

UNIVERSITY *of* PENNSYLVANIA LAW REVIEW

Founded 1852

Formerly
AMERICAN LAW REGISTER

© 2016 University of Pennsylvania Law Review

VOL. 164

MARCH 2016

NO. 4

ARTICLE

THE PATENT SPIRAL

ROGER ALLAN FORD[†]

Examination—the process of reviewing a patent application and deciding whether to grant the requested patent—improves patent quality in two ways. It acts as a substantive screen, filtering out meritless applications and improving meritorious ones.

[†] Assistant Professor of Law, University of New Hampshire School of Law; Faculty Fellow, Franklin Pierce Center for Intellectual Property. For helpful conversations and comments, I am indebted to Adam Chilton, Alex Roberts, Anna Laakmann, Antonio Della Malva, Brad Greenberg, Brian Frye, Brian Love, Chris Frerking, Christi Guerrini, Christina Mulligan, Greg Reilly, Guy Rub, Jake Linford, Jake Sherkow, James Chen, Janewa Osei-Tutu, Jennifer Berk, John Greabe, Jonathan Masur, Joseph Fishman, Katherine Strandburg, Kevin Collins, Laura Pedraza-Fariña, Lior Strahilevitz, Lisa Bernstein, Lisa Larrimore Ouellette, Mark Lemley, Markus Lang, Melissa Wasserman, Michael Frakes, Michael Risch, Nicholson Price, Oren Bracha, Patricia Judd, Peter Lee, Peter Menell, Rebecca Eisenberg, Robert Bone, Rochelle Dreyfuss, Ryan Vacca, Sarah Burstein, Sean O'Connor, Sean Pager, Yaniv Heled, and Zahr Said, and to participants at the Stanford Conference on Patent Trolls and Patent Reform, the Junior Intellectual Property Scholars Association Workshop, the Munich Conference on Innovation and Competition, the University of Chicago Legal Scholarship Workshop, and the Michigan State Junior Scholars in Intellectual Property Workshop.

After April 1, 2017, this Article will be available for reuse under the Creative Commons Attribution 4.0 International license, <https://creativecommons.org/licenses/by/4.0> [perma.cc/GX3J-N9CD].

It also acts as a costly screen, discouraging applicants from seeking low-value patents. Yet despite these dual roles, the patent system has a substantial quality problem: it is both too easy to get a patent (because examiners grant invalid patents that should be filtered out by a substantive screen) and too cheap to do so (because examiners grant low-value nuisance patents that should be filtered out by a costly screen).

This Article argues that these flaws in patent screening are both worse and better than has been recognized. The flaws are worse because they are not static, but dynamic, interacting to reinforce each other. This interaction leads to a vicious cycle of more and more patents that should never have been granted. When patents are too easily obtained, that undermines the costly screen, because even a plainly invalid patent has a nuisance value greater than its cost. And when patents are too cheaply obtained, that undermines the substantive screen, because there will be more patent applications, and the examination system cannot scale indefinitely without sacrificing accuracy. The result is a cycle of more and more applications, being screened less and less accurately, to give more and more low-quality patents. And although it is hard to test directly if the quality of patent examination is falling, there is evidence suggesting that this cycle is affecting the patent system.

At the same time, these flaws are not as bad as they seem because this cycle may be surprisingly easy to solve. The cycle gives policymakers substantial flexibility in designing patent reforms, because the effect of a reform on one piece of the cycle will propagate to the rest of the cycle. Reformers can concentrate on the easiest places to make reforms (like the litigation system) instead of trying to do the impossible (like eliminating examination errors). Such reforms would not only have local effects, but could help make the entire patent system work better.

INTRODUCTION	829
I. PATENT LAW'S EXAMINATION MODEL	833
A. <i>Examination as a Substantive Screen</i>	835
B. <i>Examination as a Costly Screen</i>	839
II. PATENT EXAMINATION'S VICIOUS CYCLE	841
A. <i>How a Flawed Substantive Screen Undermines the Costly Screen</i>	842
B. <i>How a Flawed Costly Screen Undermines the Substantive Screen</i>	850
1. Personnel Costs	850
2. Coordination Costs	852
3. Research Costs	853
III. TESTING THE VICIOUS CYCLE	854
A. <i>Testable Hypotheses</i>	854
B. <i>Some Empirical Evidence</i>	856
1. The Scale of the Patent-Examination System	856
2. The Quality of Patent Examination	858
3. The Behavior of Patent Litigants	861

IV. IMPLICATIONS AND REFORMS	863
A. <i>Flexible Patent Reforms</i>	863
B. <i>Fixing the Screens</i>	864
1. Fixing the Substantive Screen	864
2. Fixing the Costly Screen.....	866
C. <i>Fixing the Cycle</i>	867
1. Reducing the Effect of the Flawed Substantive Screen.....	867
2. Reducing the Effect of the Flawed Costly Screen.....	869
CONCLUSION.....	870

INTRODUCTION

Patent infringement is a strange legal claim. In most lawsuits, events follow a standard script: first the plaintiff's claim accrues, then the plaintiff files suit, and finally the plaintiff must prove each element of the claim. In a negligence case, for instance, only as the lawsuit proceeds does the plaintiff have to prove that the defendant owed a duty of care, that the defendant breached that duty, and that the breach caused damage.

In a patent case, this usual sequence is set aside. A key component of the claim—that the patentee invented something that is legally entitled to protection—is not proved at trial.¹ Instead, years or even decades before, a patent applicant persuades a patent examiner that she is entitled to a patent.² And the examiner's decision to grant a patent is entitled to significant deference at trial, even though there are many reasons to think examiners are not particularly good at deciding whether an applicant has really invented anything.³ It is as if the existence of a duty of care were not decided in a lawsuit, but years before, when the plaintiff asserted that a duty existed in an *ex parte* filing with a bureaucrat, with the party owing the duty not necessarily knowing of the proceeding until years later.

Why patent law uses this examination model, and whether it should do so, are fundamental questions in the field. Scholars have advanced two principal explanations for patent law's use of examination. The first is that examiners function as a substantive screen.⁴ This substantive screen performs

¹ Under the Patent Act, a patent is presumed valid, 35 U.S.C. § 282(a) (2012), though invalidity can be asserted as an affirmative defense to infringement, *id.* § 282(b).

² *Id.* § 131.

³ See, e.g., Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495, 1495 & n.1 (2001) [hereinafter Lemley, *Rational Ignorance*] (citing many articles criticizing the U.S. Patent and Trademark Office (PTO) for doing a poor job examining patents).

⁴ See, e.g., U.S. PATENT & TRADEMARK OFFICE, MPEP § 706 (9th ed., rev. 2015) [hereinafter MPEP] (“[T]he patent application should be reviewed and analyzed . . . to determine whether the

several functions. It separates deserving and undeserving applications for patent rights, protecting patent quality by ensuring that patent rights are assigned to the people who actually invented things and strengthening incentives to invent and file for patents.⁵ It also helps improve the patents that are granted, since examiners review applications to make sure inventors have properly disclosed their inventions.⁶ And it helps to clarify and provide notice of rights from the start, so inventors can invest in developing their products and the public can avoid infringing others' rights.

The second explanation for patent law's use of examination does not depend on examiners performing a substantive service. Instead, it posits that simply by making it more expensive to obtain patent rights, examination serves as a costly screen, discouraging applicants from seeking low-value patents.⁷ If it costs \$30,000 to obtain a patent, then a rational actor will only apply for one if she expects to obtain at least \$30,000 in benefits from having the patent. And since patent law theoretically allows a patent holder to capture privately much of the social value of an invention, at least for the duration of the patent term,⁸ the low-private-value patents that get screened out are also likely to be low-social-value patents that we want to exclude.

Neither of these explanations for patent law's examination model is entirely persuasive. The substantive-screen theory only works if examination provides the claimed benefits—if examiners grant patents to the right applicants, and if those grants are reliably enforceable in court. Yet most patent scholars agree that patents have a substantial quality problem, so that many granted patents are invalid.⁹ Moreover, courts often invalidate these patents when they are litigated—probably not as often as they should,¹⁰ but often enough to create uncertainty for patent holders and the public. Indeed,

claims define a useful, novel, nonobvious, and enabled invention The goal of examination is to clearly articulate any rejection”).

⁵ A high-quality patent is one that satisfies the statutory rules for patentability, and so awards exclusive rights to an inventor who has invented something novel, nonobvious, and otherwise patentable. See R. Polk Wagner, *Understanding Patent-Quality Mechanisms*, 157 U. PA. L. REV. 2135, 2138 (2009) (identifying “high-quality” patents as those meeting “statutory standards of patentability”).

⁶ See MPEP, *supra* note 4, §§ 2163–2164 (requiring applicants to fulfill the written description and enablement requirements of 35 U.S.C. § 112).

⁷ See, e.g., Jonathan S. Masur, *Costly Screens and Patent Examination*, 2 J. LEGAL ANALYSIS 687, 699 (2010) (“The administrative expense involved in obtaining a patent functions as a costly screen against low-value property rights.”).

⁸ See Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 529–30 (2001) (explaining the patentee's ability to capture monopoly profits during the patent term).

⁹ See *infra* note 39 and accompanying text.

¹⁰ See generally Roger Allan Ford, *Patent Invalidity Versus Noninfringement*, 99 CORNELL L. REV. 71 (2013) (describing invalidity proceedings and arguing that structural flaws in the patent system lead courts to decide too many cases on grounds other than validity).

there are reasons to think that patent examiners are simply *incapable* of systematically separating deserving and undeserving patent applications, or at least that it would be prohibitively expensive to do so.¹¹

The costly-screen theory may provide a better approach, since it does not depend on a level of examination accuracy that might be impossible to achieve. The problem is that the theory does not explain much of the behavior we observe in the real world. The theory predicts that the cost of prosecuting a patent application will screen out the sort of low-value patents that make up the “patent thicket”¹² or are only asserted in nuisance lawsuits.¹³ Yet stories of such patents are legion; indeed, many or even most patent cases are precisely the sort of nuisance lawsuits a costly screen might prevent.¹⁴ So if patent examination acts as a costly screen, it is not an especially effective one. Moreover, if the main benefit of patent examination stems from the cost it imposes on applicants, then much of the work of patent lawyers and examiners is wasted; the same ends could be accomplished with far less busywork by moving to a registration system in which the fee to purchase a patent is \$30,000.¹⁵

These flaws in the patent system—with patents being both too easy and too cheap to obtain—are well known.¹⁶ And yet, this Article argues, things are worse than they seem. These flaws in the patent system are not static;

¹¹ See generally Lemley, *Rational Ignorance*, *supra* note 3 (arguing that because most patents are never litigated or licensed, it would be wasteful to invest too many resources in patent examination); Robert P. Merges, *As Many as Six Impossible Patents Before Breakfast: Property Rights for Business Concepts and Patent System Reform*, 14 BERKELEY TECH. L.J. 577, 588-606 (1999) (assessing the appropriate “error rate” for patent applications).

¹² See Carl Shapiro, *Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting* (describing the danger that the patent system might “impos[e] an unnecessary drag on innovation by enabling multiple rights owners to ‘tax’ new products, processes, and even business methods”), in 1 INNOVATION POLICY AND THE ECONOMY 119, 121 (Adam B. Jaffe et al. eds., 2001).

¹³ See David Fagundes & Jonathan S. Masur, *Costly Intellectual Property*, 65 VAND. L. REV. 677, 696-700 (2012) (explaining that when patents cost more to file than the value that can be obtained by asserting them in nuisance suits or as part of a patent thicket, the costly screen acts to prevent them from being filed in the first place).

¹⁴ For instance, a study by RPX—a “defensive patent aggregator” that buys up patents that might be asserted against its members—found that of 3278 patent lawsuits that ended in 2013 and were brought by nonpracticing entities, 52% ended within six months of filing. RPX CORP., 2013 NPE LITIGATION REPORT 37 chart 55 (2014), <http://www.rpxcorp.com/wp-content/uploads/2014/01/RPX-2013-NPE-Litigation-Report.pdf> [<https://perma.cc/YV7H-YU22>] [hereinafter RPX, 2013 LITIGATION REPORT]. And in an RPX study of 900 settlements, legal costs exceeded settlement payments in all but the most expensive cases. RPX CORP., 2012 NPE COST STUDY: HIGH-LEVEL FINDINGS 9 chart 2 (2013), <http://www.rpxcorp.com/wp-content/uploads/2013/07/RPX%E2%80%99s-NPE-Cost-Study-results.pdf> [<https://perma.cc/QXS6-59WS>]. These findings suggest that many of these cases are exactly the sort of nuisance lawsuits that settle to avoid the cost of litigation, rather than because the claim is meritorious.

¹⁵ See, e.g., Fagundes & Masur, *supra* note 13, at 682 n.12 (noting that cost screens are agnostic to the method of achieving the screen, and simply represent transaction costs); see also *infra* notes 50–53 and accompanying text.

¹⁶ See *infra* note 39 and accompanying text.

instead, they interact and reinforce each other. This Article explores that interaction, which the legal literature has not previously recognized. This interaction creates what I call the patent spiral: a vicious cycle of worse and worse patent examination, leading to more and more low-quality patents, which in turn leads to worse and worse examination. In short, we should expect the patent system's flaws to get worse over time.

This effect has different causes in each half of the cycle. A flawed substantive screen weakens the costly screen because it results in more invalid patents: when it is too easy to obtain a patent, examiners will grant many invalid patents. These invalid patents are, however, usually worth more than the cost of obtaining them, thanks to the cost of patent litigation, the presumption of validity, and various other factors that lead parties to settle nuisance cases. If it costs \$30,000 to obtain a patent, but even a plainly invalid patent has a nuisance value of \$150,000, then the costly screen does not work. So the costly screen becomes less effective at discouraging patent applicants from applying for low-value patents.

And in turn, the flawed costly screen undermines the substantive screen—it makes the PTO worse at its job—because it results in more patent applications of all kinds. When it is too cheap to obtain a patent and the PTO gets applications even for patents of low social value, the substantive screen fails to do its job. The PTO, like any large bureaucracy, cannot scale indefinitely: as the number of patent applications increases, the cost of examination will increase, or the quality of examination will decline, or both. This is so because three types of costs increase with the number of applications and examiners. Personnel costs increase because hiring and search costs grow nonlinearly; the first 4000 patent examiners will be better at their jobs than the second 4000 examiners, unless the PTO pays more to find the second group. Coordination costs increase because it is harder to maintain consistency while keeping examiners' knowledge and procedures up to date when there are more examiners. And search costs increase because more prior art makes it harder to determine if an application claims a patentable invention. Since patents are the main source of prior art used by examiners,¹⁷ it becomes harder to examine patent applications as the number of patents increases. So the inadequate costly screen, which increases the number of patent applications, will also weaken the substantive screen.

¹⁷ See Christopher A. Cotropia, Mark A. Lemley & Bhaven Sampat, *Do Applicant Patent Citations Matter?*, 42 RES. POL'Y 844, 846 (2013) (reviewing a random sample of patents issued in 2007 and reporting that nearly 91% of prior-art references cited by examiners were U.S. patents or U.S. patent applications); John R. Thomas, *Collusion and Collective Action in the Patent System: A Proposal for Patent Bounties*, 2001 U. ILL. L. REV. 305, 318 (noting “reports that the Patent Office has increasingly relied upon previously issued patents as prior art”).

