Why Do Incumbent Senators Win? Evidence from a Dynamic Selection Model

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Paper and slides available from http://www.econ.umn.edu/ amoro/

Question

- Politicians in office win elections more often than their challengers. For example, incumbent senators win more than 75% of the time. Why?
- We empirically disentangle different sources of incumbency advantage:
  - incumbents improve while in office: tenure effects
  - incumbents are by definition winners: selection effect
  - incumbents face weaker challengers: candidate heterogeneity

Previously...

- A vast reduced-form literature
- Focus on House incumbency advantage ($\sim$90%)
- Deals with selection bias in different ways
  - Sophomore surge (Erikson, 1971, Gelman and King, 1990)
  - Levitt and Wolfram, 1997
- Diermeier, Keane and Merlo (2003) - Samuelson (1987)

Our approach

- Estimate parameters of an optimizing dynamic model of voter behavior
- The entire history of a seat matters, not just data on current election
- We allow for tenure effects to be different by tenure, and estimate them separately from selection and the ability of incumbents to scare off weaker challengers

Quick intuition (more details later)

Senators A , B , with tenure of 1 term (i.e. same "tenure effects")

A gained office by winning an open seat

B beat a 1 term incumbent

If selection did not matter, these two incumbents would be indistinguishable to the econometrician (same probability of being reelected).

We can look at reelection probabilities of senators with identical tenure but different histories to provide clues about the imporance of selection.

The model

- Homogeneous voters value elected senators' quality. Utility flow:

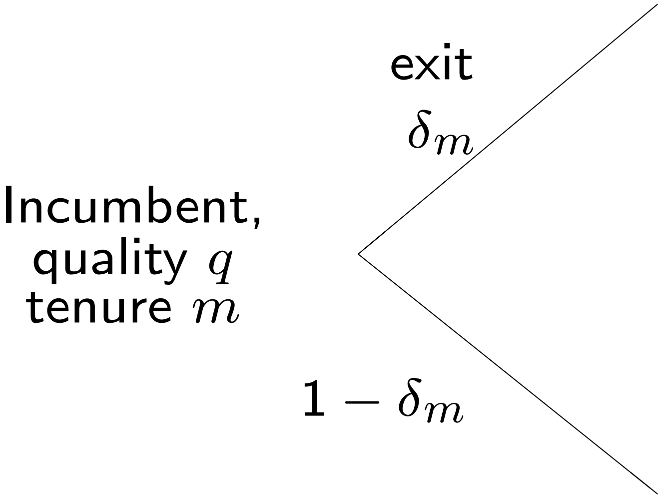
$$u(q, m) = q + \tau_m$$

- Candidates draw permanent quality $q \sim F$

  (F identical for all candidates for now)

- Tenure specific effects τ_m , $m =$ number of terms in office
- Voter observes q and τ_m (econometrician: not)
- Incumbents exit with exogenous probability δ_m

