Examination—the process of reviewing a patent application and deciding whether to issue the requested patent—plays two roles in the patent system. It acts as a substantive screen, filtering out meritless applications and improving meritorious ones. It also acts as a costly screen, discouraging applicants from seeking low-value patents. Yet with each role, examination has well-recognized flaws: examiners grant many invalid patents that should be filtered out by a substantive screen and many nuisance or patent-thicket patents that should be filtered out by a costly screen.

These flaws are usually seen as troublesome aspects of a system that may need reform at the margins, but is otherwise meritorious. This article argues, however, that these flaws are worse than has been recognized, because they interact to reinforce each other. This interaction leads to a vicious cycle of more and more patents that should never have been granted. Flaws in the substantive screen make the patent system less effective as a costly screen, because even nuisance patents are often worth more than the cost of the screen. At the same time, flaws in the costly screen undermine the substantive screen, because they increase the number of 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 having a substantial effect on the patent system.

The good news is that this 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 reforming the litigation system—instead of trying to do the impossible—like eliminating examination errors. Such reforms would have not only local effects, but could help turn the vicious cycle into a virtuous cycle, making the entire patent system work better.

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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. Instead, years or even decades before, a patent applicant persuades a patent examiner that she is entitled to a patent. 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. 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.

Patent law’s examination model is an outlier even among forms of intellectual property. Patent rights vest only after examination, and trademark holders can choose to go through an examination procedure, but most forms of IP protection vest without examination, including copyright, trademark rights, trade-secret protection, and rights of publicity. And since plaintiffs in those regimes haven’t demonstrated in advance that they are entitled to IP rights, they generally must prove that entitlement when they file suit. So a copyright holder bringing an infringement case has to prove he or she created a work that is entitled to copyright, a company asserting a violation of its trade-secret rights has to prove that it took steps to keep information confidential, and so forth.

Why patent law uses this examination model, and whether it should do so, are fundamental questions in patent law. Scholars have advanced two principal explanations for patent law’s use of examination. The first is that examiners perform a substantive service—act as a substantive screen. This substantive screen does a few things. It separates deserving and undeserving applicants 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 to file for patents. It also helps improve the patents that are granted, since examiners review applications to make sure inventors have properly disclosed their inventions. 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 substance service. Instead, it posits that simply by making it more expensive to obtain patent rights, examiners act as a costly screen, discouraging applicants from seeking low-value patents. If it costs $30,000 to obtain a patent, then a rational actor will only apply for

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1 Some of these other forms of IP rights follow a registration model, requiring a rights holder to register a claim with the government but not submitting that claim to substantive examination. Others follow a decentralized or automatic-vesting model, in which enforceable rights exist without any government involvement. See infra notes 9–20 and accompanying text.

2 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, e.g., R. Polk Wagner, Understanding Patent-Quality Mechanisms, 157 U. Pa. L. Rev. 2135, 2138 (2009).
one if he or she expects to obtain at least $30,000 in benefits from having the patent. And since patent law allows a patent holder to capture privately much of the social value from an invention, at least for the duration of the patent term, the low-private-value patents that get screened out are also likely to be low-social-value patents 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. Moreover, courts often invalidate these patents when they are litigated—probably not as often as they should,3 but often enough to create uncertainty for patent holders and the public. Indeed, 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.4

The costly-screen theory could 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”5 or are only asserted in nuisance lawsuits.6 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.7 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.\footnote{http://www.rpxcorp.com/wp-content/uploads/2013/07/RPX%E2%80%99s-NPE-Cost-Study-results.pdf. 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 a claim is meritorious.}

Just pointing to flaws in each of these roles for patent examination would not make for an interesting article. All legal rules have good and bad effects; the hard part is maximizing the good while minimizing the bad. Both the substantive-screen and costly-screen roles provide benefits, and those benefits might be enough to justify patent law’s examination system. The problem, though, is that the flaws are worse than they seem at first glance, because the two roles interact in ways that reinforce those flaws. This article explores that interaction, which has not previously been recognized in the legal literature. It argues that while patent examination might act as a costly screen that discourages low-value patent applications, that effect cannot exist independent of examination’s role as a substantive screen. Instead, when the examination process grants low-quality patents, the value of the costly screen is undermined. And that effect, in turn, leads to more low-quality patent applications and low-quality patents, undermining the substantive screen.

In short, flaws in the substantive screen and the costly screen reinforce each other, leading to a vicious cycle of more and more low-quality patents. This effect has different causes in each direction. A flawed substantive screen weakens the costly screen because it results in more 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 doesn’t work. So the costly screen becomes less effective at discouraging patent applicants from applying for such low-value patents.

And in turn, the flawed costly screen undermines the substantive screen—makes the Patent Office worse at its job—because it results in more patent applications of all kinds. The Patent Office, 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 cost increase with the number of applications and examiners. Personnel costs increase because the marginal examiner will be lower-quality than the average examiner; the first 4,000 patent examiners will, inevitably, be better at their jobs than the second 4,000 examiners. Coordination costs increase because more examiners makes it harder to maintain consistency and update knowledge and procedures. And search costs increase because more prior art makes it harder to determine if an application claims a patentable invention. So the inadequate costly screen, which increases the number of patent applications, will also lead to a weakening of the substantive screen.

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, 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 Patent Office 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).

This article is structured in 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 has existed within the patent system in the last few decades. Part IV discusses the implications of the vicious cycle for patent policy and patent reforms.
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. 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 he or she invented something new. 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 claimed invention meets the patentability requirements. If the examiner doesn’t find any disqualifying prior art, he or she will grant the patent.

