Appropriators Not Position Takers: The Distorting Effects of Electoral Incentives on Congressional Representation

Justin Grimmer
Assistant Professor
Department of Political Science
Stanford University

March 21, 2012
June 22, 2006: Defense Appropriations Bill in Senate

Amendments:
- Immediate redeployment of troops
- Both fail
- Examine debate after vote

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Jack Reed
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Appropriators Not Position Takers
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“Half the names on the Vietnam Wall are there because old men in Washington were too proud to admit a mistake”

Justin Grimmer (Stanford University)
“It’s wrong to allow mindless determination and foolish consistency to base our policy on hope and hope alone”
“The Bush Administration’s open-ended, no plan, no end Iraq policy has failed”
“Americans saw a clear difference today between Democrats who want to retreat... and Republicans who want to fight”
“It’s clear that the Senate has rejected [Democrat] plans for surrender”
“...hailed a decision by NOAA...ranking a Maine proposed conservation project first for federal funding”
“Announce that the Senate authorized funding for two significant defense projects in Arkansas”
Polarization in Political Debate

Illuminates two types of polarization in political debate

1) Exacerbated (artificial) polarization in discourse (Today)
   - Ideological extremists dominate debates
   - Moderate legislators tend to focus on particularistic spending
   - Spatial polarization: parties more polarized in debates

2) Taunting and political attacks on opponents (Grimmer and King 2011; Grimmer, King, and Superti 2012)
   - Legislators regularly engage in explicit, public, and negative attacks on opposition
   - Affective polarization: Congressional parties cultivate support with partisans through provocation
   - Undermines possibility constituents allow compromise

Institutional polarization is amplified in political debates
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1) Characterize how senators communicate with constituents
- Large collection of press releases and statistical model to measure expressed priorities
- Demonstrate a public/particularistic spectrum
- Public goods: policy debates (Position Takers)
- Particularistic goods: distributive spending (Appropriators)

2) A (partial) explanation for style adoption: fit with constituency
- Leeway and partisan competition: aligned legislators
  ⇝ positions, misaligned legislators
  ⇝ distributive spending
- Robust relationship between communicative style and constituency

3) Consequences for Debate
- Aligned senators
  ⇝ policy focus
- Aligned senators
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Presentational (Home) styles in communication (Fenno 1978)

- How legislators present themselves and their work to public
- What legislators decide to emphasize to constituents
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- I collected every press release from each senate office from 2005-2007 (64,033 press releases)
- Regularly used by each Senate Office
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Statistical Model to Measure Expressed Priorities

Statistical Model Estimates Four Quantities of Interest:

1) A set of topics: politically relevant concepts (unsupervised)
2) Senators' expressed priorities
3) Each press release's topic
4) A clustering of styles (senators clustered, using expressed priorities)

- Each senator, in each year divides attention over topics
- Priority
- Shelby, 2005, $k \equiv$ Probability press release about topic $k$
- Priorities
- Shelby, 2005 = (Priority Shelby, 2005, 1, ..., Priority Shelby, 2005, 44)
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A New Categorization Scheme for Congressional Speech

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A New Categorization Scheme for Congressional Speech

**Example Topics**

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Appropriators: Firefighters

Appropriators & Workers' Rights

Domestic Policy

Pork & Policy

Senate Statespersons
Appropriators: Firefighters

- Iraq War
- Intelligence
- Intl. Relations
- Budget
A Distributive-Public Spectrum
A Distributive-Public Spectrum

Prop. Credit Claiming – Prop. Position Taking

Principal Component, Expressed Priorities
Communication (particularly press releases) are a **publicity** effort
Why Do Legislators Differ in Home Styles?

