

PATENT OFFICE COHORTS

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ABSTRACT

Concerns regarding low-quality patents and inconsistent decisions prompted Congress to enact the first major patent reform act in over sixty years and likewise spurred the Supreme Court to take a renewed interest in substantive patent law. Because little compelling empirical evidence exists as to what features affect the patent office's granting behavior, policymakers have been trying to fix the patent system without understanding the root causes of its dysfunction.

This Article aims to fill at least part of this gap by examining one factor that may affect patent examiners' grant rates throughout their tenures: the year in which they were hired by the U.S. Patent and Trademark Office (PTO). An examiner may develop a general examination "style" in the critical early stages of her career that persists even in the face of changes in application quality or patent allowance culture at the agency. To the extent initial hiring environments influence a newly hired examiner's practice style, variations in such initial conditions suggest examiners of different hiring cohorts may follow distinct, enduring pathways with their

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examination practices. Consistent with this prediction, we find strong evidence that the year an examiner was hired has a lasting effect on her granting patterns over the course of her career. Moreover, we find that the variation in the granting patterns of different PTO cohorts aligns with observed fluctuations in the initial conditions faced by such cohorts. By documenting the existence of cohort effects and by demonstrating the importance of initial environments in explaining certain long-term outcomes, this analysis holds various implications for patent policy and the administrative state more generally.

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INTRODUCTION

There is widespread belief that the U.S. Patent and Trademark Office (PTO) issues too many low-quality patents that unnecessarily drain consumer welfare and stunt productive research.¹ There is also a general consensus that the Agency's patentability determinations are inconsistent across individual examiners—that is, the PTO's decision to grant a patent application is driven not only by the merits of the invention but also by the proclivities of the examiner to whom the application is randomly assigned.² Concerns regarding patent quality and inconsistent patentability decisions prompted Congress to enact the first major patent reform act in over sixty years,³ spurred the Supreme Court to take a renewed interest in substantive patent law,⁴ and drove the PTO to hold its first Patent Quality Summit.⁵ Yet because limited compelling empirical evidence exists as to what features of the Agency affect its granting behavior, policymakers have largely been trying to fix the patent system without understanding the root causes of its pathology.

Building upon recent efforts by the Authors to fill these gaps and to identify certain determinants of the Agency's granting practices, this Article investigates an additional, unexplored factor that may substantially affect a patent examiner's grant rate throughout her tenure: the year the examiner was hired by the Agency.⁶ Management

1. *See infra* Part I.

2. *See infra* Part I.

3. Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (codified as amended in scattered sections of 35 U.S.C.).

4. Mark A. Lemley & Bhaven Sampat, *Is the Patent Office a Rubber Stamp?*, 58 EMORY L.J. 181, 185 (2009).

5. U.S. PATENT & TRADEMARK OFFICE, *Patent Quality Summit*, <http://www.uspto.gov/patent/initiatives/patent-quality-summit> [<http://perma.cc/RZ2J-SQLZ>] (last updated June 2, 2015).

6. Michael D. Frakes & Melissa F. Wasserman, *Does Agency Funding Affect Decisionmaking?: An Empirical Assessment of the PTO's Granting Patterns*, 66 VAND. L. REV. 67, 96 (2013) [hereinafter Frakes & Wasserman, *Agency Funding*] (finding evidence that the PTO's fee structure biases a resource-constrained agency toward allowing patents); Michael D. Frakes & Melissa F. Wasserman, *Does the U.S. Patent and Trademark Office Grant Too Many Bad Patents?: Evidence from a Quasi-Experiment*, 67 STAN. L. REV. 613, 617 (2015) [hereinafter Frakes & Wasserman, *Bad Patents*] (finding evidence that the PTO's inability to finally reject a patent application biases a resource-constrained agency toward allowing patents); Michael D. Frakes & Melissa F. Wasserman, *Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data*, REV. ECON. & STAT. (forthcoming 2016) (manuscript at 3–4) [hereinafter Frakes & Wasserman, *Time Allocated*], http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2467262 [<https://perma.cc/D6GN-RML5>] (finding evidence that patent examiners are facing binding time constraints that

and labor scholars have long surmised that new hires are particularly impressionable during the beginning of their employment. During this initial period of training—be it formal or informal—new hires may begin to develop distinct “styles” of practice that become entrenched over time.⁷ This is especially true among workers like patent examiners that operate within a reasonably wide range of discretion. With this manner of learning in mind, the initial conditions to which an examiner is exposed at the PTO are of potentially critical importance. If a particular cohort of examiners is trained in a culture characterized by a very permissive granting philosophy, it is possible that this cohort will remain generally permissive throughout their careers, even if future Agency heads aspire to instill a restrictive attitude among the examiners corps. Accordingly, examiners may exhibit “stickiness” in practices. Given that initial hiring environments will likely vary over time, one might predict that examiners of different hiring cohorts develop along diverging pathways. In order to understand what drives both the levels of observed grant rates themselves and the variability in such grant rates across examiners, it is important to appreciate the existence and the nature of such diverging cohort effects.

To empirically test whether the year an examiner is hired by the PTO has a lasting effect on an examiner’s grant rate, we amassed a rich database of previously unavailable data on individual patent applications with the help of the National Center for Supercomputing Applications at the University of Illinois. We also supplemented it with information on examiners’ personnel histories (dating back to at least 1992) that we received by filing various Freedom of Information Act (FOIA) requests with the PTO. This novel patent application database comprises all 1,956,493 utility patent applications filed on or after March 2001 that were published by the Agency prior to July 2012. With rich historical information on the examinations performed by a number of overlapping cohorts of examiners, we then estimated empirical specifications which allowed us to determine the relationship between examiners’ grant rates and the hiring cohorts to which they belonged. Notably, when estimating these specifications we simultaneously controlled for a range of related factors that may have also shaped grant rates through other mechanisms including,

biases them toward allowing patents and that an examiner’s grade level has explanatory power as to her grant rate).

7. *See infra* Part I.

importantly, the year in which the application itself was processed and the experience level (in years) of the examiners at such times.

Ultimately, we find strong evidence of the existence of cohort effects—that is, evidence that the year an examiner was hired has an enduring effect on her granting patterns over the tenure of her career. In addition, we find these effects to be large in magnitude—that is, we estimate substantial differences in granting tendencies across the various hiring cohorts. For example, after controlling for examiner experience, general time trends, and other characteristics of the applications in our sample, we find that examiners in the 1993 hiring cohort have a mean grant rate roughly 11 percentage points (or 16 percent) higher than those examiners starting in the late 2000s.

In addition, we find that the observed differences in the mean grant rates of the various examiner cohorts align with changes in both the Agency's culture regarding the allowance of patents as well as new-hire training programs at the PTO. For instance, the decline in the mean grant rate for those new cohorts starting in the mid-2000s relative to the older cohorts within the Agency matches up with a shift toward a more restrictive approach in the allowance of patents, a cultural shift evidenced in part by the initiation of a new and significant patent-quality initiative implemented in 2003/2004.⁸ To be sure, the grant rate does fall somewhat among all examiners at this time, including among the older cohorts. The new examiners hired by the Agency after the implementation of the new quality programs, however, set out on a granting trajectory that was systematically lower than that of the older cohorts (again, even when accounting for general annual trends and for differences in experience levels across examiners).

Our results have a number of implications for both patent policy and the administrative state. To begin, our results suggest that culture promulgated from high-ranking officials during the beginning of an examiner's employment plays an important role in shaping her behavior throughout her career. Thus, our analysis highlights the import that agency-level preferences play in patent office outcomes. Although the existing literature has recognized that patent examiners operate with substantial discretion when applying the patentability standards, it has failed to fully appreciate the role that Agency heads

8. *See infra* Part II.B.

play in shaping and limiting this discretion.⁹ Our results also suggest that, to the extent Agency leaders want to diminish the degree of heterogeneity in patent office outcomes across examiners or reduce the extent to which patent examiners allow non-meritorious applications, they might face at least some degree of friction in light of the stickiness of examiner behavior. That is, because what patent examiners learn during the beginning of their employment can have an enduring effect on their granting styles, a PTO that seeks to achieve certain objectives may need to tailor its policies to address differences in examiner cohorts. Finally, our results also provide insight into topics that have long been of interest to scholars of the administrative state. Cohort effects raise the costs of changing agency policy today and in the future. Understanding how cohort dynamics work to entrench agency policy over time also provides insight into the effectiveness of agency monitors and the strategies available for an agency to achieve its interests over a long-term horizon.

The rest of this paper is organized as follows. Part I briefly describes the primary complaints that scholars and stakeholders have registered against the patent system: the PTO issues too many low-quality patents, while also inconsistently applying the patentability standards across examiners. Part II theorizes why the year an examiner was hired may have a lasting influence on the examiner's granting proclivities. This Part also describes how the granting culture of the Agency, as evidenced by the quality-assurance program of the PTO and new-hire training, has varied over time. Part II also delineates several testable hypotheses that will guide our empirical analysis. Part III describes the dataset and the methodology employed to test our hypotheses. The results of our empirical analysis are presented in Part IV. In Part V, we explore some of the implications of our findings for both the patent-quality debate and administrative law more generally.

9. See Michael Abramowicz & John F. Duffy, *Ending the Patenting Monopoly*, 157 U. PA. L. REV. 1541, 1559–60, 1563–64 (2009) (discussing the difficulty the PTO has controlling examiner conduct despite strict rules and oversight); Iain M. Cockburn, Samuel Kortum & Scott Stern, *Are All Patent Examiners Equal? Examiners, Patent Characteristics, and Litigation Outcomes*, in PATENTS IN THE KNOWLEDGE-BASED ECONOMY 28 (Wesley M. Cohen & Stephen A. Merrill eds., 2003) (noting that “substantial discretion is provided to examiners in how they deal with applications”); Frakes & Wasserman, *Agency Funding*, *supra* note 6, at 74–75.

I. HARMS ASSOCIATED WITH INVALID PATENTS AND INCONSISTENT PATENTABILITY DECISIONS

There is widespread agreement that the U.S. PTO grants too many invalid patents—that is, the Agency grants patents to inventions even though they fail to meet the patentability requirements.¹⁰ It is undeniable that invalid patents impose a multitude of costs on society. Erroneously issued patents can unnecessarily limit competition by impeding new market entrants¹¹ and by compromising the business relations of those already in the market.¹² Nonpracticing entities or patent trolls can utilize invalid patents to opportunistically extract licensing revenue from innovators.¹³ Erroneously issued patents can also stunt follow-on innovation.¹⁴ More fundamentally, invalid patents can result in supracompetitive pricing and diminished quantity without providing society with any innovative benefit.¹⁵

Observers have also criticized the PTO on the grounds that its patentability decisions are inconsistent across examiners. That is,

10. See FED. TRADE COMM'N, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND POLICY 5–7 (2003), <http://www.ftc.gov/os/2003/10/innovationrpt.pdf> [<http://perma.cc/A5UB-8F6Q>]; JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK 3 (2008); ADAM B. JAFFE & JOSH LERNER, INNOVATION AND ITS DISCONTENTS: HOW OUR PATENT SYSTEM IS ENDANGERING INNOVATION AND PROGRESS, AND WHAT TO DO ABOUT IT 11–13 (2004).

11. See FED. TRADE COMM'N, *supra* note 10, at 3 (noting that allowing patents on obvious inventions can thwart competition); Christopher R. Leslie, *The Anticompetitive Effects of Unenforced Invalid Patents*, 91 MINN. L. REV. 101, 119–25 (2006).

12. Customers may be deterred from transacting with a company out of fear of a contributory patent-infringement suit. *In re Ciprofloxacin Hydrochloride Antitrust Litig.*, 363 F. Supp. 2d 514, 544 (E.D.N.Y. 2005) (“Dow alleged that Exxon had threatened to sue actual and prospective Dow customers for patent infringement, even though Exxon allegedly had no good-faith belief that Dow infringed the patent when Exxon made the threats and had allegedly obtained the patent by inequitable conduct.” (citing *Dow Chem. Co. v. Exxon Corp.*, 139 F.3d 1470, 1472, 1477 (Fed. Cir. 1998))); Leslie, *supra* note 11, at 125–27.

13. James Bessen, *The Patent Troll Crisis is Really a Software Patent Crisis*, WASH. POST (Sept. 3, 2013), <http://www.washingtonpost.com/blogs/the-switch/wp/2013/09/03/the-patent-troll-crisis-is-really-a-software-patent-crisis> [<http://perma.cc/A5TQ-AZMP>].

14. Alberto Galasso & Mark Schankerman, *Patents and Cumulative Innovation: Causal Evidence from the Courts*, 130 Q.J. ECON. 317, 318 (2015); Suzanne Scotchmer, *Standing on the Shoulders of Giants: Cumulative Research and the Patent Law*, 5 J. ECON. PERSP. 29, 32 (1991) (noting that overly broad patent protection “can lead to deficient incentives to develop second generation products”); Bhaven Sampat & Heidi L. Williams, *How Do Patents Affect Follow-on Innovation? Evidence from the Human Genome* (Feb. 12, 2015) (unpublished manuscript), <http://economics.mit.edu/files/9778> [<http://perma.cc/2H9B-GZ3A>].

15. Mark A. Lemley & Bhaven Sampat, *Examiner Characteristics and Patent Office Outcomes*, 94 REV. ECON. & STAT. 817, 817 (2012).

there is a growing concern that the decision to grant a patent application is driven not only by the merits of the invention but also by happenstance as to which examiner the application is randomly assigned.¹⁶ A PTO that treats similar applications in dissimilar ways is problematic for several reasons. To begin, the existence of inter-examiner disparity itself demonstrates how much discretionary authority PTO examiners wield and instills little confidence that they are exercising this discretion to apply patentability standards in a guided and regimented manner. In other words, inconsistent behavior across examiners leaves observers wondering whether examiners are systematically “missing the mark” in making validity determinations. The patentability standards are set to generally parallel the economic justifications for patents—that is, a patent should not be granted to an invention that is not novel because such non-novel patents have the potential to impose the costs of the patent system on society without producing the commensurate innovative benefits. As a result, the consequences of examiners routinely reaching erroneous patentability determinations can be substantial.

Aside from the concerns that inconsistent examinations invoke regarding the quality of the review process itself, inter-examiner disparity may also erode confidence in the PTO by creating the appearance of unfairness and arbitrariness.¹⁷ Such an appearance could diminish the incentives for innovation, as would-be applicants decide instead to pursue other endeavors. Of course, inconsistent patentability decisions are also worrisome solely from an equity standpoint.

Finally, it should be noted that, although concerns over inter-examiner disparity and over the issuance of invalid patents are very much related, they can also be analyzed as separate and distinct concepts. After all, it is possible that the PTO could have highly inconsistent decisions that generally converge around the proper application of the patentability standards. It is also possible that the Agency could have highly consistent decisions that reflect examiners’

16. See Cockburn et al., *supra* note 9, at 19 (finding that differences in examiners explain a significant percentage of the variation in the characteristics of issued patents, and that some examiners are more likely than others to have their patents upheld in court); Douglas Lichtman, *Rethinking Prosecution History Estoppel*, 71 U. CHI. L. REV. 151, 155 (2004) (finding that certain examiners more systematically required applicants to narrow the scope of their patents).

