Empirical Models of Context Conditionality, (Inter)Dependence, and Endogeneity

Nonlinear Interaction Models

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(Here for further pedagogical slides & materials: **http://www.umich.edu/~franzese/SyllabiEtc.html**)

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Interactions in *QualDep* (Inherently Interactive) Models

- Probit/Logit Models w/ Interactions
  - Probit: $p(y=1)=\Phi\left(\mathbf{x}'\boldsymbol{\beta}\right)$ – Logit: $p(y=1)=\frac{\exp(\mathbf{x}'\boldsymbol{\beta})}{1+\exp(\mathbf{x}'\boldsymbol{\beta})}=\left[1+\mathrm{e}^{-\mathbf{x}'\boldsymbol{\beta}}\right]^{-1}$
- Marginal Effects: (nonlinear, so must specify at what **x**; effect depends on where in S-curve)
  - Start w/ $\mathbf{x}'\boldsymbol{\beta}$ purely linear-additive; model inherently interactive because S-shaped:
    - Probit: $\frac{\partial p}{\partial x_k}=\frac{\partial\Phi\left(\mathbf{x}'\boldsymbol{\beta}\right)}{\partial x_k}=\phi\left(\mathbf{x}'\boldsymbol{\beta}\right)\cdot\frac{\partial\mathbf{x}'\boldsymbol{\beta}}{\partial x_k}=\phi\left(\mathbf{x}'\boldsymbol{\beta}\right)\cdot\beta_k$
    - Logit:

$$\frac{\partial p}{\partial x_k}=\frac{\partial\left\{e^{\mathbf{x}'\boldsymbol{\beta}}[1+e^{\mathbf{x}'\boldsymbol{\beta}}]^{-1}\right\}}{\partial x}=\frac{e^{\mathbf{x}'\boldsymbol{\beta}}}{1+e^{\mathbf{x}'\boldsymbol{\beta}}}\cdot\beta_k-\frac{e^{\mathbf{x}'\boldsymbol{\beta}}}{(1+e^{\mathbf{x}'\boldsymbol{\beta}})^2}\cdot e^{\mathbf{x}'\boldsymbol{\beta}}\cdot\beta_x$$

$$=\left[\frac{e^{\mathbf{x}'\boldsymbol{\beta}}(1+e^{\mathbf{x}'\boldsymbol{\beta}})}{(1+e^{\mathbf{x}'\boldsymbol{\beta}})^2}-\frac{(e^{\mathbf{x}'\boldsymbol{\beta}})^2}{(1+e^{\mathbf{x}'\boldsymbol{\beta}})^2}\right]\cdot\beta_k=\frac{e^{\mathbf{x}'\boldsymbol{\beta}}}{(1+e^{\mathbf{x}'\boldsymbol{\beta}})^2}\cdot\beta_k$$

$$=\frac{e^{\mathbf{x}'\boldsymbol{\beta}}}{1+e^{\mathbf{x}'\boldsymbol{\beta}}}\cdot\frac{1}{1+e^{\mathbf{x}'\boldsymbol{\beta}}}\cdot\beta_k=p\cdot\left(1-p\right)\cdot\beta_k$$

Interactions in *QualDep* (Inherently Interactive) Models

- Now, if $\mathbf{x}'\boldsymbol{\beta} = \ldots + \beta_x x + \beta_z z + \beta_{xz} xz \ldots$
  - $\Rightarrow$ same except $d\mathbf{x}'\boldsymbol{\beta}/dx = \beta_x x + \beta_{xz} z$;
  - underlying propensity, i.e., movement along S-shape also interact explicitly x & z.
  - [Discuss meaning inherent v. explicit interax…]
    - Probit:

$$\frac{\partial p}{\partial x} = \phi\left(\mathbf{x}'\boldsymbol{\beta}\right) \cdot \left(\beta_x + \beta_{xz} z\right)$$

    - Logit:

$$\frac{\partial p}{\partial x} = p \cdot \left(1 - p\right) \cdot \left(\beta_x + \beta_{xz} z\right)$$

  - What about effect of z on effect of x; i.e., the conditioning effect, *in terms of* p? [Discuss…]

$$\frac{\partial^2 p}{\partial x \partial z} = \frac{\partial\left\{\frac{\partial p}{\partial x}\right\}}{\partial z} = \frac{\partial\left\{\phi\left(\mathbf{x}'\boldsymbol{\beta}\right) \cdot \left(\beta_x + \beta_{xz} z\right)\right\}}{\partial z}$$

$$= \underbrace{\phi\left(\mathbf{x}'\boldsymbol{\beta}\right) \cdot \beta_{xz}}_{1^{st} \text{ times derivative of the } 2^{nd}} + \underbrace{\left\{\phi'\left(\mathbf{x}'\boldsymbol{\beta}\right)\left(\beta_z + \beta_{xz} x\right)\right\}\left(\beta_x + \beta_{xz} z\right)}_{\text{derivative of the } 1^{st} \text{ times } 2^{nd}}$$

Interactions in *QualDep* Models

- Standard Errors?
  - ***Delta Method:***

$$Asym.Var.\left(f(\hat{\boldsymbol{\beta}})\right) \approx \left[\nabla_{\boldsymbol{\beta}} f\left(\hat{\boldsymbol{\beta}}\right)\right]' V\left(\hat{\boldsymbol{\beta}}\right)\left[\nabla_{\boldsymbol{\beta}} f\left(\hat{\boldsymbol{\beta}}\right)\right]$$

  – Probit marginal-effect s.e.:

$$\begin{bmatrix} \dfrac{\partial\left\{\phi\left(\mathbf{x}'\hat{\boldsymbol{\beta}}\right)\frac{\partial \mathbf{x}'\hat{\boldsymbol{\beta}}}{\partial x_1}\right\}}{\partial\hat{\beta}_1} \\ \vdots \\ \dfrac{\partial\left\{\phi\left(\mathbf{x}'\hat{\boldsymbol{\beta}}\right)\frac{\partial \mathbf{x}'\hat{\boldsymbol{\beta}}}{\partial x_k}\right\}}{\partial\beta_k} \end{bmatrix}' \begin{bmatrix} \hat{V}\left(\hat{\beta}_1\right) & \cdots & \hat{C}\left(\hat{\beta}_1,\hat{\beta}_k\right) \\ \vdots & \ddots & \vdots \\ \hat{C}\left(\hat{\beta}_1,\hat{\beta}_k\right) & \cdots & \hat{V}\left(\hat{\beta}_k\right) \end{bmatrix} \begin{bmatrix} \dfrac{\partial\left\{\phi\left(\mathbf{x}'\hat{\boldsymbol{\beta}}\right)\frac{\partial \mathbf{x}'\hat{\boldsymbol{\beta}}}{\partial x_1}\right\}}{\partial\hat{\beta}_1} \\ \vdots \\ \dfrac{\partial\left\{\phi\left(\mathbf{x}'\hat{\boldsymbol{\beta}}\right)\frac{\partial \mathbf{x}'\hat{\boldsymbol{\beta}}}{\partial x_k}\right\}}{\partial\beta_k} \end{bmatrix}$$

  – Logit: same, except $\hat{p}(1-\hat{p})\frac{\partial \mathbf{x}'\hat{\boldsymbol{\beta}}}{\partial x}$ replaces $\phi(\mathbf{x}'\hat{\boldsymbol{\beta}})\frac{\partial \mathbf{x}'\hat{\boldsymbol{\beta}}}{\partial x}$

  – For first-difference effects, similar, but need specify from what **x** to what **x**, and not just at what **x**.

- Or you could CLARIFY… or mfx… or inteff…

Complex Context-Conditionality

- ***Complex Context-Conditionality***: Effect of anything depends on most everything else. E.g.:
  - *Policymaking*:
    - Socioeconomic-structure of interests
    - Party-system and internal party-structures
    - Electoral system & Governmental system
    - Socio-economic realities linking policies to outcomes
  - *Comparative Democratic Budgeteering*, e.g., begins as this simple proposition…

$$B = \ldots + m(\mathbf{x}_m) \times s(\mathbf{x}_s) \times n(\mathbf{x}_n) + \ldots$$

    - […which would be a mess as a linear-interactive model…]
    - […but which eventually becomes something still pretty messy but perhaps estimable…]

Complex Context-Conditionality

- ***Complex Context Conditionality***: Effect of anything depends on most everything else. E.g.:
  - *Voting:*
    - Voter preferences & informational environment
      - E.g., new Achen & Blais paper:

$$p(\text{vote}) = \Phi\left(\text{duty}\ ,\ \text{instrumental incentives}\ ,\ \text{duty} \times \text{instru.incent.}\right)$$

    - Party/candidate locations & informational environment
    - Electoral & governmental system
  - *Institutions*: Sets of institutions; effect each depends configuration others present (e.g., this=core *VoC* claim)
  - *Strategic Interdep.*: each actors' action depends on everyone else's; complex feedback (see Franzese & Hays)

Complex Context-Conditionality

- Empirically ⇒ Linear-interactive model of complex context-conditionality =Multicolinear Nightmare.
- Options?
  - Ignore context conditionality (stay linear-additive):
    - Inefficient at best, biased more usually, and, anyway, context-conditionality is our interest!
  - Isolate one or some very few interactions for close study; ignore rest (stay linear-interactive):
    - Same, to degree lessened by amount of interaction allowed, but demands on data rise rapidly w/ that amount.
  - "Structured Case Analysis":
    - May help 'theory generation', but, for empirical evaluation, doesn't help; worsens problem! (See Franzese *OxfHndbk CP* 2007).
  - **EMTI**™: Lean harder on thry/subst to specify more precisely the nature interax: functional form, precise measures, etc.
    - Refines question put to the data (changes default tests also).
    - *GIVEN* thry/subst. specification into empirical model, can estimate complex interactivity. Side benefits. But must *give*.

