close elections are those where a candidate's record is highlighted in the media and where any position change receives more scrutiny.

Table 9: Close Elections, Data and Model Moments

	Data	Model
Frac Jumps	0.026	0.023
Serial Correlation	-0.002	-0.006
Re-elect Rate	0.707	0.706
Corr Ideo	0.415	0.426
Corr Win/Dist	-0.077	-0.083
Corr Ideo, Freshman	0.396	0.393
Re-elect Rate, Freshman	0.694	0.702
$\pounds(\Theta)$	-	0.966

Close elections are those in which, on average, incumbents are positioned further from voters (28.7 versus 24.5 ADA points) and make larger changes in position (6.92 versus 6.22). To give an idea of the magnitude of the ideological adjustment costs candidate's in close elections face, I evaluate the effect of a change of mean size on incumbent re-election probabilities and then find the change in distance between the incumbent and voter that has an equivalent effect on the re-election rate. Given the cost estimates, a change of 6.92 ADA points is equivalent to the incumbent positioning himself 13 points further from the voter. Note that fixed costs are very important in this model, as a large fixed costs are necessary to fit the low serial correlation of position changes and relatively low correlations between incumbent and voter ideology. Thus, even a change much smaller than the mean will have significant effects on a candidates re-election prospects. In general, and holding the challenger's position and cost fixed, it will be optimal for candidates to change position only when they are sufficiently far from the voter.

VIII CONCLUSION

The objective of this paper was to provide an understanding of the nature of flip-flopping amongst United States senators. Using a large panel on the ideological positions of senators and various empirical approaches, the results suggest several important conclusions regarding the costs senators face when changing position.

First, I document electoral costs to changing position. These costs are economically significant, with changes in position resulting in electoral costs of similar magnitude to those seen from a divergence between the ideology of the voters and senators. Furthermore, I was able to clearly show that models which include adjustment costs fit the data much better than models with no costs to changing position. A model with both fixed and quadratic costs to adjusting position was found to fit the data best. That is, senators face costs to deviating from their past records that increase with the distance they move and also face a significant punishment for small deviations (measured by the fixed cost associated with changes). A model with fixed and quadratic adjustment costs support both the character models of Kartik & McAfee (2007), Callander & Wilkie (2007), and Callander (2008) (where fixed costs are important) and the models of uncertainty in future candidate positions such as Enelow & Munger (1993).

Overall, the results provide more evidence against the stylized version of Downs' model and the convergence property of the Median Voter Theorem as a description of a representative democracy. Flip-flopping is indeed punished; any changes in position senators take is best done in small moves. While multiple models of electoral competition may be consistent with such a cost function, it is nonetheless important to understand such costs and their implications for electoral equilibrium such as non-convergence of candidate platforms. Understanding which model of adjustment costs fits the data best will help in the development of more realistic models of political competition.

A drawback of the model of electoral competition presented here is that it does not fully specify the dynamic models that result in the costs to adjusting position. The adjustment costs in this paper are reduced form approximations of complicated games of signaling and asymmetric information. Developing an estimable model that allows for these rich features is left as a worthwhile goal for future research.

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