Bill Sponsorship in Congress: The Moderating Effect of Agenda Positions on Legislative Proposals

Online Appendix

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May 25, 2007

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Theoretical Analysis

Proof of Proposition 1

Without loss of generality, let $\theta_L > \theta_P$. (Analogous expressions can be derived for $\theta_L < \theta_P$.) To solve for the subgame perfect Nash equilibrium, I use the standard technique of backwards induction. Let $r_L = \min\{q, 2\theta_P - q\}$ and $r_R = \max\{q, 2\theta_P - q\}$, and define four acceptance regions as follows: $R_1 = [r_L, r_R]$, $R_2 = (r_L, r_R]$, $R_3 = [r_L, r_R)$, and $R_4 = (r_L, r_R)$.

Let P's strategy be the function $\sigma_P : y \to \{y, q\}$. If given the move, P's best response is one of four strategies, each corresponding to one of the acceptance regions, so for $i \in \{1, 2, 3, 4\}$ the four strategies can be described succinctly as:

$$\sigma_P^i(y) = \begin{cases} y & \text{if } y \in R_i \\ q & \text{otherwise} \end{cases} \tag{A1}$$

Given P's strategy, L's expected utility from proposing bill y is

$$EU_L(y|\sigma_P^i(y)) = \begin{cases} -a(y-\theta_L)^2 - (1-a)(q-\theta_L)^2 - w(y-\theta_L)^2 & \text{if } y \in R_i \\ -(q-\theta_L)^2 - w(y-\theta_L)^2 & \text{otherwise} \end{cases}$$

We can find L's best response for different values of q. First, if $q > \theta_L$ or $q < 2\theta_P - \theta_L$ then $\theta_L \in R_i$ for any i and L's best response is $y^* = \theta_L$. If $q = \theta_L$ then regardless of whether P accepts or rejects y, L's best response is also $y^* = \theta_L$. If $q = 2\theta_P - \theta_L$, then L's best response is $y^* = \theta_L$ if P's strategy is σ^1 or σ^2 and L's best response is empty if σ^3 or σ^4. If $q \in [\theta_P, \theta_L)$, then since P will never accept any bill closer to θ_L than q, $y^* = \theta_L$ maximizes L's expected utility.[1]

The remaining values of q are in the interval $(2\theta_P - \theta_L, \theta_P)$. The bill that maximizes L's expected utility within the interval R_1 or R_2 is $y = 2\theta_P - q$. There is no optimal bill in the interval R_3 or R_4 due to the open set problem at r_H, and within the complement of R_i, the optimal bill is $y = \theta_L$.

[1] Unlike the canonical Romer and Rosenthal game where any proposal that is rejected would be a best response, L has a unique best response here because of the position-taking preferences.

Thus, if P's strategy is σ^1 or σ^2, then $y = 2\theta_P - q$ is a unique best response if

$$\begin{aligned} EU_L(2\theta_P - q) &> EU_L(\theta_L) \\ -(a+w)(2\theta_P - q - \theta_L)^2 - (1-a)(q-\theta_L)^2 &> -(q-\theta_L)^2 \\ -(a+w)(2\theta_P - q - \theta_L)^2 + a(q-\theta_L)^2 &> 0 \end{aligned} \tag{A2}$$

Rearranging (A2) as a condition on q gives:

$$q < 2\theta_P - \theta_L + \frac{2(\theta_L - \theta_P)(\sqrt{a(a+w)} - a)}{w}$$

Let the expression on the right be q^*. To show that $q^* < \theta_P$, for all $a \in [0,1]$ and $w > 0$, first show that q^* is increasing in a. The partial derivative is

$$\frac{\partial q^*}{\partial a} = \frac{2(\theta_L - \theta_P)}{w}\left(\frac{2a+w}{2\sqrt{a(a+w)}} - 1\right),$$

and since $\theta_L > \theta_P$ and $w > 0$, $\partial q^*/\partial a$ is positive if and only if $2a + w > 2\sqrt{a(a+w)}$. Squaring both sides and cancelling terms yields $w^2 > 0$, so the derivative is indeed positive. Thus, the maximum of q^* with respect to a occurs at $a = 1$:

$$q^*(1) = 2\theta_P - \theta_L + \frac{2(\theta_L - \theta_P)(\sqrt{1+w} - 1)}{w}.$$

Next, it is straightforward to show that $q^*(1)$ is decreasing in w for all $w > 0$. The limit of $q^*(1)$ as $w \to 0$ is θ_P, which establishes the desired inequality and part (a) of the proposition.