Timeline



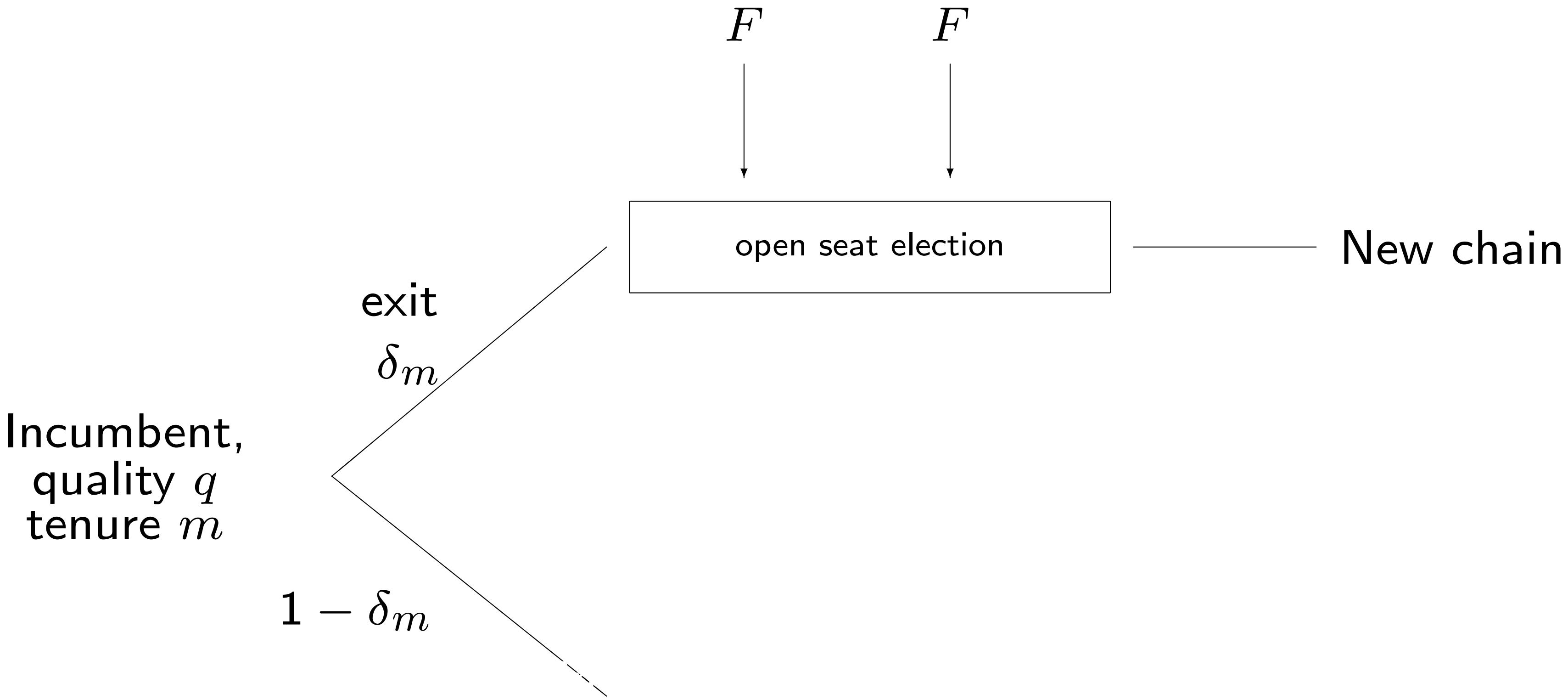
exit

δ_m

Incumbent,
quality q
tenure m

$1 - \delta_m$

Timeline



F F

open seat election

New chain

exit

δ_m

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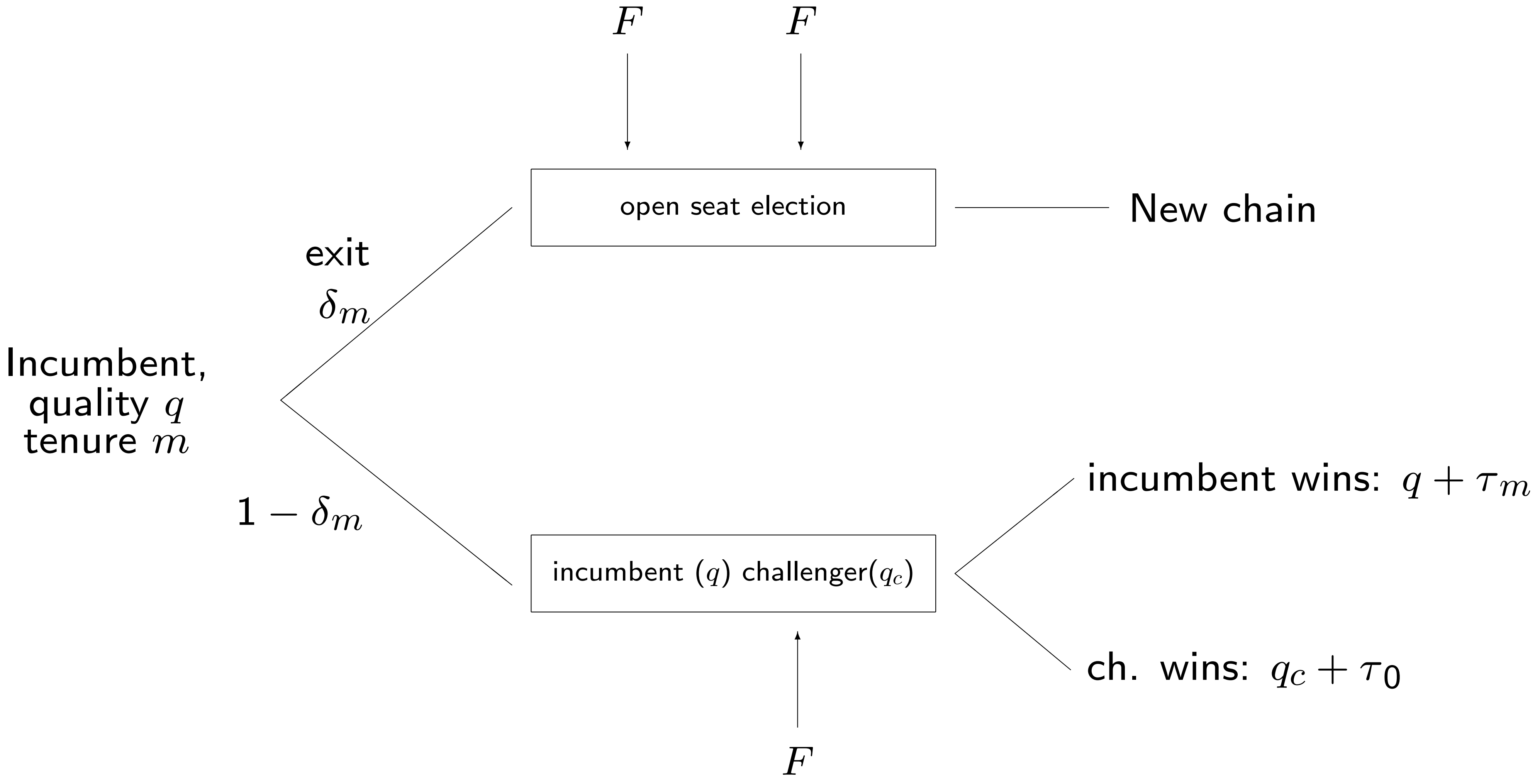


