Patent Scores

By

Roy Baharad[*] & Gideon Parchomovsky[**]

ABSTRACT

In this Article, we offer a new design for our patent system with a view to optimize its functioning. As multiple patent scholars have recognized, the root cause of the ills of our patent system is the high rate of low-quality patents. Extant patent law employs a binary screening process, under which inventions either qualify for protection or fail. Thereafter, all qualifying inventions are entitled to the same level of protection irrespectively of the degree of their novelty, utility and nonobviousness. As we establish throughout this Article, patent law's failure to distinguish among inventions based on their quality, greatly undermines the patent system's principal objective of optimally incentivizing and adequately rewarding innovative progress. Society, at least in principle, ends up paying the same price for all qualifying inventions, regardless of their level of innovation and improvement upon the prior art.

To address this problem, we advocate a fundamental, yet simple, reconceptualization of patent law. Instead of utilizing a threshold-based regime under which the USPTO merely decides whether an invention is patentable, we introduce a mechanism of Patent Scores. According to our proposal, once the USPTO determines the eligibility of a given invention to patent protection, it would proceed to assign it a score – on a 1-to-5 scale. A score of 1 would be given to the lowest quality patents and a score of 5 to the highest. The score of a patent would determine, among other things, its protection term. In contrast to the current system that entitles all eligible inventions to 20 years of exclusivity, the protection term under our proposal would vary based on the patent score. This change alone would dramatically reduce the slew of problems associated with bad patents.

As importantly, Patent Scores would be known to potential licensees, industry participants and courts. The information represented by the scores would eliminate or significantly ameliorate the abuses that arise under the present patent system. The adoption of Patent Scores would curtail the market power of patentees vis-à-vis users, attenuate the problem of trolling, reduce litigation and enhance cumulative innovation. It would also improve the examination process by equipping the USPTO with a more precise metric for evaluating the work product of patent examiners. Thus, implementation of our proposal would lead to a fairer and more efficient patent system.

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[*] Doctoral Candidate, University of Chicago Law School; Aumann-Fischer Fellow for Law, Economics and Public Policy, Faculty of Law, The Hebrew University of Jerusalem.

[**] Robert G. Fuller, Jr. Professor of Law, University of Pennsylvania Law School; Edward Silver Professor, Faculty of Law, The Hebrew University of Jerusalem. We thank Shiri Alon, Ronen Avraham, Tom Baker, Jonathan Barnett, Cary Coglianese, Laura Dolbow, David Gilo, Yehonatan Givati, Ehud Guttel, Uri Hacohen, Assaf Hamdani, Sharon Hannes, Lital Helman, Dave Hoffman, Ehud Kamar, Yotam Kaplan, Kobi Kastiel, Jon Klick, Moshe Koppel, Tamar Kricheli-Katz, Shay Lavie, Daniel Levy, Yair Listokin, Aaron Nielson, Shmuel Nitzan, Alan Schwartz, Peter Siegelman, Alex Stein, Andrea Tosato, Yanbai Andrea Wang, Sarit Weisburd, Tobias Wolff, Omri Yadlin, Christopher Yoo, Eyal Zamir, David Zaring and seminar participants at ALEA, Federmann Center for the Study of Rationality, Tel Aviv University, University of Pennsylvania, and the Yale-Hebrew University Law and Economics Conference for useful comments and suggestions. Ruoyu Ji, Ariel Melitz, Jeremy Rapaport-Stein and Amir Tzur provided superb research assistance.

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INTRODUCTION

In this Article, we propose a genuine reform of our patent system that would dramatically improve its functioning and increase the rate and quality of innovation in our society. Under extant patent law, any invention that satisfies the requirements of novelty,[1] usefulness,[2] and nonobviousness,[3] is eligible for 20 years of patent protection measured from the day of its filing, irrespectively of its quality. As we will show, the failure to distinguish among low- and high-quality inventions is the root cause of the main ailments of our patent system. Indeed, the "one size fits all" approach according to which all patentable inventions are treated alike, largely undermines the patent system's principal objectives of optimally incentivizing and adequately rewarding innovative progress.[4] Not only does society reward all inventors irrespectively of the quality of their contributions, but also the current regime provides scant information to the market. Since roughly 50% of all litigated patents are invalidated in litigation,[5] the review process leaves potential users, improvers and competitors in a sea of uncertainty about the validity of the patents in which they are interested or that are being asserted against them.

To remedy these problems, we advocate a fundamental reconceptualization of the review process of patent applications. Instead of the threshold-based regime under which the U.S. Patent and Trademark Office (USPTO) merely

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[1] 35 U.S.C. § 102 (2006).

[2] 35 U.S.C. § 101 (2006).

[3] 35 U.S.C. § 103 (2006).

[4] For previous accounts that highlight the drawbacks of the uniform working standards of patent law see, e.g., Abraham Bell & Gideon Parchomovsly, *Reinventing Copyright and Patent*, 113 MICH, L. REV. 231, 234 (2014) ("For some creations, the uniform statutory remedies are too generous. These uniform remedies therefore encourage inefficient use of the legal system in instances where voluntary bargaining would have been superior. In other cases, the remedies deter nonconsensual use that would be optimal."); Dan L. Burk & Mark Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1576-77 (2003) ("In theory, […] we have a uniform patent system that provides technology-neutral protection to all kinds of innovation. Technology is anything but uniform, however, and it displays highly diverse characteristics across different sectors."); Michael W. Carroll, *One Size Does Not Fit All: A Framework for Tailoring Intellectual Property Rights*, 70 OHIO ST. L.J. 1361, 1364 (2009) ("[T]he problem of "uniformity cost"—the social cost attributable to the lack of fit between our innovation goals and the blunt means of one-size-fits-all patents and copyrights—is at the heart of most contemporary problems with intellectual property law."). *Cf.* STEVEN SHAVELL, FOUNDATIONS OF ECONOMIC ANALYSIS OF LAW 154 (2004) ("The uniform nature of the duration of patents stands in significant contrast to the highly elaborated legal consideration given to whether to award patents to their proper scope. One suspects, therefore, that the fixed twenty-year patent length could be improved.").

[5] *See, e.g.,* John R. Allison et al., *Our Divided Patent System*, 82 U. CHI. L. REV. 1073, 1100 (2015) (finding invalidity rate of 42.6% between the years 2008 and 2009); Paul R. Gugliuzza, *(In)valid Patents*, 92 NOTRE DAME L. REV. 271, 272 (2016) ("The PTO may issue a patent only if, in its view, the patent satisfies the requirements of the federal Patent Act. In a subsequent lawsuit involving that patent, however, a court can declare the patent to be invalid, which happens in nearly half of all patent cases litigated to a final judgment on the issue of validity.").

decides whether an invention is patentable, we call for the adoption of a step-based mechanism of *Patent Scores*. According to our proposal, once the USPTO determines that an invention is eligible for patent protection, it would proceed to assign the invention a score on a scale of 1-to-5 that would reflect the quality of the invention. The term "quality" does *not* refer to the social significance of the invention. Rather, it refers to the *degree* of novelty and non-obviousness of an invention. A score of 1 would be given to the lowest-quality inventions that barely clear the patentability bar. A score of 5 would be reserved for the highest quality inventions that embody a high degree of novelty and constitute a significant improvement over the prior art.

The score given to an invention would be publicly available and determine its protection term. Patents that received the lowest score of 1 would only be eligible for 4 years of exclusivity. A protection term of 20 years—the standard under our existing system—would be reserved to the highest quality patents that received the score of 5. Patents that received the score of 2, 3, and 4 would be eligible to 8, 12 and 16 years, respectively. Implementation of our proposal would significantly ameliorate the problems to which the current patent system gives rise. Specifically, the adoption of the Patent Scores mechanism would improve the workings of our patent system along two critical dimensions.

First, correlating the protection term to inventions' quality would dramatically reduce the aggregate period of exclusivity inventions enjoy—i.e., the total number of years of patent protection—and particularly the overall period of protection of *low*-quality patents. A shorter protection period would diminish the social deadweight loss generated by patent protection and attenuate the bargaining leverage patentees currently enjoy on account of their monopolistic status.[6] Consequently, more inventions would become available to the public for free or at a lower price. In addition, more voluntary exchanges involving patents are expected to occur. Furthermore, the differential legal treatment of patents on the basis of their quality would undermine the holdup power patentees presently possess in cases of patent thickets.[7] As we will demonstrate, this would substantially alleviate the process of cumulative innovation – one of the foremost challenges that our patent system confronts.

Another important advantage of our proposal is that it would ameliorate the problem of patent trolling. It is widely documented that patent trolls, or as they are euphemistically called Non-Practicing Entities (NPEs), use low-quality patents to extract payments from productive companies by claiming patent infringement.[8] Our proposed system packs a dual mitigation of the trolling problem. First, low quality patents would be protected for shorter

[6] *See infra* notes 32-35 and accompanying text.
[7] *See infra* notes 36-40 and accompanying text.
[8] *See infra* notes 66-69 and accompanying text.

periods of time and would then fall into the public domain. Second, and perhaps more importantly, companies that are targeted by trolls would know the quality scores of the patents asserted against them and if the score is low, as we expect it to be in many cases, they may choose to fight the alleged infringement claim in court or settle for a *much lower* price.

Finally, we expect the introduction of scores to improve the application reviewing process by the USPTO. Commentators have bemoaned the USPTO's tendency to issue bad patents due to examiners' strong incentives to award patents.[9] By some estimates, the USPTO approves 97% of all patent applications.[10] The high approval rate stems from the USPTO "grant[ing] patent claims that are broader than what is merited by the invention and the prior art, resulting in so-called 'bad' or improvidently granted patents."[11] Moreover, there is broad consensus among patent scholars that the USPTO is overburdened and lacks the resources for properly reviewing each and every application.[12] Hence, the USPTO essentially confronts a tradeoff between the risk of granting bad patents and the risk of rejecting meritorious ones. Since most patents are never licensed or litigated, some argue that it makes sense to prioritize the mistaken grant of bad patents over the erroneous rejection of worthy inventions.[13] The implementation of the proposed scores mechanism would change the parameters of the tradeoff, by allowing the USPTO to make more refined decisions. Relatedly, the adoption of a scores system would enable the USPTO to monitor and improve the work of individual examiners by comparing the scores of different examiners to the overall distribution of scores.

Structurally, this Article unfolds in three parts. In Part I, we will explain how the current design of the review process is responsible for the principal shortcomings of the patent system. In Part II, we introduce the concept of patent scores and explain how it can dramatically improve the functioning of the patent system. In Part III, we will address potential objections to our proposal. A conclusion will ensue.

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[9] *See infra* notes 17-30 and accompanying text.

[10] *See* Mark A. Lemley & Bhaven Sampat, *Is the Patent Office a Rubber Stamp?*, 58 EMORY L.J. 101, 104 (2008) (reviewing different estimations offered in the literature). The authors conclude, however, that "no one can agree on how likely it is that an applicant can get a patent… [t]he uncertainty and variation in numbers has led others to make wider claims, such as that the grant rate is less than 50%." *Id.* Follow-on surveys have nonetheless emphasized the excessive patent grants and the USPTO examiners' structural incentives of admitting patent requests. *See* an extensive discussion *infra*, Part I.A.

[11] *See* Jay P. Kesan & Andres A. Gallo, *Why "Bad" Patents Survive in the Market and How Should We Change?—The Private and Social Costs of Patents*, 55 EMORY L.J. 61, 63 (2006).

[12] *See infra* notes 22-27 and accompanying text.

[13] *See generally* Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495 (2001); *cf. infra* note 21.

I. THE AILMENTS OF A BINARY PATENT SYSTEM

By and large, commentators share the belief that the inventor-state transactions offered enshrined in patent doctrine—monopolistic rights in exchange for bringing to life socially valuable inventions—are necessary retain development and incentives for innovation.[14] Thus, it is widely agreed that some cases, mainly those of high-quality inventions, warrant the grant of temporal exclusivity: the social cost of a patent protection conferred on high-quality inventions is eclipsed by the benefits society derives from technological advancement.

But not all patents are created equal. While some novelties certainly justify a full protection term, in many other instances, inventions tend to represent only a minor advancement relative to preexisting state of knowledge. The level of novelty, usefulness and nonobviousness embodied in such inventions are quite low, and, in some instances, it is doubtful that they deserve a patent protection in the first place.[15] The social benefits from such low-quality inventions, therefore, are typically outweighed by the cost of bestowing on them a 20-year protection. We refer to this discrepancy as the costs of low-quality patents. In the present Part, we first trace the origins of low-quality patents and ask what allows them to prevail in society. Then, we turn to introduce the social costs that emanate from the ubiquity of low-quality patents.

