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. Since little compelling empirical evidence exists as to what features affect the Agency’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 feature of patent examiners that may affect their grant rate throughout their tenure: the year in which they were hired by the Patent Office. 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 suggests examiners of different hiring cohorts may follow distinct, enduring pathways with their 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 tenure of her career. Moreover, we find that the variation in the particular pathways adopted by different Patent Office 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.
INTRODUCTION

There is widespread belief that the U.S. Patent and Trademark Office (Patent Office or Agency) issues too many low quality patents that unnecessarily drain consumer welfare and stunt productive research.² There is also a general consensus that the Agency’s patentability determinations are inconsistent across individual examiners—that is, the Patent Office’s decision to grant a patent application is driven not only by the merits of the invention but also

² See infra Section I.
by happenstance of which examiner the application is randomly assigned. Concerns regarding patent quality and inconsistent patentability decisions prompted Congress to enact the first major patent reform act in over sixty years, spurred the Supreme Court to take a renewed interest in substantive patent law, and drove the Patent Office to hold its first Patent Quality Summit. Yet because limited compelling empirical evidence exists as to what features of the Agency affect its granting behavior, policymakers have been largely 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 feature of the Patent Office that may substantially affect a patent examiner’s grant rate throughout her tenure: the year the examiner was hired by the Agency. Management and labor scholars have long surmised that new hires are particularly impressionable during the beginning of their employment tenure. During this initial period of training—be it formal or informal training—new hires may begin to develop distinct “styles” of practice that become entrenched over time. 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 with respect to which an examiner is exposed at the Patent Office are of potentially critical importance. Should a particular cohort of examiners be 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 should future Agency heads aspire to instill a restrictive attitude among the examiners corps. Given that examiners may exhibit “stickiness” in practices and given the variations that may likely exist in initial hiring environments 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

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3 Id.
8 See infra Section I.
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 Patent Office 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, supplemented by information on examiners’ personnel histories (dating back to at least 1992) received through the filing of various Freedom of Information Act (FOIA) requests to the Patent Office. This novel 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 estimate empirical specifications allowing us to determine the relationship between examiners’ grant rates and the hiring cohorts to which they belong, while simultaneously controlling for a range of related factors that may also shape observed grant rates through other mechanisms including, importantly, the year in which the application itself is 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 are large in magnitude—i.e., 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 Patent Office. 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 towards a more restrictive approach in allowing patents, a cultural shift evidenced in part by the initiation of a new and significant patent quality initiative implemented in 2003/2004. To be sure, the grant rate does fall somewhat among all examiners at this time, including among the older cohorts. However, the new examiners hired by the Agency after the implementation of the new quality programs set out on a granting trajectory that is 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 is an important determinant of granting decisions. 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 play in shaping and limiting this discretion. Our results also suggest that, to the extent agency leaders desire to diminish the degree of heterogeneity in patent office outcomes across examiners or to 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 Patent Office that seeks to achieve such 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 Patent Office 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 Patent Office, 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.

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I. HARMs ASSOCIATED WITH INVALID PATENTS AND INCONSISTENT PATENTABILITY DECISIONS

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

The Patent Office has also come under increasing criticism that its patentability decisions are inconsistent across examiners. That is, 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. A Patent Office that treats similar

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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) (citing Dow Chem. Co. v. Exxon Corp., 139 F.3d 1470, 1472, 1477 (Fed. Cir. 1998)) (“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.”); Leslie, supra note 11, at 125-27.


16 See Iain M. Cockburn et al., Are All Patent Examiners Equal? Examiners, Patent Characteristics, and Litigation Outcomes, in Patents in the Knowledge Based Economy 19 (Wesley M. Cohen & Stephen A. Merrill eds., Nat’l Acads. Press 2003) (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
applications in dissimilar ways is problematic for several reasons. To begin, the existence of inter-examiner disparity itself demonstrates the range of discretion over which examiners operate 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 erring in reaching 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 Patent Office by creating the appearance of unfairness and arbitrariness. Such an appearance could diminish the incentives for innovation, as would-be applicants decide their efforts would be more rewarded by pursuing other endeavors. Of course inconsistent patentability decisions are also worrisome solely from an equity standpoint.

Finally, it should be noted that while 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 Patent Office 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’ biases towards granting or rejecting patents. As such, in our analysis below, we attempt to address the implications of cohort dynamics within the Patent Office with each of these distinct social concerns in mind.

The quality and consistency of the Patent Office’s judgements 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. In 2011, Congress

upheld in court); Douglas Lichtman, Rethinking Prosecution History Estoppel, 71 U. CHI. L. REV. 151, ### (2004) (finding that certain examiners more systematically required applicants to narrow the scope of their patents).

17 See JERRY MASHAW, BUREAUCRATIC JUSTICE ### (1983); Michael Abramowicz and John F. Duffy, Ending the Patenting Monopoly, 157 U. PA. L. REV. 1541, 1558 (2009) (noting that the Patent Office’s “challenge is to ensure that the judgments of its patent examiners] are relatively high quality and highly consistent”).