Communication (particularly press releases) are a publicity effort. Legislators expend effort touting policy work or credit claiming.
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Effectiveness of Partisan Appeals:
- More co-partisans: issue and partisan appeals more effective
- District with other partisans: distributive appeals more effective

\( \Rightarrow \) Legislator’s alignment with constituency affects styles.
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→ Legislator’s alignment with constituency affects styles
Measuring Dyadic Influence on Communication

Measuring home style:
- Prop Credit Claiming
- Prop Position Taking

Measuring alignment (marginality):
- Bush (Republican) share of two party vote
- Survey data: share of two party identifiers Republican (MrP)
- Measures of state ideology (Warshaw and Tausanovitch, 2012)
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Fit With District and Expressed Priorities
Lincoln Chafee, (R-RI)
33% Credit Claiming
26% Position Taking

Airport Grants
Fit With District and Expressed Priorities

Susan Collins, (R-RI)
29% Credit Claiming
20% Position Taking

Airport Grants
Fit With District and Expressed Priorities

Two Party Vote Share, Bush
Prop Credit Claiming − Prop. Position Taking

Mike Enzi, (R-WY)
18% Credit Claiming
35% Position Taking
Tax Reform
Fit With District and Expressed Priorities

Two Party Vote Share, Bush

Prop Credit Claiming − Prop. Position Taking

Justin Grimmer (Stanford University)
Fit With District and Expressed Priorities

John Tester, (D-MT)
43% Credit Claiming
20% Position Taking
Water Grants
Fit With District and Expressed Priorities

Sheldon Whitehouse, (D-RI)
8% Credit Claiming
54% Position Taking
Iraq War

Two Party Vote Share, Bush
Prop Credit Claiming − Prop. Position Taking

Justin Grimmer (Stanford University)
Fit With District and Expressed Priorities
Evidence of constituency → communication style
Fit With District and Expressed Priorities

Evidence of constituency~→communication style
- Regress Home Style on:

- Alignment (larger score → more aligned)
- Covariates (legislator, state), state and senator random effects
- Shift from less aligned → more aligned

Change in (Pr Credit − Pr Policy)

−0.10  −0.05  0.00  0.05

Vote Share  MrP Party  State Ideal

●

Justin Grimmer (Stanford University)
Fit With District and Expressed Priorities

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Fit With District and Expressed Priorities

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Fit With District and Expressed Priorities

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\begin{align*}
\text{Change in (Pr Credit} & - \text{Pr Policy)} \\
-0.10 & \quad -0.05 & \quad 0.00 & \quad 0.05
\end{align*}

Vote Share  MrP Party  State Ideal
Fit With District and Expressed Priorities

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![Graph showing change in (Pr Credit - Pr Policy)]
Fit With District and Expressed Priorities

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- **Spatial**: out of step positions $\leadsto$ discuss topic less

![Diagram showing the relationship between change in (Pr Credit - Pr Policy) and vote share with categories MrP Party and State Ideal.](image)
Fit With District and Expressed Priorities

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Marginal legislators focus more on appropriations, Aligned legislators on substance
Aligned representatives

Dyadic Incentives, Collective Consequences

Aligned representatives

Demonstrating magnified polarization:

- Polarization = |Mean Dem. Ideal Point - Mean Rep. Ideal Point|
- Define legislator $i$'s extremism as: 
  
  $\text{Extreme}_i = \text{Mean Dem. Ideal Point} - \text{Pos}_i$, if Senator Dem 
  
  $\text{Extreme}_i = \text{Pos}_i - \text{Mean Rep. Ideal Point}$, if Senator Rep

Avg. Extremity $k$ = Average extremity of offices that issue press releases (speech) about topic $k$

Null: if random sample 

$\Rightarrow$ Avg. Extremity $k$ is 0
Dyadic Incentives, Collective Consequences

Aligned representatives $\leadsto$ more policy focused
Dyadic Incentives, Collective Consequences

**Aligned representatives** ≈ more policy focused
**Aligned representatives** ≈ more extreme policy positions
Dyadic Incentives, Collective Consequences

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Ideological Extremists Dominate Debates, magnifying polarization

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Ideological Extremists Dominate Debate
Ideological Extremists Dominate Debate

Standardized Average Extremity

-10  -5  0  5  10

Budget ● Immigration ● Iraq ● Just. Dept. ● Cons. Safety ● Stem Cells ●
FDA ●
For. Affairs ● SCHIP ● Jus. Oversight ●
Mort. Crisis ● Health Access ●
Energy/Gas ●
Tax Pol. ●