The good news is that this vicious cycle gives policymakers substantial flexibility in designing patent reforms because the effect of a reform on one piece of the cycle will propagate to the rest of the cycle. Reforms can be targeted at several distinct places in the cycle: at improving either the substantive screen or costly screen, or at disrupting the links between the two roles. Any or all of these reforms could have beneficial effects throughout the patent system. A reform that improved the substantive screen, for instance, would result in fewer invalid patents, and thus make it less lucrative for an applicant to apply for such a patent, thereby making the costly screen more effective. Or a reform that improved the costly screen would discourage applicants from seeking more low-value patents, reducing the number of patent applications and making it easier for the PTO to improve the substantive screen. Likewise, simple reforms like eliminating the presumption of validity or reducing the cost of discovery in patent cases would reduce the value of invalid patents, making the costly screen more effective (and then, in turn, improving the substantive screen). Solving some of the patent system's biggest problems, in other words, may be easier than it seems.

This Article has four parts. Part I provides background, describing the substantive- and costly-screen roles of patent examination. Part II explores the interaction of these two roles and argues that they lead to a vicious cycle of worse and worse patent examination. Part III reviews some empirical evidence suggesting that this cycle exists within the modern patent system. Part IV discusses the implications of the vicious cycle for patent policy and patent reform.

I. PATENT LAW'S EXAMINATION MODEL

A patent permits an inventor to prevent others from making, using, selling, offering to sell, or importing an invention.¹⁸ Unlike in many areas of the law, though, it is not the underlying act of inventing something new that gives a plaintiff the power to bring an enforcement action. Instead, patent law follows an examination model: the inventor must first convince a patent examiner that she invented something new.¹⁹ In this process, an examiner reviews an inventor's patent application, which describes the scope of the invention and the inventor's claimed exclusive rights, and searches the prior art to see if the

¹⁸ 35 U.S.C. § 271(a) (2012); *see also* U.S. CONST. art. I, § 8, cl. 8 (granting Congress the power “[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries”). As is usual in the literature, this Article focuses on utility patents, not design or plant patents, though many of the arguments could extend to those areas. *See* 35 U.S.C. § 161 (plant patents); *id.* § 171 (design patents).

¹⁹ *See generally* 35 U.S.C. § 111(a) (describing the requirements to apply for a patent); *id.* § 131 (requiring the PTO to examine applications for patentability and to issue a patent when an applicant is so entitled).

claimed invention meets the patentability requirements.²⁰ If the examiner does not find any disqualifying prior art, she will grant the patent.²¹

There is nothing inevitable about this examination model; it is an outlier even among forms of intellectual property.²² For instance, some types of intellectual property use a registration model, with rights vesting, or becoming enforceable, only after a rights holder registers a claim with the federal government. In this model, these claims do not go through any substantive examination, and a plaintiff has to prove her entitlement when enforcing those rights. In copyright law, for instance, an author is entitled to a copyright the moment she creates an “original work[] of authorship fixed in any tangible medium of expression,”²³ but the copyright holder cannot generally enforce those rights until a copyrighted work has been registered with the Copyright Office of the Library of Congress.²⁴ That registration, however, is largely a formality; the Copyright Office does not examine applications to determine if an author really wrote a work or if the work is too similar to another registered work.²⁵ Similarly, copyright-like protections for mask works (the

²⁰ Prior art consists of similar inventions that came before the claimed invention, usually in the form of prior patents, printed publications, and commercial products. *See generally id.* § 102 (listing prior art that can deprive an invention of novelty); *id.* § 103 (stating that prior art may render an invention obvious); MPEP, *supra* note 4, ch. 900 (providing the examination procedures involving “Prior Art, Classification, and Search”).

²¹ 35 U.S.C. § 102(a). Trademark law also follows an examination model, at least with respect to federally registered trademarks. Before granting registration of such a mark, a trademark examiner searches existing trademarks to determine if any conflict with the applicant’s proposed registration. *See generally* 15 U.S.C. § 1051 (2012) (describing the application process); *id.* § 1052 (describing grounds on which an examiner can deny registration); U.S. PATENT & TRADEMARK OFFICE, TMEP § 704 (8th ed. 2015) (describing the initial examination of a trademark application).

²² And even U.S. patent law did not always use the examination model. Before the Patent Act of 1836 set up the modern examination system, most patents were issued without substantive examination. *See* Michael Risch, *America’s First Patents*, 64 FLA. L. REV. 1279, 1282 (2012) (noting that before 1836, except for three years in the 1790s, the patent statute *forbade* substantive review); *see also* Patent Act of 1836, ch. 357, § 7, 5 Stat. 117, 119 (current version at 35 U.S.C. § 131) (requiring the Commissioner of Patents to provide for examination of patent applications).

²³ 17 U.S.C. § 102(a) (2012); *see also id.* § 201(a) (“Copyright in a work protected under this title vests initially in the author or authors of the work.”).

²⁴ *See id.* § 411 (providing, with limited exceptions, that “no civil action for infringement of the copyright in any United States work shall be instituted until preregistration or registration of the copyright claim has been made in accordance with [the Copyright Act]”); *see also id.* § 408 (describing the copyright registration system).

²⁵ Specifically, the Register of Copyrights must determine that the work “constitutes copyrightable subject matter and that the other legal and formal requirements of [the Copyright Act] have been met.” *Id.* § 410(a). This review, however, is largely perfunctory. *See* *Cosmetic Ideas, Inc. v. IAC/InteractiveCorp*, 606 F.3d 612, 621 (9th Cir. 2010) (“[T]he Register’s decision of whether or not to grant a registration certificate is largely perfunctory, and is ultimately reviewable by the courts.”).

three-dimensional patterns that define a semiconductor chip) and boat hulls use a registration model.²⁶

Other types of intellectual property use a decentralized or automatic-vesting model, in which intellectual property rights come into existence, and can be enforced, without any registration or examination by a government official. Trade-secret protection, for instance, generally applies to confidential information that derives its economic value from that confidentiality; if a third party misappropriates that information, the third party can be held liable even though there is no centralized registration or examination of potential trade secrets.²⁷ Similarly, rights of publicity arise without examination or registration.²⁸ And although trademark holders gain specific benefits from registering their marks, basic trademark rights under both federal law and most states' laws are based on use, not examination or registration.²⁹

So why does patent law use the examination model? There are two major explanations, one based on the substance of what examiners do and the other based on the costs examination imposes. But as discussed below, neither explanation is entirely persuasive.

A. *Examination as a Substantive Screen*

The most common explanation for patent law's examination model is that examiners act as a substantive screen, which improves patent quality and benefits both patent holders and the public. These benefits come in two forms.

First, and most obviously, examiners strive to grant worthy patent applications—applications that claim inventions that are novel, nonobvious, and otherwise patentable—and reject unworthy ones. This is the role most people imagine when they think of patent examiners. If an examiner uncovers prior art that demonstrates that a claimed invention was not novel, or would

²⁶ See 17 U.S.C. §§ 901–914 (protection for mask works); *id.* §§ 1301–1332 (protection for designs, specifically including designs for vessel hulls).

²⁷ See generally UNIF. TRADE SECRETS ACT (UNIF. LAW COMM'N 1985). Forty-eight states and the District of Columbia have adopted some form of the Act, albeit with significant changes in some states. Zoe Argento, *Killing the Golden Goose: The Dangers of Strengthening Domestic Trade Secret Rights in Response to Cyber-Misappropriation*, 16 YALE J.L. & TECH. 172, 178 & n.23 (2014). Federal law also provides limited protection for trade secrets. See 18 U.S.C. § 1832 (2012) (providing criminal penalties for theft of trade secrets).

²⁸ See, e.g., CAL. CIV. CODE § 3344(a) (West 2015) (“Any person who knowingly uses another’s name, voice, signature, photograph, or likeness, in any manner, on or in products, merchandise, or goods, or for purposes of advertising . . . without such person’s prior consent . . . shall be liable for any damages sustained by the person or persons injured as a result thereof.”).

²⁹ See, e.g., 15 U.S.C. § 1125(a) (2012) (providing liability for the use of a mark in a manner that is likely to cause consumer confusion, regardless of registration); 3 J. THOMAS MCCARTHY, MCCARTHY ON TRADEMARKS AND UNFAIR COMPETITION ch. 22 (4th ed. 2015) (discussing state trademark protections).

have been obvious to someone skilled in the art, then the patent examiner should refuse to grant a patent.³⁰ This, the theory goes, prevents a patent applicant from claiming a monopoly when she did not contribute anything meaningful to the world, protecting the public from spurious patent claims.³¹ It also reduces the uncertainty in the value of a granted patent, since a patent that has made it through examination is more likely to survive in court.³² This makes it easier and less risky to invest in developing commercial products based on patented technology.³³

Second, patent examiners also help improve the quality of individual patents, even when those patents would have issued under either system. Besides looking at whether a patent claim is novel and nonobvious, examiners also enforce a series of doctrines that aims to ensure an invention is fully and clearly disclosed to the public.³⁴ As the Federal Circuit observed, “An essential purpose of patent examination is to fashion claims that are precise, clear, correct, and unambiguous. Only in this way can uncertainties of claim scope be removed, as much as possible, during the administrative process.”³⁵ Examination

³⁰ See *supra* note 20 and accompanying text.

³¹ Similarly, patent examiners ensure that applicants seek patents claiming patentable subject matter, rather than inventions that are overly conceptual or abstract. See 35 U.S.C. § 101 (2012) (defining patentable subject matter as “any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof”); *Bilski v. Kappos*, 561 U.S. 593, 601-13 (2010) (evaluating the scope of § 101); *Diamond v. Chakrabarty*, 447 U.S. 303, 308-10 (1980) (same); Ford, *supra* note 10, at 80-81 (discussing the patentable-subject-matter requirement); Katherine J. Strandburg, *Much Ado About Preemption*, 50 HOUS. L. REV. 563, 567-68 (2012) (observing that rhetoric surrounding the patentable-subject-matter doctrine suggests that patent law seeks to exclude overly conceptual or abstract ideas in order to avoid preempting subsequent ideas). The vast majority of patents undoubtedly claim patentable subject matter, however, and the ones on the outer edge depend on uncertain questions of law—like what sorts of software are patentable—rather than any uncertainty in the patent itself. Accordingly, we should expect examiners to play a relatively unimportant role in enforcing the patentable-subject-matter requirement.

³² See, e.g., 1 WILLIAM C. ROBINSON, *THE LAW OF PATENTS FOR USEFUL INVENTIONS* § 49 (Boston, Little, Brown, & Co. 1890) (lamenting that, before patents went through examination, “[a] patentee receiving his grant entirely at his own risk of its subsequent defeat by the proof of any use or knowledge of the invention prior to his own, and yet having no method of ascertaining whether such use existed, except the tedious, expensive, and uncertain one of private inquiry,” received a patent that “was necessarily of small commercial value”).

³³ See *id.* § 50 (noting how establishment of the patent examination regime increased investor security). This point builds on the prospect theory of patents, which asserts that patents provide an incentive to develop new technologies while avoiding wasteful duplication of effort. See John F. Duffy, *Rethinking the Prospect Theory of Patents*, 71 U. CHI. L. REV. 439, 440 (2004) (describing “prospect” patents as those “issued in the very early stages of technical development”); Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 265-66 (1977) (proposing a prospect theory whereby innovators use patents to secure “particular opportunit[ies] to develop . . . known technological possibilit[ies]”). See generally Mark A. Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129 (2004) (criticizing ex post justifications for patents).

³⁴ Specifically, examiners enforce the written-description, enablement, best-mode, and definiteness requirements. Ford, *supra* note 10, at 79-80.

³⁵ *In re Zletz*, 893 F.2d 319, 322 (Fed. Cir. 1989).

can have this effect because applicants know in advance that an examiner will review an application for compliance with these doctrines, giving applicants incentives to provide clear disclosures, and because the examination process often turns into a negotiation between the applicant and the examiner, which refines the patent.³⁶

The substantive explanation almost certainly has *some* merit; patent examiners reject many patent applications,³⁷ and it would be shocking if an agency that employs more than 8000 patent examiners were, effectively, throwing darts.³⁸ At the same time, most patent scholars agree that there is a patent-quality problem.³⁹ It is hard to know the full scope of this problem, since most patents are never litigated or otherwise contested.⁴⁰ But the empirical evidence shows clearly that examiners grant many invalid patents and grant many patents with vague claims. For one thing, nearly half of litigated patents

³⁶ See, e.g., Dan L. Burk & Mark A. Lemley, *Fence Posts or Sign Posts? Rethinking Patent Claim Construction*, 157 U. PA. L. REV. 1743, 1749 (2009) (describing the prosecution process as a “negotiat[ion] with the examiner] over the scope of the invention”); Mark A. Lemley & Bhaven Sampat, *Examining Patent Examination*, STAN. TECH. L. REV., May 2010, ¶¶ 6–18 (comparing patent allowance rates at various stages of patent prosecution); John Shepard Wiley Jr., *Copyright at the School of Patent*, 58 U. CHI. L. REV. 119, 140 (1991) (“Inventors haggle with the patent examiner . . .”).

³⁷ It is, however, surprisingly difficult to know exactly how many applications are rejected. Estimates of the PTO’s grant rate come as low as 39% and as high as 97%. See Mark A. Lemley & Bhaven Sampat, *Is the Patent Office a Rubber Stamp?*, 58 EMORY L.J. 181, 183–85 (2008) (identifying uncertainties in determining the PTO’s allowance rate and listing possible estimates).

³⁸ As of November 2015, the PTO employed 8199 patent examiners. *Patent Examiners on Staff*, U.S. PATENT & TRADEMARK OFFICE, <http://www.uspto.gov/corda/dashboards/patents/main.dashxml?CTNAVID=1005> [<https://perma.cc/9GZB-4X4E>] (last visited Jan. 23, 2016).

³⁹ For just a few of the many arguments to that effect, see JAMES BESSEN & MICHAEL J. MEURER, *PATENT FAILURE: HOW JUDGES, BUREAUCRATS, AND LAWYERS PUT INNOVATORS AT RISK* 54–62 (2008) (arguing that patents fail to clearly demarcate patentees’ rights); ADAM B. JAFFE & JOSH LERNER, *INNOVATION AND ITS DISCONTENTS: HOW OUR BROKEN PATENT SYSTEM IS ENDANGERING INNOVATION AND PROGRESS, AND WHAT TO DO ABOUT IT* 34 (2004) (“[T]he granting of patents despite clear evidence of invalidity, in the form of prior art that makes the invention not novel and/or obvious, has become all too common.”); Joseph Farrell & Robert P. Merges, *Incentives to Challenge and Defend Patents: Why Litigation Won’t Reliably Fix Patent Office Errors and Why Administrative Patent Review Might Help*, 19 BERKELEY TECH. L.J. 943, 944–46 (2004) (citing “inadequate resources,” “biased procedures,” and “skewed incentives” as reasons for erroneous patent grants); Lemley, *Rational Ignorance*, *supra* note 3, at 1495–97 (describing criticism of the PTO for “allowing bad patents to slip through the system”); Merges, *supra* note 11, at 589–91 (noting that a high error rate is likely in the software area and has only been worsened by the increase in applications); Andres Sawicki, *Better Mistakes in Patent Law*, 39 FLA. ST. U. L. REV. 735, 736 (2012) (“The patent system makes many mistakes, frequently granting patents that should be denied and denying many patents that should be granted.”); Wagner, *supra* note 5, at 2139–45 (discussing several reasons to be concerned about a low-quality patent system). For a useful overview of the concept of patent quality, see Christi J. Guerrini, *Defining Patent Quality*, 82 FORDHAM L. REV. 3091, 3109–16 (2014).

