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COMPARATIVE PATENT QUALITY

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ABSTRACT

One of the most urgent problems with the US patent system is that there are too many patents of poor quality. Most blame the US Patent and Trademark Office (USPTO) – its mistakes, overly generous grant rate, and lack of consistency. But, the quality and quantity of patents in force is the product of three sets of decisions: to submit an application of certain quality (by the applicant), to grant the patent (by the patent office), and to renew a patent and keep it in force (by the applicant/patentee). Startling, there is no consensus way to measure patent quality. This article addresses these shortcomings by developing new, comparative ways to measure patent quality, using the benchmark of the European Patent Office (EPO), viewed as the “gold standard” for patent quality. Tracking the progress of patent submissions, grants, and renewals, including of close to 100,000 applications filed at both the EPO and USPTO, it reveals subtle and thus far overlooked differences with implications for how the US should implement and prioritize improvements to patent quality.

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COMPARATIVE PATENT QUALITY¹

On June 8, 1999, the Patent Office, like it does every Tuesday,² published the names and numbers of newly issued patents. Among them was the 6,032,137, a patent that described a way of depositing a check by imaging and sending it, rather than physically transferring it to the bank.

³ The inventor, Claudio Ballard, tried for several years to develop the invention. He failed, but the technology thrived. After unsuccessful talks with JP Morgan Chase, Ballard's company, DataTreasury, sued a dozen or so banks and companies for patent infringement.⁴ In 2003, Congress passed the "Check 21" Act, clearing the way for check imaging to become standard.⁵ In February 2006, DataTreasury used the '137 and related patents and used them to sue 30 banks.⁶ In 2010, after DataTreasury won its first lawsuit, including based on the finding that JP Morgan had knowingly infringed Ballard's patents,⁷ Ballard was named inventor of the year.⁸

In 2013, Fidelity National Information Services, after being sued by Ballard, asked the USPTO to take a second look at the Ballard patents. It agreed. In 2015, a panel of patent judges revoked the '137 patent as overly broad and vague, and therefore invalid.⁹ The Community

¹ © Colleen Chien, 2016. I thank Deitmar Harhoff, Christian Helmers, Arti Rai, Norman Siebrasse, Tom Cotter, Fabian Gaessler, Melissa Wasserman, Mark Lemley, Jorge Contreras, Michael Risch, Ted Sichelman, and audiences at Stanford, University of Washington, University of San Diego, and various other conferences for their comments and suggestions, and to Reuben Bauer, John McAdams, Theresa Yuan, Alita Carbone, Max Looper, Kali Frampton, Arun Sharma, Rajan Agrawal and Emma Stone for research assistance.

² With a few exceptions, since Tuesday, January 18, 1848 (correspondence with the USPTO on file with the author).

³ U.S. Patent No. 6,032,137 (issued Feb 29, 2000).

⁴ Jennifer A. Kingson, *Small Company is Specializing in Suing Banks*, N.Y. TIMES (Dec. 25, 2004), at http://www.nytimes.com/2004/12/25/business/small-company-is-specializing-in-suing-banks.html?_r=0. (Cases include: Data Treasury Corp v. First Data Corp, et al., N.D.Tex. 3:02-cv-02429; Datatreasury Corp v. First Data Corp, et al., E.D.Tex. 5:02-cv-00094-DF-CMC; DataTreasury Corp v. Electronic Data Sys, N.D.Tex. 3:02-cv-02643-K; DataTreasury Corp v. Bank One Corporation, N.D.Tex. 3:03-cv-00059; Datatreasury Corp v. Ingenico S.A., et al. E.D.Tex. 5:02-cv-00095-DF-CMC; Datatreasury Corp v. J.P. Morgan Chase Co, et al., E.D.Tex. 5:02-cv-00124-DF-CMC.)

⁵ See Kingson, *supra* note ____.

⁶ DataTreasury Corporation v. Wells Fargo & Company, et al., E.D.Tex. 2:06-cv-00072-DF-CE.

⁷ Jim Hammerand, *U.S. Bank Ordered To Pay \$53 Million In Check Imaging Lawsuit*, MINNEAPOLIS/ST. PAUL BUSINESS JOURNAL (Sept. 9, 2010), available at <http://www.bizjournals.com/twincities/stories/2010/09/27/daily20.html> (last visited 6/7/2016).

⁸ *DataTreasury Founder Claudio Ballard Named 2010 'Inventor of the Year' by U.S. Business and Industry Council*, BUSINESS WIRE (Oct. 5, 2010), available at <http://www.businesswire.com/news/home/20101005007171/en/DataTreasury-Founder-Claudio-Ballard-Named-2010-%E2%80%9CInventor%20-%E2%80%9CInventor#.VgFXdBFVhBc> (last visited 6/7/2016).

⁹ Matthew Bultman, *DataTreasury Patents Nixed by PTAB in AIA Review*, Law360 (Apr. 29, 2015), available at <http://www.law360.com/articles/649511/datatreasury-patents-nixed-by-ptab-in-aia-review> (last visited 6/7/2016) (describing the invalidation of the '137 and 5,910,988 patents).

Bankers hailed the verdict “a victory for community banks.”¹⁰ By that time DataTreasury and its two employees had already collected \$350M in licensing fees.¹¹

Patent 8,112,504, filed by James Logan and others, followed a similar path.¹² In the 1990s, Logan had attempted to develop an alternative to radio – a music player that would deliver music and content based on past listening habits. He failed.¹³ But through a series of legal maneuvers involving multiple patent examiners, Logan was able to get the ‘504 patent issued in 2012, more than a decade after he first told the Patent Office about the invention.¹⁴ Logan used the patent to sue Apple Inc. multiple times,¹⁵ and demanded fees from dozens of podcasters. Podcasters like Marc Maron of the show “WTF” reacted strongly, saying of the campaign, “It’s serious bullshit.”¹⁶ The Electronic Frontier Foundation launched a “Save Podcasting” campaign, attracting over a thousand donors to fund the PTO’s legal review of the patent.¹⁷ On April 11, 2015, the Office decided that it had been a mistake to issue the patent in the first place. The technology wasn’t novel – it had previously been invented by the Canadian Broadcasting Corporation, and was obvious in light of work CNN had done.¹⁸

Stories like these contribute to the perception that one of the most – if not the most – significant problems with the patent system is that there are too many patents of poor quality.¹⁹ Mistaken transfers, like the \$350M paid from banks to DataTreasury’s invalid patents, lead to higher prices and a loss of consumer welfare.²⁰ The dynamic effect of allowing patents over routine and incremental advances that would have happened anyway has led to the growth in

¹⁰ *ICBA Applauds Patent Board’s Ruling against DataTreasury*, INDEPENDENT COMMUNITY BANKERS OF AMERICA, (May 8, 2015), available at <https://www.icba.org/news/newsreleasedetail.cfm?ItemNumber=293787&navItemNumber=183939> (last visited 6/7/2016).

¹¹ Alex Lawson, *Controversial DataTreasury Patents Face Biz Method Review*, LAW360 (Nov. 8, 2013), available at <http://www.law360.com/articles/487185/controversial-datatreasury-patents-face-biz-method-review> (last visited 6/7/2016).

¹² Joe Mullin, *Infamous “Podcasting Patent” Knocked Out*, ARS TECHNICA, (Apr. 10, 2015), available at <http://arstechnica.com/tech-policy/2015/04/infamous-podcasting-patent-knocked-out-in-patent-office-challenge/> (last visited 6/7/2016).

¹³ *Id.*

¹⁴ File History of Patent 8,112,504 (available at <http://portal.uspto.gov/pair/PublicPair>), showing that the ‘504 is a divisional of the 09/782,546 patent application, filed 02-13-2001, which in turn is a divisional of the 08/724,813 application, filed 10-02-1996).

¹⁵ *Personal Audio, LLC v. Apple, Inc et al.*, (E.D.Tex. 2010), 9:09-cv-00111-RC; *Personal Audio, LLC v. Apple, Inc.* (E.D.Tex. 2010) 9:11-cv-00120-RC; *Personal Audio, LLC v. Apple, Inc.*, 2011 U.S. Dist. LEXIS 83746 (E.D. Tex. 2011).

¹⁶ Marc Maron, *Podcasters are Under Attack from Patent Trolls*, WTF WITH MARC MARON (Mar. 4, 2013), available at http://www.wtfpod.com/dispatches/entries/podcasters_are_under_attack_from_patent_trolls.

¹⁷ Daniel Nazer, *UPDATE: EFF Fights Patent Troll Demand for Save Podcasting Campaign Donor Information*, ELECTRONIC FRONTIER FOUNDATION (Mar. 31, 2014), available at <https://www.eff.org/deeplinks/2014/01/eff-fights-patent-troll-demand-eff-podcast-donor-information>.

¹⁸ PTAB Decision, *EFF v. Personal Audio, LLC Case IPR2014-00070* (available at <https://www.eff.org/document/uspto-decision>)

¹⁹ DataTreasury’s patents, in fact, motivated passage of the America Invents Act as described in Ryan Davis, *Singled Out In Patent Bill, DataTreasury Files New Suit*, LAW360 (Sept. 9, 2009), available at <http://www.law360.com/ip/articles/270394>.

²⁰ *See, e.g.* 2003 FTC IP Report, *supra* note ___, ch. 1, at 2.

certain types of patents outstripping the growth in R&D (see FIG __)²¹ and a more general tax on innovation, as small and large firms dedicate resources to filing applications to avoid having to pay licensing fees to others.²² The perception that the Patent Office makes many mistakes – 42% of the patents that are reviewed by courts,²³ and a much higher share of patents that the Patent Office chooses to review based on petitions are overturned²⁴ – invites legal maneuvers and game playing by applicants. One such tactic involves refiling the same patent multiple times until a favorable outcome is achieved²⁵ – even if it takes over a decade, as in the case of the podcasting patent.

Policy interest in patent quality has reached a new high recently, as the growth in patent litigation based business models has attracted the attention of Congress,²⁶ Supreme Court justices,²⁷ President Obama,²⁸ and numerous government agencies including the Federal Trade Commission,²⁹ and Department of Justice.³⁰ In 2015, the Director of the USPTO launched an Enhanced Patent Quality Initiative,³¹ making patent quality the cornerstone of her administration. That year, the House Judiciary Committee, with jurisdiction over the courts, initiated an investigation into “issues related to patent quality” and tasked the General Accounting Office with the production of lengthy reports on the topic.³² Volumes have been written about the

²¹ *Infra* Part II.

²² Colleen V. Chien, *From Arms Race to Marketplace: The New Complex Patent Ecosystem and Its Implications for the Patent System* (“Arms Race”), 62 HASTINGS L. J. 297 (describing the origins and practice of defensive patenting, the filing of patents in order to ensure freedom to operate and pay reduced license fees, by large and small firms).

²³ John R. Allison, Mark A. Lemley, and David R. Schwartz, *Understanding the Realities of Modern Patent Litigation*, 92 TEXAS L. REV. 1769, 1787 (2014)

²⁴ *Patent Public Advisory Committee Quarterly Meeting: Patent Trial and Appeal Board Update*, USPTO 3 (Feb. 19, 2015), available at http://www.uspto.gov/sites/default/files/documents/20150219_PPAC_PTAB_Update.pdf (showing that 84% of IPR cases have all or some of their claims invalidated).

²⁵ Mark A. Lemley & Kimberly A. Moore, *Ending Abuse of Patent Continuations*, 84 B.U.L.R. 63, 66-71 (2004). (describing and critiquing the practice of allowing applicants to seek without limit review of their patent applications), see also *infra* Part III.

²⁶ See, e.g. INNOVATION ACT, H.R. 3309, 113th Cong. (2013), which passed the House in 2013 with vote of 325 – 91, and the low-quality patents and patent troll lawsuits that the Act was designed to address, as described at the Judiciary Committee Innovation Act website, available at <https://judiciary.house.gov/the-innovation-act/> (last visited 7/6/2016).

²⁷ *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 396 and 399 (2006) Kennedy concurrence (noting the development of “firms [that] use patents not as a basis for producing and selling goods but, instead, primarily for obtaining licensing fees,” and the enforcement of patents of “potential vagueness and suspect validity.”)

²⁸ See, e.g. The White House, *President Obama Participates in a Fireside Hangout on Google+*, YOUTUBE (Feb. 14, 2013), available at https://www.youtube.com/watch?v=kp_zigxMS-Y_ (calling for the development of “smarter patent laws” to address the problems caused by patent trolls, entities that “don’t actually produce anything themselves. They’re just trying to essentially leverage and hijack somebody else’s idea and see if they can extort some money out of them.”)

²⁹ FED. TRADE COMM’N, *THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION*, 50-51, 137-48 (March 2011).

³⁰ DEPT. OF JUSTICE AND FED. TRADE COMM’N, *PUBLIC WORKSHOP ON PATENT ASSERTION ENTITIES* (December 2012), described at <https://www.justice.gov/atr/events/public-workshop-patent-assertion-entity-activities> (workshop website including public comments pertaining to patent assertion entities).

³¹ GOV’T ACCOUNTABILITY OFFICE, *INTELLECTUAL PROPERTY: PATENT OFFICE SHOULD DEFINE QUALITY, REASSESS INCENTIVES, AND IMPROVE CLARITY*, Introduction (“2016 GAO Quality Report”), at 2 (June 2016), <http://www.gao.gov/assets/680/678113.pdf>.

³² *Id.* at 7.

costs³³ and causes of low patent quality, including apparent defects, for example, in patent law,³⁴ patent procedures,³⁵ and institutional incentives.³⁶

But problems of low patent quality, while urgent, are not new. Independent government reviews in 1990, 1997, 2000, 2007, 2015, and 2016 each found serious problems with the USPTO's quality processes.³⁷ The Patent Quality Review Office at the USPTO was created in 1974 to address quality concerns.³⁸ Patent examination as we know it today was introduced in 1836 to remedy the previous system's defect of registering patents without applying any quality filters at all, "deluging the country with worthless monopolies and laying the foundation for endless litigation,"³⁹ according to a Senate report. The patent registration system that preceded it, in turn, was motivated by the challenges that the first patent examiners – a board comprised of the Secretary of State, Attorney General, and Secretary of War, among them the Founding Fathers of the United States – met in trying to thoroughly examine patent applications despite their demanding schedules.⁴⁰

Yet patent quality issues have persisted. Why? First, we lack the ability to measure patent quality. That is to say, there is no consistent definition of, much less any consensus way of measuring, patent quality.⁴¹ This omission is as crippling as it is startling, making it impossible

³³ See, e.g., 2003 FTC IP Report, *supra* note ___, at 4 (describing the anticompetitive effects of low-quality patents including unwarranted market power and unjustifiable cost increases); John R. Allison, Mark A. Lemley & Joshua Walker, *Patent Quality and Settlement Among Repeat Patent Litigants*, 99 GEO. L.J. 677 (2011) (expressing concern over the outsized impact, and high invalidity rate, of patents that are asserted more than eight times).

³⁴ See, e.g., 2003 FTC IP Report, *supra* note ___, at 10–12 (recommending the elevation of obviousness standards in US patent law); Michael Abramowicz & John F. Duffy, *The Inducement Standard of Patentability*, 120 YALE L.J. 1590 (2011) (also recommending elevated obviousness standards); Mark A. Lemley & Doug Lichtman, *Rethinking Patent Law's Presumption of Validity*, 60 STAN. L. REV. 45 (2007) (arguing that in light of low patent quality, patents shouldn't be given the presumption of validity).

³⁵ See, e.g., Michael Frakes & Melissa F. Wasserman, *Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data* ("Time Allocated"), (Nat'l Bureau of Econ. Research, Working Paper No. 20337, 2014) (blaming time pressures in patent examination for the issuing of marginal patents); Michael Abramowicz & John F. Duffy, *Ending the Patenting Monopoly*, 157 U. PA. L. REV. 1541 (2009) (blaming the USPTO's "monopoly" on assessing patentability for producing for poor-quality patents).

³⁶ See, e.g., R. Polk Wagner, *Understanding Patent-Quality Mechanisms*, 157 U. PA. L. REV. 2135 (2009) (describing the patent system incentive's support of large numbers of low-quality patents).

³⁷ *Seven Criteria for Evaluating the Patent System*, in A PATENT SYSTEM FOR THE 21ST CENTURY (Stephen A. Merrill, Richard C. Levin & Mark B. Myers eds., 2004), at 49-50 (describing government quality audits in 2000); PETER DRAHOS, *THE GLOBAL GOVERNANCE OF KNOWLEDGE: PATENT OFFICES AND THEIR CLIENTS* 72 (2010) (describing independent reviews in 1990 and 1997); *Report in Brief*, OFFICE OF INSP. GEN. U.S. DEP'T OF COM. (April 2015), available at http://www.oig.doc.gov/OIGPublications/OIG-15-026-A_Abstract.pdf; GOV'T ACCOUNTABILITY OFFICE, *INTELLECTUAL PROPERTY: PATENT OFFICE SHOULD STRENGTHEN SEARCH CAPABILITIES AND BETTER MONITOR EXAMINERS' WORK* (2016) ("2016 GAO Search and Monitoring Report"), available at <http://www.gao.gov/products/GAO-16-479>.

³⁸ Merrill et al., *supra* note ___, at 50.

³⁹ Senate Report Accompanying Senate Bill No. 239, 24th Cong., 1st Sess., at 4. (1836), available at http://ipmall.info/hosted_resources/lipa/patents/Senate_Report_for_Bill_No_293.pdf.

⁴⁰ P.J. Federico, *Commentary on the New Patent Act (1954)*, reprinted in 75 J. Pat. & Trademark Off. Society 161 (Mar. 1993).

⁴¹ Described *infra* in Part I.

to tell whether anecdotes like the ones described earlier are indicative of a broader problem with quality, and whether policy interventions like the ones currently being applied are working, or not. Second, while many lament poor patent quality, the incentives in patent examination are stacked in favor of a patent being granted⁴² whether or not the invention deserves it. Patent lawyers are paid to succeed, not fail, in getting patents for their clients. As much as patent examiners are committed to thoroughly vetting applications, the USPTO is rewarded when it grants, rather than denies applications, leading to maintenance revenues⁴³ and skirting appeals and reversals.⁴⁴ Third, patent quality is hard. Reviewing a patent application and discerning whether the invention has been done before or is obvious from the perspective of an artisan in the field, as required by law, is a challenging task.⁴⁵ Even Thomas Jefferson struggled with it, writing in 1813, "I know well the difficulty of drawing a line between the things which are worth to the public the embarrassment of an exclusive patent, and those which are not."⁴⁶ It is not always clear that getting patent quality right is worth the effort – many and perhaps most patents are economically worthless.⁴⁷

This paper does not presume to offer a silver bullet to a problem that is as old as the patent system. However it takes the position that before we can expect to make a dent in patent quality, we need to address these first order problems. It proposes borrowing an age-old practice – benchmarking – to do so. Because while patent quality is a major focus in the United States patent system, it has been a priority in other countries as well.⁴⁸ And so looking at the comparable experiences of one jurisdiction in particular – the European Patent Office (EPO), whose jurisdiction is comparable to the USPTO's in size⁴⁹ and which in recent years has come to be viewed by many as the "gold standard" in patent quality⁵⁰ – is instructive and also, helpful for overcoming several of the long-standing obstacles that confront patent quality theory and practice.

First, a comparative view provides a way to actually measure patent quality. Claims about patent examination, for example, that the resources devoted to patent examination are

⁴² Wagner, *supra* note __, generally. (arguing that by its design, the modern patent system favors the seeking and granting of patents of low quality).

⁴³ Michael Frakes & Mellissa F. Wasserman, *Does Agency Funding Affect Decisionmaking?: An Empirical Assessment of the PTO's Granting Patterns* ("Agency Funding"), 66 VAND. L. REV. 67 (2013) (finding that the PTO acts, in part, on financial incentives that favor the issuance of patents in order to receive maintenance fees on patentability decisions).

⁴⁴ Jonathan Masur, *Patent Inflation*, 121 YALE L.J. 470 (2011) (arguing that the USPTO's ability to avoid costly appeals and reversals by overgranting leads to an inflationary pressure in the patent system).

⁴⁵ See, e.g., Lichtman & Lemley, *supra* note __, at __ (describing the task of vetting patent applications as "herculean").

⁴⁶ Thomas Jefferson, *Thomas Jefferson to Isaac McPherson*, THE FOUNDERS' CONSTITUTION (Aug. 13, 1813), http://press-pubs.uchicago.edu/founders/documents/a1_8_8s12.html.

⁴⁷ Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. 1495 (2001) (arguing that the insignificance of most patents does not support greater investment in their quality).

⁴⁸ See, e.g., John R. Thomas, *The Responsibility of the RuleMaker: Comparative Approaches to Patent Administration Reform*, 17 BERKELEY TECH. L.J. 727 (2002) (describing patent quality reform agendas in Japan and Europe).

⁴⁹ See *infra* Part I.

⁵⁰ See *infra* Part I.

inadequate⁵¹ are oft made but rarely supported. But the use of benchmarks can reveal the extent and direction of the difference, if any, between the US and EPO “high standard” practice within any particular area. Second, though the details vary, the basic dynamic of ex parte examination in which “under-resourced patent-officers...struggle against well-heeled patent-lawyers”⁵² applies across patent offices. The specific practices the EPO uses to counterbalance the tilt towards granting and yet achieve the highest quality ratings can yield useful insights. Finally, because EPO examiners face the same basic challenge in vetting their applications as their USPTO counterparts, studying both sets of procedures can offer insights regarding the balance between high levels of patent quality and other interests such as cost and speed.

Several recent developments vastly improve the case for doing comparative research in patent quality. In support of international markets, companies have long sought protection in multiple jurisdictions for the same invention.⁵³ But tracing the fates of the same application in different jurisdictions has historically been impossible because the United States did not publish unsuccessful patent applications. That changed in 2002, when the United States implemented pre-issuance publication,⁵⁴ which, including time for the completion of the application cycle, now enables the study of these natural experiments.

Differences between American and European patent systems compromise the usefulness of comparing them. But a number of gaps have been smoothed recently, through the America Invents Act of 2011⁵⁵ and the America Inventor Protection Act of 1999.⁵⁶ On the procedural side, the USPTO and EPO, as well as other international patent offices, have introduced a number of collaborative initiatives,⁵⁷ making it more likely that comparative insights may be actionable despite the cultural and other differences that remain.⁵⁸

This paper exploits these developments to empirically compare and contrast patent quality in the US and Europe and to explore the policy levers that contribute to these differences.

⁵¹ 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, 944 (2004) (describing the oft-made claim that examiner resources are inadequate).

⁵² *Time to Fix Patents* (Leader), THE ECONOMIST (Aug. 8, 2015), available at <http://www.economist.com/news/leaders/21660522-ideas-fuel-economy-todays-patent-systems-are-rotten-way-rewarding-them-time-fix>.