There is nothing inevitable about this examination model; several other forms of intellectual property follow other models. For instance, some types of intellectual property use a registration model, so that rights vest, or

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9 35 U.S.C. § 271(a) (2006); 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 patents or plant patents, though many of the arguments could extend to those areas. See 35 U.S.C. § 161 (2006) (plant patents); 35 U.S.C. § 171 (2006) (design patents).


12 Trademark law also follows an examination model, at least with respect to federal 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 (2006) (describing the application process); 15 U.S.C. § 1052 (2006) (describing grounds on which an examiner can deny registration); Trademark Manual of Examining Procedure § 704 (describing the initial examination of a trademark application).

13 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 (repealed 1870) (requiring the Commissioner of Patents to provide for examination of patent applications).
are 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 his or her entitlement when enforcing those rights. In copyright law, for instance, an author is entitled to a copyright the moment he or she creates an “original work[ ] of authorship fixed in any tangible medium of expression,” 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. 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.

Copyright-like protections for mask works (the three-dimensional patterns that define a semiconductor chip) and boat hulls similarly use a registration model. Other types of intellectual property use a decentralized or automatic-vesting model, in which IP rights come into existence, and can be enforced, without any registration or examination by a government official. Trademark protection, for instance, generally applies to confidential information that derives its economic value from that confidentiality; if a third party misappropriates that information, it can be held liable even though there is no centralized registration or examination of potential trade secrets. Similarly, rights of publicity arise without examination or registration. And although trademark holders gain benefits from registering their marks,

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14 17 U.S.C. § 102(a) (2006); see also 17 U.S.C. § 201(a) (2006) (“Copyright in a work protected under this title vests initially in the author or authors of the work.”).

15 See generally 17 U.S.C. § 411 (2006) (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 this title”); 17 U.S.C. § 408 (2006) (describing the copyright-registration system).

16 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.” 17 U.S.C. § 410(a) (2006). This review, however, is largely perfunctory.


19 See, e.g., Cal. Civ. Code § 3344 (“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.”)
basic trademark rights are based on use, not examination or registration, under both federal law and most states’ laws.\textsuperscript{20}

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 they impose. 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 have been obvious to someone skilled in the art, then the patent examiner should refuse to grant a patent. This prevents a patent applicant from claiming a monopoly when he or she did not contribute anything meaningful to the world, protecting the public from spurious patent claims.\textsuperscript{21} 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 sur-

\textsuperscript{20} See, e.g., 15 U.S.C. § 1125(a) (providing liability for the use of a mark in a manner that is likely to cause consumer confusion, regardless of registration); 3 McCarthy on Trademarks ch. 22 (4th ed. 2013) (discussing state trademark protections).

vive in court. This makes it easier and less risky to invest in developing commercial products based on patented technology.

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 aim to ensure an invention is fully and clearly disclosed to the public. As the Federal Circuit observed, “[a]n 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.”

Examination can have this effect both because applicants know in advance that an examiner will review an application for compliance with these doctrines, and so have an incentive to make a clear disclosure, and because the examination process often turns into a negotiation between the applicant and examiner that refines the patent and its claims.

The substantive explanation almost certainly has some merit; patent examiners reject many patent applications, and it would be shocking if an agency that employs nearly 8,000 patent examiners were effectively throw-

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22 See, e.g., William Callyhan Robinson, 1 The Law of Patents for Useful Inventions § 49 (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”).


24 Specifically, examiners enforce the written-description, enablement, best-mode, and definiteness requirements. See generally Ford, supra note 3, at 79–80.

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


27 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) (citing sources).
At the same time, most patent scholars agree that there is a patent-quality problem, with examiners doing an imperfect job of filtering out invalid patents and approving clear and unambiguous claims. It is hard to know the full scope of this problem, since most patents are never litigated or otherwise contested. But the empirical evidence is indicative of a quality problem. For one thing, nearly half of litigated patents that make it to a final judgment are invalidated. 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. Yet there is little reason to think that the world has become three times as innovative in that time. Instead, the more-likely explanation is that rent seekers who have invented little or nothing are seeking more and more patents, and that the Patent Office 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

30 See infra notes 86–90 and accompanying text.
31 John R. Allison & Mark A. Lemley, Empirical Evidence on the Validity of Litigated Patents, 26 AIPLA Q.J. 185, 205–07 (1998). It’s 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 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 (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).
32 See infra notes 86–90 and accompanying text.
33 Cf. Zvi Griliches, Patent Statistics as Economic Indicators: A Survey, 28 J. Econ. Lit. 1661 (1990); [others].
why the applicant is not entitled to a patent. So rejecting a patent application takes more work than granting it. 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. 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 on the number of patents they grant. 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 non-patent prior art. 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.

**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 patent itself plays a valuable role in the patent system, even if examiners contribute nothing substantively. The theory is straightforward. Obtaining a patent is not free; it can cost $20,000 to $30,000 for a typical patent, in attorney’s fees, PTO filing fees, and inventors’ time. A rational patent applicant

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37 See Ford, supra note 3, at 89.
40 See, e.g., Fagundes & Masur, supra note 6, at 689–90 (estimating that “an average patentee will spend approximately $22,000 to successfully prosecute a patent application”); Lemley, supra note 4, at 1498 & n.13 (estimating that “the 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.
would apply for a patent only when the expected private value of doing so exceeds this cost: when he or she expects to gain more than $20,000 or $30,000 in royalties, monopoly profits, or other benefits from having the patent. 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.

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

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 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. 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. But the costly screen still reduces the number of

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41 These other benefits can include indirect financial benefits like signaling innovation to potential investors, see Annamaria Conti, Jerry Thursby & Marie C. Thursby, Patents as Signals for Startup Financing, LXI J. Ind. Econ. 592 (2013), and include non-financial benefits, see Jeanne C. Fromer, Expressive Incentives in Intellectual Property, 98 Va. L. Rev. 1745 (2012).