A. *The Emergence and Persistence of Low-Quality Patents*

When reviewing a patent application, USPTO examiners confront a dichotomous choice between two alternatives: "grant" or "deny". As voluminous empirical literature consistently indicates, this binary choice introduces distortions into the examination process. Only in extreme cases—roughly 3% of all applications, according to some estimations—a patent application is actually denied.[16] Ordinarily, patent scholarship points out, the USPTO examiners are strongly incentivized to grant applicants patent protection. At first glance, this propensity may appear somewhat perplexing. After all, one may reasonable wonder why a patent examiner

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[14] *See, e.g.*, Bell & Parchomovsky, *supra* note 4 at 239 ("Legal monopoly protection is supposed to […] giv[e] creators a chance to earn a profit on their inventions during the period of the monopoly."); Michael A. Carrier, *Unraveling the Patent-Antitrust Paradox*, 150 U. PA. L. REV. 761, 762 (2002) ("The patent laws increase invention and innovation by offering inventors a right to exclude."); Louis Kaplow, *The Patent-Antitrust Intersection: A Reappraisal*, 97 HARV. L. REV. 1813, 1817 (1984) ("[T]he very purpose of a patent grant is to reward the patentee by limiting competition, in full recognition that monopolistic evils are the price society will pay."). Other perspectives, however, dispute this premise and consider governmentally induced rewards, subsidies and tax benefits as a substitute to the patent system. *See*, *e.g.*, Steven Shavell & Tanguy van Ypersele, *Rewards Versus Intellectual Property Rights*, 44 J.L. & ECON. 525 (2001); Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303 (2013).

[15] *See infra* notes 17-27 and accompanying text.

[16] *Supra* note 10.

would be predisposed to confer patent privileges, rather than conduct a thorough and impartial merit-based examination.

Researchers who took a deep dive into the inner workings of the USPTO have suggested that resource allocation and compensation incentives within the USPTO as the core reasons for the proliferation of bad patents.[17] For example, Professor Mark Lemley, in his influential *Rational Ignorance at the Patent Office*,[18] argued that the pervasiveness of low-quality patents results from a simple cost-benefit calculation. In brief, the separation of low- and high-quality patents consumes ample resources from the USPTO—including time, budgets and efforts—and incurring these costs might be unjustified from a social perspective.[19] "Because so few patents are ever asserted against a competitor," Lemley notes, "it is much cheaper for society to make detailed validity determinations in those few cases than to invest additional resources examining patents that will never be heard from again."[20] Yet, what is rational for the USPTO is not in the best interest of society at large.[21]

Along similar lines, in a series of empirical studies the scrutinize the work of the USPTO, Michael Frakes and Melissa Wasserman[22] found that patent

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[17] *See, e.g.*, Michael D. Frakes & Melissa F. Wasserman, *Does the U.S. Patent and Trademark Office Grant Too Many Bad Patents?: Evidence from a Quasi-Experiment*, 67 STAN. L. REV. 613, 615 (2015) (hereinafter: Frakes & Wasserman, *Too Many Bad Patents*) ("Many believe that the root cause of the patent system's dysfunction is that the [USPTO] is issuing too many invalid patents that unnecessarily drain consumer welfare, stunt productive research, and unreasonably extract rents from innovators.").

[18] *See* Lemley, *supra* note 13.

[19] *Id.*, at 1495.

[20] *Id. See also* Joseph Farrell & Carl Shapiro, *How Strong Are Weak Patents?*, 98 AM. ECON. REV. 1347, 1348 (2008) ("[I]mproved prelicensing review would be socially desirable if, and only if, the administrative costs of examining […] patents more thoroughly were lower than the resulting savings in litigation and license negotiations costs.").

[21] *See, e.g.*, Shubha Ghosh & Jay Kesan, *What Do Patents Purchase? In Search of Optimal Ignorance in the Patent Office*, 40 HOUS. L. REV. 1219 (2004) (contending that patent applicants are incentivized "to overwhelm the patent examiner with information in the hopes that a patent application will slip through the review process[,]" and that in such cases, the USPTO's rational ignorance is not necessarily cost-justified in terms of social welfare). Others have noted that the ubiquity of patents—notwithstanding the invalidity of many and despite the fact that most patents are never asserted against competitors—carries adverse implications on market entry. *See* Christopher R. Leslie, *The Anticompetitive Effects of Unenforced Invalid Patents*, 91 MINN. L. REV. 101, 119 (2006) ("[S]o long as a would-be competitor believes that a market-dominating patent is valid or may be held valid by a court, it should rationally be deterred from entering the market, even if that patent is, in fact, invalid."). Finally, some have offered empirical examination of the "rational ignorance" argument, concluding that more thorough USPTO review will cost-effectively save future litigation expenses, which justify the allocation of more resources to the USPTO. *See* Michael D. Frakes & Melissa F. Wasserman, *Irrational Ignorance at the Patent Office*, 72 VAND. L. REV. 975 (2019) (hereinafter: Frakes & Wasserman, *Irrational Ignorance*).

[22] *See*, *e.g.*, Michael D. Frakes & Melissa F. Wasserman, *Irrational Ignorance*, *supra* note 21; Michael D. Frakes & Melissa F. Wasserman, *Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents? Evidence from Microlevel Application Data*, 99 REV.

examiners operate under a considerable time constraints, and that "on average, an examiner spends only nineteen hours reviewing an application."[23] In this short period of time, examiners must perform a series of tasks, "including reading the patent application, searching for prior art, comparing the prior art with the patent application, writing a rejection, responding to the patent applicant's arguments, and also often conducting an interview with the applicant's attorney."[24] As Frakes and Wasserman stress, the performance of examiners is assessed based on their efficaciousness, which is measured, *inter alia*, by the amount of time they allot to reviewing an application.[25] Interestingly, however, a decision to deny an application consumes much more time compared to granting a patent.[26] According to the authors, "[b]ecause patent applications are presumed to comply with the statutory patentability requirements when filed, the burden of proving unpatentability rests with the [USPTO]."[27] Denials thus require examiners to dedicate much more time and effort to reviewing the application, which may undermine their perceived effectiveness. More so, rejection might ignite an endless stream of repeat applications by denied inventors, which effectively reinitiate the review process from its very beginning.[28] Thus, rejections spell future work for examiners, whereas acceptance, by contrast, is instant and finite.[29] And sure enough, extant time allotments, as well as insufficiency of resources, have been shown to induce an excessive grant of patents.[30]

But while conventional wisdom ascribes the omnipresence of low-quality patents to resource constraints among USPTO examiners, we submit that the standard account misses a critical element: the *binarity* of the review process. The current review process leaves examiners with an "all or nothing" choice, which is highly vulnerable to structural incentives that induce granting a patent protection. Since any "grant" choice yields 20-year

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ECON. & STAT. 550 (2017) (hereinafter: Frakes & Wasserman, *Time Allocation*); Michael D. Frakes & Melissa F. Wasserman, *Patent Office Cohorts*, 65 DUKE L.J. 1601 (2016); Frakes & Wasserman, *Too Many Bad Patents*, *supra* note 17.

[23] Frakes & Wasserman, *Time Allocation*, *supra* note 22.

[24] *Id.*

[25] *Id.*

[26] *Id.*

[27] *Id.*

[28] Applicants' right to reexamination is enshrined at 35 U.S.C. § 132 (2006). In practice, repeat application may come in the form of a new application (known as "continuation application") or a protraction of the original one (known as "request for continued examination"). Despite the technical differences, both "are largely used for the same purpose: providing the applicant who has been denied the coverage she seeks with an additional chance for her patent application to be allowed." Frakes & Wasserman, *Too Many Bad Patents*, *supra* note 17 at 625.

[29] *Id.*, at 625 ("The ability of aggrieved patent applicants to continuously restart the examination process upon rejection by filing repeat applications […] [can induce the USPTO] to allow patents in an effort to cut off the never-ending stream of repeat filings."). *Cf.* Mark A. Lemley & Kimberly A. Moore, *Ending Abuse of Patent Continuations*, 84 B.U. L. REV. 63 (2004) (documenting the pervasiveness of the practice of repeat application).

[30] Frakes & Wasserman, *Time Allocation*, *supra* note 22.

exclusivity, this binary treatment maximizes the costs of erroneous grants, instead of minimizing them.

The binary nature of the review process completely disregards the USPTO's impression of inventions' *degree* of quality, i.e., the level of novelty, usefulness and non-obviousness over the prior art. Yet, this impression is crucial, as it embeds valuable information that pertains to the quality of an invention and, accordingly, to the quality of an issued patent. Hence, for the reasons set forth in Part II, a switch is required from the existing binary examination process to a richer screening mechanism that involves assigning scores to patents. As will be demonstrated, by assigning the scope of patent protection proportionally to the invention's score, the social costs of issuing low-quality patents is likely to substantially drop.

In the ensuing Sections, we turn to discuss the social costs of low-quality patents under the current binary regime. We address the distortions that result from misalignments between the quality of patents and the level of protection, and likewise point at the dilution of the informative value of patents.

B. *Binarity and Quality-Protection Misalignment*

(1) Monopolistic Pricing

As has long been established, in order to retain incentives to innovate and, even more importantly, disclose inventions to facilitate scientific progress, it is necessary for the law to bestow limited exclusivity upon inventors to protect them from free-riding by competitors.[31] Absent legal protection, users are unlikely to pay for utilizing the invention, leaving the inventor with no ability of recouping the fixed costs of development and production, let alone profiting from their inventions.[32] The monopolistic status conferred on inventors by means of patent protection for a certain period of time overcomes this problem, allowing them to bar unauthorized uses and earn profits from enforceable licensing agreements.

Yet, even if exclusivity has been selected as the method of choice for incentivizing innovation in our society, society still faces the problem of excessive pricing of new technologies. The legal exclusivity we confer upon inventors allows them to charge supra-competitive prices for their inventions, which invariably imposes allocative inefficiencies (deadweight loss) and distributional inequities on society at large.[33] Indeed, when granting

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[31] *Supra* note 14.

[32] *See, e.g.*, Bell & Parchomovsky, *supra* note 4 at 239 ("Legal monopoly protection is supposed to […] giv[e] creators a chance to earn a profit on their inventions during the period of the monopoly.").

[33] *See* Bell & Parchomovsky, *supra* note 4 at 240; WILLIAM A. MCEACHERN, ECONOMICS: A CONTEMPORARY INTRODUCTION 209 (11th ed. 2017).

a patent protection, society trades off the benefits arising from the production of inventions, against the costs users and follow-on inventors must pay to enjoy the invention.[34]

It is critical to understand, though, that the benefits that society derives from innovation *vary* across inventions. Our patent system, however, owing to its adherence to the binary review process, vests upon all inventions an identical level of protection. Patent law allows any patented invention, irrespective of its quality, to gain a 20-year exclusive term during which it is sold at an excessive price to users and cumulative inventors. Thus, while the social benefits vary, the loss that society suffers remains *fixed* for any given patent.[35] This problem is known among patent theorists as "the one size fits all" problem.

(2) Cumulative Innovation

Another problem that has preoccupied patent theorists and practitioners concerns patent thickets. The dramatic increase in the number of patents in modern time—about 200,000 patents every year—has made it necessary for follow-on developers and inventors to secure licenses from *multiple* patentees, rather than a single rightsholder.[36] Consequently, as predicted by "anti-commons" theories of intellectual property, the need to secure authorization from several owners essentially implies that each owner possesses a veto power over the process of cumulative innovation.[37] Thus, aside from making the bargaining process costlier and more cumbersome,[38] patent thickets give rise to holdups, which in turn can deter inventions that draw on existing knowledge.[39] In such cases of cumulative innovation—the

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[34] Kaplow, *supra* note 14 at 1822 (treating monopoly loss as "part of the price society pays to stimulate inventive activity…").

[35] Bell & Parchomovsky, *supra* note 4 at 234 ("Because the same monopolistic protection is accorded to all inventions irrespective of their value, society often pays too high a price for innovation.").

[36] *See, e.g.*, Ian Ayres & Gideon Parchomovsky, *Tradable Patent Rights*, 60 STAN. L. REV. 863, 864 (2007) ("Patent thickets are especially harmful in cumulative innovation settings[] [because of] the need to secure licenses from multiple patentees.").

[37] *See generally* Michael A. Heller & Rebecca S. Eisenberg, *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 280 SCI. 698 (1998); James Bessen & Eric Maskin, *Sequential Innovation, Patents, and Imitation*, 40 RAND J. ECON. 611 (2009).

