EITM*s*

Approaches for Positive Political-Science Research

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A Little History

- CfP for a training program to address Lack of Cumulation and Progress in Political-Science Research.
  - Identified @ Root: Lack integration & communication b/w theoretical & empirical work ⇒
    - Formal theory w/o empirical reference or application +
    - Qualitative analyses w/o useful, reliable generalization ⇒
    - Empirical (statistical+) results w/o theoretical/substantive meaning. I.e., an unconnected, untidy, unclear, disjointed, disorienting, metaphoric morass of Pointillistic Failures & Trains leaving station at night
  - Groups @ UMich & @ Harvard, joined: Aldrich, Alt, Brady & I…
    - I was most skeptical: simultaneously create & teach body of knowledge that not coherently exist, certainly not codified… The wiser, more experienced:
      - Bootstrap, parade scholars doing best, closest facsimiles by the brightest, eager grad students, & it will build itself… & anyway, community…
      - And darned if it didn't work! What these grad students accomplished: wow!

Empirical Analysis in Social Science

- **Three (no: four) Fundamental Challenges:**
    - Franzese (2007) "Multi-Causality, Context-Conditionality, & Endogeneity," in *Oxford Handbook of Comparative Politics*, C. Boix, S. Stokes, eds., Oxford UP, 27-72.
  - Multi-causality:
    - Just about everything matters.
  - Complex context-conditional causality:
    - The way just about everything matters depends on just about every else.
  - Ubiquitous Endogeneity: Multi-, even omni-, -directional causality
    - Just about everything causes just about everything else.
  - [Micronumerosity (originally Goldberger's coinage for multicolinearity):
    - Oh, & have precious little data (useful variation) w/ which sort it all out…]
- **EITM = very useful approach to address challenges**

EITM: Definitions, Quotes, & the Point

- EITM = a Good Response to the Challenges (of Cumulation & 3 Fundamental Challenges Soc. Sci.)
  - **<u>Definition</u>:** Tighter Integration, Deeper Interaction, & Better Communication Theoretical & Empirical Work
  - **Some <u>Quotes</u>** (that I made & like, & that you can use if you do too)**:**
    - "Empirical results are only as theoretically informative as they are theoretically informed."
      - "Empirical results will be, & can only be, as theoretically informing as the empirical specifications from which they derive are thrtclly informed."
      - "Only theoretically informed empirical models, & only insofar & to degree they are theoretically informed, inform theory."
      - "The degree to which empirical model theoretically informed equals the potential of its estimation results to inform theory."
  - **<u>Point</u>:** Specification* is everything.
    - * Note: *specification* includes measurement & identification strategy.

EITM: Many Permutations

- EITM*s*: Many visions, interpretations, & approaches:
  - EITM: **E**mpirical **I**mplications of **T**heoretical **M**odels
    - *Vision:* Theory ⇒ more, sharper predictions ⇒ better tests (typically of isolated comparative-statics, first derivatives), which ∴ inform theory more
    - *Examples* (from EITMs I involved): Morton, Granato, McCarty (1st time)
  - TMEI: **T**heory-specified **M**odels for **E**mpirical **I**nference
    - *Vision:* Theoretical model (fully) structures empirical (statistical) models & relations b/w obs ⇒ specification & (causal) identification empirical models
    - *Examples:* Diermeier, Signorino, Mebane, Achen, Sartori, Smith
  - TIEM: **T**heoretical **I**mplications of **E**mpirical **M**easures
    - *Vision:* Empirical regularity, finding, fact, measure informs theory develop.
    - *Examples:* Brady, Ericson, McCarty (2nd time)
  - EMTI: **E**mpirical **M**odels of **T**heoretical **I**ntuitions
    - *Vision:* **Intuitions** derived from theoretical models specify empirical models
    - *Examples:* Franzese, Kedar, Franzese & Hays

EITM International Relations Panel

- Five fantastic papers,
- Illustrating several of the different constructive of EITM, and
- Each demonstrating the great contributions of the multifarious EITMs to a generation of outstanding scholars producing tremendous scholarship (…at a prodigious rate!)

Empirical Specification of Theoretical Intuitions

- Core Implication Theory: $\mathbf{y} = f\left(\mathbf{X}, \mathbf{B}, \boldsymbol{\varepsilon}\right)$
  - Equivalently: $E\left(\mathbf{y}\right) = f\left(\mathbf{X}, \mathbf{B}\right), \boldsymbol{\varepsilon} \sim g\left(\boldsymbol{\varepsilon}\right)$
  - Most Common Hypotheses Regard: $\dfrac{\partial \mathbf{y}}{\partial x \in \mathbf{X}}$
- EMTI emphasizes that far too little typically drawn from theoretically implied f() & g().
  - Usually theory used just to suggest *x*'s to set as arguments, lin-addly by default, to regression or likelihood deemed appropriate.
  - Hypotheses confined to 1st-derivative >0/<0.