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. Congress intended to increase both patent quality and consistency. 19 Just this year, the Patent Office 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 a plethora of reasons as to why 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 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 feature of the patent examiner is likely to influence the examiner’s decision to grant a patent: the year the patent examiner was hired by the Patent Office, 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 Patent Office, 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

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22 Id. at 621–25. But see supra note 7 and Lemley & Sampat, supra note 15, at 817(finding that experienced examiners cite less prior art and are more likely to grant patents).
23 See supra note 7.
patent examiners who review applications in the same technological field.\textsuperscript{24} Upon arrival, the Supervisory Patent Examiner of that Art Unit randomly assigns the application to a specific examiner.\textsuperscript{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 novel\textsuperscript{26} and represents more than a trivial advancement over the existing knowledge within the field.\textsuperscript{27} The examiner must also determine whether the invention is drawn to patentable subject matter\textsuperscript{28} and is useful\textsuperscript{29} as well as determining whether the patent applications meets the disclosure requirements.\textsuperscript{30} If the invention fails one of the specific patentability requirements the examiner must reject the application.\textsuperscript{31} If the application meets the patentability requirements the examiner must issue the patent.\textsuperscript{32} Although the stages associated with the patent examination procedure are relatively structured, it is well recognized that patent examiners are afforded substantial discretion on how they approach and execute the process.\textsuperscript{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 Patent Office may have a lasting effect on an examiner’s granting patterns. Subpart A provides support for the proposition that new hires are rather susceptible to influence and that what they learn during this initial period has an enduring effect well beyond the employee’s period of acclimation to the organization. Subparts B and C turn to exploring which formal and informal aspects of the Patent Office 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

\begin{footnotesize}
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\item \textsuperscript{24} See Michael D. Frakes and Melissa F. Wasserman, \textit{Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data, Rev. of Econ. \\ & Stat.} (forthcoming 2016).
\item \textsuperscript{25} \textit{Id.}
\item \textsuperscript{26} 35 U.S.C. § 102.
\item \textsuperscript{27} 35 U.S.C. § 103.
\item \textsuperscript{28} \textit{Id.}
\item \textsuperscript{29} 35 U.S.C. § 101.
\item \textsuperscript{30} 35 U.S.C. § 112.
\item \textsuperscript{31} See Michael D. Frakes and Melissa F. Wasserman, \textit{Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data, Rev. of Econ. \\ & Stat.} (forthcoming 2016).
\item \textsuperscript{32} \textit{Id.}
\item \textsuperscript{33} Iain M. Cockburn et al., \textit{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., Nat’l Acads. Press 2003) (noting that “substantial discretion is provided to examiners in how they deal with applications”).
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that early moments of employment are especially important in understanding how these skills are shaped. In general, this literature delineates three features that are essential for the cohort effects phenomenon—that is, for the early career period of individuals to have a persistent influence on how their work duties are executed. 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. Newly hired employees are assumed to constitute more of a blank slate, in part, because of uncertainty regarding the new role requirements. 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.”

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

The final element of the cohort effects hypothesis is that molding of behavior that occurs during an individual’s transition period with an organization persists even when they cease to


35 Cohort effects can encompass more than a learning effect described in this section. Management scientists often utilize cohort effects to refer to a high degree in outcomes within cohorts. See, e.g., Aparna Joshi, John C. Dencker, Gentz Franz, Joseph J. Martocchio, Unpacking Generational Identities in Organizations, 35 Academy Mgmt. Rev. 392 (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 (i.e., individuals with similar education, ideological backgrounds). We argue that our results are more consistent with the former than the latter in Section IV.D.


40 Id.

be new hires 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. While individuals can still learn new skills outside of role transitions the rate at which they learn is less than when they are in a formative period. Thus after the transitional period ends, individuals ‘freeze’ their behavior and patterns: they stick with certain skills and habits they have learned. As a result, an individual’s behavior as to how they approach their job will tend to bear the stamp of the environment they experienced during the early stage of their 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 to an organization. This evidence has lead 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 and what they 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.

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45 John Kammeyer-Mueller, Connie Wanberg, Alex Rubenstein, and Zhaoli Song, Support, Undermining and Newcomer Socialization: Fitting in During the First 90 Days, 56 ACAD. OF MGMT. J. 1104, 1111 (2013); Michael F. Gast and Paul J. Patinka, Imprinting the Young Employee, BUSINESS HORIZONS 11 (July-Aug. 1983). The idea that employees are most impressionable during the early stage of employment has been recognized in the worker’s 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.”); Peter B. Grazier, Team Builders Plus, Overcoming Resistance to Employee Involvement, available at http://teambuildersplus.com/articles/overcoming-resistance-to-employee-involvement (“Because our prior training and condition is such a significant barrier to our ability to
As a result, we begin by hypothesizing that patent examiners are particularly suggestible during their first year at the Patent Office and that the initial conditions faced by examiners at that time—i.e., the allowance culture or the training practices in effect at the moment of hiring—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 begin to follow distinct, enduring pathways with their granting practices.

Hypothesis 1: All else 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. Patent Office’s Allowance Culture

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

Quantifying the Patent Office’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. While 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 Patent Office’s quality assurance mechanisms given change, we need to take some very proactive steps.”); ANDERS ERTENBALD, 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.”).

