KNOWLEDGE SPILLOVERS AND LEARNING IN THE WORKPLACE: EVIDENCE FROM THE U.S. PATENT OFFICE

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Motivation

Contribution to patent examiner literature

- Patent system plays an important role in shaping the growth and direction of technological development.
- Thus understanding what impacts the behavior of patent examiners in granting applications is of great interest.

Contribution to literature on peer effects in economics

- Small but growing literature in the workplace: Open questions:
  - How do magnitude of peer effects in workplace compare with supervisor effects?
  - Mechanism? Peer pressure vs. knowledge spillovers/learning?

Background on Patent Examination

Peer groups

- Art Units (our interviews confirm examiners in Art Units are generally in proximity of each other)
- Acknowledge that peer groups may go beyond Art Units, in which case our estimates may be seen as lower bound

We will take care to differentiate among three types of individuals within Patent Office:

- Assistant Examiners
- Primary Examiners
- SPEs

Telecommuting program

- Creates possibility of variation within Art Units in social accessibility

Scope for learning in conducting obviousness analysis vs novelty analysis

Data

Collected data on all 1.4 million utility patent applications from PAIR from 2001-2012

- filed on or after March 2001 and published and disposed by July 2012
- Includes which examiner assigned to the application, whether the application ultimately granted, the types of rejections made

FOIA the PTO for annual roster indicating the GS-level, experience, and date of commencement of telework (which we use to test whether the mechanism is learning versus peer pressure)

Patent citations data (for patents issued between 2000 and 2010) (which is also used to test whether the mechanism is learning versus peer pressure)

Methods

Key Empirical Exercise: explore association between likelihood of given application being allowed and the inherent grant rates of the peer group of examiners surrounding the examiner in charge of the given application.

An exercise of this sort confronts a number of well-known econometric problems:

Endogenous sorting of like examiners

- Solution: examiner fixed effects

Reflection problem—simultaneity issue (Manski 1993)

- Are my peers affecting me or the other way around?
- Various Solutions: use inherent grant rates of peer groups rather than grant rate at the time of decision

Common unobservables – e.g., supervisory policies that impact everyone in peer group alike

- Various solutions: SPE fixed effects or Art-Unit-by-year fixed effects (above solutions to reflection problem also help with this concern)

Methods (cont'd)—Mechanism?

Other Challenge: Mechanism is it learning or peer pressure

If the mechanism is learning then we look for certain markers based on the following predictions:

First prediction → If learning, one might predict peers to be most influential early on in an affected examiner's career at Patent Office when they are most impressionable and developing their examining style than later on in their career where their practice styles may be entrenched

Second prediction → If learning, one might predict that new examiners more influenced by seasoned peers than similarly junior peers

Third prediction → If learning, then does some of the learning comes through the types of prior art cited.

Results Summary

Examiner grant rates when new at Patent Office are strongly associated with composition of peers at that time

- 1 standard deviation increase in inherent peer grant rate associated with a roughly 0.15 standard deviation increase in own grant rate

Influence of peer composition weakens later in examiner's career (though doesn't totally dissipate). Evidence suggestive of persistence in effects of temporary changes in peer composition, consistent with learning.