⁴⁰ See, e.g., Lemley, *Rational Ignorance*, *supra* note 3, at 1501–03 (“Only about one hundred [patent] cases per year (and 125 patents) actually make it to trial.”).

that make it to a final judgment are invalidated.⁴¹ At the same time, the number of utility patents granted annually has tripled over the last few decades, even adjusting for population growth and the increasingly global patent system.⁴² Yet there is little reason to think that the world has become three times as innovative in that time.⁴³ Instead, the likelier explanation is that rent seekers who have invented little or nothing are seeking more and more patents, and that the PTO is willing to grant many of those patents.

The structure of the examination system exacerbates the problem. Examiners face an asymmetric burden: under federal law, they may grant a patent application, without explanation, or issue an office action explaining why the applicant is *not* entitled to a patent.⁴⁴ So rejecting a patent application takes more work than granting it.⁴⁵ And such a rejection is effectively never final; applicants may respond to each denial—albeit while sometimes paying additional fees—until the examiner gives in and grants a patent.⁴⁶ Examiners, however, have every incentive to get files off their desks: examiners' bonus pay is tied to the number of applications they finish processing, and—since a rejection usually leads to more work—effectively to the number of patents they grant.⁴⁷ Examiners are also poorly equipped to do a good job; they spend just eighteen hours on the average patent, and have limited ability to search nonpatent prior

41 John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 205-07 (1998). It is hard to know what to make of this statistic. Patent holders have a choice of patents to litigate, and are likely to choose the strongest ones, so in considering the universe of all patents, the invalidity problem may be worse than this statistic indicates. At the same time, it might simply be a reflection of the Priest-Klein hypothesis, since cases in which the parties are likely to be able to predict the outcome are most likely to settle. See George L. Priest & Benjamin Klein, *The Selection of Disputes for Litigation*, 13 J. LEGAL STUD. 1, 1-2 (1984) (observing that litigation outcomes are at best a poor predictor of overall trends in legal disputes, since most disputes are settled in the shadow of governing legal rules).

42 See *infra* notes 101-06 and accompanying text.

43 Cf. Zvi Griliches, *Patent Statistics as Economic Indicators: A Survey*, 28 J. ECON. LITERATURE 1661, 1673-78 (1990) (reviewing studies finding weak relationships between patenting and research and development activity).

44 Lemley, *Rational Ignorance*, *supra* note 3, at 1496 n.3; see also D. Christopher Ohly, Trevor Joike, Kelly L. Morron & Melvin Robinson, *It Is Not So Obvious: The Impact of KSR on Patent Prosecution, Licensing, and Litigation*, 36 AIPLA Q.J. 267, 282-84 (2008) (describing the burden on patent examiners to justify rejections for failure to meet the nonobviousness requirement).

45 Cf. Michael D. Frakes & Melissa F. Wasserman, *Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data*, 98 REV. ECON. STAT. (forthcoming 2016) (finding that when patent examiners are promoted, leaving them less time for patent examination, they become more likely to grant patent applications).

46 See MPEP, *supra* note 4, § 706.07(h) ("An applicant may obtain continued examination of an application [after a final action] by filing a [request for continued examination] . . .").

47 See U.S. GOV'T ACCOUNTABILITY OFFICE, U.S. PATENT AND TRADEMARK OFFICE: HIRING EFFORTS ARE NOT SUFFICIENT TO REDUCE THE PATENT APPLICATION BACKLOG 21 (2007) ("The agency awards bonuses at the end of each fiscal year to patent examiners who exceed their production goals by at least 10 percent.").

art.⁴⁸ Accordingly, even though the principal purpose of patent examination is likely to separate deserving and undeserving applications, there are enough reasons to doubt the effectiveness of this process that one scholar has even suggested moving to a registration system.⁴⁹

B. Examination as a Costly Screen

An alternative explanation for patent law's examination model comes from costly-screen theory, which asserts that the cost of obtaining a patent itself plays a valuable role in the patent system, even if examiners contribute nothing substantively.⁵⁰ The theory is straightforward. Obtaining a patent is not free; it can cost \$20,000 to \$30,000 for a typical patent, in attorney fees, PTO filing fees, inventors' time, and delays between invention and patent issuance.⁵¹ A rational patent applicant would apply for a patent only when the expected private value of doing so exceeds this cost: when she expects to gain more than \$20,000 or \$30,000 in royalties, monopoly profits, or other benefits from having the patent.⁵² Hypothetical low-private-value patents, then, that might exist in a world with costless examination would never come into existence in a world where examination acts as a costly screen.⁵³

The costly-screen justification might seem to select for precisely the wrong attribute of a patent, since we should care more about the social value of a patent than its private value. Patents with high private and social values would come into existence, and those with low private and social values would be

⁴⁸ See Ford, *supra* note 10, at 89 (describing time limitations on patent examiners' abilities to perform complete examinations).

⁴⁹ See F. Scott Kieff, *The Case for Registering Patents and the Law and Economics of Present Patent-Obtaining Rules*, 45 B.C. L. REV. 55, 59 (2003) (arguing that a registration system would mitigate the social costs of a patent system).

⁵⁰ See Fagundes & Masur, *supra* note 13, at 685-91 (explaining how transaction costs screen out low-value patents); Masur, *supra* note 7, at 717 (explaining how a costly screen has no effect on welfare-enhancing patents).

⁵¹ See, e.g., Fagundes & Masur, *supra* note 13, at 689-90 ("[A]n average patentee will spend approximately \$22,000 to successfully prosecute a patent application."); Lemley, *Rational Ignorance*, *supra* note 3, at 1498 & n.13 ("[T]he general range of costs for prosecuting a patent from start to finish . . . appears to be \$10,000 to \$30,000 per patent."). This estimate will vary, of course, depending on the industry, importance of the patent application, complexity of the technology, number of claims in the application, scope of the prior art, and innumerable other factors.

⁵² These other benefits can include indirect financial benefits, such as signaling innovation to potential investors. Annamaria Conti, Jerry Thursby & Marie Thursby, *Patents as Signals for Startup Financing*, 61 J. INDUS. ECON. 592, 593 (2013). There are also nonfinancial benefits. See, e.g., Jeanne C. Fromer, *Expressive Incentives in Intellectual Property*, 98 VA. L. REV. 1745, 1771-72 (2012) (demonstrating the psychological value inventors gain from self-expression in their inventions).

⁵³ To simplify this discussion, I will drop "hypothetical" from the description of patents that might come into existence but for the cost of the screen. To be clear, though, patents with low private value are those that do *not* exist, but might in the counterfactual world in which patent examination were costless for applicants.

screened out, regardless of this asymmetry. But patents with high social value and low private value would be screened out—a loss of socially useful innovation. And patents with low (or negative) social value and high private value would come into existence despite the screen—also a loss for society, since these patents would let their holders collect monopoly rents without contributing anything substantial to society.⁵⁴

This mismatch between goal (patents with high social value) and method (selecting for high private value) might not be a problem, though, since there are reasons to think that patents with asymmetric private and social values should be relatively rare. Patents with low private value but high social value should almost never occur, since the patent system is designed precisely to allow an inventor to capture a large chunk of the value that an invention creates for society. Any patent, then, that creates substantial social gains will almost certainly allow the patent holder to capture enough of those gains to make the patent worthwhile.⁵⁵ Patents with high private value but low social value likely do exist; they are the sorts of patents asserted in nuisance lawsuits and the ones that make up the “patent thicket” of overlapping rights.⁵⁶ But the costly screen still reduces the number of such patents that are granted, so even if it does not filter out all problematic patents, it is still a useful tool to reduce the problem.

There are three significant objections to the costly-screen explanation for patent law’s examination model. First, it is wasteful. If the major purpose of patent examination is to impose costs on applicants, then why do so through substantive examination? Why not cut out the middleman and just impose a larger issuance fee? Then, at least, the money could go to something productive instead of being spent on bureaucratic wrangling. Second, it may have disproportionate effects on different kinds of patent applicants. Startups and individual inventors, for instance, are the classic examples of who should expect to benefit most from the patent system, since they may be more likely to generate groundbreaking inventions and are less able to rely on competitive advantages other than patent rights. But these small entities may also be capital-constrained in a way that big companies are not, and so may be unable to invest in intellectual property. And third, the costly screen does not seem to be having the effect it should. Many patent scholars agree that the PTO grants plenty of low-value nuisance patents and “patent thicket” patents; the cost of obtaining a patent does not seem to be having a significant deterrent effect on these

⁵⁴ See Fagundes & Masur, *supra* note 13, at 695-96 (explaining how patents with low social value and high private value can be used offensively and defensively in ways that harm social welfare).

⁵⁵ See *id.* at 700-04 (explaining how patents encourage high-social-value inventions).

⁵⁶ See *id.* at 695-96 (highlighting the role of such patents in litigation and licensing).

patents.⁵⁷ Indeed, these low-value patents, and the royalties and lawsuits they prompt, are probably the biggest problem in intellectual property law today—a problem that may have cost society hundreds of billions of dollars.⁵⁸

* * *

That neither the substantive-screen explanation nor the costly-screen explanation is foolproof does not mean that patent examination is worthless. The criticisms may just mean that examination does not provide every benefit it could. Perhaps examination provides enough total benefits—from both its role as a substantive screen and its role as a costly screen—to be worthwhile.

Despite its flaws, the costly-screen theory could be a promising complement to the substantive theory because it identifies a new category of benefits from patent examination. Those benefits, though, are undermined by the interaction of the two roles, as discussed in the next Part.

II. PATENT EXAMINATION'S VICIOUS CYCLE

This Part discusses the interaction of patent examination's roles as a substantive screen and a costly screen. The basic argument is that these flaws in patent examination's two roles reinforce each other, leading to a vicious cycle of weaker and weaker patent examination.⁵⁹

The flawed substantive screen weakens the value of examination as a costly screen because it increases the value of applying for an invalid patent. Since essentially *any* patent, valid or not, can be worth more than the cost to obtain it, thanks to doctrines like the presumption of validity and factors like the cost of patent litigation,⁶⁰ examination ends up deterring fewer and fewer patent applications, reducing the effectiveness of the costly screen. The main driver of a potential applicant's decisionmaking, then, is whether an examiner is likely to grant *some* patent. And the weakened costly screen, in turn, further weakens the substantive screen since it means that the PTO has to handle many more patent applications. Like any large organization, the PTO cannot scale

⁵⁷ BESSEN & MEURER, *supra* note 39, at 68-72; DAN L. BURK & MARK A. LEMLEY, *THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT* 26-31 (2009); JAFFE & LERNER, *supra* note 39, at 11-13.

⁵⁸ See generally, e.g., James Bessen, Jennifer Ford & Michael J. Meurer, *The Private and Social Costs of Patent Trolls: Do Nonpracticing Entities Benefit Society by Facilitating Markets for Technology?*, REGULATION, Winter 2011–2012, at 26 (concluding that patent lawsuits brought by nonpracticing entities have cost defendants a half-trillion dollars without meaningfully increasing the incentive to innovate).

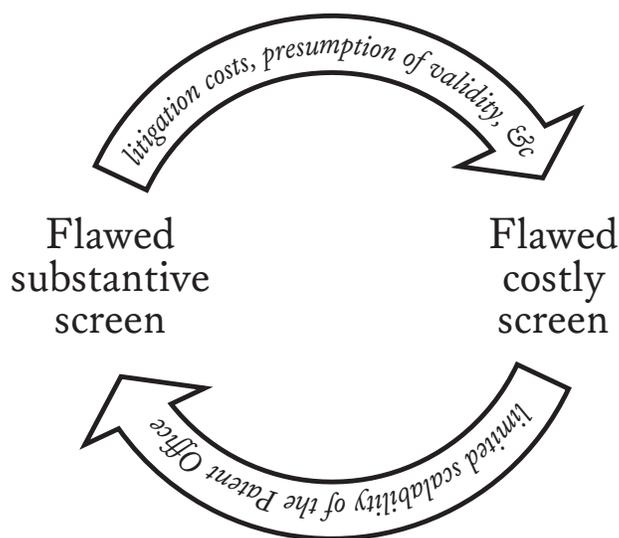
⁵⁹ A vicious cycle is “a sequence of reciprocal cause and effect in which two or more elements intensify and aggravate each other, leading inexorably to a worsening of the situation.” *Vicious Cycle*, OXFORD DICTIONARY OF ENGLISH 1978 (3d ed. 2010).

⁶⁰ See *supra* notes 1, 13 and accompanying text.

examination indefinitely without losing efficiency. As the number of applications goes up, then, the cost of examining each application will likewise rise, or the quality of examination will fall. This effect stems from three separate costs that increase nonlinearly: personnel costs, coordination costs, and search costs.

The relationship between the substantive screen and the costly screen is shown in Figure 1.

Figure 1: The Vicious Cycle



This Part is organized into two Sections. Section II.A explains how the flawed substantive screen undermines the costly screen—as shown in the top arrow in Figure 1. Section II.B explains how the flawed costly screen undermines the substantive screen—as shown in the bottom arrow.

A. *How a Flawed Substantive Screen Undermines the Costly Screen*

As a substantive screen, patent examination is supposed to ensure that an applicant is awarded a patent only when she is legally entitled to it—only when she has invented something new, useful, and nonobvious.⁶¹ When examiners perform this task correctly, all is well; inventors are precisely the people who

⁶¹ 35 U.S.C. §§ 101–103 (2012). These are not the only requirements to obtain a patent, but they are the most fundamental.

are supposed to enjoy the benefits of a patent monopoly.⁶² But when examiners fail at this task, things get more complicated. These flaws in the substantive screen end up weakening the value of examination as a costly screen because they increase both the incentive to apply for a weak patent and the expected value of a weak application.⁶³ Since the expected value of applying for a patent is greater, even for a patent that is likely invalid, the cost of obtaining a patent has less of a deterrent effect.

This effect stems from the convergence of three factors. First, patent examination is an imperfect process, such that examination outcomes are an unreliable indicator of whether a patent applicant is entitled to a patent. Though it is impossible to know exactly how large this problem is, patent scholars and lawyers agree that examiners grant many patents on inventions that either had already been invented or were obvious when they were conceived, and so are not legally entitled to a patent.⁶⁴ There are different explanations for why examiners cannot or do not perfectly sort deserving and undeserving patent applications: examiners may lack the incentives or the time to act as perfect screeners, or examination may just be an impossible task to perform at the scale of the modern patent system.⁶⁵ But the bottom line is that examiners routinely grant patents on inventions that probably should not be patented.

⁶² I set aside the issue of whether patent law strikes normatively correct balances in all its particulars. An omniscient approach to patent law might grant patents only when consistent with the incentive model underlying patent law. Such a system would undoubtedly produce different outcomes in some cases, even setting aside implementation mistakes in the current system. But errors that come from misapplying patent law are a qualitatively different problem, since they might (and, in many cases, do) allow applicants who have not invented anything to obtain patent protection, and since they could, in theory, be corrected.

⁶³ I say “weak” rather than “invalid” because it is very hard to know, *ex ante*, whether an eventual patent will be held valid or invalid, since often it is difficult to predict when filing a patent application how broad or narrow the claims an examiner will approve.