17. See JERRY L. MASHAW, *BUREAUCRATIC JUSTICE* 73 (1983); Abramowicz & Duffy, *supra* note 9, at 1558 (noting that the PTO’s “challenge is to ensure that the judgments of [its patent examiners] are relatively high quality and highly consistent”).

biases toward granting or rejecting patents. As such, in our analysis below, we attempt to address the implications of cohort dynamics within the PTO with each of these distinct social concerns in mind.

The quality and consistency of the PTO's judgments have become such important and visible issues that Congress, the judiciary, and the Agency itself have taken steps to diminish the issuance of low-quality patents and bring uniformity to the Agency's decisionmaking. The Supreme Court has recently taken a renewed interest in substantive patent law, wherein, among other things, it has strengthened the doctrine of nonobviousness in an effort to make it easier for the Agency to reject invalid patents.¹⁸ In 2011, Congress enacted the first major patent-reform bill in over six decades. This reform bill granted the agency new adjudicatory authorities and the ability to set its own fees, changes that were meant to increase both patent quality and consistency.¹⁹ Just last year, the PTO held the first Patent Quality Summit, where it sought input on a set of proposals for enhancing patent quality and consistency across examiner determinations.²⁰

Of course, finding a solution to the problems of low-quality issuances and inconsistent patentability determinations necessarily requires correctly identifying the features of the patent system that shape an examiner's granting proclivities. Although commentators have suggested many reasons that the Agency may be inclined to grant invalid patents,²¹ there exists little compelling empirical evidence showing what features of the system drive an examiner's decision to allow a patent (outside of the merits of the invention).²² As a result, policymakers have been making changes to the patent

18. See *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 420 (2007).

19. See Leahy-Smith America Invents Act, Pub. L. No. 112-29, § 6, 125 Stat. 284, 299–313 (2011) (codified as amended at 35 U.S.C. §§ 311–19, 321–29) (providing for post-grant review proceedings); *id.* § 10, 125 Stat. at 316–20 (codified as amended at 35 U.S.C. § 41) (providing for fee-setting authority); *id.* § 12, 125 Stat. at 325–27 (codified as amended at 35 U.S.C. § 257) (providing for supplemental examination); *id.* § 18, 125 Stat. at 329–31 (codified as amended at 35 U.S.C. § 321) (providing for a transitional program for covered business-method patents); H.R. REP. NO. 112-98, pt. 1, at 39–40 (noting that the primary purpose of the America Invents Act is to “improve patent quality”).

20. U.S. PATENT & TRADEMARK OFFICE, *supra* note 5.

21. See Frakes & Wasserman, *Bad Patents*, *supra* note 6, at 619 (summarizing the various reasons why the PTO may allow too many low-quality patents).

22. *Id.* at 621–25. *But see* Lemley & Sampat, *supra* note 15, at 817 (finding that experienced examiners cite less prior art and are more likely to grant patents); sources cited *supra* note 6 (same).

system absent empirical evidence to help illuminate the actual problems at hand. This paper builds upon the prior efforts of the Authors to rectify this deficiency by examining how one factor likely influences a patent examiner's decision to grant a patent: the year the patent examiner was hired by the PTO, together with the culture of the Agency and the nature of the training in place at such time.²³

II. THEORY OF COHORT EFFECTS

This Part provides the theory behind cohort effects and delineates several testable hypotheses that will guide our empirical analysis. Before doing so, however, it is helpful to provide a brief exposition of the patent-examination process. In order to obtain a patent, an individual must file an application with the PTO, an agency within the Department of Commerce. Before the application enters examination, it is routed to an art unit, a group of eight to fifteen patent examiners who review applications in the same technological field.²⁴ Upon the patent application's arrival, the Supervisory Patent Examiner of that art unit randomly assigns the application to a specific examiner.²⁵ The assigned examiner then assesses the patentability of the invention based on the criteria outlined in the Patent Act. This process typically begins with the examiner performing a prior-art search to determine whether the invention is novel²⁶ and represents more than a trivial advancement over the existing knowledge within the field.²⁷ The examiner must also determine whether the invention comprises patentable subject matter²⁸ and is useful,²⁹ as well as whether the patent application meets the disclosure requirements.³⁰ If the invention fails one of the specific patentability requirements, the examiner must reject the application.³¹ If the application meets the patentability requirements, the examiner must issue the patent.³² Although the stages associated with the patent examination procedure are relatively structured, it is well-recognized

23. See sources cited *supra* note 6.

24. See Frakes & Wasserman, *Time Allocated*, *supra* note 6 (manuscript at 6).

25. *Id.*

26. 35 U.S.C. § 102 (2012).

27. *Id.* § 103.

28. *Id.*

29. *Id.* § 101.

30. *Id.* § 112.

31. See Frakes & Wasserman, *Time Allocated*, *supra* note 6 (manuscript at 7–8).

32. *Id.*

that patent examiners are afforded substantial discretion on how they approach and execute the process.³³

With this brief exposition on the review of patent applications, this Part now turns to examining why the year in which an examiner is hired by the PTO may have a lasting effect on an examiner's granting patterns. Section A provides support for the proposition that, because new hires are rather susceptible to influence, what they learn during this initial period has an enduring effect well beyond the employee's period of acclimation to the organization. Sections B and C turn to exploring which formal and informal aspects of the PTO can help shape how newly hired patent examiners review patent applications.

A. *New-Hire Impressibility, External Stimuli, and Learning Stickiness*

Workers in many professions exercise some degree of discretion in executing the tasks required by their positions. Over time, they develop certain skills and methods that determine how they operate within the bounds of their discretion. The management literature has long recognized that early moments of employment are especially important in understanding how new hires are shaped.³⁴ In general, this literature delineates three features that are essential for the cohort-effects phenomenon—that is, for the early-career period to have a persistent influence on how work duties are executed.³⁵ The first unique feature of the cohort-effects argument is that new hires are significantly more malleable than individuals who have worked in an organization for a substantial duration of time.³⁶ Newly hired

33. Cockburn et al., *supra* note 9, at 28 (noting that “substantial discretion is provided to examiners in how they deal with applications”).

34. See, e.g., Natalie J. Allen & John P. Meyer, *Organizational Socialization Tactics: A Longitudinal Analysis of Links to Newcomers' Commitment and Role Orientation*, 33 ACAD. MGMT. J. 847 (1990); Bruce Buchanan II, *Building Organizational Commitment: The Socialization of Managers in Work Organizations*, 19 ADMIN. SCI. Q. 533 (1974).

35. Cohort effects can encompass more than the learning effect described in this Section. Management scientists often utilize cohort effects to refer to a high degree of similarity in outcomes within cohorts. See, e.g., Aparna Joshi, John C. Dencker, Gentz Franz & Joseph J. Martocchio, *Unpacking Generational Identities in Organizations*, 35 ACAD. MGMT. REV. 392, 392–94 (2010). This intra-cohort homogeneity in outcomes could result from an imprinting effect—the initial conditions of an organization imprint a new employee—as we describe in this Section or because the organization hired individuals of similar traits in a given year (that is, individuals with similar education, ideological backgrounds, etc.). In Part IV.D, we argue that our results are more consistent with the former than the latter.

36. Gordon J. DiRenzo, *Socialization, Personality, and Social Systems*, 3 ANN. REV. SOC. 261 (1977); Herminia Ibarra, *Provisional Selves: Experimenting with Image and Identity in*

employees are assumed to constitute more of a blank slate, in part, because of uncertainty regarding the new role requirements.³⁷ During the initial period of employment, it is believed that “cognitive models that . . . [individuals] hold can be challenged and replaced with scripts and schema that are more congruent with the new environment.”³⁸

The second element of cohort effects is that external-environmental features exert a substantial influence on individuals during their transition period with an organization.³⁹ Given the enhanced impressionability of employees during the early stage of their careers, new employees are especially open to an organization’s environmental stimuli.⁴⁰ As a result, the conditions of an organization during a new hire’s acclimation period are likely to have a strong influence on how the new hire approaches and executes her job functions.⁴¹

The final element of the cohort-effects hypothesis is that this molding of behavior which occurs during an individual’s transition period with an organization persists long after she ceases to be a new hire and even if significant changes take place in the environment of an organization. Individuals tend to be less receptive to learning and environmental influences outside of role transitions, such as joining a new organization.⁴² Although individuals can still learn new skills outside of role transitions, the rate at which they learn is lower than when they are in a formative period. Thus, after the transitional period ends, individuals “freeze” their behavior and patterns: they stick with the skills and habits they have learned.⁴³ As a result, an

Professional Adaptation, 44 ADMIN. SCI. Q. 764 (1999); John Van Maanen & Edgar H. Schein, *Toward a Theory of Organizational Socialization*, 1 RES. ORG. BEHAV. 209 (1979).

37. Blake E. Ashforth & Alan M. Saks, *Socialization Tactics: Longitudinal Effects on Newcomer Adjustment*, 39 ACAD. MGMT. J. 149, 149 (1996).

38. Gina Dokko, Steffanie L. Wilk & Nancy P. Rothbard, *Unpacking Prior Experience: How Career History Affects Job Performance*, 20 ORG. SCI. 51, 55 (2009).

39. Edgar H. Schein, *The Individual, the Organization, and the Career: A Conceptual Scheme*, 7 J. APPLIED BEHAV. SCI. 401, 422–23 (1971).

40. *Id.*

41. See Pierre Azoulay, Christopher C. Liu & Toby E. Stuart, *Social Influence Given (Partially) Deliberate Matching: Career Imprints in the Creation of Academic Entrepreneurs 4* (Harvard Bus. Sch. Working Paper 09-136, 2009); Aleksandra J. Kacperczyk, *Inside or Outside: The Social Mechanisms of Entrepreneurship Choices. Evidence from the Mutual Fund Industry 33–35* (2009) (unpublished Ph.D. dissertation, University of Michigan).

42. See DiRenzo, *supra* note 36, at 268; Ibarra, *supra* note 36, at 767; Van Maanen & Schein, *supra* note 36, at 213.

43. Ashforth & Saks, *supra* note 37, at 171–72.

individual's approach to her job will tend to bear the stamp of the environment she experienced during the early stage of her career.

There are a growing number of studies in a variety of populations that have found empirical support for this cohorts phenomenon. For instance, an analysis of managers, lawyers, and scientists suggest that even when individuals move past the early apprenticeship stage of their careers, they continue to carry with them behaviors and beliefs adopted during the acclimation period.⁴⁴ This evidence has led scholars to conclude that employees from a variety of disciplines such as academic advisors, accountants, coordinators, research specialists, and technicians are highly impressionable during these early stages. It has also led commentators to deduce that what employees learn during this period of acclimation to the organization can have a long-lasting effect on how they continue to operate within the range of their discretion down the road.⁴⁵

44. MONICA C. HIGGINS, CAREER IMPRINTS: CREATING LEADERS ACROSS AN INDUSTRY 12–14 (1st ed. 2005); Bill McEvily, Jonathan Jaffee & Marco Tortoriello, *Not All Bridging Ties Are Equal: Network Imprinting and Firm Growth in the Nashville Legal Industry, 1933–1978*, 23 *ORG. SCI.* 547, 559–60 (2012); Damon J. Phillips, *Organizational Genealogies and the Persistence of Gender Inequality: The Case of Silicon Valley Law Firms*, 50 *ADMIN. SCI. Q.* 440, 467–68 (2005); Azoulay et al., *supra* note 41.

45. Michael F. Gast & Paul J. Patinka, *Imprinting the Young Employee*, *BUS. HORIZONS* 11 (July–Aug. 1983); John Kammeyer-Mueller, Connie Wanberg, Alex Rubenstein & Zhaoli Song, *Support, Undermining and Newcomer Socialization: Fitting in During the First 90 Days*, 56 *ACAD. MGMT. J.* 1104, 1111 (2013). The idea that employees are most impressionable during the early stage of employment has been recognized in the workers-union context, *see* PAUL F. CLARK, *BUILDING MORE EFFECTIVE UNIONS* 57 (2009) (“It is extremely important for the union to make its case in these early stages of employment when the new employee is the most impressionable.”), the financial-advisors context, *see* LAUREN FARASATI, *STAFF TO LAST!: FOR FINANCIAL ADVISORS ONLY: HOW TO BUILD A STAFF THAT MAKES YOUR CLIENTS HAPPY, YOUR PEERS JEALOUS, AND YOUR WALLET FAT* 88 (2009) (“And the bulk of training occurs during the window in which new employees are both most impressionable and most vulnerable. Having a training structure will produce confident employees who learned the important stuff and the right skills from day one.”), as well as the medical-business context, *see* BOB PHIBBS, *THE RETAIL DOCTOR’S GUIDE TO GROWING YOUR BUSINESS* 140 (2010) (“Employees are most impressionable when they are first hired.”); *see also* ANDERS ORTENBLAD, *HANDBOOK OF RESEARCH ON THE LEARNING ORGANIZATION: ADAPTATION AND CONTEXT* 122 (2013) (noting that “[h]aving been deeply immersed in the protected business environment of SOEs in China over a protected period of time, many employees, especially old timers, had developed entrenched ‘social defenses’ against the learning and change . . . and were skeptical about the benefits promised by the reforms”); PETER B. GRAZIER, *TEAM BUILDERS PLUS, OVERCOMING RESISTANCE TO EMPLOYEE INVOLVEMENT*, <http://teambuildersplus.com/articles/overcoming-resistance-to-employee-involvement> [<http://perma.cc/UUW7-XZ9E>] (“Because our prior training and condition is such a significant barrier to our ability to change, we need to take some very proactive steps.”).

A related literature examines how employees have difficulty adjusting to new contexts and unlearning deeply embedded beliefs, practices, and knowledge. For instance, physicians

As a result, we begin by hypothesizing that patent examiners are particularly suggestible during their first year at the PTO and that the initial conditions faced by examiners at that time—that is, the allowance culture or the training practices—can have a persistent effect on how the examiner approaches the review of patent applications, including her general granting proclivities. In light of such persistence in behaviors and possible variations that likely exist in initial hiring conditions over time, we thus predict that examiners of different hiring cohorts will adopt and then largely maintain certain granting practices.

