

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

By:

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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 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 (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?
- Traditional ways of distinguishing?
 1. Predict stronger effect early in career if learning—i.e., when most impressionable and when developing granting “style.”
 2. Relatedly, would predict strong lagged effects if learning. I.e., if learning, would predict a long-term effect of even a transitory shock in peer group granting tendencies

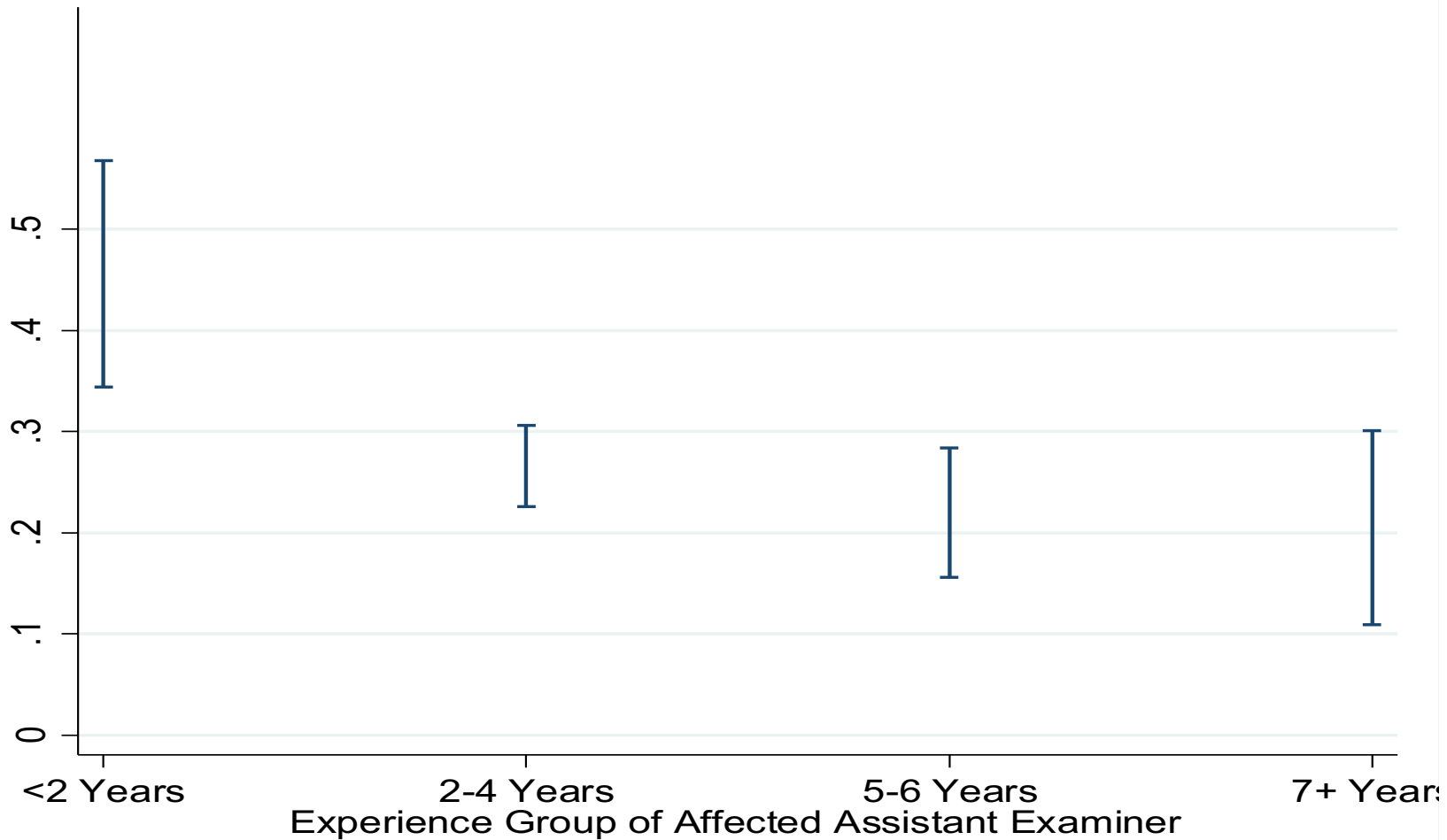
We will test for those markers, but they alone may also be consistent with peer pressure—e.g., if start to care less about stigma over time or if have delayed awareness of changing norms

What other markers can we look for?