Empirical Specification of Theoretical Intuitions (2)

- Empir. Core of Theory: $\mathbf{y} = f\left(\mathbf{X}, \mathbf{B}, \boldsymbol{\varepsilon}\right) \text{ with } \boldsymbol{\varepsilon} \sim g\left(\boldsymbol{\varepsilon}\right)$
  - I.e., that *y*=some function of **X**, some parameters **β** linking **X** to *y* by that function, & some stochastic component (random chance), **ε**.
  - In easier cases, stochastic component additively separable from systematic component:

$$\mathbf{y} = f\left(\mathbf{X}, \mathbf{B}\right) + \boldsymbol{\varepsilon} \text{ with } \boldsymbol{\varepsilon} \sim g\left(\boldsymbol{\varepsilon}\right)$$

  - Either way, theoretical model or intuitions and substance tend suggest more about some specific *f()*, & not always or even often linear-additive so that:

$$\mathbf{y} = \mathbf{XB} + \boldsymbol{\varepsilon} \text{ with } \boldsymbol{\varepsilon} \sim g\left(\boldsymbol{\varepsilon}\right)$$

  - ⇒ ***Model it!***

Nonlinear Least-Squares (NLS)

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

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

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

$\Rightarrow \underset{\hat{\mathbf{B}}}{Min}\ \text{SSE}=\mathbf{y}'\mathbf{y} - \mathbf{y}'f(\mathbf{X},\hat{\mathbf{B}}) - f(\mathbf{X},\hat{\mathbf{B}})'\mathbf{y} - f(\mathbf{X},\hat{\mathbf{B}})' f(\mathbf{X},\hat{\mathbf{B}})$

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

So, if, e.g., $f(\mathbf{X},\hat{\mathbf{B}}) = \mathbf{X}\hat{\mathbf{B}}$, then: $\mathbf{X}'\mathbf{y} = \mathbf{X}'\mathbf{X}\hat{\mathbf{B}} \Rightarrow \hat{\mathbf{B}}^*_{LS} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{y}$

$\widehat{\mathbf{V}(\hat{\boldsymbol{\varepsilon}})}_{LS} = \frac{1}{n-k}\left[\mathbf{y} - f(\mathbf{X},\hat{\mathbf{B}}^*_{LS})\right]'\left[\mathbf{y} - f(\mathbf{X},\hat{\mathbf{B}}^*_{LS})\right]$ (also, as always)

Writing $\nabla_{\hat{\mathbf{B}}} f(\mathbf{X},\hat{\mathbf{B}})$ as simply ∇, we have:

$\widehat{\mathbf{V}(\hat{\mathbf{B}}^*_{LS})}_{LS} = \widehat{\mathbf{V}\left((\nabla'\nabla)^{-1}\nabla'\mathbf{y}\right)} = (\nabla'\nabla)^{-1}\nabla'\widehat{\mathbf{V}(\mathbf{y})}\nabla(\nabla'\nabla)^{-1}$

$= (\nabla'\nabla)^{-1}\nabla'\hat{\boldsymbol{\Omega}}\nabla(\nabla'\nabla)^{-1}$, which if $f(\mathbf{X},\hat{\mathbf{B}}) = \mathbf{X}\hat{\mathbf{B}}$ meaning $\nabla = \mathbf{X}$

$\Rightarrow (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\hat{\boldsymbol{\Omega}}\mathbf{X}(\mathbf{X}'\mathbf{X})^{-1}$, &, if $\boldsymbol{\Omega}=\sigma^2\mathbf{I}, \Rightarrow \sigma^2(\mathbf{X}'\mathbf{X})^{-1}$, as always.

Nonlinear Least-Squares & EMTI

- **The Practical Point:**
  - Everything you already know about OLS, all understandings & intuitions, basically apply NLS too.
  - Good thing, b/c theories often ⇒ nonlinear predictions, & b/c we want/need incorporate that fuller information from the theories
- **Examples:** (Shift to presentations of examples if time & inclination…)
  - Principal-Agent (*Multiple Hands on the Wheel*) Contexts
    - *Two Hands on the Wheel*: Cntrl Bnks & Govts, AJPS (1999)
    - *Multiple Hands…*: Domestic & (all) Foreign Cntrl Bnks & Govts PA (2003)
  - Multiple Effects of Multiple Policymakers: Veto-Actor, Common-Pool, & Bargaining (RISP 2010 & Waseda 2007)
  - Comparative Democratic *Budgeteering*: (A cautionary tale…?)