F F

open seat election

New chain

exit

δ_m

Incumbent,
quality q
tenure m

$1 - \delta_m$

incumbent (q) challenger(q_c)

incumbent wins: $q + \tau_m$

ch. wins: $q_c + \tau_0$

F

The dynamic problem

Bellman Equation: value of incumbent with quality q and tenure m :

$$V(q,m) = \delta_m W + (1-\delta_m) \int_Q \max \left\{ \begin{array}{c} \text{incumbent wins} \\ \uparrow \\ q + \tau_m + \beta V(q, m+1), \\ \\ q_c + \tau_0 + \beta V(q_c, 1) \\ \downarrow \\ \text{incumbent loses} \end{array} \right\} f(q_c) dq_c$$

W : Value of open seat

The dynamic problem

Bellman Equation: value of incumbent with quality q and tenure m :

$$V(q,m) = \delta_m W + (1-\delta_m) \int_Q \max \left\{ \begin{array}{c} \overset{\substack{\text{incumbent wins} \\ \uparrow}}{q + \tau_m + \beta V(q, m+1)}, \\ \\ \underset{\substack{\downarrow \\ \text{incumbent loses}}}{q_c + \tau_0 + \beta V(q_c, 1)} \end{array} \right\} f(q_c) dq_c$$

W : Value of open seat

$$W = \int_Q \int_Q \max \left\{ \begin{array}{c} q + \tau_0 + \beta V(q,1), \\ \\ q_c + \tau_0 + \beta V(q_c, 1) \end{array} \right\} f(q) dq f(q_c) dq_c.$$

The simplified problem

Denote decision rule $\bar{q}(q,m)$, (cutoff challenger quality)

$$V(q,m) = \delta_m \int_Q V(x,0) df(x) dx$$

$$+(1-\delta_m)\max_{\bar{q}} \left(\begin{array}{c} \text{incumbent wins} \\ \uparrow \\ F(\bar{q})\left(q+\tau_m+\beta V(q,m+1)\right) \\ \\ +\int_{\bar{q}}^{\infty}\left(q_c+\tau_0+\beta V(q_c,1)\right) df(q_c) dq_c \\ \downarrow \\ \text{incumbent loses} \end{array} \right)$$

$V(x,0) =$ value of entering an open seat election with one candidate of quality x (define using $\delta_0 = 0$)