To establish part (b), the inequality in (A2) can be expressed in terms of a:

$$a > \frac{w(2\theta_P - q - \theta_L)^2}{(q-\theta_L)^2 - (2\theta_P - q - \theta_L)^2}. \tag{A3}$$

The expression on the right-hand side is a^*.

Figures A1, A2, and A3 graph L's expected utility as a function of proposals for selected values of $q \in (2\theta_P - \theta_L)$ and for different values of a. In Figure A1, q is sufficiently far away from θ_P to allow for beneficial policy change but the probability of consideration is too low for moderation to occur ($a < a^*$). Figure A2 uses the same value of q but for a

higher agenda position that implies proposal moderation ($a > a^*$). In Figure A3, the agenda position is as high as possible ($a = 1$) but q is too close to θ_P for policy-change to be worth seeking.

[Figure A1 about here.]

[Figure A2 about here.]

[Figure A3 about here.]

Proof of Proposition 2

From Proposition 1, we know that when $q \in (2\theta_P - \theta_L, q^*)$ that $\theta_P < y^* = 2\theta_P - q < \theta_L$ and that otherwise, $y^* = \theta_L$. The first inequality is a straightforward implication of the fact that $y^* > \theta_P$ for all q. To establish the last inequality, note that as long as $a > 0$, the interval $(2\theta_P - \theta_L, q^*)$ is non-empty so there is a positive probability that $y^* < \theta_L$ and with the remaining probability, $y^* = \theta_L$.

To establish the middle inequality, let $q^*(a)$ and $q^*(a')$ be the relevant cutoff values for a and a' respectively given by the expression in Proposition 1. Since we know from the proof of Proposition 1 that q^* is increasing in a, $q^*(a) < q^*(a')$. The expected proposals can then be expressed as

$$\begin{aligned} E[y|a] &= \int_{-\infty}^{2\theta_P-\theta_L} \theta_L f(q)dq + \int_{2\theta_P-\theta_L}^{q^*(a)} (2\theta_P - q)f(q)dq + \\ &\quad \int_{q^*(a)}^{q^*(a')} \theta_L f(q)dq + \int_{q^*(a')}^{\infty} \theta_L f(q)dq \end{aligned}$$

and

$$\begin{aligned} E[y|a'] &= \int_{-\infty}^{2\theta_P-\theta_L} \theta_L f(q)dq + \int_{2\theta_P-\theta_L}^{q^*(a)} (2\theta_P - q)f(q)dq + \\ &\quad \int_{q^*(a)}^{q^*(a')} (2\theta_P - q)f(q)dq + \int_{q^*(a')}^{\infty} \theta_L f(q)dq. \end{aligned}$$

The inequality $E[y|a'] < E[y|a]$ holds if and only if

$$\int_{q^*(a)}^{q^*(a')} (2\theta_P - q)f(q)dq < \int_{q^*(a)}^{q^*(a')} \theta_L f(q)dq,$$

which is true since $\theta_L > 2\theta_P - q$ for all $q \in (q^*(a), q^*(a'))$.

Replacing Policy-Seeking with Preference for Winning

To establish the claim that the basic results extend to the case where we substitute a pure winning component for L's policy preferences, let $b > 0$ be the value of winning that L receives if y passes (i.e. $x = y$) and that the value of losing is 0 (so that b is also the relative value of winning). Legislator L's utility function can be replaced with

$$U_L(x, y) = \begin{cases} b - w(y - \theta_L)^2 & \text{if } x = y \\ -w(y - \theta_L)^2 & \text{if } x = q \end{cases}$$

Given the best response functions for P in (A1), L's expected utility is

$$EU_L(y|\sigma_P^i(y)) = \begin{cases} ab - w(y - \theta_L)^2 & \text{if } y \in R_i \\ -w(y - \theta_L)^2 & \text{otherwise} \end{cases}$$