[38] *See, e.g.*, Ayres & Parchomovsky, *supra* note 36 at 865 ("Patent thickets also harm regular users of patented products and technology by making it more expensive for users to gain access to the relevant product or technology."); Mark A. Lemley, *Economics of Improvement in Intellectual Property Law*, 75 TEX. L. REV. 989, 997-98 (1997) ("The creators of old works can […] refuse to distribute them to anyone at all… [or can] exercise control over who can use their creation, the purposes for which they can use it, and the price they must pay.").

[39] Ayres & Parchomovsky, *supra* note 36 at 864-65; Heller & Eisenberg, *supra* note 37. *See also* Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 2047 (2007) (noting that the fundamental holdup problem lies in the fact that "each patent has the ability to charge a royalty that *exceeds* the value of its patented technology.") (emphasis in text).

primary path to technological progress in the modern era—our patent system might paradoxically inhibit advancement, rather than promote it.[40]

To a substantial extent, the binary review process, together with the uniform protection granted to all patents irrespective of their quality contribute to the cumulative innovation problem. The ease with which patents are granted, and the strong protection bestowed on all successful applicants create and determine the ability of patentees to hold-up subsequent inventors. The lack of diversification in patent protection among inventions despite the clear discrepancies in these inventions' quality, essentially implies that, in principle, a near identical holdup power is granted to each and every patentee.

The holdup concern might seem prima facie identical to the monopolistic pricing problem discussed above: just as low-quality inventions enjoy excessive monopolistic revenues—for 20 years instead of four—they also enjoy excessive holdup power. But the argument is more nuanced, because the holdup problem, in the case of cumulative innovation, is *multiplied*. In other words, since a single patentee can prevent cumulative innovation, excessive holdup power can thwart follow-on innovation *for decades to come*. Consider, for example, two independent low-quality inventions, one is patented in year Y, the other in year Y+20, shortly before the expiration of the former. Suppose that each patentee, at her time, has exercised her veto power by setting up an excessive asking price that users could not afford. In that case, cumulative innovation would have been blocked for 40 years, instead of 20. As opposed to monopolistic pricing of a low-quality invention that would come to an end even after an excessive protection term of 20 years, holdups can potentially snowball and impede the development of certain inventions, at least in principle, for eternity.

(3) Patent Quality and Marginal Improvement

In addition to the problems of monopolistic pricing and cumulative innovation, the fact that the current system fails to consider the quality of inventions gives rise to an additional problem: it distorts inventors' incentive to improve the quality of their inventions beyond the patentability threshold. To see this, one should bear in mind two core insights. First, as noted, the binary design of our patent system begets a threshold-based regime, extending to all qualifying inventions the same level of protection. Second, any improvement of the quality of an invention in progress, comes at cost for inventors: it requires them to further their investment in R&D and information acquisition, ex ante, and to publish the new information obtained in the course of improvement, ex post.

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[40] Heller & Eisenberg, *supra* note 37.

Under the current state of affairs, to secure a patent, applicants must show that their inventions meet the patentability threshold. Applicants have no real incentive to improve the quality of inventions beyond the patentability benchmark. Investing additional resources to improve of innovations, beyond what is necessary to secure protection, imposes upon them extra costs, while offering them no real marginal benefit. Moreover, the additional expenditures may actually help competitors as the additional information offered in applications becomes public after eighteen months.

In this regard, one may argue that even if, *de jure,* improving the quality of the invention or the disclosure does not benefit the patentee, *de facto*, it does. After all, so the argument goes, higher quality patents are more likely to survive in litigation. This argument is largely illusory. First, receiving a patent is the primary goal of patentees. Ownership of a patent bestows upon patentees a great deal of power vis-à-vis third parties. As we noted, the lion's share of patents never gets challenged in court. Second, patentees can strategically select poor defendants who can ill-afford the astronomical costs of patent litigation. Such defendants would by and large prefer to settle. Ironically, patentees may refuse settlement offers since litigating all the way to the end is likely to lead to a favorable ruling that can later be used against future, somewhat stronger, defendants. Worse yet, if a patentee misjudged the financial ability of a defendant, she could always discontinue the suit or offer that defendant a very attractive out of court settlement.[41] Third, in those cases where a patentee asserts her patent against a powerful defendant who refuse to settle, she would, indeed, need to expend considerable resources on defending her patent. Yet, it is much more sensible not to expend these resources, ex ante, during the examination process at which point the future is unknown, and instead, wait until an actual case that necessitate this serious outlay arises.

To be sure, the ascribed problem is hardly hypothetical. Notably, a well-documented practice of pharmaceutical patentees—known as product life cycle management—is to strategically extend their drug's market exclusivity in order to hinder the entry of generic manufacturers into the market.[42] Such artificial extension is acquired by registering "secondary patents",[43] i.e., by gradually patenting various other aspects of a drug upon the original patent's expiration, instead of revealing all information that pertains to the invention

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[41] *See infra* notes 59-65 and accompanying text.

[42] *See* Aaron S. Kesselheim et al., *The High Cost of Prescription Drugs in the United States: Origins and Prospects for Reform*, 316 JAMA 858, 861 (2016). *Cf.* Andrew Pollack, *Makers of Humira and Enbrel Using New Drug Patents to Delay Generic Versions*, N.Y. TIMES (July 15, 2016), https://www.nytimes.com/2016/07/16/business/makers-of-humira-and-enbrel-using-new-drug-patents-to-delay-generic-versions.html [https://perma.cc/9XMZ-MKEL].

[43] Amy Kapczynski et al., *Polymorphs and Prodrugs and Salts (Oh My!): An Empirical Analysis of "Secondary" Pharmaceutical Patents* 7 PLOS ONE (2012) ("[Studies] compute patent life based on the primary patents available, and generally ignore secondary patents. If secondary patents are frequently obtained later in the invention cycle than chemical compound patents, this will underestimate patent life, perhaps substantially.").

at the very outset, when filing the initial application.[44] A case-in-point is the Prilosec drug.[45] The patent's expiration has led its manufacturer to apply for—and, sure enough, be granted with—a subsequent patent on this drug's s-isomer, notwithstanding the insignificant difference between the original invention and its derivative.[46] This prompted the introduction of a new brand—Nexium—that was reportedly sold for 600% more than the competitive price of Prilosec.[47] Moreover, as has been documented before, patentees can even further their monopolistic revenues by efficient trademarking that utilizes consumers' propensity to retain "brand loyalty,"[48] or by strategically raising the primary patent's price at the foresight of its expiration in order to channel consumers toward acquiring the secondary patent.[49]

More generally stated, patentees exhibit an observable preference toward uncovering mild and even negligible inventions that would meet the patentability bar and patent each at a time, despite their ability to develop novelties and unveil information that would constitute a major technological advancement. In short, innovation is simply being filibustered – captured by the distorted incentives of manufacturers. As has been underscored in the context of the pharmaceutics industry, "[b]ecause permissive [USPTO] standards for novelty or usefulness make it relatively easy to patent many nontherapeutic aspects of a drug, companies can strategically patent small changes and try to influence prescribers and patients to transition from one linked product to the next, sometimes discontinuing production of older versions of the drug."[50]

And thus, not only does our patent system lead to the proliferation of low-quality inventions by means of a uniform level of protection, but it also fails to provide an incentive to maximize the quality of inventions beyond the patentability point. In economic parlance, the threshold-based regime that

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[44] Michael Burdon & Kristie Sloper, *The Art of Using Secondary Patents to Improve Protection*, 3 J. MED. MARKETING 226 (2003) ("A key element of any life cycle management strategy […] is to extend protection beyond the basic patent term for as long as possible, by filing secondary patents which are effective to keep generics off the market.").

[45] Kesselheim et al., *supra* note 42.

[46] *Id.*

[47] *Id.*

[48] *See, e.g.*, Gideon Parchomovsky & Peter Siegelman, *Towards an Integrated Theory of Intellectual Property Rights*, 88 VA. L. REV. 1455, 1461 (2002) ("[B]rand recognition can be used to extend the protection afforded by patents well beyond the legal protection period. For example, consumers remained loyal to Bayer Aspirin for decades after it went off patent, in spite of the existence of identical generic drugs that sold for much less….").

[49] *See*, *e.g.*, Ed Silverman, *Reckitt's Suboxone Strategy Is Really About Patients or Profits?*, FORBES (Oct. 12, 2012), https://www.forbes.com/sites/edsilverman/2012/10/12/reckitts-suboxone-strategy-is-really-about-patients-or-profits/?sh=10cdfb846c3f [https://perma.cc/C4KN-T8D9].

[50] Kesselheim et al., *supra* note 42.

originates in a binary screening process fails to retain inventors' *marginal incentives to innovate*.[51]

C. *Binarity and Informational Dilution*

(1) Signaling

In an influential theoretic article, Professor Clarisa Long analogized patents to signals.[52] Building on Michael Spence's signaling theory,[53] Professor Long argued that patents can "reduc[e] informational asymmetries between patentees and observers."[54] By bestowing patent protection on inventors, Long suggested that the law essentially grants patentholders the ability to signal favorable information to the world—investors, competitors and other industrial actors—about the patented invention as well as the owner's competence. Since patents are costly to acquire and entail institutional vetting conducted by the USPTO, the mere existence of a patent indicates, sometimes even independently of the patent's content, that the relevant patentee is a high-quality inventor who offers high-quality novelties.[55] At the same time, Long acknowledged that the USPTO's well-documented tendency to approve patents, might well dilute the signaling potential featured by patents.[56] Given that patent applications are barely denied and the resulted pervasiveness of low-quality patents, the information signal provided by the very existence of patent protection to the rest of the world is very thin. Third parties can thus infer very little about the quality of patents they face.

But there is more to it. Even if the USPTO examiners were to dedicate the appropriate amount of time and effort required to thoroughly vet each and every patent application, the binary nature of the patent system would still attenuate the power of the patent signaling. Specifically, in its current binary structure, the patent system only manages to extract a small fraction of the information that patents can *potentially* communicate. To see this plainly, it is necessary to take a step back and review the canonic economic theory of

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[51] This argument corresponds to traditional scholarship in the economic analysis of law, that has spotlighted the need to retain marginal incentives and advocated to opt out of uniform standards in different legal context. Prominent is the economic rationale to why, for example, crimes are not punished uniformly, but rather in accordance with their relative severity. *See, e.g.*, Richard A. Posner, *An Economic Theory of the Criminal Law*, 85 COLUM. L. REV. 1193, 1207 (1985) ("[U]niformity [in punishment of different crimes by the same fines] eliminates marginal deterrence—the incentive to substitute less for more serious crimes."); George J. Stigler, *The Optimum Enforcement of Laws*, 78 J. POL. ECON. 526 (1970).

[52] *See* Clarisa Long, *Patent Signals*, 69 U. CHI. L. REV. 625 (2002).

[53] *See generally* Michael Spence, *Job Market Signaling*, 87 Q. J. ECON. 355 (1973).

[54] Long, *supra* note 52 at 627.

[55] *Id.*, at 637, 651-655.

[56] *Id.*, at 667-668 ("The [USPTO] is an imperfect mechanism […] for assuring that the information contained in a patent is credible. The [USPTO's] evaluation of a patent may be so poor or hurried as to be near meaningless.").

signaling. In information economics and game theory, *signaling* is a term referring to costly actions taken by actors of a certain "type," for instance high-quality manufacturers, to separate themselves from actors of other types, e.g., low-quality manufacturers.[57] Consider the textbook example of warranty assurance.[58] A seller who issues warranty for the goods she produces, signals consumers that her goods are more durable than the ones produced by any of her competitors who does not issue warranty.

But naturally, the analysis does not end there, since durability is hardly binary. Warranty is likewise beneficial for allowing consumers to separate different sellers on a durability *continuum*: a seller offering a five-year warranty will be considered more reliable than a one offering only a three-year guarantee, whose commodity is more trustworthy than the one offered by a one-year guarantor, and so on. The very same logic applies to patents and inventions: one invention differs in quality from the other, despite the fact that both meet the requirements of patentability. But as already noted above, currently, the binary outcome of a patent review process confines third parties to a discrete separation between patented and non-patented inventions, precluding highly innovative patents away from the ability to separate themselves from low-quality inventions.

(2) Litigation and Settlement

It has long been established that a veil of ambiguity invariably envelops patent litigation.[59] As has been empirically substantiated, the outcome of a typical patent case—both in terms of liability verdicts and infringement awards—is virtually impossible to predict.[60] As noted earlier, roughly half of

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[57] *See generally* Spence, *supra* note 53. For the formal structure of signaling games see, e.g., MARTIN J. OSBORNE & ARIEL RUBINSTEIN, A COURSE IN GAME THEORY 237-38 (1994).