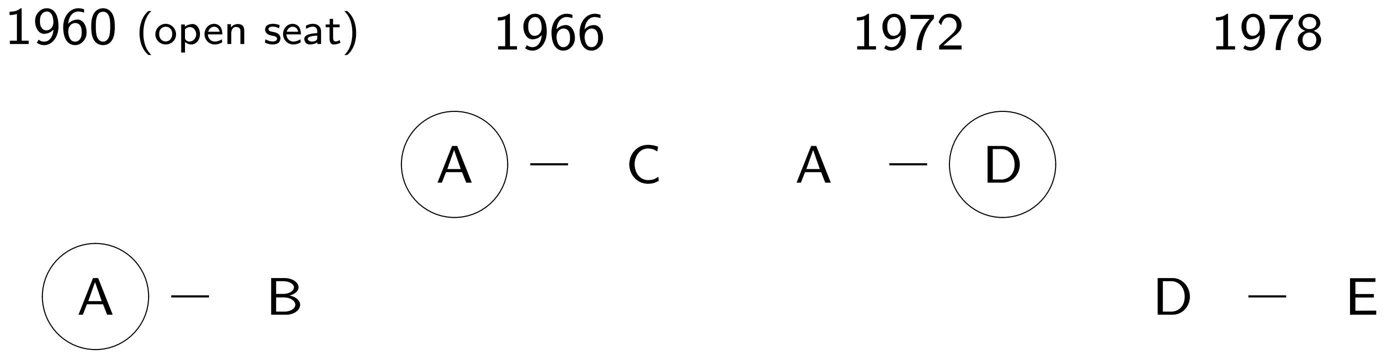
Allowing for different distribution of challengers

$F_m = F_o$ if $m = 0$,
$F_m = F_c$ if $m > 0$

$$
\begin{aligned}
V(q,m) &= \delta_m \int_Q V(x,0) df_o(x) dx + \\
&\quad +(1-\delta_m) \max_{\bar{q}} \left(\begin{array}{c} \text{incumbent wins} \\ \uparrow \\ F_m(\bar{q})\left(q+\tau_m+\beta V(q,m+1)\right) \\ \\ +\int_{\bar{q}}^{\infty}\left(x+\tau_0+\beta V(x,1)\right) df_m(x)dx \\ \downarrow \\ \text{incumbent loses} \end{array} \right)
\end{aligned}
$$

Intuition Revisited: history matters

Two histories $\delta_m = \delta$



1960 (open seat) 1966 1972 1978

A — C A — D

A — B D — E

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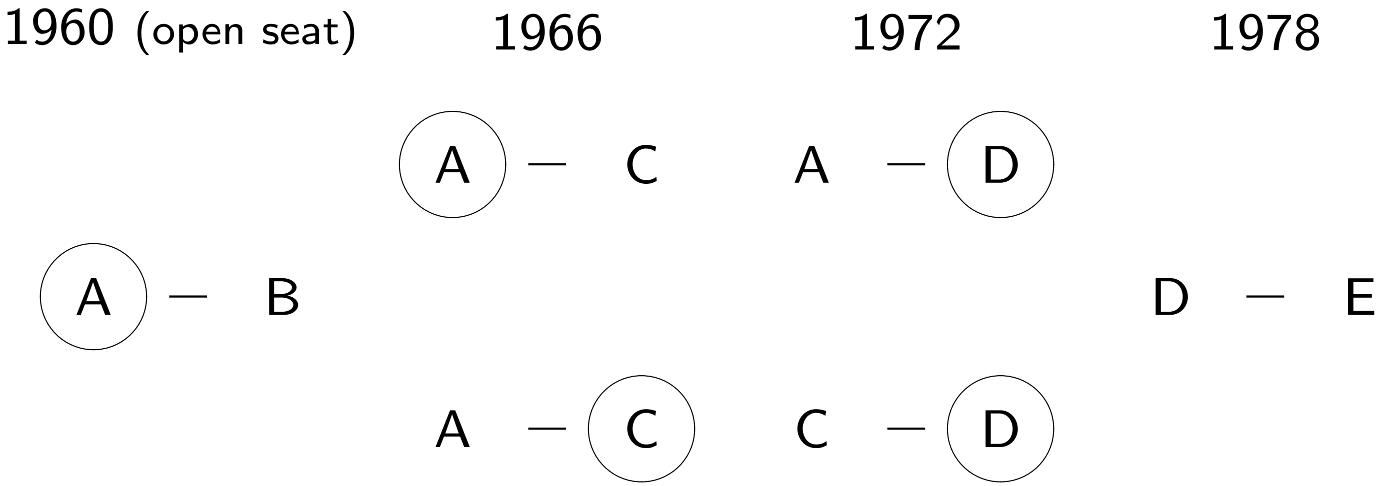
Two histories $\delta_m = \delta$