Hypothesis 1: *All else being equal, the year a patent examiner is hired by the Agency will impact the grant rate that she follows throughout the course of her tenure.*

B. *The PTO's Allowance Culture*

To the extent that new hires are particularly impressionable, initial hiring conditions may help explain an examiner's granting proclivities over the course of her career. Certain conditions present at the PTO may be of paramount significance in this regard. Perhaps most saliently, the Agency's allowance culture—or the emphasis that the PTO places on allowing versus rejecting patents—at the time an examiner was hired could have a long-lasting effect on her granting behavior. Such an effect may even persist in the face of shifts in the Agency's allowance culture over the course of an examiner's career.⁴⁶

Quantifying the PTO's allowance disposition at any moment in time is inherently difficult. To help determine this feature of the Agency, we rely primarily upon qualitative assessments of the stringency of the Agency's quality-assurance program. Although we recognize that other directives could serve as proxies for the Agency's allowance culture, we nevertheless focus on the variation in the severity of the PTO's quality-assurance mechanisms given that they

have been accused of being slow to embrace a new model of healthcare that considers costs in their diagnostic and treatment recommendations or adjust their prescribing behavior of prescription drugs in light of new evidence. *See, e.g.,* Eve Glicksman, *Teaching Doctors How to Improve Care and Lower Costs . . . at the Same Time*, AM. ASS'N MED. COLLEGES (June 2015), <https://www.aamc.org/newsroom/reporter/june2015/434756/lower-costs.html> [<http://perma.cc/7AC5-YEKC>] (“Instilling cost awareness in physicians and asking them to consider costs in their diagnostic and treatment recommendations, however, is a challenge requiring a cultural shift from deeply entrenched values and practices in medicine.”).

46. The management literature has long recognized that an organization's culture can be a strong influence in shaping the behaviors and beliefs of new hires. *See, e.g.,* HIGGINS, *supra* note 44; Dokko et al., *supra* note 38, at 55.

are the natural and effective tools by which Agency heads can convey their granting preferences.⁴⁷ That is, the operation of the Agency's quality-assurance initiatives is largely in the discretion of the Agency's upper management, which would make them an attractive policy lever to effectuate a change in management's views toward allowing or rejecting applications. If high-level management believes that the PTO is allowing too many low-quality patents, then it may choose to strengthen the Agency's quality-assurance program by sending a signal to examiners that the PTO now values rejecting patents more than it did in the preceding years. Conversely, if high-level officials at the Agency believe that the PTO is erroneously rejecting too many valid patents, they may weaken the quality-assurance initiatives in order to correct for what they perceive to be an overly restrictive granting culture.⁴⁸ Moreover, because quality-assurance programs aimed at evaluating individual examiner behavior (and aimed at assisting in promotion decisions) have such a strong potential to redirect examiner practices, this particular policy tool has the potential to powerfully implement the directives of management.

The rest of this Section utilizes variation in the nature of the PTO's quality-assurance program to help map out three distinct regimes of the Agency's "allowance culture" over the period ranging from 1993 to 2012: (1) a more permissive granting culture throughout the 1990s; (2) a less permissive granting culture in the mid- to late-2000s; and (3) a more permissive granting culture in the 2010–2012 period. We emphasize that these regimes are relative to one another. That is, we suggest only that the attitude of the Agency in the 1990s was more permissive with respect to granting than it was in the mid- to late-2000s. We do not attempt to classify these cultural eras relative to some normatively optimal benchmark.

47. Our interviews with patent examiners suggest that some believe a change in the allowance culture is effectuated through a top-down approach wherein high-ranking officials communicate a need for change in allowance culture to officials directly below them and wherein these officials further communicate these instructions to those below them, etc. Telephone Interview with Former Patent Exam'r No. 7, U.S. Patent & Trademark Office (June 30, 2015); cf. Frakes & Wasserman, *Bad Patents*, *supra* note 6, at 665 (discussing possible channels by which the PTO could favor certain patent types over others, including a top-down approach).

48. The Agency could also change the culture of allowance in an effort to address its growing backlog of patent applications. Because patent applicants can continuously refile rejected applications, allowing patents is the easiest way for the PTO to diminish or at least slow down the growth of its application backlog. See, e.g., Frakes & Wasserman, *Bad Patents*, *supra* note 6, at 616 (describing why a resource-constrained agency may allow additional patents in an effort to decrease its backlog).

The 1990s arguably represented a high water mark with respect to the Agency's culture of allowance. At this time, the Agency not only infamously stated that its "primary mission" was "to help customers get patents," but it also severely compromised much of its quality-assurance infrastructure.⁴⁹ Generally speaking, the PTO's quality-assurance efforts are implemented through two different mechanisms: quality-assurance reviews performed by the Office of Patent Quality Review and integrated quality reviews within each of the PTO's nine technology centers (that is, large collections of examiners that review applications in the same general technological field).⁵⁰ Since its inception in 1974, the Office of Patent Quality Review has randomly selected a sample of allowed applications and has conducted its own independent review of the applications to determine if the examiner properly decided the invention merited a patent.⁵¹ Decisions by high-ranking officials in the PTO, however, left the Office of Patent Quality Review largely ineffective for a substantial period of time in the 1990s.

In 1990, the Inspector General relied on data from the Office of Patent Quality Review to fault the PTO for failing to reduce error rates.⁵² The Agency's management responded by proposing to eliminate the Office of Patent Quality Review (and its evaluations) in favor of utilizing customers' (that is, patentees') satisfaction surveys as the PTO's primary measure of examination quality.⁵³ In 1993, the PTO began reducing the staff of the Office of Patent Quality Review to prepare for replacing the office with the "reengineered quality process."⁵⁴ By 1996 the PTO slashed the Office of Patent Quality Review in half, resulting in the office sampling only 2 percent of allowed applications, well below the 4 percent sampling rate the

49. U.S. PATENT & TRADEMARK OFFICE, CORPORATE PLAN—2001: PATENT BUSINESS 23 (2001), <http://www.uspto.gov/web/offices/com/corpplan/pt04.pdf> [<https://perma.cc/8SCX-VS69>].

50. Historically, the integrated quality review was mainly comprised of supervisors reviewing the work of examiners, especially the work of junior examiners. In response to the 1997 Inspector General Report, the PTO expanded integrated quality review to include some in-process review—i.e., quality review before an application was allowed. In 2000, the integrated quality review was further expanded for a small subset of applications directed toward business methods, in which all allowances were subjected to a mandatory second round of review.

51. OFFICE OF INSPECTOR GEN., U.S. DEP'T OF COMMERCE, REPORT NO. OIG-11-006-I, U.S. PATENT AND TRADEMARK OFFICE PATENT QUALITY ASSURANCE PROCESS 2 (2011).

52. OFFICE OF INSPECTOR GEN., U.S. DEP'T OF COMMERCE, REPORT NO. PTD-9977-7-0001, PATENT QUALITY CONTROLS ARE INADEQUATE 1–3 (1997).

53. *Id.*

54. *Id.* at 4.

Agency had determined was necessary to provide valid results.⁵⁵ After the Inspector General criticized the Agency's quality-assurance program in 1997, the PTO agreed to increase the Office of Patent Quality Review's staff in order to provide statistically valid samples of allowed applications.⁵⁶ Accordingly, both the compromised quality-assurance program and the Agency's own mission statement suggest that the PTO had a rather permissive allowance culture during the 1990s.

The PTO's allowance culture arguably became less permissive in 2002. At this time, the Agency proposed a series of enhanced-quality initiatives that both improved quality review at the Office of Patent Quality Review and integrated quality review within a technology center.⁵⁷ These initiatives, which represented the most significant restructuring of the PTO's quality-assurance program in over twenty-five years, were largely implemented in the end of 2003 and throughout 2004 under Jon Dudas, then Director of the PTO.⁵⁸ These quality-assurance initiatives included, among other things, an expansion of the Agency's mandatory second-review program and the implementation of a certification program that required examiners to demonstrate examination proficiency periodically.⁵⁹ Importantly, the Agency committed significant human resources to implement these initiatives, creating a series of new positions and more than doubling the number of individuals whose primary responsibility was to review

55. *Id.* The revamped survey-based evaluation process suffered delays and setbacks and never made it out of the pilot stage. *Id.* at 5–6.

56. *Id.* at 6–7. At this time the Agency also adopted the Inspector General's suggestion to review first office actions—the first substantive evaluation of an application—rather than only allowed applications. ASSISTANT SEC'Y OF COMMERCE & COMM. OF PATENTS & TRADEMARKS, DRAFT RESPONSE TO DRAFT AUDIT REPORT NO. PTD-9977-7-XXXX: "PATENT QUALITY CONTROLS ARE INADEQUATE" 1, 3 (1997).

57. See U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2003, at 12 (2003) [hereinafter 2003 PERFORMANCE REPORT].

58. THOMAS H. STANTON ET AL., NAT'L ACAD. OF PUB. ADMIN., U.S. PATENT AND TRADEMARK OFFICE: TRANSFORMING TO MEET THE CHALLENGES OF THE 21ST CENTURY 65 (2005). These new quality initiatives, among other things, represented a shift in focus from the end-of-examination review to in-process examination review, as well as a push to use quality-assurance results to improve individual examiner performance and improve training programs. 2003 PERFORMANCE REPORT, *supra* note 57, at 2–3; U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2004, at 3 (2004) [hereinafter 2004 PERFORMANCE REPORT].

59. The Agency first introduced this second review program in 2000 but only for allowed patents in class 705 of business methods. U.S. PATENT & TRADEMARK OFFICE, THE 21ST CENTURY STRATEGIC PLAN 9 (2003); 2004 PERFORMANCE REPORT, *supra* note 58.

the work of examiners.⁶⁰ After the implementation of these new directives, the Agency's grant rate dropped dramatically.⁶¹ Robert Budens, the president of the patent examiner union, remarked that these initiatives created an environment where examiners "started becoming fearful of allowing [applications] because you could run headlong into quality review problems that make life miserable."⁶² Thus, it appears that the PTO's allowance culture had waned in the mid- to late-2000s, at least in comparison to the 1990s.

The appointment of David Kappos as Director of the PTO in August 2009 arguably represents another shift in the Agency's views toward allowing patents.⁶³ Almost immediately upon starting as Director, Kappos addressed "the culture of rejection" that pervaded the office under Dudas by sending an email to all examiners stating,

60. STANTON ET AL., *supra* note 58, at 67 (noting that the agency created a director for the Office of Patent Quality and Assurance, review-quality specialists who conduct quality reviews and report to the Office of Patent Quality and Assurance, and twenty-two training quality-assurance specialists resident in the Technology Center who conduct in-process quality reviews and report directly to the Technology Center Directors). In the late 1990s, full staffing of the Office of Patent Quality Review required sixteen reviewers. OFFICE OF INSPECTOR GEN., *supra* note 52, at 4.

The result was four different types of quality review: the Office of Patent Quality Review continued to review examiner work of applications that were allowed while newly created training quality-assurance specialists conducted both second-pair-eyes-review for allowed applications in specific fields and random in-process reviews of examiners' work after first office actions were completed, and focused on in-process reviews in response to supervisors' requests. STANTON ET AL., *supra* note 58, at 67.

61. *Hearing Before the Subcomm. on Courts, the Internet, and Intellectual Prop. of the H. Comm. on the Judiciary*, 110th Cong. 11 (2008) (statement of Jon W. Dudas, Under Secretary of Commerce for Intellectual Property and Director, United States Patent and Trademark Office) (highlighting that the Agency grant rate in 2007 was only 44 percent, nearly 30 percent lower than the allowance rate in the late 1990s); Terry Carter, *A Patent on Problems*, ABA J. (Mar. 10, 2010, 11:40 AM), http://www.abajournal.com/magazine/article/a_patent_on_problems [<http://perma.cc/3UQF-U8ZE>] (noting that Jon Dudas, who was Director of the PTO from 2004 to 2008, stated, "We focused on quality with a number of new initiatives and the error rate came down . . . We anticipated the allowance rate to come down, but didn't think it would come down as much as it did"); *see infra* Table 1.

62. Carter, *supra* note 61 (noting that Robert Budens, president of the patent examiner union, stated "[t]he levels of review got ridiculous The allowance rate began to drop like a stone, in part from a larger fear created in the examining corps, and especially the supervisors who don't want to get dinged on their performance"); Telephone Interview with Former Patent Exam'r No. 7, U.S. Patent & Trademark Office (June 30, 2015) (noting that the Agency had a culture of rejection in the mid-2000s).

63. This is not to say there have not been changes to the incentive structure of examiners in efforts to increase patent quality. For instance, in 2010 the PTO changed the production schedule of examiners as well as the metrics utilized to review supervisors. *See* U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2010, at 16–17 (2010).

“Let’s be clear: Patent quality does not equal rejection.”⁶⁴ During the end of 2009 and beginning of 2010, the PTO began to rectify what Kappos believed was examiners’ reluctance to allow patents by rolling back potentially ineffective quality-assurance initiatives—that is, abolishing the mandatory second-review program and reducing the certification program for examiners.⁶⁵ In addition, in 2010 the Agency implemented initiatives to increase the effectiveness of patent prosecution, which it touted as increasing the PTO’s allowance rate while also increasing the quality of review.⁶⁶ Thus, it appears that from 2010–2012 the PTO’s allowance culture became more permissive.

Hypothesis 2: *All else being equal, patent examiners hired during a time period when the Agency had a more permissive allowance culture will have a higher grant rate throughout their careers than patent examiners hired during a time period when the Agency had a less permissive allowance culture.*

C. *The PTO’s New-Hire Training Programs*

The preceding subsection predicts that the Agency’s allowance culture at the time an examiner was hired may have a lasting influence on how an examiner approaches the review of patent applications, including her granting proclivities. This Section posits that changes in the rigor and length of new-hire training programs at the PTO can amplify or attenuate the extent to which new cohorts of examiners adhere to the prevailing allowance culture of the Agency. Assuming that the PTO will promote its allowance philosophy—be it permissive or restrictive in nature—in its new-hire training programs, this Section posits that the longer a new patent examiner receives formal new-hire training, the more likely she is to become indoctrinated into the Agency’s prevailing allowance culture (at least that component of the Agency’s culture being propagated by central Agency heads).

64. Carter, *supra* note 61.

65. Telephone Interview with Steven Griffin, Senior Adviser for the Office of Comm’r for Patents (July 6, 2015).

66. U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2009, at 14 (2009). Kappos also successfully reengineered the way examiners earn credits toward their production quotas by giving examiners more time to review patent applications. *Id.* at 3, 18. The PTO explained that this and other changes were meant to “[r]educ[e] examiner reluctance to allow applications.” U.S. PATENT & TRADEMARK OFFICE, JOINT LABOR & MGMT. COUNT SYS. TASK FORCE, OVERVIEW OF COUNT SYSTEM INITIATIVES AND CHANGES 3, 16 (Mar. 8, 2010) (on file with author).

