Practice Variation in Team Decisions: Evidence from Physicians in Training

David Chan

Stanford University and NBER

December 7, 2017

Motivation

- Identities of key individuals matter a great deal for productivity of organizations (Bertrand and Schoar, 2003; Bloom and Van Reenen, 2010; Gibbons and Henderson, 2012)
- In health care, practice variation (in team production) has received intense policy and research attention
- What causes similar professionals in teams facing similar problems to make very different decisions?
  - How do individuals sway team decisions (*influence* in teams)?
  - To what extent do individuals learn to practice similarly as they gain experience?

This Paper

- Study of physicians in training ("housestaff") in large academic hospital; setting well-suited to studying learning and team decisions
  - Intensive period of training, designed to last a professional lifetime; observe diversity of trainees
  - Decision-making explicitly made in mechanically composed teams
  - Patients randomly assigned to teams $\Rightarrow$ trainees face similar decisions
- Empirically characterize effect of trainees on team decisions as they gain experience
  - Shed light on learning and influence as function of experience

Conceptual Framework

- Team theoretic framework (Cyert and March, 1963; Garicano, 2000)
  - Decision-making distributed within teams, based on problems encountered and knowledge
  - Knowledge is tacit: "I know more than I can tell" - Polanyi's Paradox (1966) [Autor et al, 2003]
- Expand setup to include learning, possibly over a rich space of problems
  - If learning is partial and space is rich, decisions made by **extrapolation** $\Rightarrow$ practice variation due to senior team members widespread across decisions (i.e., **not** "management by exception" in the standard setup)
- Learning and team decision-making may differ across types of decisions and environments

Summary of Empirical Findings

1. Large housestaff variation in practices, summarized by spending, attributable to trainees
2. Influence within teams: discontinuous quadrupling of variation when housestaff advance in seniority on team
3. Profile of practice variation depends on decisions and setting
   - Larger variation, and greater senior influence, for decisions typically requiring discretion (e.g., diagnostic decisions)
   - Greater senior influence for patients early in their stays
   - Convergence towards common practice in specialist services (cardiology and oncology), where knowledge is more systematized, but not in general medicine
4. Rich predetermined characteristics (ability, preferences), tenure, and exposure to attending practice styles do not predict spending

Institutional Setting: Medical Residency

- Care delivered in teams
  - Interns (PGY1), residents (PGY2 and PGY3), and attending physicians
  - Intern and resident roles not formally different, although differences in span of control – one resident to two interns (Note: hierarchical structure common in many organizations)
- Quasi-random assignment of patients to teams
- Same housestaff in different environments, frequent switches (every two weeks)
- Different types of housestaff in same training

Data and Outcomes

Patient and provider data associated with 220,117 admission-days over 6 years

- Detailed cost information for each cost item: 3.2 million orders; aggregate orders to patient, day, decision type
- Providers: 724 unique interns, 410 unique residents, and 540 unique attendings
  - Each housestaff: scheduling data, characteristics (demographics, test scores, rank list position, education), track
- Patients: demographics, diagnoses (ICD-9, DRG weights)

Random Assignment

	Interns		Residents	
	Below-median test spending	Above-median test spending	Below-median test spending	Above-median test spending
Patient characteristics				
Age	62.11 (16.90)	62.13 (16.86)	62.07 (16.82)	62.15 (16.93)
Male	0.484 (0.500)	0.482 (0.500)	0.489 (0.500)	0.478 (0.500)
White race	0.706 (0.455)	0.703 (0.457)	0.708 (0.455)	0.702 (0.457)
Black race	0.161 (0.367)	0.159 (0.365)	0.157 (0.364)	0.162 (0.368)
Charlson comorbidity index	2.87 (2.79)	2.87 (2.79)	2.84 (2.77)	2.90 (2.81)
Diagnostic-related Group (DRG) weight	1.25 (0.86)	1.25 (0.84)	1.27 (0.85)	1.24 (0.84)
Supervising physicians				
Above-median-spending residents	0.500 (0.501)	0.500 (0.501)	N/A	N/A
Above-median-spending attendings	0.503 (0.501)	0.502 (0.501)	0.501 (0.501)	0.502 (0.501)