42 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 was costless for applicants.

43 See generally Fagundes & Masur, supra note 6, at 692–705.

44 See id. at 700–704.

45 See id. at 695–96.
such patents that are granted, so even if it does not filter out all problematic patents, it could still act as a useful tool to reduce the problem.

There are two significant objections to the costly-screen explanation for patent law’s examination model. First, it seems 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. And second, the costly screen doesn’t seem to be having the effect it should. Most 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 patents. 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.46

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

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

II. PATENT EXAMINATION’S VICIOUS CYCLE

This part discusses the interaction between patent examination’s roles as a substantive screen and a costly screen. The basic argument is that

46 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 2011–12, at 26–35 (concluding that patent lawsuits brought by nonpracticing entities have cost defendants a half trillion dollars, without meaningfully increasing the incentive to innovate).
flaws in examination’s two roles reinforce each other, leading to a vicious cycle of weaker and weaker patent examination.\textsuperscript{47}

The flawed substantive screen ends up weakening the value of examination as a costly screen, because it increases the value of applying for an invalid patent. Since essentially \textit{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—examination ends up deterring fewer and fewer patent applications, reducing the effectiveness of the costly screen. The main driver of a potential applicant’s decision-making, then, is whether an examiner is likely to grant \textit{some} patent. And the weakened costly screen, in turn, further weakens the substantive screen since it means that the Patent Office has to handle many more patent applications. Like any large organization, the Patent Office cannot scale 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.

\textsuperscript{47} 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.” \textit{Vicious cycle}, Oxford English Dictionary, http://www.oed.com/ (draft addition Dec. 2013).
This part is organized into two subparts. Part II.A explains how the flawed substantive screen undermines the costly screen—as shown in the top arrow in Figure 1. Part 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 he or she is legally entitled—only when he or she has invented something new, useful, and nonobvious.48 When examiners perform this task correctly, all is well; inventors are precisely the people who are supposed to enjoy the benefits of a patent monopoly.49 It’s when examiners fail at that task that things get more com-

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48 35 U.S.C. §§ 101–02 (2006). These are not, of course, the only requirements to obtain a patent, but they are the most basic.

49 I set aside the issue of whether the 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, and such a system would undoubtedly produce different outcomes in some cases than the current patent law, even setting aside implementation mistakes in the current system. But errors that come from misapplying patent law are a qualitatively different problem, since they can (and, in many cases, do) allow applicants who haven’t invented anything to obtain patent protection, and since they could, in theory, be corrected.
plicated. These flaws in the substantive screen end up weakening the value of examination as a costly screen because they increase the incentive to apply for a weak patent and the expected value of a weak patent application.\textsuperscript{50} 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, with examination outcomes representing an unreliable indicator of whether a patent applicant is entitled to a patent. Though it’s 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 aren’t legally entitled to a patent.\textsuperscript{51} There are different explanations for why examiners cannot or do not perfectly sort deserving from undeserving patent applications: examiners may lack the incentives, or the time, to act as perfect screeners, or it may just be an impossible task to perform at the scale of the modern patent system.\textsuperscript{52} But the bottom line is that examiners routinely grant patents on inventions that probably should not be patented. And these likely invalid patents include many that are routinely licensed and enforced in court.\textsuperscript{53}

\textsuperscript{50} 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, for a few reasons. First, patent applications often bear little resemblance to the patents they eventually lead to. It’s hard to predict, then, how broad or narrow the claims an examiner will approve.


\textsuperscript{52} See generally Ford, supra n.3, at 88–89.

\textsuperscript{53} Nearly half of all patents that are litigated to a final judgment, for instance, are invalidated. John R. Allison & Mark A. Lemley, Empirical Evidence on the Validity of Litigated Patents, 26 AIPLA Q.J. 185, 205–07 (1998). It is, of course, hard to conclude much about patents generally based on this statistic, given the different selection effects that determine what patents are litigated and what litigations go to final judgment. See generally George L. Priest & Benjamin Klein, The Selection of Disputes for Litigation, 13 J. Legal Stud. 1 (1984).
The second factor is that prosecuting a patent application is relatively inexpensive. There are two components to that cost: the administrative fees charged by the Patent and Trademark Office 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.\footnote{U.S.P.T.O., \textit{Fee Schedule Effective January 1, 2014}, http://www.uspto.gov/web/offices/ac/qs/ope/fee010114.htm (last revised Aug. 15, 2014).} If the examiner concludes that the applicant is entitled to a patent, add an issuance fee of $240 to $960.\footnote{Id.} Other fees are assessed for things like deadline extensions or unusually large applications,\footnote{Id.} but in general it is hard for a routine patent application to rack up more than a few thousand dollars in PTO fees.\footnote{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. U.S.P.T.O., \textit{Performance & Accountability Report: Fiscal Year 2013} at 77–78, available at http://www.uspto.gov/about/stratplan/ar/USPTOFY2013PAR.pdf (reporting earned revenue of $2.7199 billion, of which 90.4% was attributable to the patent side of the ledger). In calendar 2013, the agency received 609,052 patent applications of all kinds and granted 302,948 patents. U.S.P.T.O., \textit{U.S. Patent Statistics Chart Calendar Years 1963–2013}, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm (last accessed Aug. 19, 2014). The agency’s fee revenue, then, on an ongoing basis, was about $4,000 per application and $8,100 per patent. This doesn’t 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.} As discussed above, add in attorney fees, and a typical patent will cost $20,000 to $30,000 to obtain.\footnote{See supra note 40 and accompanying text. One patent lawyer estimated in 2011 that attorney fees for a typical patent application could vary from $5,000 to $7,000 for an “extremely simple” invention like a coat hanger or ice-cube tray to more than $15,000 for a “highly complex” invention like an MRI scanner or networking system. Gene Quinn, \textit{The Cost of Obtaining a Patent in the US}, IPWatchdog (Jan. 28, 2011, 1:14 PM), http://www.ipwatchdog.com/2011/01/28/} 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 the patent 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, \textit{ex ante}, 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. Another source of value is the cost of litigating patent-infringement claims. Patent litigation is notoriously expensive, with typical cases costing millions of dollars in legal fees and expenses.