The Section now turns to describing the two distinct new-hire training regimes of the PTO over the period of 1993 to 2012: (1) a very minimal formal training period before 2006 and (2) a robust formal training period during and after 2006. The PTO, like other organizations, requires its examiners to complete a series of training programs before they can begin routine evaluation of patent applications. Before 2006, the formal training of new patent examiners was rather modest. Newly hired patent examiners received only two to three weeks of formal, centralized training before they were assigned to an art unit.⁶⁷ Upon assignment to an art unit, new hires immediately began to review actual patent applications, during which time the supervisor of the art unit provided additional informal training.⁶⁸

In 2006, the PTO dramatically changed how the Agency trained new patent examiners with the opening of the Patent Training Academy.⁶⁹ The Patent Training Academy provided new patent

67. See U.S. GOV'T ACCOUNTABILITY OFFICE, GAO-07-1102, U.S. PATENT AND TRADEMARK OFFICE: HIRING EFFORTS ARE NOT SUFFICIENT TO REDUCE THE PATENT APPLICATION BACKLOG 10 (2007). Examiners' two weeks of formal training included an introduction to the software utilized by examiners and a brief primer on patents. ANNEMARIE L. M. FIELD, CONNOR McGRATH & ELAINA NICHOLS, PATENT EXAMINER RECRUITMENT, PROJECT NUMBER: 45-HXA-0707, at 71 (Dec. 12, 2007), <https://www.wpi.edu/Pubs/E-project/Available/E-project-121207-102952/unrestricted/USPTOFINALREPORT.pdf> [<http://perma.cc/YH4Q-2DBU>].

68. FIELD ET AL., *supra* note 67, at 71. New examiners, like other examiners, also periodically received additional formal training. U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2002, at 101–03 (2002).

Once new hires begin actually reviewing patent applications they are technically subject to production quotas like the other examiners in the examining corps are. However, production quotas are not generally enforced against new hires for the first year. Nevertheless, new hires are expected to demonstrate an increase in production with the general goal of meeting full production at approximately the one-year mark. Patent examiners also appeared to be hired under a probationary period for much of our sample period. This probationary period was two years for much of the early 2000s and one year in the late 2000s. Although production quotas are not technically utilized to determine the performance review of an examiner during her first year, they are used to determine who would be retained at the PTO. For instance, an examiner who was meeting only 50 percent of her production quota by near the end of her first year in terms of reviewing applications could be in jeopardy of being fired. Telephone Interview with Former Patent Exam'r No. 7, U.S. Patent & Trademark Office (June 30, 2015); Telephone Interview with Current Patent Exam'r No. 6, U.S. Patent & Trademark Office (July 2, 2015).

69. U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2006, at 4 (2006). This transformation in training practices coincided with an expansion in the Agency, including hiring approximately 2,000 new examiners over a two-year period which increased the number of patent examiners by 50 percent, during which the Agency realized it was no longer feasible to saddle the majority of new-hire training on senior examiners. *Id.*; see also U.S. PATENT & TRADEMARK OFFICE, 2007–2012 STRATEGIC PLAN 6–7,

examiners with an eight-month, university-style formal training program and brought more uniformity and rigor to the training process.⁷⁰ For the first two months, new hires attended large lectures that mimicked college courses in which they received training on laws and procedures associated with the examination of patent applications, and soft skills such as interpersonal and work-life skills.⁷¹ After this initial two-month period, new hires began to work on actual patent applications from their home art units, in addition to attending lectures.⁷² At the end of the eight-month period, examiners transitioned fully into their home art units, where they subsequently received informal training from their supervisors.

In 2006, however, not all new hires were subject to the redesigned training program. Approximately half of the 1,218 new patent examiners hired in 2006 received training through the new Patent Training Academy for up to eight consecutive months while the other half received training under the prior model—that is, two weeks of formal training before being assigned to their home art units.⁷³ Selection for the more rigorous new-hire training depended upon the examiner's technological specialty. That is, examiners who were hired based upon their backgrounds to review applications in certain fields, such as computer hardware and software, overwhelmingly received the more extensive new-hire training, whereas examiners who were hired to review other technologies, such as agriculture, food, and textiles, did not.⁷⁴ Beginning in 2007, all new hires were subject to the enhanced new training program.⁷⁵

<http://www.uspto.gov/sites/default/files/web/offices/com/strat2007/stratplan2007-2012.pdf> [<http://perma.cc/3FAF-8999>].

70. Examiners that enter the Patent Training Academy are divided into subgroups comprising approximately sixteen examiners with similar scientific backgrounds to whom a primary trainer and an assistant trainer are assigned. FIELD ET AL., *supra* note 67, at 71.

71. *Patent Examiner Positions*, U.S. PATENT & TRADEMARK OFFICE, <http://careers.uspto.gov/Pages/PEPositions?Training.aspx> [<http://perma.cc/65QG-7D2Y>].

72. FIELD ET AL., *supra* note 67, at 71.

73. U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2006, at 16–17 (2006).

74. The Appendix provides more details as to which technology areas examiners received the eight-month formal style training in 2006.

75. In 2010, the Agency made another change in its new training process. At this time, the Agency replaced the eight-month training program with two new initiatives. The first was a twenty-day training program for new examiners with at least one year of prior intellectual property experience. The second was a two-phased twelve-month program for new examiners without prior intellectual property experience. The two-phase twelve-month program differed from the previous eight-month training process in several respects. Most saliently, it decreased

Hypothesis 3: *The longer the amount of time new patent examiners receive formal training, the more likely their grant rates will reflect the allowance culture of the PTO at the time they were hired.*

III. DATA AND METHODOLOGY

A. Data

In order to establish the link between the granting styles of patent examiners and the hiring cohorts to which they belong, it is necessary to amass rich data on patent applications spanning enough time to be able to distinguish true cohort effects from other related but distinct determinants of granting practices—for example, the effect of gaining additional years of experience. To date, data rich enough to accomplish this task has generally been unavailable. In fact, most prior investigations into the determinants of examiner behavior have explored only issued patents.⁷⁶ A sampling frame of this nature is incapable of capturing the key decision that an examiner must make: whether or not to grant the given patent application. Furthermore, when prior studies have actually used application-level data, they have done so only with respect to a subset of applications filed at one point in time,⁷⁷ a metric which does not help to isolate true cohort effects of the sort envisioned by this Article.

To overcome these deficiencies, we collected data on the nearly 2 million utility-patent applications⁷⁸ filed on or after March 2001 that were published by July 2012 from the PTO's Patent Application Information Retrieval (PAIR) database.⁷⁹ By the end of 2012, 49

the time new examiners spend receiving formal training in the Patent Training Academy by half before examiners transitioned into their home art units. Examiners did, however, continue to periodically receive formal training at the Patent Training Academy for the first eight months after transitioning into their home art units. *See* U.S. PATENT & TRADEMARK OFFICE, *supra* note 63, at 119–21.

76. *See, e.g.*, Cockburn et al., *supra* note 9, at 19, 21; Lichtman, *supra* note 16, at 158; Ronald J. Mann, *The Idiosyncrasy of Patent Examiners: Effects of Experience and Attrition*, 92 TEX. L. REV. 2149, 2158 (2014).

77. For instance, one of the few papers that does utilize application-level data considers only 10,000 applications filed in January 2001. Lemley & Sampat, *supra* note 15, at 817.

78. Utility patents protect the way an article is used and works. 35 U.S.C. § 101 (2012).

79. In November 2000, there was a change in the law that required newly filed patent applications to be published eighteen months after they were filed. *See id.* § 122(b). Applications abandoned within the first eighteen months of filing, *id.* § 122(b)(2)(A)(i), and applications wherein the applicant filed a special exemption to maintain confidentiality, are exempted from this requirement, *id.* § 122(b)(2)(B)(i):

percent of these applications had resulted in patents, 25 percent were not patented because they had been abandoned by the applicant,⁸⁰ and the remainder were still pending. Our study focuses on the 1.4 million utility-patent applications filed from 2001 onward that received a final disposition—those that were granted or abandoned—by July 2012.

Though publicly available, the PAIR database is not readily suitable for a comprehensive analysis of the determinants of patent examiner granting practices considering that the data is divided into separate webpages for each individual application, with each webpage providing information via numerous tab delimited and portable document format (pdf) files. With help from the National Center for Supercomputing Applications at the University of Illinois, we amassed and coordinated the information provided by the more than one million distinct webpages. Importantly, these data include information on the outcome of the application process—that is, whether or not the application was granted—along with the identity of the patent examiner charged with reviewing the application. This latter data field allowed us to merge application outcomes with various characteristics of the examiner, including (1) the year in which the examiner was hired by the PTO (and if the examiner was hired in 2006, whether she received the eight-month or two-week formal new hiring training), (2) the experience (in years) of the examiner at the time of review of the application in question, and (3) the general schedule (GS) pay-grade level of the examiner at the moment of review. We collected information on these personnel-related measures by filing various FOIA requests with the PTO. Though our application-level data only starts in 2001, we collected examiner roster information dating back to 1992, allowing us to

Such applications are . . . absent from the PAIR database. When some or all of an applicant's claims are not allowed by the Patent Office, the aggrieved party will sometimes file a continuation application. This application is given a new serial number and may be assigned to a different examiner. Continuation applications are treated as unique applications in the PAIR database. A related and now far more commonly used device, known as a Request for a Continued Examination (RCE), does not receive a new application serial number and effectively allows an aggrieved applicant to keep the application on the examiner's docket for further prosecution. RCEs are not treated as new, unique filings in the PAIR database; rather, they are treated as a continuation in the prosecution of original applications.

Frakes & Wasserman, *Time Allocated*, *supra* note 6 (manuscript at 3–4 n.3).

80. Applicants may abandon their applications for a number of reasons including the failure to overcome an examiner's rejection, change in their research direction, and bankruptcy. Frakes & Wasserman, *Time Allocated*, *supra* note 6 (manuscript at 4).

nonetheless identify the distinct granting styles of those examiner cohorts starting in the 1990s.⁸¹ Finally, we treat the individual who did the majority of work on the application as the examiner charged with reviewing that application: (1) the non-signatory examiner, when both a non-signatory and an examiner with signatory authority are associated with an application, or (2) the signatory examiner, when only one examiner is associated with an application.⁸²

B. Summary Statistics

In Table 1, we summarize the mean grant rate for each PTO cohort from 1992 to 2012, using the 2002–2012 PAIR data. As demonstrated, the mean granting rates of the hiring cohorts from the 1990s are substantially higher than the hiring cohorts from the mid-2000s, with a high of nearly 84 percent and a low of roughly 45 percent for the 2010 cohort. Across most of the intervening cohorts, this decline in inherent granting tendencies appears gradual; however, the data evidence large drops in grant rates between the 2003 and 2004 cohorts (registering an 8 percentage-point drop) and between the 2006 and 2007 cohorts (registering a 7 percentage-point drop). The mean grant rates then jump for the cohorts hired in 2011 and 2012. To be clear, the grant-rate trend evidenced in Table 1 does not depict the mean grant rate of all of the observations disposed of in 1993, 1994 and so forth. Rather, the rate indicated for 1993 represents the average grant rate applied by those examiners hired in 1993 over the full 10 years of applications disposed of in our 2002–2012 PAIR sample.

These summary statistics suggest that for applications processed during the mid-2000s, the likelihood of success was far greater for applications assigned to examiners that started in the 1990s than for applications assigned to examiners who started in the mid-2000s. This observation, however, does not necessarily evidence a true cohort effect. That is, it does not provide compelling empirical support for the proposition that examiners develop practice styles during the first

81. We drop applications reviewed by those examiners who have been with the PTO since 1992 and before to ensure that we can properly track all examiners' experience lengths and starting dates; however, the analysis is not affected to the extent we simply view the pre-1993 cohorts as one group (results available from the authors upon request).

82. Signatory authority is the authority, granted by the PTO, for examiners to represent the Agency and to sign their own work. Examiners work toward obtaining such authority once they have reached the rank of general pay schedule 13. Frakes & Wasserman, *Time Allocated*, *supra* note 6 (manuscript at 4–5).

year at the PTO that generally persist over the course of their careers at the Agency. After all, factors other than actual cohort dynamics may account for this observed pattern. For instance, it could be that individual examiners do not exhibit any stickiness in behavior but that overall grant rates are falling substantially over time. As the applications reviewed by more recent cohorts would only fall on the tail end of this overall decline in grant rates, it would not be surprising that these recent cohorts carry lower mean grant rates. As such, it is first necessary to estimate the relationship between grant rates and hiring cohorts while controlling flexibly for trends in overall grant rates over time. This is a task that is made possible by the fact that the sample of applications collected follows a number of overlapping cohorts over a reasonably long period of time (in other words, given that we observe multiple cohorts for any given examination year and multiple years of examination for any given cohort, it is possible to statistically disentangle the two).

Of equally important concern is the need to distinguish cohort effects from experience effects, two related but distinct concepts. Both concepts capture mechanisms by which learning may shape granting practices; however, cohort effects focus on the early stages of learning and training, particularly on how initial hiring conditions may set a hiring cohort on a particular pathway. Some cohorts may start off on very permissive trajectories, whereas others start off on very restrictive trajectories. Once on their particular pathways, however, examiners may nonetheless undergo further longer-term developments as they spend more time with the Agency. For instance, examiners of all cohorts—whether those on high-grant-rate or low-grant-rate pathways—may experience a common evolutionary process in which they all learn how to form more effective bases of rejections over time. We characterize these latter developments as “experience” effects. To be sure, the relationship between grant rates of patent applications and experience effects is important in its own right and, in fact, has been the subject of recent scholarship.⁸³ In the present study, we aim to build on these prior efforts and focus attention on the importance of initial conditions and the entrenchment in practice styles that they carry, a phenomenon that

83. *See id.* (manuscript at 18–25) (finding that experience does not induce examiners to grant patents at a higher rate but that instead examiner’s grade level has explanatory power as to her grant rate); Lemley & Sampat, *supra* note 15, at 817 (finding that more experienced examiners have a higher grant rate than less experienced examiners).

carries with it a range of critical policy implications distinct from those pertaining to longer-term experience dynamics.

Fortunately, having collected data that allows us to follow many cohorts over a long period of time, our analysis will likewise facilitate the simultaneous estimation of cohort and experience effects in explaining granting behaviors. For instance, though examiners from the late 2000 cohorts only have limited experience, we may look to the grant rates of the earlier cohorts during years when they likewise had similarly low levels of experience in order to help us derive common experience patterns while leaving some information by which to identify the separate tendencies of the cohorts themselves.

Finally, we note that there may be other characteristics of the applications under investigation or other changes in hiring practices that may explain the simple summary statistics presented in Table 1. For instance, one might be concerned that more of the new hires in the mid-2000s were concentrated in certain technologies that are generally associated with lower grant rates, as compared to those hires from previous years. Accordingly, the empirical analysis below will attempt to disentangle cohort effects from technology effects and other application characteristics beyond experience and examination-year effects.