Empirical Strategy

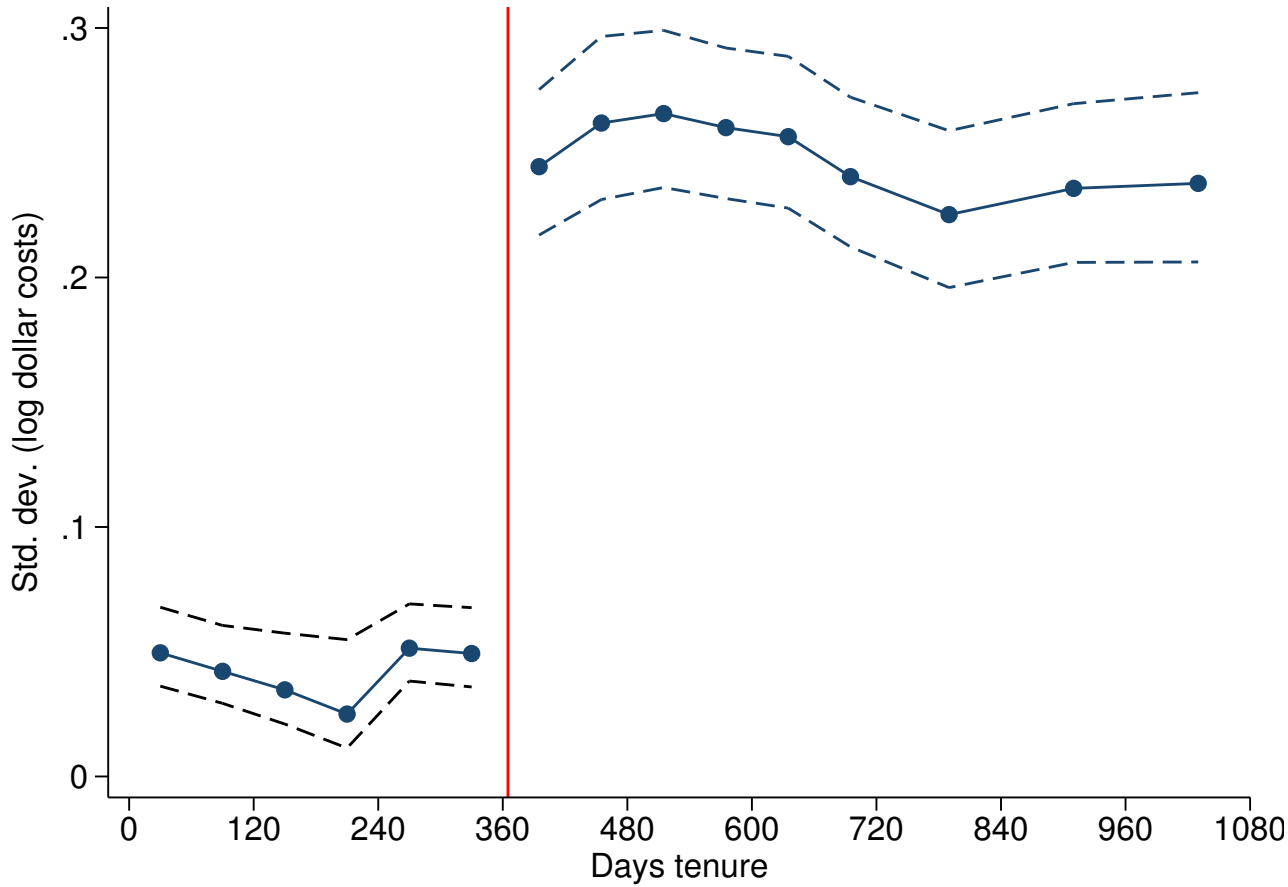
- Measure variation in housestaff *causal effects* in each 60-day tenure period τ using random effects model:

