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A spatial model of U.S. Senate elections

JAC C. HECKELMAN
Wake Forest University, Winston-Salem, NC 27109, U.S.A.; e-mail: heckeljc@wfu.edu

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Abstract. The importance of primary elections is considered within the context of U.S. Senate elections where senators serve overlapping terms and voters are assumed to balance their two senators against each other. Voters behave strategically in the primaries but convergence to the median position is not achieved except as a knife-edge result. More generally, constraints in the party space prevent the party of the sitting senator from obtaining the median's preference allowing the opposition party to nominate a candidate further away from the median while still capturing the median voter. Empirical evidence supports the notion that senate divergence is a function of the state primary system.

1. Introduction

Divided government has traditionally been analyzed in the context of federal offices, such as when differing parties control the executive and legislative branches or there is divided control over the two branches of Congress (Erikson, 1988; Fiorina, 1992; Alesina and Rosenthal, 1995). Recently, scholars have also turned their attention to explaining the phenomena of divided representation within the Senate itself for a given state (Alesina, Fiorina and Rosenthal, 1991; Jung, Kenny and Lott, 1994; Poole and Rosenthal, 1997; Heckelman, 2000). The U.S. Senate is a special case in that this legislative body has two representatives for the same electorate. Since many of the states have both a Republican and Democrat serving simultaneously, this has led some to reject the implications of the Median Voter Hypothesis (Grier and Goff, 1993; Jung, Kenny and Lott, 1994; Bender and Lott, 1996). Despite the lack of attention paid to divided senate delegations until recently, this is not a new development. Brunell and Grofman (1998) show that it has not been uncommon for states to elect a split senate ever since the adoption of the 17th Amendment in 1913 which replaced the process of appointing senators by direct voting.[1]

There are competing theories that have been promoted as explaining the occurrence of split senate delegation. One explanation is based on the dual-constituency thesis in which declining marginal productivity for voting on a single issue by a second senator allows an opposition candidate to compete

and win on a second dimension by attracting a different majority coalition (Jung, Kenny and Lott, 1994).

Alternatively, Alesina, Fiorina and Rosenthal (1991) and Heckelman (2000) argue that the electorate actively seeks to balance the ideological position of their two senators in order to moderate the policy position of their state delegation. This is the only theory which makes explicit usage of the fact that senators serve overlapping terms and thus the position of the already existing senator is known when the other seat is contested. Alesina, Fiorina and Rosenthal (1991) also present evidence that the electorate does engage in senate balancing by showing that one party is more likely to be elected if the other seat is already held by the other party (see also Schmidt, Kenny and Morton, 1996).

However, the only difference between the various state election outcomes in the Alesina, Fiorina and Rosenthal model would be due to uncertainty from random preference shocks. Thus, there is no mechanism to determine *which* states are more likely to have split senate delegations. In Heckelman (2000), divergence is a function of the state primary system but the primary voters are not sophisticated; they vote sincerely for the candidate who will give them the best representative balance irrespective of that candidate's electability in the general election, whereas models of primary elections usually assume some degree of strategic voting (Aranson and Ordeshook, 1972; Owen and Grofman, 1996). Also, no empirical evidence is presented to test for the importance of primaries.

In this paper, the earlier model in Heckelman (2000) is extended to include strategic voting in the primaries. The model still predicts primaries will lead to split party representation but the degree of ideological spread is tempered by strategic voting and is expected to increase over time. Finally, empirical evidence is presented which is consistent with senate divergence being correlated with the state primary system.

2. The model

Candidates compete in the single-dimensional policy space [–Z, Z]. Denote the set of voters $V = \{1, ..v\}$, and the utility voter i receives from platform b as $U_i(b)$. Each voter is assumed to have a well-behaved symmetric convex preference set with a single bliss point denoted as b_i such that

a) $U_i(b_j) > U_i(b_j) \forall b_j \neq b_i, b_i \in [-Z, Z] \forall i$
b) $U_i'(b_i) = 0$
c) $U_i'(b_j) > 0 \; \forall b_j < b_i$
d) $U_i'(b_j) < 0 \; \forall b_j > b_i$
e) $U_i(b_j) = U_i(b_k)$ if and only if $|b_j - b_i| = |b_k - b_i|$.