⁵³ See, e.g., studies by Jensen et al., described *infra* in Part II.

⁵⁴ Stuart Graham & Deepak Hegde, *Do Inventors Value Secrecy In Patenting? Evidence From The American Inventor's Protection Act Of 1999*, (unpublished manuscript), at 1, 5, & 23 (2014) (available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2170555) (describing the transition to a pre-issuance publication in 2002 brought by the America Inventor Protection Act). Because the Act allows certain inventors to keep their applications secret, an estimated 7.5 % of patent applications are not published. *Id.* at 1.

⁵⁵ Rochelle Cooper Dreyfuss, *The Leahy-Smith America Invents Act: A New Paradigm for International Harmonisation?*, 24 SING. ACAD. OF L.J. 669, 679 (2012).

⁵⁶ Graham and Hegde, *supra* note __ at 2 (describing the introduction in the US of the 18-month publication requirement existing in Europe and elsewhere).

⁵⁷ *USPTO Worksharing Programs and Proposals*, USPTO <http://www.uspto.gov/sites/default/files/ip/global/patents/Worksharing.pdf> (describing, e.g. the launch of the IP5, an information-sharing and coordination initiative among the USPTO, EPO, and three other patent jurisdictions, and the formation of the Patent Prosecution Highway (PPH) for sharing search results).

⁵⁸ See discussion *infra* in Part I.

It takes as its unit of analysis all US and EPO patent applications with a priority date in 2002, a year we chose because enough time has elapsed that the status of the vast majority of patent applications is resolved.⁵⁹ In addition, because the US only began publishing patent applications in 2001, 2002 was the first full year for which US application data was available. The paper proceeds as follows.

Part I discusses what patent quality is and why, historically, it's been hard to measure, reviewing the deficiencies in measures like reversal rate, allowance rate, examiner inconsistency and pendency. It makes the case for applying a comparative perspective to patent quality, while acknowledging some of the limitations of such an approach. It applies this perspective to patent filings in 2002 to reveal that, consistent with the perception that there are too many US patents of questionable quality, there are projected to be 10 times more US patents in force than by 2022 than EPO patents. However, while the Patent Office is typically blamed for the existence of too many low-quality patents, our analysis shows the surprising result that the decisions of applicants in the pre-grant and post-grant periods, not the Patent Office during examination, contribute even more to the gap between EPO and US in force patents.

Working from the empirical baseline set by Part I, Parts II through IV explore the gaps between US and EPO patenting, and the doctrinal, procedural, and institutional levers that explain them. Each part contemplates the insights that may be gleaned from the comparative view and discusses how they may be leveraged to improve US patent quality.

Patenting proceeds in three stages – application, examination, and post-issuance; choices made during each of them have implications for patent quality. This article begins by examining quality (and quantity) levers at the patent application stage in Part II. It finds that, in 2002, there were roughly two times more EPO than US patent applications, and traces this difference to a number of trends within and outside of the patent system. These include the growth in computer-enabled business models, the challenge of vetting software applications, and the proliferation of defensive and portfolio patent strategies. The relatively greater subject matter eligibility and relatively lower fees of the US system have made it more accessible and open, this paper argues, but also heighten the pressure on its quality filters, an insight that has largely been unacknowledged.

Moving to the patent examination process, and the heart of this paper's comparative analysis, Part III considers quality levers at the patent application stage from the perspective of 99,221 EPO and US application pairs (applications filed in both jurisdictions) from 2002. The fine-grained analysis presented in this part reveals several novel insights. First, it finds that the EPO granted patents at a considerably lower rate than the US, on the same applications (50% EPO vs. 75% US),⁶⁰ seemingly consistent with the hypothesis that US examiners are more

⁵⁹ Based on inspection of the legal status data for 7,417 EPO applications filed in September 2002, we found that about 6% of the EPO applications were still pending. The remainder of the applications were either granted, withdrawn, or refused. Granular legal status information is not available in bulk form for USPTO applications, however, we used PATSTAT to determine how many applications had matured into patents (N=5,542), and our analysis of the file histories of 295 of the remaining 1,876 applications, suggests that 95% of them were resolved.

⁶⁰ Discussed *infra* at Part I.

lenient. Surprisingly, however, it finds that the gap in allowance rates is driven as much by the behavior of applicants who voluntarily withdraw their applications from the EPO as it is by examiner rejections. These withdrawals, this paper finds, are often, in turn, based on the EPO's highly regarded search reports, whose citation of non-patent literature is almost double that of US examiners (30% EPO vs. 15% PTO), as well as the consistency and certainty that the EPO's team-examination and "once and done" approaches produce. Part III concludes with a discussion of the implications of these findings for US prosecution.

It may seem that once a patent is granted, its quality is fixed. However, while neglected by numerous studies of patent quality, the post-grant period, and choices made by patent holders and third parties, have a direct bearing upon the quantity and quality of patents that are in force and can help or hinder innovation. As Part IV reports, by year 20, an estimated 12% of European country patents based on EPO grants remain in force, vs. 37% of US patents, contributing more to the gap in the quantity of patents in force than differences in grant rate. Post-grant review procedures initiated by third parties, applicant choices, in response to relatively high EPO and relatively low USPTO fee levels, and the robust secondary market for US patents all contribute to the quality and quantity of patent in force. In view of the industry dynamics that fuel the sustained demand for high-tech patents, the paper argues for further consideration of several novel interventions that, rather than reducing the number of poor-quality patents, would reduce the risks associated with poor-quality patents: the "defensive only" patent, in which patentees give up certain rights of assertion in exchange for lower fees, and a closer alignment of maintenance fees with social welfare, both of which are consistent with long-standing European practices.

I. What Patent Quality Is and Why It's Hard to Measure

A. Defining Patent Quality

Patent quality encompasses two concepts – (one hard:) avoiding legal mistakes in issuing (or declining to issue) a patent,⁶¹ and (one really hard:) ensuring that society is better off in granting rather than denying a patent.⁶² The two concepts are separate, but related. While legal mistakes, for example, a patent over podcasting even though it's been done before, generally

⁶¹ The most common definition of a quality patent is a valid patent. See e.g. Ronald J. Mann & Marian Underweiser, *A New Look at Patent Quality: Relating Patent Prosecution to Validity*, 9 J. OF EMPIRICAL LEGAL STUD. 1, 6 (March 2012), Drahos *supra* note ____ at 69 (describing quality patent as a legally correct patent).

⁶² As articulated, e.g. by Duffy and Abramowicz, *supra* note ____ at _____. (arguing that a patent should only be awarded when it acts as an "inducement" for innovation), citing Judge Posner's argument that, "the framers of the Constitution and the Patent Code would not have wanted patents to be granted where the invention would have been made anyway, and about as soon, without any hope of patent protection." *Roberts v. Sears, Roebuck & Co.*, 697 F.2d 796, 797(7th Cir.), *vacated en banc*, 723 F.2d 1324, 1329 (7th Cir. 1983)), see also Mariagrazia Squicciarini, Helene Dernis, & Chiara Crisculo, *Measuring Patent Quality: Indicators of Technological and Economic Value*, OECD Science, Technology and Industry Working Papers, No. 2013/03 (2013) (proposing a wide array of patent quality metrics based on economic and technical, rather than legal criteria).

lead to the loss of social welfare, this loss can occur even if the decision to grant is technically correct.⁶³

To assess and effect measurable improvements to patent quality, patent quality needs to be measurable. To date, however, there have been no consistent, agreed-upon ways of telling whether or not a particular patent, or a patent system, is high quality. In 2012, then-Director of the USPTO David Kappos publicly lamented the lack of a common quality standard, and the “balkanized approach” of different countries and patent offices to measuring patent quality.⁶⁴ In 2016, the General Accounting Office, based on an in-depth study of the USPTO, reported that despite the USPTO’s investments in quality, that the office “does not currently have a consistent definition for patent quality articulated in agency documents and guidance.”⁶⁵

Though easier to measure than the social welfare gain or loss produced by a patent, the rate of mistakes associated with patentability decisions remain elusive. For example, the USPTO conducts audits to determine the rate of legal errors, as evaluated by quality control specialists, and to ascertain how satisfied its “customers” (patent applicants) are.⁶⁶ But these metrics are not independently calculated or observable. Citing the finding that under current criteria, most USPTO examiners are considered “above average” and, since 2011, have a better chance of being rated as “outstanding” or “commendable” with respect to patent quality, a 2015 government report described the USPTO’s quality policies as “ineffective.”⁶⁷ The academic and policy conversation has focused on several other measures of patent quality – reversal rate, grant rate, and consistency in patent examination. As discussed below, each of these has serious shortcomings.

1. Reversal Rate

One indicia of quality is the extent to which issued patents are overturned, in proceedings such as the USPTO “second look” programs used to invalidate the podcasting and check imaging patents described at the outset of this article. In *inter partes* review proceedings, 84% of adjudicated patents have at least one claim canceled.⁶⁸ However, this number is the product of selection effects, and only applies to claims that the USPTO chooses to review and that the parties don’t work out on their own.⁶⁹ When these filters are applied, only 25% of challenged

⁶³ Though not the focus of this paper, the same may be true of a patent application that fails to claim statutory subject matter, but would enhance, on net, social welfare.

⁶⁴ Stuart Graham & David Kappos, *The Case for Standard Measures of Patent Quality*, 53 MIT-SLOAN MGMT. 19 (Spring 2012) (laying out the pathway to a more consistent, unified approach to patent quality)

⁶⁵ 2016 GAO Quality Report, *supra* note ___, at 2.

⁶⁶ 2016 GAO Quality Report, *supra* note ___, at ___.

⁶⁷ OFFICE OF INSP. GEN. U.S. DEP’T OF COM, *supra* note ___, at ___.

⁶⁸ James Donald Smith & Scott Boalick, *Patent Public Advisory Committee Quarterly Meeting: Patent Trial and Appeal Board Update*, 15 (Feb. 19, 2015), available at http://www.uspto.gov/sites/default/files/documents/20150219_PPAC_PTAB_Update.pdf.

⁶⁹ For a description of the process and selection effects, see e.g. Colleen V. Chien and Chris Helmers, *Inter Partes Review and the Design of Post-Grant Patent Reviews*, ___ STAN. TECH. L. REV. (forthcoming 2016).

patent claims are invalidated.⁷⁰ When post-grant challenge outcomes at the EPO, which is seen as generating the highest quality patents, and at the USPTO, are compared, their outcomes are not statistically distinguishable.⁷¹ Litigation outcomes suffer similar selection effects – the very small handful of patents that are actually worth fighting about and sufficiently uncertain that the parties do not settle are generally of higher value, and are not necessarily representative of all issued patents.

2. Allowance Rate

A simpler description of the problem is that the USPTO too readily grants patents, applying such a low bar that a crustless peanut butter and jelly sandwich⁷² and a method of swinging on a swing⁷³ have qualified. To manage public perception, the Patent Office created a secret “sensitive application program” in 1994 to flag applications that seemed “trivial, mundane, frivolous... silly or extremely basic.”⁷⁴ The program only applied to 0.04% of applications and was retired when it came to light in 2015.⁷⁵ However, it is striking because it shows that the chances of implausible applications over “a method for curing baldness” or “a perpetual motion machine” becoming patents under standard Office procedures were significant enough that a program to reduce them was needed.⁷⁶ Whether the initiative succeeded or not is an open question. During the program’s tenure, the Office issued patents over ideas such as using a computer to facilitate and record communication between a doctor and patient⁷⁷ and a cure for cancer that combines “evening primrose oil, rice, sesame seeds, green beans, coffee, meat, cheese, milk, green tea extract, evening primrose seeds, and wine” entitled “Diane’s Manna.”⁷⁸

But determining what the PTO’s “actual” grant rate is, much less what it should be, has proven elusive. One cannot simply compare applications to grants within a single year because it takes several years and sometimes even decades for a patent application to resolve, and the number of applications rises every year. That, unlike anywhere else in the world, it’s impossible to finally reject a US patent application, further complicates attempts to discern the fates of a set of applications. Following a cohort of patent applications filed in 2001, Lemley and Sampat found that despite criticism that the USPTO is issuing too many bad patents, the Office “rejects a

⁷⁰ USPTO, *Inter Partes Review Petitions Terminated to Date* (Apr. 30, 2015), available at http://www.uspto.gov/sites/default/files/documents/inter_partes_review_petitions_%2004%2030%202015_0.pdf (finding 25% of challenged claims unpatentable)

⁷¹ In both European opposition, and post-grant US reexamination, both of which lack an initiation filter, about 60-65% of challenged patents are either amended or rejected, and in 25-30% of the cases, all the claims are rejected and the patent is revoked. See Chien and Helmers, *supra* note ___, at *___.

⁷² U.S. Patent No. 6,004,596 (issued December 21, 1999).

⁷³ U.S. Patent No. 6,368,227 (issued April 9, 2002).

⁷⁴ Joe Mullin, *USPTO Ends “Warning System” for Outlandish Patents*, ARS TECHNICA (Mar. 5, 2015), available at <http://arstechnica.com/tech-policy/2015/03/uspto-ends-program-for-patents-that-could-create-unwanted-media-coverage/>.

⁷⁵ *Sensitive Application Warning System*, USPTO (March 2015), available at <http://www.uspto.gov/patent/initiatives/patent-application-initiatives/sensitive-application-warning-system>

⁷⁶ *Id.*

⁷⁷ US Patent No. 8,762,173, titled “Method and Apparatus for Indirect Medical Consultation,” (issued June 24, 2014).

⁷⁸ US Patent No. 8,609,158 (issued December 17, 2013).

surprisingly high percentage of patents,”—about a third of them.⁷⁹ Quillen and Cotropia have tracked the grant rate over time and report higher, though varying, rates of issuance – more than 90% for most years between 1996 and 2014, except for a decline to less than 70% during the tenure of USPTO Director Jon Dudas.⁸⁰ The PTO’s own economists estimate the grant rate to be around 56%⁸¹ during this period but do not take into account the variety of ways in which applicants can continue examination even after a patent has been finally rejected. As described earlier, over half of the time patents are granted following “final” rejection, sometimes without any changes.⁸² However, while there is some evidence that the USPTO has a tendency to over-grant patents on the improper basis of the agency’s finances, rather than the merits,⁸³ and that patent offices in general favor their own nationals, over others,⁸⁴ there is no consensus about what an agency’s overall grant rate should be.

3. Examiner Inconsistency

A number of studies have documented the variation among examiners and examination at the USPTO. They generally find that a number of factors that have nothing to do with the importance of the invention or strength of the application can have a significant influence on how the patent application is examined at the USPTO and whether it is allowed. Examiner factors include how long the examiner has been at the PTO,⁸⁵ when the examiner was hired by the patent office,⁸⁶ the number of patents the examiner has examined,⁸⁷ experience levels,⁸⁸ and the amount of time given to form a rejection.⁸⁹ Some examiners are perceived to be too easy, while others are “too hard.”⁹⁰ But as troubling as a high level of inconsistency in examination is, it provides only an indirect measure of patent quality. Further, like grant rate, there is no

⁷⁹ Mark Lemley and Bhaven Sampat, *Is the Patent Office a Rubber Stamp*, 58 EMORY L. J. 181 (2008).

⁸⁰ Cotropia and Quillen, *Patent Applications and the Performance of the U.S. Patent and Trademark Office as of FY 2014* (Intellectual Property Institute Research Paper No. 2015-01), available at <http://law.richmond.edu/docs/FY-2014-Update-Figures-and-Tables-1996-2014-29.pdf>.

⁸¹ Michael Carley, Deepak Hedge and Alan C. Marco, *What is the Probability of Receiving a U.S. Patent?* 17 YALE J. L. & TECH. 203 (2015).

⁸² Zhen Lei & Brain D. Wright, *Why Weak Patents? Rational Ignorance or Pro-“customer” Tilt?* (CELS 2009 4th Annual Conference on Empirical Legal Studies Paper, 2009), available at <http://ssrn.com/abstract=1434275>.

⁸³ Michael Frakes and Melissa Wasserman have done the most comprehensive examination of this topic, and published their findings through several influential including Frakes and Wasserman, Agency Funding, *supra* note ____ and Michael Frakes & Melissa F. Wasserman, *The Failed Promise of User Fees: Empirical Evidence from the United States Patent and Trademark Office*, 11 J. EMPIRICAL LEGAL STUD. ____ [add parentheses]

⁸⁴ Paul H. Jensen, Alfons Palangkaraya, & Elizabeth Webster Webster, *Patent Examination Outcomes and the National Treatment Principle*, 45 RAND J. ECON. 449, 452 (2014)

⁸⁵ Iain M. Cockburn, Samurl Kortum, & Scott Stern, *Are all Patent Examiners Equal? Examiners, Patent Characteristics, and Litigation Outcomes*, in PATENTS IN THE KNOWLEDGE-BASED ECONOMY 19 (Wesley M. Cohen & Stephen Merrill eds., 2003). See also Ronald Mann, *The Idiosyncrasy of Patent Examiners: Effects of Experience and Attrition*, 92 TEX. L. REV. 2149, 2176 (2014). (finding the variation between Examiner to be relatively slight, but documenting the relative importance of tenure, over experience, to the examination).

⁸⁶ Frakes, Michael and Melissa Wasserman, *Patent Office Cohorts*, 65 Duke L.J. ____ (forthcoming 2016)

⁸⁷ Cockburn et al, *supra* note ____, at ____.

⁸⁸ Mark A. Lemley & Bhaven Sampat, *Examiner Characteristics and Patent Office Outcomes*, 94 REV. OF ECON. AND STAT. 817, 827 (2012).

⁸⁹ Frakes and Wasserman, *Time Allocated*, *supra* note ____ at ____.

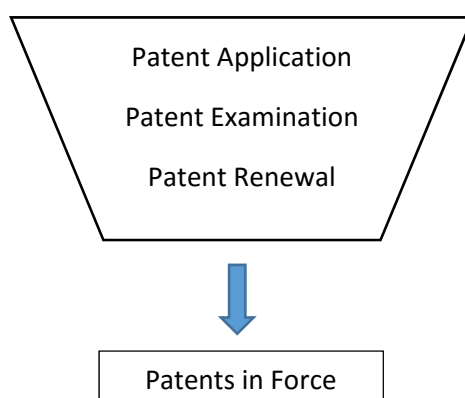
⁹⁰ Shine Tu, *Unluck/Luck of the Draw: An Empirical Analysis of Examiner Allowance Rates*, 20 STAN. TECH. L. REV. 10 (2012).

consensus about how much consistency would be desirable, and limited information about the tradeoffs between consistency and other aspects of the management of patent examination, including cost and hiring. The size of the patent backlog and variations in the pendency of patents have also been cast as matters of patent quality,⁹¹ insofar as untimely patent examination is considered to be low-quality patent examination.

B. Towards a Comparative Approach to Patent Quality

Although each is imperfect, together, existing approaches provide a wish list of sorts for measuring patent quality. Patent quality metrics should be independently calculable and observable by neutral third parties, not those with vested interests.⁹² They should provide accurate representations of applicant and examiner behavior in a large number of cases, unlike the reversal rates of the handful of patents that are adjudicated by the court or PTO. In order to inform patent improvement efforts, patent process indicators, like examiner consistency or pendency, must be measured in way that their bottom-line impact on patent quality can be understood. Finally, patent quality metrics should bear upon not only the behavior of patent examiners, but also the behavior of patent applicants and patent holders, and their contributions to quality.

Structured correctly, comparative patent metrics satisfy a number of these criteria. Tracing what happens when the same patent applications are filed in multiple jurisdictions enables neutral, third party comparisons of the diverse fates of these patents that is observable in the public record. Since 1996, the five Patent Offices have collected and published statistics on several patenting milestones, enabling direct comparisons that include all applications, issuances, and in-force patents,⁹³ not just a subset of them. The collaborative reports of the so-called “IP5” (US, Japanese, European, Korean, and Chinese Patent Offices) provide year-over-year, standardized views of the production of all patents, at the level of patent technological classes, as well as the processes of patenting (including fees),⁹⁴ supporting comparisons across time and jurisdictions.



⁹¹ See, e.g. Marc Adler, *Patent Quality Taskforce* (2010), available at http://www.uspto.gov/sites/default/files/about/advisory/ppac/patent_quality_tf_report.pdf

⁹² Kappos and Graham, *supra* note ___, at Recommendation 3 (calling for independent analysis).

⁹³ *IP5 Statistics Reports*, fiveIPOffices (2014), <http://www.fiveipoffices.org/statistics/statisticsreports.html> (listing reports of the IP5 Patent Offices from 2011, and from 2006-2010, from the IP3 Offices of the EPO).

⁹⁴ *Statistical Data Resources*, fiveIPOffices (2011-2016), <http://www.fiveipoffices.org/statistics/statisticaldata.html>.

Being able to track patenting at different phases in a patent's lifecycle has another benefit. Existing patent quality metrics tend to focus exclusively on the behavior of the patent office – its mistakes, too-high grant rate, and lack of consistency. But the quality and quantity of patents in force is the product of three sets of decisions: to submit applications of certain quality to the patent office (by the applicant), to grant the patent (by the patent office), and to keep pursuing or keep in force, a patent (by the applicant/patentee). For example, neither the US podcasting nor the US check imaging patent discussed at the beginning of this article was ever the subject of a counterpart European patent, but decisions by the applicant as well as by the European Patent Office produced this outcome. The application that matured into US Patent 6,032,137 over check imaging, for example, was also the basis of seven patent applications at the EPO,⁹⁵ but none were granted.⁹⁶ Patent protection outside the US over the '504 podcasting patent was never even sought.⁹⁷ To understand the impact of both examiner and applicant decisions on patent quality, it is important to observe, and compare metrics at each of the main three phases of a patent's life – application, examination, and renewal. The sections below do so, but only after explaining why the EPO provides the best point of comparison, despite the limits of a comparative approach.

C. Why Compare the US and EPO

Among options for comparing the US to with respect to patent quality, the EPO stands out. The GDP of the EPO's 40 member states⁹⁸ is roughly equivalent to the GDP of the United States⁹⁹, and the EPO has about double the population of the US.¹⁰⁰ The EPO is widely recognized as the “gold standard” in patent quality among patent examiners and practitioners. Industry surveys conducted in 2010, 2011, 2012, and 2015-2016 have each consistently found the EPO to have the highest ratings among the five leading Patent Offices around the world.¹⁰¹ This perception is robust across the subgroups surveyed – companies, patent lawyers, and non-

⁹⁵ See “Also Published As” section of <http://www.google.com/patents/US6032137> (listing related applications EP1008086A2, EP1008086A4, EP1688876A2, EP1688876A3, EP1986148A1, EP2267652A1, EP2267653A1)

⁹⁶ Id. (showing no “B” (or granted) EP publication).

⁹⁷ <http://www.google.com/patents/US8112504> (see list of related applications, showing only US applications).