Nonlinear Least-Squares & EMTI

- EITM: **E**mpirical **I**mplications of **T**heoretical **M**odels
  - *Vision:* Theory ⇒ more, sharper predictions ⇒ better tests, which therefore inform theory more, which…
- TMEI: **T**heory-specified **M**odels for **E**mpirical **I**nference
  - *Vision:* Theory structures empirical models & relations b/w obs ⇒ specification & (causal) i.d. of empirical models
- TIEM: **T**heoretical **I**mplications of **E**mpirical **M**easures
  - *Vision:* Emp. regularities, findings, measures inform theory dev'p.
- **EMTI**™: **E**mpirical **M**odels of **T**heoretical **I**ntuitions
  - *Vision:* Intuitions derived from theoretical models specify empirical models. I.e., empirical specification to match intuitions, not model.
- Note: Strongly counter some alternative moves stats & econometrics, & related; there toward non-parametric, matching, & experimentation—there, "model-dependence" a 4-letter word. Alternative audiences & rhetorical purposes?
  - Convince skeptic some causal effect exists, vs.
  - For the convinced, give richer, portable model of how world works.

Complex Context-Conditionality and Nonlinear Least-Squares

- ***Complex Context-Conditionality***: Effect of anything depends on most everything else. E.g.:
  - *Policymaking*:
    - Socioeconomic-structure of interests
    - Party-system and internal party-structures
    - Electoral system & Governmental system
    - Socio-economic realities linking policies to outcomes
  - *Comparative Democratic Budgeteering*, e.g., begins as this simple proposition…

$$B = \ldots + m(\mathbf{x}_m) \times s(\mathbf{x}_s) \times n(\mathbf{x}_n) + \ldots$$

  - …and eventually becomes this…

Complex Context-Conditionality and Nonlinear Least-Squares

- *Comp Dem Budgeteering*…eventually becomes this:

$$B = \ldots + s(u_s) \times m(ec, gc) \times n(d, p, \rho, u_r, IPC, DM) + \ldots$$

- …where *incentive-nature* given by…

$$n(u_r, \rho, DM, IPC, d, p) = \Lambda(\mathbf{x}'\boldsymbol{\beta}) \times \beta_p p + [1 - \Lambda(\mathbf{x}'\boldsymbol{\beta})] \times \beta_d d,$$

$$\text{where } \Lambda(\mathbf{x}'\boldsymbol{\beta}) \equiv \frac{e^{\mathbf{x}'\boldsymbol{\beta}}}{1 + e^{\mathbf{x}'\boldsymbol{\beta}}}, \text{ and where}$$

$$\mathbf{x}'\boldsymbol{\beta} = \beta_{ur} u_r + \beta_\rho \rho + \beta_{DM} \ln(DM) + \beta_{IPC} IPC^{-1} + \beta_{DMIPC} \ln(DM) \times IPC^{-1}$$

- …and *incentive-magnitude* given by…

$$m(ec, gc) = \beta_{ec} ec + \beta_{egc} ec \times gc$$

- …and *strategic-capacity* given by…
  – some Shugart-Carey & related list to specify $u_s = u_s(\mathbf{x}_s) = \mathbf{x}_s' \boldsymbol{\beta}_s$.
- [Incidentally, Achen & Blais similar proportionality argument & estimation strategy, though simpler: $\boldsymbol{\Phi}(d + (1 - d)\,inst)$; much like next example…]

Nonlinear Least-Squares (NLS)

$\mathbf{y} = f(\mathbf{X},\boldsymbol{\beta})+\boldsymbol{\varepsilon}$ with $\boldsymbol{\varepsilon} \sim g(\boldsymbol{\varepsilon})$

$\Rightarrow E\left(\mathbf{y}\right) = f(\mathbf{X},\boldsymbol{\beta})$, so $\mathbf{y}=f(\mathbf{X},\hat{\boldsymbol{\beta}}) + \hat{\boldsymbol{\varepsilon}}$

$\Rightarrow \underset{\tilde{\boldsymbol{\beta}}}{Min}\ \hat{\boldsymbol{\varepsilon}}'\hat{\boldsymbol{\varepsilon}} \Rightarrow \underset{\tilde{\boldsymbol{\beta}}}{Min}\ [\mathbf{y} - f(\mathbf{X},\tilde{\boldsymbol{\beta}})]'[\mathbf{y} - f(\mathbf{X},\tilde{\boldsymbol{\beta}})]$

$\Rightarrow \underset{\tilde{\boldsymbol{\beta}}}{Min}\ \text{SSE}=\mathbf{y}'\mathbf{y} - \mathbf{y}'f(\mathbf{X},\tilde{\boldsymbol{\beta}}) - f(\mathbf{X},\tilde{\boldsymbol{\beta}})'\mathbf{y} - f(\mathbf{X},\tilde{\boldsymbol{\beta}})'f(\mathbf{X},\tilde{\boldsymbol{\beta}})$

$\Rightarrow$ FOC: $\nabla_{\tilde{\boldsymbol{\beta}}}\text{SSE}=0 \Rightarrow -2\nabla_{\tilde{\boldsymbol{\beta}}}f(\mathbf{X},\tilde{\boldsymbol{\beta}})'\mathbf{y} + 2\nabla_{\tilde{\boldsymbol{\beta}}}f(\mathbf{X},\tilde{\boldsymbol{\beta}})'f(\mathbf{X},\tilde{\boldsymbol{\beta}}) = 0$

So, if, e.g., $f(\mathbf{X},\boldsymbol{\beta}) = \mathbf{X}\boldsymbol{\beta}$, then: $\mathbf{X}'\mathbf{y} = \mathbf{X}'\mathbf{X}\tilde{\boldsymbol{\beta}} \Rightarrow \hat{\boldsymbol{\beta}}_{LS} = \left(\mathbf{X}'\mathbf{X}\right)^{-1}\mathbf{X}'\mathbf{y}$, and if

$\mathbf{V}(\boldsymbol{\varepsilon}) \equiv \boldsymbol{\Omega} = \sigma^2\mathbf{I}$, then $\widehat{\mathbf{V}(\hat{\varepsilon})}_{LS} = \frac{1}{n-k}\left[\mathbf{y} - f\left(\mathbf{X},\hat{\boldsymbol{\beta}}_{LS}\right)\right]'\left[\mathbf{y} - f\left(\mathbf{X},\hat{\boldsymbol{\beta}}_{LS}\right)\right]$ (also, as always).

That is, intuitively, writing $\nabla_{\hat{\boldsymbol{\beta}}}f(\mathbf{X},\hat{\boldsymbol{\beta}}_{LS})$ as simply ∇, we have:

$$\hat{\boldsymbol{\beta}}_{LS} = (\nabla'\nabla)^{-1}\nabla'\mathbf{y}$$

$$\widehat{\mathbf{V}\left(\hat{\boldsymbol{\beta}}_{LS}\right)}_{LS} = \widehat{\mathbf{V}\left[(\nabla'\nabla)^{-1}\nabla'\mathbf{y}\right]} = (\nabla'\nabla)^{-1}\nabla'\widehat{\mathbf{V}(\mathbf{y})}\nabla(\nabla'\nabla)^{-1},$$

which if $f(\mathbf{X},\hat{\boldsymbol{\beta}}_{LS}) = \mathbf{X}\hat{\boldsymbol{\beta}}_{LS}$ meaning $\nabla = \mathbf{X}$, &, if $\boldsymbol{\Omega}=\sigma^2\mathbf{I}$, gives the famiar

$\hat{\boldsymbol{\beta}}_{LS} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{y}$ & $\widehat{\mathbf{V}(\hat{\boldsymbol{\beta}}_{LS})}_{LS} = \sigma^2(\mathbf{X}'\mathbf{X})^{-1}$, as always.