Voters are distributed along the line interval [-Z, Z] and the location of the median voter (MV) is normalized to be located at $b_{MV} = 0$. Democratic voters are left of the median and Republican voters are right of the median and their party medians are denoted as MD and MR respectively. The model does not address which voters participate in their party primaries, only requiring $b_{MD} < 0$, and $b_{MR} > 0$. Democrats and Republicans nominate candidates to compete in each election where the t^{th} election is represented as:

$$\sum(t) = \{D(t); R(t)\}, \text{ where } D(t) \in [-Z, 0] \text{ and } R(t) \in [0, Z]. \quad (1)$$

The limitations on party space ensure candidates cannot "leap-frog" each other such that the Republicans will not nominate a candidate further left than the Democrats and vice versa (Downs, 1957; Wittman, 1990; Owen and Grofman, 1996). Finally, denote the position of the general election winner as $\sigma(t)$.

Following Alesina, Fiorina and Rosenthal (1991) and Heckelman (2000), voters are assumed to equally balance the winner of the last senate election against the new candidates. This implies, as shown formally by Proposition 1 in Heckelman (2000),

$$\rho_i(t) = 2b_i - \sigma(t-1) \quad (2)$$

where $\rho_i(t)$ is the preferred position from voter i's perspective for the winning candidate to hold. Since the balancing electorate does not treat each election as independent of previous elections, their candidate preferences may deviate from an individual's bliss point.

2.1. *Convergence as a knife-edge result*

Consider the case of $\sigma(t) = 0$ that voters will balance against in the next election. The median voter is exactly represented by the current senator and wishes for the next senator to hold the same position in policy space. Voters in the primaries need to concern themselves with the median's desires. If primary voters are sincere and the medians in each primary are decisive, then from (2) they will nominate candidates such that $\sum(t+1) = \{\rho_{MD}(t+1); \rho_{MR}(t+1)\}$. For example, if voters are normally distributed and there is full participation in the party primaries then $\rho_{MD}(t+1) = -\rho_{MR}(t+1), 0 < \rho_{MR}(t+1) < \frac{1}{2}Z$. But strategic voters who are also concerned with the state median's desires will behave much differently. Ceteris paribus, slight movement toward the state median by either party will capture the median's vote and secure the election. Since the median wants someone to hold the position of her bliss point, and both parties will compete for the known median's vote,

this election will satisfy the requirements of the Median Voter Theorem and thus the only Nash Equilibrium is the outcome $\sum(t+1) = \{0, 0\}$. Regardless of which candidate the median selects, the new senator will hold position $\sigma(t+1) = 0$ and thus will be a clone of the other senator. Thus, all future elections will entail the same dynamics. Each election will entail full convergence to the state median, and each election winner will be a random toss-up between the two parties. In essence, the matching of the median's position by the sitting senator implies the median wants another senator that is the same as the first, and the "balancing" by the median is not observable, i.e., balancing is indistinguishable from an independent election effect.

However, the election dynamics will fundamentally change by any slight perturbation to the sitting senator's position. Without loss of generality, suppose instead $\sigma(t) = \delta > 0$. For the next election, substitution in (2) reveals $\rho_{MV}(t+1) = -\delta$, i.e. given the conservative nature of the sitting Republican, the balancing median voter wants an equally liberal candidate to counterbalance.[2] To maximize their electoral prospects, parties will still compete for the median's vote. But in this case, since Republicans are restricted in policy space to not be able to cross the median position, the best the Republican party can offer is $R(t+1) = 0$. This candidate is $|-\delta - 0| = \delta$ away from the median's preferred choice and would lead to a senatorial balance of $\frac{1}{2}\delta$. In response, balancing Democrats need only offer a candidate $\delta - \varepsilon$ away from the median's preference, where ε is a small positive number.

Thus, strategic Democrats, who want a more liberal senator than the median but still recognize the need to capture the median's vote, will nominate $D(t+1) = -2\delta + \varepsilon$ resulting in a balance of $\frac{1}{2}(-2\delta + \varepsilon + \delta) = -\frac{1}{2}\delta + \varepsilon$. As this balance is slightly closer to the median's bliss point, the median will prefer this option.