$$Y_{aijkt} = \beta \mathbf{X}_a + \eta \mathbf{T}_t + \zeta_k + \xi_i^{\tau(i,t)} + \xi_j^{\tau(j,t)} + \nu_{ai} + \varepsilon_{aijkt},$$

  where ζ_k is a fixed effect for attending k and $\xi_i^{\tau(i,t)}$, $\xi_j^{\tau(j,t)}$, and ν_{ai} are random effects.
  - Estimate distribution of random effects in each tenure period
- Trainee effect capture two objects of interest:
  - **Judgment** (what trainee would have done on her own) and **influence** (extent to which she sways team decision)
  - Separate influence by discontinuity in role on team at one-year mark

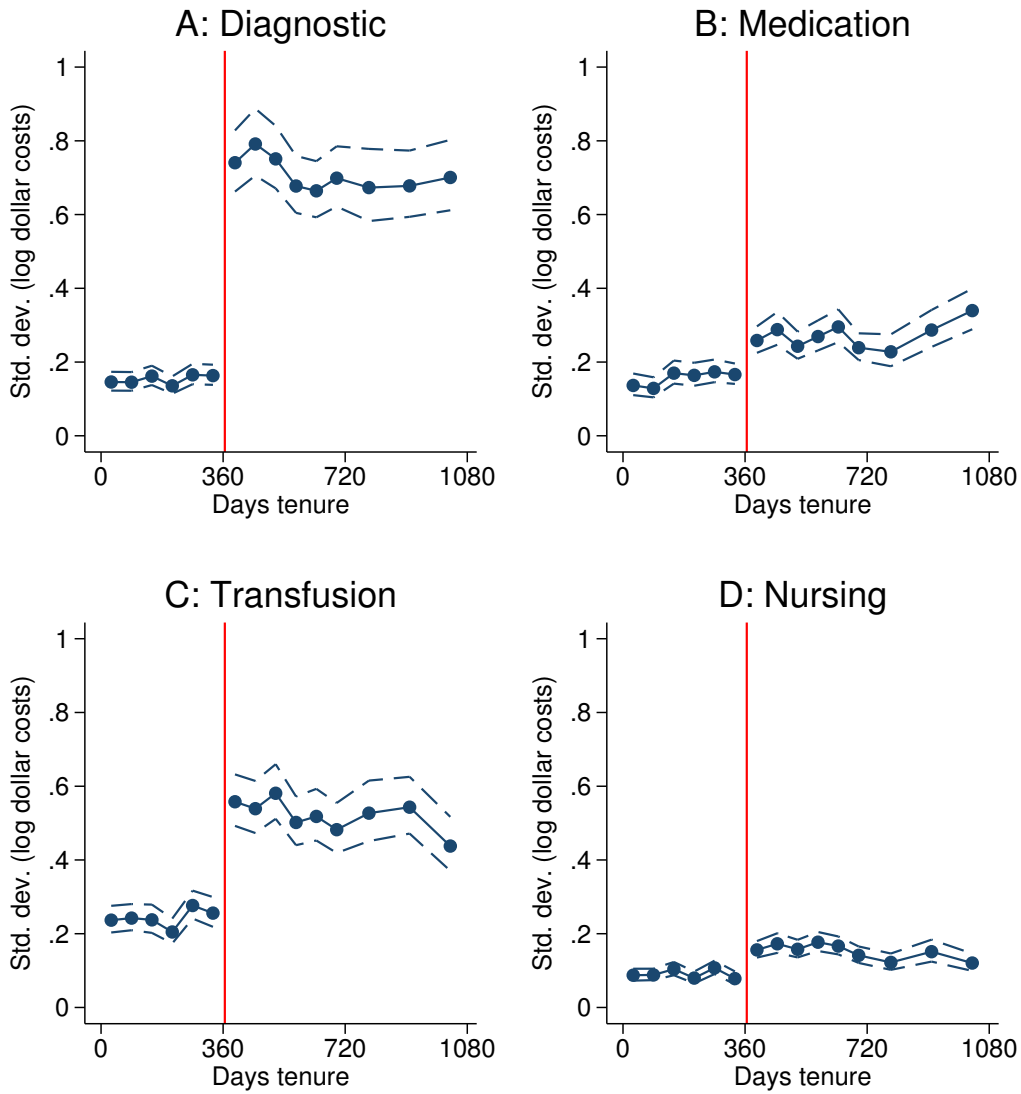
Practice Variation Profile

Standard Deviation of Trainee Effects by Tenure



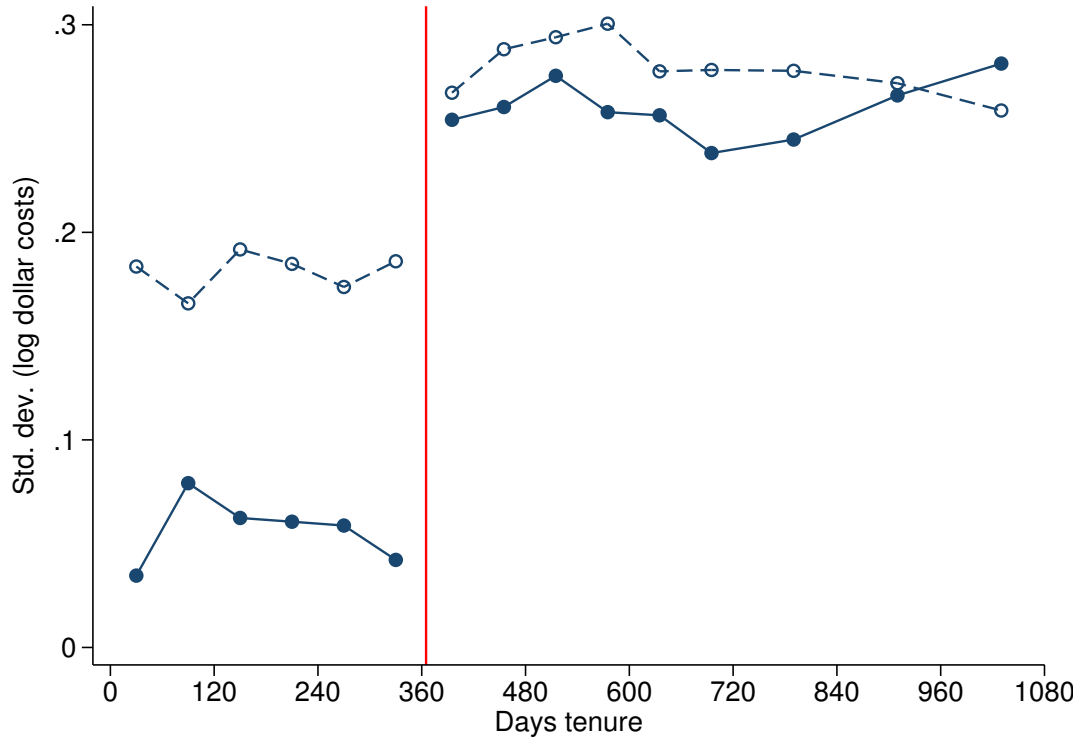
Practice Variation Profile by Decision Type