⁶⁴ See, e.g., JAFFE & LERNER, *supra* note 39, at 12 (noting that recent decades’ “rapid increase in the rate of patenting has been accompanied by a proliferation of patent awards of dubious merit”); Farrell & Merges, *supra* note 39, at 944-46 (describing examples of and traditional explanations for “blatantly silly patents,” and urging reform of the PTO to prevent such low-quality patents from being issued); Ford, *supra* note 10, at 87-91 (explaining that the PTO might issue invalid patents because of bad incentives, overwhelming application volume, and poor information); Lemley, *Rational Ignorance*, *supra* note 3, at 1495-97 (collecting academic and popular criticism of high patent issuance rates); Merges, *supra* note 11, at 589-91 (discussing reasons for poor patent quality); Sawicki, *supra* note 39, at 736-39 (discussing types of harm from different kinds of mistakes in patent issuance); Wagner, *supra* note 5, at 2139-45 (arguing that we should care about patent quality in part because proliferation of low-quality patents increases marketplace uncertainty, masks erroneous denials of meritorious applications, and leads to increased litigation costs); cf. BESSEN & MEURER, *supra* note 39, at 46-72 (arguing that patent law’s inability to draw clear boundaries should make us question whether patent rights are true property rights).

⁶⁵ Ford, *supra* note 10, at 88-89.

And these likely invalid patents include many that are routinely licensed and enforced in court.⁶⁶

The second factor is that prosecuting a patent application is relatively inexpensive. There are two components to application costs: the administrative fees charged by the PTO and the legal fees of the attorney prosecuting the application. It costs just \$70 to \$280 to file a utility-patent application, depending on the applicant's size, plus search (\$150 to \$600) and examination (\$180 to \$720) fees.⁶⁷ If the examiner concludes that the applicant is entitled to a patent, add an issuance fee of \$240 to \$960.⁶⁸ Other fees are assessed for things like deadline extensions or unusually large applications,⁶⁹ but in general it is hard for a routine patent application to rack up more than a few thousand dollars in PTO fees.⁷⁰ As discussed above, add in attorney fees, and a typical patent will cost \$20,000 to \$30,000 to obtain.⁷¹ And as we will see, that cost is often small compared to the expected benefit.

The third factor is that once a patent is granted it often has substantial value, even if it is unlikely to be valid. This value stems from different sources. One source of value is rooted in uncertainty: it is very difficult to tell, *ex ante*,

⁶⁶ Nearly half of all patents litigated to a final judgment are invalidated. Allison & Lemley, *supra* note 41, at 205-07. But it is hard to conclude much about patents in general from this statistic, given the different selection effects that determine what patents are litigated and what litigations go to final judgment. See generally Priest & Klein, *supra* note 41.

⁶⁷ U.S. PATENT & TRADEMARK OFFICE, USPTO FEE SCHEDULE (2014 ed., rev. 2015), http://www.uspto.gov/sites/default/files/documents/USPTO%20fee%20schedule_current.pdf [<https://perma.cc/EVT3-T8NT>] [hereinafter PTO, FEE SCHEDULE].

⁶⁸ *Id.*

⁶⁹ *Id.*

⁷⁰ It is possible to corroborate these numbers for the patent system as a whole, albeit with a relatively large margin of error. In the 2013 fiscal year, the PTO's total fee revenue for the patent program was \$2.46 billion. See U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE & ACCOUNTABILITY REPORT: FISCAL YEAR 2013, at 77-78, 92 (2013), http://www.uspto.gov/about/stratplan/ar/USPTO_FY2013PAR.pdf [<https://perma.cc/SZZ8-HZJR>] [hereinafter PTO, 2013 ACCOUNTABILITY REPORT] (reporting earned revenue of \$2.7199 billion, 90.4% of which was attributable to the patent side of the ledger). In calendar year 2013, the PTO received 609,052 patent applications of all kinds and granted 302,948 patents. U.S. PATENT & TRADEMARK OFFICE, U.S. PATENT STATISTICS CHART: CALENDAR YEARS 1963-2014, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm [<https://perma.cc/GY6P-XFMX>] (last visited Jan. 23, 2016) [hereinafter PTO, PATENT STATISTICS 1963-2014]. The agency's fee revenue on an ongoing basis, then, was about \$4000 per application and \$8100 per patent. This does not mean that the average application or patent costs that much; some of that revenue comes from maintenance fees on older patents, and some comes from unsuccessful applications. Still, the numbers provide a reasonable order-of-magnitude estimate of the fees necessary to prosecute a patent application and obtain a patent.

⁷¹ See *supra* note 51 and accompanying text. One patent lawyer estimated in 2011 that attorney fees for a typical patent application could vary from \$5000 to \$7000 for an "extremely simple" invention like a coat hanger or an ice-cube tray, to more than \$15,000 for a "highly complex" invention like an MRI scanner or a networking system. Gene Quinn, *The Cost of Obtaining a Patent in the US*, IPWATCHDOG (Apr. 4, 2015), <http://www.ipwatchdog.com/2015/04/04/the-cost-of-obtaining-a-patent-in-the-us/id=56485/> [<https://perma.cc/WY8D-LKZ3>].

whether a court would invalidate a patent, so even a seemingly weak patent has value stemming from the possibility that it will be upheld by a court.⁷² Another source of value is the cost of litigating infringement claims. Patent litigation is notoriously expensive, with typical cases costing millions of dollars in legal fees and expenses.⁷³ So potential infringers are often willing to license even patents of dubious validity.

Since settlement allows a defendant to avoid the substantial costs of litigating even a frivolous claim, even a nakedly invalid patent can have a substantial nuisance-settlement value.⁷⁴ Accordingly, a patent holder will bring a case not only when it expects the court to award damages greater than the cost of bringing the case, but also when it expects to receive a sufficiently large nuisance settlement.

To express these points mathematically, the expected value from a patent P , enforced against the universe of potential defendants, can be modeled as

$$E(P) = \sum_{d \in D} \max[nv_d, p_d r_d - c_d],$$

where D is the probability distribution of sets of potential defendants,⁷⁵ d is an individual defendant from that distribution, nv_d is the nuisance value of a claim against defendant d (net of the plaintiff's litigation costs), p_d is the probability that the plaintiff wins against defendant d , r_d is the recovery the plaintiff would obtain from defendant d if the plaintiff wins, and c_d is the plaintiff's litigation costs of prosecuting the case against defendant d to a final

⁷² See, e.g., Mark A. Lemley & Carl Shapiro, *Probabilistic Patents*, J. ECON. PERSP., Spring 2005, at 75, 80-83 (describing patents as "lottery tickets" carrying uncertain, but potentially enormous, value).

⁷³ See *infra* note 81 and accompanying text.

⁷⁴ Under the standard model of settlement, rational litigants settle disputes to avoid litigation costs. See, e.g., Joseph A. Grundfest & Peter H. Huang, *The Unexpected Value of Litigation: A Real Options Perspective*, 58 STAN. L. REV. 1267, 1275-76 (2006) ("The traditional expected value mode of analysis suggests that [a] case will settle for its discounted expected value."). Since the cost of defending even a frivolous patent suit is often in the hundreds of thousands of dollars, see *infra* note 81 and accompanying text, in the absence of fee shifting or a threat of sanctions, both sides will rationally settle for \$100,000 or more in many cases. See, e.g., Amy Farmer & Paul Pecorino, *Dispute Resolution*, in 2 THE NEW PALGRAVE DICTIONARY OF ECONOMICS 500, 500-02 (Steven N. Durlauf & Lawrence E. Blume eds., 2d ed. 2008); see also David Rosenberg & Steven Shavell, *A Solution to the Problem of Nuisance Suits: The Option to Have the Court Bar Settlement*, 26 INT'L REV. L. & ECON. 42, 42-43 (2006) (analyzing why rational defendants might be willing to settle even when the plaintiffs have weak cases).

⁷⁵ A patent applicant may not know, when filing for a patent, what the set of potential defendants will look like when the patent is granted. This is the case both because the patent can evolve over the course of prosecution, changing the set of potential defendants, and because the relevant industry will almost certainly evolve between the application filing and any subsequent infringement lawsuits. So a potential patent applicant must consider the different ways the set of potential defendants could evolve; the model does this by summing over a probability distribution of possible sets of potential defendants.

judgment. But both nv_d and p_d can be substantial in patent cases, even with a seemingly weak patent. The intuition is this. The model assumes that patent holders will seek to enforce their patents against all plausible defendants, and that parties to a given case will know early how strong the case is. A strong case will have a value dictated by the likelihood of success and the eventual recovery; even if the case is settled, as most are, the settlement will be for the expected value of the case if it were litigated to final judgment. (This is the term $p_d r_d - c_d$ in the expected-value formula.) A weak case, however, has an expected return from litigation to final judgment that is smaller than the nuisance-settlement value, because, for instance, p_d , the probability of success, is small. So with a weak case, the value of suing defendant d is just the nuisance value, nv_d . Aggregating the value of each case against a potential defendant d (the greater of nv_d and $p_d r_d - c_d$) gives the expected value of the patent. Accordingly, while a patent is surely worth more if it is likely to be upheld by a court, even a relatively weak patent can have substantial expected value if there are enough potential defendants.

Patent law does contain doctrines that could limit the ability of patent holders to extract nuisance settlements and thus reduce the value of weak patents, but those doctrines are offset by ones working in the other direction. For instance, the Patent Act has a fee-shifting provision that permits a court to award a defendant attorney fees in exceptional cases.⁷⁶ This provision was mostly toothless until 2014,⁷⁷ when the Supreme Court gave district courts broader discretion to award attorney fees in patent cases.⁷⁸ If district courts take advantage of this broader discretion, then the nuisance value of a weak patent claim may fall, since defendants will have less incentive to settle cases and avoid litigation costs. At the same time, courts are also required to presume that a patent claim is valid unless an accused infringer proves otherwise by clear and convincing evidence.⁷⁹ This presumption makes it easier

⁷⁶ 35 U.S.C. § 285 (2012).

⁷⁷ Under the Federal Circuit's previous cases interpreting § 285, to recover fees a defendant had to prove that the patent holder either engaged in misconduct (in the litigation or while obtaining the patent) or brought a case that was both objectively baseless and brought in subjective bad faith. *Taurus IP, LLC v. DaimlerChrysler Corp.*, 726 F.3d 1306, 1326 (Fed. Cir. 2013), *abrogated by* *Octane Fitness, LLC v. Icon Health & Fitness, Inc.*, 134 S. Ct. 1749 (2014); *Brooks Furniture Mfg. v. Dutallier Int'l, Inc.*, 393 F.3d 1378, 1381 (Fed. Cir. 2005), *overruled by* *Octane Fitness*, 134 S. Ct. 1749.

⁷⁸ See *Octane Fitness*, 134 S. Ct. at 1756-58 (rejecting the Federal Circuit's *Brooks Furniture* test, and holding that under § 285, an "exceptional" case is simply one that stands out from others with respect to the substantive strength of a party's litigating position . . . or the unreasonable manner in which the case was litigated"); *Highmark Inc. v. Allcare Health Mgmt. Sys., Inc.*, 134 S. Ct. 1744, 1748-49 (2014) (holding that district court determinations under § 285 should be reviewed for abuse of discretion, not de novo).

⁷⁹ See 35 U.S.C. § 282(a) (requiring that patents be "presumed valid"); *Microsoft Corp. v. i4i Ltd. P'ship*, 131 S. Ct. 2238, 2242 (2011) (holding that this presumption may be rebutted only by clear and convincing evidence); Ford, *supra* note 10, at 103-04 (arguing that the nonadversarial nature

for a patent holder to win with a patent of dubious validity and increases the value of an issued patent, since it changes the patent holder's likelihood of success in litigation and the relative bargaining powers of the litigants. It also makes it harder to argue that a claim is exceptional and should be the subject of a fee award, since nearly every patent holder can make at least a good-faith claim of validity.

Each of these factors—the unreliability of patent examination, the low cost of patent prosecution, and the value of even a weak patent—can have effects on its own, but, when combined, they yield an especially perverse result. Since even a weak patent often has substantial value once granted, and the PTO frequently grants weak patents, the expected value of *applying* for a weak patent can also be substantial. Yet this is precisely the scenario that a costly screen is supposed to prevent.

In this simple model, a potential applicant considering whether to file for a patent would do so if and only if its expected value is positive. This expected value is the expected value of the granted patent, as described above, multiplied by the probability of obtaining the patent, minus the cost of patent prosecution. So the expected value from patent application A is

$$E(A) = p_A \sum_{d \in D} \max[nv_d, p_d r_d - c_d] - c_A,$$

where p_A is the probability that the prosecution of application A will result in a granted patent, c_A is the cost of prosecuting application A , and the other values are contingent upon the patent being granted.

But the factors described above mean that the expected value of applying for a patent will often be large even when the patent would likely be invalid. The first factor, the unreliability of patent prosecution, means that p_A (the probability of obtaining a granted patent) is above zero even for a weak application. The second factor, the low cost of prosecuting a patent application, means that c_A (the cost of patent prosecution) is insubstantial compared to the potential value of the patent. And the third factor, the value of any granted patent, means that nv_d (the nuisance value of a patent) and the summation term are both large. So all three factors tend to increase the expected value of a patent application: p_A is larger than it would be if the PTO effectively sorted deserving and undeserving applications; c_A is smaller than it would be if

of patent prosecution and the limited time spent reviewing each application undermine the traditional rationale for the presumption of validity); Doug Lichtman & Mark A. Lemley, *Rethinking Patent Law's Presumption of Validity*, 60 STAN. L. REV. 45, 53-56 (2007) (arguing that a presumption of validity predicated on deference to the PTO's expert decisionmaking makes little sense because PTO review will inherently be limited by budget constraints and the nonadversarial nature of the proceedings).

applying for a patent were expensive; and the summation term is large because the nuisance value, nv_d , is substantial even for a weak patent.

How do these factors undermine the costly screen? The cost of obtaining a patent is supposed to deter applicants from seeking low-value patents, including invalid patents. But if the potential upside from applying for such a patent is large, and the cost of doing so is small, then the examination process will not deter applicants from seeking invalid patents.

It is worth putting these variables into concrete terms. As discussed above, the cost of prosecuting a patent application, c_A , is on the order of \$20,000 to \$30,000.⁸⁰ But the cost of litigating a patent case is much greater—frequently hundreds of thousands of dollars even in low-stakes cases.⁸¹ And since the whole point of a nuisance settlement is to avoid this litigation cost, settlements of \$100,000 or more are common, even in cases involving facially weak patents or claims.⁸² But even if the nuisance value of a claim against a particular defendant, nv_d , is less than \$100,000, when aggregated across multiple defendants, the expected value of a weak granted patent,

$$\sum \max[nv_d, p_d r_d - c_d],$$

can be hundreds of thousands or millions of dollars—well more than an application cost, c_A , of \$30,000.

⁸⁰ See *supra* note 51 and accompanying text. This number might be falling, as clients increasingly demand flat-fee and bulk-rate patent prosecution. Gene Quinn, *The Strange Case of the Vanishing Patent Boutiques*, IPWATCHDOG (Apr. 6, 2010), <http://www.ipwatchdog.com/2010/04/06/the-strange-case-of-the-vanishing-patent-boutiques/id=9877> [<https://perma.cc/N6F2-732F>].