1960 (open seat) 1966 1972 1978

Ⓐ — B

Ⓐ — C A — Ⓓ

A — Ⓒ C — Ⓓ

D — E

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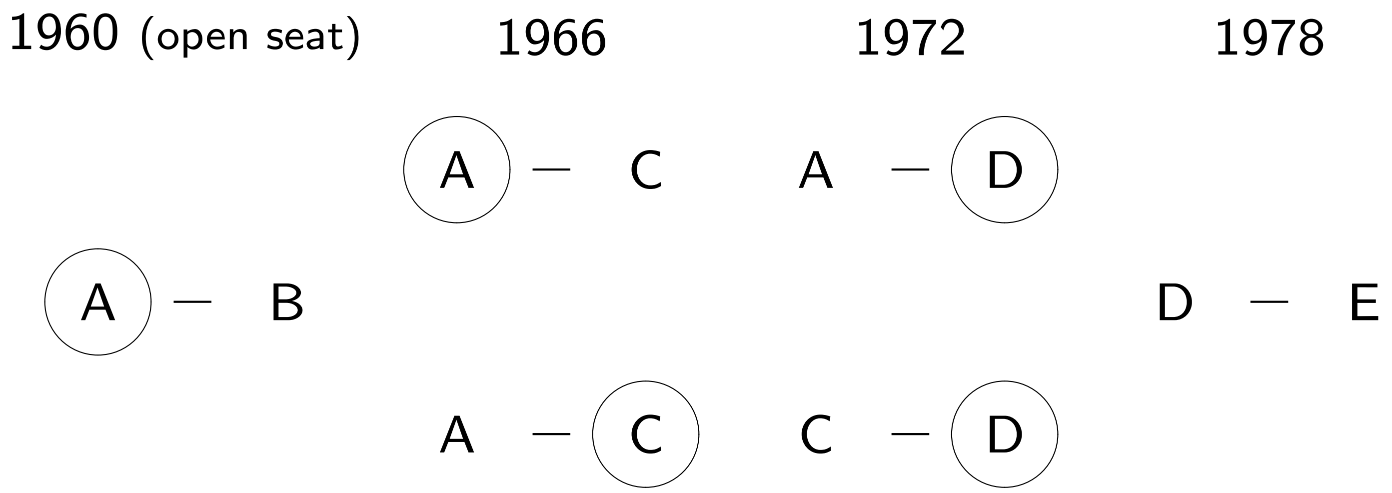
Two histories $\delta_m = \delta$



Hyp. 1: $\tau_m = \bar{\tau}$ (constant) : re-election depends on terms since open

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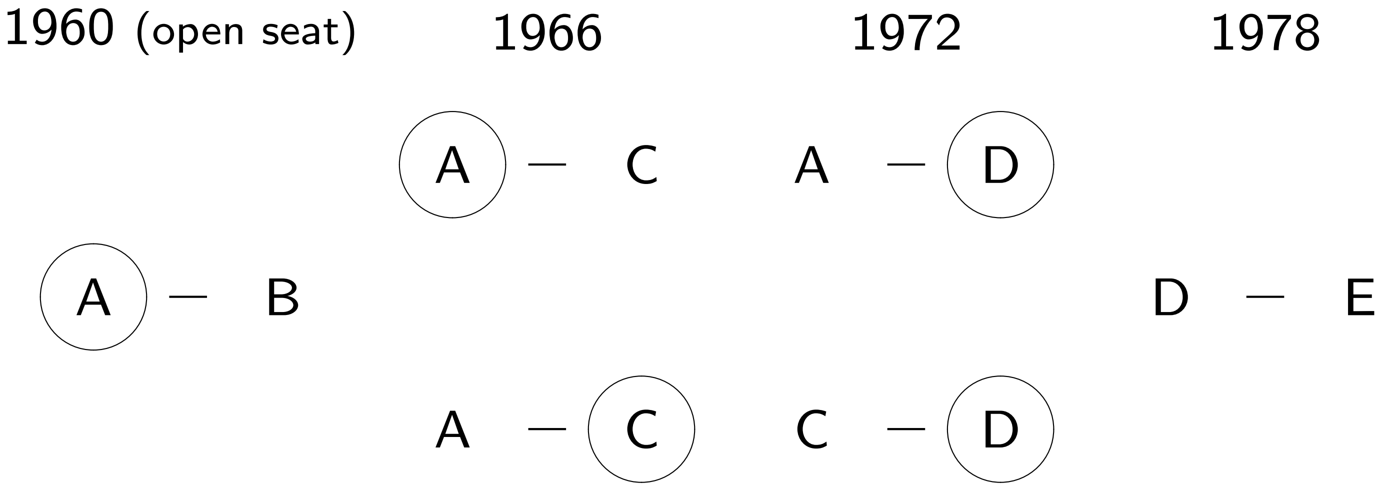

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Hyp. 1: $\tau_m = \bar{\tau}$ (constant): re-election depends on terms since open

Hyp. 2: τ_2 large, τ_1 small : re-election depends on tenure, history

Data

ICPSR: *Roster of congressional office holders*:
in each *congress* (a 2 year period) records who is holding a seat, their characteristics, why they entered, why they left

Chain: history of a seat between open seat elections

$$c = (c_1, c_2, ...c_I)$$

I : number of elections between open seats
$c_i = 1$ if incumbent wins
$c_i = 0$ if incumbent loses

Institutional Details

Senators elected every 6 years since 1914.