Assistant examiner effects just as strong as primary examiner effects

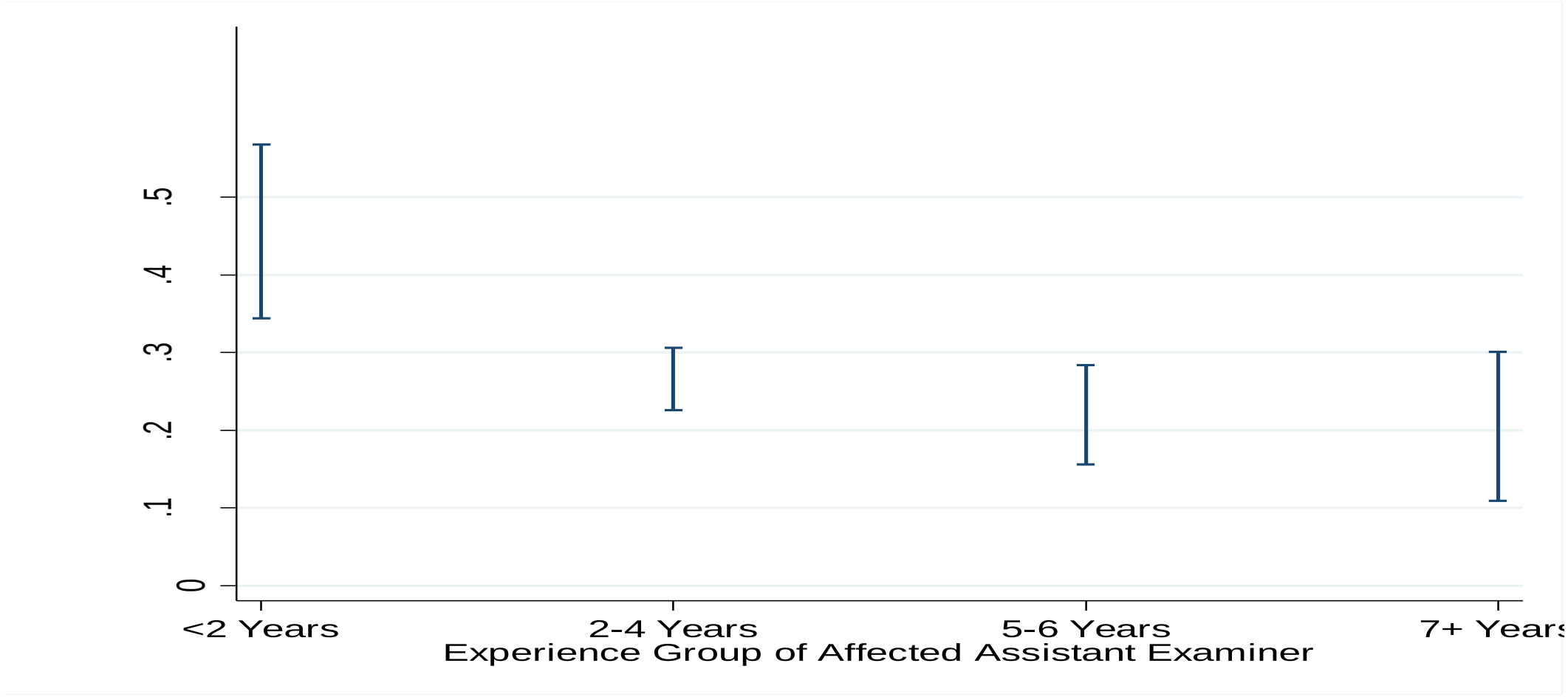
Assistant examiner effects stronger than SPE effects

Evidence indicating that knowledge flows may even be at the specific prior art level

Effects of Peer and Supervisor Granting Tendencies on Assistant Examiner Grant Rates, By Years of Assistant Examiner Experience

	(1)	(2)	(3)	(4)	(5)	(6)
	Pure Peer Effects (Assistant Examiner Effects)		Quasi-Supervisory Effects (Primary Examiner Effects)		Supervisory Effects (SPE Effects)	
Peer Score	0.426*** (0.075)	0.401*** (0.057)	0.482*** (0.104)	0.341*** (0.056)	0.314*** (0.078)	0.196*** (0.061)
(Omitted: Peer Score X 0-2 Years Experience)						
Peer Score X 2-4 Years Experience	-0.173*** (0.031)	-0.161*** (0.022)	-0.219*** (0.041)	-0.210*** (0.029)	-0.135*** (0.049)	-0.088*** (0.029)
Peer Score X 4-6 Years Experience	-0.182*** (0.049)	-0.191*** (0.037)	-0.298*** (0.068)	-0.312*** (0.049)	-0.190** (0.077)	-0.169*** (0.051)
N	153906	415575	153584	413499	68063	183,268
Balanced Sample?	YES	NO	YES	NO	YES	NO

Effect of Inherent Peer Granting Tendencies on Assistant Examiner Grant Rate, By Years of Experience of the Affected Assistant Examiner