1. If learning, one might also predict that new examiners more influenced by seasoned peers than similarly junior peers
2. Also, if learning, might expect to see transmission of specific types of knowledge among examiners—we will look at transmission of knowledge regarding specific pieces of prior art. More on this below

	(1)	(2)	(3)
Peer Score	0.262 (0.047)	0.426 (0.075)	0.401 (0.057)
(Omitted: Peer Score X 0-2 Years Experience)			
Peer Score X 2-4 Years Experience	-	-0.173 (0.031)	-0.161 (0.022)
Peer Score X 4-6 Years Experience	-	-0.182 (0.049)	-0.191 (0.037)
N	521275	153906	415575
Balanced Sample Over Years of Experience, in Experience Interaction Specifications?	-	YES	NO

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

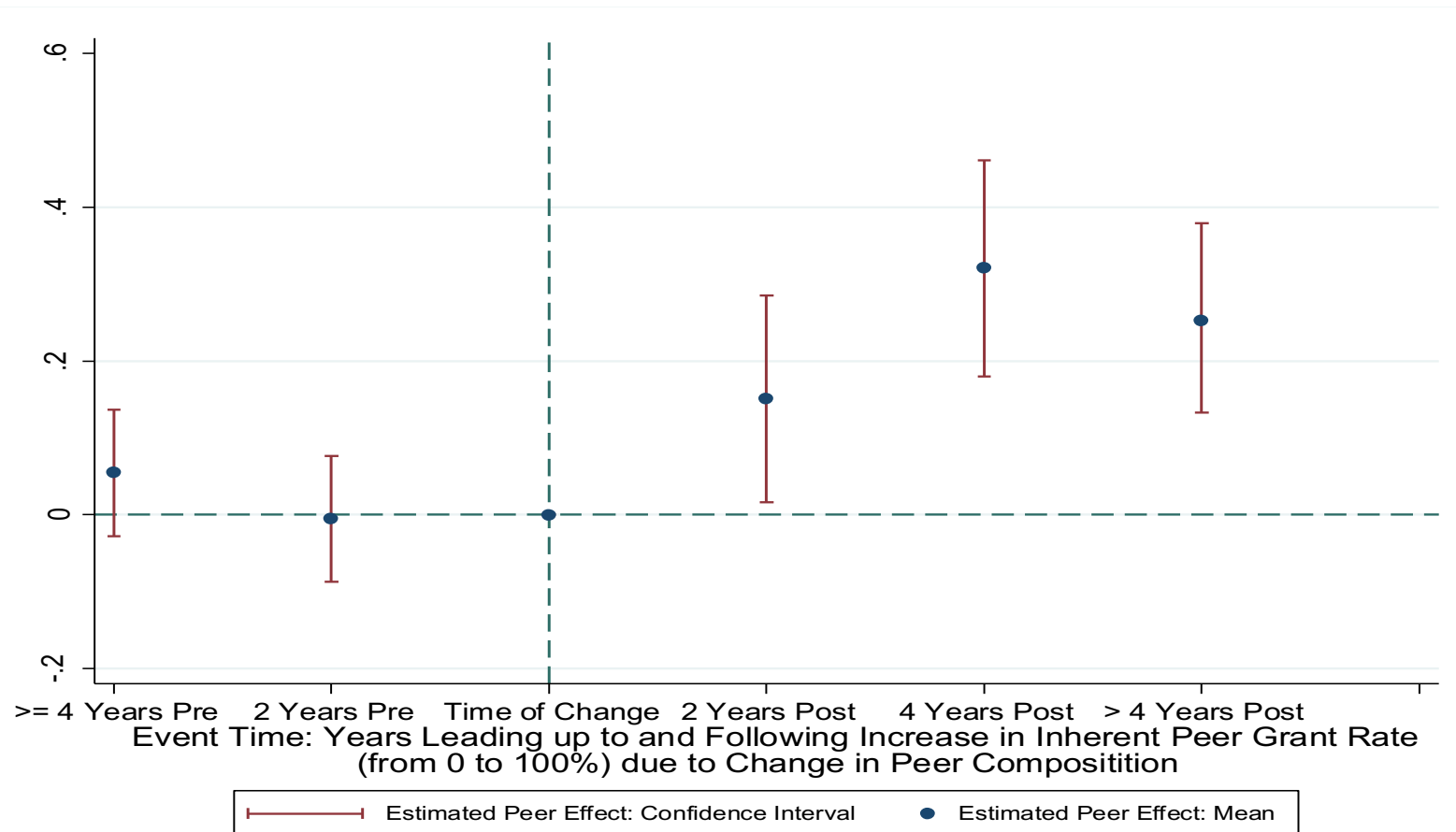


	(1)	(2)	(3)
			FALSIFICATION TEST: PEER EFFECTS IN ASSIGNMENT OF LARGE-ENTITY APPLICATIONS
Non-Telecommuting Peer Score	0.322 (0.065)	0.176 (0.046)	-0.001 (0.037)
(Omitted: Non-Telecommuting Peer Score X 0-2 Yrs Experience)			
Non-Telecommuting Peer Score X 2-4 Years Experience	-0.079 (0.045)	-	-
Non-Telecommuting Peer Score X 4-6 Years Experience	-0.233 (0.069)	-	-
Telecommuting Peer Score	0.139 (0.058)	0.071 (0.046)	0.013 (0.028)
(Omitted: Telecommuting Peer Score X 0-2 Yrs Experience)			
Telecommuting Peer Score X 2-4 Years Experience	-0.060 (0.038)	-	-
Telecommuting Peer Score X 4-6 Years Experience	-0.064 (0.061)	-	-
N	245,221	313359	314949