⁹⁸ The EPO includes EU member states and a number of others including Albania, Iceland, Lichtenstein, Macedonia, Monaco, Slovenia, Serbia, Switzerland, and Turkey. See IP5 2014 report for a list of members (available at <http://www.fiveipooffices.org/statistics/statisticsreports/2014edition/chapter2.pdf>), at page 5

⁹⁹ See “World Economic Outlook Database”. International Monetary Fund. April 2016. (estimating US GDP in 2015 to be \$18.6T, as compared to \$17.8T including the European Union, Turkey, and Switzerland).

¹⁰⁰ The combined population of the EPO member states is about 619M (<http://www.fiveipooffices.org/statistics/statisticsreports/2014edition/chapter2.pdf>, page 5), while the US population is 320M (<http://data.worldbank.org/indicator/SP.POP.TOTL>).

¹⁰¹ Intellectual Asset Management Magazine surveys (available at the following links, some behind firewall 2011: <http://www.iam-media.com/Blog/Detail.aspx?g=4ae808a6-8240-41bf-a6e0-9b1828bfe372>; 2010: <http://www.iam-media.com/Magazine/Issue/42/Cover-story/The-state-of-play>; 2012: <http://www.iam-media.com/blog/detail.aspx?g=f7470c76-8fe7-42e3-a4bb-fce2b4fa1a17>; 2015: [http://documents.epo.org/projects/babylon/eponet.nsf/0/4783c6465d9a2b5fc1257e5900242b3f/\\$FILE/IAM72_benchmarking_q_p_en.pdf](http://documents.epo.org/projects/babylon/eponet.nsf/0/4783c6465d9a2b5fc1257e5900242b3f/$FILE/IAM72_benchmarking_q_p_en.pdf); 2016: <http://www.iam-media.com/Magazine/Issue/78/Features/Hard-times-in-the-global-patent-market-but-hope-too-in-places>)

practicing entities.¹⁰² Based on interviewing about 140 examiners from countries all around the world from the period covering 2004-2008, Peter Drahos found that the EPO had the best reputation, including for its searching capabilities and esprit de corps – the personal pride examiners took in the quality of their work product.¹⁰³

But while Europe may be closer to the US than other patent jurisdictions, significant differences remain. As detailed later, the two systems are different in law, procedure, and administration, and to some degree that is actually the point, to look at how such differences translate into different outcomes. In Parts III and IV, for example, we explore the consequences of the Europe’s “once and done” approach to examination, as opposed to the US’ approach of allowing patent-seekers to continue examination even after final rejection, as well as the relatively more aggressive schedule of renewal fees in Europe than the US, as departure points for considered discussion.

We also acknowledge, however, that some differences are much harder to compensate for than others. Examiner salaries must follow US Civil Service grades.¹⁰⁴ At the European Patent Office,¹⁰⁵ the average examiner gets nearly double the salary of her American counterpart and is exempt from national taxes.¹⁰⁶ Buoyed by the strong demand for technical and legal talent in the US, US patent examiners often have opportunities to advance professionally by leaving the USPTO to become patent lawyers or an engineer at a startup or existing firm,¹⁰⁷ whereas EPO examiners tend to view EPO jobs as prestigious and conferring lifetime tenure.¹⁰⁸ Because the USPTO lacks substantive rulemaking authority, anytime it does something that appears to heighten the burden on applicants¹⁰⁹ it is vulnerable to claims by patent applicants, sometimes bitterly contested legal ones, that it is overstepping its authority.¹¹⁰ While the EPO and USPTO have similar GDPs, European patents must be perfected and enforced in individual countries whose markets are much smaller than the US.¹¹¹ Finally, the EPO is also continuously evolving, making it a moving target at best.¹¹²

¹⁰² See *id.*, e.g. 2015 survey at Tables 6-8 (showing EPO ratings to be consistently highest).

¹⁰³ Drahos *supra* note ___, at 62, 74

¹⁰⁴ Bruno van Pottelsberghe de la Potterie, *The Quality Factor in Patent Systems*, 20(6) INDUS. AND CORP. CHANGE, 1755, at 1776–7, OD3.4: Incentives (wages and social recognition).

¹⁰⁵ *Id.*

¹⁰⁶ Pierre Picard & Bruno van Pottelsberghe de la Potterie, *Patent Office Governance*, CEPR Discussion Paper No. DP8338 (2011), at 17, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1815813.

¹⁰⁷ Drahos, *supra* note ___ at ___.

¹⁰⁸ *Id.*

¹⁰⁹ For example, by requiring more fulsome disclosure or the up-to-date disclosure of a patentee’s owner, or to limit the options of patentees to get multiple chances to get a patent granted,

¹¹⁰ Arti K.Rai, *Improving (Software) Patent Quality Through the Administrative Process*, 51 HOUSTON L. REV. 503, 506 (2013) (describing the controversy within the patent community and suit, *Tafas v. Dudas*, against the USPTO over proposed changes to the so-called “continuation rules.”)

¹¹¹ See IP5 2014 report, *supra* note ___, at Sec. 5 (describing the process of perfecting and enforcing European patents).

¹¹² See e.g. Katrin Cremers, Max Ernicke, Fabian Gaessler, Dietmar Harhoff, Christian Helmers, Luke McDonagh, Paula Schliessler, and Nicolas Zeebroeck, Patent litigation in Europe, EUR. J. OF L. AND ECON. (2016): 1-44. (discussing the anticipated introduction of the “European Patent” to the EPO, changing the enforcement of patents from being country-by-country to being effective across the member states of the EPO).

Differences both within and outside the control of patent system administrators and patent policy mean that particular insights gleaned below may be actionable to different extents, and based on varying degrees of effort. With this important caveat in mind, the next part of this paper details our methodological approach for carrying out the empirical portion of comparison, then implements it.

1. *Methodological Approach*

Empirical analyses of patents are limited by the quality and completeness of available data, and those issues are compounded in comparative studies. Fortunately, analyses of patents filed in multiple jurisdictions have been of interest for several decades,¹¹³ and I, working together with a team of research assistants, draw primarily on familiar approaches and data sources to carry out our comparison. For numbers of patents applied for and granted, the legal status of claims, and their technology classifications, we rely upon data provided directly by the USPTO and the EPO to PATSTAT, one of the most widely used patent databases for researchers.¹¹⁴ PATSTAT was created by the EPO at the request of the international patent offices,¹¹⁵ and the data contained within it has several limitations, which we describe below.

The European Patent Office was formed in 1978 and so continent-wide data is not available before then. The United States only began systematically publishing patent applications in March 2001, so this paper relies on application data reported in PATSTAT from then until June 2015.¹¹⁶ The technology field and sector data technology categories reported by PATSTAT are based on international patent classes whose definitions change often, and a patent is often assigned to more than one class (with the sector assignment based on the first, or primary, class), reducing the precision of technology category data.¹¹⁷ We rely on the technology field and sector codings provided by PATSTAT based on WIPO's classification of patents into one of five sectors (electrical engineering, instruments, chemistry (and pharmaceuticals), mechanical engineering, and other fields) and 35 fields devised by Schmoch.¹¹⁸ In focusing on patents applied for through the EPO, we exclude the minority of patent filings in each individual country pursued directly through national offices.¹¹⁹ We also exclude non-utility patents (e.g. design

¹¹³ Catalina Martínez C. Patent families: When Do Different Definitions Really Matter?. 86 SCIENTOMETRICS 39 (2011), at 40 (describing work in the 1980s done by German economist Conrad Faust. Comparisons have been used, for example, to identify valuable inventions (that are subject to multiple applications), understand trends in technological internationalization, and to compare patent filing strategies. (Martinez, at 4-6).

¹¹⁴ As described, e.g. in Gianluca Tarasconi and Byeongwoo Kang, *PATSTAT Revisited* (IDE Discussion Paper No. 527, 2015), available at <http://www.ide.go.jp/English/Publish/Download/Dp/pdf/527.pdf>

¹¹⁵ Id.

¹¹⁶ Updates to PATSTAT do not happen in real time, so the cut-off date for the data is sometime prior to June 2015. Even before this date, some subset of US patent applications can remain unpublished if the patentee is eligible to request non-publication, does so, and the application never matures into a patent. The share of patent applications that falls into this category is small. Graham and Hegde have found that the overwhelming majority of those who are eligible to keep their patent applications secret chose to forgo this secrecy. See Graham and Hegde, *supra* note ____.

¹¹⁷ For all of these reasons, the exact results of our analysis may not be reproducible.

¹¹⁸ Ulrich Schmoch, *Concept of a Technology Classification for Country Comparisons*, WORLD INTELL. PROP. ORG. (2008), available at http://www.wipo.int/export/sites/www/ipstats/en/statistics/patents/pdf/wipo_ipc_technology.pdf

¹¹⁹ Patents can be obtained in a contracting state of the EPO, such as Germany, in one of three ways: 1) through “national” filing directly at the country’s local patent office, 2) through “regional” filing directly at the EPO, 3) through “international” filing through a Patent Cooperation Treaty that has designated the EPO at the national phase.

patents, utility model patents), some of which are offered by the US and certain countries in Europe.

D. Comparative Applications, Patents, and Renewals

This article takes as its unit of analysis all US and EPO patent applications filed in 2002, the first full year for which US application data was available following the USPTO's implementation of the American Inventor's Protection Act of 1999.¹²⁰ Approximately 120,076 utility patent applications were filed at the EPO with a priority date of 2002.¹²¹ The USPTO received more than double that number, 273,619.¹²² By 2015, the USPTO had granted about 74% of these applications and the EPO had granted about 50% of these applications¹²³ with about 6% of applications still pending.¹²⁴ This translates into about 203K US patents and 57.6K EPO patents from filing year 2002.¹²⁵ At the time of this writing, not enough time had passed to know the number of patents in force at the end of the eligible patent term of 20 years. However, the USPTO and EPO calculate that 37% and 12% of US and EPO patents, respectively, filed in 2002 will remain in force 20 years after filing,¹²⁶ so we use the numbers in our estimate.

Unless otherwise indicated, the EPO statistics presented in this chapter represent EPO applications and grants, received through both "regional" and "international" routes. While the percentage of patents pursued through national filings is small, it varies by country. For example, in the years 2006 and 2012, the EPO received about 70% of all applications for Germany and 90% of all applications for the UK.

(In 2006 and 2013 the EPO received 137,408 and 148,494 patent applications, respectfully. Source:

<http://www.trilateral.net/statistics/tsr/2006.html>,

<http://www.fiveipoffices.org/statistics/statisticsreports/2013edition.html>), Germany received 60,585, 61,356 direct national applications (source:

http://www.dpma.de/docs/service/veroeffentlichungen/jahresberichte_en/dpma_jb_2006_engl.pdf,

http://www.dpma.de/docs/service/veroeffentlichungen/jahresberichte_en/dpma_annualreport2013.pdf), and the UK

received 17,488, and 17,500, direct nationally applications (source: <https://www.ipo.gov.uk/about-review2006.pdf>,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/246753/0214.pdf), respectfully.

¹²⁰ Described in Graham and Hegde, *supra* note ____.

¹²¹ Excluding int'l PCT applications, based on PATSTAT 2015, cf

<http://www.trilateral.net/statistics/tsr/2002/TSR.pdf>, Table 2.1. (reporting, in 2002, 106, 243 total Euro-Direct and Euro-PCT regional phase patent applications and 165,066 total Euro-Direct and Euro-PCT international phase applications, and calculated based on filing date, rather than priority date). (source: 9/24 correspondence with academic advisor to the EPO).

¹²² Excluding PCT applications, based on PATSTAT 2015, cf *The USPTO Historical Patent Data Files: Two Centuries of Innovation*, Office of Chief Economist at the USPTO (2015) available at

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2616724,

and annual data file available at <http://www.uspto.gov/learning-and-resources/electronic-data-products/historical-patent-data-files> (reporting, in 2002, 289,762 US patent applications, excluding PCT internationally filed applications) (a number that includes unpublished and continuation applications). Cf also

<http://www.trilateral.net/statistics/tsr/2002/TSR.pdf>, Table 2.3. (reporting 334,445 applications from 2002, including about 40,000 PCT applications (source: 9/8/15 correspondence with the PTO))

¹²³ Using the "Granted" status field in PATSTAT for the 2002 patents available in that database.

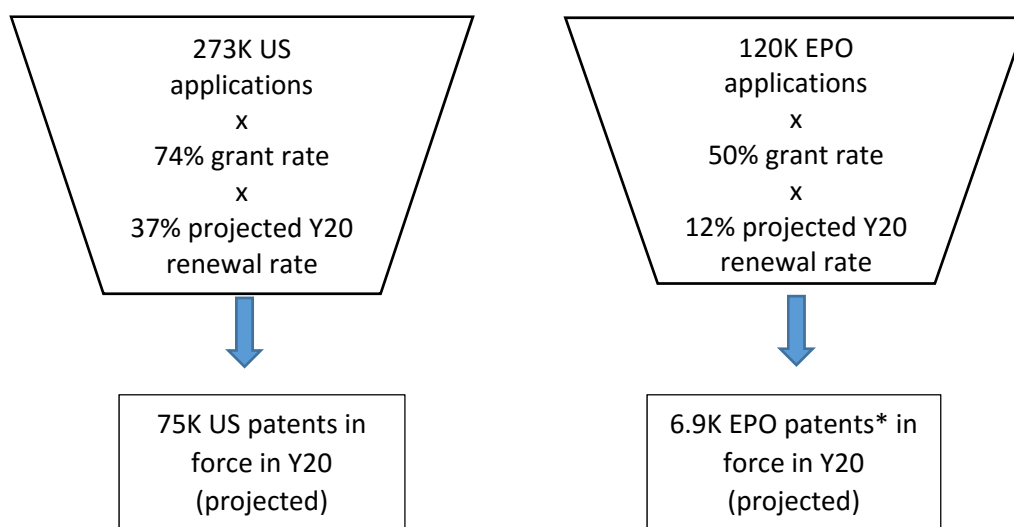
¹²⁴ Explained in Part I, *supra*.

¹²⁵ These ratios are roughly in line, for example, with grants in 2013, which totaled 277.8K and 66.7K (numbers include PCT filed applications).

¹²⁶ Trilateral Statistics, *Trilateral Statistics Report 2012*, available at

<http://www.trilateral.net/statistics/tsr/2002/annex.pdf>, (Maintenance of Patents Granted by the Trilateral offices Table). Cf 2013 renewal projections of 40% and 20% in the US and EPO, respectively, for patents filed in 2013 (<http://www.fiveipoffices.org/statistics/statisticsreports/2013edition.html> (Statistical Tables)).

FIG __ Projected Patents in Force based on Patent Applications filed at the USPTO and EPO in 2002



Sources: PATSTAT 2015 (application and grant numbers), Trilateral Statistics 2002 Report (renewal rates). *patents originally issued by the EPO and validated in at least one member state.

The data shows that at every stage in the patent lifecycle, the US system tilts towards a higher quantity patent system than does the EPO. In 2002, the USPTO saw more than double the applications that the EPO saw and granted 50% more of its applications than did the EPO, resulting in about three to four times more issued patents. Holders of US patents were projected to be three times more likely to leave their patents in force for 20 years after filings than were holders of EPO patents validated in member states. Collectively, this translates into a situation where 20 years after filing about 75K US patents will remain in force, while less than a tenth of that quantity of EPO patents— 6.9K — are expected to be in force somewhere in an EPO member state,¹²⁷ a striking difference.

We observed strong technology effects. The most dramatic gaps between EPO and US performance appear among applications that belong to the “electrical engineering” category, a field that includes computer technology, digital communication, telecommunications, and related fields.¹²⁸ Three times as many applications were filed in 2002, and five times as many technology patents were issued on these applications by the USPTO than by the EPO, resulting in a seventeen-fold difference in the number of patents in force by year 20 after filing.¹²⁹ In contrast, less than two times as many chemical and pharmaceutical patents were filed in the US

¹²⁷ As noted before, the EPO’s numbers exclude national patent applications filed directly within a country, and patent holders may chose not to validate their EPO patents within those countries, so the number of patents within an individual European country will vary from this total.

¹²⁸ Schmoch, *supra* note __, at Table 2

¹²⁹ The USPTO and EPO received 99,764 and 32,861 non-PCT electrical engineering patent applications, and issued 75,557 and 13,464 patents on these applications, respectively. Assuming a 37% and 12% Year 20 in-force rate (<http://www.trilateral.net/statistics/tsr/2002/annex.pdf> (Maintenance of Patents Granted by the Trilateral offices Table), this would result in 27,956 and 1,615 US and EPO electrical engineering patents, respectively, a ratio of approximately 17 to 1.

than the EPO, and fewer than three times as many patents were issued in the US than were issued in the EPO.¹³⁰ Although there have been many demands to reform software patents,¹³¹ it is worth noting that just applying European grant and renewal rates or even US chemical application rates to US applications would reduce, dramatically, the number of technology patents in force.

The overall view reveals the relative contribution of applicant and examiner decisions regarding the quality and quantity of patents in force. Although the US grant rate is about 50% higher than the EPO grant rate, even greater gaps exist between the two jurisdictions in the number of applications filed and the number of patents maintained. A number of variables determine the application rate, including patent doctrine, industry norms and uses for patents that do not require exclusivity (e.g. signaling). In addition, while relatively less attention has been paid to post-grant, as opposed to pre-grant, quality control mechanisms, the potential gains from a shorter patent life are just as considerable as the gains from increased quality.

Over time, the numbers in this snapshot have changed, though in different directions. The gap in applications has increased, with the USPTO receiving close to four times as many patent applications as the EPO did in 2014, the last year for which complete data is available.¹³² Reported application allowance rates in the US and the EPO have also fluctuated from 2002 through 2013, however, the 20-30% difference in grant between the two jurisdictions has stayed constant.¹³³ Finally, the gap in renewal rates has narrowed a bit, from patents being three times as likely to remain in force in the US to two times as likely to remain in force by the end of year 20.¹³⁴ With this baseline established, we now proceed to explore the determinants of quality at each stage in a patent's life.

II. Quality (and Quantity) Levers at the Patent Application Stage

The quality and quantity of patent applications submitted to the USPTO is a function of a number of factors including levels of R&D, the pace of innovation, industry norms, and the letter and administration of patent law. While it has been widely noted that the US experienced growth in patent applications with the expansion of patentable subject matter and strengthening of US patents by the Federal Circuit in the 1990s, quantifying the contribution of this and other factors, like fluctuations in innovation or R&D, industry dynamics, and technology trends has remained elusive. A comparative view helps control for these factors, and disaggregates legal, technology, applicant, and other effects on patent quality.

¹³⁰ The USPTO and EPO received 51,662 and 30,295 non-PCT “chemical” patent applications, and issued 34,192 and 14,452 patents on these applications, respectively, a ratio of approximately 2.4 to 1.

¹³¹ Described, e.g. in Colleen V. Chien, *Reforming Software Patents*, 50 HOUS. L. REV. 325 (2012) (describing proposals including a five-year software patent term for mitigating the harms associated with software patents); see also, e.g., Pamela Samuelson, *Benson Revisited: The Case Against Patent Protection for Algorithms and Other Computer Program-Related Inventions*, 39 EMORY L.J. 1025, 1139 (1990) (describing opposition to software patents by many mathematicians, computer scientists, and others in the software development community.)

¹³² FIVEIPOFFICES, *IP5 Statistics Report 2014: Chapter 4 Patent Activity at the IP5 Offices*, 49 (available at <http://www.fiveipoffices.org/statistics/statisticsreports/2014edition/chapter4.pdf>).

¹³³ Quillen & Cotropia, *supra* note ____, at Figure 9.

¹³⁴ *Id.* at 57 and accompanying Table (showing maintenance rates of 40% and 20% by year 20 in the US and EPO, respectfully)

A. The Differences in Application Rates (Including Over Time) and What Explains Them

1. *Technology Effects - The Software Patent Problem*

As noted earlier, the USPTO now gets four times more patent applications as the EPO, which has nearly double the covered population. However, this snapshot of patenting behavior and outcomes doesn't reveal when and how the relative increase in demand for US patents was experienced. Looking more closely, at patent grants by year (since US applications are not available prior to 2001), we can see that a surge in technology patents in particular has grown the gap.¹³⁵ (FIG. ____). From 1996 to 2008, in the US, the percentage of "electrical engineering" patents, which includes computer technology, digital communication, telecommunications, and related fields,¹³⁶ nearly doubled, from 24% to 46%¹³⁷ of all patents by the USPTO issued annually. During this time, shares of electrical engineering patents at the JPO and EPO grew, but much more modestly, about 25%.¹³⁸ Driven by legal, technological, and industry developments the increase in filings strained patent examination resources in the US. As the Patent Office attempted to cope with the backlog, there was a decline and then an increase in patent grant rate.¹³⁹

¹³⁵ As to the EPO patents, it should be noted that patents in Europe may be sought outside of the EPO, however the proportion of non-EPO European patent applications is generally small, around 10-30%. See discussion in Part I, *supra*.

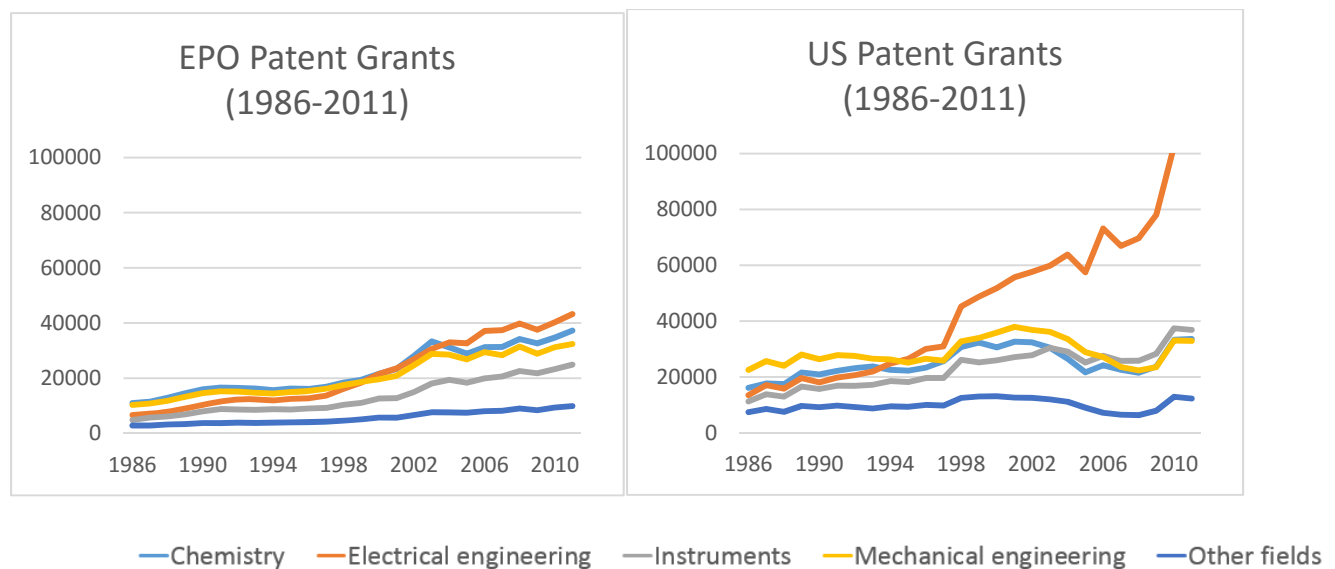
¹³⁶ *Id.* at Table 2.