	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Peer Score	0.334*** (0.088)	0.327*** (0.067)	0.443*** (0.062)	0.329*** (0.048)	0.486*** (0.074)	0.517*** (0.089)	0.906*** (0.213)	0.456*** (0.056)
(Omitted: Peer Score X 0-2 Years Experience)								
Peer Score X 2-4 Years Experience	-0.163*** (0.034)	-0.148*** (0.048)	-0.122*** (0.036)	-0.177*** (0.027)	-0.122*** (0.030)	-0.140*** (0.032)	-0.183*** (0.052)	-0.190*** (0.020)
Peer Score X 4-6 Years Experience	-0.165*** (0.055)	-0.214*** (0.069)	-0.216*** (0.049)	-0.199*** (0.043)	-0.124*** (0.046)	-0.136*** (0.050)	-0.354*** (0.082)	-0.236*** (0.032)
Peer Score X 7+ Years Experience	-	-	-	-	-	-	-	-0.251*** (0.048)
N	145804	152745	152841	150504	153905	153905	68063	521275
Treatment of Art Unit and Time Effects	Art Unit and Year Effects	Art-Unit-by-Year Fixed Effects	Art-Unit-by-Bi-Year Fixed Effects	Art Unit and Year Effects	Art Unit and Year Effects	Art Unit and Year Effects	Art Unit and Year Effects	Art Unit and Year Effects
SPE Dummies?	YES	NO	NO	NO	NO	NO	NO	NO
Balanced or Unbalanced?	Balanced	Balanced	Balanced	Balanced	Balanced	Balanced	Balanced	Unbalanced
Construction of Peer Grant Score at Year *t*	Lifetime Grant Rates	Lifetime Grant Rates	Lifetime Grant Rates	Grant Rate for Years Prior to *t*	Estimated Examiner Fixed Effects	Empirical Bayesian Estimator	Lifetime Grant Rates	Lifetime Grant Rates
Limit to Art-Unit-Year Cells With Data on SPE Grant Rate?	NO	NO	NO	NO	NO	NO	YES	NO

Specifications with Leads and Lags

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2-Year Lead Score	0.057 (0.061)	0.056 (0.041)	0.009 (0.042)	-	-	-	0.043 (0.044)
Contemporaneous Peer Score	0.302*** (0.082)	0.332*** (0.064)	0.151*** (0.069)	0.253*** (0.079)	0.234*** (0.048)	0.112** (0.052)	0.191*** (0.069)
2-year Lagged Peer Score	-	-	-	0.118* (0.060)	0.141*** (0.043)	0.138*** (0.053)	0.139** (0.068)
N	131575	409752	388813	116812	374417	360708	286041
Balanced Sample (Over first 6 Years of Career)?	YES	NO	NO	YES	NO	NO	NO
Other Restrictions?	NO	NO	NO	Limit to Examiners in their 3rd-6th Years	Limit to Examiners Beyond their Second Years	Limit to Examiners Beyond their Second Years	Limit to Examiners Beyond their Second Years
SPE Effects?	NO	NO	YES	NO	NO	YES	YES