⁸¹ See, e.g., AM. INTELLECTUAL PROP. LAW ASS'N, REPORT OF THE ECONOMIC SURVEY 2015, at I-105, I-108 (2015) (finding, based on a survey of patent lawyers, that the median cost of litigating a case through trial was \$400,000 for each side in patent cases with less than \$1 million at stake, and \$3 million for each side when more than \$25 million was at stake).

⁸² Much of this cost is due to discovery, so the prospect of summary judgment is not usually a meaningful constraint on the litigation cost. See Greg Reilly, *Linking Patent Reform and Civil Litigation Reform*, 47 LOY. U. CHI. L.J. 179, 196-99 (2015). When a defendant can obtain a pre-discovery dismissal, litigation costs are much lower, though such cases are relatively rare in patent law. In the last few years, however, dismissals have become more common in one category of cases: those involving software patents, thanks to the Supreme Court's decision in *Alice Corp. v. CLS Bank International*, 134 S. Ct. 2347 (2014). In that case, the patent claims at issue covered software methods of mitigating settlement risk in financial transactions. *Id.* at 2352. The Court held that the claims were not directed to patent-eligible subject matter because they covered simple computer implementations of abstract ideas. *Id.* at 2359-60. Several courts have dismissed software-patent cases since *Alice*, and since patent eligibility is a question of law, little or no discovery is required beforehand. See Brian McCall, *Lessons from 4 Months of Post-Alice Decisions*, LAW360 (Oct. 31, 2014, 10:18 AM), <http://www.law360.com/articles/590465/lessons-from-4-months-of-post-alice-decisions> [<https://perma.cc/92ZY-77DL>] (observing that four of the six courts that decided motions to dismiss patent claims in the four months after the *Alice* decision held the patents to be invalid).

The hardest quantity to estimate is the probability, p_A , that an examiner would grant a weak patent—a measure of how reliable patent examination is. This value is hard to determine because it is almost impossible to know, without an expensive examination of a particular patent, whether an invention is really patentable and whether the decision to grant the patent was correct. If there were an easy method for figuring this out, examiners could just turn to that method and the process would be reliable. And though economists and legal scholars have proposed different measures of patent quality, many of them focus on factors other than whether the PTO was correct or not in granting a patent.⁸³ But if the cost of prosecuting a patent application, c_A , is \$30,000, and the value of the patent, once granted, is \$150,000—a reasonably conservative order-of-magnitude estimate in many industries⁸⁴—then the probability of obtaining a patent, p_A , only has to be over 20% to make applying for a weak patent worthwhile. Indeed, as discussed above, there are good reasons to suspect that the examination process is systematically flawed,⁸⁵ which suggests that p_A may be at least that large.

The point, of course, does not depend on the precise value of any of these quantities. Rather, it is that as examination becomes less reliable and examiners become more likely to grant invalid patents, the cost of obtaining a patent

⁸³ See Guerrini, *supra* note 39, at 3126-37 (suggesting factors—a patent’s likelihood of validity, clarity, faithfulness to the invention, social utility, and commercial success—that could be used to evaluate patent quality). *But see* Wagner, *supra* note 5, at 2138-39 (distinguishing between patent value and patent quality and arguing that the latter term solely addresses whether a patent satisfies the Patent Act’s statutory requirements).

⁸⁴ In the information-technology industries, for example, numerous patent portfolios have been sold for six figures per patent. *See, e.g.*, Steven Church, Tim Culpan & Devin Banerjee, *Apple Joins Microsoft, RIM in \$4.5 Billion Buy of Nortel Patents*, BLOOMBERG (July 1, 2011, 12:18 PM), <http://www.bloomberg.com/news/articles/2011-07-01/nortel-sells-patent-portfolio-for-4-5-billion-to-group> [<https://perma.cc/V73L-HM2A>] (reporting the sale of more than 6000 telecommunications patents for \$4.5 billion, approximately \$750,000 per patent); Steve Lohr, *Microsoft’s AOL Deal Intensifies Patent Wars*, N.Y. TIMES (Apr. 9, 2012), <http://www.nytimes.com/2012/04/10/technology/microsoft-to-buy-aol-patents-for-more-than-1-billion.html> [<https://perma.cc/5NKE-V99X>] (reporting the sale of 800 Internet patents, plus a license to 300 more, for \$1.056 billion, approximately \$960,000 per patent licensed or purchased); *id.* (noting that of the \$12.5 billion Google paid for Motorola Mobility, more than half might represent the value of Motorola Mobility’s 17,000 patents, at more than \$400,000 per patent). Much of this value, of course, is likely attributable to the value of the claimed inventions, or the defensive value of the patents, rather than the patents’ nuisance or enforcement value. But one telling portfolio sale is Round Rock Research’s purchase of 20% of Micron Technology’s patent portfolio. Patrick Anderson, *Micron Retains Interest in Round Rock Patent Monetization Proceeds*, GAMETIME IP (May 9, 2012), <http://gametimeip.com/2012/05/09/micron-retains-interest-in-round-rock-patent-monetization-proceeds> [<https://perma.cc/MG8Q-EREN>]. Round Rock is a litigation-focused nonpracticing entity that reportedly paid \$400 million for 4500 Micron patents, which is about \$90,000 per patent. *Id.* On the problems and complexities that arise in valuing patents, see WILLIAM J. MURPHY, JOHN L. ORCUTT & PAUL C. REMUS, *PATENT VALUATION: IMPROVING DECISION MAKING THROUGH ANALYSIS* (2012).

⁸⁵ See *supra* notes 37-49 and accompanying text.

becomes less meaningful as a screen. This happens because as examination becomes less reliable, p_A changes accordingly, increasing the expected value of a patent application. And this effect is exacerbated by several endogenous features of the patent system, such as the cost of patent litigation and the heightened burden of proof for invalidity defenses. This is the first half of the vicious cycle.

B. *How a Flawed Costly Screen Undermines the Substantive Screen*

The costly screen's shortcomings also weaken the substantive screen. As patent examination becomes a less effective costly screen, more and more people apply for patents, invalid or otherwise. This, in turn, further reduces the reliability of patent examination, making the substantive screen less effective. The patent system, like any large bureaucracy, cannot scale indefinitely without losing efficiency—the law of diminishing returns applies to hiring within an organization like it does anywhere else⁸⁶—so as the number of patent applications increases, the cost of examining each application will necessarily increase, or the quality of examination will necessarily fall.

There are at least three different categories of costs that increase as the number of applications and examiners increase: personnel costs, coordination costs, and research costs.

1. Personnel Costs

As applicants file more patent applications, the PTO has to hire more examiners, which, all else being equal, will lead to lower-quality examinations. The PTO is a huge agency, with nearly 12,000 employees, including more than 8000 patent examiners.⁸⁷ Since examiner turnover is fairly high, the PTO hires a lot of examiners each year.⁸⁸ The more examiners that have to be hired each year, the harder this task becomes. So, as the number of applications and examiners increases, the average quality of examination will necessarily fall, unless the PTO devotes greater resources to the problem.

This talent dilution stems from the sheer size of the PTO. An organization that hires 500 new employees per year can select the 500 best applicants (or

⁸⁶ See RONALD G. EHRENBERG & ROBERT S. SMITH, MODERN LABOR ECONOMICS: THEORY AND PUBLIC POLICY 61-62 (8th ed. 2003).

⁸⁷ As of September 30, 2013, the PTO had 11,773 federal employees, including 8051 patent examiners and 409 trademark examiners. PTO, 2013 ACCOUNTABILITY REPORT, *supra* note 70, at 9.

⁸⁸ Historically, most examiners left the PTO after less than three years. John Schmid, *Turnover Troubles Agency: Workload, Low Pay Keep Doors Revolving*, MILWAUKEE J. SENTINEL (Aug. 16, 2009), <http://www.jsonline.com/business/53365652.html> [https://perma.cc/Z7YF-GJX8]. In recent years, however, the PTO has reduced turnover, in part by giving examiners the flexibility to telework. PTO, 2013 ACCOUNTABILITY REPORT, *supra* note 70, at 4.

the 500 best applicants who will accept an offer), but if that organization has to hire 1000 new employees in a year, those 500 applicants will only fill half the quota. The rest will have to come from a less qualified part of the applicant pool. Let's say there are 500 "A" examiner candidates in a year. If the PTO has to hire 500 examiners, it can hire only "A" candidates, but if it has to hire 1000 examiners, it will have to dip into the pool of "B" and maybe "C" candidates for the second 500 hires. Overall quality will suffer. Of course, the hiring process is not this simple in the real world; applicants fall on a spectrum, not into discrete buckets. The point is that quality differences between applicants exist, and these differences matter when the PTO increases hiring.

These quality differences between hires can manifest themselves in different ways. Perhaps lower-quality examiners are likely to commit substantive errors, granting invalid patents or rejecting meritorious applications. If so, the effect on examination as a substantive screen is clear: lower-quality examiners would increase the likelihood of obtaining a low-quality patent. Or, perhaps, lower-quality examiners are just slower, increasing the time it takes to process a patent application. This has a subtler effect: it makes it more expensive to obtain a patent, in nonmonetary costs like delayed patent protections and, perhaps, in monetary costs like extra attorney fees. This slowdown can have a salutary effect: by increasing the cost of obtaining a patent, it could strengthen the role of examination as a costly screen. But it also increases the cost of obtaining a valid patent, and does so in a particularly inefficient way, compared to alternatives like increasing the issuance fee.⁸⁹

The PTO could overcome these effects by investing greater resources into the examination process, either by paying examiners more to attract better applicants or hiring more examiners to process fewer applications each. And in times of economic downturn, the pool of potential examiners will be larger, and of higher quality, mitigating the problem. It is also possible that growth in the PTO is matched by growth in the number of potential examiners, so that increasing numbers of patent applications do not lead to problems of examiner quality. But these mitigating effects are necessarily temporary; recessions pass, and if the quality of examination is declining over time, then the PTO can increase personnel costs only so much before it becomes financially unsupportable.⁹⁰

⁸⁹ See *infra* note 129 and accompanying text.

⁹⁰ The PTO is funded through fees paid by patent holders and applicants. 35 U.S.C. § 42 (2012). Though Congress could, of course, make up any shortfall in the PTO's budget caused by greater personnel costs, such a strategy could only go so far, and at all events Congress has been far more willing to take money from the PTO than to appropriate additional money for its use. See Arti K. Rai, *Growing Pains in the Administrative State: The Patent Office's Troubled Quest for Managerial Control*, 157 U. PA. L. REV. 2051, 2057 n.24 (2009) (noting that Congress redirected hundreds of millions dollars in patent fees during the 1990s).

2. Coordination Costs

As applicants file more patent applications, and the PTO hires more examiners, its coordination costs will also increase. Indeed, this is the traditional explanation for diminishing returns as an organization expands.⁹¹ As the size of an organization increases, so too do the number of decisionmakers, the number of people who have to be consulted on a decision, and the number of people to whom a decision must be communicated. Beyond a certain size, the sheer number of connections between people overwhelms gains from specialization, and the costs of making and implementing decisions begin to rise as the organization grows larger.⁹²

Patent examination is largely an independent, parallelizable activity that involves one examiner per application, not a team that must coordinate. Accordingly, increased coordination costs likely occur not at the examiner level, but at management levels.⁹³ These managers include workers in the Office of the Deputy Commissioner for Patent Operations, the Office of Patent Examination Policy, and the Office of Patent Administration, who are charged with coordinating patent examination across nine technology centers, establishing examination policies and procedures, monitoring patent quality, reviewing and responding to changes in patent law from courts and Congress, and managing the PTO's resources and strategic planning.⁹⁴ All these decisions take time and involve numerous workers, and as the PTO grows, they are likely to take longer and may be more likely to go wrong.

This effect may be muted since, as mentioned above, patent examiners work largely individually. At the same time, though, effects at the management level are likely to trickle down to line examiners. This could happen in several

⁹¹ See EHRENBERG & SMITH, *supra* note 86, at 6.

⁹² See, e.g., R. H. Coase, *The Nature of the Firm*, 4 *ECONOMICA* 386, 394 (1937) (“[A]s a firm gets larger . . . the costs of organising additional transactions within the firm may rise.”); Stephen J. DeCanio & William E. Watkins, *Information Processing and Organizational Structure*, 36 *J. ECON. BEHAV. & ORG.* 275, 289 (1998) (observing, based on a statistical model, “that an organization’s size may constrain its speed in adopting innovations”); Michael Keren & David Levhari, *Decentralization, Aggregation, Control Loss and Costs in a Hierarchical Model of the Firm*, 11 *J. ECON. BEHAV. & ORG.* 213, 221-23 (1989) (identifying circumstances under which unit costs are certain to increase as the size of an organization grows due to coordination costs and increased errors); Michael Keren & David Levhari, *The Internal Organization of the Firm and the Shape of Average Costs*, 14 *BELL J. ECON.* 474, 481 (1983) [hereinafter Keren & Levhari, *Internal Organization*] (concluding that marginal production costs are unlikely to decrease indefinitely as an organization increases in size because of increases in coordination costs).

⁹³ In the terms of the organizational-theory literature, the examiners are the production workers—“specialized units whose exact mode of operation has to be coordinated by the supervising hierarchy in accordance with changing circumstances”—while the rest of the PTO is that hierarchy. Keren & Levhari, *Internal Organization*, *supra* note 92, at 475.

⁹⁴ *Office of the Commissioner for Patents*, U.S. PAT. & TRADEMARK OFF., <http://www.uspto.gov/about/offices/patents/index.jsp> [<https://perma.cc/VEL3-NUN9>] (last visited Jan. 23, 2016).

ways. Increased coordination costs could lead to lower-quality policies and procedures within the PTO or lower-quality communication from management to examiners. They could also hurt the agency's responsiveness to changes in the law.⁹⁵ All of these effects would reduce the reliability of examination as a substantive screen. Accordingly, the consequences of coordination problems in the PTO might be stronger than they appear at first glance.

3. Research Costs

Finally, as applicants file more patent applications, and more patents are granted, the PTO's research costs will also increase. Patent examination is fundamentally a research job: the most important thing examiners do is compare applications to the prior art to determine if applicants have really invented things that are useful, novel, and nonobvious. But searching for prior art is a notoriously difficult and costly process, and the greater the universe of possible prior art, the harder and costlier it can become.

Searching for prior art is a labor-intensive process. In a typical search, the searcher will look for similar patents and patent applications issued by or filed in the PTO, the European Patent Office, or the Japan Patent Office. Depending on the scope of the search and the searcher's diligence, she may also review patents issued by other countries or search for nonpatent prior art in various databases of engineering and scientific research. Prior-art searches are conducted both by patent examiners and by private attorneys, who may be trying to determine whether a patent is likely to survive litigation or may be looking for prior art to invalidate it. In the private sector, searches to identify potentially invalidating prior art for litigation start in the \$500 to \$2000 range, and depending on the scope of a search, its technical complexity, and the expertise of the searcher, can easily cost \$10,000, \$20,000, or more.⁹⁶ And these estimates are just the cost of identifying potentially relevant prior art, not analyzing the prior art to see if it invalidates a patent claim. That second step can take attorneys and experts dozens or hundreds of hours.