A related literature examines how employees have difficulty adjusting to new context and unlearning deeply embedded beliefs, practices, and knowledge. For instance, physicians have been accused of being slow to embrace a new model of healthcare that considered costs in their diagnostic and treatment recommendations or adjust their prescribing behavior of prescription drug in light of new evidence. See, e.g., EVE GLICKSMAN, TEACHING DOCTORS HOW TO IMPROVE CARE AND LOWER COSTS . . . AT THE SAME TIME, available at https://www.aamc.org/newsroom/reporter/june2015/434756/lower-costs.html (“Instilling cost awareness in physicians and asking them to considers costs in their diagnostic and treatment recommendations, however, is a challenge requiring a cultural shift from deeply entrenched values and practices in medicine.”).

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., MONICA C. HIGGINS, CAREER IMPRINTS: CREATING LEADERS ACROSS AN INDUSTRY (1st ed. 2005); Gina Dokko, Steffanie L. Wilk, and Nancy P. Rothbard, Unpacking Prior Experience: How Career History Affects Job Performance, 20 Org. Sci. 51, 55 (2009).
that they are such natural and effective tools by which Agency heads can convey their granting preferences.\textsuperscript{47} That is, the operations of the Agency’s quality assurance initiatives is largely in the discretion of the Agency’s upper management, which would make it an attractive policy lever to effectuate a change in management’s views towards allowing or rejecting applications. If high-level management believes that the Patent Office is allowing too many low quality patents then it may choose to strengthen the Agency’s quality assurance program, sending a signal to examiners that the Patent Office now values rejecting patents more than it did in the preceding years. Conversely, if high-level officials at the Agency believe that the Patent Office is erroneously rejecting too many valid patents, they may weaken the quality assurance initiatives in order to correct for what they perceive as an overly restrictive granting culture.\textsuperscript{48} Moreover, since 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, it is worth emphasizing that 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 Patent Office’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 throughout 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.

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

\textsuperscript{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). \textit{Cf.} Michael D. Frakes and Melissa F. Wasserman, \textit{Does the U.S. Patent and Trademark Office Grant Too Many Bad Patents?: Evidence from a Quasi-Experiment}, 67 Stan. L. Rev. 613, 665 (2014) (discussing possible channels by which the Patent Office could favor certain patent types over others, including a top-down approach).

\textsuperscript{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 Patent Office to diminish or at least slow down the growth of its application backlog. \textit{See}, e.g., Michael D. Frakes and Melissa F. Wasserman, \textit{Does the U.S. Patent and Trademark Office Grant Too Many Bad Patents?: Evidence from a Quasi-Experiment}, 67 Stan. L. Rev. 613, ### (2014) (describing why a resource constrained agency may allow additional patents in an effort to decrease its backlog).
infrastructure. The Patent Office’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 Patent Office’s nine technology centers (i.e., large collections of examiners that review applications in the same general technological field). 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. However, decisions by high-ranking officials in the Patent Office 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 Quality Review to fault the Patent Office for failing to reduce error rates. The Agency’s management responded by proposing to eliminate the Office of Quality Review (and its evaluations) in favor of utilizing customer (that is, patentees’) satisfaction surveys as the Patent Office’s primary measure of examination quality. In 1993, the Patent Office began reducing the staff of the Office of Patent Quality Review in preparation for replacing the office with the “reengineered quality process.” As a result, by 1996 the Patent Office slashed the Office of Patent Quality Review in half, resulting in the office sampling only 2% of allowed applications, well below the 4% sampling rate the Agency had determined was necessary to provide valid results. After the Inspector General criticized the Agency’s quality assurance program in 1997, the Patent Office agreed to increase the Office of Patent Quality Review’s staff in order to provide statistically valid samples of allowed applications. As a result, both the compromised quality assurance program and Agency’s own mission statement suggest that the Patent Office had a rather permissive allowance culture during the 1990s.

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 Patent Office 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 towards business methods, in which all allowances were subjected to a mandatory second round of review.
53 Id. at 4.
54 Id. The revamped survey-based evaluation process suffered delays and setbacks and never made it out of the pilot stage. Id. at 5–6.
55 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. BRUCE A. LEHMAN, ASSISTANT SEC’Y OF COMMERCE AND COMM. OF PAT. AND TRADEMARKS, DRAFT RESPONSE TO DRAFT AUDIT REPORT NO. PTD-9977-7-XXXX “PATENT QUALITY CONTROLS ARE INADEQUATE,” at 1 & 3 (1997).
The Patent Office’s allowance culture arguably became less permissive in 2002. At this time, the Agency’s proposed a series of enhanced quality initiatives that both improved quality review at the Office of Patent Quality and Review and integrated quality review within a technology center. These initiatives, which represented the most significant restructuring of the Patent Office’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 Patent Office. 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 wherein examiners were required to periodically demonstrate examination proficiency. 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 the work of examiners. After the implementation of these new directives, the Agency’s grant rate dropped dramatically (as we report below). Robert Budens, the president of the patent examiner union, remarked that these initiatives created an environment where examiners “started becoming fearful of


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. THOMAS H. STANTON ET AL., NAT’L ACADEM. OF PUBLIC ADMIN., U.S. PATENT AND TRADEMARK OFFICE: TRANSFORMING TO MEET THE CHALLENGES OF THE 21ST CENTURY 67 (2005).