- NLS is BLUE under same conditions as OLS, w/ ∇ for **X**.
- Interpreting NLS (already know how): Effects = derivatives & 1st-differences; s.e.'s by Delta Method or simulation as usual…

Generalized Nonlinear Least-Squares

- GNLS:

$$\mathbf{y} = f(\mathbf{X},\boldsymbol{\beta}) + \boldsymbol{\varepsilon} \quad \text{with} \quad V(\boldsymbol{\varepsilon}) = \sigma^2\boldsymbol{\Omega} \neq \sigma^2\mathbf{I}$$
$$\Rightarrow \hat{\boldsymbol{\beta}}_{GNLS} = (\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1}\nabla'\boldsymbol{\Omega}^{-1}\mathbf{y}$$
$$\Rightarrow V(\hat{\boldsymbol{\beta}}_{GNLS}) = (\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1}\nabla'\boldsymbol{\Omega}^{-1}V(\mathbf{y})\boldsymbol{\Omega}^{-1}\nabla(\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1}$$
$$= (\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1}\nabla'\boldsymbol{\Omega}^{-1}\boldsymbol{\Omega}\boldsymbol{\Omega}^{-1}\nabla(\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1}$$
$$= (\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1}\nabla'\boldsymbol{\Omega}^{-1}\nabla(\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1} = (\nabla'\boldsymbol{\Omega}^{-1}\nabla)^{-1}$$

  - GNLS is BLUE in same cond's NLS, but $\boldsymbol{\Omega}$ for $\mathbf{I}$.
  - …don't know $\boldsymbol{\Omega}$, so need consistent 1st stage (e.g., NLS)

- FGNLS is asymptotically BLUE:

$$\mathbf{y} = f(\mathbf{X},\boldsymbol{\beta}) + \boldsymbol{\varepsilon} \quad \text{with} \quad V(\boldsymbol{\varepsilon}) = \sigma^2\boldsymbol{\Omega} \neq \sigma^2\mathbf{I}$$
$$\Rightarrow \hat{\boldsymbol{\beta}}_{FGNLS} = (\nabla'\hat{\boldsymbol{\Omega}}^{-1}\nabla)^{-1}\nabla'\hat{\boldsymbol{\Omega}}^{-1}\mathbf{y}$$
$$\Rightarrow V(\hat{\boldsymbol{\beta}}_{FGNLS}) = (\nabla'\hat{\boldsymbol{\Omega}}^{-1}\nabla)^{-1}\nabla'\hat{\boldsymbol{\Omega}}^{-1}V(\mathbf{y})\hat{\boldsymbol{\Omega}}^{-1}\nabla(\nabla'\hat{\boldsymbol{\Omega}}^{-1}\nabla)^{-1}$$
$$= (\nabla'\hat{\boldsymbol{\Omega}}^{-1}\nabla)^{-1}$$

Nonlinear Least-Squares:

"Multiple Hands on the Wheel" Model (Franzese, *PA* '03)

- Monetary Policy in Open & Institutionalized Econ
  - Key C&IPE Insts/Struct: CBI, ER-Regime, Mon. Open
    - ° CBI ≡ ° Govt Delegated Mon Pol to CB
    - ° Peg ≡ ° Domestic (CB&Gov) Delegate to Peg-Curr (CB&Gov)
    - ° FinOp ≡ ° Dom cannot delegate b/c effectively del'd to globe
  - Effect of ev'thing to which for. & dom. mon. pol-mkrs would respond diff'ly depends on combo insts-structs & v.v., &, through intl inst-structs, for. on dom. & v.v.

$$\pi = \begin{cases} P\cdot E\cdot C\cdot \pi_1(X_1) + P\cdot E\cdot(1-C)\cdot\pi_2(X_2) \\ +P\cdot(1-E)\cdot C\cdot\pi_3(X_3) + P\cdot(1-E)\cdot(1-C)\cdot\pi_4(X_4) \\ (1-P)\cdot E\cdot C\cdot\pi_5(X_5) + (1-P)\cdot E\cdot(1-C)\cdot\pi_6(X_6) \\ +(1-P)\cdot(1-E)\cdot C\cdot\pi_7(X_7) + (1-P)\cdot(1-E)\cdot(1-C)\cdot\pi_8(X_8) \end{cases}$$

  - Multicolinear Nightmare:
    - 2^3=8 inst-struct conds, *i*, times *k* factors per $\pi_i(\mathbf{X}_i)$ if lin-interact
    - Exponentially more if all polynominials; k!/2(k-2)! if all pairs.
    - Good thing can lean on some thry to specify more precisely!

Nonlinear Least-Squares: "Multiple Hands on the Wheel" Model

- CB & Govt Interaction (Franzese, *AJPS* '99):

$$E(\pi)=c\cdot\pi_c(\mathbf{x}_c)+(1-c)\cdot\pi_g(\mathbf{x}_g)$$

$$\pi_c=\bar{\pi}_c \quad \pi_g(\mathbf{x}_g)=\pi_g(GP,UD,BC,TE,EY,FS,AW,\pi_a)$$

  - *Note*: in this case, NL model nested within linear-interactive model; test is that $b_{x\cdot cbi}/b_x$ equal $\forall x$.

- Full Monetary Exposure & Atomistic ⇒ zero domestic autonomy ⇒

$$\left.\begin{array}{r}\widehat{\pi_1(\mathbf{x}_1)}=\widehat{\pi_2(\mathbf{x}_2)}\\ =\widehat{\pi_5(\mathbf{x}_5)}=\widehat{\pi_6(\mathbf{x}_6)}\end{array}=\pi_a\right\}\Rightarrow\left\{\begin{array}{l}E\cdot\pi_a+P\cdot(1-E)\cdot C\cdot\pi_3(\mathbf{x}_3)+P\cdot(1-E)\cdot(1-C)\cdot\pi_4(\mathbf{x}_4)\\ +(1-P)\cdot(1-E)\cdot C\cdot\bar{\pi}_c+(1-P)\cdot(1-E)\cdot(1-C)\cdot\pi_g(\mathbf{x}_8)\end{array}\right.$$

- s.t. that, full e.r.fix⇒CB&Gov match peg⇒

$$\widehat{\pi_3(\mathbf{x}_3)}=\widehat{\pi_4(\mathbf{x}_4)}=\pi_p\Rightarrow\left\{\begin{array}{l}E\cdot\pi_a+P\cdot(1-E)\cdot\pi_p\\ +(1-P)\cdot(1-E)\cdot\left[C\cdot\bar{\pi}_c+(1-C)\cdot\pi_g(\mathbf{x}_8)\right]\end{array}\right.$$

Nonlinear Least-Squares: "Multiple Hands on the Wheel" Model

- Compact & intuitive, yet gives all theoretically expected interactions, in the form expected

$$\pi = E \cdot \pi_a + (1-E) \cdot \left\{ P \cdot \pi_p + (1-P) \cdot \left[C \cdot \overline{\pi_c} + (1-C) \cdot \pi_g(\boldsymbol{X_g}) \right] \right\}$$

$$\Rightarrow$$

$$\frac{\partial \pi}{\partial E} = \pi_a\left(P^*, E^*, C^*, \boldsymbol{X}^*, \pi_a^*\right) - \left\{ P \cdot \pi_p\left(P^*, E^*, C^*, \boldsymbol{X}^*, \pi_p^*\right) + (1-P) \cdot \left[C \cdot \overline{\pi_c} + (1-C) \cdot \pi_g(\boldsymbol{X_g}) \right] \right\}$$

$$\frac{\partial \pi}{\partial P} = (1-E) \cdot \left\{ \pi_p\left(P^*, E^*, C^*, \boldsymbol{X}^*, \pi_p^*\right) - \left[C \cdot \overline{\pi_c} + (1-C) \cdot \pi_g(\boldsymbol{X_g}) \right] \right\}$$

$$\frac{\partial \pi}{\partial C} = (1-E) \cdot \left\{ (1-P) \cdot \left[\overline{\pi_c} - \pi_g(\boldsymbol{X_g}) \right] \right\}$$

$$\frac{\partial \pi}{\partial x} = (1-E) \cdot \left\{ (1-P) \cdot \left[(1-C) \cdot \frac{\partial \pi_g}{\partial x} \right] \right\}$$

$$\frac{\partial \pi}{\partial z^*} = E \cdot \frac{\partial \pi_a}{\partial z^*} + (1-E) \cdot \left\{ P \cdot \frac{\partial \pi_p}{\partial z^*} + (1-P) \cdot \left[(1-C) \cdot \frac{\partial \pi_g}{\partial \pi_a} \cdot \frac{\partial \pi_a}{\partial z^*} \right] \right\}$$

Nonlinear Least-Squares: "Multiple Hands on the Wheel" Model

- Effectively Estimable, yet gives all theoretically expected interactions, in the form expected

$$E(\pi) = \boldsymbol{B_0} + \beta_e E \cdot \beta_{\pi*}\pi_a + (1-\beta_e E)\cdot\left\{\begin{array}{l}\left[\begin{array}{l}\left(\beta_{gp}GP + \beta_{ey}EY + \beta_{up}UP + \beta_{bc}BC + \beta_{aw}AW + \beta_{fs}FS + \beta_{te}TE + \beta_a\pi_a\right)\\ \cdot\left(1-\beta_{c1}C\right) + \beta_{c1}C\cdot\beta_{c2}\end{array}\right]\\ \cdot\left(1-\beta_{sp}SP - \beta_{mp}MP\right) + \beta_{sp}SP\cdot\beta_{\pi*}\pi_{sp} + \beta_{mp}MP\cdot\beta_{\pi*}\pi_{mp}\end{array}\right\}$$

- Just 14 parameters (plus intercepts & dynamics, assuming those constant), just 3 more than lin-add!
- Parameters substantive meaning, too:
  - Degree to which…constrains certain set of actors.
  - Yields est. of inflation-target hypothetical fully indep CB
    - $\Rightarrow$ **general strategy for estimating/measuring unobservables:**
      - If know role factor will play & explanators of factor well enough, can estimate unobservables conditional on both those theories, if both powerful enough & enough empirical variation.