The arguments from the proof of Proposition 1 carry through when $q \leq 2\theta_P - \theta_L$ or $q \geq \theta_P$. When $q \in (2\theta_P - \theta_L, \theta_P)$, we need to find the critical value a^* such that $a \geq a^*$ implies that $y = 2\theta_P - q$ is a best response:

$$\begin{aligned} EU_L(2\theta_P - q) &\geq EU_L(\theta_L) \\ ab - w(2\theta_P - q - \theta_L)^2 - (1 - a)(q - \theta_L)^2 &\geq 0 \\ ab &\geq w(2\theta_P - q - \theta_L)^2 \\ a &\geq \frac{w(2\theta_P - q - \theta_L)^2}{b} \end{aligned}$$

The denominator in the right-hand side is b, which is the relative value of winning versus losing. (The denominator in (A3) can also be interpreted as the relative value of winning versus losing. Under the policy motivated assumption, this value is determined by the *locations* of the policies resulting from winning, $2\theta_P - q$, and losing, q, relative to θ_L).

A similar expression can be obtained for q^*, though it is possible for the interval (q^*, θ_P) to be empty if b is sufficiently large. That is, when $b > w(2\theta_P - q - \theta_L)^2$.

Allowing For the Possibility of an Open Rule

The assumption that a bill will only be considered under a closed rule once it is considered seems restrictive and unrealistic, but it is straightforward to show that allowing for the possibility of an open rule does not change the results at all. The intuition is that when a bill is considered under an open rule, L's proposal is irrelevant to the outcome, so it is strategically equivalent from the proposer's point of view to the bill not being considered at all.

To be more precise, suppose we modify the model by assuming that once L proposes y, Nature chooses with probability a_c that P can respond only by choosing between y and q (the original "closed rule") case, with probability a_o that P can propose a substitute amendment z and that the substitute passes (effectively an "open rule"), and with probability $1-a_c-a_o$ that the proposal is not considered at all. This sequence of events is depicted in Figure A4.

[Figure A4 about here.]

P's best response if given the opportunity to propose an amendment is $z^* = \theta_P$ and P's best responses if consideration is under a closed rule are the same as in Proposition 1. As before, the interesting case is when $q \in (2\theta_P - \theta_L)$, and in all other cases, $y^* = \theta_L$.

As before, L must choose between $y = \theta_L$ and $y = 2\theta_P - q$, and given any best response strategy of P, L's expected utilities from these proposals are

$$EU_L(\theta_L) = -a_o(\theta_P - \theta_L)^2 - (1 - a_0)(q - \theta_L)^2$$

$$EU_L(2\theta_P - q) = -(a_c + w)(2\theta_P - q - \theta_L)^2 - a_o(\theta_P - \theta_L)^2 - (1 - a_c - a_o)(q - \theta_L)^2$$

After cancelling terms, the inequality $EU_L(2\theta_P - q) > EU_L(\theta_L)$ reduces to

$$-(a_c + w)(2\theta_P - q - \theta_L)^2 + a_c(q - \theta_L)^2$$

which is exactly the expression in (A2) only with $a = a_c$. The rest of the results, including Proposition 2, follow exactly as before.

Estimating Pivot Locations

This section presents the derivation of the pivot estimator (constrained regression model) and presents the full results of the weighted nonlinear least squares estimates for each Congress.

As stated in the text, the key to the deriving the estimator is to impose the constraint that all of the regression lines pass through (ρ, ρ), then this implies a set of nonlinear constraints on the intercept-related parameters $\alpha, \delta_M, \delta_C$, and δ_L. To derive the constraints, we first substitute Bill $= \rho$ and $X = \rho$ into the regression equation. By rewriting and collecting terms so that the independent variables are on the right hand side and the remaining parameters on the left, we get:[2]

$$(1-\beta)\rho - \alpha = (\delta_C + \Delta_C \cdot \rho)D_C + (\delta_L + \Delta_L \cdot \rho)D_L + (\delta_M + \Delta_M \cdot \rho)D_D \tag{A4}$$

where D_C, D_L, and D_M are the agenda position variables.