Elections take place in November of even numbered years, office is taken the following January.

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Reasons to leave:
(a) Lose a regular election/primary
(b) Retirement/death/change jobs

If (b) happens before the natural end of the term, a Senator is nominated by the state governor and an election is held the next November (called *Special Election* unless the seat would have been up for election at that time)

Assumptions

- Both special elections and regular elections count as one term
  — imperfect: time period between terms is not always 6 years
  — interpretation of τ: tenure effects depend on elections won, not years served

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- Senators appointed by governor that subsequently run are treated as challengers in an open seat election

- Treat election and primary as one election

Statistics

Use chains that started after 1914.

– 389 chains, 593 different senators, 1330 elections.

– 72 chains start with a special election

– Incumbents win 78% of the times.

– 21% of incumbent losses occur in primary

– Longest chain: 7 senators and 15 elections.

– Only 23 senators served more than 5 terms (we assume $\tau_m = \tau_5$ and $\delta_m = \delta_5$ for all $m \geq 5$).

Evidence from data

Terms since last open seat election

Terms of tenure	1	2	3	4	≥ 5
1	.79 (.02)				
2		.78 (.03)			
3			.81 (.04)		
4				.81 (.06)	
≥ 5	Re-election probabilities (std. dev.)				.89 (.05)

1) Constant diagonal: tenure effects are declining

Evidence from data

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Evidence from data

		Terms since last open seat election				
		1	2	3	4	≥ 5
Terms of tenure	1	.79 (.02)	.72 (.06)	.63 (.08)	.57 (.09)	.77 (.06)
	2		.78 (.03)	.76 (.09)	.86 (.08)	.91 (.05)
	3			.81 (.04)	1.00 (.00)	.79 (.07)
	4				.81 (.06)	.75 (.11)
	≥ 5	Re-election probabilities (std. dev.)				.89 (.05)

1) Constant diagonal: tenure effects are declining

2) Rows not increasing: $\tau_1 \leq 0$

3) Rows declining: challengers of incumbents are worse on average

Maximum Likelihood Estimation

Fundamental parameters

$$\Theta = \begin{cases} \text{candidate quality densities} & f_c \sim N(\mu_c, \sigma), f_o \sim N(\mu_o, \sigma) \\ \text{tenure effects} & \tau_m \\ \text{exit probabilites} & \delta_m \\ \text{discount factor} & \beta \end{cases}$$

Model 1: $\mu_c = \mu_o$
Model 2: $\mu_c \neq \mu_o$

– Only $\mu_c - \mu_o$ is identified in Model 2 (set $\mu_c = 0$)
– One of the tenure effects is not identified (set $\tau_0 = 0$)
– σ not identified (set $\sigma = 1$)

Estimation - Strategy

- For a given parameter vector, solve the dynamic programming problem to get $\bar{q}(q, m)$
- Generates a posterior distribution over incumbent quality, given election outcome, via Bayes' Rule
- Use this to get probability of a election outcomes given parameters
- Iterate over the parameter space to maximize log-likelihood

The likelihood function

Consider chain d of dimension T

$h_t \equiv \langle d_1, ...d_{t-1} \rangle$ is the history up to t^{th} election .

m_{h_t} is the number of terms served by the incumbent .

$$L(d|\Theta) = \prod_{t=1}^{T} \mathrm{Pr}\left(e_t = d_t | h_t; \Theta\right)$$

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$$L(d|\Theta) = \prod_{t=1}^{T} \Pr\left(e_t = d_t | h_t; \Theta\right)$$

Where the probability of election outcome $\Pr\left(e_t = d_t | h_t; \Theta\right) =$

$$\int \underset{\text{incumbent wins}}{\underset{\downarrow}{d_t \cdot F_c\left(\bar{q}(x, m_{h_t})\right)}} + (1 - d_t) \cdot \left[\underset{\text{incumbent loses}}{\underset{\downarrow}{1 - F_c\left(\bar{q}(x, m_{h_t})\right)}}\right] dg(x|h_t)dx$$