These results can be generalized as follows:

Proposition 1: Under the assumptions of a balancing electorate and strategic primary voters,

$$\begin{aligned}
&\text{A}: \text{ If } \sigma(t) = 0, \text{ then } \sum(t+f) = \{0, 0\} \text{ and } \sigma(t+f) = 0, \text{ for all } f > 0.\\
&\text{B}: \text{ If } \sigma(t) = \delta > 0\ (< 0), \text{ then } \exists \varepsilon > 0 \text{ such that}\\
&\sum(t+f) = \begin{cases} \{\text{MIN}\{-2^f\delta + \varepsilon, -Z\}; 0\}, & \text{for all f odd (even)},\\ \{0; \text{MIN}\{Z, 2^f\delta - \varepsilon\}\}, & \text{for all f even (odd)} \end{cases}\\
&\text{and } \sigma(t+f) = \begin{cases} \text{MIN}\{-2^f\delta + \varepsilon, -Z\} \text{ for all f odd (even)},\\ \text{MIN}\{Z, 2^f\delta - \varepsilon\} \text{ for all f even (odd)}. \end{cases}
\end{aligned}$$

Proof:
A: As outlined above, the median voter prefers a candidate identical to her bliss point over all other potential candidate options. The median voter theorem result then follows directly from Downs (1957) in this case, leading to full convergence to the median position. Any movement away from the median will, ceteris paribus, cost that candidate the election. Since the winning senator holds the same position as the other senator, each election will repeat the same outcome.
B: The primary voters need only nominate someone close enough to the median to capture her vote and still win the general election. By manipulation of (2), the Nash Equilibrium in unconstrained space will lead to convergence to $-\delta$. But the Republicans are constrained to only nonnegative positions by the limits established in (1) and cannot move further left than the median, so the vote maximizing position for the general election leads to $R(t+1) = 0$. To entice the median, then, the Democrats need a candidate at least as close to the median as $D(t+1) = -2\delta$ by the symmetry condition on preferences imposed in assumption (e). Any position further right will capture her vote with certainty, so $D(t+1) = -2\delta + \varepsilon$, who wins the election since this balanced outcome is $-\frac{1}{2}\delta + \frac{1}{2}\varepsilon$, just slightly closer to the median's bliss point than the Republican can offer.

In the next election, voters balance against $\sigma(t+1) = -2\delta + \varepsilon$. Now from (2) the median prefers $2\delta - \varepsilon$, and repeating the same analysis reveals $\sum(t+2) = \{0, 4\delta - \varepsilon\}$, and the Republican wins. Thus $\sigma(t+2)$ is twice as far away from the median as $\sigma(t+1)$, and four times as far away from the median as $\sigma(t)$. The next election leads to $\sum(t+3) = \{-8\delta + \varepsilon, 0\}$, and $\sigma(t+3) = -8\delta + \varepsilon$. The pattern is distinct. Each election leads to a doubling of the previous divergence. Since $2^f\delta > Z$ for large enough f, candidates are constrained to positions no further away from the median than $\text{MIN}\{Z, 2^f\delta\}$.

The case of $\sigma(t) < 0$ follows directly starting from $\sigma(t+1)$ above.QED.

Thus, if the median position is currently held by a sitting senator full convergence should follow in all future elections. But a non-median senator will lead to further deviation in the future. These deviations will continue to increase in each election with opposite party candidates winning. This result supports the conjecture of Alesina, Fiorina and Rosenthal (1991) for increased divergence in Senate representation over time.

Therefore, there are two dramatically opposing long-run possibilities as delineated in the next proposition.

Proposition 2: The long-run equilibrium will entail either full convergence or full divergence in the senate.