60 Terry Carter, A Patent on Problems, ABA Journal, http://www.abajournal.com/magazine/article/a_pateint_on_problems/ (last visited July 1, 2015) (noting that Jon Dudas, who was Director of the Patent Office from 2004-2008 stated: “[w]e 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.”). USPTO Oversight Hearing: Hearing Before H. Comm. on the Judiciary, 110th Cong. (2008) (statement of Jon W. Dudas, Under Sec. of Commerce for Intell. Prop. And Dir. of the U.S. Pat. And Trademark Off.) (Dudas highlighted that the Agency grant rate in 2007 was only 44%, nearly thirty percent lower than the allowance rate in the late 1990s).
allowing [applications]” out of the concern that “quality review problems that [could make their lives] miserable.”

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

Hypothesis 2: 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, all else equal, than patent examiners hired during a time period when the Agency had a less permissive allowance culture.

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61 Id. (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 dined on their performance. People started becoming fearful of allowing things because you could run headlong into quality review problems that make life miserable.”).

62 This is not to say there haven’t been changes to the incentive structure of examiners in efforts to increase patent quality. For instance, in 2010 the Patent Office changed the production schedule of examiners as well as the metrics utilized to review supervisors. See, U.S. PATENT AND TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT 2010, at 16-17, available at http://www.uspto.gov/sites/default/files/about/stratplan/ar/USPTOY2010PAR.pdf.


64 Telephone Interview with Steven Griffin, Senior Adviser for the Office of Commissioner for Patents (July 6, 2015).

C. Patent Office’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 Patent Office can amplify or attenuate the extent to which new cohorts of examiners adhere to the prevailing allowance culture of the Agency. Assuming that the Patent Office will promote its allowance philosophy—be it permissive or restrictive in nature—in their new hiring programs, this section posits the longer a new patent examiner receives formal new hire training the more likely she is to become indoctrinated into the prevailing Agency’s allowance culture (at least that component of the Agency’s culture being propagated by central Agency heads).

The section now turns to describing the two distinct new hire training regimes of the Patent Office over the period of 1993 to 2012: (1) a very minimal formal training period before 2006 and (2) a robust formal training period 2006 and after. The Patent Office, 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, an administrative unit in the Patent Office that comprises eight to fifteen examiners who review patent applications in the same technological field.\(^{66}\) 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.\(^{67}\)


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 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. While production quotas are not technically utilized to determine the performance review of an examiner during their first year they are used to determine who would be retained at the Patent Office. For instance, an examiner who was meeting...
In 2006, the Patent Office dramatically changed how the Agency trained new patent examiners with the opening of the Patent Training Academy. The Patent Training Academy provided new patent examiners with an eight-month, university style formal training program and brought more uniformity and rigor to the training process. For the first two months, new hires attended large lectures that mimicked college courses in which they receive training on laws and procedures associated with the examination of patent applications, and soft skills such as interpersonal and work life skills. 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. 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—i.e., two weeks of formal training before being assigned to their home art units. Selection into 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

only 50% 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 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. Annemarie L. M. Field, Connor McGrath, Elaina Nichols, Patent Examiner Recruitment, Project Number: 45-HXA-0707 (Dec. 12, 2007) at 71, available at https://www.wpi.edu/Pubs/E-project/Available/E-project-121207-102952/unrestricted/USPTOFINALREPORT.pdf.


who were hired to review other technologies, such as agriculture, food, and textiles, did not.\textsuperscript{73} In 2007 and after, all new hires were subject to the enhanced new training program.\textsuperscript{74}

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 Patent Office 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—e.g., 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.\textsuperscript{75} 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 at one snapshot in time,\textsuperscript{76} which precludes the ability isolate true cohort effects of the sort envisioned by this Article.

\textsuperscript{73} The Online Appendix provides more details as to which technology areas examiners received 8 month style formal training in 2006.

\textsuperscript{74} 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 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. U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT FOR FISCAL YEAR 2010, at XX (2010).


\textsuperscript{76} For instance, one of the few papers that does utilize application-level data considers only 10,000 applications filed in January of 2001. Lemley & Sampat, supra note 15, at 817.
To overcome these deficiencies, we collected data on the nearly 2 million utility patent applications filed on or after March, 2001 that were published by July, 2012 from the Patent Office’s Patent Application Information Retrieval (PAIR) database. By the end of 2012, 49 percent of these applications had resulted in patents, 25 percent were not patented because they had been abandoned by the applicant, and the remainder were still pending. Our study focuses on the 1.4 million utility patent applications filed from 2001 onwards 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 1+ million distinct webpages. Importantly, these data include information on the outcome of the application process—i.e., 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 Patent Office (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 Patent Office. Though our application-level data only starts in 2001, we collected examiner roster information dating back to 1992, allowing us to nonetheless identify the distinct granting

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77 Utility patent protects the way an article is used and works. 35 U.S.C. § 101.