We then use the fact that equation (A4) must be true regardless of the values that the D_i variables take on. First, if $D_C = D_L = D_M = 0$, then by substitution we find that:

$$\alpha = (1-\beta)\rho. \tag{A5}$$

Next, substitute equation (A5) into (A4) to get:

$$0 = (\delta_C + \Delta_C \cdot \rho)D_C + (\delta_L + \Delta_L \cdot \rho)D_L + (\delta_M + \Delta_M \cdot \rho)D_D. \tag{A6}$$

Then let $D_C = 1$ and $D_L = D_M = 0$ and substitute into (A6) to obtain

$$\delta_C = -\Delta_C \cdot \rho \tag{A7}$$

In a similar manner, we obtain two more equalities:

$$\delta_L = -\Delta_L \cdot \rho \tag{A8}$$

$$\delta_M = -\Delta_M \cdot \rho. \tag{A9}$$

[2]The bill, legislator, and time subscripts are dropped to enhance the clarity of presentation.

Equations (A5), (A7), (A8), (A9) are the intercept-related terms as functions of ρ and the slope-related terms $\beta, \Delta_C, \Delta_L$, and Δ_M. (Equations (A7), (A8), (A9) are the nonlinear constraints on the original regression equation in terms of the new parameter ρ.)

After rearranging and collecting terms, we can write the new regression equation as:

$$\text{Bill} = \rho + (\beta + \Delta_C D_C + \Delta_L D_L + \Delta_M D_M)(X - \rho) + \epsilon \tag{A10}$$

where the independent variables are the ideal points X and the agenda position indicators D_M, D_C, and D_L.

The parameters, including ρ, can be estimated by weighted nonlinear least squares. (The weighting accounts for heteroskedasticity as in the original analysis). The full results of the weighted nonlinear least squares estimation are presented in Tables A1 and A2. Only Congress-specific (unpooled) estimates are presented because the pivots vary from Congress to Congress. The pivots are summarized in Table 4 of the text, which also discusses the interpretation of results.

[Table A1 about here.]

[Table A2 about here.]

Table A1. House Estimated Pivots and Effects of Preferences and Agenda Positions on Proposal Locations

Variable	101st	102nd	103rd	104th	105th	106th	107th	108th
Pivot	0.009	0.03	0.01	-0.306**	-0.335**	-0.413**	-0.369**	-0.497**
	(0.027)	(0.026)	(0.035)	(0.053)	(0.051)	(0.036)	(0.048)	(0.033)
Baseline Slope	0.590**	0.726**	0.764**	0.713**	0.716**	0.674**	0.719**	0.581**
	(0.031)	(0.026)	(0.024)	(0.051)	(0.046)	(0.048)	(0.049)	(0.062)
Difference in Slope								
Committee	-0.006	-0.049**	0.054**	0.007	-0.052**	0.005	0.019	0.019
	(0.014)	(0.014)	(0.017)	(0.018)	(0.016)	(0.015)	(0.016)	(0.016)
Committee Leader	0.065**	0.080**	-0.021	-0.044*	0.017	0.001	-0.054**	-0.060**
	(0.016)	(0.016)	(0.019)	(0.020)	(0.018)	(0.017)	(0.018)	(0.019)
Majority	0.003	-0.192**	-0.128*	-0.045	-0.047	-0.042	-0.093	0.127
	(0.057)	(0.053)	(0.054)	(0.080)	(0.070)	(0.064)	(0.070)	(0.071)
N	1925	2033	1738	1556	1836	2127	2006	1939
RMSE	0.245	0.255	0.258	0.253	0.258	0.262	0.283	0.289

Notes: * p <.05, ** p<.01, estimates obtained by nonlinear weighted least squares assuming variance of each observation is the variance of the bill estimate, asymptotic approximations of standard errors in parentheses

Table A2. Senate Estimated Pivots and Effects of Preferences and Agenda Positions on Proposal Locations

Variable	101st	102nd	103rd	104th	105th	106th	107th	108th
Pivot	-0.036	0.015	0.037	0.07	-0.166*	-0.277***	-0.007	-0.271**
	(0.022)	(0.037)	(0.043)	(0.050)	(0.070)	(0.039)	(0.043)	(0.041)
Baseline Slope	0.542***	0.686***	0.653***	0.660***	0.529***	0.356***	0.499**	0.582**
	(0.032)	(0.035)	(0.043)	(0.046)	(0.077)	(0.085)	(0.051)	(0.059)
Difference in Slope								
Committee	0.024	-0.046	0.05	0.034	-0.088**	-0.013	-0.060**	-0.007
	(0.026)	(0.026)	(0.033)	(0.034)	(0.029)	(0.029)	(0.022)	(0.022)
Committee Leader	0.012	0.081**	-0.064*	-0.114**	0.043	-0.067*	0.069**	0.028
	(0.025)	(0.026)	(0.032)	(0.036)	(0.030)	(0.030)	(0.024)	(0.023)
Majority	-0.324***	-0.186*	-0.201	-0.14	0.093	0.244*	0.012	-0.138
	(0.092)	(0.089)	(0.114)	(0.094)	(0.128)	(0.110)	(0.093)	(0.090)
N	1005	1017	794	694	843	1096	1102	1099
RMSE	0.244	0.247	0.255	0.276	0.281	0.288	0.280	0.282