Proof: Given a median position by the current senator, all future winners will also hold the median position as shown in Proposition 1. If a senator ever does not hold the median position, then Proposition 1 shows future winners will be increasing in distance away from the median. Eventually the endpoint will be met by one of the winners and in the next election the median prefers an opposite endpoint candidate to balance. Without loss of generality, suppose $\sigma(t + g) = Z$. From proposition 1, $\sum(t + g + 1) = \{-Z, 0\}$ and $\sigma(t + g + 1) = -Z$. For the next election, $\sum(t + g + 2) = \{0, Z\}$ and $\sigma(t + g + 2) = Z$ and all future elections entail this oscillating outcome. Therefore, both senators in the state hold fully divergent positions. QED

The long-run equilibrium can thus be one of either full convergence in the senate or full divergence. The former is unstable. Any slight deviation from the median position will cause the analysis in Proposition 1 to move from case A to case B, and therefore will eventually result in the long-run equilibrium of full divergence. This result is stable. Slight deviation toward the median will lead back to full divergence over time.

The stable long-run result of full divergence is the same as found by Heckelman (2000) for the case of sincere voting. Each election has a median candidate *losing* to the endpoint candidate, and the winning endpoint candidates are of opposite party in successive elections. Thus, the distinction between sincere and strategic voting does not alter the conclusions regarding the stable long-run equilibrium. The only difference is the speed of attaining the long-run outcome. Under sincere voting, it is immediate (Heckelman, 2000). Under strategic voting, it takes longer. At any given point in time, some degree of senate divergence is predicted but full divergence may not yet be achieved.

The comparison between sincere and strategic voting leads directly to the final prediction of the model.

Proposition 3: If $|b_{MD}, b_{MR}| < \frac{1}{2}Z$ there is no strategic voting in the "stable" long-run equilibrium.

Proof: Recall that the long-run equilibrium of case A involving median senators being elected is unstable in the sense that if for any reason a non-median senator takes office (either due to non-elected appointment or a one-time voting error) the model immediately takes on the form of case B. The long-run equilibrium of case B is stable in that one-time replacements of non-endpoint senators will lead back to only endpoint senators in the long-run.

When voters seek to balance against an endpoint senator, the preferences of the median voter coincide with that of the opposite party voters in preferring an opposite endpoint senator from substitution in (2) and obeying the endpoint constraints for viable candidates. Thus they can vote sincerely in their primary and still win the general election. Also from (2), the median voter of the existing senator's party will prefer a balancing senator who is on the opposite side of the median since $0 < b_{MR} < \frac{1}{2}Z$ and $0 > b_{MD} > -\frac{1}{2}Z$ but party policy space restrictions in (1) limit them to the median position. Thus for example given $\sigma(t) = Z$, future election outcomes take the form of

$$\sum(t+f = \begin{cases} \{-Z; 0\} \text{ for all f odd , and } \sigma(t+f) = \\ \{0; Z\}, \text{ for all f even,} \end{cases} \begin{cases} -Z \text{ for all f odd,} \\ Z \text{ for all f even} \end{cases}$$

under both sincere and strategic voting. QED

The constraints on party median positions in Proposition 3 does not alter the election winners. Under both sincere and strategic primary voting, opposite endpoint candidates will win successive elections regardless of who the other party nominates. But if the party median of the sitting senator's party is closer to the endpoint than the state median, then the sincere preference would have been to nominate a non-median on the party's side. Strategically, a candidate closer to the median's preference is nominated. In either case, this candidate will lose the general election to the endpoint candidate nominated by the other party.

2.2. *Discussing the critical assumptions*

The model considers the case of a senate-balancing electorate in the fashion of Alesina, Fiorina and Rosenthal (1991) and Heckelman (2000). If the electorate does not balance the two senators, and each senate election is considered in isolation, then full convergence is to be expected in this perfect information model (Heckelman 2000). Strategic primary voters looking to capture the median voter in the general election will still need to nominate candidates at the median position. Thus primaries will not have any effect as long as the median position is known. Others have therefore considered imperfect information primary models (Aranson and Ordeshook, 1972; Owen and Grofman, 1996) but it is shown here that primaries will generate divergence even under perfect information if the electorate is balancing senators with overlapping terms.