78 In November 2000, there was a change in the law that required newly filed patent applications to be published 18 months after they were filed. 35 U.S.C. § 122(b). Applicants abandoned within the first 18 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). Such applications are thus 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.

79 Applicants may elect to abandon their applications when they are unable to overcome an examiner’s rejection or they may do so for other reasons, such as when a business becomes insolvent or decides to change its research direction. A small portion of these applications were actually abandoned after being allowed by the examiner.
styles of those examiner cohorts starting in the 1990s. 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.

B. Summary Statistics

In Table 1, we summarize the mean grant rate for each Patent Office 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, falling from a high with the 1993 cohort of nearly 84 percent to a low with the 2010 cohort of roughly 45 percent. 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 cohort (registering an 8 percentage-point drop) and between the 2006 and 2007 cohort (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, for example, 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 tend to suggest that when observing those applications processed during the mid-2000s, an applicant’s likelihood of success is far greater to the extent they are assigned examiners that started in the 1990s rather than having started recently in the mid-2000s. This observation, however, does not necessarily evidence a true cohort effects. That is, it does not provide compelling empirical support that examiners develop practice styles during the first year at the Patent Office 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. Since 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

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80 We drop applications reviewed by those examiners who have been with the Patent Office 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).

81 Signatory authority is the authority, granted by the Patent Office, for an examiner to represent the Agency and to sign their own work. Examiners work towards obtaining such authority once they have reached the rank of general pay schedule 13.
In the present study, we aim to build on these prior efforts and focus the attention on the importance of initial conditions and the entrenchment in practice styles that they carry, a phenomenon that 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

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82 See Lemley and Sampat, supra note 15, at 817 (finding that more experienced examiners have a higher grant rate than less experienced examiners); Michael D. Frakes and Melissa F. Wasserman, Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data, REV. OF ECON. & STAT. (forthcoming 2016) (finding that experience does not induce examiners to grant patents at a higher rate but that instead examiner’s granted level has explanatory power as to her grant rate), available at http://papers.ssrn.com/sol3/papers.cfrm?abstract_id=2467262.
Table 1. For instance, one might be concerned that the new hires at the Patent Office in the mid-2000s were concentrated more in certain technologies—those generally associated with lower grant rates—relative to those newly hired in previous years. Accordingly, the empirical analysis below will likewise 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 2012\(^83\) and regress the incidence of the relevant application being granted on a series of dummy variables indicating: (1) the year in which the examiner associated with the application began working with the Patent Office—i.e., cohort effects, (2) the year in which the application was disposed of—i.e., 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,\(^84\) (5) the technology category associated with the application,\(^85\) and (6) the maximum number of years the relevant

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\(^83\) 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 few dispositions we do observe in 2001 and focus our analysis on the applications disposed of between 2002 and 2012. In the Online 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.


\(^85\) For these purposes, we use the 37 technology sub-categories set forth by Bronwyn Hall and colleagues, *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 Online 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 Online Appendix, we take matters one step further and include technology-
examiner spends at the Patent Office—i.e., 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 that stay with the Patent Office for a long time.\footnote{To the extent that cohort effects are not a real phenomenon and that the pattern of declining mean grant rates by hiring cohort from Table 1 can be explained by these other factors (e.g., 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 we plotted the estimated cohort coefficients, they would stay roughly flat over time—e.g., the effect of the examiner being in the 1993 cohort, \textit{all else 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 Section 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 Section 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—e.g., the culture of the Agency and a function of the nature of examiner training at such times. 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.

\footnote{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 Patent Office), (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.}

\footnote{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 Patent Office), (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.}
TABLE 1. SUMMARY STATISTICS: MEAN GRANT RATES BY HIRING COHORT YEAR, BASED ON APPLICATIONS DISPOSED OF BETWEEN 2001 AND 2012

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

IV. RESULTS

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

A. Primary Results

To recap, in Section II, we set forth the following testable hypothesis:

Hypothesis 1: All else 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 Section III (the tabular regression results underlying this Figure are presented in the Online 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. While 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**

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

To recap, in Section II, we set forth the following testable hypothesis:

Hypothesis 2: 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, all else equal, than patent examiners hired during a time period when the Agency had a less permissive allowance culture.

As discussed in Section II, the Patent Office 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 grant culture during the period of 2010–2012. These cultural shifts are reflected in overall year-by-year grant rate of the Agency, controlling for the variety of variables set forth in Section III. In Figure 2, we present estimates of the coefficients of the year fixed effects that are included in 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, and that the grant rate of the entire examiner corps reversed and trended upwards in 2010, aligning with a more permissive granting culture in the 2010s.

87 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 and Wasserman supra note 7. 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 fee- and continuation-related mechanisms of interest in that prior research. While 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—i.e., year effects—but rather whether the Patent Office’s granting culture has a lasting effect on the allowance rate of examiners hired at that time—i.e., cohort effects. That is, we are interested in the degree to which any such temporal changes in Agency culture / directives have an especially sticky and long-lasting impact on new hires’ granting proclivities. As suggested in Section III, we might predict that the estimated cohort effects will fall 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 Section III, the regression results depicted in Figure 1 comply with these expectations. Relative to the 2002 cohort, the 2003 cohort follows 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.