P-value of difference between Non-Telecommuting Peer Score Coefficient and Telecommuting Peer Score Coefficient	0.046	0.097	0.772
Experience Restrictions?	First 6 Years of Career (Unbalanced)	No Experience Restrictions	No Experience Restrictions
Measure on Which Dependent Variable and Peer Score Are Based	Grant Incidence	Grant Incidence	Incidence of Large-Entity Application

Results Summary

- Telecommuting and non-telecommuting Peers
 - Peer influences are weaker when constructing peer scores based on the set of examiners that telecommute versus those that don't

Event Study Analysis: Estimated Peer Effect in years Leading UP to and Subsequent to Change in Composition of Peer Group Leading to Change from 0 to 100% in Mean Life-Time Peer Grant Rate



Results Summary

- Magnitude of Effects
 - Assistant examiner effects just as strong as primary examiner effects
 - Assistant examiner effects nearly three times stronger than SPE effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Quasi-Supervisory Effects (Primary Examiner Effects)			Supervisory Effects (SPE Effects)		
Peer Score	0.200 (0.046)	0.482 (0.104)	0.341 (0.056)	0.074 (0.034)	0.314 (0.078)	0.196 (0.061)
(Omitted: Peer Score X 0-2 Years Experience)						
Peer Score X 2-4 Years Experience	-	-0.219 (0.041)	-0.210 (0.029)	-	-0.135 (0.049)	-0.088 (0.029)
Peer Score X 4-6 Years Experience	-	-0.298 (0.068)	-0.312 (0.049)	-	-0.190 (0.077)	-0.169 (0.051)
N	552754	153584	413499	238287	68063	183,268
Balanced Sample?	-	YES	NO	-	YES	NO