Although voters are not viewing the senate elections in isolation from each other, they are only considering the past winner to properly balance. This might not be perfectly rational for the median voter. In each election, she is offered someone at her bliss point, but votes for the other candidate if the previous winner does not hold the median position in order to create

a better balance. But this new balance is typically not ideal from her perspective. From proposition 1, the two senators will not balance each other completely until the long-run equilibrium is reached. If the median voter is not short-sighted in looking to achieve the best possible *current* balance, then by choosing the median-position candidate she can ensure future elections will result in full convergence to her bliss point. The down-side is a current balance that is worse than choosing the non-median candidate, which lasts only for the remainder of the previous senator's term. Thus a fairly high discount rate is required to make the non-median candidate the optimal choice for the median voter.

Finally, the main factor driving the results is the presence of primaries, and the restriction that the two candidates cannot cross each other in policy space. Although intuitively appealing, and the standard assumption in the primary elections literature, this restriction in essence hurts the parties' electoral chances. Without primaries and no restriction in policy space, there will always be full convergence to whatever is the median voters' preference. If there is a non-median senator (again suppose $\sigma(\mathrm{t}) = \delta > 0$) she seeks to balance against, then the general election will entail complete convergence of both candidates to the position equidistant from the median position (compared to the current senator) on the opposite side of the median creating a perfect balance for the median voter. Thus, every election will be a toss-up, but successive winners will alternate as $\sigma(\mathrm{t+f}) = -1^{\mathrm{f}}\delta$. Following this logic, the presence of primaries, while hurting each party alternately in successive elections, does ensure that each party will be represented in the senate. As in Ingberman and Villani (1993), primaries are beneficial to the parties if they are risk averse.

3. Empirical evidence

The presence of primaries in the senate model prevents full convergence in the general election (if there is not already an exact median currently in the senate) and allows one party to nominate a candidate further away from the median who will still win the election. This consequently leads to greater divergence among the two elected senators from each state. Without primaries, candidates converge to a position which just balances the returning senator on the opposite side of the median and less divergence among the two sitting senators is expected. Also, under the full convergence outcome the election is a toss-up between the Democratic and Republican candidates in each election, whereas the primary model predicts opposite parties to win in successive elections, consistent with the evidence in Schmidt, Kenny and Morton (1996).

Thus, two testable implications arise from the model which turn on the relationship between primaries and divergence. This is the main difference between the model presented here and the model by Alesina, Fiorina and Rosenthal (1991). Their empirical support is limited to showing voters do balance the senate positions, which is also consistent with the senate model derived above.

To further distinguish the model here from Alesina, Fiorina and Rosenthal (1991), I will now present evidence that primaries contribute to senate divergence. As presented in Table 1, Bibby (1992) classifies state primary systems as:[3]

- closed – party registration is required prior to election
- semiclosed – party registration is required on or before election day
- semiopen – public request required for party ballot
- open – voters choose party ballot in private
- blanket – voters can switch between primaries for different offices
- "nonpartisan" – all candidates, regardless of party, listed on single ballot

It would be ideal to compare those states with primaries against those without, but only Louisiana has the "nonpartisan" system where all candidates, regardless or party affiliation, are grouped together. Instead, the more liberal definition of designating primaries by party registration requirements is adopted. Under the most stringent condition, 17 states are classified as closed primary states, whereas a more relaxed definition which allows party registration to be created or altered on election day adds 10 additional states to the list thus breaking the nation into two roughly equal divisions; 27 of the 50 states are designated to have closed or semiclosed primary systems.[4] As Keefe (1991) notes, allowing same day party registration and changes makes the system basically open. It does, however, erect a slight additional barrier to voting in a particular primary if not previously registered for that party. Thus it is possible to still expect slightly greater divergence in semiclosed states compared to open systems, but the effects should certainly be smaller than in purely closed states.

Senate divergence is measured two ways. First, split states are defined to be those where a state has senators from both parties in office at the same time.[5] This treats all senators from each party as identical, when there may be strong voting divergence between members of the same party or little true divergence between a moderate Republican and a moderate Democrat serving the same state. Second, the ideological positions of the two senators are contrasted by finding the difference between their individual American Conservative Union (ACU) scores.