C. Methodology

In the Appendix, we set forth in greater detail the precise empirical specification that we estimate in order to both test for the existence of cohort effects and to determine the nature and shape of such effects. In short, we consider the sample of individual applications from the PAIR database that were disposed of by July 2012⁸⁴ and regress the incidence of the relevant application being

84. Though we begin collecting applications that were filed as of March 2001, our goal is to understand the determinants of the application being allowed or not. Few applications filed in 2001 will reach a final disposition in that year. As such, we simply ignore any final dispositions we do observe in 2001 and focus our analysis on the applications disposed of between 2002 and 2012. In the Appendix, we present robustness checks to account for some degree of sample imbalance that may arise through the timing of this analysis—e.g., by the fact that those applications that will be disposed of in the early years of this sample are those that reach a final disposition relatively quickly, whereas those disposed of in later years will represent a mix of applications of varying prosecution lengths. To achieve better balance, the robustness exercise conducted in the Appendix simply performs the analysis set forth below on a set of applications that all reach a final disposition within three years while only looking at dispositions between 2004 and 2012, thereby ensuring that all applications in any given year of the sample are similar in terms of length of prosecution.

granted on a series of dummy variables indicating (1) the year in which the examiner associated with the application began working with the PTO—that is, cohort effects, (2) the year in which the application was disposed of—that is, year effects, (3) the number of years of experience of the associated examiner at the time of examination of the relevant application (specified in accordance with the experience-year groupings set forth in the Appendix to address the well-known econometric issues with simultaneously estimating year effects, cohort effects, and age/experience effects), (4) the GS-level of the examiner, which we have previously shown is an important determinant of the grant rate of the examiner insofar as it bears on the amount of examination time at the examiner’s disposal,⁸⁵ (5) the technology category associated with the application,⁸⁶ and (6) the maximum number of years the relevant examiner spends at the PTO—that is, the examiner’s “tenure”—which is of potential relevance to the extent that those who depart the office quickly are of inherently different dispositions relative to those who stay with the PTO for a long time.⁸⁷

85. Frakes & Wasserman, *Time Allocated*, *supra* note 6 (manuscript at 9–10).

86. For these purposes, we use the thirty-seven technology sub-categories set forth by Bronwyn Hall and colleagues, *see The NBER Patent-Citations Data File: Lessons, Insights, and Methodological Tools*, in *PATENTS, CITATIONS, AND INNOVATIONS: A WINDOW ON THE KNOWLEDGE ECONOMY* 403, 452–54 tbl.9 (Adam B. Jaffe & Manuel Trajtenberg eds., 2002). In the Appendix, we demonstrate the robustness of the findings to the alternative use of PTO Class groupings (which are more fine-grained). The inclusion of technology-category fixed effects forces us to test for the presence of cohort effects by looking at dynamics *within* given technologies. As such, this set of controls alleviates concerns that the estimated patterns of cohort effects can be explained by trends in the technological emphasis of hiring over time. In the Appendix, we take matters one step further and include technology-category-by-year fixed effects. This richer set of controls can account for concerns that the PTO may differentially hire in different fields over time and that each technology has its own idiosyncratic time trend in grant rates. For example, it could be that the Agency hires more within a particular technology in the mid-2000s—a technology that is generally associated with a low grant rate—but that this particular technology also has an especially low grant rate—relative to its mean—in the mid-2000s for some reason unrelated to the learning and training dynamics of interest in this Article. Technology-by-year fixed effects allow for flexible trends in granting patterns over time within each technology, thereby alleviating any such concerns. As we are still observing multiple, overlapping cohorts of examiners over a long period of time within each separate technology, we can still impose technology-by-year fixed effects while retaining the ability to tease out the independent and general influence of the hiring year.

87. In robustness checks, we also control for certain additional characteristics of the underlying application, including (1) an indicator variable for whether the applicant is a large or small entity (as such terms are used to set application fees by the PTO), (2) the duration of the prosecution period, (3) an indicator variable for whether the application was previously filed at the EPO or JPO; and (4) an indicator variable for whether or not the applicant filed a request for continued examination during the prosecution of the application.

If cohort effects are not a real phenomenon—that is, if the pattern of declining mean grant rates by hiring cohort from Table 1 can be explained by these other factors (for example, year, experience, tenure, or GS-level effects)—we would expect to observe few differences among the estimated coefficients of the cohort-year dummies. In other words, if one plotted the estimated cohort coefficients, they would stay roughly flat over time. For example, the effect of the examiner being in the 1993 cohort, *all else being equal*, would be roughly the same as the effect of the examiner being in the 1994 cohort, the 1995 cohort, and so on and so forth. In Part IV, we will present results of this regression analysis and formally test for the presence of differences in granting tendencies across cohorts.

Finally, the theory set forth in Part II also predicts that the nature of such effects (to the extent they exist) will be a function of certain conditions of the Agency at the time of hiring for the relevant cohort—for example, the culture of the Agency and the nature of examiner training. Accordingly, after having established that cohort effects exist as a general phenomenon, our final methodological step will test (via simple graphical observation) whether the pattern of cohort effects that we estimate via our regression analysis aligns with our priors regarding the evolution of training practices and granting culture.

Table 1. Summary Statistics: Mean Grant Rates by Hiring Cohort Year, Based on Applications Disposed of Between 2002 and 2012

| (1) | |
|--------|---------------------------|
| Cohort | Mean (Standard Deviation) |
| 1993 | 83.7 (36.9) |
| 1994 | 77.2 (42.0) |
| 1995 | 76.3 (42.5) |
| 1996 | 78.3 (41.2) |
| 1997 | 78.6 (41.0) |
| 1998 | 78.5 (41.1) |
| 1999 | 75.1 (43.3) |
| 2000 | 74.4 (43.7) |
| 2001 | 72.9 (44.4) |
| 2002 | 71.3 (45.2) |
| 2003 | 67.0 (47.0) |
| 2004 | 58.6 (49.3) |
| 2005 | 58.5 (49.3) |
| 2006 | 55.4 (49.7) |
| 2007 | 48.4 (50.0) |
| 2008 | 45.9 (49.8) |
| 2009 | 47.1 (49.9) |
| 2010 | 45.4 (49.8) |
| 2011 | 56.8 (49.5) |
| 2012 | 52.6 (49.9) |

IV. RESULTS

This Part turns to testing the key hypotheses presented in Part II above. Generally, these hypotheses set forth that initial hiring conditions at the PTO impact the granting behavior of an examiner over the tenure of her career.

A. Primary Results

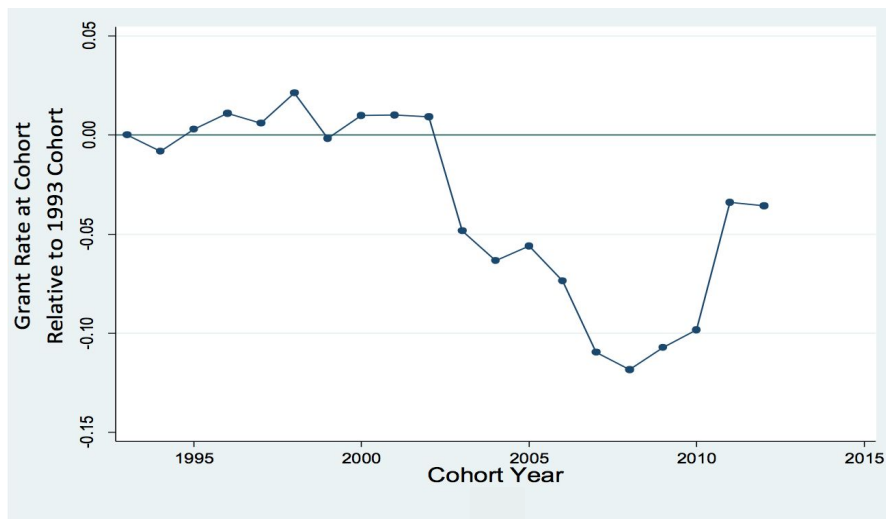
In Part II, we set forth the following testable hypothesis:

Hypothesis 1: All else being equal, the year a patent examiner is hired by the Agency will impact the grant rate that she follows throughout the course of her tenure.

In Figure 1, we present estimates of the coefficients of the cohort-year dummies from the regression described in Part III (the tabular regression results underlying this Figure are presented in the Appendix). These coefficients can effectively be interpreted as the trend in inherent grant rates across different cohorts of examiners

based on the year in which they are hired, where each point should be interpreted with reference to the 1993 cohort, whose grant rate is normalized at 0. For instance, the mean grant rate for the 2007 cohort is roughly 11 percentage points lower (or roughly 16 percent lower in light of an overall grant rate of 68 percent) than the mean grant rate of the 1993 cohort. Although the regression underlying these estimates includes controls for year effects, experience effects, GS-level effects, tenure effects, and technology effects, we present only the coefficients of the cohort-dummy variables in Figure 1, which represent the measures of interest in this Article.

Figure 1: Relationship Between Grant Rates and Hiring-Year Cohort of Associated Patent Examiner, Among Applications Disposed of Between 2002 and 2012, Controlling for Year Effects and Other Application and Examiner Characteristics



Note: This figure presents results from a regression of a dummy variable indicating a granted application on dummy variables representing the hiring year of the associated patent examiner. The dummy variable for the 1993 cohort is omitted, representing the reference group. The figure plots the estimated mean coefficients of the cohort effects only. Regressions include year fixed effects, examiner-experience effects, GS-level effects, examiner tenure effects, and technology effects.

As above, if cohort dynamics were not an actual determinant of observed granting practices, one would predict a flat relationship across the various coefficients of cohort indicators. Figure 1 hardly fits this description, instead evidencing a strongly declining grant rate as we head into the cohorts of examiners hired in the mid-2000s and a

subsequent increase in granting tendencies as we view the cohorts at the very end of the sample. With an F-statistic of 9.54 on the estimated cohort effects, we can reject at beyond a 1 percent level of statistical significance the hypothesis that the estimated cohort effects are all jointly equal to 0—that is, that the grant rates do not differ across cohorts. Accordingly, we can conclude that the pattern estimated in Figure 1 is not merely a product of random noise, but instead evidences a true pattern of cohort dynamics. Moreover, the cohort effects we find are substantial. As noted above, examiners in the 1993 hiring cohort have a mean grant rate roughly 11 percentage points (or 16 percent) higher than those examiners starting in the late 2000s. Thus, our findings are consistent with *Hypothesis 1* in suggesting that the year that an examiner was hired will impact her grant rate throughout the course of her career.

B. Explaining Direction of Cohort Effects

In Part II, we set forth the following testable hypothesis:

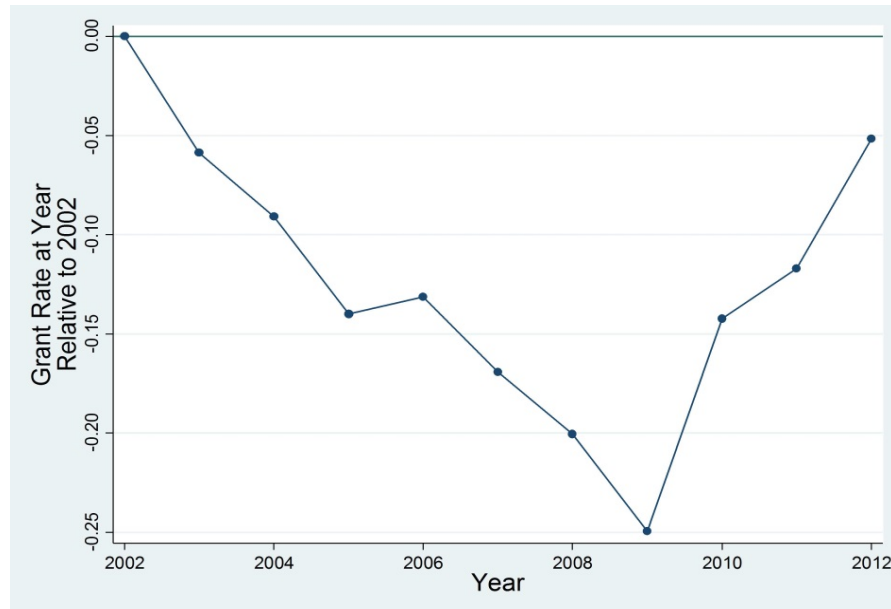
Hypothesis 2: All else being equal, patent examiners hired during a time period when the Agency had a more permissive allowance culture will have a higher grant rate throughout their careers than patent examiners hired during a time period when the Agency had a less permissive allowance culture.

As discussed in Part II, the PTO generally had three distinct allowance cultures over the period of our study: (1) a more permissive allowance culture throughout the 1990s, (2) a less permissive granting culture throughout the mid- to late-2000s, and (3) a more permissive granting culture during the period of 2010–2012. These cultural shifts are reflected in overall year-by-year grant rates of the Agency, controlling for the variety of variables set forth in Part III. In Figure 2, we present estimates of the coefficients of the year fixed effects that are included in the regression underlying Figure 1. Figure 2 demonstrates that the grant rate of the entire examiner corps was trending downwards throughout the mid- to late-2000s, aligning with the less permissive granting culture throughout that time period,⁸⁸ and

88. In our previous research, we stressed that the financial strain placed on the Agency over this decade may have incentivized it to grant patents at higher rates in order to generate additional fee revenue and/or to discourage the filing of costly continuation applications. See generally Frakes & Wasserman, *Agency Funding*, *supra* note 6; Frakes & Wasserman, *Bad Patents*, *supra* note 6. How can these previous arguments be reconciled with the present predictions of a decreasing grant-rate philosophy of the Agency over this time? As emphasized in our prior work, the grant rate may change from year to year due to stories unrelated to the

that the grant rate of the entire examiner corps reversed and trended upward in 2010, aligning with a more permissive granting culture in the 2010s.

Figure 2. Relationship Between Grant Rates and Year of Disposition of Application, Among Applications Disposed of Between 2002 and 2012, Controlling for Cohort Effects and Other Application and Examiner Characteristics

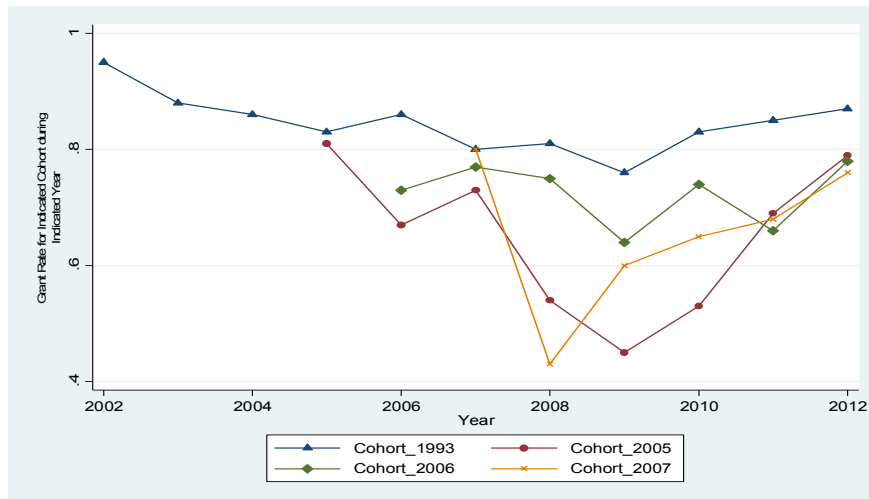


Note: This figure presents the mean estimates of the coefficients of the year fixed effects that are included in the regression underlying Figure 1.

fee- and continuation-related mechanisms of interest in that prior research. Although we did not specify as such during these prior articles, one unrelated story of this nature could be the desire of the Agency to improve the quality of its examination practices and to retreat from the customer-focused mentality of the previous decade. What this prior research effectively did then was to predict that financial considerations may have caused the Agency to hold back on pushing grant rates as low as it otherwise may have wanted absent such financial woes. Moreover, we predicted (and found evidence consistent with such predictions) that the Agency may have targeted this fee- or continuation-related granting bias on those types of applications that would deliver the Agency the largest payoff. As such, taking all of our research together, one can say that the Agency in the mid-2000s sought to generally depress the elevated grant rates it had been administering previously, but perhaps not as much in the case of those application types with respect to which elevated grant rates garner certain financial benefits for the Agency.