Notes: this figure presents the mean estimates of the coefficients of the year fixed effects that are included in the regression underlying Figure 1.
entering the Agency at that time. The mean grant rates of these burgeoning cohorts—comprised of impressionable, fledgling examiners—are lower than that of previous cohorts, all else equal. This is further demonstrated in Figure 3, which compares, by way of example, the year-by-year granting trends over 2002–2012 of a cohort emerging during a permissive regime—1993—with the trends of a cohort emerging during a more restrictive environment—the mid-2000s. While 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 each do so at a 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)**

Notes: 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 Section 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, all else equal, start their careers on a higher grant-rate pathway than those examiners who had started in the mid-2000s. Admittedly 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 heading into the future even should the environment turn more restrictive in nature again.

In the Online 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

To recap, in Section 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 Patent Office 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—i.e., the two-week program described in Section II—that was offered to new hires in previous years. For these examiners, we may not predict much change in their inherent granting patterns—i.e., in their cohort effect—relative to the 2004 and 2005 cohorts. However, new hires in certain technological fields in 2006 were exposed to a novel, extensive training period that lasted 8-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 cohort 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. \[88\] The 2006 cohort with extensive training has a

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88 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 Online Appendix, we show that these findings are robust to the alternative use of technology-by-year fixed effects. While the Patent Office did not randomly assign examiners into the new training program, it appears as if they made these determinations on a technological basis. Given our
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 this estimate, we estimate a specification in the Online Appendix that modify the three-cohort-bin approach discussed above and that 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. 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).

While only half (roughly) of the new hires in 2006 were subject to the extensive new training program, all new hires in 2007 were subject to the 8-month training initiative. Accordingly, we further predict that the mean grant rate for the 2007 cohort, all else 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 Hypothesis 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.

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.

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

Notes: this figure modifies that of Figure 1 to divide the 2006 cohort into two groups: one of which was subject to the 8-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 Patent Office hires as examiners—e.g., in the mid-1990s, the Patent Office 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 may 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 Patent Office’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 thus when the Agency faces less labor competition from industry, it is possible that the Patent Office hires new examiners that are more competent on average. One might argue that examiners with greater competency may be more effective at finding and articulating bases of rejections and thus enter the Patent Office with a lower baseline granting proclivity than patent examiners hired in years when the unemployment rate is low and when the Patent Office faces tighter labor competition from industry. While plausible, we think it unlikely for several reasons that our findings may be explained by fluctuations of this nature in the labor market.

To begin, 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. 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 8 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 interpretation of the results in favor 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 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 followed by 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.

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V. IMPLICATIONS

The above analysis demonstrates that the year in which an examiner is hired by the Patent Office has a lasting effect on her granting propensities. The extent and direction of such cohort effects depends on various conditions of the Patent Office 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. Examiners that are hired in a year in which the Patent Office’s allowance culture was more permissive evidence a higher grant rate than examiners hired when the Agency’s allowance culture was less permissive, all else being equal. 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, all else being equal. This section 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 manner, our analysis suggests that more attention should be paid to cohort effects when discussing these critical policy considerations. If the Patent Office 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 target certain outcomes. Likewise, should the Patent Office wish to better harmonize examiner decision making, it should arguably recognize the fundamental differences in how examiner cohorts exercise their discretion and tail their 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 office 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 Patent Office that wishes to espouse a restrictive approach to granting 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 Patent Office 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 potentially additional costs associated with cohort dynamics may change the cost-benefit analysis the Agency partakes when considering what policy initiatives to adopt.

Our results also have implications for the literature that delineates inter-examiner disparity in Patent Office outcomes. Our results suggest that the prevailing account that there are “as many patent offices as there are patent examiners” is incomplete and over simplifies the current state of affairs. 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. Thus, while 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 patents grants, our 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 Patent Office 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 initial hiring environment likely has additional payoffs. For instance, one of us has previously argued that 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.

**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. Yet, the administrative law scholarship has not fully

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91 See supra note 16.
93 In a statistical exercise outlined in the Online Appendix, we find that roughly 20% of variation in grant rates among examiners can be explained by individual examiner fixed effects alone. We also find that 20% of the variation in examiner fixed effects are explained by the cohorts examiner belongs.
95 For a discussion on the internal agency decisionmaking process, see generally ANTHONY DOWNS, INSIDE BUREAUCRACY (1964) and JAMES Q. WILSON, BUREAUCRACY: WHAT GOVERNMENT AGENCIES DO AND WHY THEY DO IT (1989).
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.\(^\text{96}\) The study of cohort effects could thus help us better understand the strategies that are available to agencies to achieve their interests, especially in 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.\(^\text{97}\)

Additionally, a better understanding of cohort effects can also help to provide insight into the effectiveness of agency monitors. Congress and the President have a variety of mechanisms in which they can attempt to control agencies, including restricting the agency’s budget and removing the agency’s high-ranking officials.\(^\text{98}\) 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 in administrative governance would likely find the ability of an agency to diminish political controls troubling. Conversely, those who value agency autonomy would likely find blunting political controls, in most cases, a positive outcome.


\(^{97}\) As noted earlier, cohort effects may be large in magnitude especially with employees wield substantial discretion in performing their work functions.