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. Accordingly, a patent holder will bring a case not only when it expects that the court would award damages greater than the cost of bringing the case, but 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, \( d \) 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 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

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59 See, e.g., Mark A. Lemley & Carl Shapiro, Probabilistic Patents, 19 J. Econ. Persp. 75 (2005).

60 Under the standard model of settlement, rational litigants settle disputes to avoid litigation costs. Since the cost of defending even a frivolous patent suit is often in the hundreds of thousands of dollars, see infra note 67 and accompanying text, in the absence of fee shifting or a threat of sanctions, in many cases both sides will rationally settle for $100,000 or more. See, e.g., Amy Farmer & Paul Pecorino, Dispute Resolution, in The New Palgrave Dictionary of Economics (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 (2006).

61 This point is worth explaining. A patent applicant may not know, ex ante, what the set of potential defendants will look like when the patent is granted, 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.
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, for instance because $p_d$, 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 $p_dr_d - c_d$—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’s fees in exceptional cases. Until recently, this provision was mostly toothless, but in April 2014, the Supreme Court gave district courts broader discretion to award attorney’s fees in patent cases. 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.

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63 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); Brooks Furniture Mfg., Inc. v. Dutailier Int’l, Inc., 393 F.3d 1378, 1381 (Fed. Cir. 2005).

64 See Octane Fitness, LLC v. ICON Health & Fitness, Inc., 572 U.S. ___, 134 S. Ct. 1749, 1756-58 (Apr. 29, 2014) (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,” and rejecting the Federal Circuit’s Brooks Furniture test); Highmark Inc. v. Allcare Health Mgmt. Sys., Inc., 572 U.S. ___, 134 S. Ct. 1744, 1748-49 (holding that district-court determinations under § 285 should be reviewed for abuse of discretion, not de novo).

65 See generally 35 U.S.C. § 282(a) (requiring that patents be “presumed valid”); Microsoft Corp. v. i4i Ltd. P’ship, 131 S. Ct. 2238, 2240 (2011) (holding that this presumption may be rebutted only by clear and convincing evidence); Doug Lichtman & Mark A. Lemley,
This presumption makes it easier 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 patent office frequently grants weak patents, the expected value of applying for a weak patent can also be substantial. But 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. And that expected value would be 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

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

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 $p_A$ is nonzero even for a weak application. The second factor, the low cost of prosecuting a patent application, means that $c_A$ is insubstantial compared to the potential value of the patent. And the third factor, the value of a granted patent, means that the summation term is 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 Patent Office effectively filtered deserving from undeserving applications; $c_A$ is smaller than it would be if applying for a patent was expensive; and the summation term is large because the nuisance value, $nv_d$, is substantial even for a weak patent.

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How does this 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 numbers into concrete terms. The cost of prosecution a patent application, \( c_A \), is on the order of $20,000 to $30,000. But the cost of litigating a patent case is much greater—frequently hundreds of thousands of dollars even in low-stakes cases. 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. Even if the nuisance value of a claim against a particular defendant, \( n_v_d \), is less than $100,000, however, when aggregated across multiple defendants, the expected value of a weak granted patent, \( \sum \max[n_v_d, p_d r_d - c_A] \), can be hundreds of thousands or millions of dollars, depending on the industry—well more than a \( c_A \) of $30,000.

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 the decision to grant the patent was correct. If there were an easy method for figuring this out, then examination would be reliable; examiners could just turn to that method. And though economists and legal scholars have proposed different measures of patent quality, many of them focus on factors other than whether the Patent Office was correct or not to grant a patent. But if the cost of prosecution a patent application, \( c_A \), is $30,000, and the value of the patent, once granted, is $150,000—a reasonably conservative order-of-

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66 See supra note 40 and accompanying text. This number might be falling, as clients increasingly demand flat-fee and bulk-rate patent-prosecution services. See, e.g., Gene Quinn, The Strange Case of the Vanishing Patent Boutiques, IPWatchdog (Apr. 6, 2010, 3:55 PM), http://www.ipwatchdog.com/2010/04/06/.

67 See, e.g., Am. Intellectual Prop. Law Ass’n, Report of the Economic Survey 2011, at I-153 to I-154 (2011) (finding, based on a survey of patent lawyers, that the median cost of litigating a case through trial was $650,000 for each side in patent cases with less than $1 million at stake, and $5 million for each side when more than $25 million was at stake).

magnitude estimate in many industries—then the probability of obtaining a patent, \( p_A \), just has to be over 20% for applying for a weak patent to be worthwhile. And, as discussed above, there are good reasons to suspect that the examination process is systematically flawed, 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 becomes less valuable 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, like 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**

There is also an effect in the reverse direction. As patent examination becomes a less-effective costly screen, more and more people apply for patents, invalid and otherwise. And that, in turn, further reduces the reliability of patent examination, making it worse as a substantive screen. The patent system, like any large bureaucracy, cannot scale indefinitely without losing efficiency—the law of diminishing returns applies to hiring within an organ-

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69. In the information-technology industries, for example, numerous patent portfolios have been sold for six figures per patent. E.g., Chris V. Nicholson, Nortel Sells Last Patent Assets for $4.5 Billion to Alliance Including Apple and Microsoft, N.Y. Times (July 2, 2011) (reporting the sale of more than 6,000 telecommunications patents for $4.5 billion, approximately $750,000 per patent); Steve Lohr, Microsoft’s AOL Deal Intensifies Patent Wars, N.Y. Times (April 10, 2012) (reporting the sale of 800 internet-technology 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 be represent the value of Motorola’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 their nuisance or enforcement value. But one telling portfolio sale is Round Rock Research’s purchase of 20% of Micron Technology’s patent portfolio. Round Rock is a litigation-focused non-practicing entity that reportedly paid $400 million for 4,500 Micron patents—about $90,000 per patent. Patrick Anderson, Micron Retains Interest In Round Rock Patent Monetization Proceeds, Gametime IP (May 9, 2012), http://gametimeip.com/2012/05/09/micron-remains-interest-in-round-rock-patent-monetization-proceeds/. 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).