This Article's primary focus, however, is not whether the Agency's allowance culture affects the grant rate of the entire examiner corps—that is, year effects—but rather whether the PTO's granting culture has a lasting effect on the allowance rate of examiners hired at that time—that is, cohort effects. In other words, we are interested in the degree to which temporal changes in the Agency's culture and the Director's communications have a long-lasting impact on new hires' granting proclivities. As suggested in Part III, we might predict that the estimated cohort effects fell when the Agency's granting rhetoric took a restrictive turn in 2003/2004 with the roll out of a new patent-quality initiative. Consistent with the preliminary summary statistics set forth in Table 1 and discussed in Part III, the regression results depicted in Figure 1 align with these expectations. Relative to the 2002 cohort, the 2003 cohort exhibits a roughly 5 percentage-point drop in its mean grant rate. The mean grant rate of the 2004 cohort, in turn, drops a subsequent 1.5 percentage points relative to the 2003 cohort. As such, not only are grant rates generally falling across all examiners as a result of these cultural shifts—which we demonstrate via the estimated year fixed effects presented in Figure 2—but the impact of the cultural developments is especially felt by the new cohorts of examiners entering the Agency at that time. All else being equal, the mean grant rates of these burgeoning cohorts—comprised of impressionable, fledgling examiners—are lower than that of previous cohorts. This is further demonstrated by the year-by-year granting trends from 2002–2012 set forth in Figure 3. It compares, by way of example, a cohort emerging during the permissive 1993 regime with a cohort emerging during a more restrictive environment of the mid-2000s. Although the grant rates of the older cohorts did trend in the direction of these cultural shifts in the 2000s, they experienced this downward trend while nonetheless remaining at a higher general level than the emerging cohorts. That is, although the grant rates of the 1993 cohort are falling into the mid-2000s, once the mid-2000s cohorts enter the scene, they emerge with a grant rate that remains consistently below that of the 1993 cohort.

Figure 3: Year-by-Year Grant-Rate Trend over 2002–2012 for 1993 Hiring Cohort (Permissive Culture) and 2005–2007 Hiring Cohorts (Restrictive Cultures)



Note: This figure compares annual grant rate trends for the first cohort in our records to three cohorts in the mid-1990s using data from the 2002–2012 PAIR database.

As discussed in further detail in Part II, the 2010s were associated with a retreat of the restrictive culture of the mid- to late-2000s and a return to a more permissive environment. Similarly, not only do we observe that grant rates generally increase across the board after this time (as depicted by the estimated year effects in Figure 2), but we also see from Figure 1 that the new cohorts of examiners at this time start their careers on a higher grant-rate pathway than those examiners who started in the mid-2000s. Due to the time period of our study, it is difficult to say for sure without having the benefit of foresight that these newer cohorts will maintain this more permissive disposition if the environment becomes more restrictive in the future.

In the Appendix, we estimate regression specifications that group hiring cohorts into the three general bins characterized by the three relevant cultural regimes. This grouping better facilitates an assessment of the statistical significance of the above claims. Specifically, this exercise suggests that the downward trend in estimated cohort effects between the 1990s permissive era and the mid- to late-2000s restrictive era is indeed statistically significant (at the 1 percent level), as is the subsequent increase in cohort effects in

moving from the mid- to late-2000s to the post-2009 period (at the 5 percent level in the full specification with individual application controls).

C. *Magnifying Effect of Examiner Training Intensity*

In Part II, we set forth the following testable hypothesis:

Hypothesis 3: *The longer the amount of time new patent examiners receive formal training, the more likely their grant rates will reflect the allowance culture of the PTO at the time they were hired.*

In other words, we further predicted that training has an amplification effect on the role of culture in shaping long-term practice styles. We first test this by looking at the new examiners hired in 2006, a time, again, characterized by the restrictive granting philosophy that was initially set forth in 2003–2004. Some of the new hires at this time received the same level of training—that is, the two-week program described in Part II—that was offered to new hires in previous years. For these examiners, we may not predict much change in their inherent granting patterns—that is, in their cohort effect—relative to the 2004 and 2005 cohorts. New hires in certain technological fields in 2006, however, were exposed to a novel, extensive training period that lasted eight months. In light of the substantially longer period of formal indoctrination in the prevailing culture of the Agency, we predict that the mean grant rate of this particular set of the 2006 cohort will fall even lower relative to the 2004 and 2005 cohorts and to that portion of the 2006 cohort that was not subject to the new training program. The results presented in Figure 4 are consistent with this prediction. In this new figure, we modify the approach taken in Figure 1 to simply lay out two cohorts in 2006: one subject to the new training initiative and one subject to the prior training program.⁸⁹ The 2006 cohort with extensive training has a mean grant rate that is 2.3 percentage points (or roughly 3.4 percent) below the 2006 cohort that lacks the extensive formal training. To facilitate an assessment of the statistical significance of

89. Technology-fixed effects should address any concerns that the results are attributable to differences in grant-rate dynamics across technologies insofar as some technologies received the new training in 2006 and some did not. In alternative specifications presented in the Appendix, we show that these findings are robust to the alternative use of technology-by-year fixed effects. Although the PTO did not randomly assign examiners into the new training program, it appears as if they made these determinations on a technological basis. Given our ability to control for this assignment feature (i.e., technology), the residual separation into the new training group and the old training group can be viewed as effectively random.

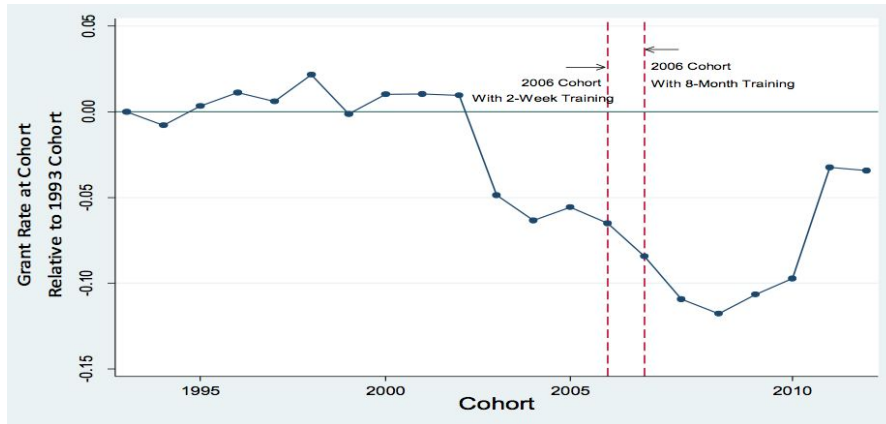
this estimate, we estimate a specification in the Appendix that modifies the three-cohort-bin approach discussed above and breaks the mid- to late-2000s cohorts into four groups: (1) between 2003 and 2006, (2) 2006 with the old training regime, (3) 2006 with the new training regime, and (4) between 2007 and 2009.⁹⁰ This exercise demonstrates a statistically significant difference in mean grant rates over their careers between the 2006 cohorts with and without the new training program (at either a 10 percent or a 1 percent level of significance depending on the precise specification).

Although only (roughly) half of the new hires in 2006 were subject to the extensive new training program, all new hires in 2007 were subject to the eight-month training initiative. Accordingly, we further predict that the mean grant rate for the 2007 cohort, all else being equal, will fall even further relative to the prior cohorts. Figure 4 is likewise consistent with this prediction.

Accordingly, beyond demonstrating the general presence of cohort effects themselves (*Hypothesis 1*), the findings presented in Figures 1–4 also lend support to *Hypotheses 2* and *3* and confirm that the nature of the estimated effects are consistent with what one would expect given the initial hiring conditions present in the relevant hiring years.

90. Using those specifications with separate effects for each cohort year is arguably not designed to conduct inference on the specific hypotheses posed by this Article, which do not predict particular differences in cohort effects for each hiring year, but instead make predictions across a coarser set of hiring years—for example, 1990s cohorts versus mid-2000s cohorts. Using the standard errors from specifications with cohort effects for each hiring year is perhaps unnecessarily taxing.

Figure 4: Estimation of Cohort Effects, Separating the 2006 Cohort into an Old-Training 2006 Cohort and a New-Training 2006 Cohort



Note: This figure modifies Figure 1 to divide the 2006 cohort into two groups: one of which was subject to the eight-month training program and one of which was subject to the prior two-week training program. The 2006 cohort with the old training program is marked by the first vertical dashed line from the left. The 2006 cohort with the new training program is marked by the second vertical dashed line from the left.

D. Caveats

Finally, we should note an important caveat to our analysis. It is possible that the documented cohort effects may be explained by fluctuations over time in the type of individuals the PTO hires as examiners—for example, in the mid-1990s, the PTO happened to hire examiners that entered their positions with an inherently restrictive granting philosophy, even before receiving any training. Such an explanation would differ from the hypothesized story in which early periods of training shape enduring granting philosophies and in which fluctuations in Agency culture over time leave examiners of different hiring cohorts on separate trajectories. Nevertheless, we believe there are several reasons why our results are more consistent with the latter than the former.

To start, our analysis does control for some fluctuations in the type of patent examiners hired. For instance, technology-fixed effects included in our base specification control for fluctuations in the PTO's technological-hiring preferences from year to year. Technological shifts in hiring aside, it is conceivable that the underlying pool of new hires changes as a function of the strength of the overall labor market. That is, in the years when the unemployment rate is high and the Agency faces less labor

competition from industry, it is possible that the PTO hires new examiners that are on average more competent. One might argue that examiners with greater competency may be more effective at finding and articulating bases of rejections and thus enter the PTO with a lower baseline granting proclivity than patent examiners hired in years when the unemployment rate is low and the PTO faces tighter labor competition from industry. While plausible, we do not think it is likely that our findings may be explained by fluctuations of this nature in the labor market for several reasons.

First, changes in the unemployment rate do not generally align with observed changes in the granting proclivities of patent office cohorts in the way predicted by this alternative theory.⁹¹ For instance, the unemployment rate was trending downwards from 1993 to 2001, but cohort effects are largely flat during this time period. Likewise, the unemployment rate was trending downwards in the mid-2000s (from 2003 to 2008), despite our observation of falling—not rising—cohort effects over this time period. Second, the results presented in Figure 4 support the contention that the promulgation of Agency culture through examiner training—not changes in labor markets—is driving the granting proclivities of patent office cohorts. That is, the fact that differences in the granting proclivities of examiners hired in 2006 can be explained in part by whether these examiners were subjected to eight months of formal new hiring training or two weeks of formal new hiring training cannot be explained by labor markets—all examiners hired during 2006 were part of the same labor market pool. The presence of credible training effects of this nature lends greater credibility to the remaining findings as stemming from a story in which early periods of training shape durable practice styles and in which variations over time in top-down views over the proper application of patentability standards determine variations in practice styles across cohorts.

Finally, Figure 3 further supports this cohorts interpretation of the results in lieu of the labor market alternative. As examiners from the permissive cohorts of the 1990s proceeded into the mid-2000s—at which time the Agency began calling for more restrictive practices—they did indeed begin to grant at lower rates. The argument raised in this Article—as supported by Figure 3—is that these reductions in

91. See *Unemployment Rate, Databases, Tables & Calculators by Subject*, BUREAU OF LAB. STATS., U.S. DEP'T OF LAB. (Jan. 27, 2016, 9:40 AM), <http://data.bls.gov/timeseries/LNS1400000> [<http://perma.cc/4EBP-W7C9>].

rates were not as strong as they might have otherwise been absent the hypothesized stickiness in examiner behavior (and thus did not go as low as the rates of the cohort of new hires at that time). If the pattern of cohort effects depicted in Figure 1 were to be explained by fluctuations over time in the strength of the labor market, one would not predict to observe any reductions in grant rates by the permissive cohorts over this mid-2000s time period.

V. IMPLICATIONS

The above analysis demonstrates that the year in which an examiner is hired by the PTO has a lasting effect on her granting proclivities. The extent and direction of such cohort effects depends on various conditions of the PTO at the time of hiring. Our analysis intimates that the Agency's allowance culture and new-hire training play a potentially significant role in setting a cohort's baseline granting behavior. All else being equal, examiners that are hired in a year in which the PTO's allowance culture was more permissive generally manifest a higher grant rate than examiners hired when the Agency's allowance culture was less permissive. In addition, examiners subject to more intense formal new-hire training adhere more closely to the prevailing allowance culture of the Agency in developing their granting style than examiners subject to less intense formal new-hire training. This part begins to explore the implications of our results for both patent policy and administrative law more generally.

A. *Patent Policy*

With respect to patent policy, our results are relevant to the ongoing debates about patent quality—often expressed as a concern over the allowance of invalid patents—and about inconsistent patentability determinations across examiners. As an initial matter, our analysis suggests that more attention should be paid to cohort effects when discussing these critical policy considerations. If the PTO wants to effectuate change in the Agency's culture, including patent-quality culture, it may need to direct more resources to certain cohorts than others. At the least, it should acknowledge that the presence of overlapping cohorts may limit the degree to which it can achieve certain outcomes. Likewise, if the PTO wishes to better harmonize examiner decisionmaking, it should recognize the fundamental differences in how examiner cohorts exercise their

discretion and tailor its initiatives in part by the year examiners are hired.

Importantly, while demonstrating the role of cohort effects in potentially interfering with the desire of Agency leaders to effectuate change at the PTO at any particular point in time, the analysis also suggests that current Agency leaders might wish to consider the lasting effect of their short-term decisions on the future Agency. For instance, consider a PTO that wishes to espouse a restrictive approach to granting patents but that is under budgetary constraints that limit its ability to conduct a robust training program at the present time. Given its budgetary woes, this Office may wish to cut back on its training expenses in an effort to align costs with expenses, believing that it may be able to put the examiners corps back on track at a later date. Our results suggest that its ability to correct matters down the road may be more difficult than the Agency originally believed, because examiners hired during the budgetary shortfall may continue, in future years, to follow whatever styles they developed during this initial period—a period characterized by a non-robust training program. The PTO may ultimately have to commit more resources than initially envisioned at a later date to redirect the practice of examiners who received the non-robust new-hire training. Understanding the potential additional costs associated with cohort dynamics may change the Agency's cost-benefit analysis as it considers what policy initiatives to adopt.