**CONCLUSION**

Despite the general agreement that the Patent Office 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 system without understanding all of the root causes of its dysfunction. This Article contributes to recent efforts of the Authors in rectifying this deficiency in the literature by exploring whether the year an examiner was hired has explanatory power over her granting proclivities. We find strong evidence that hiring cohort effects do exist. Moreover, we find that changes in Patent Office 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, to the extent agency leaders desire 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 what patent examiners learn during the beginning of their employment can have an enduring effect on their granting styles, a Patent Office 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. 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.
Online Appendix

Patent Office Cohorts

By: Michael D. Frakes and Melissa F. Wasserman

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 Section III:

\[
GRANT_{ait} = \alpha + \lambda_t + \delta_k + \beta_1 \text{COHORT}_i + \beta_2 \text{EXPER}_{it} + \beta_3 \text{GS}_{it} \\
+ \beta_4 \text{TENURE}_i + \beta_5 \text{X}_{ait} + \varepsilon_{ait}
\]

where \(a\) 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. \(GRANT_{ait}\) indicates whether or not the given application was allowed by the examiner. Year fixed effects are captured by \(\lambda_t\). \(\text{GS}_{it}\) 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. \(\text{GS}_{it}\) also includes separate categories for GS-13 without partial signatory authority and GS-13 with partial signatory authority. \(\text{EXPER}_{it}\) captures a set of dummy variables for the incidence of the relevant examiner falling into a range of experience-level categories, where the specification of the experience ranges is discussed further below and where experience captures the number of years at the time of the application’s disposition that the relevant examiner has been with the Patent Office. Further, we include a set of technology fixed effects, \(\delta_k\), using the 37 technology subcategories set forth by
Bronwyn Hall and colleagues\textsuperscript{1} (in other specifications, we include a set of technology-by-year fixed effects). Other specifications include various individual characteristics of the applications, $X_{aikt}$, 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).

**Experience Groupings**

As explained extensively in our prior work,\textsuperscript{2} 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. Why? 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 which we would desire 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, 4
years of experience, 5 years of experience, 1997 hiring year and 1998 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, one retains 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 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 primary approach taken in the
paper 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. Since examiners falling into this 10+ group span 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. Since we have already specified experience levels in a way to truly break the age + cohort = year identity (by grouping 10+ experience years together), we have the ability elsewhere in the model to provide information about the effect of 2002 disposals and about 1997 and 1998 hiring years. We now have greater flexibility to use the information from these 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, which may prove useful for our purposes given the 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 attempting to make one important inference—i.e., that the post-2009 cohorts have higher granting tendencies than earlier cohorts.

Nonetheless, in this Online 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**

Notes: this figure replicates that of Figure 1, except that the experience group dummies included in the regression are grouped into 2-year bins.
### Tabular Regression Results

**TABLE A1: RELATIONSHIP BETWEEN GRANT RATES AND HIRING YEAR COHORT OF ASSOCIATED PATENT EXAMINER**

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<td>(0.021)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>2007 Cohort Dummy</td>
<td>-0.110***</td>
<td>-0.122***</td>
<td>-0.124***</td>
<td>-0.099***</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.023)</td>
<td>(0.022)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>2008 Cohort Dummy</td>
<td>-0.118***</td>
<td>-0.129***</td>
<td>-0.141***</td>
<td>-0.101***</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.026)</td>
<td>(0.024)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>2009 Cohort Dummy</td>
<td>-0.107***</td>
<td>-0.122***</td>
<td>-0.129***</td>
<td>-0.091***</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.026)</td>
<td>(0.024)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>2010 Cohort Dummy</td>
<td>-0.098***</td>
<td>-0.119***</td>
<td>-0.130***</td>
<td>-0.077***</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.027)</td>
<td>(0.026)</td>
<td>(0.030)</td>
</tr>
<tr>
<td>2011 Cohort Dummy</td>
<td>-0.033</td>
<td>-0.055*</td>
<td>-0.066**</td>
<td>-0.008</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.033)</td>
<td>(0.031)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>2012 Cohort Dummy</td>
<td>-0.036</td>
<td>-0.054*</td>
<td>-0.074**</td>
<td>-0.007</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.032)</td>
<td>(0.030)</td>
<td>(0.034)</td>
</tr>
<tr>
<td><strong>N</strong></td>
<td>1148154</td>
<td>1148154</td>
<td>1148154</td>
<td>1014155</td>
</tr>
</tbody>
</table>
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%; ** significant at 5%; *** significant at 1%. 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).