70. See supra notes 27–38 and accompanying text.
ization like it does anywhere else\textsuperscript{71}—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 inefficiencies that increase as the number of applications and examiners increase. These inefficiencies stem from increasing personnel costs, coordination costs, and research costs.

\textit{Personnel costs.} As applicants file more patent applications, the Patent Office has to hire more examiners, which, all else being equal, will lead to lower-quality examination. The Patent Office is a huge agency, with nearly 12,000 employees, including more than 8,000 patent examiners.\textsuperscript{72} And examiner turnover is fairly high, so the office hires a lot of examiners each year.\textsuperscript{73} The more examiners have to be hired each year, the harder this task will be. As a result, as the number of applications and examiners increases, the average quality of examination will necessarily fall, unless the Patent Office devotes greater resources to the problem.

This talent dilution stems from the sheer size of the Patent Office. An organization that hires 500 new employees in a year can select the 500 best applicants (or the 500 best applicants who will accept an offer), but if that organization has to hire 1,000 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 Office has to hire 500 examiners, it can hire only “A” candidates, but if it has to hire 1,000 examiners, it will have to dip into the pool of “B” and maybe “C” candidates for the second 500 hires. Overall quality, then, will suffer.

This quality difference between hires can manifest itself 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,


\textsuperscript{73} Historically, most examiners left the Office after less than three years. \textit{See}, \textit{e.g.}, John Schmid, \textit{Turnover troubles agency: Workload, low pay keep doors revolving}, Milwaukee Journal-Sentinel (Aug. 17, 2009). In recent years, however, the Office has reduced turnover, in part by giving examiners the flexibility to telework. \textit{See} U.S.P.T.O., \textit{Performance & Accountability Report}, supra note 57, at 4.
increasing $p$. 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 attorney fees. This can have a salutary effect: by increasing the cost of obtaining a patent, $c_p$, 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.74

The Patent Office could overcome these effects by investing greater resources into the examination process—whether by paying examiners more to attract better applicants, or hiring more examiners to process fewer applications each. But those measures can only do so much; if I am right that there is a vicious cycle making examination worse, then the Patent Office can only increase personnel costs so much before it becomes financially unsupportable.75

Coordination costs. As applicants file more patent applications, and the Patent Office hires more examiners, the Office’s coordination costs will also increase. Indeed, this is the traditional explanation for diminishing returns as an organization expands.76 As the size of an organization increases, so too do the number of decision-makers, the number of people who have to be consulted on a decision, and the number of people to whom a decision must be communicated. Past a certain organization size, the sheer number of connections between people overwhelms gains from specialization, and the costs of making and implementing decisions begins to rise as the organization grows larger.77

74 See infra at _____.
75 The PTO is funded through fees paid by patent holders and applicants. See 35 U.S.C. § 42. Though Congress could, of course, make up any shortfall in the PTO’s budget due to 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 it additional money. See, e.g., 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, 2065–67 (2009).
76 See Ehrenberg & Smith, supra note 71, at 65.
These increasing coordination costs mostly occur not at the examiner level—patent examination is largely an independent, parallelizable activity that involves one examiner per application, not a team that must coordinate—but at the management levels. 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, which are charged with coordinating patent examination across nine technology centers, establishing patent-examination policies and procedures, monitoring patent quality, reviewing and responding to changes in patent law from courts and Congress, and managing the Office’s resources and strategic planning. All these decisions take time and involve numerous workers, and as the PTO grows, they 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 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. 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.

Research costs. Finally, as applicants file more patent applications, and more patents are granted, the Office’s research costs will also increase. Patent examination is fundamentally a research job: the most important thing examiners do is comparing applications to the prior art to determine if ap-
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 is.

Searching for prior art is a labor-intensive process. In a typical prior-art search, the searcher will look for similar patents and patent applications issued by or filed in the United States Patent and Trademark Office, the European Patent Office, and the Japan Patent Office. Depending on the scope of the search and the searcher’s diligence, he or she may also search other international patent offices, or may search for non-patent prior art in various databases of engineering and scientific research. Prior-art searches are done both by patent examiners and by private attorneys, trying to determine if a patent is likely to survive litigation or trying to find prior art to invalidate it. In the private sector, prior-art 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 run $10,000, $20,000, or more. And that’s just to identify potentially relevant prior art, not to analyze the prior art to see if it invalidates a patent claim. That second step can require dozens or hundreds of hours of attorneys’ and experts’ time.

Searches performed by patent examiners are necessarily more cursory than those performed by litigants, since examiners have far less time and since a comprehensive search is only cost-effective when a patent is important enough to be litigated. But both kinds of searches are subject to the same fundamental constraint: the difficulty and time required to conduct a prior-art search varies 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 figure out if an invention is patentable in view of that prior art. So if examination’s role as a costly screen is weakened, 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 absolute. As I discuss below, the Patent Office has ways to combat increasing personnel costs, coordination costs, and research costs. But those ways are themselves costly, and they can only

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

82 See generally Lemley, supra note 4.

83 See infra Part IV.C.
reduce the problem, not eliminate it completely. And the patent system is growing so quickly that scale effects are likely inevitable, so it is worth paying attention to their consequences.