Our results also have implications for the literature that delineates inter-examiner disparity in PTO outcomes.⁹² Our results suggest that the prevailing account that there are “as many patent offices as there are patent examiners” is incomplete and oversimplifies the current state of affairs.⁹³ Most saliently, our results suggest that a substantial portion of heterogeneity among examiners' application outcomes is not simply idiosyncratic to individual examiners, but instead is driven by cohort effects.⁹⁴ Thus, although the prior literature's analysis may be helpful in encouraging commentators not to overlook the role of individual examiner heterogeneity in understanding the determinants of patent grants, our

92. See note 16 and accompanying text.

93. See Cockburn et al., *supra* note 9, at 21.

94. In a statistical exercise outlined in the Appendix, we find that roughly 20 percent of variation in grant rates among examiners can be explained by individual examiner-fixed effects alone. We also find that 20 percent of the variation in examiner-fixed effects are explained by the cohorts to which the examiner belongs.

analysis takes matters one step further by urging analysts not to overlook the role of hiring cohorts in understanding what it is about examiners that may be driving this heterogeneity. Recognizing that the PTO is not comprised of examiners who make haphazard decisions without substantial guidance from high-ranking officials, but instead that examiner behavior is heavily shaped by Agency heads through the environmental conditions of the Agency at hiring, likely has additional payoffs. For instance, one of us has previously argued that the prevalence of the overly simplified haphazard-examiner account has resulted in the literature's failure to appreciate the Agency's practical effect on the development of substantive patent law.⁹⁵

B. Administrative State

Beyond patent policy, our results also have implications for the administrative state more generally. The administrative-law literature has long recognized that agencies are not monolithic actors but instead are governed by complex internal decisional dynamics that influence institutional outcomes.⁹⁶ Yet, the administrative-law scholarship has not fully appreciated the role that cohort effects may play on agency decisionmaking, especially across a temporal dimension.

As discussed above, cohort effects can inhibit current agency leaders in effectuating policy changes while also acting to entrench current policy into the future. That is, cohort effects raise the costs of changing agency policy both contemporaneously and prospectively. As a result, cohort effects, like the well-known "midnight" regulations, provide agencies with another mechanism to entrench policy horizontally across time.⁹⁷ The study of cohort effects could thus help us better understand the strategies that are available to agencies seeking to achieve their interests. This is especially true in

95. Melissa F. Wasserman, *The PTO's Asymmetric Incentives: Pressure to Expand Substantive Patent Law*, 72 OHIO ST. L.J. 379, 388 (2011).

96. For a discussion on the internal agency decisionmaking process, see generally ANTHONY DOWNS, *INSIDE BUREAUCRACY* (1964); JAMES Q. WILSON, *BUREAUCRACY: WHAT GOVERNMENT AGENCIES DO AND WHY THEY DO IT* (1989).

97. See Jack M. Beermann, *Presidential Power in Transitions*, 83 B.U. L. REV. 947, 969 (2003); Anne Joseph O'Connell, *Political Cycles of Rulemaking: An Empirical Portrait of the Modern Administrative State*, 94 VA. L. REV. 889, 891-92 (2008). Scholars have also recognized how self-regulation can serve as an entrenchment mechanism. See Elizabeth Magill, *Agency Self-Regulation*, 77 GEO. WASH. L. REV. 859, 888 (2009).

light of the fact that cohort effects have several features that make them distinct from other ways in which an agency may choose to insulate its policy decisions from change. Perhaps most saliently, cohort effects are less transparent than other tools by which an agency may entrench its policy preferences against a future agency. In contrast to entrenching policy by promulgating a legislative rule interpreting the agency-administered statute before a regime change, an agency may simply alter the training of its new employees to ensure that certain types of its policy preferences have some staying power. Cohort effects will then amplify the consequences of these policies by providing a vehicle in which the effects of the policy will continue to be appreciated even after the policy itself has been terminated.⁹⁸

Additionally, a better understanding of cohort effects can help to provide insight into the effectiveness of agency monitors. Congress and the President have a variety of mechanisms with which they can attempt to control agencies, including restricting the agency's budget and removing the agency's high-ranking officials.⁹⁹ Cohort effects can help to increase our understanding about the effectiveness of these external controls on agencies. As we have already discussed, cohort effects can potentially blunt the ability of political principals or the future agency to influence and control the agency's behavior. Whether this is a normatively desirable outcome necessarily depends upon one's view of administrative governance. Those who prize accountability would likely find an agency's ability to diminish political controls troubling. Conversely, those who value agency autonomy would likely view the constraint of political process controls as a positive outcome.

CONCLUSION

Despite the general agreement that the PTO allows too many low-quality patents and that its patentability decisions are inconsistent across examiners, there exists little compelling evidence as to what features of the system affect the Agency's granting behavior. As a result, policymakers have been trying to fix the patent

98. As noted earlier, cohort effects may be large in magnitude especially when employees wield substantial discretion in performing their work functions.

99. Rachel E. Barkow, *Insulating Agencies: Avoiding Capture Through Institutional Design*, 89 TEX. L. REV. 15, 42–44 (2010); Lisa Schultz Bressman & Robert B. Thompson, *The Future of Agency Independence*, 63 VAND. L. REV. 599, 610 (2010).

system without understanding all of the root causes of its dysfunction. This Article contributes to recent efforts by the Authors to rectify this deficiency in the literature by exploring whether the year an examiner was hired may help explain her granting proclivities. We find strong evidence that hiring cohort effects do exist. Moreover, we find that changes in PTO cohorts' granting behavior align with changes in the Agency's culture and new hiring training programs. Our results provide insight into pressing issues of patent policy. For instance, if agency leaders want to diminish the degree of heterogeneity in patent office outcomes across examiners, they might face at least some degree of friction in light of the stickiness of examiner behavior. That is, because agency culture and environment at the beginning of an examiner's employment may have an enduring effect on an examiner's granting style, a PTO that seeks to achieve such objectives may need to tailor its policies to address differences in examiner cohorts. Our results also provide insight into topics that have long been of interest to scholars of the administrative state. Because cohort effects raise the costs of changing agency policy today and in the future, understanding how cohort dynamics work to entrench agency policy over time also provides insight into the effectiveness of agency monitors and the strategies available for an agency to achieve its interests over a long-term horizon.

APPENDIX

I. EMPIRICAL SPECIFICATION

To test for the presence (and direction) of hiring-year cohort effects, we estimate the following specification on the PAIR sample described in Part III:

$$\begin{aligned} \mathbf{GRANT}_{ait} = & \alpha + \lambda_t + \mathbf{\theta}_k + \beta_1 \mathbf{COHORT}_i + \beta_2 \mathbf{EXPER}_{it} \\ & + \beta_3 \mathbf{GS}_{it} + \beta_4 \mathbf{TENURE}_i + \beta_5 \mathbf{X}_{ait} + \varepsilon_{ait} \end{aligned} \quad (1)$$

In this equation, a indexes the individual application, i indexes the individual examiner, k indexes the technology associated with the application, and t indexes the year in which the application is disposed of by the examiner. \mathbf{GRANT}_{ait} indicates whether or not the given application was allowed by the examiner. Year-fixed effects are captured by λ_t . \mathbf{GS}_{it} represents a set of dummy variables capturing the incidence of the examiner assigned to the underlying application falling into each of the general schedule (GS) pay-grade levels. \mathbf{GS}_{it} also includes separate categories for GS-13 without partial signatory authority and GS-13 with partial signatory authority. \mathbf{EXPER}_{it} captures a set of dummy variables for the incidence of the relevant examiner falling into a range of experience-level categories, where experience captures the number of years at the time of the application's disposition that the relevant examiner has been with the PTO (the specification of the experience ranges is discussed further below). Further, we include a set of technology-fixed effects, $\mathbf{\theta}_k$, using the thirty-seven technology subcategories set forth by Bronwyn Hall and colleagues¹⁰⁰ (in other specifications, we include a set of technology-by-year fixed effects). Other specifications include various individual characteristics of the applications, \mathbf{X}_{ait} , including the entity-size status of the applicant (large versus small) and the foreign-priority status of the application (previous filings at the European Patent Office and the Japan Patent Office).

100. Bronwyn H. Hall, Adam B. Jaffe & Manuel Trajtenberg, *The NBER Patent-Citations Data File: Lessons, Insights, and Methodological Tools*, in PATENTS, CITATIONS, AND INNOVATIONS: A WINDOW ON THE KNOWLEDGE ECONOMY 403, 452–54 tbl.9 (Adam B. Jaffe & Manuel Trajtenberg eds., 2002).

II. EXPERIENCE GROUPINGS

As explained extensively in our prior work,¹⁰¹ estimating cohort/individual effects in the face of both time/year effects and age/experience effects poses certain econometric challenges due to the well-known identity: “age + cohort = year.” In other words, if one is looking at a given application and trying to understand what factors determine the outcome of that application and one knows the hiring year of the examiner in question and the number of years of experience of the examiner in question at the time of disposal, then one already has the information needed to understand what effect the year of disposal has on the outcome of that application. How? Because the year of disposal can immediately be gleaned from knowing the precise hiring year and the precise number of years of experience.

As such, it becomes hard to disentangle the separate contributions of the experience of the examiner, the cohort of the examiner, and the year of the disposal of the application—an exercise we would like to do, considering that we are trying to isolate cohort effects and distinguish them from experience effects and general time trends. As we have discussed previously, researchers in these contexts, provided they have a rich data source covering many years of data with many overlapping cohorts, can attempt to achieve the necessary separation by breaking the identity (age + cohort = year) through the imposition of at least some additional normalization restriction. Commonly, researchers will impose the necessary restriction by grouping age/experience into bins—e.g., 0–1 years, 2–3 years, 4–5 years, and so on and so forth. By imposing such restrictions, the researchers may retain some information by which they can isolate individual hiring-year cohort effects. Consider, for instance, an application disposed of in 2002 by examiners hired in 1997 and 1998. At this time, they have 4–5 years of experience. If we tried to separately identify effects for 2002 disposals by examiners with 4 years of experience (1998 hiring year) and 5 years of experience (1997 hiring year), we could not do so for the above-stated reasons. However, by grouping the experience effects into a 4–5 year bin and estimating a mean effect for that bin, we retain some information by which to separately identify a 1997 cohort effect and a 1998 cohort effect (by looking at deviations from the 4–5 year

101. See generally Frakes & Wasserman, *Time Allocated*, *supra* note 6.

experience mean). There is a cost to this approach, of course, in that it implicitly assumes that the fact of gaining 4 years of experience has an effect common with the fact of gaining 5 years of experience, when in fact they may have different effects.

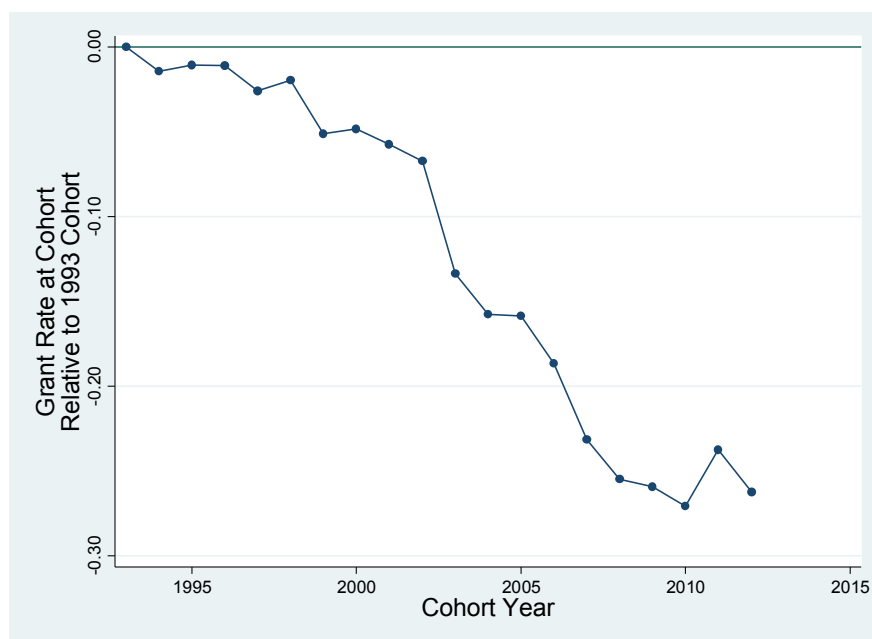
It should be emphasized that normalization restrictions other than grouping into 2-year bins are also employed by researchers to break the “age + cohort = year” identity, for instance, grouping age/experience into a 0–1 year bin and then estimating individual age effects thereafter, or using individual age/experience effects up to some point and then censoring at some age and grouping all individuals above that age into one group. In our Article we take this latter approach, including separate dummy variables for examiners who have 0, 1, 2 . . . 9 years of experience and then including a dummy variable to indicate examiners with 10+ years of experience. Because examiners falling into this 10+ years of experience group spans a range of hiring years in our sample and a range of disposal years, we are able to use these examiners to provide substantial information to identify hiring-year and disposal-year effects (without burdening us with separately identifying the various experience-year effects beyond 10 years), providing us with some relief by which we can separately identify individual experience effects for younger experience levels. For instance, consider again applications reviewed in 2002 by examiners starting in 1997 and 1998. Because we have already specified experience levels in a way to truly break the “age + cohort = year” identity (by grouping people with 10+ experience years together), we have the ability elsewhere in the model to provide information about the effect of 2002 disposals and the effect of 1997 and 1998 hiring years. We now have greater flexibility to use the information from this particular set of applications to separately identify the effect of 4 years of experience and 5 years of experience.

A benefit of achieving the necessary normalization restriction by grouping together experience years beyond some censoring point at the end of the experience distribution is that we may better estimate the independent effects of early experience years. This may prove useful given our desire to separate cohort effects from experience effects near the end of our sample period (where experience is naturally limited for new hires), a period of time where we attempt to make one important inference—i.e., that the post-2009 cohorts have higher granting tendencies than earlier cohorts.

Nonetheless, in this Appendix, we demonstrate the general robustness of the main results to alternative normalization

restrictions. In Figure A1, we replicate Figure 1 of the text but group experience levels into 2-year bin dummies in the underlying regression. The results demonstrate even stronger declines in mean grant rates as cohorts age from the 1990s to the mid-2000s. This figure, however, demonstrates a weaker increase in cohort means for the post-2009 period. As above, however, with coarser experience groupings of this nature, it is perhaps more difficult with this specification to separate cohort effects from experience effects at the end of the sample.

Figure A1: Relationship Between Grant Rates and Hiring Year Cohort of Associated Patent Examiner with Alternative Treatment of Experience Groupings



Note: This figure replicates that of Figure 1, except that the experience group dummies included in the regression are grouped into 2-year bins.