Standard Deviation of Trainee Effects by Tenure



Practice Variation Profile by Day of Patient Stay

Standard Deviation of Trainee Effects by Tenure

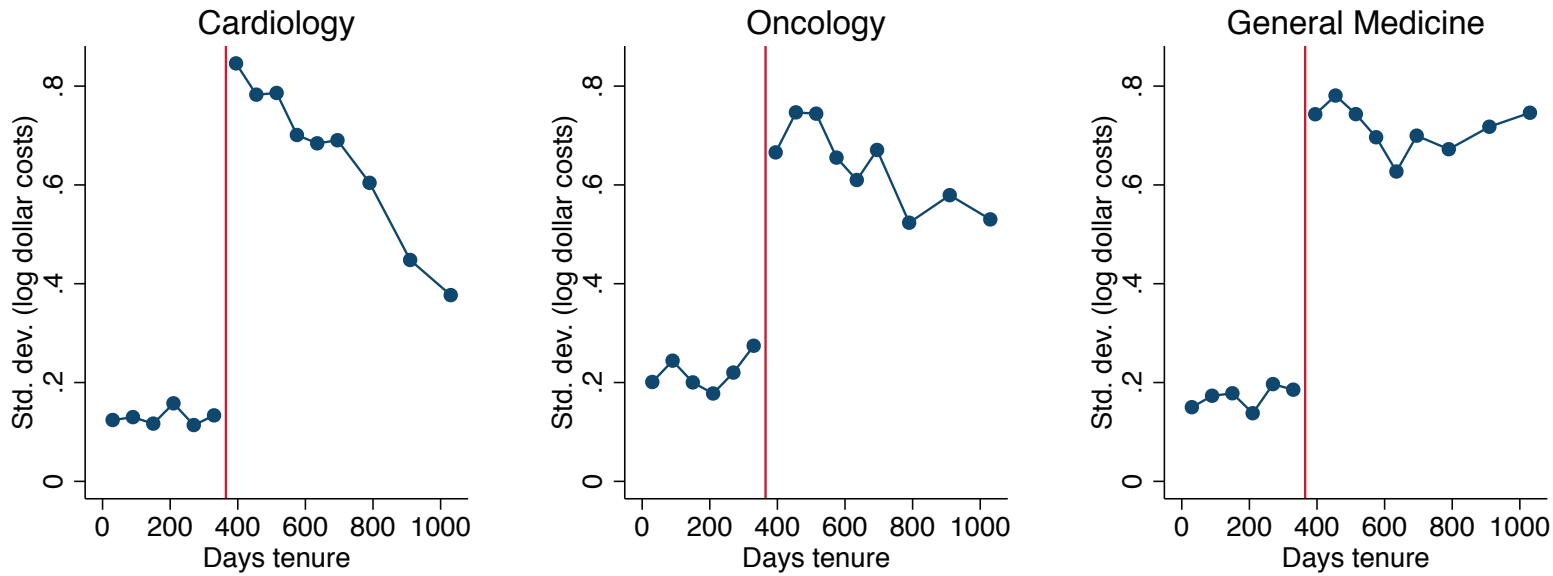


solid dots = earlier in stay; hollow dots = later in stay

Learning Environments

- Does practice variation evolve differently in different environments?
  - Trainees rotate across services of medicine: general, cardiology, oncology (three most common nationwide)
  - Services use distinct knowledge and are staffed by distinct supervising (attending) physicians $\Rightarrow$ distinct *learning environments*
  - Cardiology and oncology care represent speciallist care, knowledge more formalized

Learning Environments



- Different evolution practice variation by service, for *same group* of trainees
- Suggests learning toward a "best practice" in cardiology; interestingly, not explained by formal patient diagnostic codes