[58] *See* George A. Akerlof, *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*, 84 Q. J. ECON. 488, 499 (1970) ("Most consumer durables carry guarantees to ensure the buyer of some normal expected quality.").

[59] *See*, *e.g.*, Mark A. Lemley & Carl Shapiro, *Probabilistic Patents*, 19 J. ECON. PERSP. 75, 76 (2005) ("[T]he uncertainty associated with patents is especially striking, and indeed is fundamental to understanding the effects of patents on innovation and competition.") (cited hereinafter as Lemley & Shapiro, *Probabilistic Patents*). *See also* Gretchen Ann Bender, *Uncertainty and Unpredictability in Patent Litigation: The Time is Ripe for a Consistent Claim Construction Methodology*, 8 J. INTELL. PROP. L. 175, 175 (2001) ("[T]he field of patent infringement litigation currently lacks the certainty and predictability necessary to efficiently litigate (and resolve) cases."); Farrell & Shapiro, *supra* note 20 (modelling patent litigation under uncertainty); Oscar Liivak, *The Unresolved Interpretive Ambiguity of Patent Claims*, 49 UC DAVIS L. REV. 1851, 1853 (2016) (contending that litigation outcomes are "hard to predict and appear[] judge-dependent."); Michael J. Mazzeo et al., *Explaining the "Unpredictable": An Empirical Analysis of U.S. Patent Infringement Awards*, 35 INT'L REV. L. & ECON. 58, 58 (2013) (noting that "[p]atent infringement awards are commonly thought to be unpredictable.").

[60] Lemley & Shapiro, *Probabilistic Patents*, *supra* note 59 at 75 ("[A] patent does not confer upon its owner the right to exclude but rather a right to *try* to exclude by asserting the patent in court […]. When a patent holder asserts its patent against an alleged infringer, the patent holder is rolling the dice.") (emphasis in text).

the judgments pertaining to patent grants actually overturn the USPTO's original decision and invalidate the patentability of the invention in question.[61] Similarly, any attempt to spot a common ground that typifies all reversals would be fruitless, as courts' review of USPTO patentability decisions is devoid of any unified and consistent jurisprudence. This, in turn, rules out any feasible reliance ability by patentees and users alike. The high rate of invalidations, on the one hand, and courts' tendency to award high damages if infringement is found,[62] on the other hand, increase the risks involved in litigation and induce parties to prioritize out-of-court settlements. Uncertainty thereby yields unjust and inefficient outcomes at once. In some cases, plaintiffs whose justified patent rights have been bluntly infringed by users, will be willing to settle for an amount considerably lower than their well-deserved one. In other instances, even defendants with compelling argument against the patent's validity may prefer to transfer excessive payments instead of rolling the dice in trial. As studies indicate, "[n]early 200,000 patents are issued every year after a very limited examination process[,]" and yet, "only 1.5 percent of patents are every litigated, and only 0.1 percent of patents are ever litigated *to trial*."[63]

The ambiguity that surrounds patent litigation thus taxes high-quality inventions and subsidizes low-quality patents. The binary operation of our patent system—by depriving litigants of pertinent information regarding the case—is once again a foremost contributor to this problem. When confronting the current binary framework, parties lack substantial information with respect to the plaintiff's probability of prevailing. Normally, the plaintiff's odds of winning a patent infringement suit are affected, first and foremost, by whether the court is expected to defer to the USPTO's original patentability decision. Under a binary review process, especially when accounting for examiners' bias toward granting patents, one can hardly answer with confidence. The entire information that parties observe—the sole "signal" they receive about the state of the world—is the fact that a patent has been granted. But when accounting for examiners' bias toward granting patents, it can be readily realized that this is nothing but an "empty," uninformative signal,[64] since patentability decisions are very weakly correlated with the inventions' quality.[65] Courts' validity decisions, on the

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[61] *Id.*, at 76. *See also supra* note 5.

[62] *See, e.g.*, William F. Lee & A. Douglas Melamed, *Breaking the Vicious Cycle of Patent Damages*, 101 CORNELL L. REV. 385, 439 (2016) ("Excessively generous remedies can induce parties to obtain patent as litigation tools beyond their economic value to technology users and consumers.").

[63] Lemley & Shapiro, *Probabilistic Patents*, *supra* note 59 at 77.

[64] *See*, *e.g.*, Emir Kamenica & Matthew Gentzkow, *Bayesian Persuasion*, 101 AM. ECON. REV. 2590, 2591 (2011) (equating uninformative signaling to a complete absence of communication).

[65] This can be demonstrated in a simple formal fashion. There are two states of the world – an invention is either valid (V) or not (N). The state is only realized upon the court's final decision. Upon reviewing a patent application, the USPTO confronts a binary decision between two actions: grant (γ) and deny (δ). Assume that a patent has been

other hand, *are* in fact affected by the quality of the relevant invention, as courts do not share the USPTO's systemic bias toward admitting patents. So, to equip litigants with useful information that allows for an adequate assessment of their probability to prevail in litigation, the patent system's binarity—which informs litigants merely by letting them know that a patent has been issued—is just ill-fitted.

(3) Patent Trolls

Parties' reluctance to pursue an ultimate validity judgment on account of litigation uncertainty serves primarily patentees of low-quality, borderline inventions – inventions whose patentability is dubious in the first place. The fact that the USPTO's initial patentability decision is unlikely to be scrutinized by judicial review, mainly benefits patent trolls.

Patent trolls, or NPEs, compile stocks of patents, predominantly low-quality ones – for the sole purpose of asserting them against other individuals and businesses, threatening to initiate an infringement suit, and extract a payment in exchange for withdrawing the threat.[66] Patent trolls strategically select their targets in the search of ill-informed and vulnerable victims. Their motivation in doing so is obvious: they wish to avoid litigation that might lead to the invalidation of their patents. The dearth of information contained in patents under extant law aids the business model of trolls. Individuals and business on which trolls prey have no cost-effective way to verify whether

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granted, and is now asserted against a user for an alleged infringement claim. Both litigants try to predict the court's final judgment and assess the suit's expected value, based on the fact that patent has been granted. In assessing $\Pr(V|\gamma)$—the probability that the patent is valid given that it has been granted by the USPTO—we may apply Bayes' rule and obtain:

$$\Pr(V|\gamma) = \frac{\Pr(\gamma|V)\Pr(V)}{\Pr(\gamma)}$$

The USPTO's decision on γ is only relevant if it is actually correlated with the state of the world, namely, the USPTO's decision is an informative signal if and only if $\Pr(\gamma|V) > \Pr(\gamma)$, for in that case, by Bayes' rule, we learn that $\Pr(V|\gamma) > \Pr(V)$ (ruling out negative correlation between the USPTO's decision and the state—in that case, the USPTO's grant decision would indicate that the patent is of increased likelihood of being invalidated, which is unreasonable). But if the USPTO constantly chooses γ, or chooses it often alongside random deviations in which it chooses δ, this implies that $\Pr(\gamma|V) = \Pr(\gamma)$, and consequently, $\Pr(V|\gamma) = \Pr(V)$—hence no information can be inferred as a result of a USPTO patentability decision. The event γ is thus irrelevant and serves as an uninformative signal.

[66] *See*, *e.g.*, John M. Golden, "*Patent Trolls*" *and Patent Remedies*, 85 TEX. L. REV. 2111, 2112 (2007) (defining trolls as "patent owners who do not provide end products or services themselves, but do demand royalties as a price for authorizing the work of others."); Mark A. Lemley & A. Douglas Melamed, *Missing the Forrest for the Trolls*, 113 COLUM. L. REV. 2117, 2118 (2013) (treating trolls as "patent owners whose primary business is collecting money from others that allegedly infringe their patents."); Gerard N. Magliocca, *Blackberries and Barnyards: Patent Trolls and the Perils of Innovation*, 82 NOTRE DAME L. REV. 1809, 1810 (2007) (describing trolls as "firms that use their patents to extract settlements rather than license or manufacture technology.").

the patents asserted against them are low- (or high-) quality patents. The only mechanism capable of furnishing them with this critical information is litigation, an option that most of them cannot afford owing to its high cost. To make matters worse, in light of the high cost of litigation, trolls can always dissuade victims from litigating by making them, in appropriate cases, "attractive" settlement proposals and, if all else fails, to withdraw the lawsuit.

Moreover, uncertainty exacerbates the collective action problem customarily associated with patent litigation, to the benefit of trolls. Even in those irregular cases where trolling victims do possess the financial wherewithal required for litigating, the riskiness associated with litigation—on account of the prevailing uncertainty—renders validity challenge an underprovided public good: users normally prefer to settle instead of incurring the cost of litigation even if patent invalidity is the most likely scenario.[67] As pointed out by Joseph Farrell and Carl Shapiro in the context of low-quality patents, since a validity challenge by one user carries positive externality on the entire cohort, any individual user would exhibit reluctance to be the pioneer that bears the full costs of litigation but shares the benefit of success with others.[68] Farrell and Shapiro thereby conclude that "incentives to challenge patents are suboptimal, and downstream firms will accept surprisingly large per-unit royalty."[69]

II. A SCORE-BASED PATENT SYSTEM

In Part I, we analyzed the costs that the binary design of our patent system imposes on the public. Faced with a binary choice of "grant" or "deny", patent examiners tend, by and large, to grant low quality patents.[70] In this Part, we propose a reform that can dramatically improve the operation of our patent system. Instead of placing all granted patents on an equal footing and bestow upon them the same scope of protection, we call for the introduction of a system of patent scores under which granted applications would receive a quality score of 1 (lowest) to 5 (highest). The score would determine the scope of protection granted to the invention as well as provide information to third parties and the patentees regarding the strength of the patent. The protection term of a patent would be a direct function of its score, as would be the list of remedies available to the owner, as we detail below.

As importantly, the score would provide critical information to licensees and defendants, allowing them to make better informed decision in their interaction with patentees. Specifically, licensees would be able to form a

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[67] *See, e.g.*, Joseph Farrell & Robert P. Merges, *Incentives to Challenge and Defend Patents: Why Litigation Won't Reliably Fix Patent Office Errors and Why Administrative Patent Review Might Help*, 19 BERKELEY TECH. L.J. 943, 952-53 (2004) (discussing the public good problem in patent litigation). *See also* Lemley & Shapiro, *supra* note 59 at 88.

[68] Farrell & Shapiro, *supra* note 20 at 1349.

[69] *Id.*

[70] *Supra* notes 17-30.

more accurate reservation price based on the score of a patent.[71] For instance, if the relevant patent had received a low score, say 1, licensees should offer a lower price for the right to use it, as it might not survive litigation.[72] More generally, the introduction of scores would enhance the leverage to licensees vis-à-vis patent holders, leading to fairer licensing terms. Defendants, for their part, would have more information about the quality of the patent asserted against them, which would allow them to calculate their steps more accurately. For example, a defendant faced with an infringement claim of a high score patent should reasonably assume that there is a low probability that the patent would be found invalid and should thus either settle the case or focus her resources on showing that she did not infringe the patent, rather than on challenging the patent's validity – and vice versa.

Finally, the introduction of scores should also improve the performance of the USPTO. The binary system we now have affords the USPTO a very limited ability to monitor the quality of work of individual examiners. Most importantly, it allows us to know what percentage of approved patents were overturned in litigation.[73] It is possible, of course, to trace those patents that did not survive judicial scrutiny to the individual examiners who granted them.[74] Yet, this tool can only be used with respect to patents that were challenged in court, a tiny subset of all patents.[75] The introduction of scores would allow for inter-personal quality comparisons irrespectively of litigation. It would enable the USPTO and the public at large to learn about the tendency of individual examiners by comparing their *distribution* of scores to those of their peers. For example, if a particular examiner gives a score of 3 to all patents, whereas the scores of other examiners are distributed between 1 to 5, it warrants providing additional training to this examiner. Similarly, it would be possible to analyze the correlation between scores and reversal rates and thereby assess the overall performance of the USPTO. Concretely, if it is disclosed that low quality (score 1) and high quality (score 5) patents face equal reversal rates in litigation, it is an indication that the examination process must be overhauled. If, conversely, many low-quality patents are struck down in litigation and very few high-quality patents do, it is a sign that the USPTO is functioning well. We elaborate on these effects below

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[71] The term "reservation price" stands for the maximum licensing fee they will be willing to pay. *See, e.g.*, HOWARD RAIFFA, THE ART AND SCIENCE OF NEGOTIATIONS 45 (1982) ("The buyer has some reservation price […] that represents the very maximum she will settle for….").