III. TABULAR REGRESSION RESULTS

Table A1: Relationship Between Grant Rates and Hiring Year Cohort of Associated Patent Examiner

| | (1) | (2) | (3) | (4) |
|----------------------|----------------------|----------------------|----------------------|----------------------|
| Omitted: 1993 Cohort | — | — | — | — |
| 1994 Cohort Dummy | -0.008 (0.019) | -0.011 (0.019) | -0.002 (0.015) | -0.007 (0.021) |
| 1995 Cohort Dummy | 0.003 (0.018) | -0.000 (0.018) | -0.010 (0.015) | 0.008 (0.019) |
| 1996 Cohort Dummy | 0.011 (0.015) | 0.008 (0.015) | 0.016 (0.013) | 0.011 (0.016) |
| 1997 Cohort Dummy | 0.006 (0.021) | 0.002 (0.020) | -0.001 (0.017) | 0.004 (0.022) |
| 1998 Cohort Dummy | 0.021 (0.018) | 0.017 (0.018) | 0.010 (0.016) | 0.019 (0.020) |
| 1999 Cohort Dummy | -0.002 (0.018) | -0.007 (0.018) | -0.011 (0.016) | -0.006 (0.020) |
| 2000 Cohort Dummy | 0.010 (0.020) | 0.006 (0.019) | -0.014 (0.018) | 0.006 (0.022) |
| 2001 Cohort Dummy | 0.010 (0.020) | 0.005 (0.020) | -0.005 (0.017) | 0.004 (0.022) |
| 2002 Cohort Dummy | 0.009 (0.020) | 0.002 (0.020) | -0.014 (0.018) | 0.004 (0.022) |
| 2003 Cohort Dummy | -0.048** (0.023) | -0.054** (0.022) | -0.058*** (0.020) | -0.048** (0.025) |
| 2004 Cohort Dummy | -0.063*** (0.023) | -0.070*** (0.022) | -0.077*** (0.020) | -0.059** (0.025) |
| 2005 Cohort Dummy | -0.056** (0.022) | -0.064*** (0.022) | -0.079*** (0.020) | -0.049** (0.024) |
| 2006 Cohort Dummy | -0.074*** (0.023) | -0.083*** (0.022) | -0.103*** (0.021) | -0.067*** (0.025) |
| 2007 Cohort Dummy | -0.110*** (0.024) | -0.122*** (0.023) | -0.124*** (0.022) | -0.099*** (0.026) |
| 2008 Cohort Dummy | -0.118*** (0.027) | -0.129*** (0.026) | -0.141*** (0.024) | -0.101*** (0.028) |

| | | | | |
|---|----------------------|----------------------|----------------------|----------------------|
| 2009 Cohort Dummy | -0.107*** (0.026) | -0.122*** (0.026) | -0.129*** (0.024) | -0.091*** (0.028) |
| 2010 Cohort Dummy | -0.098*** (0.028) | -0.119*** (0.027) | -0.130*** (0.026) | -0.077*** (0.030) |
| 2011 Cohort Dummy | -0.033 (0.033) | -0.055* (0.033) | -0.066** (0.031) | -0.008 (0.035) |
| 2012 Cohort Dummy | -0.036 (0.033) | -0.054* (0.032) | -0.074** (0.030) | -0.007 (0.034) |
| N | 1148154 | 1148154 | 1148154 | 1014155 |
| F statistic on Joint Significance of Cohort Dummies | 9.24 | 10.20 | 10.14 | 6.67 |
| P-value of F-test on Joint Significance of Cohort Dummies | 0.00 | 0.00 | 0.00 | 0.00 |
| Technology Dummies (Hall et al. Categories)? | YES | NO | NO | YES |
| Technology-by-Year Dummies? | NO | YES | NO | NO |
| Technology Dummies (PTO Classes)? | NO | NO | YES | NO |
| Individual Application Covariates? | NO | NO | NO | YES |
| Examiner Grade Level Dummies? | YES | YES | YES | YES |
| Examiner Experience Group Dummies? | YES | YES | YES | YES |
| Examiner Tenure Group Dummies? | YES | YES | YES | YES |
| Disposal Year Fixed Effects? | YES | YES | YES | YES |

* Significant at 10 percent. ** Significant at 5 percent. *** Significant at 1 percent.

Note: Standard errors are reported in parentheses and are clustered to correct for autocorrelation within given examiners over time. 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. Individual application covariates in Column (4) include an indicator for the entity-size status of the applicant (large or small entity) and an indicator for whether or not the application has foreign priority (whether it was previously filed at the European Patent Office or Japan Patent Office).

IV. SAMPLE BALANCE

One concern with the primary specification is that the applications reviewed by examiners hired at the end of the sample will generally be of the sort that are disposed of quickly by the PTO, whereas those applications reviewed by the older cohorts may have been disposed of over a range of durations, bearing in mind that the average application in our sample spends nearly three years in prosecution. Accordingly, despite random assignment of applications to examiners, one may be concerned with the potential for some degree of imbalance in the applications that we are assessing across the different cohorts.

To alleviate this concern, we estimate specifications that condition the sample on applications that were prosecuted to disposition within 2 years, regardless of whether we are observing an older hiring cohort or a newer hiring cohort. To achieve balance in the recent years, we drop those examiners hired in 2012 from this specification because they will not have had the opportunity to examine applications in the 1+ year duration range. We also drop observations disposed of in 2002, because those applications will also represent (for all cohorts) quickly processed applications, to the extent that the PAIR sample under investigation starts with applications filed on or after March 2001. As demonstrated by Table 2, the results are robust for this alternative exercise. The findings hold when conditioning the sample on applications reaching disposition within 3 years, dropping both applications disposed of in 2002 and 2003, and applications reviewed by examiners hired in 2011 and 2012—for the reasons just identified (see Table A2).

Table A2: Relationship Between Grant Rates and Hiring Year Cohort of Associated Patent Examiner, Balanced Sample Approach

| | (1) | (2) |
|----------------------|----------------------|----------------------|
| Omitted: 1993 Cohort | — | — |
| 1994 Cohort Dummy | 0.012 (0.016) | -0.002 (0.019) |
| 1995 Cohort Dummy | 0.001 (0.019) | 0.001 (0.019) |
| 1996 Cohort Dummy | 0.016 (0.014) | 0.007 (0.015) |
| 1997 Cohort Dummy | 0.017 (0.020) | 0.010 (0.021) |
| 1998 Cohort Dummy | 0.013 (0.018) | 0.015 (0.019) |
| 1999 Cohort Dummy | -0.013 (0.019) | -0.013 (0.019) |
| 2000 Cohort Dummy | 0.001 (0.021) | -0.013 (0.021) |
| 2001 Cohort Dummy | -0.011 (0.022) | -0.022 (0.022) |
| 2002 Cohort Dummy | -0.019 (0.022) | -0.033 (0.021) |
| 2003 Cohort Dummy | -0.051* (0.030) | -0.080*** (0.027) |
| 2004 Cohort Dummy | -0.094*** (0.029) | -0.098*** (0.026) |
| 2005 Cohort Dummy | -0.089*** (0.027) | -0.094*** (0.025) |
| 2006 Cohort Dummy | -0.103*** (0.029) | -0.120*** (0.026) |
| 2007 Cohort Dummy | -0.164*** (0.031) | -0.190*** (0.028) |
| 2008 Cohort Dummy | -0.173*** (0.038) | -0.213*** (0.033) |
| 2009 Cohort Dummy | -0.197*** (0.035) | -0.192*** (0.033) |

| | | |
|------------------------------------|----------------------|----------------------|
| 2010 Cohort Dummy | -0.215*** (0.042) | -0.200*** (0.033) |
| 2011 Cohort Dummy | -0.103* (0.063) | — |
| 2012 Cohort Dummy | — | — |
| <hr/> | | |
| N | 226148 | 478571 |
| <hr/> | | |
| Disposition Condition | <= 2 Years | <= 3 Years |
| Examiner Grade Level Dummies? | YES | YES |
| Examiner Experience Group Dummies? | YES | YES |
| Examiner Tenure Group Dummies? | YES | YES |
| Disposal Year Fixed Effects? | YES | YES |

* Significant at 10 percent. ** Significant at 5 percent; *** Significant at 1 percent.

Note: Standard errors are reported in parentheses and are clustered to correct for autocorrelation within given examiners over time. Each observation is a given application from the PAIR database that reached a final disposition and was published in the PAIR records between March 2001 and July 2012, subject to the stated prosecution duration restriction. Column (1) drops applications disposed of in 1993 and by examiners hired in 2012, while Column (2) drops applications disposed of in 1993 and by examiners hired in 2011 and 2012.

V. INFERENCE

The numerous hiring-year coefficients presented in Table A1 are meant to be interpreted with reference to the omitted hiring-year cohort—that is, the 1993 cohort. The specific hypotheses that we are testing in this Article (beyond the general hypothesis of the presence of cohort effects in the first instance, which can be assessed via the F-tests presented in Table A1) do not necessarily bear on the year-by-year comparisons that the standard errors in Table A1 may be designed to facilitate. Rather we are seeking to compare grant rates across a coarser divide of hiring-year cohorts, mainly pre-2003–2004 cohorts vs. mid- to late-2000 cohorts, and mid- to late-2000 cohorts vs. post-2010 cohorts. In Table A3, we estimate specifications identical to those estimated above, but we group hiring cohorts into three groups: 1993–2002 cohorts, 2005–2008 cohorts, and 2011–2012 cohorts. To address concerns over how to specify the operable regime when the quality-assurance initiatives driving our delineation of hiring-culture

eras are being rolled out, we drop those cohorts from the specification that started at the PTO during the specific years marking the transition across the relevant eras (2003 and 2004, 2009 and 2010), allowing us to make steady-state comparisons across eras. In Column (2) of Table A3, we control for the available individual application covariates at our disposal (entity-size and foreign-priority status).

Table A3: Relationship Between Grant Rates and Hiring Era Cohorts (Omitting Transition Years)

| | (1) | (2) |
|--|----------------------|----------------------|
| Omitted: Permissive Era I (Pre-2003–2004 Cohorts) | — | — |
| Restrictive Era (2005–2008 Cohorts) | -0.071*** (0.009) | -0.052*** (0.010) |
| Permissive Era II (2011+ Cohorts) | -0.042* (0.023) | -0.003 (0.025) |
| N | 999275 | 867867 |
| P-value of Test: Restrictive Era vs. Permissive ERA II | 0.15 | 0.02 |
| Individual Application Covariates? | NO | YES |
| Technology Dummies (Hall et al. Categories)? | YES | YES |
| Examiner Grade Level Dummies? | YES | YES |
| Examiner Experience Group Dummies? | YES | YES |
| Examiner Tenure Group Dummies? | YES | YES |
| Disposal Year Fixed Effects? | YES | YES |

* Significant at 10 percent. ** Significant at 5 percent. *** Significant at 1 percent.

Note: Standard errors are reported in parentheses and are clustered to correct for autocorrelation within given examiners over time. Each observation is a given application from the PAIR database that reached a final disposition and was published in the PAIR records between March 2001 and July 2012. Individual application covariates in Column (2) include an indicator for the entity-size status of the applicant (large or small entity) and an indicator for whether or not the application has foreign priority (whether it was previously filed at the European Patent Office or Japan Patent Office).

The final hypothesis that we test in this Article bears on the effect of moving from a short, centralized training period of two weeks to a robust, PTO-run training program of eight months in 2006, with roughly half of the examiners in the 2006 cohort receiving the

new training program and half receiving the old program (with assignment based on technology, which we control for). Rather than just comparing the grant rate of these two particular cohorts, we still estimate an empirical specification on the full set of cohorts and sample years, allowing us to achieve separation between year effects, cohort effects, and experience effects while trying to isolate the inherent granting tendencies of these two particular groups. As such, we estimate specifications that modify the approach taken in Table A3 to break the mid-2000s era into four separate groups: a 2005 cohort (a mid-2000 restrictive cohort purely under the old training regime), a 2006 cohort under the old training regime (the 2006 cohort control group), a 2006 cohort under the new training regime (the 2006 cohort treatment group), and the 2007 and 2008 cohorts (mid-2000 restrictive cohorts purely under the new training regime). We present the results of this exercise in Table A4.

All else being equal, Tables A3 and A4 suggest a statistically significant decline in mean grant rates between examiner cohorts starting with the PTO in the mid-2000s and cohorts starting in the prior period. They also suggest a statistically significant subsequent increase in granting tendencies for the most recently hired cohorts relative to the prior cohorts (note that Table A4 arguably allows for a better test of this second comparison to the extent it allows for an observation of how things change around the time of transition to the recent permissive regime). Moreover, Table A4 demonstrates that the 2006 treatment cohort that was subjected to the new training program had a lower grant rate relative to the 2006 control cohort that was not subject to the new training program (statistically significant at the 10 percent level or 1 percent level depending on the specification), consistent with expectations that the training would more strongly induce new hires to adopt the prevailing views promulgated by the agency heads at that time.

Table A4: Relationship Between Grant Rates and Hiring Era Cohorts (Omitting Transition Years)

| | (1) | (2) |
|--|----------------------|----------------------|
| Omitted: Permissive Era I (Pre-2003–2004 Cohorts) | — | — |
| Restrictive Era Old Training Regime (2005 Cohort) | -0.064*** (0.011) | -0.049*** (0.011) |
| 2006 Cohort under Old Training Regime | -0.074*** (0.013) | -0.057*** (0.014) |
| 2006 Cohort under New Training Regime | -0.097*** (0.012) | -0.087*** (0.013) |
| Restrictive Era New Training Regime (2007–2008 Cohorts) | -0.122*** (0.012) | -0.102*** (0.013) |
| Permissive Era II (2011+ Cohorts) | -0.065*** (0.023) | -0.031 (0.024) |
| N | 999275 | 867867 |
| P-value of Test: 2006 Cohort under Old Training Regime vs. 2006 Cohort under New Training Regime | 0.06 | 0.01 |
| P-value of Test: Restrictive Era New Training Regime vs. Permissive Era II | 0.01 | 0.00 |
| Individual Application Covariates? | NO | YES |
| Technology Dummies (Hall et al. Categories)? | YES | YES |
| Examiner Grade Level Dummies? | YES | YES |
| Examiner Experience Group Dummies? | YES | YES |
| Examiner Tenure Group Dummies? | YES | YES |
| Disposal Year Fixed Effects? | YES | YES |

* Significant at 10 percent. ** Significant at 5 percent. *** Significant at 1 percent.

Note: Standard errors are reported in parentheses and are clustered to correct for autocorrelation within given examiners over time. 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. Individual application covariates in Column (2) include an indicator for the entity-size status of the applicant (large or small entity) and an indicator for whether or not the application has foreign priority (whether it was previously filed at the European Patent Office or Japan Patent Office).