¹³⁷ Accord USPTO Chief Economist Office, *supra* note ____ at Figure 9 (showing disproportionate growth in US electrical and electronics and computers and communication patent applications from 1995 to 2015).

¹³⁸ In the EPO and JPO the share of electrical engineering patent grants grew from 24% to 29% and 28% to 35% of patents, respectfully, based on analysis of PATSTAT data. This time period was chosen because of the availability of Japanese data, which is hard to obtain reliably by class IPC prior to 1996 and after 2008. Author's own analysis. Accord Trilateral Patent Offices Report (2012), *supra* note ____ (reporting, by 2011, that 29% of EPO patent applications, vs. 49% of USPTO applications, and 35% of JPO application were electrical engineering patents. Earlier year views by these categories are not available.)

¹³⁹ Dennis Crouch, *USPTO Allowance Rate*, PATENTLY-O (Aug. 10, 2015), <http://patentlyo.com/patent/2015/08/uspto-allowance-rate.html> (depicting and describing, regarding the PTO allowance rate, the "Dudas-Drop in the second-half of the last decade and the subsequent Kappos-Climb").

FIG. ____: EPO and US Patent Grants by Industry, 1986 to 2011



Source: PATSTAT 2015, author's analysis. Technology sector data provided by WIPO in accordance with Schmoch (2008)¹⁴⁰ [File: combined surge data 2]

We are hardly the only ones to notice the prominent role that software and business method patents, and disputes about them, have played in the US patent system. The share of overall patents covering software, which spans several technological categories, grew from 20% of patents in 1991 to more than half of all issued patents in 2011,¹⁴¹ and software-related patents were associated with nearly 90% of the increase in defendants to patent litigations initiated from 2007 through 2011,¹⁴² a period also associated with an increasing share of assertions brought by patent assertion entities.¹⁴³ Non-practicing entities disproportionately litigate software patents, based on judicial decisions.¹⁴⁴ Software patents have overwhelmingly lost when put to the test in litigation, but only after they have been asserted multiple times.¹⁴⁵

2. Legal Effects and Approaches to Software

¹⁴⁰ Schmoch, *supra* note _____. The “Electrical Engineering” category includes Computer Technology, Basic Communication Processes, IT Methods For Management, Semiconductors, Electrical Machinery, Audio-Visual Technology, Telecommunications, Digital Communication.

¹⁴¹ GOV’T ACCOUNTABILITY OFFICE, *Assessing Factors that Affect Patent Infringement Litigation Could Help Improve Patent Quality* (2013), at 13; available at http://www.uspto.gov/sites/default/files/aia_implementation/GAO-12-465_Final_Report_on_Patent_Litigation.pdf; accord Colleen V. Chien, *Exclusionary and Diffusionary Levers in Patent Law*, 90 SOUTHERN. L. REV. (forthcoming 2016), at FIG. 1.

¹⁴² *Id.*, Gov’t Accountability.

¹⁴³ EXEC. OFFICE OF THE PRESIDENT, *Patent Assertion and U.S. Innovation*, (June 2013) (available at http://www.whitehouse.gov/sites/default/files/docs/patent_report.pdf).

¹⁴⁴ John R. Allison, Mark A. Lemley & David Schwartz, *How Often Do PAEs Win Patent Suits?*, 31 BERKELEY TECH. L.J. *3-4 (forthcoming 2016).

¹⁴⁵ John R. Allison, Mark A. Lemley & Joshua Walker, *Patent Quality and Settlement Among Repeat Patent Litigants*, 99 GEO. L.J. 677, 695–96 (2011). See also Shawn P. Miller, *What’s the Connection Between Repeat Litigation and Patent Quality? A (Partial) Defense of the Most Litigated Patents*, 16 STAN. TECH. L. REV. 313, 316 (2013) (concurring that software and NPE-owned patents lose more).

Although software has not always been broadly patentable, the Federal Circuit's *State Street* decision in 1998 ruled that inventions that produced "a useful, concrete and tangible result" could be patented.¹⁴⁶ For three decades, the Supreme Court did not find any patent barred on subject matter restrictions, although inventions could still be ineligible on other grounds. The little known Federal Circuit case *In re Vaack*,¹⁴⁷ in combination with the USPTO practice, made it harder to reject inventions as obvious. The case held that an invention would not be considered obvious unless there was a teaching, suggestion, or motivation in the prior art to combine old elements to make the invention.¹⁴⁸ Taking the three-judge panel's decision literally, the USPTO instituted a practice of requiring Examiners to complete the difficult task of search for writings that in a sense, reflected the obvious, in order to reject patents.¹⁴⁹ In 2006, Justice Kennedy's concurrence in the *eBay* case noted that "burgeoning number" of business-method patents were of "potential vagueness and suspect validity."¹⁵⁰

The EPO's approach was, and continues to be, different. According to Chapter 52 of the European Patent Convention, only inventions with a technical character are eligible for patents, and methods of doing business and computer programs "as such" are explicitly excluded.¹⁵¹ However software inventions that nonetheless represent an "inventive step," towards solving a technical problem are patentable.¹⁵²

In 2013, 25 years after the Federal Circuit's *State Street* decision, the Supreme Court broke with its pattern of not rejecting patents on eligibility ground. Denying a patent application over a method of hedging risk in energy commodities trading, in *Bilski v. Kappos*, the Supreme Court rejected a single test for patentability¹⁵³ and the *State Street* test.¹⁵⁴ In *Alice v. CLS Bank*, the Court decided that merely implementing an abstract idea on a computer did not make it patentable. These cases, along with a few others on the patentability of subject matter, have called into question scores of already issued as well as pending patents, not only on software but

¹⁴⁶ *State Street Bank and Trust Co. v. Signature Financial Group, Inc.*, 149 F.3d 1368 (Fed. Cir. 1998).

¹⁴⁷ 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

¹⁴⁸ *Id.* ("To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure").

¹⁴⁹ Jake Ward, *The Evolution of MPEP 2143 – Prima Facie Case of Obviousness*, PATENT AND TRADEMARK LAW BLOG (Feb. 23, 2008), <https://anticipatethis.wordpress.com/2008/02/23/the-evolution-of-mpep-2143-prima-facie-case-of-obviousness/> (showing that pre-KSR MPEP guidance to Examiners reflected the *Veack* standard).

¹⁵⁰ *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 396–97 (2006).

¹⁵¹ *The European Patent Convention*, EUROPEAN PATENT OFFICE, <https://www.epo.org/law-practice/legal-texts/html/epc/2013/e/ar52.html> (last visited Oct. 4, 2015).

¹⁵² European Commission Press Release, *Proposal For A Directive On The Patentability Of Computer-Implemented Inventions - Frequently Asked Questions*, Reference: MEMO/02/32, Brussels, Feb. 20 2002, [europa.eu/rapid/press-release MEMO-02-32_en.pdf](http://europa.eu/rapid/press-release_MEMO-02-32_en.pdf) (describing the standard for patentability applied by the EPO to software patents and noting that, by 2002, at least 30,000 patents for computer-implemented inventions had been issued by the EPO).

¹⁵³ 561 U.S. 593, 594 (2010).

¹⁵⁴ *Id.* at 601.

diagnostic methods¹⁵⁵ and DNA. The check imaging patent described at the outset of this article, as well as patents over recognizing different data formats¹⁵⁶ and using digital signatures to identify spam email,¹⁵⁷ have been deemed ineligible.

The courts have elevated other patent-quality standards as they apply to software. In June 2013, the White House and USPTO announced an initiative to apply greater scrutiny to functional claiming, the practice common in software patents of drafting claims in order to capture broad, and many would argue unwarranted, scope in enforcement.¹⁵⁸ However, the PTO's job is to apply the law, and few court decisions had addressed the sort of scrutiny that is warranted. The Federal Circuit's *Williamson en banc* decision¹⁵⁹ in 2015 addressed this void. Further, the Supreme Court's decision in *Nautilus* did away with the incredibly low bar set by the Federal Circuit that only "insolubly ambiguous" patents are too vague to warrant protection.¹⁶⁰ The Court's earlier decision in *KSR v. Teleflex*, part of the same stretch of decisions that made the Federal Circuit the most overturned circuit court in the United States,¹⁶¹ did away with the rigid rule that a finding of obviousness requires a teaching, suggestion, or motivation, and enabled examiners to rely more on common sense.¹⁶²

The long-term impact on patent quality of recent case law shifts will depend on how these cases influence the behavior of applicants and the PTO. Already they have had a significant impact on the existing stock of challenged patents¹⁶³ and, all other things being equal, fewer inventions should be patent eligible and fewer applications received by the USPTO. Some commentators believe that the US patent system's patent quality woes began with the formation of the Federal Circuit as well as the *State Street* decision.¹⁶⁴ But whether they end with the current slate of decisions will depend on the robustness of other non-doctrinal dynamics, discussed next.

3. Industry Effects – Defensive, Strategic, and Portfolio Patenting

¹⁵⁵ See, e.g., *Exergen Corp. v. Thermomedics, Inc.*, 132 F. Supp. 3d 200 (D. Mass. 2015) (invalidating a patent on a forehead thermometer based on the insight that forehead measurements are reliable); Kevin Noonan, *Patent Watch: Diagnostic Patents at Risk after Federal Circuit Decisions*, NATURE: NATURE REVIEWS DRUG DISCOVERY (May 20, 2016), <http://www.nature.com/nrd/journal/v15/n6/full/nrd.2016.105.html> (describing cases of diagnostic tools being deemed ineligible for patent protection).

¹⁵⁶ *Content Extraction & Transmission LLC v. Wells Fargo Bank, Nat. Ass'n*, 776 F.3d 1343 (Fed. Cir. 2014).

¹⁵⁷ *Intellectual Ventures I LLC v. Symantec Corp.*, 100 F. Supp. 3d 371 (D. Del. 2015).

¹⁵⁸ Mark A. Lemley, *Software Patents and the Return of Functional Claiming*, 2013 WIS. L. REV. 905 (2013).

¹⁵⁹ *Williamson v. Citrix Online, LLC*, 792 F.3d 1339 (Fed. Cir. June 16, 2015) (en banc), superseding 770 F.3d 1371 (Fed. Cir. 2014).

¹⁶⁰ *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S.Ct. 2120 (2014).

¹⁶¹ Roy E. Hofer, *Supreme Court Reversal Rates: Evaluating the Federal Courts of Appeals*, 2 LANDSLIDE (Jan./Feb. 2010), available at http://www.americanbar.org/content/dam/aba/migrated/intelprop/magazine/LandslideJan2010_Hofer.authcheckdam.pdf (documenting an 83% reversal rate for the Federal Circuit from 1999-2008, the highest among all circuits, and a 92.3% reversal rate in patent cases).

¹⁶² *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398 (2007).

¹⁶³ Robert R. Sachs, *#Alicestorm: July is Smoking Hot, Hot, Hot...And Versata is Not, Not, Not*, BILSKI BLOG (Jul. 14, 2015), <http://www.bilskiblog.com/blog/2015/07/alicestorm-july-is-hot-hot-hotand-versata-is-not-not-not.html> (reporting an invalidation rate of ~70% of patents challenged on patentable subject matter grounds in the first 13 months following the *Alice Corp v. CLS Bank* decision).

¹⁶⁴ See, e.g. Bessen & Meurer, *supra* note ____, at ____.

The quality of issued patents depends on the quality of applications submitted to the patent office. But a number of factors independent of patent law have put upward pressure on the number of patents filed, and a corresponding downward pressure on the amount of time and money each applicant puts into each individual patent. Unpacking these motives reveals that the demand for patents will remain even as the courts remove some of the scope of patentable subject matter, reducing the chance that dramatic changes to the law will alone translate into dramatic changes in the number of application filings.

In technology areas characterized by cumulative innovation, for example, the purpose of patents has become largely strategic: entities seek patents in order to have something to trade with others and thereby achieve freedom to innovate, rather than to exclude others from the technology. The pursuit of patents over incremental improvements in order to build defensive arsenals, a dynamic that was spurred by the licensing campaigns of IBM and Texas Instruments in the late 1990s in software and technology industries, has been well documented.¹⁶⁵ “Defensive” patenting is now pervasive in many industries besides computers.¹⁶⁶ The embrace of strategic or portfolio¹⁶⁷ patenting has also placed a greater emphasis on the quantity of the whole rather than the quality of the individual parts within a set of patents.

In a number of surveys, half or more of patentees say they pursue patents for defensive reasons,¹⁶⁸ and we believe that the proportion of patents pursued primarily for those reasons is at least as high. When Google acquired Motorola and its 25,000 patents in 2011, CEO Larry Page said that it did for defensive reasons— in order “to better protect [its operating system] Android from anti-competitive threats from Microsoft, Apple and other companies.”¹⁶⁹ Among the top 50 owners of patents,¹⁷⁰ many if not most of them are “high-tech” companies that depend on freedom of action in order to keep up with the rapid pace of competition. Over 2,000 companies, including five out of the top ten have taken steps to commit some or all of their patents to defensive uses.¹⁷¹

¹⁶⁵ See, e.g., Bronwyn H. Hall & Rosemarie Ham Ziedonis, *The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979–1995*, 32 RAND J. ECON. 101 (2001) (examining the propensity of semiconductor firms to obtain patents despite their ineffectiveness in appropriating returns to research and development (“R&D”)); James Bessen & Robert M. Hunt, *An Empirical Look at Software Patents*, 16 J. ECON. & MGMT. STRATEGY 157 (2007). (providing empirical accounts of the apparent “arms race” in the semiconductor and software industries); Wesley M. Cohen, Richard R. Nelson & John P. Walsh, *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (or Not)*, 26–27 (Nat’l Bureau of Econ. Research, Working Paper No. 7552, 2000) (documenting the prevalence of defensive motives in patenting); Chien, *Arms Race* supra note ____ at ____ (same).

¹⁶⁶ See, e.g., JESSICA SILBEY, *THE EUREKA MYTH: CREATORS, INNOVATORS, AND EVERYDAY INTELLECTUAL PROPERTY*, 44–45 (2014) (documenting the prevalence of defensive patenting in biopharma industries).

¹⁶⁷ Gideon Parchomovsky & R. Polk Wagner, *Patent Portfolios*, 154 U. PA. L. REV. 1 (2005).

¹⁶⁸ See Chien, *Exclusionary and Diffusionary*, supra note ____ at Part II.A. for an overview of surveys.

¹⁶⁹ Larry Page, *Supercharging Android: Google to Acquire Motorola Mobility*, GOOGLE OFFICIAL BLOG (Aug. 15, 2011), available at <http://googleblog.blogspot.com/2011/08/supercharging-android-google-to-acquire.html>.

¹⁷⁰ IFI CLAIMS Patent Services, *IFI CLAIMS 2014 Top 50 US Patent Assignees* (Jan. 29, 2015), http://www.ificlaims.com/index.php?page=misc_top_50_2014 (last visited ____).

¹⁷¹ *The OIN Community*, OPEN INVENTION NETWORK, <http://www.openinventionnetwork.com/community-of-licensees/> (listing over 2,050 companies as within the Open Invention Network community as licensees, members, or affiliate members, that commit themselves to the OIN patent non-aggression pledge) (last visited Aug. 2, 2016).

Comparing national R&D and national patenting trends also provides information about the amount of investment reflected in each individual patent. As described earlier, the vast majority of companies doing R&D do not file for patents making the match between R&D and patents inexact at best.¹⁷² However, based on our independent calculation using available data, and building on work done by Hunt and Bessen,¹⁷³ we observe that the rise in the number of technology patents over the past few decades has been accompanied by a diminishing amount of R&D per patent,¹⁷⁴ consistent with the evolving industry dynamic discussed above, and likely due to other factors as well. Using R&D figures provided by the National Science Foundation by SIC/NAICS category, and the numbers of patents applied for by US entities during the same period within these categories,¹⁷⁵ we calculated the ratio between R&D and patents from 1980 to 2008. At its peak, in 1983, \$5M of national R&D was spent per electrical equipment and computing patent. By 2007, according to the same methodology, this number had declined to about a fifth of that, \$1.04M of national R&D per patent in inflation-adjusted dollars.¹⁷⁶ (FIG ____) In contrast, chemicals patents have reflected a declining, but then rising R&D per patent ratio.¹⁷⁷

For further discussion of the OIN pledge and others, see Jorge L. Contreras, *Patent Pledges*, 47 ARIZ. ST. L.J. 543 (2015).

¹⁷² Brandon Shackelford, *One in Five U.S. Businesses with R&D Applied for a U.S. Patent in 2008*, NA'L SCIENCE FOUNDATION (Feb. 2013), <http://www.nsf.gov/statistics/infbrief/nsf13307/>.

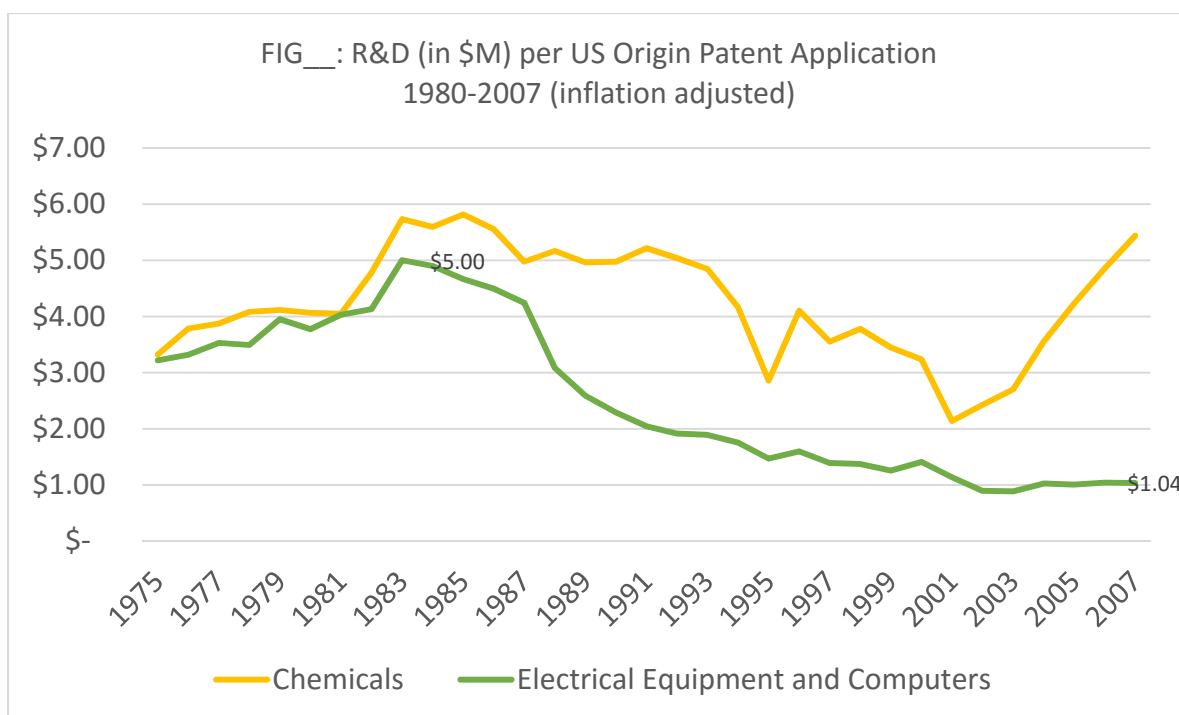
¹⁷³ Bessen & Hunt, *supra* note ____ at ____.

¹⁷⁴ In order to correlate R&D and patenting activity, we drew from two sets of data. For R&D data, we relied on the National Science Foundation's Survey of Industrial Research and Development, the "the primary source of information on research and development performed or funded by businesses within the United States." The annual survey, conducted by the Census Bureau examines a nationally representative sample of companies in manufacturing and nonmanufacturing industries, and establishes total US R&D expenditures, by the government and private companies. (<http://www.nsf.gov/statistics/srvyindustry/>) The survey reports on total manufacturing and non-manufacturing R&D by SIC code, up to 1998, and NAICS code in 1999 and after. We took several steps to compensate for deficiencies in the data. First, at the individual line item level (encompassing one or more SIC codes), data over the time series was at times missing or suppressed for confidentiality reasons. To reduce distortions that could be caused by missing data, we selected for analysis the two subcategories - Chemicals and Computer and Electronic products - where few data points were missing: 8 out of 68. We approximated these 8 missing values by applying a simple averaging or ratio functions based on available data, consistent with other researchers (correspondence with the NSF). The transition from SIC- to NAICS-based reporting created a discontinuity in the data in 1999. Although the SIC and NAICS categories that represent Chemicals and Computer/Electronic Products are similar, they are not a perfect match. To compensate, we applied a smoothing function to enable a time series view, performing checks on the individual time series before doing so. For patent counts, we relied on the USPTO's databases of patent and patent applications, and relied upon their primary IPC number to associate them, using the "Algorithmic Links with Probabilities" (ALP) concordance devised by Lybbert and Zolas, (described at http://www.wipo.int/export/sites/www/econ_stat/en/economics/pdf/wp5.pdf) to specific SIC and NAICS categories of interest. The match from patents to industrial categories was inexact as, for example, patents were at times assigned to multiple IPCs, which were in turn associated with particular SIC or NAICS codes. We used the first IPC class to assign each patents to an industrial class, making each patent count potentially both under and over inclusive.

¹⁷⁵ Application data was not available for the entire period.

¹⁷⁶ Based on applying a smoothing function to compensate in a change from SIC to NAICS-based reporting in 1999.

¹⁷⁷ See also Helene Dernis & Mosahid Khan, *Triadic Patent Families Methodology* Fig. 12 (OECD, STI Working Paper 2004/2, 2004) (reporting relatively constant ratios of triadic patent families to industry-financed R&D from 1985 to 1999, based on residence of the inventor).