Justin Grimmer (Stanford University)
Ideological Extremists Dominate Debate

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Ideological Extremists Dominate Debate

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Ideological Extremists Dominate Debate

- Immigration press releases: 9.5% more polarized
- Immigration press releases: 9.5% more polarized
- Iraq press releases: 8.6% more polarized
- Immigration press releases: 9.5% more polarized
- Iraq press releases: 8.6% more polarized
- Pattern exists in floor speeches: Immigration 13.2% more polarized, Iraq: 7.9%
Ideological Extremists Dominate Debate

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Daily Imbalance in Partisan Debates

Average Extremity

Date

1Jan2005  1Jul2005  1Jan2006  1Jul2006  1Jan2007  1Jul2007
Daily Imbalance in Partisan Debates

![Daily Imbalance in Partisan Debates](image)

Justin Grimmer (Stanford University)  Appropriators Not Position Takers  March 21, 2012  18 / 19
Communication and Political Polarization

How parties engage in debate:

- Legislators are increasingly aligned with constituents
- Constituents are increasingly ideological (sorting, polarization)
- Abandonment of non-partisan and particularistic styles
- Policy and Partisan styles

Rhetoric amplifies polarization that occurs in institution
Communication and Political Polarization

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<Appendix>
< Posterior and Variational Approximation >
Specifics of the Model

- $\pi_{itk} \equiv$ Attention senator $i$ allocates to issue $k$ in year $t$
- $\pi_{itk} \equiv$ Probability press release is about issue $k$
- $\pi_{it} \equiv (\pi_{it1}, \ldots, \pi_{it44})$

Press release-level parameters (press release $j$ from senator $i$ in year $t$)

- **Assume**: Each press release $j$ assigned to one topic.
- Let $\tau_{ijt}$ indicate press release $j$’s topic.

\[ \tau_{ijt} \sim \text{Multinomial}(1, \pi_{it}) \]

- Conditional on topic, draw document’s content.
- If $\tau_{ijtk} = 1$ then

\[ y_{ijt} \sim \text{Multinomial}(n_{ijt}, \theta_k) \]
Priors

Each $\pi_{it}$ is a draw from one-of-$S$ styles.

$$\sigma_{it} \sim \text{Multinomial}(1, \beta).$$

$$\pi_{it} | \sigma_{its} = 1, \alpha_s \sim \text{Dirichlet}(\alpha_s)$$

$$\alpha_{ks} \sim \text{Gamma}(0.25, 1)$$

Other priors:

$$\theta_k \sim \text{Multinomial}(1)$$

$$\beta_k \sim \text{Multinomial}(1)$$
Posterior:

\[ p(\alpha, \beta, \theta, \sigma, \pi, \tau | Y) \propto \prod_{k=1}^{K} \prod_{s=1}^{S} \exp(-\frac{\alpha_{ks}}{4}) \times \frac{\Gamma(\sum_{w=1}^{W} \lambda_{w})}{\prod_{w=1}^{W} \Gamma(\lambda_{w})} \prod_{w=1}^{W} \theta_{k,w}^{-1} \times \prod_{i=1}^{n} \prod_{t=2005}^{2007} \prod_{s=1}^{S} \left[ \beta_{s} \frac{\Gamma(\sum_{k=1}^{K} \alpha_{ks})}{\prod_{k=1}^{K} \Gamma(\alpha_{ks})} \prod_{k=1}^{K} \pi_{itk}^{\alpha_{ks} - 1} \prod_{j=1}^{D_{it}} \prod_{k=1}^{K} \prod_{w=1}^{W} \left[ \pi_{itk} \prod_{w=1}^{W} \theta_{k,w}^{-1} \right]^{\tau_{ijtk}} \right]^{\sigma_{its}} \]
Inference

Invariance in posterior makes it difficult (impossible) to approximate with sampling based methods (relabeling, aliasing problem).
Deterministic alternative: variational approximations.
Intuition: approximate posterior with simpler (still very general) approximating distribution.
Make approximation as “close” as possible.
Approximate posterior with:

\[
q(\alpha, \beta, \theta, \sigma, \pi, \tau) = q(\alpha)q(\beta)q(\theta)q(\sigma)q(\pi)q(\tau)
\]

\[
= q(\beta) \prod_{k=1}^{K} q(\theta)_k \prod_{i=1}^{n} \prod_{t=2005}^{2007} \left[ q(\sigma)_{it} q(\pi)_{it} \prod_{j=1}^{J} q(\tau)_{ijt} \right] \prod_{s=1}^{S} q(\alpha)_s
\]
Variational Approximation