[72] *See* Farrell & Shapiro, *supra* note 20 (studying the effect of the probability of court-invalidation on licensing fees).

[73] *Supra* note 5.

[74] For studies that stress the relationship between examiner-specific characteristics and granting decisions see, e.g., Mark A. Lemley & Bhaven Sampat, *Examiner Characteristics and Patent Office Outcomes*, 94 REV. ECON. & STAT. 817 (2012); Prakes & Wasserman, *Patent Office Cohorts*, *supra* note 22.

[75] *See* Lemley & Shapiro, *Probabilistic Patents*, *supra* note 59 at 77.

A. *Tailoring Protection to Quality*

Our patent system has three defining characteristics: First, it is binary as it admits only two results – grant or reject. Second, it employs a threshold screening mechanism in determining which inventions are eligible for patent protection. Third, it embodies a "one size fits all" design with respect to qualifying inventions. We discussed in detail the distortions created by these design features in Part I.

All of the ascribed distortions can be addressed by the introduction of patent scores. Under this alternative design, each qualifying invention would receive a score of 1 to 5 based on its quality. The score would not reflect the social significance of the invention. Rather, it would represent its novelty, nonobviousness and utility. A score of 1 would be given to low-quality inventions that barely clear that patentability bar. A score of 5 would be reserved to the highest quality inventions that embody a high level of novelty and non-obviousness and whose utility is clear and undeniable. Inventions falling between these two reference points would receive a score of 2, 3 or 4, depending on how they fare on the novelty, nonobviousness and utility tests. Of course, patent applications that do not satisfy the patentability prerequisites would be denied protection altogether and would not be assigned a score.

(1) Correlating Scores and Protection Terms

An important component of our proposal is to tie the scope of protection granted to a patent to its score. We propose that the protection term a patent receives be determined by its score. In contrast to the current system that grants all inventions 20 years of protection, measured from the date of filing, we envision a system with varying protection terms, under which only the highest quality patents that received a score of 5 would be eligible to the full statutory protection term. Low quality patents that were assigned a score of 1 would be entitled to only four years of protection. Patents with a score of 2, 3 or 4 would be eligible to a protection term of eight, twelve and sixteen years, respectively.[76]Correlating protection terms to quality scores will go a long way toward alleviating the social deadweight loss created by the current patent system. The exclusivity granted by patents is necessary to incentivize innovation. Patents are the instrument selected to fulfill the Constitutional goal of "Promot[ing] the Progress of Science and the Useful Arts."[77] Yet, they come at a cost. The exclusivity conferred upon patentees allows them

[76] It should be noted that the degrees of protection need not increase linearly. It is perfectly reasonable to suggest, for example, that a score of 1 should be accorded with 2-year protection, that 7-years protection should be set in commensuration with a score of 2, and that the compatible protection term with a score of 3 is 10 years. We do not dispute this line of argumentation. However, the calculative discussion is beyond the scope of this Article, and we leave the technical analysis on the proper numeric relationship between scores and protection term to an empirical examination.

[77] U.S. CONST. art. I, § 8, cl. 8.

to charge supra-competitive prices for the use of their inventions, which leads to the exclusion of users who would have paid the competitive price to secure access to the invention. This represents a net loss—deadweight—to society.[78] The forgone transactions resulting from the monopolistic pricing that accompanies patents imply that certain users who would have licensed the invention at a competitive price do not get to enjoy it and the money they would have paid never reaches the patentee.[79] The exclusivity conferred by patents is also undesirable from a distributive perspective as it allows patentees to capture the lion's share of the bargaining surplus.[80] Individuals who wish to use a patented invention must either pay the patentee the price she requests or abstain from using it altogether. The harsh distributive results of patent protection are most obvious in the context of pharmaceutical drugs, where patients often cannot afford to pay the high prices posted by drug manufacturers.[81] The ability of patentees to charge monopolistic prices constitutes a problem not only to consumers, but also to follow-on innovators, who may not be able to pay patentees their asking price.[82] Innovation is a cumulative process. Very few inventions, if any, are new in the strong sense of the term.[83] Innovators invariably rely on prior knowledge in producing new inventions. Adopting a dynamic perspective to innovation makes it clear that excessively strong patent protection may hinder innovation.[84]

Calibrating protection to score would considerably reduce the undesirable side-effects of patent protection. First and foremost, it would lower the *aggregate* years of patent protection. Critically, it would not do so in an arbitrary manner. Our patent system has been justified by commentators as a hypothetical bargain between society and inventors, a quid pro quo. Society grants inventors a limited legal monopoly in exchange for the benefits the latter confer on society in the form of new products and processes. But the

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[78] *See* MCEACHERN, *supra* note 33 at 209 ("[This phenomenon] is called the deadweight loss of monopoly because it is a loss to consumers but a gain to nobody."); Richard A. Posner, *The Social Cost of Monopoly and Regulation*, 83 J. POL. ECON. 807 (1975).

[79] *See* MASSIMO MOTTA, COMPETITION POLICY 41-42 (2004). *Cf.* Bell & Parchomovsky, *supra* note 4 at 240.

[80] Bell & Parchomovsky, *supra* note 4 at 240 ("[T]he monopolist becomes richer than she would be in a competitive market and the [consumer] becomes poorer."); MCEACHERN, *supra* note 33 at 209 ("[T]he monopolist's economic profit comes entirely from what was consumer surplus under perfect competition.").

[81] *See, e.g.*, Kesselheim et al., *supra* note 42 at 867 ("High drug prices […] arise in large parts from the approach to United States has taken to the granting of government-protected monopolies to drug manufacturers…"); Rebecca E. Wolitz, *States, Preemption, and Patented Drug Prices*, 52 SETON HALL L. REV. 385, 388 (2021) ("[E]xtremely expensive patented prescription drugs present a recurrent problem for patients and health systems alike.").

[82] *Supra* notes 36-40.

[83] This dynamic was best captured by Sir Isaac Newtown who famously proclaimed, in a letter addressed to Robert Hooke: "If I have seen further, it is by standing on the shoulders of giants."

[84] *See, e.g.*, Ayres & Parchomovsky, *supra* note 36 at 867 (discussing the dynamic-efficiency approach to patent law).

hypothetical bargain metaphor is clearly incomplete as it fails to explain why all inventors should receive the same compensation (or award) irrespectively of their contribution to society. In standard market transactions the price paid always reflects the value or quality received. The transactional logic used to justify the patent system dictates a differential compensation (or price) system. The same result can be justified by reference to theories of desert.[85] Inventors who invested more time and effort to ensure that their inventions possess a high degree of innovation, utility and non-obviousness deserve higher rewards than their peers who settled for the minimum effort required of them to satisfy the patentability requirements.

Trimming down the protection term based on quality means that the least deserving patents (score 1 patents) would receive the shortest term, while the protection term of the most deserving ones (score 5 patents) would remain unchanged. Adopting our proposal would reduce the total number of patent years given to low-quality by 80%. But the effect does not end there. Since it is reasonable to assume that the number of low-quality patents far exceeds that of high-quality patents, as it is much easier for the reasons we explain to create low-quality inventions, implementation of our proposal would disproportionately affect the *aggregate* protection term enjoyed by low-quality patents. Specifically, the reform would substantially delineate the holdup power of *n* low-quality patentholders from a maximum time period of 20 years to 4.

Moreover, there exists broad consensus among patent theorists that low-quality patents are the weapon of choice of Non-Practicing Entities, or as they are popularly called "patent trolls." Such entities acquire scores of low-quality patents on the cheap and assert them against aspiring up-starts that can ill-afford to litigate.[86] Irrespectively of the merits of the infringement claims—and they may well be justified in certain cases—shortening the protection term for low-quality patents would facilitate follow-on innovation. At present, follow-on innovators who rely on patented inventions must either secure a license from the patent holder or wait *up to 20 years* for the patent to expire. Under our system of scores, the wait would be shortened to 4 years at most – and in many cases it would be even shorter. Also, since the introduction of scores may induce individuals with low-quality inventions not to seek patent protection at all,[87] the salutary effect of our proposal on cumulative innovation is likely to be even greater than first meets the eye. It bears emphasis, that it is nearly impossible to estimate the full social benefit of enhancing the cumulative innovation. Given that innovation is a dynamic process, increasing the rate and pace of cumulative

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[85] *See, e.g.*, Mark A. Lemley, *Ex Ante versus Ex Post Justifications for Intellectual Property Rights*, 71 U. CHI. L. REV. 129, 131 (2004) (discussing intellectual property theories that "seem to provide economic support for the legions of new intellectual property owners who claim a moral entitlement to capture all possible value from [the information they produced].").

[86] We discuss this problem in detail in Section C, below.

[87] For a discussion, see Section B below.

innovation can expedite the production of new technologies, which would result in a virtuous cycle, leading to even more innovation.

(2) Correlating Scores and Infringement Remedies

Another intervention we propose concerns the remedial menu available to patentees. We suggest that courts take into account the score of the litigated patent in fashioning remedies. Specifically, we call on court to withhold preliminary injunctions from patentees whose patents received a score of under 3. In the past, injunctive relief was granted to patentees as a matter of course, as courts adopted a presumption of "irreparable harm" in patent infringement cases.[88] This changed in 2006. In *eBay v. Merc Exchange*,[89] a unanimous Supreme Court ruled that patentees are not automatically eligible to receive injunctive relief even when they are successful. The Court further stated that patentees are required to satisfy the traditional four-factor equitable test, demanding plaintiffs to show: (1) irreparable harm; (2) that remedies at law cannot adequately address their injury; (3) the balance of equities tips in their favor; and (4) no harm to the public from an injunction.[90] In the case of *preliminary injunctions,* a plaintiff is also required to show "likelihood of success of the merits."[91]

The introduction of scores should assist courts in determining this factor. Courts can adopt a *rebuttable presumption* that plaintiffs alleging an infringement of a patent whose score falls *below* 3 are unlikely to be successful on the merit. Patents with a score of 1 or 2 fall on the low side of the quality scale. This does not mean, of course, that they would ultimately be invalidated. However, given the current rate of invalidation in litigation that stands at roughly 50% and encompasses the entire universe of patents, it is fair to adopt a presumption against the issuance of a *preliminary* injunction. It must be born in mind that, in addition to proving the validity of the patent, a plaintiff must show that the defendant infringed it. Again, it is entirely possible that the plaintiff would successfully accomplish this task and would even be able to secure a permanent injunction. That said, however, given that a grant of preliminary injunction often marks the end of the road for defendants, we believe that courts should err on the side of caution when

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[88] *See*, *e.g.*, Smith Int'l, Inc. v. Hughes Tool Co., 718 F.2d 1573, 1581 (Fed. Cir. 1983) ("[W]here the validity and continuing infringement have been clearly established, […] immediate irreparable harm is presumed."). *See also* Christopher B. Seaman, *Permanent Injunctions in Patent Litigation After* eBay: *An Empirical Study*, 101 IOWA L. REV. 1949, 1992 (2016) (noting that in the past, "prevailing patentees were presumed to suffer irreparable harm, and this presumption was rarely rebutted.").

[89] 547 U.S. 388 (2006).

[90] *Id.*, at 391.

[91] See Trebro Mfg., Inc. v. Firefly Equip., LLC, 748 F.3d 1159, 1165 (Fed. Cir. 2014) ("A plaintiff seeking a preliminary injunction must establish that he is likely to succeed on the merits, that he is likely to suffer irreparable harm in the absence of preliminary relief, that the balance of equities tips in his favor, and that an injunction is in the public interest." (quoting *Winter v. Nat. Res. Def. Council, Inc.*, 555 U.S. 7, 20 (2008))).

dealing with low score patents. We would like to note that, if a system of patent scores is implemented, it would allow for future corrections. For example, if experience teaches that even low score patents are rarely invalidated, it would be wise to abolish our rebuttable presumption. Conversely, if experience indicates that even score 3 patents are at a serious peril of reversal, the rebuttable presumption can be extended to such patents, too.

B. *Enhancing the Informational Value of Patents*

The introduction of scores likewise provides an effective fix to the signaling problem, discussed in detail in Part I.[92] As we show in the paragraphs to come, the addition of scores to the review process would transform the position of licensees and defendants vis-à-vis patentholders, in general, and trolls, in particular.