III. TESTING THE VICIOUS CYCLE

If I am right that examination’s roles as a substantive screen and a costly screen interact to create a vicious cycle, then we should see evidence of the cycle in the patent system. And although many of the predicted effects of the vicious cycle, like a reduction in the reliability of patent examination, are hard to measure, others are borne out by the data. This section takes a preliminary look at that empirical evidence. It first reviews some testable hypotheses that follow from the vicious-cycle theory. It then reviews some empirical data suggesting that the theory may be playing out in the real world.

A. Testable hypotheses

The vicious-cycle theory predicts broad changes to 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 patent-examination system. If applicants apply for more and more patents, with applications of lower and lower quality, then we should expect to see the numbers of patents and patent applications increasing over time. We should also see corresponding growth in the number of patent examiners. These predictions should be true even when correcting for other factors that could cause there to be more patents and patent applications, like population growth, the increasing globalization of the patent system, and increasing amounts of innovation.84

84 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. But the link between innovation and patent activity is uncertain at best, and if I am right that patent examination leads to a vicious cycle, then that is another reason to be skeptical of innovation metrics that rely on patents. See, e.g., 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.”); Daniele Archibugi & Mario Pianta, Measuring Technological Change Through Patents and Innovation Surveys, 16 Technovation 451 (1996); Zoltan J. Acs & David B. Audretsch, Patents as a Measure of Innovative Activity, 42 Kyklos 171 (1989); 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
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 Patent Office 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 or invalid.\(^{85}\)

Third, the theory makes predictions about the behavior of litigants in patent-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. 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 early by plaintiffs, walking away from lawsuits when it looks like defendants may not be willing to settle early.

B. Some empirical evidence

Some of the predictions discussed in the last section are more amenable than others to testing, and this represents only a preliminary examination of some readily available data. Still, empirical data is 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, that the vicious-cycle theory is correct, or that examination quality is falling. But they suggest promising avenues for further inquiry.

\(^{85}\) Several studies have examined indicators of patent value and, of course, 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 later patents. See, e.g., David S. Abrams, Ufuk Akcigit & Jillian Popadak, Understanding the Link between Patent Value and Citations: Creative Destruction or Defensive Disruption?, U. Pa. Inst. for Law & Econ. Research Paper No. 13-23 (Nov. 5, 2013), available at http://ssrn.com/abstract=2351809; Manuel Trajtenberg, A Penny for Your Quotes: Patent Citations and the Value of Innovations, 21 RAND J. Econ. 172 (1990). 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., Lemley & Shapiro, supra note 59; Kimberly A. Moore, Worthless Patents, 20 Berkeley Tech. L.J. 1521 (2005); John R. Allison, Mark A. Lemley, Kimberly A. Moore & R. Derek Trunkey, Valuable Patents, 92 Geo. L.J. 435 (2004). But these factors just predict value in the aggregate; they cannot tell us whether an individual patent is likely to be held valid or not. To determine that, there is no efficient substitute for a costly prior-art search and expert evaluation.
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 per year and the number of examiners have grown tremendously. The number of utility patents granted grew from 56,860 in 1983 to 277,835 in 2013.86 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 8.8.87 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.88 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.

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88 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 U.S.P.T.O., supra note 86; U.S. Census Bureau, Historical National Population Estimates, supra note 87; U.S. Census Bureau, Monthly Population Estimates for the United States, supra note 87.
Consistent with the growth in patent grants, there has also been a consistent growth in the number of examiners, going from 3,061 at the end of the PTO’s fiscal year 2001 to 7,831 at the end of 2012.

There are several possible reasons for these trends, including some optimistic explanations. One important possibility is that the United States

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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 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 so forth. 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. It is also possible that firms have become more sophisticated about protecting intellectual-property rights to legitimate innovations that would have existed before, just without patent protection.

This trend is also consistent with a pessimistic explanation, though: 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. This explanation 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 we can examine some indirect measures to see if we observe 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 patent office has nearly tripled the size of its examiner corps over the last decade, the average workload per examiner has fallen in that time, with each examiner handling fewer patents per year. Despite this decreased workload per examiner, applications have taken longer to process, with the average application pendency increasing in that time. In 2001, for instance, the average patent examiner was responsible for 107.0 patent applications and 54.6 granted patents. By 2012, however, those numbers had

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declined to 69.5 applications and 32.5 grants.\textsuperscript{92} These trends are shown in Figure 3.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure3.png}
\caption{Patent applications and patent grants per examiner per year, 2001–2012. Figures include utility, reissue, and plant patents, and exclude design patents.\textsuperscript{93}}
\end{figure}

One possible explanation for this trend would be if the Patent Office were hiring additional examiners to cut down on the backlog of patent applications—a stated goal of the Office.\textsuperscript{94} If examiners are spending more time clearing out the backlog, then that would 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 had more time to spend on each patent application, the average pendency of patent applications has increased, from 25.0 months in 2000 to 32.4 months in 2012 (and 35.3 in 2010). This trend is shown in Figure 4.

\textsuperscript{92} This trend appears to have begun in the early 2000s. Polk Wagner observed the beginning of it in a 2009 article. Wagner, \textit{supra} note 2, at 2159 fig. 4.

\textsuperscript{93} Application and grant data were taken from U.S.P.T.O., \textit{U.S. Patent Statistics}, \textit{supra} note 57. Examiner data was taken from the PTO’s annual \textit{Performance and Accountability Reports}, which are available at \texttt{http://www.uspto.gov/about/stratplan/ar/}.