Nonlinear Least-Squares: "Multiple Hands on the Wheel" Model

- Neat, but does it work? (**Try it!** Data online; **stata**: **`help nl`**). Estimated Equation, w/ Std. Errs.:

$$E(\pi) \approx \left\langle \begin{array}{l} .53^{.30} + .55^{.05}\pi_{t-1} - .12^{.04}\pi_{t-2} + .44^{.14}E \cdot .59^{.07} \cdot \pi_a + \\ \left(1 - .44^{.14}E\right) \cdot \left\{ \begin{array}{l} 1.0^{.05}SP \cdot .59^{.07}\pi_{sp} + .22^{.12}MP \cdot .59^{.07}\pi_{mp} + \\ \left(1 - 1.0^{.05}SP - .22^{.12}MP\right) \cdot \left[\begin{array}{l} 1.0^{.11}C \cdot \left(-.59^{1.2}\right) + \\ \left(1 - 1.0^{.11}C\right) \cdot \left(\begin{array}{l} -.60^{.30}GP + 2.6^{1.3}EY + 16^{4.6}UP - 11^{2.4}BC \\ +1.2^{.49}AW - 1.1^{.30}FS - 8.2^{4.9}TE + .64^{.24}\pi_a \end{array} \right) \end{array} \right] \end{array} \right\} \end{array} \right.$$

- Estimated Effects (highly context-conditional):

$$E\left(\frac{d\pi}{dx}\right) = (1 - .44E) \cdot \left\{(1 - SP - .22MP) \cdot \left[(1 - C) \cdot b_x\right]\right\}$$

$$E\left(\frac{d\pi}{dC}\right) = (1 - .44 \cdot E) \cdot \left\{(1 - SP - .22MP) \cdot \left[(.6GP - 2.6EY - 16UP + 11BC - 1.2AW + 1.1FS + 8.2TE - .64\pi_a) - .59\right]\right\}$$

$$E\left(\frac{d\pi}{dP}\right) = (1 - .44E) \cdot b_p \cdot \left\{.59\pi_p - \left[(1 - C) \cdot (-.6GP + 2.6EY + 16UP - 11BC + 1.2AW - 1.1FS - 8.2TE + .64\pi_a) - .59C\right]\right\}$$

$$E\left(\frac{d\pi}{dE}\right) = .44 \cdot \left(.59\pi_a - \left\{b_pP \cdot .59\pi_p + (1 - b_pP) \cdot \left[(1 - C) \cdot (-.6GP + 2.6EY + 16UP - 11BC + 1.2AW - 1.1FS - 8.2TE + .64\pi_a) - .59C\right]\right\}\right)$$

Nonlinear Least-Squares: "Multiple Hands on the Wheel" Model

Table 2: Estimated Effects of Domestic Political-Economic Conditions, $d\pi/x$, as Function of Central Bank Autonomy, *CBA*, International Monetary Exposure, *E*, and Exchange-Rate Regime, *P*

		Little Exposed (E=0.40)			*Moderately Exposed (E=0.65)*			*Highly Exposed (E=0.90)*		
		Float	*Basket Peg*	*Simple Peg*	*Float*	*Basket Peg*	*Simple Peg*	*Float*	*Basket Peg*	*Simple Peg*
		Estimated Impact of a Post-Election Year ($d\pi/dEY$)								
central	*0.26*	$+1.563^{.79}$	$+1.224^{.61}$	$+0.000^{.09}$	$+1.352^{.69}$	$+1.059^{.53}$	$+0.000^{.07}$	$+1.142^{.60}$	$+0.894^{.47}$	$+0.000^{.06}$
bank	*0.46*	$+1.120^{.57}$	$+0.877^{.44}$	$+0.000^{.06}$	$+0.970^{.50}$	$+0.759^{.39}$	$+0.000^{.05}$	$+0.819^{.44}$	$+0.641^{.34}$	$+0.000^{.05}$
auton.	*0.66*	$+0.678^{.37}$	$+0.531^{.29}$	$+0.000^{.04}$	$+0.587^{.32}$	$+0.459^{.25}$	$+0.000^{.03}$	$+0.495^{.28}$	$+0.388^{.22}$	$+0.000^{.03}$
		Estimated Impact of 10% Increase in Union Density ($0.1\cdot d\pi/dUP$)								
central	*0.26*	$+0.98^{.25}$	$+0.76^{.18}$	$+0.00^{.05}$	$+0.84^{.21}$	$+0.66^{.16}$	$+0.00^{.04}$	$+0.71^{.19}$	$+0.56^{.14}$	$+0.00^{.04}$
bank	*0.46*	$+0.70^{.18}$	$+0.55^{.13}$	$+0.00^{.04}$	$+0.61^{.15}$	$+0.47^{.11}$	$+0.00^{.03}$	$+0.51^{.14}$	$+0.40^{.10}$	$+0.00^{.03}$
auton.	*0.66*	$+0.42^{.13}$	$+0.33^{.10}$	$+0.00^{.02}$	$+0.37^{.11}$	$+0.29^{.08}$	$+0.00^{.02}$	$+0.31^{.10}$	$+0.24^{.08}$	$+0.00^{.02}$
		Estimated Impact of 1% Increase in Financial-Sector Employment-Share ($d\pi/dFS$)								
central	*0.26*	$-0.66^{.18}$	$-0.52^{.12}$	$-0.00^{.03}$	$-0.57^{.16}$	$-0.45^{.11}$	$-0.00^{.03}$	$-0.48^{.15}$	$-0.38^{.11}$	$-0.00^{.03}$
bank	*0.46*	$-0.47^{.13}$	$-0.37^{.09}$	$-0.00^{.02}$	$-0.41^{.12}$	$-0.32^{.08}$	$-0.00^{.02}$	$-0.35^{.11}$	$-0.27^{.08}$	$-0.00^{.02}$
auton.	*0.66*	$-0.29^{.10}$	$-0.22^{.07}$	$-0.00^{.01}$	$-0.25^{.09}$	$-0.19^{.06}$	$-0.00^{.01}$	$-0.21^{.08}$	$-0.16^{.06}$	$-0.00^{.01}$
		Estimated Impact of 1% Increase in Average Inflation Abroad ($d\pi/d\pi_a$)								
central	*0.26*	$+0.49^{.14}$	$+0.41^{.13}$	$+0.11^{.05}$	$+0.50^{.12}$	$+0.43^{.11}$	$+0.17^{.07}$	$+0.52^{.10}$	$+0.46^{.10}$	$+0.24^{.09}$
bank	*0.46*	$+0.38^{.10}$	$+0.32^{.09}$	$+0.11^{.04}$	$+0.41^{.08}$	$+0.36^{.08}$	$+0.17^{.06}$	$+0.44^{.08}$	$+0.39^{.08}$	$+0.24^{.08}$
auton.	*0.66*	$+0.27^{.06}$	$+0.24^{.06}$	$+0.11^{.04}$	$+0.32^{.06}$	$+0.28^{.06}$	$+0.17^{.06}$	$+0.36^{.06}$	$+0.33^{.06}$	$+0.24^{.08}$

NOTES: These are *first-year effects*, meaning before the estimated dynamics unfold. Standard errors noted in superscripts.