Optimization goal:

- Minimize the Kullback-Leibler divergence between approximating distribution $q$ and true posterior $p$
  - KL-divergence is a functional: takes functions as an input, returns a positive scalar
  - Measures “divergence” between two measures
- Use calculus of variations and theory from exponential models to derive iterative algorithm
- See “An Introduce to Bayesian Inference via Variational Approximations” for extended introduction (Grimmer, 2011)
Minimize KL-divergence by Maximizing a Lower Bound

\[
\log p(Y) = \log \sum_\sigma \sum_\tau \int \int \int \int p(\alpha, \beta, \theta, \sigma, \pi, \tau | Y) d\theta d\alpha d\beta d\pi
\]

\[
\log p(Y) = \log \sum_\sigma \sum_\tau \int \int \int \int p(\alpha, \beta, \theta, \sigma, \pi, \tau | Y) \frac{q(\alpha, \beta, \theta, \sigma, \pi, \tau)}{q(\alpha, \beta, \theta, \sigma, \pi, \tau)} d\theta d\alpha d\beta d\pi
\]

\[
\log p(Y) \geq \sum_\sigma \sum_\tau \int \int \int \int q(\alpha, \beta, \theta, \sigma, \pi, \tau) \log \frac{p(\alpha, \beta, \theta, \sigma, \pi, \tau | Y)}{q(\alpha, \beta, \theta, \sigma, \pi, \tau)} d\theta d\alpha d\beta d\pi.
\]

\[\mathcal{L}(q)\]
Minimize KL-divergence by Maximizing a Lower Bound

\[
\log p(Y) = \mathcal{L}(q) + \text{KL}(q \| p)
\]
Minimize KL-divergence by Maximizing a Lower Bound

\[ \log p(Y) = \mathcal{L}(q) + \text{KL}(q\|p) \]

fixed number \quad \text{Positive}

If \( \mathcal{L}(q) \) get bigger, \( \text{KL}(q\|p) \) get smaller. \Rightarrow If \( \mathcal{L}(q) \) is at a maximum \( \text{KL}(q\|p) \) is at a minimum (duals).
Minimize KL-divergence by Maximizing a Lower Bound

\[
\log p(Y) = \mathcal{L}(q) + \text{KL}(q\|p)
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Minimize KL-divergence by Maximizing a Lower Bound

\[
\log p(Y) = \mathcal{L}(q) + \text{KL}(q \parallel p)
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If \( \mathcal{L}(q) \) get bigger, \( \text{KL}(q \parallel p) \) get smaller. \( \Rightarrow \)
If \( \mathcal{L}(q) \) is at a maximum \( \text{KL}(q \parallel p) \) is at a minimum (duals).
Maximizing $\mathcal{L}(q)$

Goal: choose $q$ to maximize $\mathcal{L}(q)$.

$q(\alpha)^{\text{old}}, q(\beta)^{\text{old}}, q(\theta)^{\text{old}}, q(\sigma)^{\text{old}}, q(\pi)^{\text{old}}, q(\tau)^{\text{old}}$.