Searches performed by patent examiners are necessarily more cursory than those performed by litigants, since examiners have far less time and a

⁹⁵ The PTO routinely issues memoranda to examiners addressing changes in the law, especially after Supreme Court decisions or particularly important Federal Circuit decisions. *See, e.g.*, Memorandum from Andrew H. Hirshfeld, Deputy Comm'r for Patent Examination Policy, U.S. Patent & Trademark Office, to Patent Examining Corps, Preliminary Examination Instructions in View of the Supreme Court Decision in *Alice Corporation Pty. Ltd. v. CLS Bank International, et al.* (June 25, 2014), http://www.uspto.gov/patents/announce/alice_pec_25jun2014.pdf [<https://perma.cc/TM5D-45RW>] (providing guidance on how to apply the Court's interpretation of the patentable-subject-matter requirement, six days after the Court's decision in *Alice Corp. v. CLS Bank International*, 134 S. Ct. 2347 (2014)).

⁹⁶ These estimates are based on the author's litigation experience and conversations with patent litigators and prior-art searchers in private practice.

comprehensive search is only cost effective when a patent is important enough to be litigated.⁹⁷ But both kinds of searches are subject to the same fundamental constraint: the difficulty and time required to conduct a search vary linearly with the size of the prior-art universe being searched. If there are twice as many patents relating to wireless networking or benzodiazepine drugs or online shopping carts, then a searcher will have to sort through twice as many prior-art references and spend twice as long analyzing them to determine if an invention is patentable in view of that prior art. So if the examination process becomes less of a costly screen and applicants file more patent applications, examiners will have to work harder to review those applications, further weakening the substantive screen.

None of these effects is inescapable. As I discuss below, the PTO has means to combat increasing personnel costs, coordination costs, and research costs.⁹⁸ But these means are themselves costly and can only reduce the problem, not eliminate it completely. And the patent system is growing so quickly that scale effects are likely inevitable, with consequences that require careful examination.

III. TESTING THE VICIOUS CYCLE

The vicious-cycle theory developed in Part II makes several predictions about patent examination in the real world. Though many of these predicted effects—like a reduction in the reliability of patent examinations—are hard to measure, others are borne out by the data. This Part takes a preliminary look at that empirical evidence. It first reviews some testable hypotheses that follow from the theory and then reviews data suggesting that the theory is consistent with developments in the patent system.

A. Testable Hypotheses

The vicious-cycle theory predicts broad effects in several aspects of the patent system, including both patent examination and the behavior of patent holders after patents have been issued. These predictions fall into three broad categories.

First, the theory makes predictions about the scale of the examination system. If applicants apply for more and more patents with applications of lower and lower quality, then we should expect the numbers of patents and patent applications to increase over time. We should also see corresponding growth in the number of patent examiners. These effects should persist even when correcting for other factors that could lead to more patents and patent

⁹⁷ See generally Lemley, *Rational Ignorance*, *supra* note 3.

⁹⁸ See *infra* Section IV.C.

applications, such as population growth, the globalization of the patent system, and increases in innovation.⁹⁹

Second, the theory makes predictions about the quality of patent examination. The theory predicts that the reliability of examination—the ability of patent examiners to accurately separate deserving and undeserving patent applications—is declining over time, or, in the alternative, that the PTO is expending more money to obtain the same results. These predictions are difficult to test, however, because there are few or no high-quality predictors of whether a patent is likely to be found valid.¹⁰⁰

Third, the theory makes predictions about the behavior of litigants in infringement suits. In particular, if applicants seek and obtain more low-value patents, then we should see a rise in the number of low-value patent lawsuits.

⁹⁹ This last factor is particularly important and difficult to quantify. Scholars have had a hard time quantifying innovation other than by looking at patent data. *See, e.g.*, Daniele Archibugi & Mario Pianta, *Measuring Technological Change Through Patents and Innovation Surveys*, 16 *TECHNOVATION* 451, 463 (1996) (recognizing, despite patent data's limitations, the increasing reliance in the empirical literature on this data for measuring innovation, because the data are readily accessible and comparable across countries). But the link between innovation and patent activity is uncertain at best, and the vicious-cycle theory suggests another reason to be skeptical of innovation metrics that rely on patents. *See, e.g.*, Edwin Mansfield, *Patents and Innovation: An Empirical Study*, 32 *MGMT. SCI.* 173, 180 (1986) (“Despite the fact that the patent system generally is defended at least partly on the grounds that it increases the rate of innovation, the present study indicates that its effects in this regard are very small in most of the industries we studied.”). *But see* Zoltan J. Acs, Luc Anselin & Attila Varga, *Patents and Innovation Counts as Measures of Regional Production of New Knowledge*, 31 *RES. POL'Y* 1069, 1080 (2002) (“The empirical evidence suggests that patents provide a fairly reliable measure of innovative activity.”). *See generally* Zoltan J. Acs & David B. Audretsch, *Patents as a Measure of Innovative Activity*, 42 *KYKLOS* 171 (1989).

¹⁰⁰ Several studies have examined indicators of patent value and unsurprisingly, all else being equal, valid patents are likely to be more valuable than invalid patents. The most significant indicator of patent value is the number of times that patent is cited in subsequent patents. *See, e.g.*, Manuel Trajtenberg, *A Penny for Your Quotes: Patent Citations and the Value of Innovations*, 21 *RAND J. ECON.* 172 (1990) (suggesting that the number of patent citations may be a reliable indicator of patent value); *cf.* David S. Abrams, Ufuk Akcigit & Jillian Popadak, *Patent Value and Citations: Creative Destruction or Strategic Disruption?* (Univ. of Pa. Inst. for Econ. Research, Working Paper No. 13-065, Univ. of Pa. Law Sch. Inst. for Law & Econ., Research Paper No. 13-23, 2013), <http://ssrn.com/abstract=2351809> [<https://perma.cc/FJB4-MLTR>] (finding that at lower patent values, citations seem to be directly correlated with patent value, while at higher patent values, the relationship inverts). Other indicators include the length of a patent, the number of claims, and the amount of prior art cited in the patent. *See, e.g.*, John R. Allison, Mark A. Lemley, Kimberly A. Moore & R. Derek Trunkey, *Valuable Patents*, 92 *GEO. L.J.* 435, 451-55 (2004) (determining that, besides patent citations, the number of claims and prior-art references were strong indicators of patent value, as measured by likelihood of litigation); Lemley & Shapiro, *supra* note 72, at 82-84 (suggesting that the PTO should focus on applications with more claims and citations to prior art because these factors are “correlated with greater ultimate value”); Kimberly A. Moore, *Worthless Patents*, 20 *BERKELEY TECH. L.J.* 1521, 1537-38 (2005) (finding that a patent’s number of claims was a statistically significant indicator whether the patentee continued to pay patent maintenance fees, a metric used to assess patent value). But these factors just predict value in the aggregate; they cannot tell us whether an individual patent is likely to be held valid. To determine validity, there is no efficient substitute for a costly prior-art search and expert evaluation.

This effect could manifest itself in an increase in the absolute number of nuisance-level settlements or in the proportion of patent cases that result in such settlements, or in a fall in the average value of patent settlements. It could also result in an increase in the number of cases dismissed by plaintiffs early in the case, walking away when defendants appear unwilling to settle.

B. *Some Empirical Evidence*

Some of the predictions discussed in the last Section are more amenable to testing than others, and what follows is only a preliminary examination of some readily available data. Still, empirical data are consistent with the predictions of the vicious-cycle theory in each of the three categories discussed above. These trends are merely suggestive; they do not prove or disprove the theory, or that examination quality is falling. These data, however, do suggest promising avenues for further inquiry.

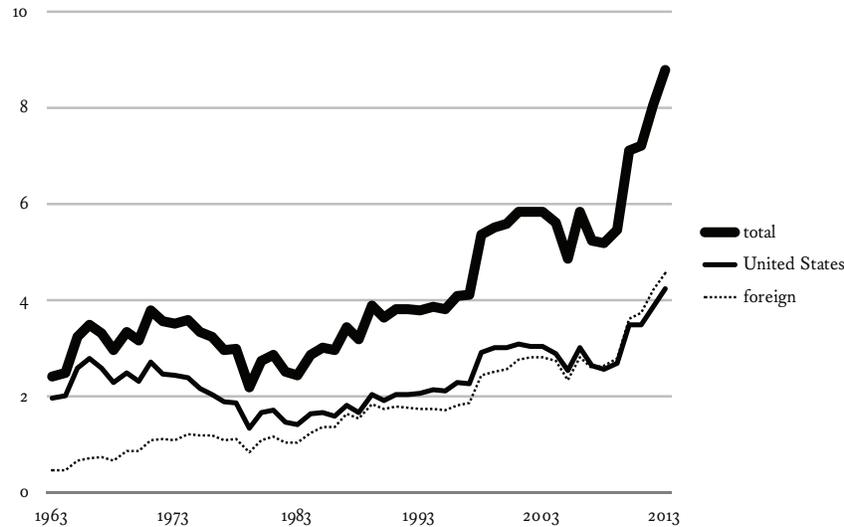
1. The Scale of the Patent-Examination System

Over the last several decades, the patent-examination system has shown the growth predicted by the vicious-cycle theory. Both the number of patents issued annually and the number of examiners have grown tremendously. The number of utility patents granted grew from 56,860 in 1983 to 300,678 in 2014.¹⁰¹ This is not just a reflection of population growth: in that same period, the number of patents granted per year per 10,000 people in the United States went from 2.4 to 8.8.¹⁰² Nor is it just a reflection of the growth of patenting by foreign inventors; limiting the set to patents issued to domestic inventors shows the same trend.¹⁰³ In 1980, for instance, the PTO granted 1.6 U.S.-origin utility patents per 10,000 people in the United States; by 2013, that number had nearly tripled, growing to 4.2 patents per 10,000 people. This trend is shown in Figure 2.

¹⁰¹ PTO, PATENT STATISTICS 1963–2014, *supra* note 70.

¹⁰² For the data that I used, see PTO, PATENT STATISTICS 1963–2014, *supra* note 70; *Monthly Population Estimates for the United States: April 1, 2010 to December 1, 2014*, U.S. CENSUS BUREAU (Dec. 2014), <http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk> [<https://perma.cc/FH9Y-6X92>]; U.S. CENSUS BUREAU, HISTORICAL NATIONAL POPULATION ESTIMATES: JULY 1, 1900 TO JULY 1, 1999 (2000), <http://www.census.gov/popest/data/national/totals/pre-1980/tables/popclockest.txt> [<https://perma.cc/CU4V-8VSL>] [hereinafter CENSUS, POPULATION ESTIMATES: 1900–1999]. For consistency, I used the population estimate as of July 1 of each year.

¹⁰³ Specifically, the number of such patents grew from 32,871 issued in 1983 to 133,593 in 2013, a jump from 1.4 to 4.2 patents per 10,000 U.S. residents. See sources cited *supra* note 102.

Figure 2: Population-Adjusted Patent Grants per Year (1963–2013)¹⁰⁴

Consistent with the growth in patent grants, there has also been a steady growth in the number of examiners, increasing from 3061 at the end of the PTO's fiscal year 2001¹⁰⁵ to 7831 at the end of 2012.¹⁰⁶

There are several possible explanations for these trends, including some that are optimistic. One possibility is that the United States has become substantially more innovative over the last several decades, leading to more inventions that are entitled to patent protection. The growth of the computer

¹⁰⁴ The y-axis shows utility patents granted per 10,000 U.S. residents, with separate lines broken out for patents issued to U.S. and foreign applicants. Population-adjusted figures were calculated based on patent data from PTO, PATENT STATISTICS 1963–2014, *supra* note 70, and population data from several U.S. Census Bureau sources. For 1963 to 1999, data were taken from CENSUS, POPULATION ESTIMATES: 1900–1999, *supra* note 102. For 2000 to 2010, data were taken from U.S. CENSUS BUREAU, INTERCENSAL ESTIMATES OF THE RESIDENT POPULATION BY SEX AND AGE FOR THE UNITED STATES: APRIL 1, 2000 TO JULY 1, 2010 (2011), <http://www.census.gov/popest/data/intercensal/national/tables/US-EST00INT-01.xls> [<https://perma.cc/K24R-3J8D>]. For 2011 to 2013, data were taken from U.S. CENSUS BUREAU, MONTHLY POPULATION ESTIMATES FOR THE UNITED STATES: APRIL 1, 2010 TO NOVEMBER 1, 2013 (2013), <http://www.census.gov/popest/data/state/totals/2012/tables/NA-EST2012-01.xls> [<https://perma.cc/K2VE-SNJ7>]. For each year, the population as of July 1 was used in the calculation.

¹⁰⁵ U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT FOR FISCAL YEAR 2005, at 148 (2005), <http://www.uspto.gov/sites/default/files/about/stratplan/ar/USPTOFY2005PAR.pdf> [<https://perma.cc/CH87-UYAJ>].

¹⁰⁶ U.S. PATENT & TRADEMARK OFFICE, PERFORMANCE AND ACCOUNTABILITY REPORT: FISCAL YEAR 2012, at 203 (2012), <http://www.uspto.gov/sites/default/files/about/stratplan/ar/USPTOFY2012PAR.pdf> [<https://perma.cc/VQR9-D6UC>] [hereinafter PTO, 2012 ACCOUNTABILITY REPORT]. These numbers include examiners of utility, reissue, and plant patents (categories that are grouped by the PTO), but not of design patents.

and information industries could be responsible for much of this increase in innovation. Indeed, the technology classes with the greatest patent growth over the last two decades include several classes related to software, information processing, and similar emerging technological fields.¹⁰⁷ But I am not aware of any reason to think that the United States has become 2.6 *times* as innovative, on a per capita basis, since 1980. Another possibility is that firms have become more sophisticated about protecting intellectual property rights to legitimate innovations that would have remained unprotected earlier.

Yet this trend is also consistent with a pessimistic hypothesis: that the growth in patent grants is driven by speculators obtaining the sort of low-value patents that fail to pan out or that are asserted in nuisance litigation. Such an account would be consistent with the predictions of the vicious-cycle theory.

2. The Quality of Patent Examination

It is difficult to measure directly the quality of patent examination, but indirect measures may reveal patterns consistent with a reduction in examination quality. Two such indirect measures—the average workload of a patent examiner and the average pendency of a patent application—are consistent with the vicious-cycle theory.

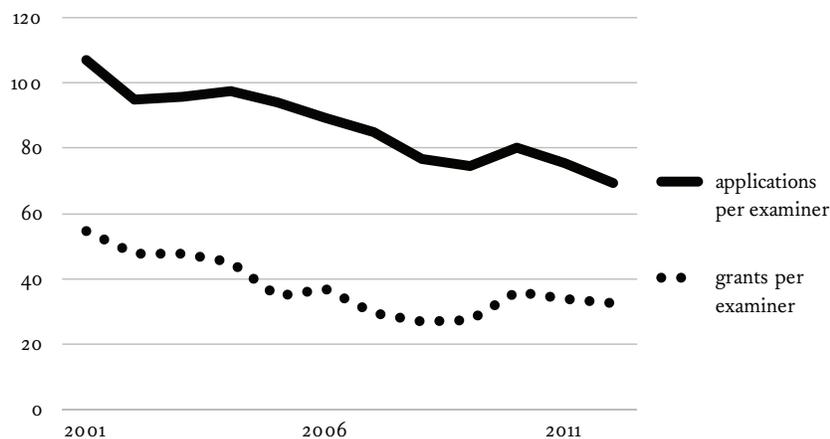
While the PTO has nearly tripled the size of its examiner corps over the last decade, the average workload per examiner, as measured by the number of applications handled annually, has fallen.¹⁰⁸ Despite this decreased workload per examiner, applications have taken longer to process, with the average application pendency increasing over the same period.¹⁰⁹ In 2001, for instance, the average patent examiner was responsible for 107 patent applications and 54.6 granted patents. By 2012, however, those numbers had declined to 69.5 applications and 32.5 grants.¹¹⁰ These trends are shown in Figure 3.