(1) Licensees

Presently, licensees have scant information about the patent in which they are interested. All they know is that the patent was issued. Nothing prevents them from inquiring further and doing their due diligence about the patent. Yet, this process is very costly. Identifying the relevant prior art and researching it can take weeks and typically necessitates expertise that licensees do not have. Furthermore, it is impossible to know the status of a patent for certain until a court determines it. Hence, licensees, like patent holders, prefer not to incur the cost of verifying the quality of patents. Instead, they resort to one of two strategies. First, they can estimate the probability that the patent is invalid. To this end, they can begin with the general reversal rate of patents and adjust it upward or downward based on the specific features of the patent or the patentee. Then, they can use the figure at which they arrive to determine the maximum amount they are willing to pay for the right to use the patent. Second, licensees can insist on the inclusion of a contractual term entitling them to restitution of the licensee fees, ex post, if the patent is found invalid in litigation. Obviously, the inclusion of such a term depends on the consent of the patentee. It is also noteworthy that as we explained earlier, most patents are never challenged in courts and that even though, in principle, licensees can themselves challenge the validity of a licensed patent, patentees can contractually forbid them from doing so.

Introducing patent scores would enable licensees to adopt a better approach, which they cannot currently use. Under our system, every patent would be given a score. The score would be registered together with the patent and would therefore be publicly available. The score would inform potential licensees of the patent quality and the rights they wish to license. If the patent

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[92] *Supra* notes 52-58.

received a high score, licensees would be naturally inclined to pay a higher fee for the right to use it. If, by contrast, the score the patent was assigned is low, licensees may rationally make a much lower offer to the patentee, or even use it without permission and risk being sued. The latter option is a high-risk option that should be reserved to extreme cases. Yet, its very existence should induce patentees to agree to lower licensing fees. Also, it should be remembered that since under our proposal low-quality patents are entitled to a shorter protection term, the infringement would result in much lower damage awards than under the current regime. One of the measures that courts use to assess damages in infringement cases is the hypothetical license measure that represents the amount the patentee could have obtained from a licensee. Our proposal would allow holders of score 1 patent to collect fees for a maximum period of 4 years, as opposed to 20 under the current system.

Scores would improve decision-making by licensees in yet another way. Assume a licensee facing a choice between two patented technologies, A and B. Both technologies are offered at the same price and on identical terms. Under the existing system, the licensee has no informational basis for choosing between the two. The dilemma disappears once scores enter the analysis. A received a score of 2. Assume now, that the patent covering technology A received a score of 2, while the patent on technology B received a score of 4. Patent scores may therefore serve as important tie-breakers for licensee. But the point is more general: the introduction of scores would provide licensees with a better informational basis in choosing among patented products and technologies. The quality of the patent is an important consideration for licensees, independently of the invention it covers. Licensees might be understandably averse to license a technology or a process that may lose its patent protection and become available to competitors for free in the near future.

(2) Litigants

As noted, litigants confront an insurmountable veil of ambiguity with respect to their odds of prevailing in trial. As noted previously, this means that under a binary system necessarily gives rise to misalignments. Being devoid of information regarding their probability of prevailing, righteous plaintiffs are expected to settle for payments that fall short of their suit's actual expected value in order to avert the risk of patent invalidation. Similarly, innocent defendants may well succumb to frivolous plaintiffs and pay an excessive amount in settlement for lacking the ability of properly estimating the odds of their infringement suit.

Our proposed mechanism feeds litigants with relevant information about quality and fixes the misallocation due to the uncertainty imposed by a binary patent system. In general, patent scores not only signal inventions' quality, but also equip society at large with more rigorous indication with respect to

their probability of prevailing in court. This informational surplus is critical for fixing the distortive effect of uncertainty, as it precludes certain actors—typically well-informed corporate entities—from taking advantage of the surrounding ambiguity and extracting an imbalanced settlement agreement. Actors may reasonably rely on the assumption that a lower (resp., higher) score implies a higher (lower) likelihood of reversal, and consequently, accord by estimating the relevant patentee's probability of winning an infringement suit as relatively low (high). This probability would be translated into a possible settlement agreement that better reflects the suit's expected value.[93] Consequently, the misallocation problem is remedied.

To begin with, holders of low-quality patents are less likely to solicit users into a predatory settlement payment: the mechanism of patent scores attenuates the credibility of those patentees' threat to proceed with litigation, since their patent score implies a low probability of actually prevailing in trial. Defendants would thus only accept settlement offers—or propose ones—that involve sufficiently low payments. By the same token, rightsholders to high-quality patents can pursue an infringement suit with more confidence, without being deterred by the prospect of judicial intervention, which is much less likely for inventions that enjoy relatively high scores. Therefore, patentees of high-quality whose inventions are justly monopolized for being, would not be subdued by a modest settlement payout: if infringers indeed wish to avoid trial and eliminate the lawsuit, they would have to transfer sufficiently handsome royalties in the settlement.

(3) Trolling Victims

The provision of scores is even more important for potential and actual defendants in patent infringement cases. One may assume the opposite is correct since defendants have their back against the wall and must therefore fight until the end. This assumption is incorrect, however, as most patent infringement cases settle. Defendants therefore face a "litigate or settle" dilemma. Currently, defendants must decide how to respond to an infringement suit based on very partial information. Like licensees, defendants can gather information about the patents asserted against them. Since the stakes in litigation are much higher than in licensing negotiations, we grant that this option may be cost-effective. Yet, it is very expensive and may thus not be a viable option for many defendants, especially small businesses who can ill-afford the expense. It is important to understand in this context that patentees can select their targets and pick on the most vulnerable ones. This is not true of all patentees, but it is true of patent trolls.

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[93] *See generally* Kathryn E. Spier, *Litigation, in* HANDBOOK OF LAW AND ECONOMICS, VOL. 1 (A. Mitchel Polinsky & Steven Shavell, Eds.) 259, 268-82 (reviewing litigation models that study the effect of a suit's expected value on the damages determined in a settlement agreement).

Patent trolls, or at least the largest ones, compile a large arsenal of patents and then prey on vulnerable targets.[94] It is critical to understand that the lynchpin of the strategy of trolls is *not* to litigate. Litigation is costly and, worse, unpredictable.[95] Accordingly, they select defendants that do not have the wherewithal to fight them in court. Patent trolls do not produce anything. Their adversaries, small upstarts, are strapped for cash, striving to make it in a competitive environment. Such firms and businesses would almost always prefer to settle out of court – or in the colorful parlance of patent scholars "feed the troll."[96]

Patent scores would not put an end to the phenomenon of trolling, but they would change the underlying power relationship. First, recall that under our proposal low quality patents would enjoy only 4 to 8 years of protection, this change would significantly weaken the threat point of patent trolls in their dealings with "putative" infringers. Not only would it limit the ability of trolls to reach exorbitant settlements, but it would also force them to renew their stock of patents more frequently, making the practice of trolling less profitable. Second, the leverage of trolls would be further weakened by our proposal to deny preliminary injunctions to holders of low-quality patents. The issuance of a preliminary injunction can handle a deadly blow to start-up companies that work on a single technology or product. Removing this option in suits involving low-quality patents would therefore allow small companies more elbow room in their dealings with patent trolls. Third, the inclusion of scores would provide defendants with crucial information about the strength of the patent asserted against them. If the patent at issue received a score of 1, or even 2, alleged infringers might be rationally inclined to expend the necessary resources to fight the suit in court. To be sure, litigation would remain a costly option even if our proposal is implemented, but its cost would drop considerably. Judges, too, would know the score of the plaintiff's patent and might be more inclined to invalidate patents that barely passed muster with the USPTO. This means that defendants would not have to invest the same resources as they do now in convincing a judge that the patent should not have been issued in the first place or that its scope is much more limited than was recognized by the USPTO, and thus they did not infringe it. A much smaller investment may suffice.

C. *Changing Patentees' Incentives*

Incorporating scores into the examination process would also change patentees' behavior. As we explained, under the present system, patentees

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[94] *See, e.g.*, Tom Ewing & Robin Feldman, *The Giants Among Us*, 2012 STAN. TECH. L. REV. 1, 1 ("Troll activity is generally reviled by operating companies as falling somewhere between extortion and a drag on innovation.").

[95] *Supra* notes 59-65.

[96] *See generally* Gideon Parchomovsky & Alex Stein, *The Relational Contingency of Rights*, 98 VA. L. REV. 1313 (2012) (demonstrating how wealthier actors take advantage on their counterpart's anticipated litigation expenditures to extract an out-of-court settlement agreement).

have little incentive to invest resources in the quality of their patents, beyond what is needed to get them past the patentability threshold. Since high-quality plays no role in the examination process, investment in *high*-quality represents a pure cost. Adopting a system of scores that correlates protection with quality can transform the field. Patentees with high scores would find themselves in a very different position than ones with lower scores. Not only would the former receive longer and stronger protection relative to the latter, but they would also be able to credibly signal the high-quality of their patents.

Assigning scores to patents is likely to have a profound effect on the behavior of patentees in two ways. Since high score patents would confer significant advantages on patentees, inventors would be motivated to invest more efforts and greater resources into the inventive process in order to produce high-quality inventions. Specifically, inventors would research prior art more thoroughly and then strive to improve their inventions to ensure that they embody a significant (as opposed to sufficient) level of novelty and non-obviousness. Second, inventors would have a built-in incentive to provide the USPTO with their invention and the prior art. Patents scholars have long observed that patent law in its current form provides applicants with a limited incentive to disclose information to the patent office.[97] Since

[97] Specifically, at present, patent law sets a rather narrow disclosure requirement – that an application should be specific so as to "contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable a person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention." *See* 35 U.S.C. § 112(a) (2006). Contributors have suggested that this minimal requirement hardly incentivizes efficient disclosure. *See, e.g.*, Dan L. Burk, *Patent Silences*, 69 VAND. L. REV. 1603 (2016) (reviewing several patent doctrine that encourage patentees to conceal information of pertinence to their invention); Jeanne C. Fromer, *Patent Disclosure*, 94 IOWA L. REV. 539, 544 (2009) ("Due to limited resources, skewed incentives, and too-abstract guidelines, the [USPTO] regularly grants patents that do not meet current standards of disclosure."); Lisa Larrimore Ouellette, *Do Patents Disclose Useful Information*, 25 HARV. J. L. & TECH. 545, 548-49 (2012) (reporting that "only 38% of the patent-reading respondents believe that the patents they were reading were reproductible, which raises serious questions about whether the current enablement standard is generally being met."); Note, *The Disclosure Function of the Patent System (Or Lack Thereof)*, 118 HARV. L. REV. 2007, 2024 (2005) ("[S]ome applicants still withhold crucial information from their disclosures, which diminishes their value to the public."); Gideon Parchomovsky & Michael Mattioli, *Partial Patents*, 111 COLUM. L. REV. 207, 209 (2011) ("[U]nder the existing regime, patentees have every incentive to disclose as little as possible."); Sean B. Seymore, *Heightened Enablement in the Unpredictable Arts*, 56 UCLA L. Rev. 127, 130 (2008) ("[T]he current patent examination framework allows a patentee to obtain a broad claim encompassing millions of compounds enabled by a trivial amount of supporting disclosure."); Jacob S. Sherkow, *Patent Law's Reproducibility Paradox*, 66 DUKE L.J. 885 (2017) ("Patentees for new drugs […] have little incentive to include in their application a full description of the statistical methods used in any of their preclinical research[, and] are encouraged to say little about the methodology of any supporting studies…."); R. Polk Wagner, *Understanding Patent-Quality Mechanisms*, 157 U. PA. L. REV. 2135, 2150-21 (2009) (enumerating several reasons for applicants to be succinct and limit clarity at their disclosures).

patent applications become public eighteen months after their filings, applicants are disposed to provide as little information as possible when applying for a patent. Disclosure of details beyond those necessary to secure patent protection, inures solely to the benefit of the applicant's competitors. The calculus changes dramatically when scores are added. Extensive disclosure is the key to obtaining a high score. Applicants operating under a system of scores would therefore be motivated to share more information with the USPTO than they do today.[98] This, in turn, would make the work of patent examiners easier and more accurate. The information provided by patent applicants forms the basis for the review process.