Source: Author analysis based on NSF, USPTO. Source File: 1975-2007 Dataset CC

Other studies, using different methodologies and timeframes, have shown mixed results regarding the overall ratio between R&D and patents.¹⁷⁸ However, the two studies we found which disaggregate patent per R&D by technology category report findings consistent with ours. Kim and Marschke find that until 1983 patents per R&D in the computer industry declined but from 1983–2000 it increased.¹⁷⁹ The authors also find that patents per R&D decreased for the pharmaceutical industry through 2000. Hicks and her coauthors found that patents per million dollars in R&D doubled in the information technology category between 1989 and 1998, but that patents per R&D was stable for chemical and other technology categories.¹⁸⁰

The downward trend in R&D per tech patent is consistent with the perception that over the past few decades more technology patent applications, each covering less, have been filed. Empirical work, generally surveys, have also led to a better understanding of the other reasons

¹⁷⁸ Cf. Daniel Wilson, *Are We Running out of New Ideas? A Look at Patents and R&D*, FED. RESERVE BANK OF S.F. (Sept. 12, 2003) available at <http://www.frbsf.org/economic-research/publications/economic-letter/2003/september/are-we-running-out-of-new-ideas-a-look-at-patents-and-research-and-development/>, 2011 *World Intellectual Property Indicators*, WORLD INTELL. PROP. ORG. 8 (2011), http://www.wipo.int/edocs/pubdocs/en/intproperty/941/wipo_pub_941_2011.pdf (finding that US R&D expenditures have increased faster than US patenting has over the periods 1953 to 1999 and 1995-2010, respectively), and Samuel Kortum, *Equilibrium R&D and the Patent–R&D Ratio: U.S. Evidence*, 83 AM. ECON. REV. 450, ____ (1993) (finding that the ratio of patents to R&D fell 1975 and 1989).

¹⁷⁹ Jinyoung Kim & Gerald Marschke, *Accounting For the Recent Surge In U.S. Patenting: Changes in R&D Expenditures, Patent Yields, and the High Tech Sector*, 13 ECON. OF INNOVATION AND NEW TECH. 543 (2004).

¹⁸⁰ Diana Hicks et al., *The Changing Composition Of Innovative Activity In The US—A Portrait Based On Patent Analysis*, 30 RES. POL'Y 681 (2001).

companies file for patents, and the often non-exclusionary motives that motivate, at least in part, the decision to patent. For specialized innovators, like universities and technology specialists, for example, patents facilitate transfer of the technology to commercialization partners in support of “open innovation,”¹⁸¹ given that patents are generally easier to transact in than trade secrets. Small companies and startups are motivated to file for patents in order to attract financing, in addition to reasons of exclusion and defense.¹⁸²

B. Application Patent Quality Levers

1. Separating the Wheat from the Chaff at the Application Stage

Certain patent mistakes are very expensive. Take the example of the ‘137 check imaging patent that was only invalidated after it had helped to generate licensing fees of \$350M. None of the seven related applications at the EPO became a patent – 4 were refused outright by the EPO, and 3 were withdrawn.¹⁸³ In an ideal world, more resources would be allocated to examining such applications, while less would be used to vet those that will never be enforced. On the same day the USPTO granted the ‘137 patent, it granted thousands of other patents. In the vast majority of cases, the patent were neither asserted in court nor used to pursue high-profile patent licensing campaigns. A number of the patents likely served as the basis for a technology transaction, enhanced a company’s reputation for innovation, were used to recognize the contributions of an inventor, or just sat on the shelf. The odds are that many were so economically unimportant that they were left to lapse before their full 20-year term.¹⁸⁴ How important is it to ensure the quality, for example, of a patent relied upon by a young company to secure a bank loan but which the company has no intention to enforce? Somewhat, two scenarios suggest. First, it is impossible for follow-on innovators to know that the intention of the patentee is to use the patent only in non-exclusionary ways, leading other to greater inefficiency as others unnecessarily “design-around” the patent. Second, even if the original owner of the patent disavows exclusionary motives, things can change, for example in the bankruptcy or sale of a company, or a shift in company strategy.¹⁸⁵ Patent trolls often buy patents from defunct or still operating companies that themselves often aren’t in a position to assert the patents, due, for example, to the threat of retaliation, reputational costs, and a lack of alignment with the business. If a patent is broad, even if its validity is highly suspect, it can still be used as the basis of a licensing campaign or lawsuits.

Still, given the diverse uses to which patents are applied, it is worthwhile to consider how we might distinguish between applications that, once they mature into patents, are likely to

¹⁸¹ Ashish Arora, Wesley M. Cohen & John P. Walsh, *The Acquisition and Commercialization of Invention in American Manufacturing: Incidence and Impact* (Nat’l Bureau of Econ. Res., Working Paper No. 20264, 2014).

¹⁸² Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255 (2009).

¹⁸³ Based on reviewing the “Legal Events” of each application at Google Patents.

¹⁸⁴ Patentholders abandon their patents before their full term in the majority of cases. *See, e.g.*, Kimberly Moore, *Worthless Patents* (Geo. Mason Law & Econ. Res. Paper No. 04-29, 2004); Dennis Crouch, *Maintenance Fees 2015*, PATENTLY-O (Jul. 21, 2015), <http://patentlyo.com/patent/2015/07/maintenance-fees-2015.html> (showing that less than 50% of patentees pay the third renewal fee).

¹⁸⁵ *See* Chien, *Arms Race*, *supra* note __ (describing the phenomenon of “once defensive” patents turning offensive).

matter, from the rest, and to allocate examination resources accordingly. One option would be to create two tiers of patent applications – one that receives little or no examination, and one that receives heightened examination. The move to a patent registration system in 1793 that Jefferson carried out,¹⁸⁶ effected half of this transition, and both Germany and China allow inventors to apply for “petty patents,” that are registered with little examination, alongside regular, utility patents.¹⁸⁷ In a similar vein, Lemley and his co-authors have proposed allowing patentees to designate the applications they think matter and elect more rigorous examination for them. The applications that withstand the higher level of scrutiny would be considered “gold-plated” and would therefore receive a heightened presumption of validity.¹⁸⁸ This proposal has often been coupled with the idea that, regarding the other, less significant, patents, examiners are justified in remaining “rationally ignorant,” because the patents don’t matter much.¹⁸⁹ An alternative to allowing applicants to “upgrade” their patent before they issue through heightened reviews, is to allow third parties to “downgrade” or invalidate after they issue, through post-grant quality reviews.

Differentially applying quality filters in these ways has problems, however. It is difficult for patentees to know ahead of time which patents are worth gold plating, as a patent’s value only emerges over time.¹⁹⁰ The idea of relegating all remaining patents to limited review, because they don’t seem to matter, has been roundly criticized.¹⁹¹

Post-grant challenges that take place after a patent has issued have the advantage of reflecting evolving market and technical conditions and information, however they are expensive and time-consuming, and because they are largely brought by third party challengers, in a sense, come “too late” – after the challenger has been accused in a patent case. An ideal mechanism would combine the virtues of these two approaches and eliminate their vices – by enabling the identification and heightened scrutiny of patents that are likely to be enforced to come later in a patent’s life and be initiated by the patentee as well as third parties. We discuss one proposal for doing so, through the implementation of a “defensive only” patent, in Part IV.

However, if designating only certain applications for heightened quality reviews when they are applied for isn’t possible, another alternative is to increase quality for all patents during the examination process, which we explore next.

III. Patent Quality Levers At the Examination Stage

Conversations about patent quality tend to devolve into discussions about patent office shortcomings. This part begins differently, by following the lead of Thomas Jefferson, one of

¹⁸⁶ Described *supra*, at notes ____.

¹⁸⁷ Described, *e.g.*, in PATENTS AROUND THE WORLD, Vol. 1-2, 2013.

¹⁸⁸ Mark A. Lemley, Douglas Lichtman & Bhaven N. Sampat, *What to Do About Bad Patents*, 28 REG. 10 (2005) (recommending reducing the overall presumption of validity while strengthening it for certain patents that undergo more rigorous search and examination).

¹⁸⁹ Described in Mark A. Lemley, *Rational Ignorance at the Patent Office*, 95 NW. U. L. REV. (2001).

¹⁹⁰ Colleen V. Chien, *Predicting Patent Litigation*, 90 TEX. L. REV. 283 (2011) (analysis showing that the ability to identify which patents will be enforced improves over time).

¹⁹¹ See, *e.g.*, Bronwyn H. Hall & Dietmar Harhoff, *Post-Grant Reviews in the U.S. Patent System – Design Choices and Expected Impact*, 19 BERKELEY TECH. L.J. 989 (2004).

America's first patent examiners, in acknowledging that applying patent quality filters is both difficult and time consuming. As historian PJ Federico recounts, Jefferson was "quite favorable to the granting of patents, and granted them with great consideration, the other duties of members of this Board, in view of their high offices, made it impossible for them to devote much time to this work. As a result the law was changed in 1793 to make the granting of patents a clerical function."¹⁹² This transition reflected the sense that if examination couldn't be done properly, it shouldn't be done at all.

The case studies described at the beginning of this article highlight the challenges. Before the '137 check imaging patent described above was revoked by the Patent Office, it was upheld by the Patent Office,¹⁹³ in a proceeding called reexamination, as well as by a Texas jury.¹⁹⁴ The question of patent validity is not purely a technical determination but also a legal and evidentiary one. To examine a patent, as described in Chapter 2, requires interpreting and understanding the claims, applying external knowledge and references to an evolving legal standard, and arriving at a legal conclusion. To evaluate the application that eventually became the '704 podcasting patent, a patent examiner had to search for references that were more than a decade old. One of the references ultimately relied on to invalidate the patent, supplied by an outsider, not the USPTO or applicant, was an unpublished master's thesis from MIT.¹⁹⁵

While examiners in the USPTO and EPO carry out the tasks described above in very different ways, they apply largely the same standards. These are some differences in how the tests are articulated – for example, European examiners apply an "inventive step," rather than "obviousness" filter and, unlike American examiners, use a "problem-solution" approach to determine whether or not a patent application meets the standard.¹⁹⁶ For years, certain classes of prior art were not available in the US, due to the American grace period, but these differences, minor to start with, have narrowed in recent years.¹⁹⁷ Trilateral studies of patent examination conducted by the PTO, EPO, and JPO¹⁹⁸ have found that, despite the different articulation of legal standards in each jurisdiction, the application of them and the same technical references to the same application yields largely the same outcomes.

¹⁹² S. REP. NO. 82-1979 (1952), available at <http://digital-law-online.info/misc/SRep82-1979.pdf>.

¹⁹³ File history of the '137 patent, *supra* Part I. Lisa Lerer, *Senate, Old Legal Woes Drawn into Patent Fight*, POLITICO (Mar. 25, 2008), available at <http://www.politico.com/story/2008/03/senate-old-legal-woes-drawn-into-patent-fight-009202>.

¹⁹⁴ Described in Hammerand, *supra* note ____.

¹⁹⁵ PTAB Decision, *supra* note ____.

¹⁹⁶ See, e.g., Stephen Kunin & Philippe Signore, *A Comparative Analysis of the Inventive Step Standard in the European and Japanese Patent Offices from a U.S. Perspective*, IP LITIGATOR 15 (Jan./Feb. 2008).

¹⁹⁷ Robert P. Merges, *Priority and Novelty Under the AIA*, 27 BERKELEY TECH. LJ. 1023 (describing the redefined scope of prior art under the America Invents Act and closer, though not complete, alignment with global standards)

¹⁹⁸ See, e.g., USPTO, JPO, and EPO, *Comparative Study on the Hypothetical/Real Cases: Inventive Step and Nonobviousness* (Sept. 2008), available at https://www.jpo.go.jp/torikumi/kokusai/kokusai3/pdf/sinsa_jitumu_3kyoku/sinpo_en01.pdf (reporting that, out of six cases independently reviewed the USPTO and EPO, the same result was reached in all of them); Melanie J. Howlett & Andrew F. Christie, *An Analysis of the Approach of the European, Japanese and United States Patent Offices to Patenting Partial DNA Sequences (ESTs)*, 34 INT'L REV. OF INDUS. PROP. AND COPYRIGHT 581 (2003) (finding that, "despite the varied approaches [of the three offices] the end result with respect to the success of the six claims was similar for all offices").

What explains, then, the differences in outcomes between the two jurisdictions? In the following paragraphs, we document that there are differences, not only with respect to the grant rate, which is higher for the US, but also with respect to customer satisfaction and quality, which are higher for the EPO. We focus on two practices that contribute to the EPO's favorable quality ratings. First, the EPO invests heavily in getting quality right – it allocates more examiners, more time, and more checks to ensuring that patentability decisions are accurate. The US examination process, in contrast, has a high tolerance for mistakes, because it allows applicants to refile their rejected applications, and in many cases, get these cases allowed. This practice, while it limits the negative consequences associated with any bad examiner decision, makes examiner inconsistency and mistakes tolerable, in turn, driving lower patent quality and satisfaction. Second, the EPO process has several notable safeguards for overcoming the tunnel vision that results from the *ex parte* nature of the examination process. It dedicates extensive time and resources to searching and accurately reflecting the state of the art, produces a higher citation to non-patent literature, and uses a team examination approach which reduces inconsistency and promotes the application of “common sense” perspectives. It is also slower, more expensive, and less likely to give applicants the patents they seek.

1. The Differences in Grant Rates and What Explains Them

Ours is not the first study to document the disparities in EPO and US grant rates. Jensen and his colleagues have done a series of studies looking at comparative outcomes.¹⁹⁹ Analyzing a cohort of patent applications submitted to the Australian, European, and Japanese Patent Offices from 1990-1995 that matched as equivalents 9,618 US patents,²⁰⁰ they found that the Australian Patent Office granted almost all (86%) of these applications, while the JPO granted less than half of them (42.6%) and the EPO grant rate was between (74%) these two figures.²⁰¹ Harhoff and Graham analyzed the EPO counterparts of a sample of 2,474 US patents litigated from 1963-2003 and their non-litigated counterparts, and report comparable grant rates, between EPO grant rates of 68% (among counterparts to non-litigated US patents) and 80% (among counterparts litigated US patents), as compared to US patents (100% grant rate).²⁰²

¹⁹⁹ Paul H. Jensen, Alfons Palangkaraya & Elizabeth Webster, *Disharmony in International Patent Office Decisions*, 15 FED. CIR. B.J. 679 (2006); Webster et al., *Characteristics of International Patent Application Outcomes*, 95 ECON. LETTERS 362, 368 (2007); Paul H. Jensen, Elizabeth Webster, and Alfons Palangkaraya, *Misclassification between Patent Offices: Evidence from a Matched Sample of Patent Applications*, 93 REV. OF ECON. AND STAT. 1063, 1075 (2011); Elizabeth Webster, Alfons Palangkaraya, and Paul H. Jensen, *Patent Examination Outcomes and the National Treatment Principle*, 45 RAND J. OF ECON. 449, 469 (2014) (finding that local offices tend to favor local applicants).

²⁰⁰ Paul H. Jensen, Alfons Palangkaraya & Elizabeth Webster, *Application Pendency Times and Outcomes Across Four Patent Offices* (Melbourne Institute Working Paper Series, No. wp2008n06, 2008).

²⁰¹ Figure 2. These estimates are slightly deflated, as 1.7-13% of applications were still pending at the time of the analysis.

²⁰² Graham and Harhoff, *Separating Patent Wheat from Chaff: Would the U.S. Benefit from Adopting a Patent Post-Grant Review?* (“Wheat from Chaff”), 43 RES. POLICY 1649, 1659 (2009). In other work by the same authors, they found that EPO equivalents of US litigated patent applications were more likely to be awarded EPO patent protection than were equivalents of unlitigated patents (Stuart J.H. Graham and Dietmar Harhoff, *Can Post-Grant Reviews Improve Patent System Design? A Twin Study of US and European Patents* (Center for Economic Policy Research Discussion Paper No. 5680, 2006)).

One limitation of both of these studies is that they are based on US patents, rather than applications, necessarily excluding applications that never matured into patents in the United States. It could be the case, for example, that while the EPO only grants a portion of United States patents, the inverse is also true – that the United States only grants a portion of EPO patents, reducing any perceived gap in allowance rates. Quillen and Cotropia have documented the relatively lower overall grant rate in the EPO, as compared to the US, using official data. But while their analysis, as well as the one that we report earlier in this article, of applications from both jurisdictions, addresses the mismatch caused by comparing applications to patents, it could still be the case that the applications submitted to the EPO are weaker than those submitted to the USPTO, downward biasing the EPO grant rate, relative to the US one. Another weakness of these studies, is that, due to their design, they did not observe time and technology effects.

To address these limitations, we created a set of matched EPO – USPTO patent applications from the cohort year analyzed earlier, 2002. Patent rights are territorial, so an inventor seeking protection over the same invention in multiple jurisdictions must file multiple applications. If an applicant for a US patent also seeks protection in Europe, she will typically file the same application, with slight modifications,²⁰³ within a year to the European Patent Office or World Intellectual Property Office (WIPO). While there are numerous ways to associate EPO and US patent applications, in our analysis we applied the most conservative approach and matched US and EPO patent documents with identical priority claims.²⁰⁴ We included in our set all available EPO and US application pairs from 2002²⁰⁵ (N=99,221), and traced the fate of each application through the two jurisdictions. We focused first on whether or not the application had been “Granted,” a status designated in PATSTAT.²⁰⁶

Based on the same set of applications, 77% were granted in the US, while only 52% were granted in the EPO. This difference was robust across all 5 sector categories – in each case, more US than EPO patents resulted. Among technology sectors, the differences were most pronounced for electrical engineering (or “technology”) patents (FIG ____). While technology patent applications had a less than one in two chance of maturing into a patent in the EPO, it had a

²⁰³ *Id.* Wheat from Chaff, at ____.

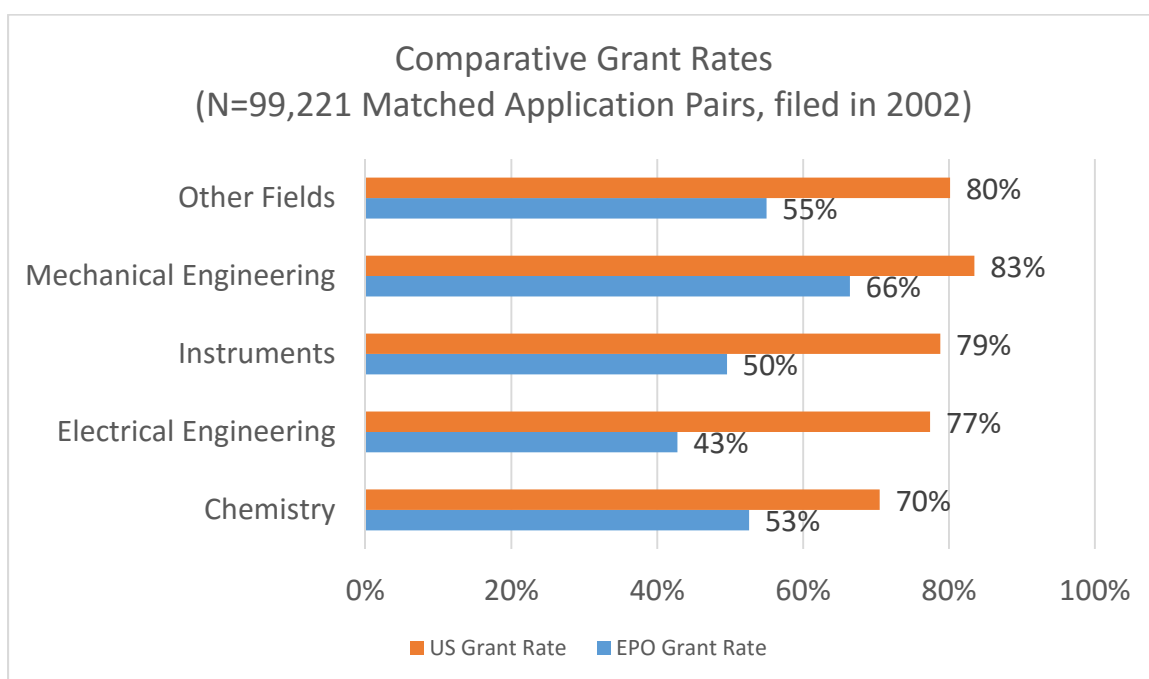
²⁰⁴ Under the Patent Cooperation Treaty, a claim of “priority” to the first application by the second application confers the important benefit that the second application is treated as if it were filed on the same day as the first application. Subsequent applications can claim priority to one or more applications, within the same or different jurisdictions, creating the possibility of multiple applications within a single patent “family.” A patent family, in turn, can be either “simple” or “extended” – the members of a simple family share at least one common priority or “parent,” while members of an extended family include documents linked directly or indirectly through common priority claims. Patent families may also be formed through “expert-review,” for example through priority information as well as the review of content by experts as performed by the Derwent World Patent Index. *Id.* at ____; See also Martinez, *supra* note ____, at 45. We obtained these matches, called “equivalents,” from PATSTAT which publishes such matches through the DOCDB database.

²⁰⁵ That is, with a US filing date of September 2002.

²⁰⁶ While the “granted” variable is viewed as very reliable by PATSTAT researchers, in two cases, it may not reflect the current status – first, because PATSTAT is not updated in real time, it does not always reflect the most recent months’ of grants. Second, where there is a subsequent revocation of a patent, the granted status does not reflect the change in status. These divergences should have limited if any impact on our reported results.

greater than three out of four chances to mature into a US patent.²⁰⁷ This translated into a 34% difference between EPO and US grant rates among electrical engineering patents. The difference was less pronounced, but still significant for the other classes of patents. Chemistry and mechanical engineering applications were 17%, and instruments applications, 29% more likely to be awarded in the US as compared to the EPO. (FIG __)

The differences were remarkably robust. In every one of the 35 sector subcategories defined by WIPO, we found, the US was more likely to grant a patent than was the EPO.²⁰⁸ However, it is possible that they are an artifact of the period of time tested, as the fluctuations in US grant rates over time has been well-documented. To rule out this possibility, we expanded our analysis to a sample that included EPO applications matched to US grants from the period from 1975-2014. We found the relatively lower EPO grant rate to persist over time, consistent with the findings of Quillen and Cotropia,²⁰⁹ and observed that the relative EPO grant rate, in fact, declined over the tested period, though we believe some of the decline is due to time effects. These results confirm and expand upon earlier results.²¹⁰



²⁰⁷ Of the 2,784 applications classified as “electrical engineering,” 76%, or 2,105 became US patents, while 43%, or 1,273 became EPO patents.

²⁰⁸ We performed T-tests on each difference, finding p-values between 0 and 2.49341704573321E-32, allowing us to reject the null hypothesis that the difference in grant rates were the result of chance. (ADD T-Test table to Appendix)

²⁰⁹ Quillen and Cotropia, *supra* note __, at Fig 9 (documenting a persistently lower EPO grant rate over the period of time 1996 to 2013).