¹⁰⁷ See U.S. PATENT & TRADEMARK OFFICE, EXTENDED YEAR SET—PATENTING BY GEOGRAPHIC REGION (STATE AND COUNTRY), BREAKOUT BY TECHNOLOGY CLASS: COUNT OF 1963–2014 UTILITY PATENT GRANTS AS DISTRIBUTED BY CALENDAR YEAR OF GRANT (2015), http://www.uspto.gov/web/offices/ac/ido/oeip/taf/stcteca/allstcl_gd.htm [https://perma.cc/UJ9M-JKKK] (showing the greatest growth in patent grants from 1990–1993 to 2010–2013 in technology classes, including class 726, Information Security; 709, Multicomputer Data Transferring; 707, Database and File Management or Data Structures; 717, Software Development, Installation, and Management; 719, Interprogram Communication or Interprocess Communication; and 800, Multicellular Living Organisms and Unmodified Parts Thereof and Related Processes).

¹⁰⁸ See *infra* Figure 3.

¹⁰⁹ See *infra* Figure 4.

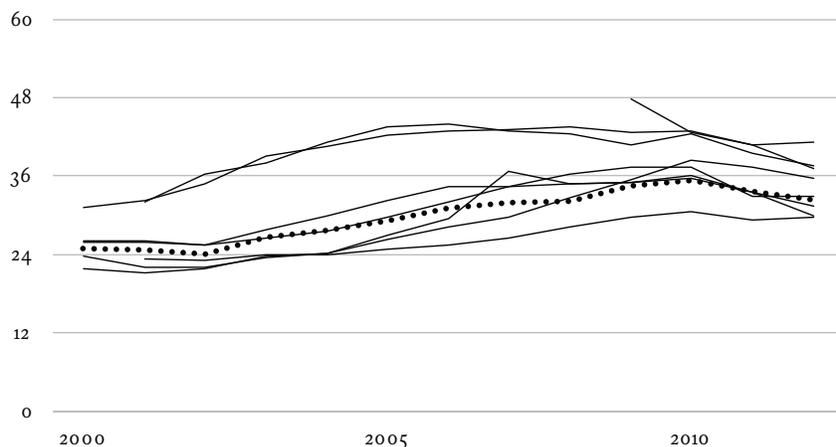
¹¹⁰ This trend appears to have begun in the early 2000s. Polk Wagner observed the beginning of it in his 2009 article. Wagner, *supra* note 5, at 2159 fig.4.

Figure 3: Patent Applications and Grants per Examiner per Year (2001–2012)¹¹¹

One possible explanation for this trend would be if the PTO was hiring additional examiners to cut down on the backlog of patent applications—a stated goal of the PTO.¹¹² If examiners are spending more time clearing out the backlog, then that will not be captured by a metric that looks at the number of applications filed in one year. Yet, while examiners have handled fewer applications, and thus presumably have more time to spend on each patent application, the average pendency of patent applications has increased, from 25 months in 2000 to 32.4 months in 2012 (and 35.3 months in 2010). This trend is shown in Figure 4.

¹¹¹ These numbers include utility, reissue, and plant patents, and exclude design patents. Application and grant data were taken from PTO, PATENT STATISTICS 1963–2014, *supra* note 70. Examiner data were taken from the PTO's annual *Performance and Accountability Reports*, which are available at <http://www.uspto.gov/about-us/performance-and-planning/uspto-annual-reports> [<https://perma.cc/LS8V-FBEN>].

¹¹² See PTO, 2012 ACCOUNTABILITY REPORT, *supra* note 106, at 17 (stating that “Strategic Goal 1” is to “Optimize Patent Quality and Timeliness”).

Figure 4: Average Application Pendency (2000–2012)¹¹³

As with the numbers of patent grants and examiners, both optimistic and pessimistic explanations for these trends are possible. The optimistic explanation is that when examiners spend more time on individual patent applications, they may do a better job, leading to more accurate outcomes and fewer low-quality patents. There may be some truth to this account, since the data appear to reflect a substantial increase in the amount of time an examiner spends on each patent application. If each examiner works 2000 hours per year, then a patent examiner in 2001 could dedicate only 18.7 hours to each of the 107 applications assigned to her,¹¹⁴ an estimate that is largely consistent with past estimates of the time an examiner spends on a typical application.¹¹⁵ But by 2012, with each examiner responsible for 69.5 applications, each examiner could devote 28.8 hours to each application¹¹⁶—a 54% increase in the time available for each application. If examiners make effective use of this extra time, then examination outcomes may be substantially improved.

The pessimistic account, however, suggests that this increased time per application could itself be a sign of lower-quality examinations. Lower-quality examiners, for instance, might need more time to perform the tasks of patent examination. And even if the extra time was enough to make up for a lower-quality

¹¹³ The dotted line shows average pendency, in months, for all utility-patent applications, while the solid lines show trends for individual technology centers. Pendency data are from PTO, 2012 ACCOUNTABILITY REPORT, *supra* note 106, at 17.

¹¹⁴ See *supra* Figure 3.

¹¹⁵ See, e.g., Lemley, *Rational Ignorance*, *supra* note 3, at 1500 (estimating that examiners spend an average of about 18 hours on a patent application).

¹¹⁶ See *supra* Figure 3.

corps of examiners, it would represent a substantially higher personnel cost for the PTO. Without an independent metric of patent quality, it is hard to distinguish between these two accounts. But the pessimistic account is consistent with the predictions of the vicious-cycle theory, while there is little evidence that patent quality has improved.

3. The Behavior of Patent Litigants

Finally, the behavior of patent litigants is consistent with the theory. Of course, as others have observed, the sheer number of patent cases has increased substantially in recent decades; for instance, in 2000, 2295 patent cases were filed in federal district courts, while by 2010 that number had increased to 2714 cases, and by 2013 it had hit 6062 cases.¹¹⁷ The increase after 2010 represents both growth in patent litigation and the increasing number of cases filed after the joinder provisions of the America Invents Act (AIA) went into effect, making it harder to join multiple defendants in one lawsuit.¹¹⁸

More notably, this group contains an increasing proportion of cases that are terminated quickly, within six months of filing. These quickly terminated cases are notable because they are more likely to represent low-quality patents, nuisance suits, and low-value nuisance settlements or walk-away agreements. For instance, RPX reported that more than half of lawsuits brought by nonpracticing entities end within six months of filing.¹¹⁹ They thus provide a useful proxy for lawsuits brought with low-quality patents.

To determine whether an increasing proportion of cases are terminated within six months, I obtained a dataset of all 43,166 patent cases filed in federal district courts between 2000 and 2013.¹²⁰ For each case in the dataset, I calculated the time from filing date to termination, as indicated in PACER. Next, I constructed a categorical dependent variable with a value equal to 1 if the time from filing to termination was 180 days or less, and 0 if the time was more than 180 days or if the case was ongoing. I then performed a logistic regression with the independent variable equal to the filing date (normalized to years) and the categorical dependent variable.

¹¹⁷ These numbers are from Lex Machina, a database of intellectual property litigation. LEX MACHINA, <http://www.lexmachina.com/> (search conducted Sept. 18, 2014). On the benefits of using Lex Machina, rather than sources like LexisNexis, Westlaw, or PACER, see John R. Allison, Mark A. Lemley & David L. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1772-73 (2014). For just a few of the many observers noting the growth of patent litigation, see BESSEN & MEURER, *supra* note 39, at 120-64; JAFFE & LERNER, *supra* note 39, at 11-16.

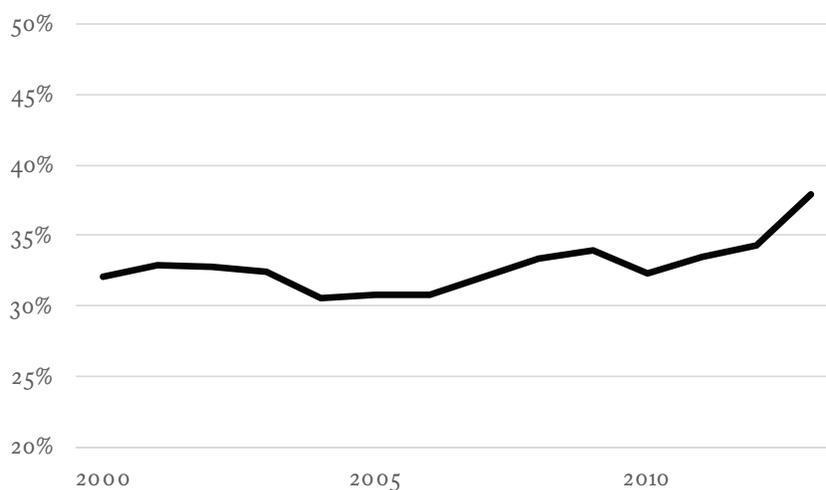
¹¹⁸ See 35 U.S.C. § 299 (2012).

¹¹⁹ RPX, 2013 LITIGATION REPORT, *supra* note 14, at 37 chart 55.

¹²⁰ The dataset was kindly provided by Lex Machina. See *supra* note 117.

The results indicate a slight, but statistically significant, increase over time in the proportion of cases that were terminated within 180 days.¹²¹ This increase is shown in Figure 5.

Figure 5: Quickly Terminated Cases (2000–2013)¹²²



There are different possible explanations for this trend. One explanation consistent with the vicious-cycle theory is that as the quality of patent examination declines, more low-quality patents are issued and more low-value patent lawsuits are brought. The greater proportion of quickly terminated cases, then, corresponds to the increasing number of early settlements and nuisance suits. An alternative explanation is that litigants have become more sophisticated and willing to settle quickly as the number of patent lawsuits has grown. Especially among defendants, there may be an increasing willingness to see patent litigation as a cost center that must be managed through tools like quick settlements. It is also possible that the AIA has bolstered the trend by making it harder to sue numerous defendants in one case. If multiple defendants are joined in one lawsuit, that suit will have a termination date corresponding to the last defendant to resolve the case, rather than one termination date corresponding to each defendant. The trend, however, predates the AIA, suggesting that it cannot account for the entire increase.

¹²¹ The estimated coefficient for the filing-date independent variable is $\beta = 0.01557$, with $p = 1.02 \times 10^{-10}$, statistically significant at the $p = 0.01$ level.

¹²² Figure 5 shows the proportion of patent cases filed in federal district courts terminated within 180 days of filing. The regression coefficient corresponds to an increase in the probability that a case will be quickly terminated of approximately 0.34% per year over the relevant period.

* * *

It is important to emphasize the limitations of these findings. I am not aware of direct evidence that the PTO is actually hiring lower-quality examiners, or that patent or examination quality has fallen. But the evidence does show that over the last few decades, the patent system has expanded far faster than is easily explained by population growth, globalization, or increased innovation. One possible explanation is that patents have been increasingly used in socially undesirable ways—for example, to extract rents from successful firms. The evidence also suggests that even though the PTO has hired more examiners to keep pace with the growth in applications, examiner productivity has not kept up with that growth. And the data show that more patent cases are resolved quickly, suggesting that a greater portion of patent cases consists of low-value nuisance lawsuits. These findings are consistent with, if not demonstrative of, the predictions of the vicious-cycle theory and a decline in patent quality.

IV. IMPLICATIONS AND REFORMS

The news is not all bad. One key implication of the vicious-cycle theory is that policymakers have substantial flexibility in designing patent reforms, because the effect of a reform on one piece of the cycle will propagate to the rest of the cycle. This Part discusses that flexibility. It first discusses how reforms to different pieces of the vicious cycle would propagate to the rest of the cycle. It then discusses some specific reforms that could help temper the vicious cycle, both by targeting the substantive and costly screens and by reducing their interactions.

A. Flexible Patent Reforms

A vicious cycle is a feedback loop: each step of the cycle triggers the next step, so any interruption of the cycle would prevent the feedback loop from continuing. This gives reformers a lot of power, since a reform that affects any step in the cycle would produce effects throughout the cycle. In this cycle, there are four possible targets for reform: the flawed substantive screen and costly screen, and the links between the two screens that allow the flaws in one screen to undermine the other screen. These latter two targets correspond to the arrows in Figure 1.

This flexibility is fairly straightforward. If reforms fixed the problems with the substantive screen so that an examination outcome was a reliable indicator of whether an invention was patentable, there would be no incentive to apply for the sort of low-quality patents that are most likely to be asserted in nuisance litigation. The costly screen, then, would better deter applicants from seeking

low-value patents. Likewise, if the costly screen were more effective—e.g., if the cost of obtaining a patent were greater than its nuisance value—then there would be fewer patent applicants, and the examination system would not need to keep up with the same massive growth in patent applications.

Even if the flaws in the substantive screen and costly screen persist, reforms to other elements of the patent system could mitigate the vicious cycle by disrupting the causal links between the flawed screens. For example, reforms that would reduce the value of low-quality patents—including measures that make it harder to exploit these patents in nuisance litigation—would discourage applicants from seeking low-quality patents even if a flawed substantive screen would grant them. This reduction in the value of low-quality patents would make the costly screen more effective. Likewise, reforms that would make it easier for the examination system to scale would help maintain the quality of patent examination even in the face of growth from a flawed costly screen. Flaws in the costly screen, then, would have less of an effect on the substantive screen. The next two Sections discuss different reforms that could accomplish these two goals.

B. *Fixing the Screens*

Reforms that would make patent examination better at fulfilling its role as a substantive screen or as a costly screen would have the most direct effect on the examination system. Improving the substantive screen, however, would be difficult or even impossible without massively increasing the cost of the patent system. Improving the costly screen, in contrast, would be straightforward because it simply requires increasing the cost to obtain a patent, but such a measure would also deter applicants from seeking some high-quality patents.

1. *Fixing the Substantive Screen*

One set of reforms would work to improve patent examination as a substantive screen. Scholars and policymakers have made numerous proposals aimed at improving the quality of patent examination, and I have little to add to their proposals.¹²³ In general, these proposals fall into two categories. One class of proposals seeks to devote greater resources to patent examination. It is far from clear, however, that doing so would be cost effective, especially since most

¹²³ For just a few of the many articles discussing how to improve patent examination, see John R. Allison & Starling D. Hunter, *On the Feasibility of Improving Patent Quality One Technology at a Time: The Case of Business Methods*, 21 BERKELEY TECH. L.J. 729 (2006); Mark A. Lemley, *Can the Patent Office Be Fixed?*, 15 MARQ. INTELL. PROP. L. REV. 295 (2011); Michael Meehan, *Increasing Certainty and Harnessing Private Information in the U.S. Patent System: A Proposal for Reform*, STAN. TECH. L. REV., Feb. 2010; Kristen Osenga, *Entrance Ramps, Tolls, and Express Lanes—Proposals for Decreasing Traffic Congestion in the Patent Office*, 33 FLA. ST. U. L. REV. 119 (2005); Stephen Yelderman, *Improving Patent Quality with Applicant Incentives*, 28 HARV. J.L. & TECH. 77 (2014).

patents are never asserted and it is hard to tell, ex ante, which patents will prove important.¹²⁴

The other class of proposals seeks to give examiners more information to use in the examination process. These proposals come in several types. One type is designed to provide application-specific information in each examination, for instance by requiring applicants to submit the results of commercial prior-art searches.¹²⁵ Another type is designed to solicit information from third parties about prior art, for instance by crowdsourcing prior-art searches or by facilitating post-grant review of granted patents.¹²⁶ A third type of proposals is designed to make it easier for examiners to find information on their own, for instance by developing better databases of prior art.¹²⁷

All of these reforms could undoubtedly help improve the substantive screen, though just how much progress can be made is unclear. There are reasons

¹²⁴ See Lemley, *Rational Ignorance*, *supra* note 3, at 1510–11, 1511 n.65 (claiming that expending resources to improve the examination process would prove inefficient because the vast majority of patents are either not practiced or are of little commercial significance).