The introduction of scores is likely to lead inventors who believe that their patents would receive a score of 1 not to seek patent protection at all. It must be born in mind that it is costly to apply for a patent. Even if one assumes that inventors are not perfectly rational, but only moderately so, in the sense that they conduct a rough cost-benefit when deciding to file for a patent, it is likely that many would choose not to incur the cost of applying for a patent if they expect the process to yield a score 1 patent. The reason is simple: under our scheme, the expected value of low score patents would be significantly lower than it is today. Licensees, defendants and courts would be able to identify low-quality patents. The cost of securing a patent would remain roughly the same. Hence, in many cases, it might not make sense for owners of low-quality inventions to incur the relatively high cost of filing for a patent.[99]

D. *Improving the Examination Process*

The use of scores would also improve the quality of the examination process. First, as we have already noted, the inclusion of scores in patent grants would spur applicants to provide more information to the USPTO in patent applications. The improved disclosure would allow patent examiners to conduct a better and faster examination of applications. The richer data supplied by patentees would provide examiners with a better understanding of the invention and its contributions. It would also shorten the time patent examiners spend on prior art searches, as applications would cite more prior art references than they do today. These expected benefits should clearly offset the extra time patent examiners would have to invest in assigning scores to patents. Experienced examiners who are intimately familiar with the state of the art in the industry in which they specialize should be able to

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[98] This of course does not mean that applicants will disclose all the information available to them. They will clearly not disclosure adverse information of which they are aware, such as prior art that may be used to deny their application. Selective disclosure will continue to exist even if our proposal is implemented. *See*, *e.g.*, Bhaven N. Sampat, *When Do Applicants Search for Prior Art?*, 53 J. L. & ECON. 399 (2010) (offering an empirical examination of patentees' strategic citation to prior art).

[99] We are fully cognizant of the fact that inventors of low-quality inventors may seek other forms of intellectual property protection. We discuss this possibility extensively in Part III, *infra.*

assign scores to the vast majority of inventions rather easily, especially when they can compare them to other inventions submitted for their review. However, the benefits of a system of scores do not end with improved disclosure.

Adopting a system of scores would also significantly improve internal controls within the USPTO. Empirical studies of the USPTO revealed, *inter alia*, the average examination time of applications,[100] the number of comments examiners write,[101] rejection and acceptance rates,[102] and the timing of decisions.[103] Yet, at present, there is almost no information about the quality of the work of individual examiners and no metric for assessing this dimension. Patent scores provide the missing metric. The introduction of scores would allow for inter-personal comparisons between different examiners. The use of scores would make outliers readily apparent. This, in turn, would allow the USPTO to provide personalized training to examiners and ensure uniformity among them.

The use of scores would also enable the USPTO to conduct an accurate analysis of the quality of patents in different fields of innovations. Time and again, commentators have argued that the quality of patents in certain areas of innovation is of especially low-quality. Such claims are typically raised with respect to new technological fields, such as biotechnology and telecommunications. If our proposal is implemented, the USPTO and its critics will be able to engage in an informed discussion about the quality of patents in given areas. By comparing summary statistics from different fields of innovation, researchers will have a better handle on the quality of patents in different fields.

Finally, the addition of scores would make it possible for the USPTO to assess its own overall performance by analyzing how patents with different quality score fare in court. If scores are assigned diligently by examiners, we should expect to see a higher invalidation rate of patents that received a score of 1 than of patents that received a score of 2,3,4 and 5. More generally, there should be an inverse correlation between scores and invalidation rates – i.e., as the score gets higher, the invalidation rate drops. This proposition should be the case for all areas of examination. If the USPTO notices that courts invalidate a relatively high number of score 5 patents in a particular field, or worse, across the board, it is a sign that something is amiss in the

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[100] Frakes & Wasserman, *Time Allocation*, *supra* note 22.

[101] Frakes & Wasserman, *Patent Office Cohorts*, *supra* note 22. *See also* Douglas Lichtman, *Rethinking Prosecution History Estoppel*, 71 U. CHI. L. REV. 151 (2004) (empirically demonstrating disparities across examiners).

[102] *Supra* note 5.

[103] *See* Michael D. Frakes & Melissa F. Wasserman, *Procrastination in the Workplace: Evidence from the U.S. Patent Office*, NBER Working Paper no. 22987 (2017). Available at https://www.nber.org/papers/w22987 [https://perma.cc/67QN-TXAL] (indicating procrastination among examiners, in that roughly 50% of the substantive reports are filed immediately prior to the operable deadline in order to meet it).

examination process and that corrective measures ought to be implemented. More generally, the use of scores would allow the USPTO to identify problems in the examination process that are hidden from view under the current system.

III. POTENTIAL OBJECTIONS

In this Part, we raise four possible objections to our proposal and evaluate their merits. The first objection that we address is that the introduction of scores would lead inventors who expect their invention to get a low score to use trade secrecy, instead of patent protection, for their inventions. A second criticism that may be leveled at our proposal is that it would increase in number of reexaminations and appeals, and thus, increase the workload of the USPTO and the courts. The third criticism is that the implementation of our proposal may perversely lead examiners to approve more applications than it does now. The reason is that some applications that are rejected under the current system would be approved with a low score of 1. The fourth, and final, argument that can be raised against our proposal is that it is not the quality of patents that should concern us, but rather the *social benefit of inventions*. In the paragraphs below, we discuss each of these objections. It is important to note at the outset that while each objection is not without merit, we would demonstrate that the potential benefits of adopting a system of scores far outweigh the potential costs.

A. *Trade Secrecy*

Patents are not the only form of intellectual property protection that can be used to appropriate new products, processes and compositions of matter. Trade secrecy can also be employed to this end. Almost all patentable inventions may be claimed, instead, as trade secrets.[104] The prerequisites for securing trade secrets protection are less strict than the preconditions for obtaining patent protection. Trade secrets law can be used to protect any form of commercially valuable information that is not publicly known, provided that reasonable measures were taken to secure secrecy. The subject matter of trade secrets law is thus broader than that of patent law – trade secrets protection also applies to discoveries and information that is neither novel nor nonobvious.[105] Yet, there is an important exception to trade secrets protection that is not recognized under patent law: reverse

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[104] *See, e.g.*, I.P.L. Png, *Law and Innovation: Evidence from State Trade Secrets Laws*, 99 REV. ECON. & STAT. 167 (2017) (hereinafter: Png, *Law and Innovation*) and I.P.L. Png, *Secrecy and Patents: Theory and Evidence from the Uniform Trade Secrets Act*, 2 STRATEGY SCI. 176 (2017) (identifying that trade secrets and patents are substitutes in appropriating returns from innovation).

[105] *See, e.g.*, J. Jonas Anderson, *Secret Inventions*, 26 BERKELEY TECH. L.J. 917, 925 (2011) ("[S]ecret inventions require a measure of self-help in order to exclude. By choosing secrecy, inventors avoid the cost of obtaining a patent and the risky, costly business of patent enforcement.").

engineering.[106] Hence, information that may be derived via reverse engineering can be protected under trade secrets law only to the extent that it is not accessible to the public. This, of course, critically impairs the marketability of products and processes that may be reversed engineered and are protected by trade secrecy. It bears emphasis that patent and trade secrets protection cannot be employed simultaneously. The two modes of protection constitute a perfect example of legal substitutes: patent protection requires disclosure, whereas trade secrecy necessitates non- (or very limited) disclosure.[107] The two types of protection cannot coexist with respect to the same subject matter.

Intellectual property scholars and practitioners are well aware of the tradeoff between patent and trade secrecy, as well as of the mutual exclusivity of both types of protection.[108] Empirical studies suggest that in certain cases, firms and individuals prefer trade secrets protection to patent protection.[109] The reasons are ample. Trade secrecy can be obtained at a lower cost,[110] can—at least in theory—last forever,[111] and requires no disclosure of valuable information as a prerequisite for protection;[112] patents, by contrast, are more expensive to secure, involve a cumbersome and uncertain application process that may take many months, lapse after 20 years, and entail the duty

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[106] *Id.*, at 924-25 ("Secret inventions risk discovery through independent invention or reverse engineering… [and] nothing prevents the discoverer from commercializing [the secret]."). *See also* Oren Bar-Gill & Gideon Parchomovsky, *Law and the Boundaries of Technology-Intensive Firms*, 157 U. PENN. L. REV. 1649, 1677 (2009) ("[A] trade secret does not confer exclusivity in the subject matter of the secret, as the law does not protect against reverse engineering or independent discovery of the trade secret."); Richard A. Posner, *Intellectual Property: The Law and Economics Approach*, 19 J. ECON. PERSP. 57, 62 (2005) ("A competitor is free to appropriate a trade secret by reverse engineering or independent discovery, or because the firm that possessed the trade secret failed through negligence or inadvertence to keep it secret.").

[107] *See, e.g.*, David D. Friedman et al., *Some Economics of Trade Secret Law*, 5 J. ECON. PERSP. 61, 64 (2001) ("[P]atenting results in the disclosure of socially valuable information, and trade secret protection does not.").

[108] *See, e.g.*, Mark A. Lemley, *The Surprising Virtues of Treating Trade Secrets as IP Rights*, 61 STAN. L. REV. 311, 314 (2008) ("[T]he law operates in various ways to encourage inventors to choose patent over trade secret protection where both are possible."). For formal approaches see, e.g., Sudipto Bhattacharya & Sergei Guriev, *Patents vs. Trade Secrets: Knowledge Licensing and Spillover*, 4 J. EUR. ECON. ASSOC. 1112 (2006).

[109] *See generally* David S. Levine & Ted Sichelman, *Why Do Startups Use Trade Secrets?* 94 NOTRE DAME L. REV. 751 (2018); Richard C. Levin et al., *Appropriating the Returns from Industrial Research and Development*, 3 BROOKINGS PAPERS ON ECON. ACTIVITY 783 (1987); Andrew A. Schwartz, *the Corporate Preference for Trade Secret*, 74 OHIO ST. L.J. 623 (2013).

[110] Friedman et al., *supra* note 107 at 63 (discussing the substantial fixed costs of preparing a patent application vis-à-vis the cost of establishing a trade secret); Mark A. Lemley, *supra* note 108, at 313 ("[Trade secrecy] is cheaper and quicker to obtain, since it doesn't require government approval….").

[111] *See, e.g.*, Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590, 1622 (2011) ("[T]rade secrecy protection can theoretically provide even more powerful incentives than patents because trade secrecy rights are potentially infinite in duration.").

[112] Friedman et al., *supra* note 107.

to make valuable information public. Implementing our proposal would make trade secrecy even more attractive to owners of low-quality inventions. Under our scheme, the costs of applying for a patent would remain the same, but the expected benefit from a low-quality patent would drop precipitously. We therefore expect to see a shift from patent protection to trade secrets protection, especially among inventors who expect their patents to achieve a low score.

We openly acknowledge this possibility. Moreover, we admit that our proposal may cause a shift from patent protection to trade secrets protection. This is not the point, however. The question is what are, if any, the welfare losses (or gains) that may result from such a shift? A review of the academic literature reveals that the answer is inconclusive. Scholars have failed to form a consensus about which mode of protection is more (or less) socially desirable.[113] Patents have a built-in expiration date (20 years from filing), whereas trade secrets do not. Yet, in reality, trade secrets are often disclosed or abandoned, as the rate of technological change renders them obsolete and devoid of economic value to their holders.[114] Furthermore, trade secrecy, unlike patent protection, allows for reverse engineering and independent creation. Hence, third parties can reproduce trade secrets as long as they did not obtain them illicitly.[115] Finally, trade secrecy, by contrast to patents, does not imply exclusivity. Several individuals or entities may be in possession of the same trade secrets and any of them can simply disclose it to the public.[116] Theorists appear to be in consensus, however, that patents outpace trade secrets in fostering cumulative innovation.[117] Because patent applications are made public eighteen months after filing, the information contained in them may inspire the development of new inventions. As importantly, since almost all patents expire within 20 years from filing,[118] and a sizable portion ever earlier since their holders choose not to renew them, all patented inventions can be used by the rest of the world within two

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[113] *Id.* (comparing the costs and benefits of each regime).

[114] *See, e.g.*, Camilla A. Hrdy & Mark A. Lemley, *Abandoning Trade Secrets*, 73 STAN. L. REV. 1 (2021) (arguing that the conventional wisdom—suggesting that trade secrets last indefinitely—is mistaken, since firms may lose their trade secrets by failing to derive economic value from them).

[115] *Supra* note 106.

[116] Bar-Gill & Parchomovsky, *supra* note 106 at 1676 ("[T]rade secrets do not confer exclusivity upon their holder; a trade secret may be held by multiple holders at the same time.").

[117] *See*, *e.g.*, Png, *Law and Innovation*, *supra* note 104 at 168 (pointing out that trade secrecy undermines knowledge spillovers).

[118] The exception is pharmaceutical patents whose protection may be extended to account for the regulatory process and the long examination process. *See* 35 U.S.C. § 156 (2006); Ann Kotze, *Reining in Patent Term Extensions for Related Pharmaceutical Products Post*-Photocure *and* Ortho-McNeil, 106 NW. U. L. REV. 1419, 1421 (2012) ("The Patent Term Extension provision provides up to five additional years on a patent to compensate for the patent term length and potential profits lost to the increasingly lengthy period of mandatory Food and Drug Administration (FDA) regulatory testing.").

decades. Trade secrets do not become similarly public and the information contained in them cannot be used by others.