Tacit Knowledge, Partial Learning

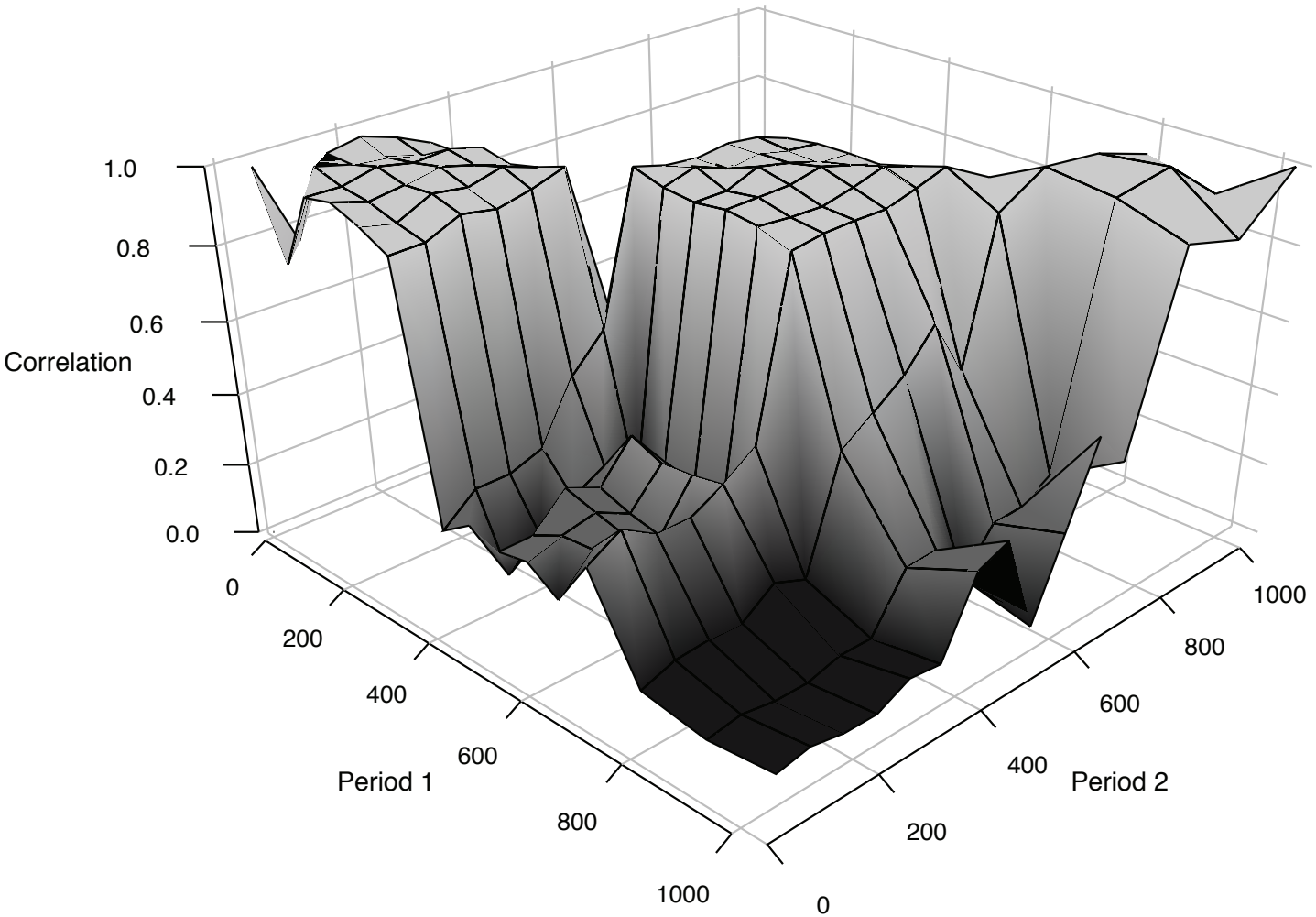
- Influence of senior trainees pervasive across decisions (i.e., not "management by exception")
  - Especially so in decisions with little formal knowledge (diagnostic decisions) or prior experience (early days in patient stay)
- General lack of convergence
  - This depends on learning environment: more convergence in specialist-driven environments
- Consistent with team decision-making with tacit knowledge, partial knowledge

Alternative Hypothesis: Intrinsic Heterogeneity

- Could practice variation be generated by intrinsic heterogeneity?
  - Trainees may have different skills or preferences
- Evaluate with two types of analyses:
  - Serial correlation: if variation due solely to intrinsic (unchanging) heterogeneity, then effects should be highly correlated across time
  - Detailed trainee characteristics: observe very different trainees in same training (e.g., future radiologists vs. primary care doctors)