Nonlinear Least-Squares: "Multiple Hands on the Wheel" Model

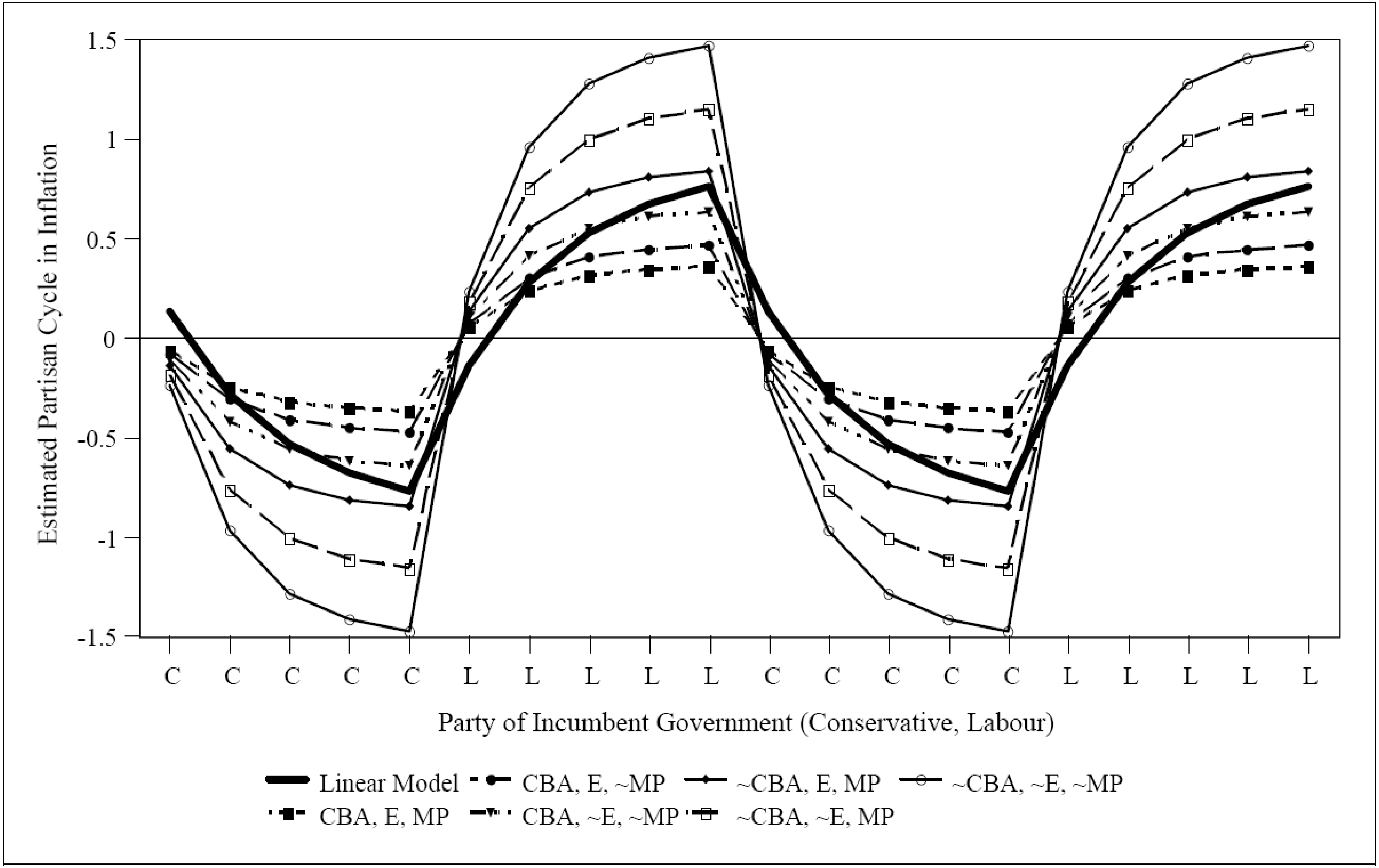


Figure 1: Estimated Partisan Cycles in the Linear & Theoretically Informed Models at High & Low *CBA*, *E*, & *MP*

Nonlinear Least-Squares: "Multiple Hands on the Wheel" Model

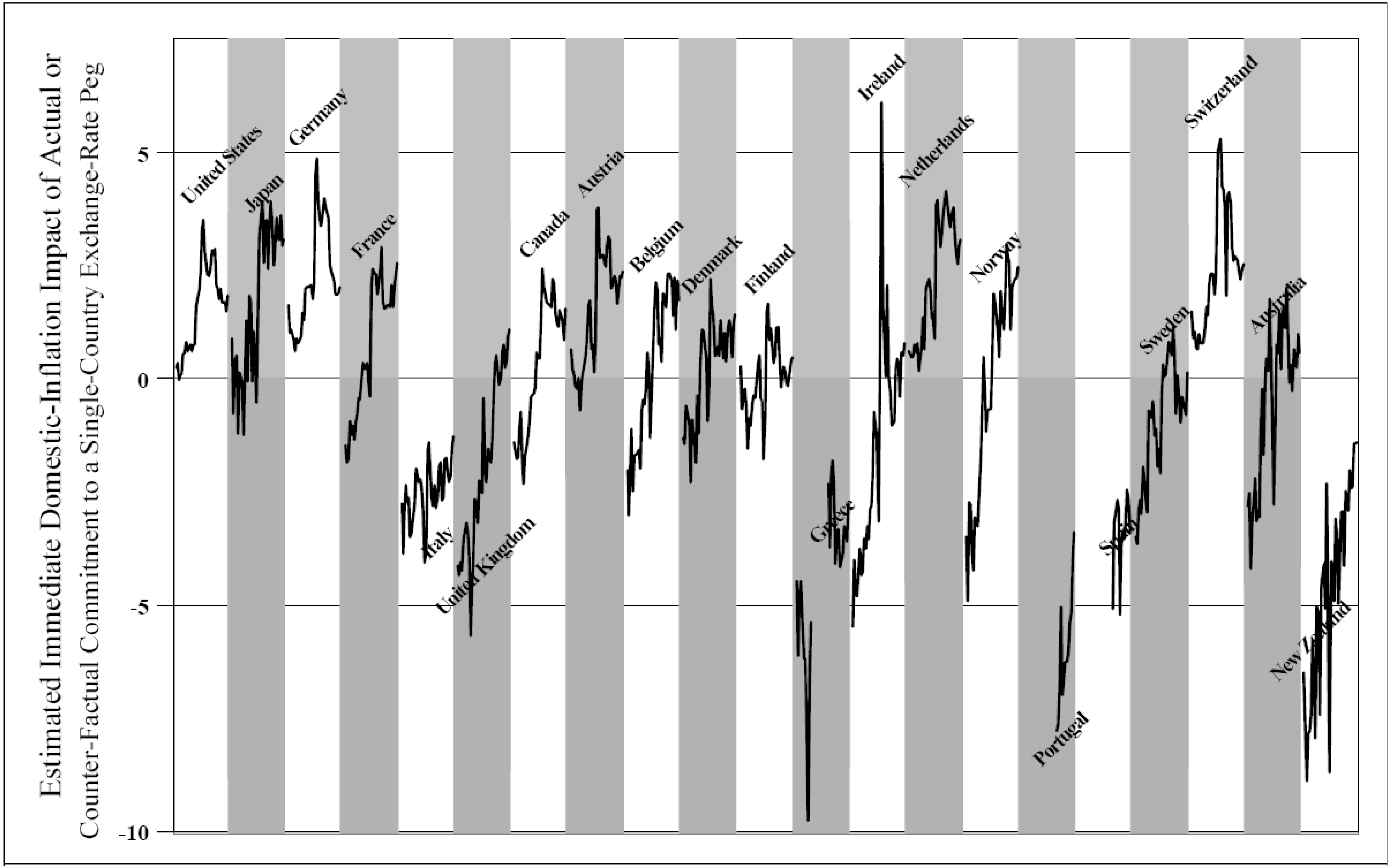


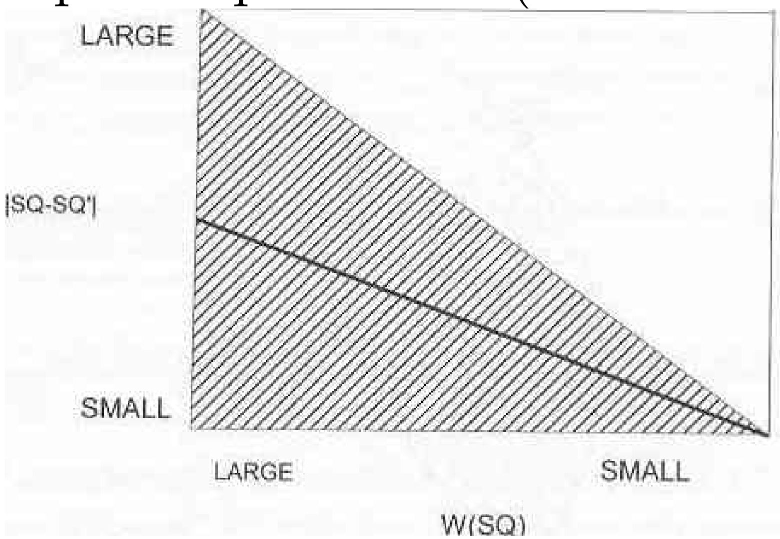
Figure 2: Estimated Domestic-Inflation Effect of Actual or Counter-Factual *SP* in 21 Countries, 1957-90. Estimates plotted for dINF/dSP at the values of all other variables in the equation actually occurring in that country-year. For counter-factual pegs, peg country assumed to have OECD-average inflation that year. Shading separates countries and extends from 1955 to 1990 in each country, left to right.

Multiple Policymakers: Veto Actors Bargaining in Common Pools

- Multiple implications for policy outcomes dispersal of policymaking-authority across diverse actors:
  - Veto-Actor Theory (Tsebelis '02) emphasizes:
    - Privileges *S.Q.*, & so retards policy adjustment, reduces change.
  - Collective-Action/Common-Pool Theories (WSJ '81):
    - Externalities & so overexploit/underinvest public goods.
  - Bargaining & Delegation Theories rather stress:
    - Bargaining Strengths/Positions, yielding Weighted Compromise.
- This project attempts a synthesis:
  - Disting. theoretically/conceptually many effects of # (fragment.) & diversity (polar., partisan) policymakers.
  - Empirical model of many effects distinctly & effectively.
  - Preliminary application to evolution fiscal policy (pub debt) in developed democracies, 1950s-90s.