Notes: * p <.05, ** p<.01, estimates obtained by nonlinear weighted least squares assuming variance of each observation is the variance of the bill estimate, asymptotic approximations of standard errors in parentheses

Figure A1. Expected utility as a function of proposals for $q \in (2\theta_P - \theta_L, \theta_P)$ and $a < a^*$ (low agenda position)

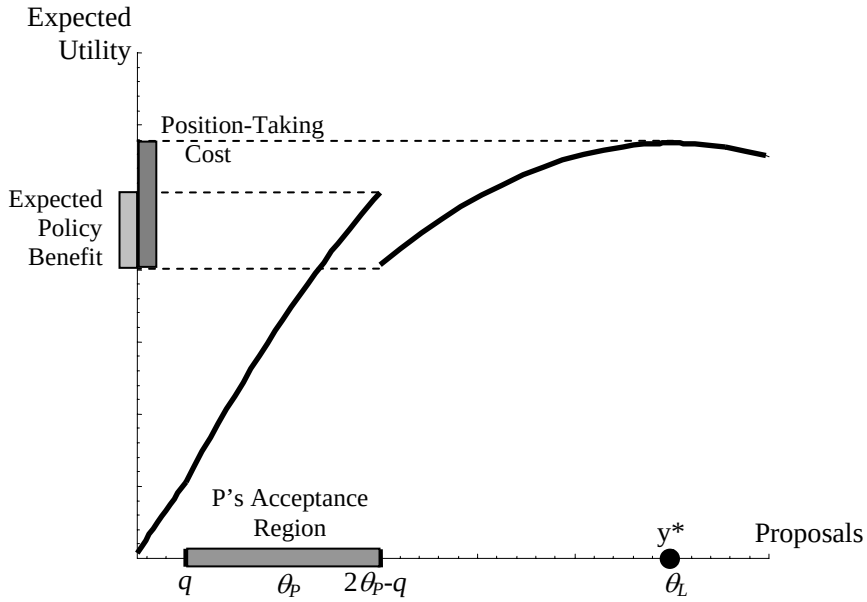


Figure A2. Expected utility as a function of proposals for $q \in (2\theta_P - \theta_L, \theta_P)$ and $a > a^*$ (high agenda position)

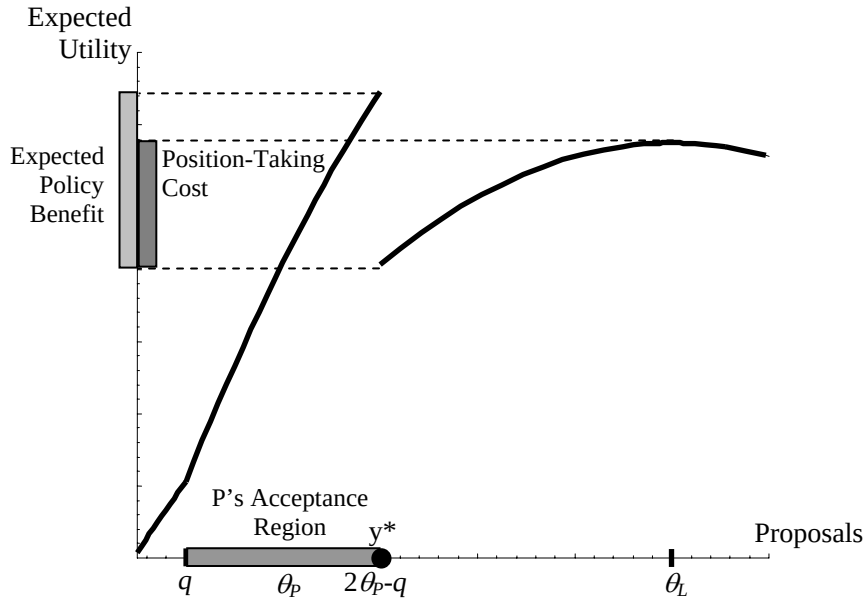


Figure A3. Expected utility as a function of proposals for q close to θ_P and $a = 1$