Iterative Algorithm:
Choose, $q(\pi)^{\text{new}}$ to max $\mathcal{L}(q)$–holding $q(\theta)^{\text{old}}, q(\tau)^{\text{old}}, q(\alpha)^{\text{old}}, q(\beta)^{\text{old}}, q(\sigma)^{\text{old}}$ constant.
Choose, $q(\theta)^{\text{new}}$ to max $\mathcal{L}(q)$–holding $q(\pi)^{\text{new}}, q(\tau)^{\text{old}}, q(\alpha)^{\text{old}}, q(\beta)^{\text{old}}, q(\sigma)^{\text{old}}$ constant.
Choose, $q(\tau)^{\text{new}}$ to max $\mathcal{L}(q)$–holding $q(\theta)^{\text{new}}, q(\pi)^{\text{new}}, q(\alpha)^{\text{old}}, q(\beta)^{\text{old}}, q(\sigma)^{\text{old}}$ constant.
Choose, $q(\alpha)^{\text{new}}$ to max $\mathcal{L}(q)$–holding $q(\theta)^{\text{new}}, q(\tau)^{\text{new}}, q(\pi)^{\text{new}}, q(\beta)^{\text{old}}, q(\sigma)^{\text{old}}$ constant.
Choose, $q(\beta)^{\text{new}}$ to max $\mathcal{L}(q)$–holding $q(\theta)^{\text{new}}, q(\tau)^{\text{new}}, q(\pi)^{\text{new}}, q(\alpha)^{\text{new}}, q(\sigma)^{\text{old}}$ constant.
Choose, $q(\sigma)^{\text{new}}$ to max $\mathcal{L}(q)$–holding $q(\theta)^{\text{new}}, q(\tau)^{\text{new}}, q(\pi)^{\text{new}}, q(\alpha)^{\text{new}}, q(\beta)^{\text{new}}$ constant.
Example for $q(\pi)^{\text{new}}$

$$L(q) = \int q(\pi)^{\text{new}} \left\{ \sum_{\sigma} \sum_{\tau} \int \int \int \log p(Y, \pi, \alpha, \theta, \tau) q(\sigma)^{\text{old}} q(\tau)^{\text{old}} q(\theta)^{\text{old}} q(\alpha)^{\text{old}} q(\beta)^{\text{old}} d\theta d\alpha d\beta \right\} d\pi$$

$$- q(\pi)^{\text{new}} \log q(\pi)^{\text{new}} + \text{constants}$$

Define

$$\log \tilde{p}(\pi) = E_{\alpha, \tau, \theta, \sigma, \beta}[\log p(Y, \pi, \alpha, \theta, \tau, \beta, \sigma)] + \text{constants}$$
Example for $q(\pi)^{\text{new}}$

Substituting $\log \tilde{p}(\pi)$,

\[
\begin{align*}
= & \int q(\pi)^{\text{new}} \log \left( \frac{\tilde{p}(\pi)}{q(\pi)^{\text{new}}} \right) d\pi \\
= & -\text{KL}(q(\pi)^{\text{new}} || \tilde{p}(\pi))
\end{align*}
\]

$\Rightarrow$ At a maximum when $q(\pi)^{\text{new}} = \tilde{p}(\pi)$.

Equivalently,

\[
\begin{align*}
\log q(\pi)^{\text{new}} = & \log \tilde{p}(\pi) \\
= & E_{\alpha,\tau,\theta,\sigma,\beta}[\log p(Y, \pi, \alpha, \theta, \tau, \beta, \sigma)] + \text{constants}
\end{align*}
\]

Or,

\[
q(\pi)^{\text{new}} = \frac{\exp(E_{\alpha,\tau,\theta,\sigma,\beta}[\log p(Y, \pi, \alpha, \theta, \tau, \beta, \sigma)])}{\int \exp(E_{\alpha,\tau,\theta,\sigma,\beta}[\log p(Y, \pi, \alpha, \theta, \tau, \beta, \sigma)]) d\pi}
\]
To maximize $\mathcal{L}(q)$ we use the following iterative algorithm