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 Agency, 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 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 those 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 from this specification those examiners hired in 2012 since they will not have had the opportunity to examine applications in the 1+ year duration range. We also drop observations disposed of in 2002 since those applications will also represent (for all cohorts) quickly processing ones 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 to this alternative exercise. The findings likewise hold when conditioning the sample on those applications reaching disposition within three years and dropping applications disposed of in 2002 and 2003 and those 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**

<table>
<thead>
<tr>
<th>Cohort Dummy</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omitted: 1993 Cohort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1994 Cohort Dummy</td>
<td>0.012</td>
<td>-0.002</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>1995 Cohort Dummy</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>1996 Cohort Dummy</td>
<td>0.016</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>1997 Cohort Dummy</td>
<td>0.017</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>1998 Cohort Dummy</td>
<td>0.013</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>1999 Cohort Dummy</td>
<td>-0.013</td>
<td>-0.013</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>2000 Cohort Dummy</td>
<td>0.001</td>
<td>-0.013</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>2001 Cohort Dummy</td>
<td>-0.011</td>
<td>-0.022</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>2002 Cohort Dummy</td>
<td>-0.019</td>
<td>-0.033</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.021)</td>
</tr>
<tr>
<td>2003 Cohort Dummy</td>
<td>-0.051*</td>
<td>-0.080***</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.027)</td>
</tr>
<tr>
<td>2004 Cohort Dummy</td>
<td>-0.094***</td>
<td>-0.098***</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>2005 Cohort Dummy</td>
<td>-0.089***</td>
<td>-0.094***</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>2006 Cohort Dummy</td>
<td>-0.103***</td>
<td>-0.120***</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>2007 Cohort Dummy</td>
<td>-0.164***</td>
<td>-0.190***</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>2008 Cohort Dummy</td>
<td>-0.173***</td>
<td>-0.213***</td>
</tr>
<tr>
<td></td>
<td>(0.038)</td>
<td>(0.033)</td>
</tr>
</tbody>
</table>
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: (1) pre-2003/2004 cohorts vs. mid- to late-2000 cohorts and (2) mid- to late-2000 cohorts vs. post-2010 cohorts. In Table A3, we estimate specifications identical to that estimated above, except that we group hiring cohorts into three groups: (1) 1993-2002 cohorts, (2) 2005-2008 cohorts and (3) 2011 and 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 Agency 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)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omitted: Permissive Era I (Pre-2003/2004 Cohorts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Restrictive Era (2005-2008 Cohorts)</td>
<td>-0.071***</td>
<td>-0.052***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Permissive Era II (2011+ Cohorts)</td>
<td>-0.042*</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>N</td>
<td>999275</td>
<td>867867</td>
</tr>
<tr>
<td>P-value of Test: Restrictive Era vs. Permissive ERA II</td>
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<td>0.02</td>
</tr>
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<td>Individual Application Covariates?</td>
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<td>YES</td>
</tr>
<tr>
<td>Technology Dummies (Hall et al. Categories)?</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Examiner Grade Level Dummies?</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Examiner Experience Group Dummies?</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Examiner Tenure Group Dummies?</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Disposal Year Fixed Effects?</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

* significant at 10%; ** significant at 5%; *** significant at 1%. 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).

The final hypothesis that we test in the paper bears on the effect of moving from a short centralized training period (2 weeks) to a robust Agency-run training program (8 months) in 2006, with roughly half of the examiners in the 2006 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 still 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 4 separate groups: (1) 2005 cohort (a mid-2000 restrictive cohort purely under the old training regime), (2) 2006 cohort under old training regime (the 2006 cohort control group), (3) 2006 cohort under the new training regime (the 2006 cohort treatment group) and (4) 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.

Ultimately, Tables A3 and A4 suggest a statistically significant decline in mean grant rates, all else equal, between examiner cohorts starting with the Patent Office in the mid-2000s relative to the prior period, along with 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 latter comparison to the extent it better allows 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 subjected 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>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Omitted: Permissive Era I (Pre-2003/2004 Cohorts)</td>
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<td></td>
</tr>
<tr>
<td>Restrictive Era Old Training Regime (2005 Cohort)</td>
<td>-0.064***</td>
<td>-0.049***</td>
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<tr>
<td></td>
<td>(0.011)</td>
<td>(0.011)</td>
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<td>2006 Cohort under Old Training Regime</td>
<td>-0.074***</td>
<td>-0.057***</td>
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<tr>
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<td>(0.013)</td>
<td>(0.014)</td>
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<tr>
<td>2006 Cohort under New Training Regime</td>
<td>-0.097***</td>
<td>-0.087***</td>
</tr>
<tr>
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<td>(0.012)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>Restrictive Era New Training Regime (2007 and 2008 Cohorts)</td>
<td>-0.122***</td>
<td>-0.102***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>Permissive Era II (2011+ Cohorts)</td>
<td>-0.065***</td>
<td>-0.031</td>
</tr>
<tr>
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<td>(0.023)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>N</td>
<td>999275</td>
<td>867867</td>
</tr>
<tr>
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<td>0.01</td>
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<tr>
<td>P-value of Test: Restrictive Era New Training Regime vs. Permissive Era II</td>
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<td>0.00</td>
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<td>YES</td>
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<tr>
<td>Technology Dummies (Hall et al. Categories)?</td>
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<td>YES</td>
</tr>
<tr>
<td>Examiner Grade Level Dummies?</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Examiner Experience Group Dummies?</td>
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<tr>
<td>Examiner Tenure Group Dummies?</td>
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<td>YES</td>
</tr>
<tr>
<td>Disposal Year Fixed Effects?</td>
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<td>YES</td>
</tr>
</tbody>
</table>

* significant at 10%; ** significant at 5%; *** significant at 1%. 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).