¹²⁵ See Marc S. Adler, *Defining the Invention: Searching Before Filing*, INTELL. PROP. OWNERS ASS'N (July 26, 2006), http://ipoa.typepad.com/presidents_column/2006/07/defining_the_in.html [<https://perma.cc/65VZ-JDBF>] (“Attempting to define an invention in the absence of a thorough prior art search is akin to throwing darts at a target blindfolded.”). Both Congress and the PTO have also considered this approach. See Patent Reform Act of 2007, H.R. 1908, 110th Cong., § 123 (2007) (introducing a patent reform bill which provides in part that “[t]he [PTO] Director shall, by regulation, require that applicants submit a search report and other information and analysis relevant to patentability”); Notice of Public Hearing and Request for Comments on Issues Related to the Identification of Prior Art During the Examination of a Patent Application, 64 Fed. Reg. 28,803, 28,805 (May 27, 1999) (seeking public comment on the questions, “Should applicants be required to conduct a prior art search and submit corresponding search results, including where they searched, to the USPTO when filing a patent application? If not, should applicants be required to disclose whether or not a search was conducted?”).

¹²⁶ The PTO is trying both approaches. The AIA created a new system of post-grant review under which third parties may petition the PTO to cancel previously issued patents. See *generally* 35 U.S.C. §§ 321–329 (2012). Under a different provision in the AIA, the PTO must accept from “[a]ny person at any time” a citation to “prior art consisting of patents or printed publications which that person believes to have a bearing on the patentability of any claim of a particular patent.” *Id.* § 301(a)(1); see also *id.* § 122(e). Acting under this provision, third parties have partnered with the PTO to form crowdsourced projects to find and submit invalidating prior art. See, e.g., Joel Spolsky, *AskPatents.com: A Stack Exchange to Prevent Bad Patents*, STACK OVERFLOW (Sept. 20, 2012), <http://blog.stackoverflow.com/2012/09/askpatents-com-a-stack-exchange-to-prevent-bad-patents> [<https://perma.cc/36A9-QKL9>] (announcing the launch of a Stack Exchange site that enables users to submit anticipatory prior art); see also Request for Comments and Notice of Roundtable Event on the Use of Crowdsourcing and Third-Party Preissuance Submissions to Identify Relevant Prior Art, 79 Fed. Reg. 15,319, 15,320 (Mar. 19, 2014).

¹²⁷ See, e.g., Request for Comments Regarding Prior Art Resources for Use in the Examination of Software-Related Patent Applications, 79 Fed. Reg. 644, 645 (Jan. 6, 2014) (requesting comments on what databases stakeholders find helpful in identifying software prior art and, more broadly, how the PTO should “formulate and implement search strategies to identify” software prior art); Daniel Nazer, *Why Is the Patent Office So Bad at Reviewing Software Patents?*, ELECTRONIC FRONTIER FOUND.: DEEPLINKS BLOG (Mar. 17, 2014), <https://www.eff.org/deeplinks/2014/03/why-patent-office-so-bad-reviewing-software-patents> [<https://perma.cc/9VV5-UMNU>] (proposing that the PTO develop “searchable databases of existing software programs” to help patent examiners find software prior art).

to think that patent examination will always have a certain baseline error rate, even aside from the errors expected in any system with the scale of the patent system. By its very nature, the patent system handles cutting-edge technologies in a wide variety of fields, making it harder to tell *ex ante* whether something is truly new. Prioritizing especially important applications might help, since it would reduce the scope of the problem and let examiners focus on getting the key decisions right.¹²⁸ But because patents are obtained early in the development cycles of new technologies, it is often hard to tell whether an invention will become important.

2. Fixing the Costly Screen

Unlike the substantive screen, the costly screen is easy to fix. Since the major flaw in the costly screen is that the cost of applying for a low-quality patent is often less than the benefit of doing so, the obvious fix is just to increase the cost. This could be done in several ways: by imposing higher application, issuance, or maintenance fees, or by imposing other costs, like requiring applicants to submit detailed validity charts or the results of commercial prior-art searches.

Indeed, a strong case can be made that PTO fees should be substantially higher than they are now. The basic filing fee for a utility patent varies from \$70 to \$280, depending on the size of the filer, with search and examination fees adding another \$330 to \$1320; the issuance fee is \$240 to \$960; and maintenance fees (which are due 3.5, 7.5, and 11.5 years into the 20-year patent term) vary from \$400 to \$7400.¹²⁹ If the nuisance value of a patent is \$150,000,¹³⁰ then these fees will not have a significant deterrent effect. A fee schedule approaching \$10,000 at issuance, \$100,000 after 5 years, \$1 million after 10 years, and \$10 million after 15 years would more effectively deter applicants from seeking low-value (and thus low-quality) patents. And the effect on nonnuisance patents would be relatively insignificant, since low-quality patent suits are disproportionately brought near the end of a patent's life.¹³¹

¹²⁸ See Mark Lemley, Doug Lichtman & Bhaven Sampat, *What to Do About Bad Patents?*, REGULATION, Winter 2005–2006, at 10, 10, 12–13 (proposing that applicants could pay for a more detailed patent examination and obtain a “gold-plate[d]” patent).

¹²⁹ PTO, FEE SCHEDULE, *supra* note 67.

¹³⁰ See *supra* note 84 and accompanying text.

¹³¹ See Brian J. Love, *An Empirical Study of Patent Litigation Timing: Could a Patent Term Reduction Decimate Trolls Without Harming Innovators?*, 161 U. PA. L. REV. 1309, 1331 (2013) (finding that nonpracticing entities assert their patents relatively late in their term, while product-producing entities tend to enforce their patents soon after issuance). Similarly, although the cost of obtaining a patent would still be lower than the nuisance value of a patent under the current system, that value varies over time. If most of the nuisance value of a patent can only be captured toward the end of a patent term—once, for example, the industry has matured and the number of potential defendants is larger—then large maintenance fees may deter applicants from seeking low-value patents even if the front-end fees are small.

There are limits, of course, to how costly patent fees should be. Because patents are granted early in the development cycle to give inventors time to commercialize their inventions, fees should escalate over a patent's term.¹³² And if fees are too high, inventors will rely on trade secrecy or increase their relative investments in nonpatentable innovations, which could deprive society of new inventions and their public disclosures. Still, the most valuable inventions (which are protected by the most valuable patents) are the ones least likely to be affected by dramatically higher PTO fees. Since these are the inventions society has the greatest interest in encouraging, substantially higher PTO fees could have limited downsides.

C. *Fixing the Cycle*

Other reforms could disrupt the feedback loop that results from flaws in the costly and substantive screens. While these reforms do not target examination directly, they could nevertheless significantly temper the vicious cycle.

1. Reducing the Effect of the Flawed Substantive Screen

One set of reforms would reduce the effects of flaws in the substantive screen. (These reforms would work to eliminate the top arrow in Figure 1.) Flaws in the substantive screen feed into the vicious cycle by increasing the expected value of applying for a low-quality patent. Reforms that reduce the value of a low-quality patent, then, would discourage applicants from applying for such patents, reducing the effect of the flawed substantive screen. Several possible reforms fall into this category, though they all amount to changing the patent holder's cost-benefit analysis in bringing an infringement suit asserting a low-quality patent.

One class of reforms would increase the cost of bringing an infringement suit based on a low-quality patent. For instance, heightened pleading requirements for patent cases—such as requiring patent holders to include detailed infringement allegations or claim charts in complaints, or imposing a higher filing fee for patent suits—would impose an *ex ante* cost on a patent holder seeking to bring a nuisance case. Likewise, a fee-shifting rule in patent cases would impose *ex post* costs on unsuccessful patent plaintiffs. All of these proposals would reduce the expected value of a nuisance patent suit and thus reduce the expected value of a low-quality patent.

Another class of reforms would reduce the benefit of bringing an infringement suit based on a low-quality patent. Since that benefit is driven by

¹³² The patent system largely does this now. For a standard large entity, the application fee is \$280; the issuance fee is \$960; and maintenance fees are, in order, \$1600, \$3600, and \$7400. PTO, FEE SCHEDULE, *supra* note 67.

nuisance-settlement value, which is, in turn, driven by the costs of patent litigation for defendants, these reforms would aim to reduce those costs. For instance, rules limiting discovery in patent cases would cut down on one of the most expensive parts of patent litigation (and an expense borne disproportionately by defendants).¹³³ Likewise, a bifurcation rule requiring courts to decide validity before moving on to an infringement phase of a case would, in many cases, allow defendants to avoid expensive discovery and would give defendants additional leverage in settlement negotiations.¹³⁴ These proposals would reduce the expected benefit of bringing a patent lawsuit with a low-quality patent, and thus reduce the incentive to apply for such patents.

A third class of reforms would change the likelihood of success on the merits, affecting the expected value of bringing a patent lawsuit. For instance, eliminating the heightened burden of proof that applies to invalidity defenses would make it easier for defendants to prevail, reducing the value of a low-quality patent.¹³⁵ Similarly, broadening the standard for obviousness would reduce the value of a low-quality patent. Notably, these reforms would only affect patents with borderline validity; high-quality patents would be largely unaffected.

Many of these reforms are usually considered litigation measures, not reforms to patent *examination*. Yet a critical implication of the vicious-cycle theory is that they will also have a salutary effect on patent examination. By reducing the incentive to apply for low-quality patents, these reforms would reduce the PTO's workload, making it easier to devote resources to higher-quality patent applications. Likewise, they would improve the quality of the application pool, reducing the number of potential low-quality patents in the first place.

Some of these reforms may become law in the coming years. For instance, the Innovation Act, which passed the House of Representatives in 2013 by a vote

¹³³ Many patent plaintiffs, and especially patent plaintiffs bringing nuisance cases, are small entities without many discoverable business records. Defendants, on the other hand, are necessarily entities that make, use, or sell an allegedly patented technology, and often have voluminous records relating to that technology. Under current law, such records are almost always discoverable in an infringement suit. *See* FED. R. CIV. P. 26(b)(1) ("Parties may obtain discovery regarding any nonprivileged matter that is relevant to any party's claim or defense and proportional to the needs of the case . . ."); Reilly, *supra* note 82, at 196-99 ("Because patent defendants tend to possess 'the bulk of the relevant evidence,' they have higher discovery costs than the patent holder. . . . Patent assertion entities normally are small operations focused just on licensing and litigation that have few relevant witnesses, documents, or other evidence."); Letter from Sixty-One Professors to Congress in Support of Patent Reform Legislation 1 (Nov. 25, 2013), <http://ssrn.com/abstract=2359621> [<https://perma.cc/7NEN-LMUR>] ("[T]he bulk of . . . expenses [defending against a patent suit] are incurred during the discovery phase of the litigation . . .").

¹³⁴ *See* Ford, *supra* note 10, at 119-22 (concluding that bifurcating discussion of invalidity and infringement in patent cases would reduce the pressure on defendants to settle cases early by reducing the costs of discovery and providing parties with more information about the strength of lawsuits).

¹³⁵ This would change p_d in the model discussed *supra* Section II.A.

of 325 to 91,¹³⁶ would implement several of these reforms, including heightened pleading requirements, discovery limitations, and presumptive fee shifting in patent cases.¹³⁷ Though the bill did not pass the Senate in 2013, it has been reintroduced in the 114th Congress and stands a reasonable chance of passage.¹³⁸

2. Reducing the Effect of the Flawed Costly Screen

Another set of reforms would work to reduce the effects of flaws in the costly screen. (These reforms would work to eliminate the bottom arrow in Figure 1.) Flaws in the costly screen propagate throughout the system because they increase the number of patent applications, causing the PTO to expand more quickly than it can while maintaining the quality of examination. These reforms, then, work to increase the scalability of the PTO.

One set of reforms would give patent examiners better tools, which, as discussed above, would help them find better prior art.¹³⁹ Besides improving the substantive screen, this would also help reduce the effect of the flawed costly screen because it would help make up for any reductions in the quality of the examiner pool and would help reduce training and startup costs when the PTO hires new examiners. For instance, new databases of prior art and new crowdsourcing platforms would help a larger examiner pool examine more patent applications without sacrificing quality.

A strategy that may be more scalable would be to find ways to expand the size of the PTO without sacrificing quality, usually by finding new pools of potential examiners. The PTO has made moves in this area that may prove to be quite valuable, both by permitting many examiners to work from home and by opening new satellite offices in Dallas, Denver, Detroit, and San Jose.¹⁴⁰ These programs have improved examiner retention and opened up new pools of potential examiners who would not be willing or able to work in Alexandria, Virginia.¹⁴¹ Although these programs do not eliminate the scaling problem presented by coordination and research costs, they could eliminate or substantially reduce the problems presented by personnel costs and declining examination quality.

¹³⁶ *Final Vote Results for Roll Call 629*, OFF. CLERK: HOUSE REPRESENTATIVES (Dec. 5, 2013, 1:12 PM), <http://clerk.house.gov/evs/2013/roll629.xml> [<https://perma.cc/9GX7-9E2E>].

¹³⁷ Innovation Act, H.R. 3309, 113th Cong. (2013).

¹³⁸ Innovation Act, H.R. 9, 114th Cong. (2015).

¹³⁹ See *supra* notes 125–27 and accompanying text.

¹⁴⁰ See PTO, 2012 ACCOUNTABILITY REPORT, *supra* note 106, at 51, 52 fig.29 (describing the PTO's telework program).

¹⁴¹ Telework and satellite offices also bring numerous new examiners into the PTO, which may itself be good for patent quality. See Frakes & Wasserman, *supra* note 45 (finding that, upon promotion to jobs limiting the time available for examination, patent examiners become more likely to grant invalid patents).

* * *

All of these reforms would have particular direct effects, but they would also help improve the patent-examination system as a whole by reducing the feedback effects that lead to the vicious cycle.

CONCLUSION

Although patent examination aims to protect the quality of the patent system by screening out low-quality and low-value patents, there is a growing consensus that it does an imperfect job at best. While some examination errors are probably inevitable, this Article suggests that patent examination may be trapped in a vicious cycle in which the quality of examination progressively worsens, as more applicants seek low-quality patents and the patent system struggles to keep pace. Such a cycle is especially troubling since nuisance patents are playing an increasingly large role in the patent system.

Yet the same feedback effects that lead to the vicious cycle in the first place also make it easier to solve, since the effects of a reform would propagate throughout the cycle. This gives policymakers the ability to focus on the easiest places to make reforms (like limiting discovery in patent cases or imposing larger fees on patent recipients) instead of trying to do the impossible (like making examiners substantively better at their jobs).