\[
\begin{align*}
q(\sigma)^{\text{new}} & \propto \exp \left( E_{\tau, \theta, \alpha, \beta, \pi} \left[ \log p(\alpha, \beta, \theta, \sigma, \pi, \tau, Y) \right] \right) \\
q(\tau)^{\text{new}} & \propto \exp \left( E_{\sigma, \theta, \alpha, \beta, \pi} \left[ \log p(\alpha, \beta, \theta, \sigma, \pi, \tau, Y) \right] \right) \\
q(\theta)^{\text{new}} & \propto \exp \left( E_{\sigma, \tau, \alpha, \beta, \pi} \left[ \log p(\alpha, \beta, \theta, \sigma, \pi, \tau, Y) \right] \right) \\
q(\alpha)^{\text{new}} & \propto \exp \left( E_{\sigma, \tau, \theta, \beta, \pi} \left[ \log p(\alpha, \beta, \theta, \sigma, \pi, \tau, Y) \right] \right) \\
q(\beta)^{\text{new}} & \propto \exp \left( E_{\sigma, \tau, \theta, \alpha, \pi} \left[ \log p(\alpha, \beta, \theta, \sigma, \pi, \tau, Y) \right] \right) \\
q(\pi)^{\text{new}} & \propto \exp \left( E_{\sigma, \tau, \theta, \alpha, \beta} \left[ \log p(\alpha, \beta, \theta, \sigma, \pi, \tau, Y) \right] \right)
\end{align*}
\]
Update for $q(\sigma)_{it}$

$q(\sigma)_{it}$ is a Multinomial$(1, c_{it})$ distribution, with typical parameter $c_{its}$

$$c_{its} \propto \exp \left\{ \mathbb{E}[\log \beta_s] + \log \Gamma(\sum_{k=1}^{K} \alpha_{ks}) - \sum_{k=1}^{K} \log \Gamma(\alpha_{ks}) + \sum_{k=1}^{K} (\alpha_{ks} - 1)\mathbb{E}[\log \pi_{itk}] \right\}.$$
Update for $q(\tau)_{ijt}$

$q(\tau)_{ijt}$ is a Multinomial(1, $r_{ijt}$) distribution with typical parameter,

$$r_{ijtk} \propto \exp \left\{ \mathbb{E}[\log \pi_{itk}] + \sum_{w=1}^{W} y_{ijtw} \mathbb{E}[\log \theta_{kw}] \right\}.$$
Update for $q(\pi)_{it}$

$q(\pi)_{it}$ is a Dirichlet($\gamma_{it}$) distribution, with typical parameter $\gamma_{itk}$ equal to

$$\gamma_{itk} = \sum_{s=1}^{S} c_{its} \alpha_{sk}^* + \sum_{j=1}^{D_{it}} r_{ijtk}$$
Update for \( q(\theta)_k \)

\( q(\theta)_k \) is a Dirichlet(\( \eta_k \)) distribution, with typical parameter equal to,

\[
\eta_{kw} = \lambda_w + \sum_{i=1}^{n} \sum_{t=2005}^{2007} \sum_{j=1}^{D_{it}} r_{itjk} y_{itw}
\]
Update for \( q(\beta) \)

\( q(\beta) \) is a Dirichlet(\( \phi \)) distribution, with typical parameter \( \phi_s \) equal to,

\[
\phi_s = 1 + \sum_{i=1}^{n} \sum_{t=2005}^{2007} c_{its}
\]
Completing $q(\sigma)_{it}$ and $q(\tau)_{ijt}$

Finishing $q(\sigma)_{it}$:
- $\mathbb{E}[\log \beta_s] = \psi(\phi_s) - \psi(\sum_{z=1}^{S} \phi_z)$ where $\psi(\cdot)$ is the digamma function (the derivative of the gamma function)
- $\mathbb{E}[\log \pi_{itk}] = \psi(\gamma_{itk}) - \psi(\sum_{z=1}^{K} \gamma_{itz})$

Finishing $q(\tau)_{ijt}$
- $\mathbb{E}[\log \theta_{kw}] = \psi(\eta_{kw}) - \psi(\sum_{z=1}^{w} \eta_{kz})$. 
Update Steps for $\alpha_s$

(Newton-Raphson, Minka 2000)

- Define $N_s = \sum_{i=1}^{n} \sum_{t=2005}^{2007} c_{its}$.