Additional Test for Learning

- Early career effects are stronger when we construct peer scores based on the inherent grant rate of the more experienced co-workers surrounding her

	(1)	(2)
Senior Peer Score (Peers with at least 2 years of experience)	0.380 (0.083)	0.192 (0.048)
(Omitted: Senior Peer Score X 0-2 Yrs Experience)		
Senior Peer Score X 2-4 Years Experience	-0.248 (0.064)	-
Senior Peer Score X 4-6 Years Experience	-0.288 (0.079)	-
Junior Peer Score (Peers with less than 2 years of experience)	-0.059 (0.064)	0.006 (0.017)
(Omitted: Junior Peer Score X 0-2 Yrs Experience)		
Junior Peer Score X 2-4 Years Experience	0.097 (0.064)	-
Junior Peer Score X 4-6 Years Experience	0.128 (0.074)	-
N	133173	451334
P-value of difference between Non-Telecommuting Peer Score Coefficient and Telecommuting Peer Score Coefficient	0.001	0.000
Experience Restrictions?	First 6 Years of Career (Unbalanced)	No Experience Restrictions
Measure on Which Dependent Variable and Peer Score Are Based	Grant Incidence	Grant Incidence

- Specific Knowledge Flows

- Examiners are significantly more likely to cite to a prior art reference that is among set of “pet” prior art of peer examiners when those peers are not telecommuting relative to when those peers are telecommuting

Falsification Checks

- Find no evidence to suggest a change in focal examiner behavior prior to the change in peer composition.
- Stronger signs of peer-based learning and influence in the case of obviousness grounds relative to the case of rejections based on novelty

	(1)	(2)	(3)	(4)
	Incidence of Any Obviousness Rejection		Incidence of Any Lack-of-Novelty Rejection	
Peer Score	0.107 (0.039)	0.192 (0.073)	-0.006 (0.037)	-0.035 (0.079)
(Omitted: Peer Score X 0-2 Yrs Experience)				
Peer Score X 2-4 Years Experience	-	-0.119 (0.035)	-	0.021 (0.050)
Peer Score X 4-6 Years Experience	-	-0.133 (0.059)	-	0.032 (0.080)
N	467967	136654	469456	136701