Veto Actors: Deadlock, Delayed Stabilization, & Policy-Adjustment Retardation

- Tsebelis ('95b, '99, '00, '02): Essential Argument:
  - ↑ # &/or ideological/interest polarization of pol-mkng actors whose approval required to ΔSQ, i.e., *veto actors*, ⇒, loosely, ↓ probability &/or magnitude policy Δ.
  - I.e., strictly, as size W(SQ) ↓, which generally does as # &/or polarization VA ↑, range *possible* policy Δ(SQ) ↓.
  - ⇒ following empirical prediction (Tsebelis 2002, Fig. 1.7):



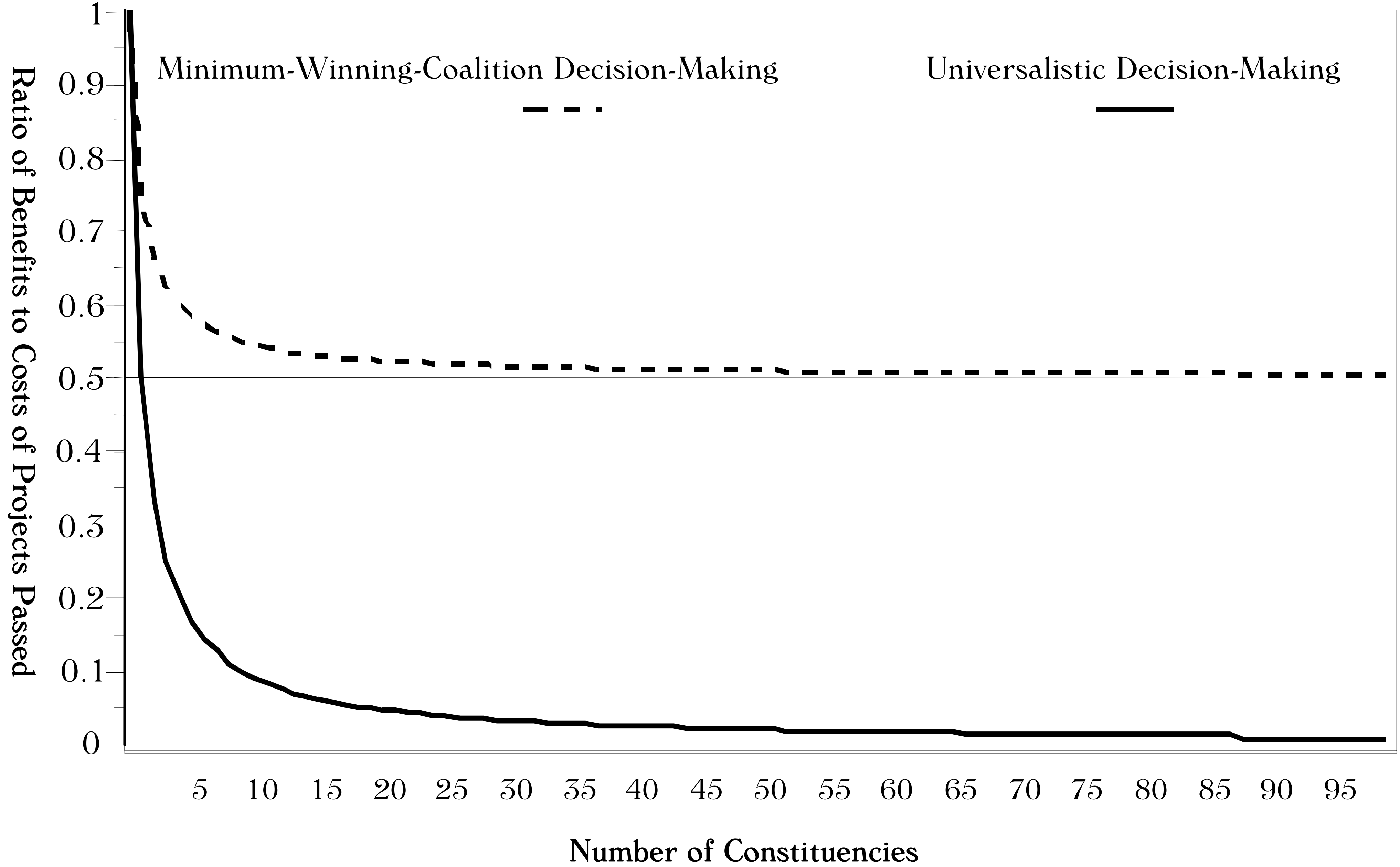
  - Suggests both mean/expected policy-Δ & variance pol & pol-Δ ↑↓ as size of W(SQ) ↑↓ (aside: why only suggests)
  - No prediction of pol-level or of direction pol-Δ, only of E(|Δp|), V(Δp).

Veto-Actor Implications

- $\uparrow$ # (=Frag) & Polar of VA Privileges SQ $\Rightarrow$
  - Retards policy-adjustment rates/delays stabilization,
  - $\downarrow$ range of possible policy-Δ, & so, possibly,
  - $\downarrow$ magnitude/variance policy- Δ (1^{st}- & 2^{nd}-order $E(\Delta)$).
- Results, e.g. in fiscal policy, deficits & debts; originally mixed, but tighter specify thry into empirical analysis:
  - (F '00, '02) **How model:** policy-adjustment-rate effect = conditional coefficient on LDV in dynamic model, not level.
  - (F '00, '02) **How measure:** frag & polar in VA theory =
    - raw #, not eff. # (size-wtd) VA;
    - max range pref's, not $V(pref's)$ or $sd(pref's)$, (size-wtd)
- $\Rightarrow$ Model: $y_t = \ldots + \rho(\#VA, Range\{pref(VA)\}) \times y_{t\text{-}1} \ldots$ &/or $V(y_t) = f(\#, Range)$ $\Rightarrow$ empirical support.

Common-Pool Theory (1)

- Weingast, Shepsle, Johnsen (1981): districting & distributive/pork-barrel spend (***law of 1/n***)
  - Benefits concentrate district *i*: $B_i = f(C)$, $f' > 0$ & $f'' < 0$
  - Costs disperse across *n* districts: $C_i = C/n$
  - $\Rightarrow$optimal project-size from *i*'s view $\uparrow$ in # districts: $f'(C^*) = 1/n$ (…log-linearly?)
- Alternative Decision Rules/Processes […] $\Rightarrow$
  - […] *Law of 1/n* is general, & stronger as legislative behavior more Universalistic & less Minimal-Winning, which tendency $\uparrow$ as rational ignorance, winning-coalition uncertainty, or legislative-rule closure to amend or veto $\uparrow$.
  - E.g., PubRev = common pool for *n* reps, overused to distribute bens; this CA prob worsens "proportionally" by *law 1/n*, i.e. at rate b/w those at which $(n+1)/2n$ (MWC) & $1/n$ (uni) $\downarrow$ in n
    - See next slide for illustration…



Minimum-Winning-Coalition Decision-Making
Universalistic Decision-Making
Ratio of Benefits to Costs of Projects Passed
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95
Number of Constituencies

Manifestations of Common Pools

- Velasco ('98, '99, '00): inter-temporal totality pub rev is C-P to today's policymakers ⇒ deficits & debts also *law of 1/n*
- Peterson & co's, Treisman: federalism ⇒ multiple tax authorities ⇒ several common-pool problems:
  - Inter-jurisdiction competition (w/ high factor mobility) ⇒ C-P of investment resources ⇒ over-fishing: taxes too low.
  - National govt as lender last resort ⇒ subnational jurisdictions see fed guarantee & funds as common pool ⇒ excessive borrowing by subnat'l units. (e.g., EU, EMU & Euro ⇒ common pools...)
- Again, should be quite general:
  - **Anything that gains set of pol-makers credit ⇒ underinvested as ↑n**
  - **Anything that gains set of pol-makers blame ⇒ overexploited as ↑n**
- E.g., (theory of the 2nd-best), ELECTIONEERING:
  - Magnitude incentive electioneer fades w/ n (see, e.g., Goodhart)
  - Control over electioneering diminishes w/ n.
- Notice: CP not arise in Tsebelis' VA Theory b/c # & pref's of VA's exog & predetermined, whereas in CP theory: prefs=$f(\#)$.