²¹⁰ See, e.g. Webster et al. *supra* note __, at __; Harhoff and Graham, *Wheat From Chaff*, *supra* note __ (finding the EPO to grant a fraction of US patents in their samples), and Quillen and Cotropia, *supra* note __ (documenting a lower EPO grant rate over time). Webster et al. also reported comparative grant rates by select international patent classifications. While they do not correspond with the industry sectors from WIPO that we considered, they also found relatively smaller differences in the treatment of mechanical and instruments patent applications and relatively larger differences in grant rates of hardware and communications applications. (FIG 3)

Source: Author's analysis based on PATSTAT 2015, Smoch/WIPO, [File: Slide 14 data]²¹¹

The pervasiveness of the gap in grant rates across technology areas between the two jurisdictions is striking. What explains it? There are several possibility. One is that US patents are not strictly comparable to EPO patents because they are narrower in scope and claims. Because of the difficulty of testing this hypothesis we were not able to test it, and cannot rule it out as a major contributor. However, one might also assume that the difference is in the stringency of examiners at the EPO and USPTO, and based on the perspective that the US is issuing too many patents of low quality (rather than that the EPO is applying too high a standard to issue too few patents), that US examiners are too lenient. If this were the case, we would expect a lower rate of rejection in the USPTO than the EPO, a testable hypothesis.

To probe whether or not applicants experienced fewer rejections at the PTO than EPO, consistent with the hypothesis of examiner leniency, we compared the outcomes of non-granted and granted cases, taking into account key differences among possible outcomes. The allowability of an application filed at the EPO is determined over a series of steps, culminating, if it proceeds all the way, in an Examiner's decision to grant or refuse the application. Along the way the applicant may withdraw from the application process, affirmatively or passively, or the application may remain pending, leading to each application having one of four statuses: granted, withdrawn, refused, or still pending.²¹² The US process is similar in a number of ways, allowing applicants to "abandon" their cases by not responding to an office action or paying a patent issue fee, but it also differs in one important way – a US Patent examiner can never definitively refuse an application after examining it.²¹³ This is because, in the US Patent office, unlike anywhere else in the world, applicants have the right to continue examination with the patent office despite a final rejection, by filing a request for continued examination (RCE), or, within a limited period of time, a continuation application. There are no limits to the number of times an applicant can refile the same application, and the negotiation can go on for years.²¹⁴ As a result, patent applications filed at the USPTO only have three effective statuses: granted, withdrawn (or abandoned), or still pending.

We looked at the legal status histories of EPO non-granted patent applications in our cohort to determine how they were resolved.²¹⁵ But the results of our analysis (FIG ____) revealed a surprising result – when an application was not granted at the EPO, the reason was not that a case had been refused, but instead because it had been withdrawn. Among the 3,517 applications that were not granted in the EPO, 81% of ungranted cases were withdrawn by the applicant,

²¹¹ *Accord*, Webster et al., *supra* note ____ at Fig.3.

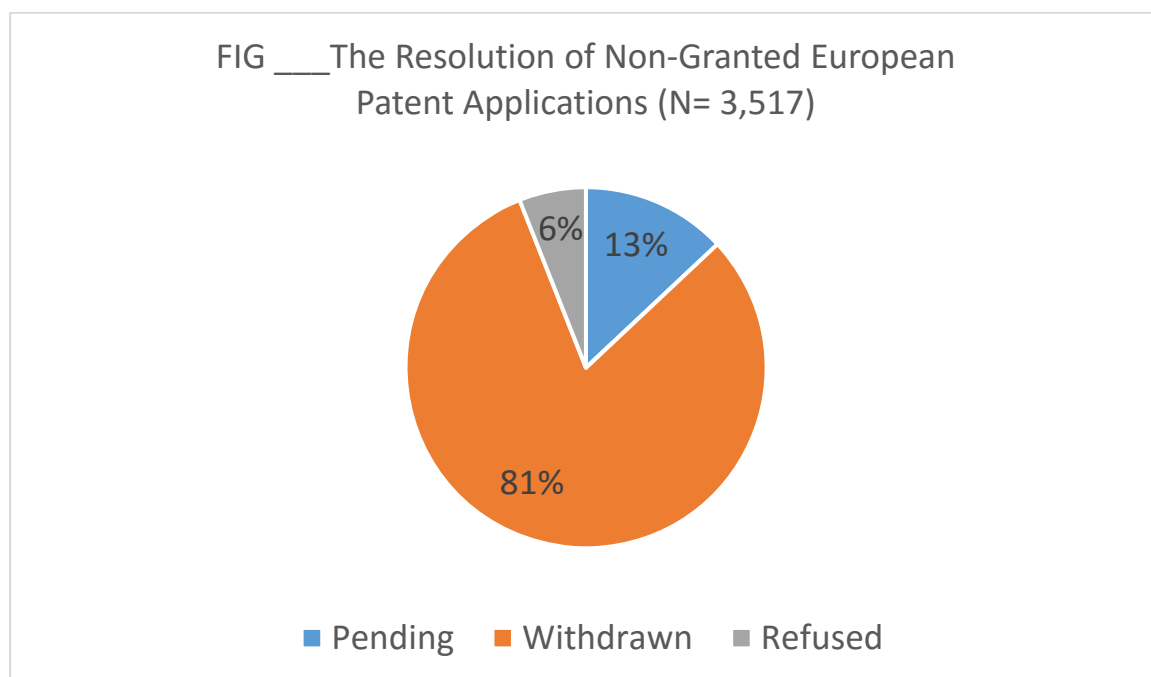
²¹² Described, *e.g.*, in *Id.*

²¹³ Lemley & Moore, *supra* note ____, at 66.

²¹⁴ Although delays that are not attributed solely to the patent office count against the effective term of the patent

²¹⁵ For non-granted EPO applications, we relied upon the "Legal Status" filed in PATSTAT associated with each patent application in our September 2002 cohort.

while 13% were pending and 6% were refused. Of the US counterparts to these non-granted EPO applications, in contrast, the majority (64%) were granted, and the rest were abandoned.²¹⁶



2. Investing in Accuracy at the EPO v. Tolerating Error at the USPTO

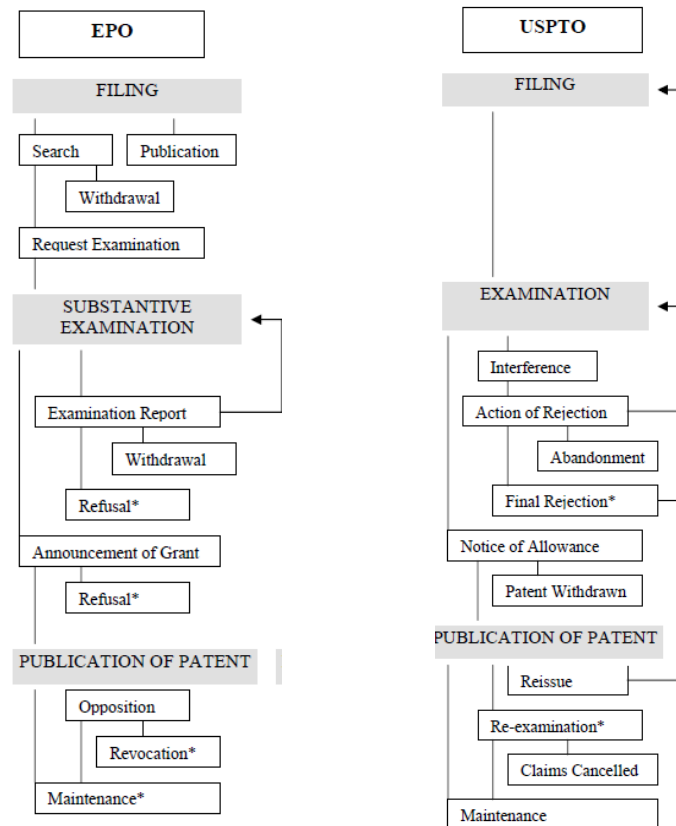
When one looks at the EPO examination process to explain the large share of withdrawn applications, a few features stand out. First, in the EPO, as in other jurisdictions,²¹⁷ search and examination are separate, and examination only takes place if there is an affirmative request for examination. (FIG ____) This results in a large percentage of applications being abandoned even before examination has taken place: as EPO President Battistelli has stated, “patents are granted in 49% of total filings, with 22% of applications abandoned after the search report and 29% abandoned after examination.”²¹⁸ In our cohort, in which 81% of ungranted cases were withdrawn, that translates into 35% of cases withdrawn after search, and 46% after examination. (FIG ____)

FIG ____ : Examination Procedures at the EPO and the USPTO (adapted from IP5 2013 Handbook)

²¹⁶ Out of the 3,516 matched applications that were not granted in the EPO, 2,257 or 64% were granted in the US, the rest were abandoned, based on our hand-inspection of a sample comprising 295 file histories associated with these patents (yielding a 95% confidence rating / 5% confidence interval). [File “appln history G-Doc”]

²¹⁷ The Japanese, Korean and Chinese patent offices also share this feature. (FIVEIPOFFICES, *IP5 Statistics Report 2013*, Fig. 4.9, available at <http://www.fiveipoffices.org/statistics/statisticsreports/2013edition/ip5sr2013corr.pdf>)

²¹⁸ EPO President Battistelli at the 30th Annual US Bar-EPO Liaison Council Meeting, 10/30/2014, transcript available at http://www.aipla.org/committees/committee_pages/IP-Practice-in-Europe/Committee%20Documents/Annual%20Meeting%202014/US%20Bar-EPO%20Liaison%20Council/EPO%20Liaison%20Report%2010%2030%202014.docx). These figures include rejections, which are overwhelmingly provided during the examination, not search, phase of patent prosecution (Correspondence with the EPO on file with the author).



But while the EPO process affords the applicant discretion during examination, this discretion in principal ends when the patent is refused. At this point, the applicant's options are limited,²¹⁹ as the EPO has decided the merits of the case, and reached a determination that the patent as filed does not meet its requirements. In contrast, in the US, even if the Examiner has reached a "final" decision about the application's success or lack of success, the applicant has the right to effectively refile the application through a "request for continued examination," or through a "continuation" application and have new claims issued and considered.

The ability of applicants to extend examination has benefits for applicants who can use the additional time to determine whether or not their invention is commercial valuable, as well as to avoid the consequences of an inadequate examiner that rejects their claims. But the ability to extend examination indefinitely has also raised concerns because it enables applicants to draft patent claims to cover emerging developments in the marketplace, interfering with

²¹⁹ The applicant can still do two things: file an appeal, which will be heard by the Boards of Appeal, or, if time limits permit, file a divisional application. The EPO does not have "continuation" or "continuation in part", applications and if a parent application is refused it is possible that the child application is also refused. Since the application is searched as a whole, and the content of the divisional cannot extend beyond the originally filed application (the parent), the chances of success are viewed as not great. (Correspondence with EPO official, 4/28/15) However, this apparently has not deterred the consistent use of divisional applications at the EPO in recent years even as the fees charged by the EPO have risen. See Dietmar Harhoff, *Patent Quality and Examination in Europe* 106 AM. ECON. REV. 5 (2016) (describing effects of recent administrative reforms at the EPO, resulting in claims numbers declining, claims sections in patents becoming shorter, and independent claims longer and presumably more specific, but continued use of divisional filings.)

competition.²²⁰ “Submarine” patents which are delayed in examination before being “launched” onto a mature industry have been a feature of the US patent since at least 1873, when the Woodbury planing-machine patent issued 24 years after it was filed, and subsequently used as the basis for mass litigation.²²¹

The inability of patent examiners to definitively dispense of patent applications has consequences for patent quality. It effectively incorporates a high tolerance for mistakes made by an examiner in her rejection of the application, as a continued filing or a refiling can overcome an examiner’s adverse “final rejection”. This, in combination with the high levels of inconsistency among Examiners documented by others,²²² encourages patentees who at first do not succeed to try, and try again, in what has been described as an attempt to “wear down” the Examiner,²²³ or get another, “better” or more favorable one. This contributes to an overall dynamic in which the failure of the applicant and Examiner to get it right, in a sense, is viewed as routine and expected, and lacking in permanent consequence as to the eventual grant of the application.

The same tolerance for error is not present in the EPO process. Instead, the EPO invests more upfront in ensuring that the prior art search report is comprehensive and that the substantive examination of the invention and application are technically correct. This greater investment translates into more people, more time, and more checks during the process.

For example, in the EPO, an Examination Division of at least three examiners²²⁴ makes the decision to grant a patent.²²⁵ When an application advances to the examination phase, a first examiner, a second examiner, and a chairman are assigned to the case, “[f]or maximum objectivity.”²²⁶ Although the first examiner bears primary responsibility, she confers with her colleagues and the decision to grant or refuse a patent is issued by the entire Division.²²⁷ This panel approach reduces the risk of inconsistency, and the impact of an individual outlier examiner as decisions are the product of a group review. Although the process of search at the EPO is carried out by a single examiner, the examiner is required to consult with other examiners if her search report is positive, to avoid improperly raising the expectations of the applicant. In the US, an application is also assigned to an art unit, or group of examiners. However, the decision to allow the patent is the primary responsibility of a single Examiner, though a Supervisory Patent Examiner (SPE) may weigh in.²²⁸

The significant investment by the EPO into upfront patent examination is also reflected in the amount of time that examiners are allocated. According to a study by van Pottelsberghe de la

²²⁰ Lemley & Moore, *supra* note ___, at ___. (criticizing

²²¹ Described, e.g. in CHRISTOPHER BEAUCHAMP, *INVENTED BY LAW*, 100 (2014).

²²² See studies by described *supra* in Part I.

²²³ Lemley & Moore, *supra* note ____.

²²⁴ At times, a fourth, legal counselor, is added to the Division (correspondence with the EPO on file with the author)

²²⁵ van Pottelsberghe de la Potterie, *supra* note ____

²²⁶ European Patent Office, *The Patenting Process*, available at <http://www.epo.org/learning-events/materials/inventors-handbook/protection/patents.html> (last visited Oct. 6, 2015)

²²⁷ Chapter 18(2)(EPC)

²²⁸ See Carley et al. *supra* note ____ (providing an overview of the examination process).

Potterie, former EPO Chief Economist, EPO Examiners on average get about 30 hours to examine a patent, vs. 19 at the PTO.²²⁹ Much of the extra time is spent earlier, rather than later in prosecution, as further discussed below.

3. *Looking Beyond the Patent Office, at Non-Patent Literature*

Through this comparative analysis, we are not saying that the US should necessarily strive to reduce its grant rates to EPO levels or move overnight to separate examination from search, for example. The relatively greater investment of the EPO in quality comes at a cost – for example, while US examiners have less time to carry out search and examination tasks, their output is also higher than their counterparts – each US examiner examines an average of 1700 claims per year, vs. 500 per EPO examiner.²³⁰ The fees associated with a US patent are lower, and in fact are the lowest in the world, when examination and maintenance fees are taken into account. (See FIG ____) While we save our discussion of the tradeoffs between cost and efficiency to later in this article, we discuss in this subsection the outcomes associated with the additional investment in quality, from the perspective of technical accuracy, social calculus, and applicant satisfaction.

We return to the basic task of a patent examiner – to ensure that patents are granted to novel and nonobvious ideas. Although seemingly simple, finding the closest reference to an invention has long been recognized as challenging. For example, in 1967, a Presidential Commission opposed granting software patents for this reason, stating that “the Patent Office now cannot examine applications for programs because of the lack of a classification technique and the requisite search files. Even if these were available, reliable searches would not be feasible or economic because of the tremendous amount of prior art being generated.”²³¹ To carry out searches requires an examiner to be “a living encyclopedia of science... His multifarious duties require an intimate and thorough knowledge of the whole circle of science and art.”²³² While the US Patent Commissioner in his Annual Review wrote these words in 1845, the challenges remain.

It is no longer feasible, for example, if it ever were, for patent examiners to know the relevant art in all technology fields. This puts pressure on the classification of applications, which in turn determines the universe of prior art that is searched in the first instance. Compounding the problem, particularly within high-technology areas, is the prevalence of non-standard ways of referring to technical object, and the diversity of relevant technology precursors to any particular invention. An examiner looking for prior references to “smartphones” may need to search the literature on pagers, telephony, mobile communication, and personal computers, for example. In contrast, there are only a limited number of ways to refer to a hydrogen molecule.²³³

²²⁹ Frakes & Wasserman, *supra* note __ at 4.

²³⁰ van Pottelsberghe de la Potterie, *supra* note __ at 1778.

²³¹ Committee on the Judiciary of the United States, *Report of the President’s Commission on the Patent System*, Historical and Topic Legal Documents, at 21 (1967), available at <http://digitalcommons.law.scu.edu/historical/9>

²³² Described in Drahos, *supra* note __, at 149 note 27.

²³³ Federal Trade Commission, *the Evolving IP Marketplace: Aligning Patent Notice and Remedies with Competition* (March 2011), available at <http://www.ftc.gov/os/2011/03/110307>

Perhaps the most significant problem, however, is the large volume of innovation that happens outside of the patent system. The job of an examiner is to evaluate the invention before them in light of the current state of the art. While patents provide some indicia, the patent statute requires many other classes of references, including any written materials (digitized or not), sales, and prior uses of inventions, to be considered. Only one in five companies doing research and development files for patents,²³⁴ and in many industries technology is now openly disseminated in written yet non-standard form, whether through shared source code, standards or technical disclosures. There are ways for the patent office to access these outside perspectives, including through submissions by the applicant, who are required, as described in Chapter 2, to disclose all relevant references to the patent office. However, the limited amount of time that US examiners have to conduct prior art searches, and the ex parte nature of the patent examination, as we have previously described, tend towards tunnel vision and the decision to grant, rather than deny, applications.

A number of scholars have looked at the adequacy – or inadequacy – of references relied upon during examination. These studies have documented the heterogeneity in citation patterns,²³⁵ and compared references provided by the applicant to references found independently by the Examiner.²³⁶ However, to date there has been no systematic way to measure the quality of examination based on prior art, raising again the problem of measurement.

An important indicia of the quality of examination is the extent to which non-patent references are cited by the examiner. Working scientists and engineers, whose knowledge is to serve as the yardstick for evaluating the technical merit of an invention, largely do not rely on patents to figure out whether or not something has been done before or how to do it.²³⁷ Neither should patent examiners, although patents may be the easiest source for them to access, since they are generated for examiners and with the input of examiners (on the claims). Studies have documented the greater prevalence of non-patent prior art references among certain, highly litigated patents,²³⁸ as well as the greater propensity of applicants to submit non-patent references to the examiner for her consideration.²³⁹ However, just because a reference was submitted to the patent examiner does not mean that the reference was meaningfully considered in the course of examination. Indeed, Cotropia and his co-authors have documented the disproportionate reliance by examiners upon the references they find themselves, and on patent

patentreport.pdf.

²³⁴ Brandon Shackelford, *One in Five U.S. Businesses with R&D Applied for a U.S. Patent in 2008*, NSF (February 2013), available at www.nsf.gov/statistics/infbrief/nsf13307/#tab1

²³⁵ Juan Alcacer, Michelle Gittelman & Bhaven Sampat, *Applicant and Examiner Citations to Patents: An Exploration and Overview*, 38 RESEARCH POL'Y 415, 427 (2009)

²³⁶ See, e.g. Christopher Cotropia, Mark Lemley & Bhaven Sampat, *Do Applicant Patent Citations Matter?*, 42 RESEARCH POL'Y 844, 854 (2013)

²³⁷ See, Chien, *Rethinking Patent Disclosure*, __ VAND. L. REV. __ (forthcoming) for a summary of the relevant literature on the use of patents as sources of technical information.

²³⁸ John R. Allison et al., *Extreme Value or Trolls on Top? The Characteristics of the Most-Litigated Patents*, 158 U PA. L. REV. 1, 56 (2009) (finding most-litigated patents to cite *ten* times as many non-patent prior art references when compared to a controlled set).

²³⁹ Cotropia, et al. *supra* __, at 844-54

references, and the tendency of examiners to ignore art that is submitted by applicants.²⁴⁰ To put yourself in the eyes of someone in the field, the examiner's basic job, requires one to read what those in the field are reading, and to understand the references that one in the field understands. An important indicator that the patent examiner is doing her job is the examiner's citation of non-patent literature.

The metric of examiner use of non-patent literature has several advantages. Unlike in other areas of patent law, it is generally undisputed that, "core to substantive quality is the prior art search."²⁴¹ The extent of US examiner citation of non-patent literature citation is also readily observable, due to a policy change in 2001 in the way in which patent citations are reported.²⁴² Perhaps most importantly, the USPTO itself has recognized the importance of "ways to get the best prior art in front of an examiner as soon as possible in the examination process," making it a priority in its most recent patent quality initiative.²⁴³ The USPTO and the executive branch, during the Obama Administration, have also acknowledged the importance of incorporating outside perspectives and non-patent literature into the examination process through a number of initiatives.²⁴⁴

To take stock of the extent of US and EPO examiner use of non-patent literature in the examination of patents, we returned to our matched sample of patents filed in September 2002. We applied slightly different methodologies to each analysis, due to differences in how EPO and US examination are carried out, and the ways in which examination records are constructed. In the US, examiner citation patterns are memorialized in two ways in US patent records. First, during the course of examination, the examiner lists the references that she relies upon in a prior art rejection or mentions as pertinent in a separate form.²⁴⁵ Each reference is designated as belonging to one of three categories: patent reference, foreign patent reference, and non-patent documents.²⁴⁶ Second, whenever a patent application or patent is published, the same references, "relied upon by Examiner" are memorialized through an asterix on the face of the publication, according to a practice that was introduced in 2001.²⁴⁷ Just as is the case with references cited by

²⁴⁰ Id.

²⁴¹ Vince Garlock, *AIPLA Letter on Enhancement in the Quality of Patents and Merits* (June 2010), available at <http://www.uspto.gov/sites/default/files/patents/law/comments/aipia23jun2010.pdf>.

²⁴² See "Notice of References Cited," PTO Form-892 and USPTO, *Advance Notice of Change to "Reference Cited" on the Front Page of a Patent* (2000), available at <http://www.uspto.gov/web/offices/com/sol/og/2000/week52/patrefr.htm> (describing that "when an examiner lists references on a Form PTO-892, the examiner lists references that are relied upon in a prior art rejection or mentioned as pertinent.")

²⁴³ Federal Register, *Request for Comments on Enhancing Patent Quality* (Feb 5, 2015), available at <https://www.federalregister.gov/chapters/2015/02/05/2015-02398/request-for-comments-on-enhancing-patent-quality>.

²⁴⁴ USPTO, *USPTO-led Executive Actions on High Tech Patent Issues, Executive Action 5: Crowdsourcing Prior Art*, available at <http://www.uspto.gov/patent/initiatives/uspto-led-executive-actions-high-tech-patent-issues> (last visited Oct. 7, 2015).

²⁴⁵ See "Notice of References Cited," PTO Form-892 and USPTO, *Advance Notice of Change to "References Cited" on the Front Page of a Patent* (2000), available at <http://www.uspto.gov/web/offices/com/sol/og/2000/week52/patrefr.htm>.