Conclusion

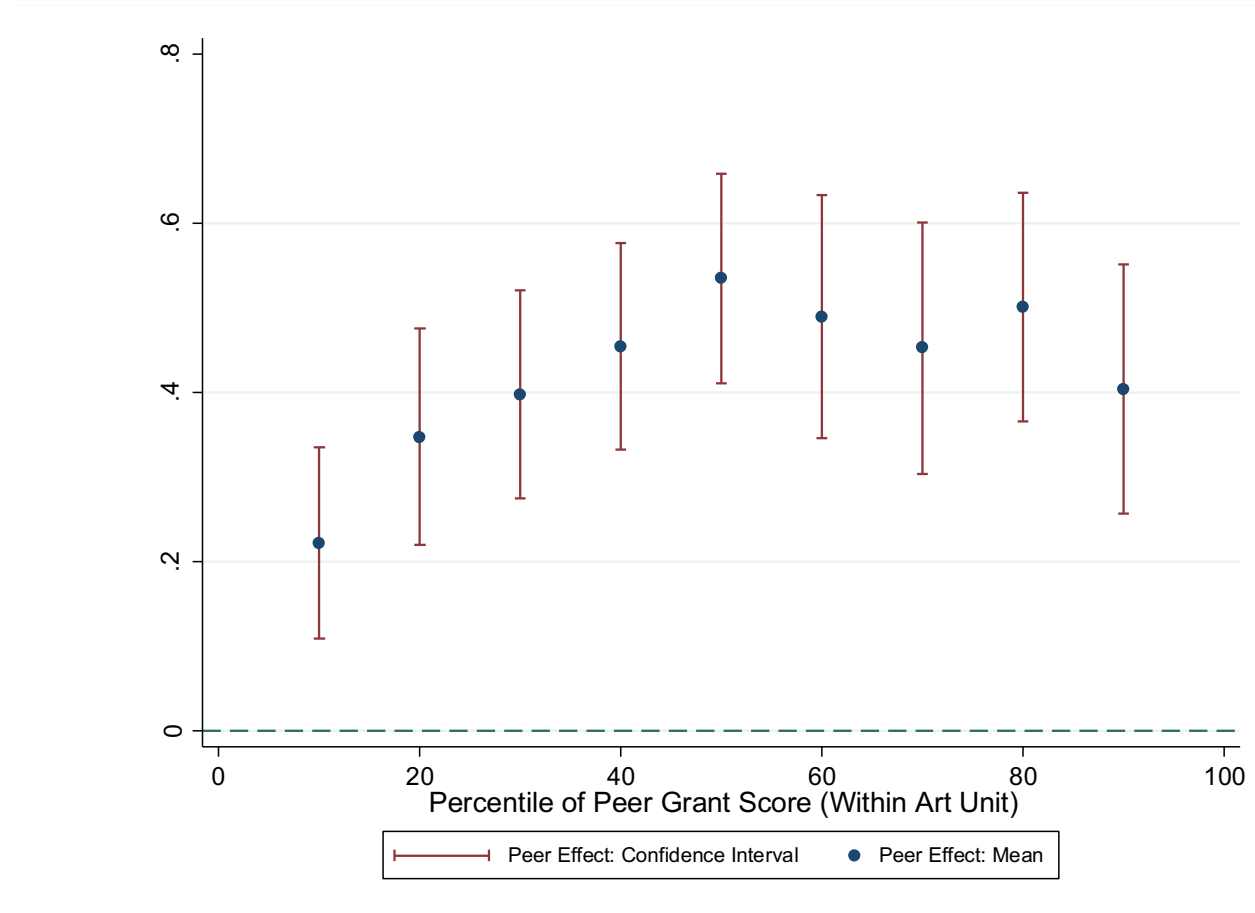
- Initial conditions matter significantly (consistent with Frakes and Wasserman 2016)
- Information may be useful for Patent Office in allocating examiners, determining training policies, etc.
 - This especially true of outliers
- Results suggest that proximity matters a lot
 - Implication: if peer effects 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