The ACU ranks each senator based on how often they vote in favor of the ACU's position. The scores range from 0–100, where higher numbers

Table 1. Primary system classifications

	CLOSED	SEMICLOSED	SEMIOPEN	OPEN	BLANKET	NONPARTISAN
	AZ	CO	AL	HA	AK	LA
	CA	IA	AR	ID	WA	
	DE	KS	GA	MI		
	FL	MA	IL	MN		
	KY	ME	IN	MT		
	MD	NH	MO	ND		
	NC	NJ	MS	SC		
	NE	OH	TN	UT		
	NM	RI	TX	VT		
	NV	WY	VA	WI		
	NY					
	OK					
	OR					
	PA					
	SD					
	WV					
n	17	10	10	10	2	1

represent more conservative positions. The ACU scores are very similar in concept to the more typically used Americans for Democratic Action (ADA) scores where higher scores indicate more liberal positions. The ADA, however, treats nonvoting or absences the same as a vote against their position, whereas the ACU only considers actual Yea/Nay votes and treats absences as neutral. This represents a distinct disadvantage to using ADA scores since dead-pair voting by senators is counted as if each had voted against the ADA when in fact one of the two would have voted in favor of their position. In addition, extended absences, such as Senator Joseph Biden's presidential campaigning in 1988, makes a liberal politician appear to be suddenly voting conservatively. The problem can be easily overcome by adjusting the reported ADA scores for absences (Jung, Kenny and Lott, 1994). However, Poole and Rosenthal (1997) report on the likelihood for interest-group ratings to suffer from "folding".[6] Of all the interest-group ratings they considered, only the ACU scores did not contain such a bias.

One remaining problem with using interest-group ratings is the divergence in voting will be underreported. For example, two senators each taking the ACU's position on half of the issues would each receive a score of 50 and

have a difference of 0, implying that they were identical in their voting, when they may have voted opposite on every issue. The calculated ACU differences therefore represent a lower bound estimate on divergence.[7]

Higgs (1989) interprets any voting differences among a state's two senators as prima facie evidence that one of them, by definition, must be voting against constituency interests since both senators represent the same constituency. 'When a state's two senators vote differently, one of them is *necessarily* voting against constituency preference; *one or both* are ideologically driven' (p. 77, italics in original). Thus, (at least) one of the senators is indulging their personal interest at the expense of the constituents' interest, which is commonly referred to as 'shirking'.

Grier and Goff (1993) note that in a multi-dimensional issue space, there will typically not exist a unique median in every dimension. Rather, there will be multiple positions that are strictly undominated ('the uncovered set') and thus two senators can get elected even when choosing different positions in the uncovered set, and thus they actually represent different constituencies in the sense of those who actually voted in support of each senator. As such, there is a distinction between constituency as the state electorate which is the same for both senators, and constituency as the supporters which may differ for the two senators. Based on this, Grier and Goff argue directly against Higgs' interpretation: 'The implication of this reasoning is that shirking cannot be measured by comparing intra-state differences in senator behavior' (p.8). The balancing model developed here supports the concerns of Grier and Goff, but also shows how even in a single-dimensional issue space, where a unique winning median voter position does exist in any given election, two senators purported to represent identical electorates can actually be representing a different base of supporters since the median voter's preferences change across elections. Thus, the intra-state interest group rating differential used here is not intended to capturing shirking behavior.

The data set used here covers nine Congressional sessions during the years 1981–1998.[8] Almost half of the states (44%) during this time were split between the two parties and the average ideological spread between a state's two senators was 29.05 on the 100 point scale, with a standard deviation of 27.03. The two measures of split-state status and ideological divergence are not surprisingly highly correlated.[9] For the entire sample, the correlation between the average ACU difference and split-state designation is .75. Split states have on average an ACU difference for their two senators of more than three and a half times the difference for single party states. A strong relationship was also found by Dougan and Munger (1989) for the period of 1963–84 using unadjusted ADA scores.