Modeling Common-Pool Effects

- CP Effects distinguishable from VA Effects:
  - C-P Effects on *levels*, not (as in VA) in dynamics.
  - Proportional to *1/n* for *equal-sized* actors. Standard Olsonian encompassingness logic ⇒ proper *n* here ***is*** *size-weighted* (effective & s.d./var.)
  - Fractionalization (#) & esp. polarization (het.) relate to VA effects; CP, conversely, relate primarily to #, although het. can exacerbate some CA probs.
- Suggests Proper Model of Policy-Response to some public demand for, $\mathbf{x}_1'\boldsymbol{\beta}_1$, or against, $\mathbf{x}_2'\boldsymbol{\beta}_2$:
  - $\ldots+(\mathbf{x}_1'\boldsymbol{\beta}_1)(1\text{-}f(ln(Eff\#))+(\mathbf{x}_2'\boldsymbol{\beta}_2)(1+f(ln(Eff\#))+\ldots$
  - Same $f(ln(Eff\#)$, b/c overexploit/underinvest same °

Bargaining, Delegation, & Compromise

- **Explicit extensive-form delegation & bargaining games:** huge theoretical & empirical literature
- F ('99,'02,'03): less context-specific empirical strategy…
  - Because broad comparativist seek thry that *travels*, not that requires different model each context.
- Offering is roughly equivalent Nash Bargaining.
  - Most ext forms ⇒ eqbm bounded by actors' ideal pts:
    - Convex set/hull, upper-contour set (=core of coop. game thry),
    - So like Tsebelis, but further, though short of explicit ext-form
  - Policy outside that range possible,
    - e.g., if uncertainty resolved unfavorably,
    - but that ⇒ highly unlikely that E(pol) outside this range
  - Thus, E(pol)=some convex-combo (wtd-avg) pol-mkrs' ideals ⇒ convex-combo emp. models ≈ compromise
    - If Nash Bargain, e.g., (n.b. NB=coop. game-thry but equiv. sev. reasonable ext-form non-coop barg. games: Rubinstein '82), ⇒ (geometric) ***wtd-influence pol-mkng***; i.e., simple wtd-avg.

Empirical Manifestations & Model of Compromise Policymaking

- Re: def's & debt, Cusack ('99, '01; cf., Clark '03)
  - *Arg:* left more Keynes-active counter-cyc; right less, even pro-cyc
  - *Add Nash-Barg Model* $\Rightarrow$ wtd-avg pol-mkr partisanship conditions º Keynesian cntr-cyc fisc-pol response to macroecon.
- Empirical Implementation:
  - Ideally:
    - Describe barg power party i as $f($charact's i & barg envir, j, $\Rightarrow f(\boldsymbol{v}_{ij})$
    - Desc. pol response to conditions $\mathbf{x}_\mathrm{k}$ if i sole pol-mkng control: $q_i(\mathbf{x}_\mathrm{k})$
    - Then embed Nash-Barg sol'n, $\boldsymbol{\Sigma}_\mathrm{i} f(\boldsymbol{v}_{ij}) q_i(\mathbf{x}_\mathrm{k})$, in emp. model to est.
  - Currently:
    - Assume wtd-avg compromise outcome pre-estimation.
    - I.e., simply assume by measure & specification that Policy responds to $WtdPartisanshipCurrGovt \times MacroeconomicConditions$.

Empirical Model of the Theoretical Synthesis (1)

- Different aspects of policy-maker fragmentation, polarization, & partisanship:
  - V-A Effects: raw # (frag) and ideological ranges (polar)
  - C-P Effects: eff # (frag) &, maybe, ideol. s.d./var (polar)
  - D-B Effects: power-wtd mean ideologies (partisanship)
- Different ways these distinct effects manifest in pol:
  - V-A (primarily) to slow pol-adjust (delay stabilization);
  - C-P induces over-draw from common resources (incl. from future as in debt); under-invest in common properties (less electioneering), log-proportionately
  - D-B induces convex-combinatorial (compromise) policies, incl. greater left-activist/right-conservative Keynesian-countercyclical/conservative pro-cyclical, in proportion to degree left/right controls policymaking

Empirical Model of the Theoretical Synthesis (2)

- …implies specification where:
  - Abs # VA & ideol range modify pol-adjust rates
  - (log) Eff # pol-mkrs & s.d. ideol (wtd measures) gauge C-P prob in *electioneering* (+debt-lvl effect?)
  - Some barg process among partisan pol-mkrs (e.g., Nash ⇒ wtd-influence) determines combo reflected in net policy responsiveness to macro (° K-activism)
- ⇒

$$
\begin{aligned}
D_{it} = {} & \alpha_i + \left(1+\rho_n NoP_{it} + \rho_{ar} ARwiG_{it}\right)\times\left(\rho_1 D_{i,t-1} + \rho_2 D_{i,t-2} + \rho_3 D_{i,t-3}\right) \\
& + \left(\beta_{\Delta Y}\Delta Y_{i,t} + \beta_{\Delta U}\Delta U_{i,t} + \beta_{\Delta P}\Delta P_{i,t}\right)\times\left(1+\beta_{cg} CoG_{it}\right) \\
& + \left(\gamma_{e1} E_{it} + \gamma_{e2} E_{i,t-1}\right)\times\left(1+\gamma_{en} ENoP_{it} + \gamma_{sd} SDwiG_{it}\right) + \mathbf{x}'_{it}\boldsymbol{\eta} + \mathbf{z}'_{it}\boldsymbol{\omega} + \varepsilon_{it}
\end{aligned}
$$

Empirical Model Specification & Data

$$D_{it} = \alpha_i + \left(1 + \rho_n NoP_{it} + \rho_{ar} ARwiG_{it}\right) \times \left(\rho_1 D_{i,t-1} + \rho_2 D_{i,t-2} + \rho_3 D_{i,t-3}\right) + \mathbf{x}'_{it}\boldsymbol{\eta} + \mathbf{z}'_{it}\boldsymbol{\omega} + \varepsilon_{it}$$

$$+\left(\beta_{\Delta Y}\Delta Y_{i,t} + \beta_{\Delta U}\Delta U_{i,t} + \beta_{\Delta P}\Delta P_{i,t}\right) \times \left(1 + \beta_{cg} CoG_{it}\right) + \left(\gamma_{e1} E_{it} + \gamma_{e2} E_{i,t-1}\right) \times \left(1 + \gamma_{en} ENoP_{it} + \gamma_{sd} SDwiG_{it}\right)$$

D_{it} = Debt (%GDP);

NoP & *ARwiG* = raw *N*um *o*f *P*rtys in *G*ovt & *A*bs *R*ange *w/i G*ovt:

VA conception, so modify dynamics. Expect ρ_n & $\rho_{ar} > 0$.

By thry & for efficiency: modify all lag dynamics same.

CoG (govt center, left to right, 0-10):

Modifies response to macroecon (equally, by thry & for eff'cy) : $\beta_{cg} < 0$.

Macroec: ΔY = real GDP growth; ΔU = Δ unemp rate; ΔP = infl rate.

$\boldsymbol{x'\eta}$ = controls: set pol-econ cond's response to which not partisan-differentiated or gov comm-pool: (e.g., E(real-int)-E(real-grow), *ToT*)

ENoP & *SDwiG* = *E*ffective *N*um *o*f *P*rtys in govt & *S*td *D*ev *w/i G*ovt:

Frag & Polar by *wtd-influence* concept. CP lvl-effects modify (at same rate) electioneering, pre-elect: E_t & post-elect: E_{t-1}: γ_{en} & $\gamma_{sd} < 0$.

$\boldsymbol{z'\omega}$ = set of constituent terms in the interactions:

ENoP, *SDwiG* *may* have positive coeff's by CP effect lvl debt, but issue is *temporal fract*, not curr. govt *fract*. Thry o/w says omit.

		Coeff.	Std. Err.	*t*-Stat.	Pr($T>\|t\|$)
Lagged Dependent Variables	D_{t-1}	1.212	0.060	20.112	0.000
	D_{t-2}	-0.153	0.085	-1.792	0.074
	D_{t-3}	-0.121	0.045	-2.677	0.008
$\boldsymbol{\rho_n}$ (*veto-actor effect: fractionalization*)		**0.007**	**0.006**	**1.089**	**0.277**
$\boldsymbol{\rho_{ar}}$ (*veto-actor effect: polarization*)		**-0.000**	**0.006**	**-0.013**	**0.990**
Macroeconomic Conditions	ΔY	-0.336	0.111	-3.033	0.003
	ΔU	0.992	0.308	3.219	0.001
	ΔP	-0.188	0.063	-2.965	0.003
$\boldsymbol{\beta_{cg}}$ (*partisan-compromise bargaining*)		**-0.037**	**0.037**	**-0.988**	**0.323**
Controls	x_1 (*open*)	15.891	5.279	3.010	0.003
	x_2 (*ToT*)	0.388	1.744	0.222	0.824
	x_3 (*open·ToT*)	-10.681	5.156	-2.072	0.039
	x_4 (*dxrig*)	-0.036	0.066	-0.544	0.587
	x_5 (*oy*)	2.064	1.094	1.886	0.060
Pre- and Post-Electoral Indicators	E_t	0.687	0.568	1.210	0.227
	E_{t-1}	1.490	0.645	2.310	0.021
$\boldsymbol{\gamma_{en}}$ (*common-pool effect: fractionalization*)		**-0.547**	**0.182**	**-3.001**	**0.003**
$\boldsymbol{\gamma_{sd}}$ (*common-pool effect: polarization*)		**0.573**	**0.486**	**1.179**	**0.239**
Constituent Terms from the Interactions	z_1 (*CoG*)	0.051	0.131	0.390	0.697
	z_2 (*ENoP*)	0.281	0.446	0.629	0.530
	z_3 (*SDwiG*)	0.542	0.437	1.242	0.215
	z_4 (*NoP*)	0.181	0.277	0.654	0.514
	z_5 (*ARwiG*)	-0.312	0.259	-1.205	0.228
Summary Statistics					
N (Deg. Free)		735 (691)		s_e^2	2.525
R^2 ($\overline{R}^2$)		0.991 (0.990)		**DW-Stat.**	2.101