²⁴⁶ See "Notice of References Cited," PTO Form-892, available at http://www.uspto.gov/web/offices/pac/mpep/graphics/707_05a.png (last visited Oct. 7, 2015).

²⁴⁷ See supra note ____

the examiner during examination, references are designated as falling into one of three categories: “US Patent documents,” “Foreign Patent documents,” or “Other Publications.” The examiner is allowed, but not required, to draw from search reports provided by international searching authorities or references provided by applicants when they decide which references to rely upon.

In the EPO, search and examination proceed separately (FIG ____). During the search phase, the EPO examiner, in consultation with other examiners as described earlier, reviews the prior art. A report including the results of the search, as well as an initial opinion regarding patentability based on the search, is published by the EPO.²⁴⁸ In cases where EPO applications have been first filed internationally, and the EPO is designated as the search authority, preparation of the international search report fulfills the search phase, and the examiner that performs this search becomes part of the EPO team assigned to the application, should it advance through EPO examination.²⁴⁹ When the internationally filed patent application is subject to an earlier search carried out by another office, the EPO examiner may generate an additional, “supplementary search,”²⁵⁰ to complement the existing international search. The search report designates the ways in which the examiner is relying on the references through a series of codes, with the most common codes representing documents that establish the application’s lack of novelty (“X” document) or inventive step (“Y”).²⁵¹ The references cited by the EPO examiner and in international search reports are accessible in the EPO at two different websites, “Espacenet” and “EP Register,” the latter of which also includes search results associated with EPO applications that have been filed internationally and searched by a non-EPO national office, and some applicant filed citations.²⁵² Each cite identifies the source of the citation: international

²⁴⁸ Generally, EPO search reports are published as an Annex to the “A1” publication of the patent application 18 months after the application was filed, an “A2” or “A3” publication of the application, or a “A4” supplementary search, described *infra* at note ____ . EPO “B” publications, which are granted patents, do not include search report results (US “B” publication do contain the citation history of the patent). European Patent Office, *Basic Definitions*, available at <http://www.epo.org/searching/essentials/definitions.html> (last visited Oct. 7, 2015), presentation by Kris Loveniers, EPO, “Search Matters 2014”

²⁴⁹ Correspondence with EPO official on file with author.

²⁵⁰ *supra* note ____

²⁵¹ Kris Loveniers, *How to Interpret EPO Search Reports*, EUROPEAN PATENT OFFICE (2014), available at <http://people.unica.it/liaisonoffice/files/2014/05/How-to-Interpret-EPO-Search-Reports.pdf>

²⁵² The two databases vary in scope and purposes, but for the identification of examiner-cited prior art, have few differences except that the EP Register includes references generated by non-EP searching authorities in the case of EP patents first filed through the PCT (It also includes some additional references cited by the applicant, but we do not include such references in our analysis as they are not “examiner-cited.”). Espacenet is “a database of publications and documents, comprising patent publications from all around the world, including those from the EPO. Espacenet also includes other prior art documents such as non-patent literature, designs, utility models etc. Espacenet is, in short, a “prior art” database. The European Patent Register is a database of legal and procedural status data, only for patents processed by the EPO. It also contains access to the file wrapper associated with each patent dossier.” Correspondence with the EPO, Sept 3. References at both websites can be found in the “citations” tab of an application, however, the EP Register consolidates information from all publications into a single website, whereas Espacenet has different pages for each publication cf., e.g., for EP patent application EP2021283, with publications A1 and A4,

<http://worldwide.espacenet.com/publicationDetails/biblio?CC=EP&NR=2021283A1&KC=A1&FT=D>,
<http://worldwide.espacenet.com/publicationDetails/biblio?CC=EP&NR=2021283A4&KC=A4&FT=D> (separate

search report, EP search, or applicant search, and we included the first two categories as “Examiner-cited.”²⁵³

We coded for the citation of non-patent literature in the two offices by consulting the sources mentioned, making a few adjustments to ensure an accurate comparison. With respect to US applications, in the majority of cases (N=5,542 out of 7,417), the patent had already been issued, and we consulted the front page asterix information of the published patent, as captured and made available by Google Patents,²⁵⁴ and performed spot checks to ensure that this information was consistently reported. Where the application had not yet matured into a patent (N=1,875), we hand-inspected the patent’s file history posted to PAIR and looked at the references that had been cited by the Examiner, if any.²⁵⁵ In some cases, citation information was not publicly available due to secrecy requests by the applicant, or because the application was abandoned prior to publication or search and we excluded these applications from our analysis.

We carried out a similar process with respect to European applications. First, we consulted the consolidated citation history of the EP Register for each patent. Next, to see if the results were significantly different based on studying Espacenet and Google Patents citation data, we coded 100 patents using all three methods. The Register and Google Patents contained substantially the same information,²⁵⁶ but we found Espacenet to periodically exclude references

Espacenet links to publications A1 and A4 listing) and

<https://register.epo.org/application?number=EP07748672&lng=en&tab=citations> (single Register link).

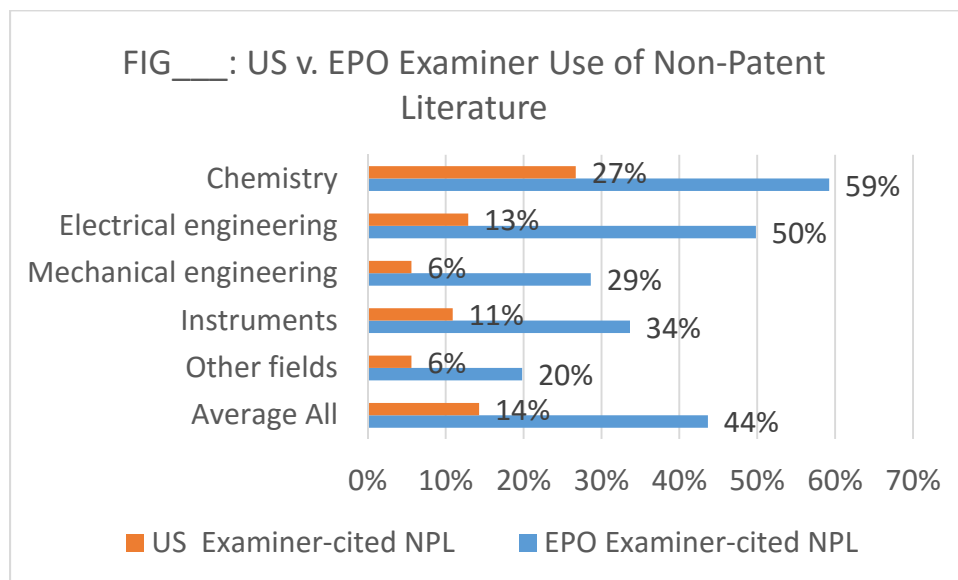
²⁵³ We made this decision based on consultation with EPO officials, who relayed to us that within the EPO, international search results are considered “examiner-cited” in the same way that EPO search results are, since generation of the international search satisfies the search phase of examination of the EP patent. The approach is different in the USPTO, as an international search or the references generated therein are only considered “examiner-cited” if they are actually cited by the examiner in a subsequent office action. This introduces a potential distortion in our results given the high percentage of EPO patent applications that are first filed internationally (see [http://documents.epo.org/projects/babylon/eponet.nsf/0/af3a2fbb58589e51c1257def00465dc3/\\$FILE/epo_facts_and_figures_2015_en.pdf](http://documents.epo.org/projects/babylon/eponet.nsf/0/af3a2fbb58589e51c1257def00465dc3/$FILE/epo_facts_and_figures_2015_en.pdf), 13, estimating that the EPO receives 60,000 direct European filings, and 214,000 international filings under the PCT). To investigate the impact of including international search results in our results, we coded ~500 EP applications for non-patent literature both including and excluding international searches. The difference was small: 41% of cases that included international search results cited NPL (188 out of 484 cases, with 16 cases in which information was not available) while 43% of cases that excluded international search results cited NPL (148 out of 345 cases where non-international search results were available). (file: NPL III, EPO Sept 2002 PCT Check)

²⁵⁴ Which, in turn, pulls from the DOCDB database (author email). We compared front page asterix information and Google Patents asterix information and found a discrepancy rate of ~1%.

²⁵⁵ Not surprisingly, perhaps, the rate of NPL citation was higher among patent application that did not mature into patents than among applications that did mature into patents. The NPL citation rate among non-issued US application was 25%, whereas the NPL citation rate among US applications that became grants was 12%. For EP cases, the NPL citation rates were 41% and 45%, respectively, among granted and non-granted apps.

²⁵⁶ To access citation information for Google Patents, we consulted all versions of the application (A1, A2, A4, etc.). Also, international search reports within Google Patents citations data are often stored at a link included on the page of the application, whereas all of this information is consolidated within the EP Register record. (cf.e.g. Google Patents and EP Register information for EP applications with the publication numbers EP1266394 and EP1328947). In 36 out of the 100 cases, an international search report was part of the record, reflecting the high concentration of EPO cases generated through the PCT route but in 14 of these 36 cases, the examiner-cited NPL information was redundant of information already in the record.

included by the other two sources,²⁵⁷ and, at times, for there to be disagreements between the sources as to whether a source was Non-Patent Literature.²⁵⁸ We report the EP results based on the Register, as it represents the most comprehensive source of data, but as before, when examiner citations data was unavailable, for example because an application was abandoned before search could be carried out, we excluded it from our results. We were left with 7,176 USPTO and 7,255 EPO data points (out of the possible 7,417), in our analysis. We report our results in FIG ____.



Source: Author Analysis based on USPTO PAIR, Google Patents, EP Register

There were strong differences in citation patterns. Across the board, in every single category, the EPO was more likely to cite non-patent literature than the USPTO, in its examination of the same, non-withdrawn patent applications. While 44% of EPO applications included a reference to non-patent literature, only about 14% of US patents did. The gaps were most pronounced among mechanical engineering applications, where non-patent literature was nearly six times more likely to be relied upon an Examiner in the EPO case than by an examiner in the US case. Electrical engineering applications were four times as likely to be evaluated in view of non-patents by EPO examiners than by US examiners, while, among the major sectors, US and EPO examiners of chemistry patents were the most likely to cite non-patent literature. We also observed variations at the class level. For example, class 705 patents “business method” applications were almost twice as likely to receive examiner-based NPL citations as applications

²⁵⁷ Cf, e.g. Google, EP Register, and Espacenet information for EP applications with the publication numbers EP1298704, EP1294036, EP1080477

²⁵⁸ See, e.g. characterizations of EP applications with the publication numbers EP1396745 and EP1428282.

in general.²⁵⁹ This could be an artifact of the PTO's "second pair of eyes program" that put greater scrutiny on business method patents but also resulted in much lower grant rates.²⁶⁰

4. Taking Time To Get it Right

Why and how do EPO examiners rely so heavily on non-patent prior art? There are a number of reasons, beginning with the way in which examination is designed. Search is separated from examination and Examiners are instructed to, at the outset, carry out "thorough, high-quality, all-embracing search ...[and] reduce to a minimum the possibility of failing to discover complete anticipations (sic) for any claims."²⁶¹ The intent of the search report is to support a decision by the applicant, "whether to continue prosecuting their applications and have them examined," and overall, to "make it possible to determine, on the basis of the documents mentioned in the search report, whether and to what extent the invention is patentable,"²⁶² in the words of the EPO board of appeals. Almost half of all withdrawn cases are withdrawn during the search phase before examination, as mentioned earlier.²⁶³

The EPO also makes efforts to ensure that its examiners have access to the best prior art, including non-patent literature. The EPO's "EPOQUE" search system, which contains more than a hundred databases, is viewed by many to be the best in the world.²⁶⁴ For example, it maintains a partnership with the IEEE and other standards setting bodies to collect non-patent specifications,²⁶⁵ and the USPTO has been urged to do the same.²⁶⁶ The Patent Cooperation Treaty, which supplies a large number of EPO applications,²⁶⁷ requires "mandatory search" of certain databases of non-patent references that the public can submit prior art to.²⁶⁸

²⁵⁹ 17% (vs. 10%). Author's analysis.

²⁶⁰ Described, e.g. in Mark A. Lemley, *Fixing the Patent Office*, 13 INNOV. POL. AND THE ECON. 83 (2013), at 87.

²⁶¹ EPO, *Guidelines on Completeness of Search*, at B-III, 2.1, available at http://www.epo.org/law-practice/legal-texts/html/guidelines/e/b_iii_2_1.htm. (Complete description in context: "The European search is essentially a thorough, high-quality, all-embracing search. Nevertheless, it must be realized that in a search of this kind, 100% completeness cannot always be obtained, because of such factors as the inevitable imperfections of any information retrieval system and its implementation. The search should be carried out in such a manner as to reduce to a minimum the possibility of failing to discover complete anticipations for any claims, or other highly relevant prior art. For less relevant prior art, which often exists with a fair amount of redundancy amongst the documents in the search collection, a lower recall ratio can be accepted.")

²⁶² Id.

²⁶³ EPO President Battistelli, *supra* note ____.

²⁶⁴ Drahos, *supra* note ___, at 61-62.

²⁶⁵ *Patent Challenges for Standard-Setting in the Global Economy: Lessons from Information and Communication Technology*, NATIONAL RESEARCH COUNCIL, 32 (2013) (describing collaborations between the EPO and a standards setting organization to include technical, non-patent documents in its search).

²⁶⁶ Linda Kahl, *Comments to the USPTO on Crowdsourcing* (Apr. 18, 2014), available at http://www.uspto.gov/sites/default/files/patents/law/comments/cr_f_kahl_20140418.pdf (recommending that the USPTO ensure that existing registries of biological parts are available to and searchable by USPTO examiners).

²⁶⁷ European Patent Office, *Facts and Figures 2015*, 13, available at [http://documents.epo.org/projects/babylon/eponet.nsf/0/af3a2fbb58589e51c1257def00465dc3/\\$FILE/epo_facts_and_figures_2015_en.pdf](http://documents.epo.org/projects/babylon/eponet.nsf/0/af3a2fbb58589e51c1257def00465dc3/$FILE/epo_facts_and_figures_2015_en.pdf) (estimating that the EPO receives 60,000 direct European filings, and 214,000 international filings under the PCT))

²⁶⁸ *Research Disclosure Website*, RESEARCH DISCLOSURE, <http://www.researchdisclosure.com/> (last visited ____). ("Patent examiners are required to search Research Disclosure by PCT statute").

But greater access to outside perspectives alone can't explain the EPO's higher rate of non-patent literature citation. The US examination process actually arguably provides more access than does the EPO examination process to the relevant references that applicants know about, by requiring them to be provided to the examiner under the applicant's duty of disclosure, described in Chapter 2.²⁶⁹ In fact, when there is a matching case before the EPO, the EPO search report normally will be submitted to the USPTO through this route. However, while applicant references generally include a high share of non-patent literature, they are infrequently used by US examiners, who overwhelmingly rely upon only the references they find themselves.²⁷⁰ This makes intuitive sense, particularly when the motivation for submission by applicants may be unclear,²⁷¹ and presumably, applicants have reviewed the art that they have supplied and are submitting claims that steer clear of those references. However, it also means that USPTO examiners are not focusing or relying on the most relevant prior art – that which the applicant and other examiners know about.

The simpler explanation is that US examiners are not allocated enough time to do their job, in particular to search for, review, and apply prior art, as others have noted.²⁷² Searches for prior art, are reportedly performed, on average, in about two hours or less at the USPTO, as compared to eight hours at the EPO,²⁷³ and the average in 2015 is believed to be even higher, around twelve hours,²⁷⁴ although, in both jurisdictions, the amount of time allocated to search tasks depends on the technology.²⁷⁵ Finding and digesting new references applicable to the particular case takes time and reduces examiner output on a per hour basis. It is also required in order for examiners to fulfill their statutory mandate to grant patents only on novel and non-obvious inventions. The substantially greater amount of time dedicated to search in the EPO, which leads to substantially higher rates of NPL citation, is consistent with the overall contrast we have drawn between the US and EPO, and the substantial, early investment of the EPO in examination.

5. Quality v. Efficiency of Examination

That a greater investment in search leads examiners to cite a more diverse set of references hardly surprises. But the different approaches that the USPTO and EPO apply have largely overlooked consequences for the quantity and quality of granted patents. In the US, the upfront investment in quality by the Patent Office is relatively lower, in terms of examiner time,

²⁶⁹ In the EPO, examiners also have the ability to request information from applicants but doing so is not the norm.

²⁷⁰ Cotropia et al. *supra* note at 844, 845 (Table 1) (showing that 94% of non-patent literature and 66% of patent literature cited by patents are applicant supplied)

²⁷¹ Lemley and Sampat, *supra* note __, describing the “flooding” or “burying” of patent examiners through applicant disclosure submissions, ____.

²⁷² See, e.g. Michael Frakes & Melissa Wasserman, *Is the Time Allocated to Review Patent Applications Inducing Examiners to Grant Invalid Patents?: Evidence from Micro-Level Application Data* (NBER Working Paper No. w20337, 2014) (“Our results demonstrate that the less time an examiner is given to review an application the less prior art they cite, the less likely they are to make prior-art-based rejections (especially obviousness), and the more likely they are to grant the patent.”), Cotropia et al., *supra* note __ (discussing the time pressures faced by examiners)

²⁷³ van Pottelsberghe de la Potterie, *supra* note __ at 1778 n.9.

²⁷⁴ Correspondence with the EPO.

²⁷⁵ Frakes & Wasserman, *supra* note __ at 4.

but the risks associated with examination mistakes or inconsistencies is also reduced through the ability of patent applicants to refile their application if they get outcomes they are dissatisfied with. Examination and grants come earlier and more often to US applicants, and at a lower cost.

The EPO process has other strengths and weaknesses. The measured and staged nature of the EPO examination process invites applicants to evaluate at each phase of the process their options for pursuing the patent, and to develop a strong sense of the patent's likely fate within the EPO. Cases that are not granted are withdrawn, often just based on the search, conveying the sense that even though applicants often do not get the patents they apply for at the PTO, they decide, at least in part, the fate of their applications. This leads applicants to withdraw their applications to an extensive level, and to actually fail much more often in the pursuit of their patents – about 50% more, than in the US. The process is high-touch with a number of quality checks, supported by Examination teams who are careful not to raise expectations along the way, among applicants.

From a social welfare perspective, the fewer unnecessary patents – patents that don't disclose anything new or nonobvious, or that induce innovation – the better. But what about the private value of patent quality? Surprisingly, when asked, patent holders and companies have given the highest marks to the jurisdiction that is less likely to give them what they want (a granted patent), more slowly, and at a higher cost – the EPO. In surveys, the EPO has earned the highest marks of any patent office for the quality of the patents it issues, and also the highest levels of customer satisfaction. In a 2015 survey, for example, 62% of practicing lawyers and 60% attorneys and corporate IP managers gave EPO-issued patents a rating of excellent or very good quality.²⁷⁶ The USPTO received ratings of 30% and 35% from the same populations.²⁷⁷ In the 2015 survey, the EPO also received the highest marks of all five “IP5” offices in terms of customer service.²⁷⁸ The strong support for the highly structured, quality-focused European model is striking. Though applicants don't necessarily get the patents they seek at the EPO, or the unlimited freedom to continue having their patents examined, they remain in control of the process, receiving early warnings of an application's likely fate.

These findings imply that applicants favour European style examination, reflecting greater upfront investment and a more circumscribed patent examination process. In 2006, the USPTO moved to implement the latter when it proposed curtailing the use of “continuation” applications and requests for continued examination,²⁷⁹ in order to address existing backlogs. Patent lawyers and biopharmaceutical companies who file early in their product's lifecycle, and use the continuation process to refine their applications based on marketplace developments strenuously resisted this initiative.²⁸⁰ While this sort of strategic game playing²⁸¹ is detrimental to

²⁷⁶ Intellectual Asset Management, *Quality and Procurement* (2015), available at [http://documents.epo.org/projects/babylon/eponet.nsf/0/4783c6465d9a2b5fc1257e5900242b3f/\\$FILE/IAM72_benchmarking_q_p_en.pdf](http://documents.epo.org/projects/babylon/eponet.nsf/0/4783c6465d9a2b5fc1257e5900242b3f/$FILE/IAM72_benchmarking_q_p_en.pdf), see also Sara-Jayne Clover, *USPTO Still Struggling to Convince on Quality*, IAM (May 11, 2012), available at <http://www.iam-media.com/Blog/Detail.aspx?g=4ae808a6-8240-41bf-a6e0-9b1828bfe372> (reporting 2011 and 2010 results that report the EPO as having the highest quality rankings)

²⁷⁷ *Id.*

²⁷⁸ *Id.*

²⁷⁹ *Tafas v. Dudas*, 541 F. Supp. 2d 805 (E.D. Va. 2008)

²⁸⁰ Drahos, *supra* note ___, at 157.

the system, to the extent it reflects a legitimate mismatch between product and patent lifecycles, as discussed below, other ways of addressing this mismatch that are more narrowly tailored would be preferable. However, if the resistance to curtailing continuations is based on the perception that the USPTO makes a lot of mistakes in examination, it is worth considering whether a commitment to fewer mistakes through a greater investment could offset this resistance.

The benefits of thoroughly considering prior art when a patent is examined, rather than later in the patent's life, are real. To probe them, we took patents that had been the subject of a finally decided *inter partes review* challenge as of summer 2015 (N=311), and determined that over half of them (N=169) had a European counterpart application. Of these 169 applications, less than half have matured into European patents.²⁸² This means that, though most of the claims that have been reviewed in the *IPR* proceedings have been invalidated completely by the Board, many never even made it out of the European Patent Office, and were rejected much earlier. It is also notable that, while US examiners cited non-patent literature in 16% of the US applications, EPO relied on non-patent literature 30% of the time, and the PTAB relied on non-patent literature in its final decision in 40% of these cases, by our count.²⁸³ According to a study by John King, a 1% increase in examination hours might reduce the amount of litigation by an estimated 3.94 cases per year. Whether this a good deal, of course, depends on how much the increased costs and how much the reduction nets are.²⁸⁴

In recent years, the USPTO has recognized that patent quality is a major priority, and announced initiatives around search and non-patent references. During the Obama administration, the USPTO has made significant efforts to increase the stock of available non-patent references, noting that "the most relevant information about a particular technology in an application is sometimes difficult for examiners to locate and use. Because this information often resides with the technical and scientific community, crowdsourcing and third-party submissions are promising ways to uncover hard-to-find prior art," and securing agreements from a number of companies to provide hard-to-find references such as manuals to the office.²⁸⁵ In 2010, the Office created the Patent Examiner Technical Training Program (PETTP), in order to help patent examiners keep up with fast-changing technological fields, inviting technologists, engineers, and other experts to provide relevant technical training and guidance to patent examiners,²⁸⁶ and hundreds of companies have participated.²⁸⁷

²⁸¹ Steve Blount & Louis S. Zarfes, *The Use of Delaying Tactics to Obtain Submarine Patents and Amend Around a Patent That a Competitor Has Designed Around*, 81 J. PTO SOC'Y. 11, 13 (1999).