Probit estimates of the bivariate regressions testing the hypothesis that closed primary states have a greater probability of being a split state are presented in the top half of Table 2.[10] The coefficients are statistically significant for both definitions of closed primaries. Non-closed primaries have a 39% probability of leading to split senate representation, whereas closed states are 16 percentage points greater, at 55%. Grouping the closed and semiclosed primary states together reduces the difference to 10 percentage points, or a 49% probability of creating a split delegation. Ordinary Least Squares estimates for ACU Difference in the bottom half of Table 2 reveal that the degree of divergence is also affected by the type of primary. Ideological differences between the two senators are 9 points (35%) higher on average when they come from a state with a closed primary system, or 8 points (34%) higher on average when they come from a state with either a closed or semiclosed primary system.

Next we consider the stability of the results over time. The model predicts ideological divergence to grow over time until maximal divergence is achieved. Since senators serve staggered six-year terms, each six year period represents two elections and an opportunity for voters to reelect or replace either or both senators. A trend term is created increasing linearly in value from 0 to 2 for each six year period to capture changes in the propensity for states to have divergent representation in the open primary states, and an interactive term captures changes over time for the closed (or semiclosed) primary states. In these regressions, reported in the last two columns of Table 2, the intercept term can be interpreted as the average propensity for a non-closed state to be split, or the average ideological difference among the state's two senators, during the first six-year period, that is from 1981–1986. The averages for 1987–1992 are found by adding the estimated coefficient on the trend term to the intercept, and finally the averages for 1993–1998 are found by adding twice the estimated coefficient on the trend term to the intercept. Similarly, averages for closed (or semiclosed) states is found for the first period by adding the estimated coefficient on the primary dummy variable to the intercept term, for the second period by adding all the estimated coefficients, and finally for the last period by adding twice the estimated coefficients on the trend and interaction terms to the intercept and primary coefficient.

The propensity for a state to have two senators of differing party affiliation does not change by statistically significant amounts over the sample period. The trend terms are not statistically significant either individually or jointly, suggesting the stationary regressions without the trend terms are more appropriate. Even with the trend terms included, purely closed primary states still retain a higher propensity to be a split state. Including the semiclosed states

Table 2. Effect of primary system on Senate divergence

	Primary = 1 if closed	Primary = 1 if closed or semiclosed	Primary = 1 if closed	Primary = 1 if closed or semiclosed
SPLIT STATE				
Intercept	–0.287**	–0.276**	–0.182	–0.127
	(0.074)	(0.088)	(.0116)	(0.138)
Primary	0.410**	0.240**	0.480**	0.200
	(0.126)	(0.119)	(0.199)	(0.188)
Trend			–0.105	–0.150
			(0.090)	(0.108)
Trend X Primary			–0.068	0.042
			(0.154)	(0.146)
Joint test for null hypothesis that coefficients on:				
Trend = 0			3.28	3.14
Primary = 0			10.88**	4.13
Pseudo R^2	.017	.007	.022	.011
ACU DIFFERENCE				
Intercept	25.94**	24.53**	21.91**	19.73**
	(1.55)	(1.86)	(2.43)	(2.91)
Primary	9.15**	8.37**	6.77*	8.31**
	(2.66)	(2.53)	(4.16)	(3.97)
Trend			4.03**	4.81**
			(1.88)	(2.26)
Trend X Primary			2.38	0.056
			(3.22)	(3.07)
Joint test for null hypothesis that coefficients on:				
Trend = 0			5.29**	5.00**
Primary = 0			6.31**	5.57**
R^2	.026	.024	.048	.045

Notes: Split state regressions computed by probit analysis. ACU difference regressions computed by ordinary least squares analysis. Standard errors reported in parenthesis below coefficient estimates.
*significant at 10%; **significant at 5%

Table 3. Estimated ideological divergence for a state's two senators, by primary system type

	1981–1986	1987–1992	1993–1998
Closed	28.68	35.09	41.50
Other	21.91	25.94	29.97
difference	6.77	9.15	11.53
% difference	30.9	35.3	38.5
% change in difference compared to 1981–1986	–	35.1	70.3
Closed or semi-closed	28.04	32.91	37.77
Other	19.73	24.54	29.35
difference	8.31	8.37	8.42
% difference	42.1	34.1	28.7

Notes. Estimated from the last two columns in Table 2.

suggests these states are no different from the open and semiopen states, as none of the variables are individually significant, nor are the trend terms or primary terms even jointly significant.[11]