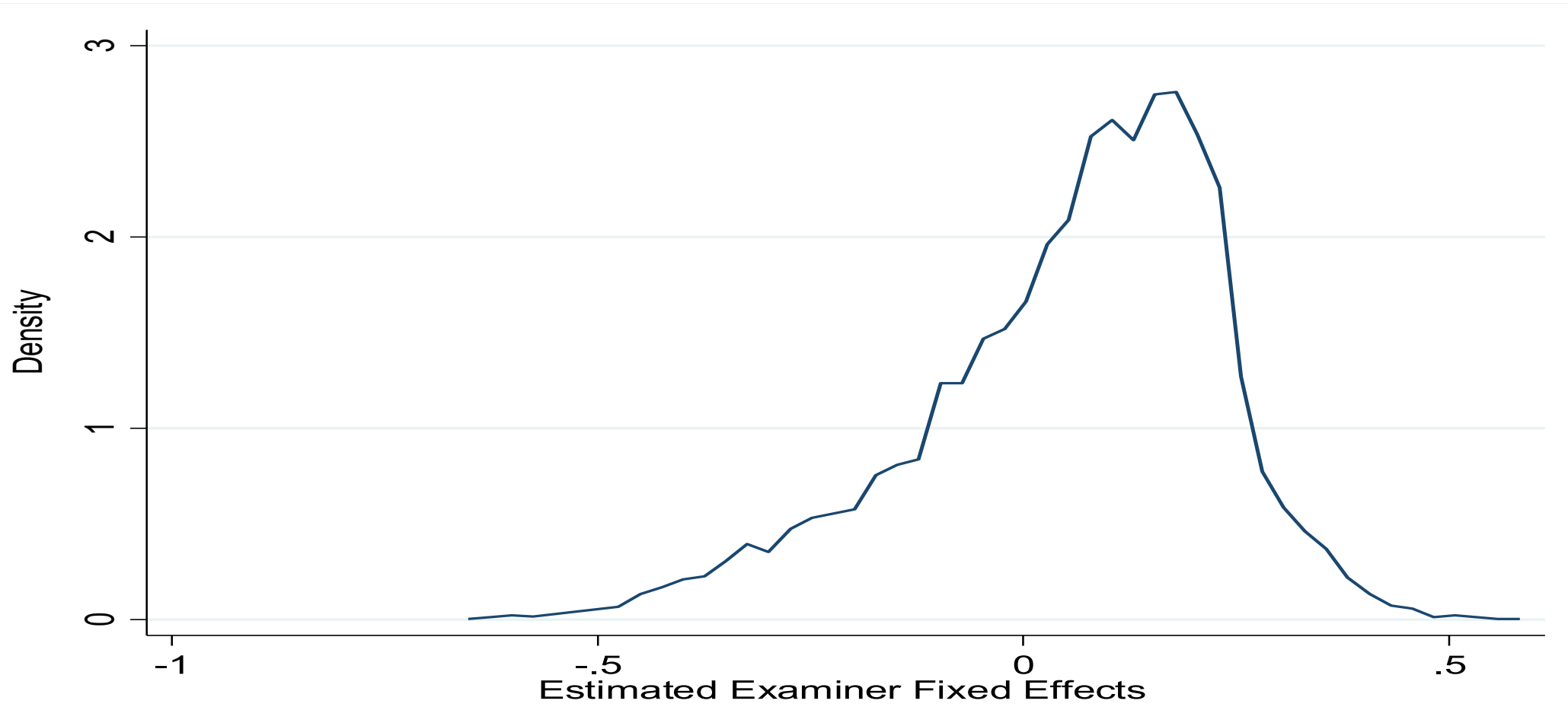
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Experience Restrictions?	First 6 Years of Career (Unbalanced)	No Experience Restrictions	No Experience Restrictions
Measure on Which Dependent Variable and Peer Score Are Based	Grant Incidence	Grant Incidence	Incidence of Large-Entity Application

	(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
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

	(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

EFFECT OF INCREASE IN INHERENT PEER GRANTING TENDENCIES ON NEW EXAMINER GRANT RATE AT DIFFERENT PERCENTILES OF PEER GRANT SCORES