Differentiating with respect to $\alpha_{ks}$ shows that

$$
\frac{\partial \log q(\alpha)^{\text{new}}}{\partial \alpha_{ks}} = -\frac{1}{\lambda} + N_s \Psi(\sum_{k=1}^{K} \alpha_{ks}) - N_s \Psi(\alpha_{ks}) + \sum_{i=1}^{n} \sum_{t=2005}^{2007} c_{its} \left( \frac{\Psi(\gamma_{itk}) - \Psi(\sum_{z=1}^{K} \gamma_{itz})}{N_s} \right)
$$

- Call Gradient $\frac{\partial \log q(\alpha)^{\text{new}}}{\partial \alpha_k}$.
- Define $H$ as the Hessian (matrix of second derivatives).
- Diagonal element $h_{jj} = N_s \Psi'(\sum_{k=1}^{K} \alpha_{ks}) - N_s \Psi'(\alpha_{js})$ where $\Psi'(\cdot)$ is the trigamma function.
- Off-diagonal element ($a \neq b$) $h_{ab} = N_z \Psi'(\sum_{k=1}^{K} \alpha_{ks})$.

For each $s$ we iterate,

$$
\alpha_s^{\text{new}} = \alpha_s^{\text{old}} - H^{-1} \frac{\partial \log q(\alpha)^{\text{new}}}{\partial \alpha_k}
$$

until convergence.
Initialize $\gamma_{it}^{\text{old}}$ (for all $i$ and $t$), $\eta_k^{\text{old}}$ (for all $k$), $\phi_s^{\text{old}}$, $\alpha_s^{\text{old}}$ (for all $s$).
Do until convergence in lower-bound.
- for all $i$, $t$, $j$ and $k$, set
  \[ r_{ijtk}^{\text{new}} \propto \exp \left( \psi ( \gamma_{itk}^{\text{old}} ) - \psi ( \sum_{z=1}^{K} \gamma_{itz}^{\text{old}} ) + \sum_{w=1}^{W} y_{ijtw} \left[ \psi ( \eta_{kw}^{\text{old}} ) - \psi ( \sum_{z=1}^{W} \eta_{kz}^{\text{old}} ) \right] \right) \]
- for all $i,t$, and $s$ set
  \[ c_{its}^{\text{new}} \propto \exp ( \psi ( \phi_s^{\text{old}} ) - \psi ( \sum_{s=1}^{S} \phi_s^{\text{old}} ) + \log \Gamma ( \sum_{k=1}^{K} \alpha_s^{\text{old}} ) - \sum_{k=1}^{K} \log \Gamma ( \alpha_s^{\text{old}} ) + \sum_{k=1}^{K} ( \alpha_s^{\text{old}} - 1 ) \left[ \psi ( \gamma_{itk}^{\text{old}} ) - \psi ( \sum_{z=1}^{K} \gamma_{itz}^{\text{old}} ) \right] ) \]
- for all $i$, $t$, and $k$ set
  \[ \gamma_{itk}^{\text{new}} = \sum_{s=1}^{S} c_{its}^{\text{new}} \alpha_s^{\text{old}} + \sum_{j=1}^{D_{it}} r_{ijtk}^{\text{new}} \]
- for all $k$ and $w$ set
  \[ \eta_{kw}^{\text{new}} = \lambda_w + \sum_{i=1}^{n} \sum_{t=2005}^{2007} \sum_{j=1}^{D_{it}} r_{ijtk}^{\text{new}} y_{ijtw} \]
- for all $s$ set
  \[ \phi_s^{\text{new}} = 1 + \sum_{i=1}^{n} \sum_{t=2005}^{2007} c_{its}^{\text{new}} \]
- For all $s$ obtain $\alpha_s^{\text{new}}$ using Newton-Raphson algorithm.
- Evaluate lower-bound.
If converged:
Return posterior approximation.
\[ \text{Variational Approximation} \]
< Model Selection >
Number of Topics

1) Substantive search (about 40-50)

2) 10-fold cross-validation. Loss function, approximate predictive posterior

\[ p(\hat{y}|Y) \approx \sum_{\hat{\tau}} \int \int p(\hat{y}|\hat{\tau}, \theta)p(\hat{\tau}|\pi)q(\theta|\eta)q(\pi)d\theta d\pi \]

3) Convergence with Nonparametric Bayesian model (Dirichlet process prior)

All converge on about 44 topics
Number of Styles

\[ \text{BIC} = 2 \log p(\mathbf{Y}) \]

1) \( \text{BIC} \approx 2(\mathcal{L}(q) + \log K! + \log S!) - (K \times S)(n) \)