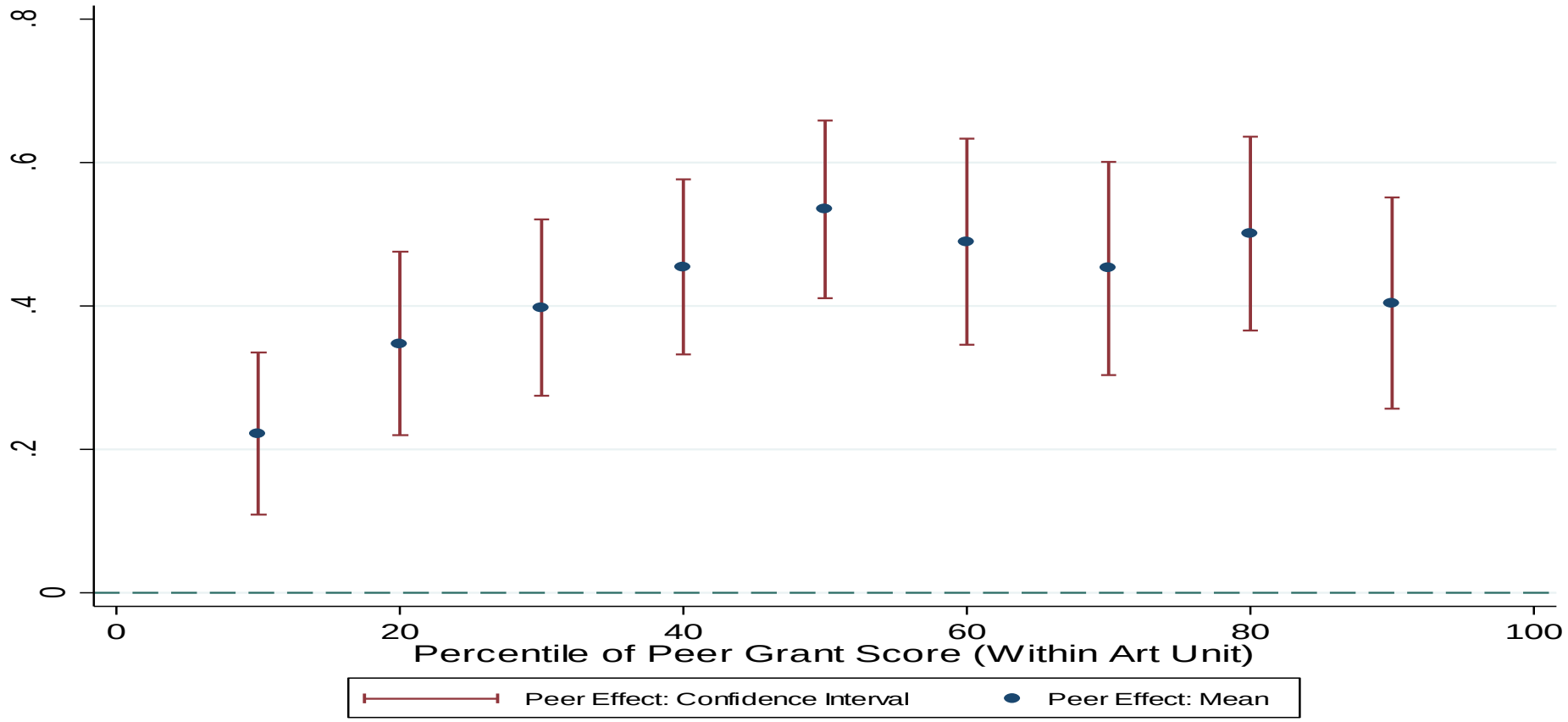
Effects of Peer Granting Tendencies on Assistant Examiner Grant Rates: Various Falsification Exercises

	(1)	(2)	(3)	(4)	(5)	(6)
	Incidence of Any Obviousness Rejection	Incidence of Any Lack-of-Novelty Rejection	Peer Group: Assistant Examiners With Less than 2 Years of Experience	Peer Group: Assistant Examiners With 2 or More Years of Experience	Peer Group: Non-Teleworking Assistant Examiners (2006+)	Peer Group: Teleworking Assistant Examiners (2006+)
Peer Score	0.192*** (0.073)	-0.035 (0.079)	0.098** (0.047)	0.400*** (0.072)	0.462*** (0.075)	0.244*** (0.082)
(Omitted: Peer Score X 0-2 Years Experience)						
Peer Score X 2-4 Years Experience	-0.119*** (0.035)	0.021 (0.050)	-0.082*** (0.034)	-0.185*** (0.031)	-0.166*** (0.038)	-0.116*** (0.057)
Peer Score X 4-6 Years Experience	-0.133*** (0.059)	0.032 (0.080)	-0.065* (0.048)	-0.201*** (0.049)	-0.297*** (0.055)	-0.232*** (0.069)
N	136654	136701	135314	152659	131629	85473

Relationship between Likelihood that Assistant Examiner Will Cite to Set of "Pet" / Favorite Patents of Her Peer Group and an Indicator Variable for the Non-Telecommuting Status of that Peer Group (Relative to the Telecommuting Status of that Peer Group)

	(1)	(2)
Non-Tele-commuting Peer Group	0.003*** (0.001)	0.004*** (0.001)
N	326460	326460
Coefficient of Non-Tele-commuting Peer Group as a Fraction of Mean of Dependent Variable	0.19	0.25
Sample	Sample of Issued Patents with Information on Telecommuting Peer Group Stacked on Sample of Issued Patents with Information on Non-Telecommuting Peer Group	
Parameterization of Controls for Count of Telecommuting and Non-Telecommuting Examiners	Relevant Examiner Count and its Square	Dummies for Different Quartiles of Relevant Examiner Count
Issued Patent Fixed Effects?	YES	

Effect of Increase in Inherent Peer Granting Tendencies on New Examiner Grant Rate at Different Percentiles of Peer Grant Scores