As with the numbers of patent grants and examiners, both optimistic and pessimistic accounts of these trends are possible. The optimistic account 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. And there may be some truth to this account, since the data appears 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 an application workload of 107.0 applications per examiner in 2001 corresponds to 18.7 hours per application, an estimate that is largely consistent with past reports of the time an examiner spends on a typical application. But by 2012, with each examiner was responsible for 69.5 applications, each examiner could devote 28.8 hours to each application—a 54% increase in the time available to be spent on 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 examination. Lower-quality examiners, for instance, might need more time to perform the tasks

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**Figure 4: Average application pendency, 2000–2012.** The dotted line shows average pendency, in months, for all utility-patent applications, while the solid lines show trends for individual technology centers. 

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95 Pendency data is from *id.*

96 See, e.g., Lemley, *supra* note 4, at 1500 (estimating that examiners spend an average of about 18 hours on a patent application, and citing sources).
of patent examination. And even if the extra time were enough to make up for a lower-quality corps of examiners, it would represent a substantially higher personnel cost for the Patent Office. 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 vicious-cycle theory. Of course, as others have observed, the sheer number of patent cases has increased substantially in recent decades; for instance, in 2000, 2,295 patent cases were filed in federal district courts, while by 2013 that number had almost tripled, to 6,062 cases.97

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 non-practicing entities end within six months of filing.98 They thus provide a useful proxy for lawsuits brought with low-quality patents.

To determine if 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 2013.99 For each case in the dataset, the time from filing date to termination, as indicated by PACER, was calculated. A categorical dependent variable was constructed 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 had not yet been terminated. A logistic regression was performed with the independent variable equal to the filing date and the categorical dependent variable.

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98 RPX Corp., 2013 NPE Litigation Report, supra note 7, at 37.

99 The dataset was kindly provided by Lex Machina. See supra note 97.
The results indicate a slight, but statistically significant, increase over time in the proportion of cases that were terminated within 180 days.\textsuperscript{100} This increase is shown in Figure 5.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure5}
\caption{Quickly terminated cases, 2000–2013. This figure 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 0.7\% per year.\textsuperscript{101}}
\end{figure}

There are different possible explanations for this trend. The explanation that is 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 America Invents Act has bolstered the trend by making it harder to sue numerous defendants in one case; if multiple defendants are named in one lawsuit instead of many, then that lawsuit will have a termination date cor-

\textsuperscript{100} The logistic-regression estimated coefficient for the filing-date independent variable was $4.431 \times 10^{-5}$ per day, with $P(>|z|)=1.9 \times 10^{-11}$, statistically significant at the $p=0.01$ level.

\textsuperscript{101} This estimate is higher than the graph would appear to indicate because the later years, with greater increases, have more patent cases, and thus are weighted more heavily in the regression.
responding to the last defendant to resolve the case, rather than one termination date corresponding to each defendant. The trend, however, predates the Act, suggesting that it cannot account for the entire increase.

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It is important to emphasize the limitations of these findings. I am not aware of direct evidence that the Patent Office 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, as a way to extract rents from successful firms. The evidence also shows that even though the Patent Office has hired more and more examiners to keep up with that growth, examiners are less and less productive. And it shows 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 with a decline in patent quality.

IV. IMPLICATIONS AND REFORMS

The news is not all bad. One 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 depends on each step of the cycle, since any interruption would prevent the feedback loop from continuing. So a reform that affects any step in the cycle would have an effect on the rest of the cycle. In this cycle, there are four possible targets for reform: the flawed substantive screen and costly screen, and the factors that cause the flawed screens to undermine each other. These possible targets for reform are shown in Figure 6, an annotated version of Figure 1.
This flexibility is fairly straightforward. If reforms solved the problems with the substantive screen—so that an examination outcome was a reliable indicator of whether an invention was patentable or not—then 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 was more effective—if, for instance, the cost of obtaining a patent was 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 substantive screen and costly screen remain flawed, however, reforms to other elements of the patent system could likewise disrupt the vicious cycle because they could disrupt the causal links between the flawed screens. (These are designated by the two arrows in Figure 6.) For example, reforms that would reduce the value of low-quality patents, such as by making it harder to exploit them in nuisance litigation, would lead fewer applicants to seek 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 patent-examination system to scale would help main-
tain examination’s quality 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 subparts 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, though, would be difficult and may be impossible without massively increasing the cost of the patent system. And while improving the costly screen would be easy, since it just requires increasing the cost to obtain a patent, it would also deter applicants from seeking some high-quality patents.

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.\footnote{For just a few of the many pieces to this effect, see, e.g., Stephen Yelderman, Improving Patent Quality with Applicant Incentives, \_\_\_ Harv. J.L. & Tech. \_\_\_ (forthcoming); Mark A. Lemley, Can the Patent Office be Fixed?, 15 Marquette I.P. L. Rev. 295 (2011); Michael Meehan, Increasing Certainty and Harnessing Private Information in the U.S. Patent System: A Proposal for Reform, 2010 Stan. Tech. L. Rev. 1 (2010); 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); 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).} In general, 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 patents are never asserted and since it is hard to tell, ex ante, which patents will prove important.\footnote{See generally Lemley, supra note 4.}

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 of proposal is designed to provide application-specific information in each examination, for instance by requiring applicants to submit the results of commercial prior-art searches.\footnote{See Marc S. Adler, Defining the Invention: Searching Before Filing, President’s Column, http://ipoa.typepad.com/presidents_column/2006/07/defining_the_in.html (July 26, 2006) (proposal by the president of the Intellectual Property Owners Association). Both Congress and the Patent Office have also considered this approach. See Notice of Public Hearing and
prior-art information from third parties, for instance by crowd-sourcing prior-art searches or by facilitating post-grant review of granted patents. 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.