$g(\cdot|h_t)$ is the density over incumbent's quality

Likelihood: the density over the incumbent's quality

The quality distribution is updated using Bayes' Rule:

$$\overset{\text{Posterior density given } d_{t-1}}{\overset{\uparrow}{g(q|d_{t-1};h_{t-1})}} = \frac{\overset{\text{Prior density}}{\overset{\uparrow}{p(q|h_{t-1})}} \cdot \overset{\text{Probability of outcome } d_{t-1} \text{ given } q}{\overset{\uparrow}{\Pr\left(d_{t-1}|q;h_{t-1}\right)}}}{\underset{\text{Probability of election outcome } d_{t-1}}{\underset{\downarrow}{\Pr\left(d_{t-1}|h_{t-1}\right)}}}$$

more

Results - Probabilities of leaving office

We use $\beta = 0.96^6$ and consistently estimate the exit probabilities directly from data:

	N. obs.	Estimate
δ_1	593	0.1484 (0.015)
δ_2	358	0.2347 (0.022)
δ_3	199	0.2915 (0.032)
δ_4	100	0.3300 (0.047)
δ_5	90	0.3500 (0.050)

Results: tenure effects estimates

	Model 1 $(f_o = f_c)$	Model 2 $(f_o \neq f_c)$
$ln\ L$	-504.851	-486.751
τ_1	-0.013 (0.281)	-0.646 (0.200)
τ_2	0.116 (0.195)	-0.657 (0.211)
τ_3	0.181 (0.251)	-0.615 (0.259)
τ_4	-0.754 (0.581)	-1.495 (0.543)
τ_5	0.241 (0.516)	0.738 (0.523)
$\mu_o - \mu_c$	0	0.742 (0.093)

Small, statistically insignificant or negative tenure effects.

Goodness of fit: re-election probabilities

Tenure	Data	Model 1 $(f_o = f_c)$	Model 2 $(f_o \neq f_c)$
1 $(N = 474)$	.755 (.020)	-0.029	-0.003
2 $(N = 249)$	.799 (.025)	$+0.001$	$+0.006$
3 $(N = 122)$	.820 (.035)	-0.010	$+0.002$
4 $(N = 58)$	.793 (.053)	-0.042	-0.036
≥ 5 $(N = 38)$	.895 (.050)	$+0.021$	$+0.009$
All $(N = 941)$	.783 (0.013)	-0.008	$+0.007$

Model 2, forcing $f_o = f_c \Longrightarrow$ incumbents win 63% of the time
No quality differences: 50%.

Goodness of fit: Model 1

Re-election probabilities, models and data (std. dev. in parentheses):

Cannot generate decreasing probabilities in any row

		Terms since last open seat election				
		1	2	3	4	≥ 5
Terms of tenure	1	.66 .79 (.02)	.76 .72 (.06)	.81 .63 (.08)	.84 .57 (.09)	.86 .77 (.06)
	2		.75 .78 (.03)	.81 .76 (.09)	.86 .86 (.08)	.87 .91 (.05)
	3			.78 .81 (.04)	.81 1.00 (.00)	.86 .79 (.07)
	4	Model 1 Data (st. err.)			.71 .81 (.06)	.79 .75 (.11)
	≥ 5					.92 .89 (.05)

Goodness of fit: Model 2

Re-election probabilities, models and data (std. dev. in parentheses):

Can generate decreasing probabilities by row

	Terms since last open seat election				
Terms of tenure	1	2	3	4	≥ 5
1	.77 .79 (.02)	.71 .72 (.06)	.73 .63 (.08)	.74 .57 (.09)	.75 .77 (.06)
2		.82 .78 (.03)	.77 .76 (.09)	.80 .86 (.08)	.78 .91 (.05)
3			.84 .81 (.04)	.78 1.00 (.00)	.80 .79 (.07)
4	Model 2 Data (st. err.)			.78 .81 (.06)	.73 .75 (.11)
≥ 5					.90 .89 (.05)

Additional information: house experience

Re-election frequencies (senators who just won an open seat)	
House experience	81%
No house experience	78%

Additional information: party

Idea: voters have special preference for a party in some states / point in time

Open seat winning frequency	
Same party as previous sen.	39%

With a positive local preference for a party we would expect this to be $>$50%.