Conclusion

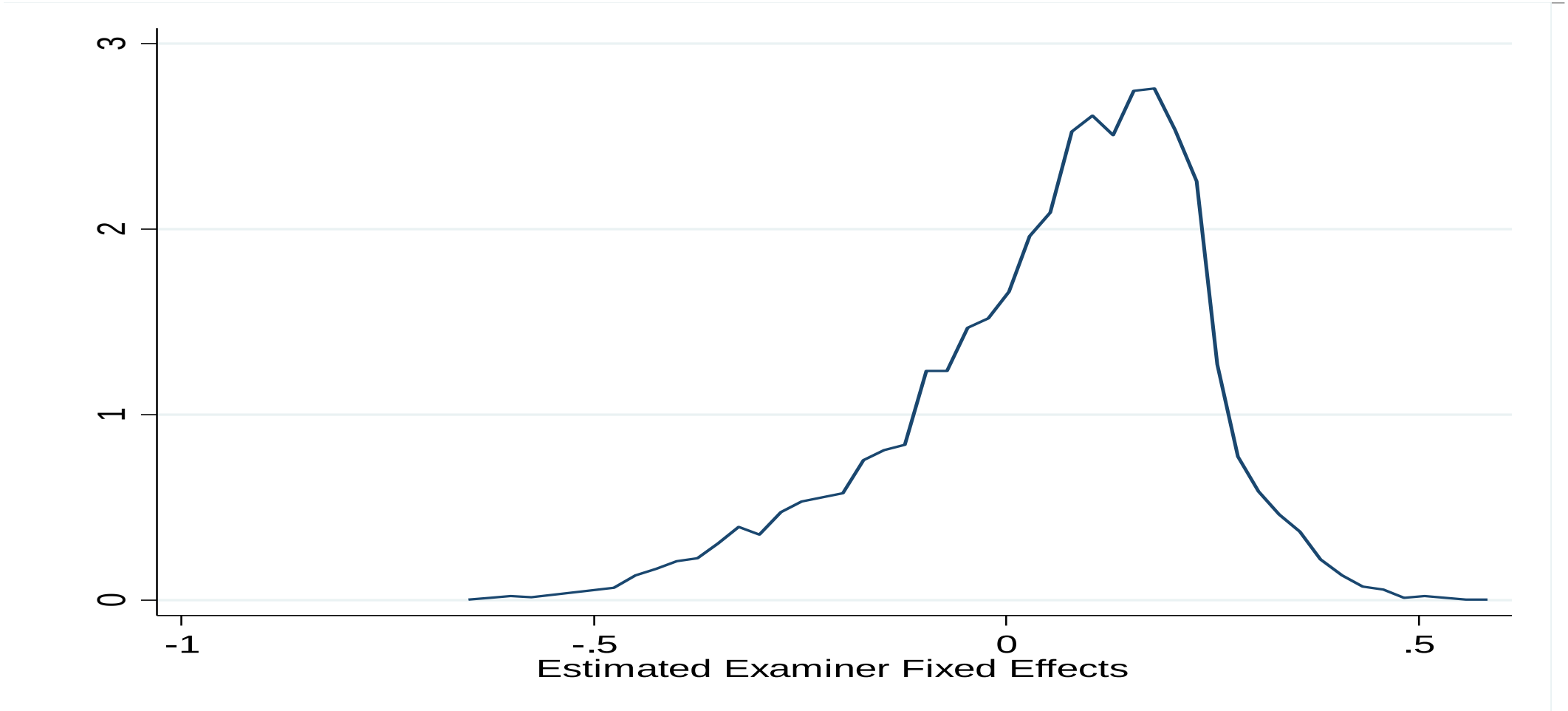
Peers appear to matter significantly in high skilled workplace settings (counter to Cornelissen et al. AER 2017)

Initial conditions matter significantly (consistent with Frakes and Wasserman 2016)

Information may be useful for Patent Office in allocating examiners, determining training policies, etc.

Results suggest that proximity matters a lot

- Implication: if peer effects steered so as to generate positive knowledge spillovers, there may be consequences to push towards telecommuting
- At least these harms from telecommuting should be weighed against its benefits when setting telecommuting policies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1
2
3
-1
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Estimated Examiner Fixed Effects