All of these reforms could undoubtedly help improve the substantive screen, though just how much progress can be made is unclear. There are reasons to think that the 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 deals with 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 most-important decisions right. But

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107 E.g., Mark Lemley, Doug Lichtman & Bhaven Sampat, What to Do about Bad Patents?, 28 Regulation 10 (Winter 2005–06) (proposing that applicants could pay for a more-detailed patent examination and obtain a “gold-plated” patent).
because patents are obtained early in the development cycles of new technologies, it is often hard to know whether an invention will be important.

**Fixing the costly screen.** Another set of proposals would work to improve patent examination as a costly screen. Unlike the substantive screen, fixing the costly screen is easy. 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 to just 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, I think there is a strong case to be made that Patent Office 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 $1,320; 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 between $400 and $7,400. If the nuisance value of a patent is $150,000, then these fees will not have a significant deterrent effect. A fee schedule that looked more like $10,000 at issuance, $100,000 after five years, $1 million after ten years, and $10 million after 15 years could do a much better job of deterring applicants from seeking low-value patents (and thus low-quality patents). And it could do so without having a significant effect on non-nuisance patents, since low-quality patent suits are disproportionately likely to be brought at the end of a patent’s life.

There are limits, of course, to how large patent fees should be. Patents are granted early in the development cycle to give inventors time to commercialize their inventions without being subjected to early competition, so

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109 *See supra* note 69 and accompanying text.

110 *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 (2013). 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 is time-dependent. 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.
fees should escalate over the course of the patent term.\textsuperscript{111} And if fees are too high, patent-holders will substitute into trade secrecy instead of patent protection, or into investing in non-patentable innovations, which could deprive society of new inventions and their public disclosure. Still, the most-valuable inventions (which are protected by the most-valuable patents) are precisely the ones least likely to be affected by dramatically higher Patent Office fees. Since these are the inventions society has the greatest interest in encouraging, it is possible that substantially higher Patent Office fees would have limited downsides.

C. Fixing the cycle

Other reforms would target the factors that cause flaws in the screens to propagate throughout the cycle. These reforms are less direct, since they do not target examination directly. They nevertheless could significantly temper the vicious cycle.

\textit{Reducing the effect of the flawed substantive screen.} One set of reforms would work to reduce the effects of flaws in the substantive screen. (These reforms would work to eliminate the top arrow in Figure 1 and Figure 5.) Flaws in the substantive screen propagate throughout the system because they increase the expected value of applying for a low-quality patent. Reforms that reduce the value of a low-quality patent, then, would cause fewer applicants to apply for such patents, reducing the effect of a 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 on 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 rules requiring patent-holders to include detailed infringement allegations or claim charts in complaints), or an enlarged filing fee for patent cases, 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. Both of these costs 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

\textsuperscript{111} 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, $1,600, $3,600, and $7,400. See U.S.P.T.O., \textit{supra} note 54.
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 faced disproportionately by defendants.\textsuperscript{112} 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.\textsuperscript{113} 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 be to 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.\textsuperscript{114} Similarly, changing the obviousness standard to make it easier for defendants to prove invalidity would reduce the value of a low-quality patent. And, notably, these reforms would only affect patents with borderline validity; high-quality patents would be largely unaffected.

Many of these reforms are usually thought of as 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 Patent Office’s workload, making it easier to devote resources to more-deserving patent applications. And they would improve the quality of the application pool, reducing the number of potential low-quality patents in the first place.

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 and Figure 5.) Flaws in the costly screen propagate throughout the system because they increase the number of patent applications, causing the Patent Office to ex-

\textsuperscript{112} Many patent plaintiffs, and especially patent “trolls” and others 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 United States law, such records are almost always discoverable in a patent-infringement suit.

\textsuperscript{113} See Ford, supra note 3, at 119–23.

\textsuperscript{114} This would change $p_v$ in the model discussed supra at Part II.A.
pand more quickly than it can while maintaining the quality of examination. These reforms, then, work to increase the scalability of the Patent Office.

One class of reforms would be to give patent examiners better tools, which, as discussed above, would help make examiners better at their jobs.\textsuperscript{115} 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 Patent Office 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 more interesting class of reforms would be to find ways to expand the size of the Patent Office without sacrificing quality, usually by finding new pools of potential examiners. The Patent Office 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.\textsuperscript{116} These programs have improved examiner retention and have opened up new pools of potential examiners who would not be willing or able to work in Alexandria, Virginia.\textsuperscript{117} 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.

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All of these reforms would have their individual direct effects, but they would also help improve the patent-examination system as a whole because they would reduce the feedback effect that leads to a vicious cycle.

\textsuperscript{115} See supra notes 104–106 and accompanying text.

\textsuperscript{116} See U.S.P.T.O., Performance and Accountability Report Fiscal Year 2012, supra note 90, at 51–52 (detailing the Patent Office’s telework program);

\textsuperscript{117} They would also bring numerous new examiners into the Patent Office, which may itself be good for patent quality. See 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, NBER Working Paper No. 20337 (July 2014) (finding that, upon promotion to jobs limiting the time available for examination, patent examiners become more likely to grant invalid patents).
**CONCLUSION**

Most patent scholars agree that low-quality patents are a substantial problem, with the Patent Office granting numerous patents that are likely invalid. Patent examination is supposed to prevent these patents from being issued, but examiners often grant low-quality patents. While some errors are likely inevitable in patent examination, this article suggests that patent examination may be trapped in a vicious cycle of worse and worse examination, as more applicants seek low-quality patents and the patent system struggles to keep up. Such a cycle is especially troubling since nuisance patents are playing an increasingly large role in the patent system.

The good news is that the same cycle that is making the problem worse also makes it easier to solve, since the cycle itself would propagate the effects of a reform 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).