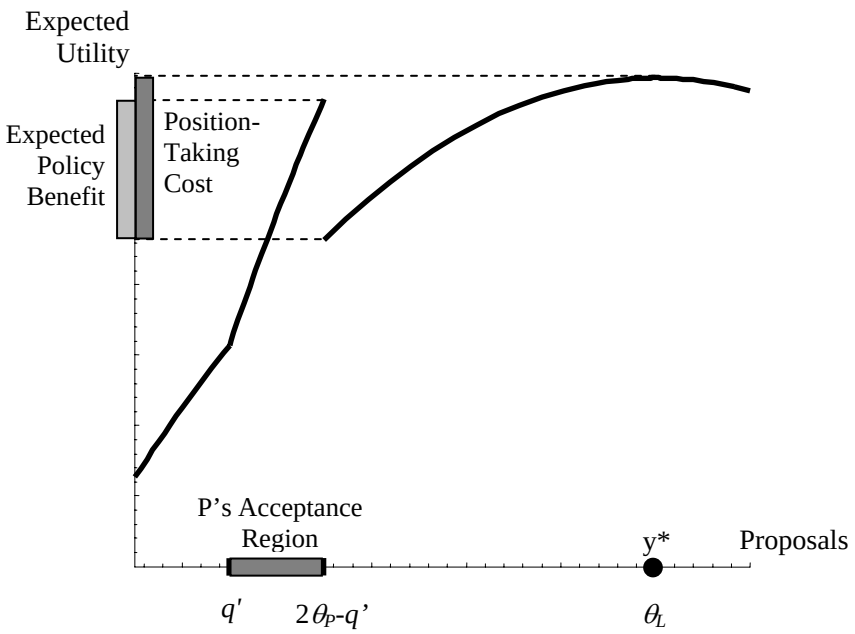
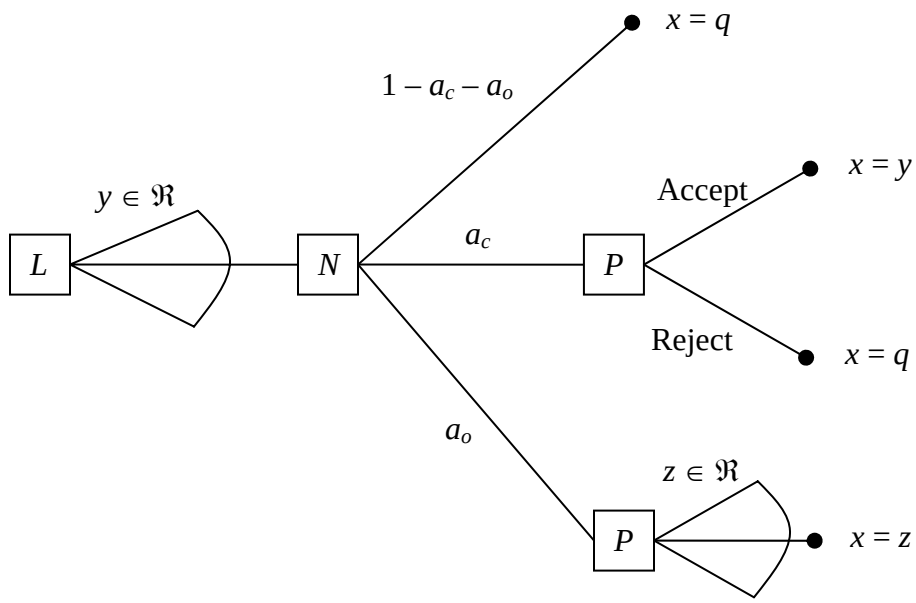


Figure A4. Sequence of actions with both “closed” and “open” rules



L is the legislator proposing a bill y, N is Nature, and P is the pivotal legislator; a_c denotes the probability Nature allows the bill to be considered under a “closed” rule and a_o is the probability of an “open” rule; z is P’s substitute amendment when consideration is under an open rule; x denotes the policy outcome and q denotes the status quo.