Ideological divergence between the two senators does change over time for all states, and even more so among the closed primary states; although the additional effect is not statistically significant it is quantitatively important, growing by an additional 35% relative to the other states in each subsequent interval. These effects are summarized in the upper portion of Table 3. As expected, including the semiclosed states with the closed states reduces the average ideological spread for both groupings, and the degree of divergence remains statistically significantly different across the groups. The trend effect in estimated ideological divergence is slightly larger for the typical state, with no discernible increase for the closed/semiclosed group beyond the general increase for all states. As shown in the lower portion of Table 3, senators in the closed/semiclosed states retain 8.3–8.4 percentage points greater ideological differences compared to the other open primary states in each subperiod.

4. Conclusions

A model is presented which suggests split senate delegations are caused by two institutional arraignments: a two-stage electoral process where candidates must first win party nomination and the staggered terms of the two senators. Given the known ideological position of one existing senator, voters

are assumed to attempt to balance with the new senator. The model adds to the literature by introducing strategic voting in the primaries within the context of candidate balancing. Empirical evidence supports the notion that split senate delegations, evidenced by dual party representation and interest-group rating divergence, is significantly correlated with the state primary system.

Previous studies have considered in isolation the importance of strategic voting in primary elections (Aranson and Ordeshook, 1972; Owen and Grofman, 1996) or conscious voter balancing within the senate (Alesina, Fiorina and Rosenthal, 1991; Heckelman, 2000). With the exception of Heckelman (2000), only a single election is considered. Here, the importance of combining these results, and tracing the effects over time, yield new insights into senate elections.

Much of the attention on divided governments has focused on balancing across branches of government (Wittman, 1990; Fiorina, 1992; Alesina and Rosenthal, 1995). The results obtained here suggest it would be interesting to extend the other types of policy balancing models to also incorporate the importance of primary elections.

Notes

1. Brunell and Grofman also show that split senates occurred prior to the 17th Amendment but the analysis concerning senate appointments differs from any theory of mass electorate voting.
2. The restriction on party positions in (1) requires any candidate to the right of the state median to be a Republican.
3. Examining various editions of Bibby's book, and earlier volumes of *The Book of the States* suggests the states did not change their primary system during the sample time period of 1981–1998.
4. Keefe's (1991) listing of closed primary states coincides with Bibby's (1992) combined group of closed and semi-closed, except for the exclusion of Rhode Island. According to *The Book of the States*, however, party registration is required in this state so Bibby's listing is used.
5. Harry Byrd Jr. (VA-I), is classified as a Democrat (his former party) as he often referred to himself as an Independent Democrat. Richard Shelby (AL) and Ben Nighthorse Campbell (CO) switched from Democrat to Republican in 1994 and 1995 respectively but both are coded as Democrats until the next senate election in 1996, which would be the first time after the switch the voters had the opportunity to actively decide if the state should be split or not.
6. If an interest group's ideological position in policy space is not at or beyond the position of the most extreme senator, then senators equidistant from the group in each direction will receive the same scores. Thus, estimated divergence among senators on opposite sides of the group's position will be underestimated relative to those on the same side.
7. This downward bias in estimated divergence holds for all interest groups ratings.

8. Each congressional session is treated as a single observation, yielding 450 total observations. Since the ACU rates each senator each year, individual senator scores are averaged across the two years of each session before divergence is calculated.
9. The bivariate relationship is found to be (standard errors in parenthesis):
   ACU DIFF = 11.09 + 40.62 SPLIT
   (1.14) (1.71)
   R^2 = .56, no. of observations = 450.
10. Certainly there are other socio-economic factors which also contribute to senate divergence (Jung, Kenny and Lott, 1994) but as long as these are not correlated with the state primary system the estimated bivariate relationships will be unbiased.
11. These results are mainly an artifact of the nuisance parameters from the trend terms. Note that by the second subperiod, the differences between the groups are the same as found in the stationary effect column without the trend terms, and in the third subperiod the differences are even larger. Nonsignificance is due to the inflated standard errors associated with having to estimate coefficients for additional nuisance parameters.

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