- Joint-significance of multiple-policymaker conditioning effects (γ_{en}, γ_{sd}, ρ_n, ρ_{ar}, β_{cg}) overwhelmingly rejects excluding (p≈.001), whereas joint-sig coeff's on constit. terms, **z**, clearly fails reject (p≈.602) exclusion. (Almost) All theory says should be zero (*SDwiG* & *ARwiG* closest thry & emp.), so…

		Coeff.	Std. Err.	*t*-Stat.	Pr(*T*>|*t*|)
Lagged Dependent Variables	D_{t-1}	1.207	0.060	20.290	0.000
	D_{t-2}	-0.158	0.085	-1.851	0.065
	D_{t-3}	-0.117	0.045	-2.577	0.010
ρ_n (*veto-actor effect: fractionalization*)		**0.011**	**0.005**	**2.369**	**0.018**
ρ_{ar} (*veto-actor effect: polarization*)		**-0.002**	**0.004**	**-0.437**	**0.662**
Macroeconomic Conditions	ΔY	-0.375	0.087	-4.332	0.000
	ΔU	1.095	0.286	3.829	0.000
	ΔP	-0.207	0.053	-3.889	0.000
β_{cg} (*partisan-compromise bargaining*)		**-0.051**	**0.020**	**-2.484**	**0.013**
Controls	x_1 (*open*)	16.128	5.314	3.035	0.002
	x_2 (*ToT*)	0.414	1.728	0.239	0.811
	x_3 (*open·ToT*)	-10.780	5.194	-2.076	0.038
	x_4 (*dxrig*)	-0.038	0.066	-0.578	0.563
	x_5 (*oy*)	1.898	1.100	1.724	0.085
Pre- and Post-Electoral Indicators	E_t	0.475	0.420	1.133	0.258
	E_{t-1}	1.146	0.562	2.040	0.042
γ_{en} (*common-pool effect: fractionalization*)		**-0.570**	**0.209**	**-2.727**	**0.007**
γ_{sd} (*common-pool effect: polarization*)		**0.881**	**0.586**	**1.503**	**0.133**
		Summary Statistics			
N (Deg. Free)		735 (696)		s_e^2	2.522
R^2 ($\overline{R}^2$)		0.991 (0.990)		**DW-Stat.**	2.099

Veto-Actor Effects: Estimates of Policy-Adjustment Rate

Adjustment Rates	***NoP*=1**	***NoP*=2**	***NoP*=3**	***NoP*=4**	***NoP*=5**	***NoP*=6**
Lag Coefficient[a]	0.943	0.952	0.960	0.969	0.978	0.986
Policy-Adjust/Yr[b]	0.057	0.048	0.040	0.031	0.022	0.014
Long-Run Mult.[c]	17.498	20.639	25.154	32.200	44.727	73.208
½-Life[d]	11.778	13.956	17.087	21.971	30.654	50.397
90%-Life[e]	39.127	46.362	56.761	72.985	101.832	167.415

Bargaining Effects: Estimates of Keynesian Fiscal Responsiveness

	Mean Econ. Performance -2 std. dev.	*Mean Econ. Performance -1 std. dev.*	*Mean Economic Performance*	*Mean Econ. Performance +1 std. dev.*	*Mean Econ. Performance +2 std. dev.*	
Growth	-2.354	0.454	3.261	6.069	8.877	
d(UE)	1.915	1.034	0.153	-0.728	-1.608	
Infl	-3.593	1.230	6.054	10.877	15.701	
CoG	*E(D|Econ)*[f]	*E(D|Econ)*	*E(D|Econ)*	*E(D|Econ)*	*E(D|Econ)*	*Fiscal-Cycle Magnitude*[g]
3.0	3.157	0.599	-1.959	-4.516	-7.074	10.231
4.2	2.930	0.556	-1.818	-4.192	-6.566	9.496
5.4	2.703	0.513	-1.677	-3.867	-6.058	8.761
6.6	2.476	0.470	-1.536	-3.543	-5.549	8.026
7.8	2.250	0.427	-1.396	-3.218	-5.041	7.291
9.0	2.023	0.384	-1.255	-2.894	-4.533	6.555

Collective-Action/Common-Pool Effects: Estimates of Electoral Debt-Cycle Magnitude

	***ENoP*=1**	***ENoP*=2**	***ENoP*=3**	***ENoP*=4**	***ENoP*=5**
Electoral-Cycle Magnitude[h]	1.07410	0.86454	0.65497	0.44541	0.23585

Extension & Refinement

$$E(y_t) = \delta^0 + \mathbf{x}_t^0\mathbf{b}^0 + \left(\rho_0 + \rho_1 \ln(NoP_t) + \rho_2 \ln(1 + ARwiG_t)\right) y_{t-1}$$

$$+ \left\{ \begin{array}{l} \left[\mathbf{x}_t^1\mathbf{b}^1 + \sum_{i=1}^{I} p(\mathbf{c}_{it}) \times q_i(\mathbf{x}_t^2) \right] \\ \times \left[1 + \gamma_1 \ln(ENoP_t) + \gamma_2 \ln(1 + SDwiG_t) \right] \end{array} \right\} \times \left[1 + \alpha_1 \ln(NoP_t) + \alpha_2 \ln(1 + ARwiG_t) \right]$$

- $\mathbf{x}^0$ = factors that affect policy-outcomes *unless* pol-mkrs act to change *status quo*, i.e., that have effect on pol-out directly.
- $\mathbf{x}^1$ = factors affecting policy-outcomes *if* policymakers act to change status quo, *without* partisan-differentiated response
- $\mathbf{x}^2$ = factors affecting policy-outcomes *if* policymakers act to change status quo, *with* partisan-differentiated response
- $\{NoP, ARwiG\}$ = sources of **veto-actor effects**; as before
- $\{ENoP, SDwiG\}$ = sources of **common-pool effects**; as before
- $\{p(\mathbf{c}_{it}), q_j(\mathbf{x}_t)\}$ = sources of **bargaining & delegation effects**:
  - $p(\mathbf{c}_{it})$: Effective policy-influence of party i in context t. (E.g., as now: cabinet seat-shares, but could become richer model.)
  - $q_j(\mathbf{x}_t)$: Model of response of party i to pol-econ conditions $\mathbf{x}_t$. (E.g., as now: $CoG_i \times Macroecon_t$, but could become richer model.)

Preliminary Results of Fuller Model

		Coeff.	Std. Err.	*t*-Stat.	Pr(*T*>|*t*|)
Temporal Dynamics	D(t-1)	1.197	0.059	20.144	0.000
	D(t-2)	-0.139	0.085	-1.629	0.104
	D(t-3)	-0.121	0.045	-2.698	0.007
Veto-Actor Effect On Outcome-Adjustment Rate	**NoP**	**0.008**	**0.004**	**1.883**	**0.060**
$\mathbf{x}_0$: Variables with "Direct" Effect on Outcome	Open	16.624	3.758	4.423	0.000
	Open*ToT	-11.190	3.135	-3.569	0.000
$\mathbf{x}_1$: Variables with Effects via Non-Partisan-Differentiated Policy Response	Ele(t)	0.315	0.363	0.867	0.386
	Ele(t-1)	0.873	0.399	2.186	0.029
	OY	2.833	1.295	2.187	0.029
	DXRIG3	-0.073	0.072	-1.009	0.314
Common-Pool Effect on Policy Response	**ln(ENoP)**	**-0.277**	**0.071**	**-3.903**	**0.000**
$\mathbf{x}_2$: Variables with Effects via Partisan-Differentiated Policy Response	Growth	-0.238	0.084	-2.815	0.005
	d(UE)	0.749	0.228	3.289	0.001
	Inflation	-0.137	0.047	-2.947	0.003
Bargaining-Compromise Effects on Partisan Policy-Responses	**CoG**	**-0.049**	**0.026**	**-1.893**	**0.059**
Veto-Actor Effect On Policy-Adjustment Rate	**NoP**	**0.215**	**0.121**	**1.773**	**0.077**
Common-Pool Effect on Debt Level	*ln(ENoP)*	*1.128*	*0.486*	*2.320*	*0.021*
Summary Statistics					
N (Deg. Free)		735 (697)		s_e^2	2.510
R^2 ($\overline{R}^2$)		0.991 (0.990)		**DW-Stat.**	2.090