2) \( \text{BIC} \approx 2 \log p(\mathbf{Y}|\bar{\pi}, \bar{\theta}, \bar{\tau}) - (K \times S)(n) \)
< / Model Selection >
< Expressed Priorities and Home Style >
Four Examples from Fenno

- Member of Congress “talks a great deal about public policy…[m]ostly defense policy”
- “presents himself…as issue oriented and independent”
- “service-oriented” representative, describes his focus in public speeches on “the dams, the highways, the buildings, the casework”
- “I’m identified for my interest in local problems”
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<td><strong>US Senators Olympia J. Snowe and Susan Collins today announced that the US Department of Labor has approved their request for $894,918 in National Emergency Grant funding for Domtar and Fraser Mill workers. Last month Senators Snowe and Collins sent Secretary Chao a letter urging the Department of Labor to quickly review and approve the NEG funding request for the 300 workers who lost their jobs at Domtar Industries in Baileyville and Fraser Papers of Madawaska. “This is great news for 300 workers in Northern and Eastern Maine who lost their jobs through no fault of their own” said Senators Snowe and Collins.</strong></td>
<td><strong>U.S. Sens. Olympia J. Snowe and Susan Collins Thursday announced that the U.S. Department of Labor has approved their request for $894,918 in National Emergency Grant funding for Domtar and Fraser Mill workers. Last month, the senators sent Secretary Elaine Chao a letter urging the Department of Labor to quickly review and approve the NEG funding request for the 300 workers who lost their jobs at Domtar Industries in Baileyville and Fraser Papers of Madawaska. “This is great news for 300 workers in Northern and Eastern Maine who lost their jobs through no fault of their own,” said the senators.</strong></td>
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<td>Newspaper</td>
<td>Senator</td>
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<td>Boxer (D-CA)</td>
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<td>San. Fran. Chron.</td>
<td>Feinstein (D- CA)</td>
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"U.S. Senator Richard Shelby (R-Ala.), a member of the Senate Appropriations Committee, today announced that the Department of Homeland Security will release $51,984 to the Priceville Volunteer Fire Department in Decatur, Alabama."
Preprocessing Press Releases

**Goal:** Represent text as data, preserve *useful* information

“U.S. Senator Richard Shelby (R-Ala.), a member of the Senate Appropriations Committee, today announced that the Department of Homeland Security will release $51,984 to the Priceville Volunteer Fire Department in Decatur, Alabama.”
Preprocessing Press Releases

**Goal:** Represent text as data, preserve *useful* information

- Remove punctuation, lower case

“us senator richard shelby r ala a member of the senate appropriations committee today announced that the department of homeland security will release 51984 to the priceville volunteer fire department in decatur alabama”
Preprocessing Press Releases

**Goal:** Represent text as data, preserve *useful* information

- Remove punctuation, lower case
- Remove stop words \{ the, and, or \}

“us senator richard shelby r ala member senate appropriations committee today announced department homeland security release 51984 priceville volunteer fire department decatur alabama”
Preprocessing Press Releases

**Goal**: Represent text as data, preserve *useful* information

- Remove punctuation, lower case
- Remove stop words \{ the, and, or \}
- Stem \{ family, families, family’s \} → \{ famili \}

“us senat richard shelbi r ala member senat appropri committe today announc depart homeland secur releas 51984 pricevil volunt fire depart decatur alabama ”
Goal: Represent text as data, preserve useful information

- Remove punctuation, lower case
- Remove stop words \{ the, and, or \}
- Stem \{ family, families, family’s \} $\rightarrow$ \{ famili \}
- Retain frequent stems (and non-senators specific stems)

“senat member senat appropri committe today announc depart homeland secur releas volunt fire depart”
Preprocessing Press Releases

**Goal:** Represent text as data, preserve *useful* information

- Remove punctuation, lower case
- Remove stop words \{ *the*, *and*, *or* \}
- Stem \{ *family*, *families*, *family’s* \} $\rightarrow$ \{ *famili* \}
- Retain frequent stems (and non-senators specific stems)
- Discard word order

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Each press release is now a count vector ($2,796 \times 1$)
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