Serial Correlation Implies Learning

- Correlation high between adjacent periods, low between distant periods

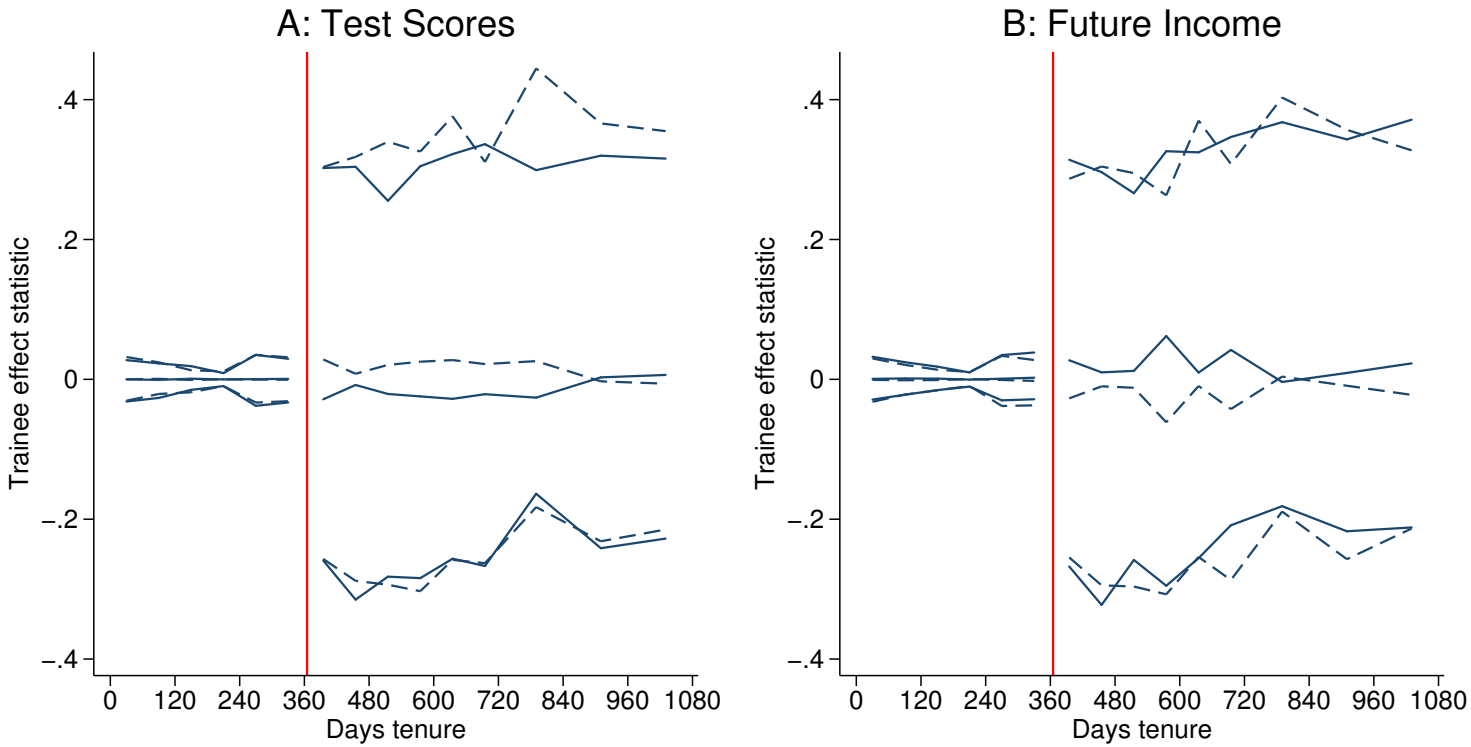


Trainee Characteristics and Practice Variation

- Use large number of observable trainee characteristics to predict practice
  - E.g., demographics position on rank list, medical school, future specialty
- Only individually significant characteristic: female sex (4% less spending)
- LASSO predictions are poor; order of magnitude smaller than observed (persistent) variation attributable to housestaff identities
- In contrast, characteristics predict quite well residency rank, perfectly predict future career

Trainee Characteristics and Practice Variation

- Mean and variation of trainee effects similar across different groups



Summary and Policy Implications

- Large practice variation despite intensive, highly selective training
- Evidence supportive of informational frictions (tacit knowledge, partial learning) as underlying mechanism
- Extensive policy discussion about variation in health care
  - "Third of health care spending could be eliminated" if we get rid of variation
  - Yet no one can prespecify what should be done for a given clinical scenario
  - Fundamentally informational and organizational issue
- Future research on how to reduce variation and whether doing so improves outcomes
  - Management, technology