The empirical and theoretic literature directly bear on our proposal. First, the empirical literature suggesting that inventors harbor a preference for trade secrets protection over patent protection, indicates that inventors who can take use trade secrecy to protect their innovations would be inclined to do so, irrespectively of our proposal. Second, no substitution from patent protection to trade secrecy is likely among inventors of inventions that can be reverse engineered. This implies that by and large developers of new pharmaceutical drugs, chemical compounds and products and processes to be marketed to the public would continue to seek patent protection. Trade secrecy would be of no avail to them the information embodied in their inventions can be derived via reverse engineering. In the case of pharmaceutical drugs, generic companies know the ingredients and the formulation within weeks from the release of a drug. It is the patent that stands in their way and prevents them from marketing generic substitutes. The same is true of many patented products, from hardware tools to production processes. Patent protection is vital in all these cases. Third, the substitution from patent to trade secrets protection, to the extent that it would happen, would affect inventors who expect to receive a low-quality patent. Recall that the degree of innovation and non-obviousness in low-quality inventions is rather minimal. Consequently, there is a good chance that the information that may be suppressed from the public on account of the use of secrecy would be discovered or developed independently. Fourth, and finally, it is impossible to know, given the state of empirical research, whether the shift from patent to trade secrecy protection enhances or decreases social welfare.

At the end of the day, then, it appears that even though there may well be a shift from patent to trade secrets protection as a result of the implementation of our proposal, it is not clear that the effect would be detrimental. More importantly, even if there are going to be some costs from the substitution to trade secrecy, they would not be significant and the benefits of our proposal would far outweigh them.

B. *Reexaminations and Appeals*

The second criticism of our proposal focuses on its effect on reexaminations and appeals. According to this argument, the introduction of scores would lead to a rise in the number reexaminations and appeals and thus increase the workload of the USPTO and the federal courts. Extant law allows anyone to seek reexamination of a patent during its period of enforceability.[119] This option is used by applicants whose application was

[119] Specifically, reexamination is available in two forms. The first is an ex parte reexamination process, from which third parties are excluded even if they are the initiators. *See* 35 U.S.C. § 301-307 (2006). The second is an inter partes reexamination proceeding,

denied or not granted fully, on the one hand, and by third parties who seek to reverse a decision to grant a patent or restrict the scope of its claims, on the other. The inclusion of scores in the review process would give both applicants and opposers new grounds for filing for a reexamination and in case they fail to achieve the desired result at the USPTO, appeal the decision in court.

We readily concede that the introduction of scores would likely lead to a higher rate of reexamination requests and appeals. The addition of a new dimension to any process, not just patent examination, is liable to produce this effect. One way to address the problem is not to allow reexaminations or appeals of scores. A less extreme solution is to allow reexamination and forbid appeals, or vice versa. Leaving score decisions exclusively to the discretion of a single examiner is patently unfair. We do not endorse either of these solutions. We believe that reexaminations and appeals should be *allowed*. Given the implications of our system for patentees, it would be unfair to deny them the right to seek reexamination of scores and file appeals in appropriate cases. Also, it is critical to allow reexaminations and appeals to incentivize patent examiners to assign scores professionally and ethically. Bestowing immunity upon them can lead to neglect and even abuse. This leaves us with the task of evaluating the effects of permitting reexaminations and appeals.

At first blush, one might think that at the very least, many applicants whose applications received a sub-3 score would be inclined to appeal the decision. Similarly, third parties might seek reexamination of high-score patents and appeal decisions that are unfavorable to them. This analysis is in error. The actual rate of reexaminations and appeals critically depends on two factors that cannot be determined in the abstract: success rates and costs. Both factors can be affected by the USPTO and the courts.

Insofar as success rates are concerned, it is critical to remember that, all things being equal, scores are as likely to go down as they are to go up or remain unchanged. This means that at least in the abstract there is a substantial chance that the original score would either stay the same or go down. Yet, the probabilities in our case are not exogenous; they do not depend on pure chance. If the examiners of the USPTO do a good job, the likelihood that the score assigned to patent would be changed upon reexamination or appeal decreases. If examiners do their job properly, only in rare cases would their initial decisions be overturned. The cost involved in reexamination and appeal processes would serve as an additional screen. It should also be remembered that the vast majority of patents are never commercialized and produce no revenues to their holders. Thus, patentees who seek reexamination would clearly take a risk. Granted, some patentees (and third parties) would take advantage of the reexamination option and

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wherein challengers are allowed to actively participate. *See* 35 U.S.C. § 311-318 (2006). For a detailed review see Parchomovsky & Mattioli, *supra* note 97 at 220-21.

may even file appeals. And that is a good thing. We do not want to deter patentees from challenging scores.

Accordingly, we do not expect the USPTO to be inundated with reexamination requests. Nor would courts be overwhelmed with appeals. But even if one finds our analysis excessively sanguine, the problem would not be insoluble. Reexamination fees can be adjusted to the number of requests. The cost should not and would not fall on society. It should be fully borne by patentees. The fees, in our case, constitute a ready internalization mechanism and should be raised or lowered to offset the costs borne by the USPTO. Raising the fee would allow the USPTO to hire additional employees to process new requests. As long as the costs of the additional processes are borne by the relevant private actors, society should be no worse off.

C. *Can Scores lead to More Patents?*

The third objection to our proposal emanates from the law and psychology literature. Studies in psychology suggest that the introduction of new options can change individual behavior. These studies are relevant to our scheme because the addition of scores to the examination process—especially low-scores—can change the rate of approval by patent examiners. Currently, boarder-line applications that do not clearly satisfy the patentability criteria, face a real chance of rejection. Patent examiners cannot consciously grant such patents because of the high cost they impose on society. Once scores are implemented the analysis changes. Instead of rejecting boarder-line applications may be approved and assigned a score of 1. Doing this allows patent reviewers to "split the difference" give something to the applicant without imposing an excessively high cost on the public.

We cannot categorically deny this possibility. However, in the patent context it presents a very small risk. Empirical studies of the patent system suggest that at the most only 3 percent of applications are rejected.[120] Hence, the adverse effect we discussed pertains, if at all, to only 3 percent of all applications. Recall that the aforementioned effect does not apply to all rejected applications, but rather only to a much smaller subset of boarder-line applications. The analysis does not end here, however. Other studies in law and psychology suggest that when actors are faced with a binary choice with one of the results being extreme or even unfair, they strive to avoid the extreme option.[121] This finding suggests that if patent examiners perceive

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[120] *Supra* note 10.

[121] Along similar lines, some have noted that judges and jurors are sensitive to the severity of the sanction, suggesting that the probability of conviction may be negatively correlated with the magnitude of punishment. *See, e.g.*, James Andreoni, *Reasonable Doubt and the Optimal Magnitude of Fines: Should the Penalty Fit the Crime?*, 22 RAND J. ECON. 385 (1991); Ehud Guttel & Doron Teichman, *Criminal Sanctions in the Defense of the Innocent*, 110 MICH. L. REV. 597 (2012); Rita James-Simon & Linda Mahan, *Quantifying Burdens of Proof: A View from the Bench, the Jury and the Classroom*, 5 L. & SOC'Y REV. 319 (1971).

rejections of applications as an extreme or unfair result, they are likely to approve undeserving boarder-line applications. *If* they do, they impose a very high cost on society. Under extant law, such patents receive full protection, which their holders enjoy for a term of 20 years. Under our proposal, by contrast, patents that receive a score of 1 would only be protected for a period of 4 years and the scope of the protection be much more limited. Thus, it is far from clear that implementation of our proposal would increase the number of approved patents, and moreover, it is highly doubtful that it would be welfare diminishing; on the contrary, the opposite is likely to be true.

D. *Patent Quality and Social Welfare*

The fourth, and final, objection that may be raised with respect to our proposal is that what society should care about it the social benefit of inventions, not patent quality.[122] Some inventions representing a minor advancement over the prior art and contain a minimal degree of novelty may dramatically enhance social welfare. Contrariwise, there could be high quality patents that may turn out to be of little significance to society.

In our opinion, this objection is unpersuasive for several reasons. First, while it is entirely possible that certain low-quality patents may be socially valuable and some high-quality patents may be of little use, it does little to undermine our proposal. The patentability criteria—novelty, usefulness and non-obviousness—have not been selected arbitrarily. They are the mechanisms used to separate inventions deserving from patent protection from those that do not. From a social standpoint, only inventions that satisfy the patentability criteria represent sufficient *benefit to society* that justifies the price of patent protection. In other words, there is meaningful correlation between success on the patentability criteria and social welfare. Accordingly, in principle, the greater the degree of innovation, usefulness and obviousness embedded in invention, the greater its social significance. Granted, it is not true in all cases, but the exceptions do not prove the rule.

Second, the issue is not whether discrepancies may arise between our system of scores and social utility, but rather whether society might be worse off if our system is implemented. The existence of high-quality patents that offer no benefit to society is not a problem at all. Even the highest-quality patents, i.e., score 5 patents, would *not* receive greater protection than *all* patents currently receive. So, society cannot be worse off in this respect. Furthermore, those high- quality patents that are of absolutely no interest to society impose no cost on third parties as they would not be commercialized or licensed. They would simply lie fallow until they expire.

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[122] For a comprehensive discussion on the proper definition of patent quality see Christi J. Guerrini, *Defining Patent Quality*, 82 FORDHAM L. REV. 3091 (2014).

As for low-quality patents that are socially important, the question with respect to such patents is two-fold: first, would implementation of our system of score suppress such as inventions? Second, if the answer to the first question is yes, is the expected-cost greater than the expected-benefit? We address these questions in order.

We do not think that our proposal would substantially suppress low-quality inventions. Low-quality patents typically embody small improvements over the prior art. This means that inventors of low-quality inventors must, on average, expend fewer resources and less effort on developing their inventions. The lower reward afforded to such inventions under our proposal may therefore suffice to secure their production. True, developers of low-quality inventions are not confined to patent protection and may choose to protect their inventions via trade secrecy. Yet, as we explained earlier, many inventions cannot be effectively protected under trade secrets law. Those inventions suitable for trade secrets protection would probably be claimed as trade secrets irrespectively of our proposal. Thus, only a relatively small subset of low-quality inventions may be adversely affected by our proposal and these inventions are unlikely to be of great social utility.

This brings us to the second question that concerns the net effect of our proposal. The benefits stemming from our proposal are highly likely to dwarf the cost associated with a modest drop in the number of low-quality inventions. Recall that low-quality inventions impose the highest social on society. Our proposal dramatically attenuates this problem. But the potential benefits of our score system do not end there. Our scheme also reduces the cost associated with average-quality, improves the informational signals of patents and enhances the operation of the USPTO.

CONCLUSION

In this Article, we proposed a novel design for our patent system that substantially improves its functioning. For decades, scholars have bemoaned the prevalence of low-quality patents – the root cause of the main ailments of our patent systems. Low-quality patents generate a sizeable portion of the social deadweight loss associated with patent protection, inhibit cumulative innovation, facilitate the activity of patent trolls, engender excessive litigation and unfair settlements, dilute the informational signal of patents and distort the allocation of labor and resources within the USPTO.

As we demonstrated a major contributor to the omnipresence of low-quality patents is the binary nature of the existing patent system. Currently, patent examiners face a binary choice when they review applications. They can either deny the application or grant it. Under this design, 97% of all applications are granted. Once an application is granted, the underlying invention receives a uniform level of protection. Worse yet, by structuring patentability as a threshold examination, our patent system fails to

incentivize inventors to improve inventions beyond the bare minimum necessary to secure patent protection. Binarity also deprives patentees, licensees and third parties of the ability to distinguish high- from low-quality inventions, which creates uncertainty, foments litigation and dilutes the capability of patents to signal quality.

To remedy these problems, we called for the introduction of patent scores into the review process. Under our proposal, every approved invention would be assigned a score from 1 to 5 commensurate with its quality. The quality of inventions would be assessed based on the existing patentability criteria of novelty, usefulness and non-obviousness. The score of a patent would determine its level of protection, which would dramatically alleviate the deadweight loss and holdup problems associated with patent protection. The use of scores would also motivate inventors to develop their inventions beyond the bare minimum necessary to secure patent protection in order to receive greater protection and signal the high-quality of their inventions to the market. As importantly, the addition of scores would enhance the quality of information available to market actors, allowing them to properly assess the strength of the patents they wish to license or those asserted against them. Finally, the employment of patent scores is expected to improve the USPTO review process, by allowing scrutiny and inter-personal comparison and enabling comparability among different fields of innovation.