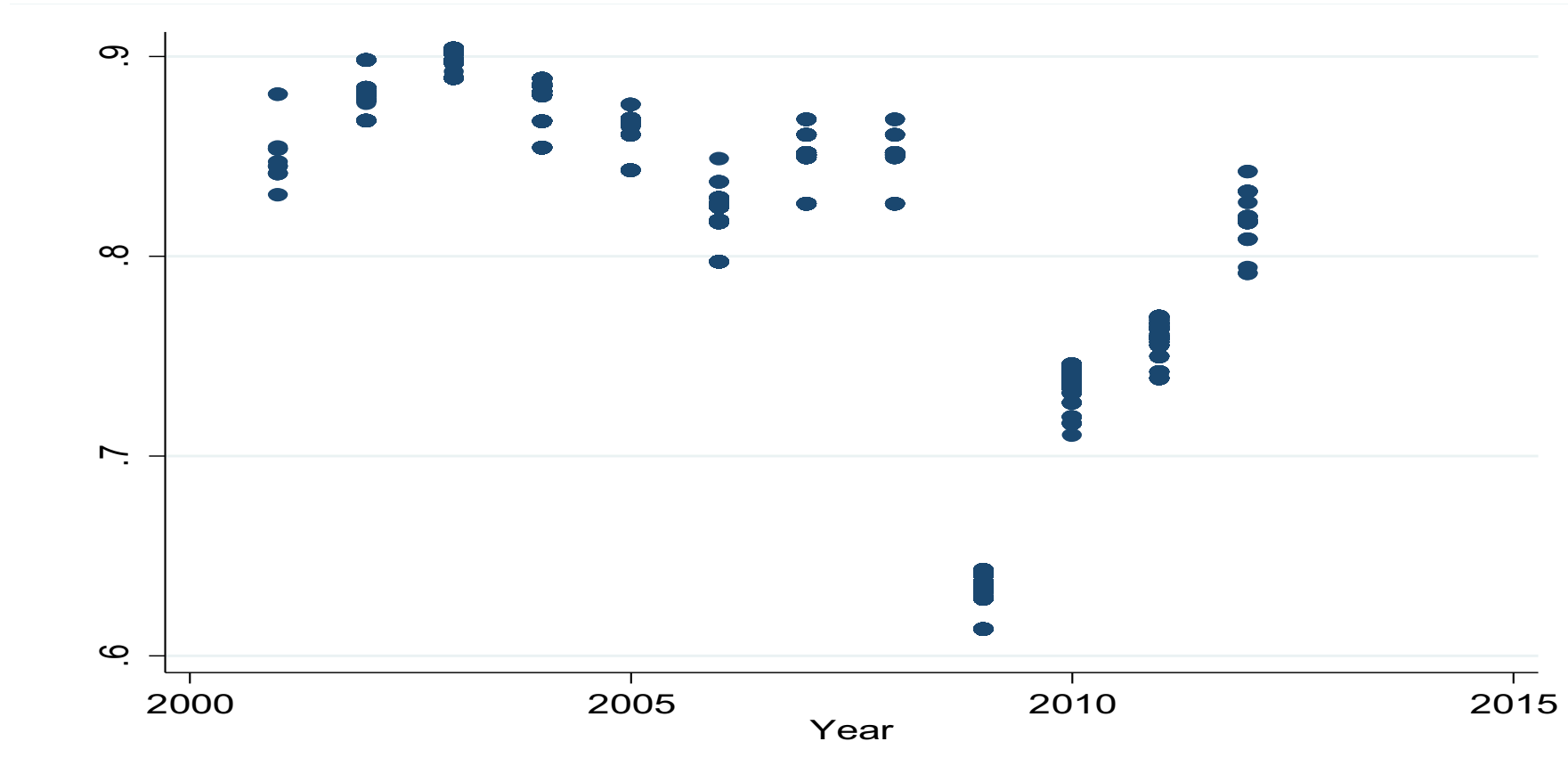




	(1)
Omitted: Dummy for First Quartile of Peer Score	-
Dummy for Second Quartile of Peer Score	0.023 (0.014)
Dummy for Third Quartile of Peer Score	0.077*** (0.017)
Dummy for Fourth Quartile of Peer Score	0.096*** (0.023)
N	153906

* significant at 10%; ** significant at 5%; *** significant at 1%. Standard errors are reported in parentheses and are clustered to correct for autocorrelation within given Art Units. Each observation is a given application from the PAIR database that reached a final disposition and that was published in the PAIR records between March, 2001 and July, 2012. Each specifications tracks the granting decisions of assistant examiners (GS-level 13 and below) over the first six years of their careers at the Patent Office, focusing on a balanced set of examiners that we can observe practicing at the Patent Office over the entirety of their first six years at the Patent Office. All specifications include examiner fixed effects, Art Unit fixed effects, year fixed effects and controls for various application-level characteristics

TIME TREND IN PEER SCORES IN ART UNIT 2858 (ELECTRICITY, MEASURING AND TESTING)



TIME TREND IN PEER SCORES IN ART UNIT 2827 (STATIC INFORMATION STORAGE AND RETRIEVAL)