Unobserved heterogeneity

LogL -479.02327	Type 1	Type 2
τ_1	5.86	-0.90
τ_2	1.09	-0.67
τ_3	7.99	-0.89
τ_4	4.54	-1.88
τ_5	1.76	-0.86
$\mu_o - \mu_c$	-3.40	0.953
Type Probabilities		
Post 1945, South	0.024	
Post 1945, No south	0	
Pre 1945, South	0.166	
Pre 1945, No south	0.281	

(more)

Summary

- Selection has a strong effect on incumbency advantage in Senate elections
- No strong evidence that being in the senate gives candidates a special ability to win that they didn't have as challengers
- Challengers being of lower quality accounts for about 50% of the incumbency advantage

Summary

- Selection has a strong effect on incumbency advantage in Senate elections
- No strong evidence that being in the senate gives candidates a special ability to win that they didn't have as challengers
- Challengers being of lower quality accounts for about 50% of the incumbency advantage
- *Can compute the probability of senators winning based on seat history*

The End

Evidence from data

	Terms since last open seat election				
Terms of tenure	1	2	3	4	≥ 5
1	.79 (.02) $N = 308$	.72 (.06) $N = 50$	.63 (.08) $N = 41$	.57 (.09) $N = 28$	.77 (.06) $N = 47$
2		.78 (.03) $N = 170$	.76 (.09) $N = 25$	.86 (.08) $N = 21$	.91 (.05) $N = 33$
3			.81 (.04) $N = 79$	1.00 (.00) $N = 10$	.79 (.07) $N = 33$
4				.81 (.06) $N = 42$	.75 (.11) $N = 16$
≥ 5					.89 (.05) $N = 38$

Re-election probabilities (std. dev.)

next

Likelihood - the posterior density: 3 cases

$t = 1$
(open seat at $t-1$)

$$g\left(q|h_0\right) = \frac{f_o\left(q\right)\cdot F_o\left(\bar{q}(q,0)\right)}{\int_Q f_o\left(x\right)\cdot F_o\left(\bar{q}(x,0)\right)dx}.$$

$t > 1, d_{t-1} = 1$
(same incumbent)

$$g\left(q|h_t\right) = \frac{g\left(q|h_{t-1}\right)\cdot F_c\left(\bar{q}(q,m_{h_{t-1}})\right)}{\int_Q g\left(x|_{h_{t-1}}\right)\cdot F_c\left(\bar{q}(x,m_{h_{t-1}})\right)dx}$$

$t > 1, d_{t-1} = 0$
(new incumbent)

$$g\left(q|h_t\right) = \frac{f_c\left(q\right)\cdot \int\limits_{z:\bar{q}(z,m_{h_{t-1}})<q} g(z|h_{t-1})dz}{\int_Q f_c\left(x\right)\cdot \int\limits_{z:\bar{q}(z,m_{h_{t-1}})<x} g(z|h_{t-1})dzdx}$$

next

Unobserved heterogeneity (2)

$ln\ L = -483.698$	Type 1	Type 2
τ_1	8.00 (11.95)	-0.86 (0.21)
τ_2	3.44 (12.10)	-0.68 (0.34)
τ_3	8.00 (21.92)	-0.83 (0.39)
τ_4	8.00 (15.12)	-1.84 (0.51)
τ_5	3.62 (8.16)	-0.83 (0.50)
$\mu_o - \mu_c$	-3.55 (6.73)	0.901 (0.23)
Type prob.	0.091 (0.10)	

next

Goodness of fit (2)

Re-election probabilities, models and data, standard deviation in parentheses

Terms since last open seat election

Terms of tenure	1	2	3	4	≥ 5
1	.66 .77 .79 (.02)	.76 .71 .72 (.06)	.81 .73 .63 (.08)	.84 .74 .57 (.09)	.86 .75 .77 (.06)
2		.75 .82 .78 (.03)	.81 .77 .76 (.09)	.86 .80 .86 (.08)	.87 .78 .91 (.05)
3			.78 .84 .81 (.04)	.81 .78 1.00 (.00)	.86 .80 .79 (.07)
4	Model 1 Model 2 Data (st. err.)			.71 .78 .81 (.06)	.79 .73 .75 (.11)
≥ 5					.92 .90 .89 (.05)

next

Goodness of fit (differences)

Terms since last open seat election

Terms of tenure	1	2	3	4	≥ 5
1	(.02) −.13 −.03	(.06) +.04 −.01	(.08) +.18 +.09	(.09) +.26 +.17	(.06) +.09 −.02
2		(.03) −.03 +.05	(.09) +.05 +.01	(.08) +.01 −.06	(.05) −.04 −.13
3			(.04) −.03 +.03	(.00) −.19 −.22	(.07) +.07 +.01
4		Model 1 Model 2		(.06) −.10 −.03	(.11) +.04 −.02
≥ 5					(.05) +.02 +.01

next