²⁸² Author's analysis [Sept 2002 Sample]

²⁸³ Author's analysis

²⁸⁴ JOHN L. KING, "Patent Examination Procedures and Patent Quality," *IN PATENTS IN THE KNOWLEDGE-BASED ECONOMY* 54-73, (Wesley M. Cohen & Stephen Merrill eds., 2003).

²⁸⁵ USPTO, *Calling on the Crowd to Help Increase Patent Quality* (Mar. 13, 2014), available at http://www.uspto.gov/blog/director/entry/calling_on_the_crowd_to1

²⁸⁶ Federal Register, Vol. 75, No. 178 (Sep. 15, 2010), available at <http://www.gpo.gov/fdsys/pkg/FR-2010-09-15/pdf/2010-23006.pdf>

²⁸⁷ USPTO, *PETTP 2015 Companies and Speaker(s)*, available at <http://www.uspto.gov/patent/initiatives/patent-examiner-technical-training-program/pettp-2015-companies-and-speakers> (last visited Oct. 7, 2015)

But the low citation of non-patent literature provided to Examiners already through applicant disclosures casts serious doubt that greater access alone to references, without more time to consider them, will translate into the more robust consideration of relevant references. Fortunately, the examiner-cited non-patent literature metric, and progress on this dimension, can independently be measured over time, using the techniques described in this article. In this way, it has several advantages over some of the metrics discussed at the outset of this article. Unlike grant rates, which reflect not only the quality of examination but also changes in the law and the quality of applicant submission, the references that an examiner reviews and cites are largely within the examiner's control. Citation behavior is also observable for all patents and immune from the selection issues that accompany court and PTAB- reversals. Comparisons against an EPO benchmark are also possible, as we have demonstrated. Finally, as a process, rather than outcome based metric, Examiner citation of non-patent literature can be measured and tracked in real-time, at the granular level of an art unit, class, or even examiner, enabling progress to be measured.

Being able to track the benefits associated with a greater investment in quality will be important because, just as the downstream benefits of increased quality are real, the upfront costs of increased quality could also be significant. If all US cases received a sixfold increase in the amount of time allocated to search, and allocated a three-person panel to each case, for example, holding all other things equal, the growth in costs and backlog and examination backlog could also be considerable. There are two ways of limiting these effects, however.

First, more time could be allocated selectively, to give examiners more time, for example, to consider international search results, or non-patent literature in particular. The applications that are the subject of international search are more valuable, insofar as they reflect a greater investment of resources by the applicant, and therefore are likely to be the ones that applicants want to be sure will withstand later challenges, and any supplemental fees could be passed on to applicants, particularly large ones. The examination units that feature the cases where missing non-patent literature is most likely to matter could also get more time. These could include the USPTO art units that have the most patents invalidated at the PTAB, on the basis that they are novel or obvious, or which have the highest litigation hazard,²⁸⁸ or which show the greatest gaps when compared to their EPO counterparts. Sorting for greater scrutiny in these ways has the benefit of incorporating insights from related and past patterns of examination and litigation.

Another risk is that, higher costs, if passed on directly to applicants, could disproportionately impact those who are more sensitive to them, including start-ups and small and medium sized enterprises.²⁸⁹ Low filing fees have been the feature of the US patent system

²⁸⁸ See, e.g. Josh Lerner, *the Litigation of Financial Innovations* (NBER Working Paper No. 14324, 2008), available at <http://www.nber.org/papers/w14324> (documenting that financial patents are 27 to 39 times more likely to be litigated than average patents), James E. Bessen & Brian J. Love, *Make the Patent Polluters' Pay: Using Pigovian Fees to Curb Patent Abuse*, 4 CAL. L. REV. CIRCUIT 84 (2013) (suggesting the idea of using hazard rates to determine)

²⁸⁹ Gaétan de Rassenfosse & Bruno van Pottelsberghe de la Potterrie, *On the Price Elasticity of Demand for Patents*, 74 OXFORD BULL. OF ECON. AND STAT. 58 (2010).

for many years,²⁹⁰ and they facilitate greater access to the patent system. However, there is no reason that the costs of higher quality standards must be borne disproportionately by small and medium enterprises, and a number of schemes could be used to prevent this result; indeed, the fee increases that the USPTO introduced following passage of the America Invents Act actually reduced the fees for the smallest applicants, “microentities” that are now entitled to a 75% discount off examination fees, while it raised them for larger entities.²⁹¹ We would favour continuing to distribute future application rate increases in this way, that is to say, disproportionately on larger companies, for whom an additional incremental patent filing, on a portfolio of thousands, is likely to matter less to the health of the company than for a company with a small portfolio.

There are a number of arguments that fee rises should, all things being equal, take place during the maintenance, rather than examination phase of a patent. First, administrative fees at the examination stage are only one component of the total cost to the applicant, as the cost of preparing an application currently far outstrips patent office costs on the average application, reducing their impact.²⁹² Second, although raising fees at the examination stage can also reduce congestion and increase the quality of submitted patents, studies that have looked at changing patent filing behaviour by adjusting patent filing fees, including some by several of us, aren’t encouraging.²⁹³ Increasing fees after a patent has issued, rather than before it, aligns the private costs with the costs to society.²⁹⁴ We consider this policy lever in the next section.

IV. Post-Grant Quality Mechanisms

Because a patent’s value only emerges over time, the point of a patent’s grant (or denial) can both be thought of as “too late” to make a difference, since the patent has already issued (or denied) as well as “too early” to know whether the patent actually matters. During the post-grant period, the ability of members of the public to ask Patent Office judges to take a closer look at an issued patent, through post-grant review procedures available both in the EPO, and in the US, is a critical check on patent quality. In the US, post-grant review is expensive, costing each side in

²⁹⁰ Drahos, *supra* note ____ at 99-109 (describing US fees are set below UK fees at the outset, in 1790, and lower than most European countries, for the first half of the 19th century).

²⁹¹ See 78 FR 4212 (Jan. 18, 2013).

²⁹² Rassenfosse & Bruno van Pottelsberghe de la Potterie, *supra* note ____ at ____.

²⁹³ See, e.g. William M. Landes & Richard A. Posner, *An Empirical Analysis of the Patent Court*, 71 U. CHI. L. REV. 111, 114 (2004) (finding a short-term price elasticity of patent fees of only -0.03), Rassenfosse & Van Pottelsberghe de la Potterie, *USPTO Section 10 Fee Setting— Description of Elasticity Estimates*, USPTO (2013), available at http://www.uspto.gov/sites/default/files/aia_implementation/AC54_Final_Elasticity_Supplement.pdf (finding a short-term price elasticity of pre-grant fees of just -.09, but a long run price elasticity of -.30); Petra Moser, *How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World’s Fair*, 95 AMER. ECON. REV. 1214, 1221 (2005) (“Although the upfront costs of patenting were extremely high in Britain, at the equivalent of 37,000 current U.S. dollars but modest in the United States (at 618 U.S. dollars), the share of innovations that were patented was similar in Britain and in the United States: 11.1 percent in Britain compared to only 14.2 percent in the United States. Moreover, British and American inventors chose to patent (and not to patent) in the same industries”)

²⁹⁴ See e.g. de Rassenfosse & van Pottelsberghe de la Potterie, *supra* note ____ (arguing that when there is limited information by the time of filing to assess an invention’s value, it is better to raise fees as time goes on, rather than at the outset)

a review hundreds of thousands of dollars to complete.²⁹⁵ It is also narrow, only enabling review on certain grounds or under certain circumstances.²⁹⁶ As a result, although generally justified only for patents that are the subject of an active litigation or dispute.²⁹⁷ In Europe, for example, whose well-regarded “opposition” system provided one model for the design of the current US system,²⁹⁸ the share of patents subject to post-grant review is about 5%.²⁹⁹ Thus, while considered the primary mechanism of post-grant patent quality control, post-grant reviews can only provide limited relief.

In this Part, rather than focusing only the few patents that are contested, we consider ways of influencing the quality and quantity of the majority of patents that are not. For example, the patent term of 20 years is longer than the lifecycle of many products, as discussed below. But relatively low US renewal fees enable patent holders to hold on to their patents for longer. In this subsection, we discuss adjusting renewal fees and several other “post-grant” quality levers to reward patent owners for voluntarily reducing the risks associated with their patents and putting the public on notice concerning the patents its owners are practicing or planning to enforce. Consistent with the use of patents for many purposes, many of them non-exclusionary, we believe that patentees would respond to these incentives and therefore, many would voluntarily opt into reduced effective terms beyond the life of a product covered by a patent.

A. Aligning Maintenance Fee Policy with Social Welfare

After a patent is granted, its owners must pay to keep it in force. United States “maintenance fees” were introduced to the US in 1980;³⁰⁰ before that, the owners of a patent were automatically entitled to the full term. The change was dramatic when it took place – following the introduction of fees, the growth in patents abruptly stopped, as expiring patents offset new patents.³⁰¹ In the same vein, changes to current maintenance fees, if significant enough, would impact the quality and quantity of patents in force. Right now, US fees are among the cheapest in the world, on a per capita GDP basis. (FIG___) US patents are also kept in force longer than other leading jurisdictions,³⁰² leading to a longer period of monopoly and higher supracompetitive prices.

Some inventions arguably deserve a longer exclusivity term than 20 years. Budish and his co-authors have noticed that company cancer researchers tend to invest less in earlier-stage

²⁹⁵ Jay P. Kesan, Arti K. Rai, & Saurabh Vishnubhakat, *Strategic Decision Making in Dual PTAB and District Court Proceedings*, 31 BERK. TECH. L.J. 45, 55 (2016).

²⁹⁶ As described in Chien & Helmers, *supra* note ____, post-grant review is only available for the first nine months after issue, CBM review is only available for financial services patents, and only novelty and obviousness can be revisited in *inter partes* review.

²⁹⁷ See *Id.* (documenting the high proportion of IPRed patents that are the subject of parallel litigation, and the low percentage of litigated patents that is the subject of a post-grant review)

²⁹⁸ Joe Matal, *A Guide to the Legislative History of the America Invents Act: Part I of II*, 21 FED. CIR. B.J. 435, 438. 47 (2012).

²⁹⁹ See references described, e.g. in Chien & Helmers, *supra* note ____.

³⁰⁰ Marco et al, *supra* note ____. (citing 94 Stat. 3017 § 41; 35 USC 41)

³⁰¹ *Id.* FIG. 6 (Annual Count of Patents in Force)

³⁰² IP5 report, *supra* note ____ at FIG 4.8 (showing the USPTO, by year 20 after the filing date, to have the highest rate of renewal (~48%), followed by the JPO (~27%), SIPO, EPO, and KIPO.)

cancer drugs than late-stage cancer drugs because they are much slower to bring to the market, leaving a limited amount of time to recoup development expenses.³⁰³ But many product lifecycles are shorter than the 20-year term offered by a patent.³⁰⁴ During a typical 5-year period, two-thirds of US manufacturing firms switch their products,³⁰⁵ and in the US, people replace their cellphones every two to three years.³⁰⁶ According to a study by Bilir, the shortest product life cycles are in the electronics machinery (6.7 years) and computer and office equipment (8.4 years) industries, and the longest product lifecycles are in non-electric heating equipment (10.9 years) and metal cans and shipping containers (10.6).³⁰⁷ Broda and Weinstein find that computer software ranks third highest in turnover of the 100 product types they studied.³⁰⁸ The misalignment of patent and product times in the software industry extends to the application process as well. In July 2016, it took about 25 months to get a patent.³⁰⁹ But in certain markets, for example, the mobile app market, “fast followers” that mimic aspects of the original are often introduced in less time.³¹⁰ It has been reported that half of the revenue in the semiconductor industry is derived from products that have been on the market for less than six months.³¹¹

One risk of patents that outlive the products they support is that they are sold to patent assertion entities (PAEs), or trolls and then asserted. Love has found that non-practicing entities disproportionately assert their patents at the end of a patent’s life, rather than the

³⁰³ Eric B. Budish et al., *Do Fixed Patent Terms Distort Innovation?: Evidence from Cancer Clinical Trials* (Chicago Booth Research Paper 13-79, 2013) (it takes a median of 9.1 years to conduct a study on early-stage prostate cancer treatment, as compared to a 12.8-month median for treatments of late-stage cancer)

³⁰⁴ Roger Entner, *2014 US Mobile Phone Sales Fall by 15% and Handset Replacement Cycle Lengthens to Historic High*, RECON ANALYTICS (Feb 10, 2015), available at <http://reconanalytics.com/2015/02/2014-us-mobile-phone-sales-fall-by-15-and-handset-replacement-cycle-lengthens-to-historic-high/>

³⁰⁵ Andrew B. Bernard, Stephen J. Redding, and Peter K. Schott, *Multiple-Product Firms And Product Switching*, 100 AM. ECON. REV. 70-97 (2010).

³⁰⁶ Entner, *supra* note ____.

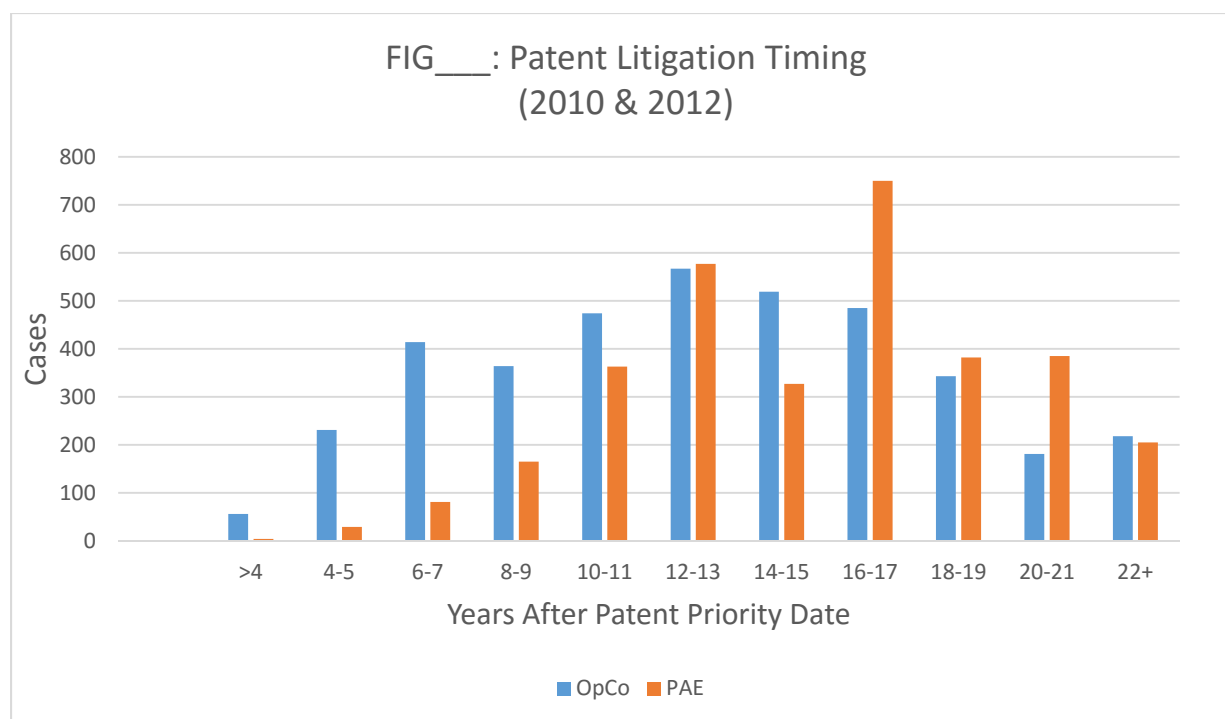
³⁰⁷ Kamran Bilir, *Patent Laws, Product Lifecycle Lengths, and Multinational Activity*, 104 AM. ECON. REV. 1979 (2013), at Table 1, available at <https://www.aeaweb.org/chapters.php?doi=10.1257/aer.104.7.1979>

³⁰⁸ Christian Broda & David Weinstein, *Product Creation and Destruction: Evidence and Price Implications*, 100 AM. ECON. REV. 691, 723 (2010).

³⁰⁹ PATENTS DASHBOARD - TRADITIONAL PENDENCY (MONTHS), available at <http://www.uspto.gov/dashboards/patents/main.dashxml> (showing ~25 months in July 2016)

³¹⁰ Sebastian Kraaijenzank, *Innovation Without Patents? Evidence from the Smartphone App Markets*, 30 (2013), available at <http://ssrn.com/abstract=2529669>. (providing examples of mobile app introductions and “fast followers,” most within 1-2 years).

³¹¹ Brian Love, *Research Handbook on the Economics of Intellectual Property Law Volume II (Patent Duration Chapter)*, reporting on Aboagye, Aaron, et al., 2012. “Finding the Next \$100 Billion in Semiconductor Revenues,” *McKinsey on Semiconductors* Autumn, 5-6.



Source: Christopher Cotropia, Jay P. Kesan & David L. Schwartz, 2010 and 2012 Patent Holder and Litigation Dataset (last updated May 28, 2014), Lex Machina, Innography, Author’s Analysis

[File: Data for Histogram v3, Histogram for Maintenance and Priority]

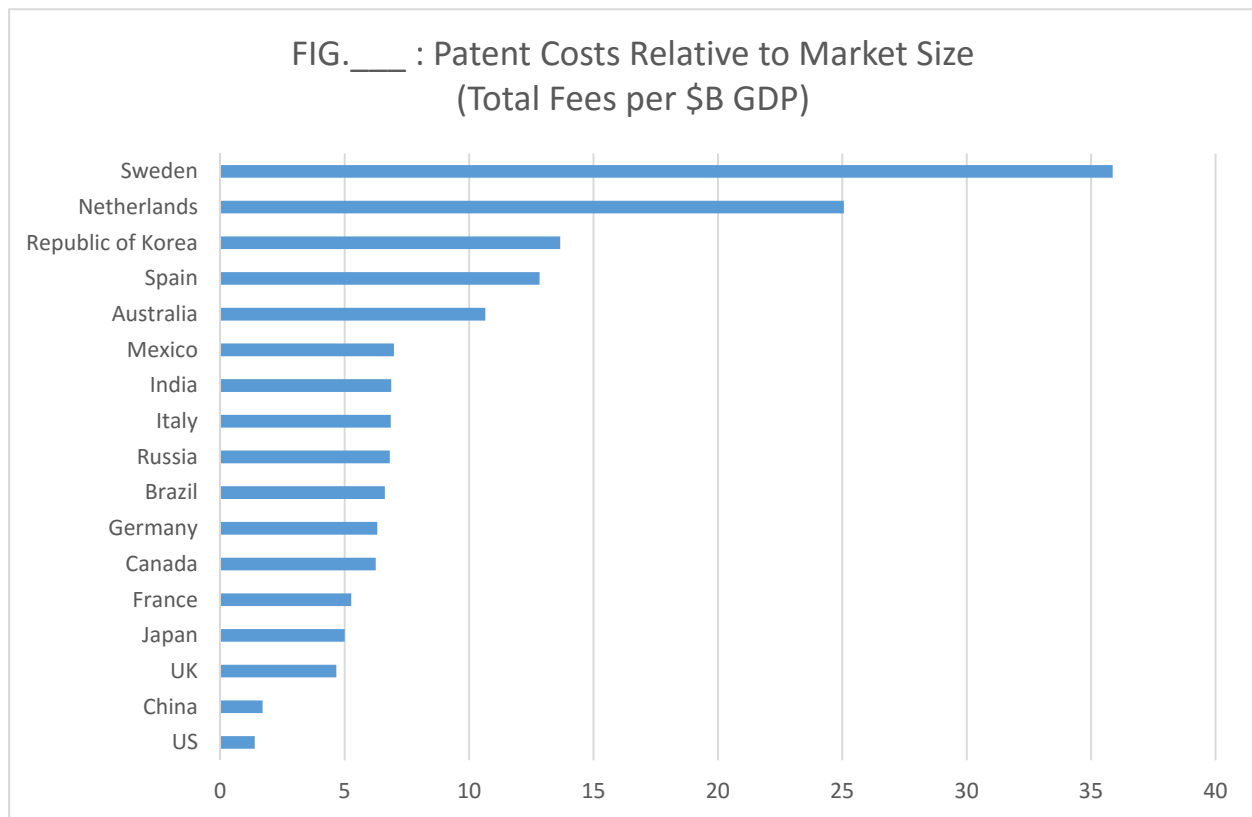
beginning,³¹² while the reverse is true of operating companies. Replicating his analysis, among patents litigated in 2010 and 2012, and relying on codings by Cotropia, Kesan, and Schwartz,³¹³ we find a similar pattern (FIG____) – that PAE assertions were weighted towards the later years of a patent’s term. Returns that outlast the original product that the patent was filed to support are more likely to reflect an unexpected windfall than form any incentive to innovate that a patent may provide.

For a variety of reasons, then, the duration of a patent has a considerable impact on the costs and benefits to society associated with the patent. The longer a patent supports

³¹² Brian J. Love, *An Empirical Study of Patent Litigation Timing: Could a Patent Term Reduction Decimate Trolls Without Harming Innovators?*, 161 UNIV. OF PENN. L. REV. 1309, 1359 (2011).

³¹³ Christopher Cotropia, Jay P. Kesan & David L. Schwartz, *2010 and 2012 Patent Holder and Litigation Dataset* (last updated May 28, 2013), available at <http://npedata.com/article/>. The authors coded each case from 2010 as belonging in one of 10 categories. For ease of viewing we grouped patent holding companies, large aggregators, individuals and failed operating company/failed start-up in the PAE category, due to their inability to be retaliated against, and included operating companies (including IP arms of Operating companies) and technology development companies in “OpCo.” We conducted our analysis based on the first named patent in each case and omitted from the analysis cases in which the plaintiff’s status or the asserted patents could not be determined. For the patent numbers associated with each case, we received data from Lex Machina, and for the patent priority dates, we used data from Innography.

supracompetitive pricing, the greater the deadweight loss to society.³¹⁴ Renewal fees influence a patentee's decision to keep a patent in force, or not, and are an important driver of patent quality. Comparatively speaking, US fees are on the low to lowest end of the range on a per capita basis. This is because USPTO fees have been in an almost continuous decline (relative to GDP per capita) since 1800.³¹⁵ As a result, Park has found, the US charges the least, among major jurisdictions, on a GDP per capita basis, to pursue and maintain a US patent, in an analysis. (FIG___) On an absolute basis, it costs approximately \$12600 (large entity) for the full twenty-year term,³¹⁶ compared to €23855 in Europe for twenty years (approximately \$26270).³¹⁷ Changing how much it costs to keep a patent in force would likely lead to the earlier expiry of patents that are “sitting on the shelf.”



Includes official filing fees, agent (legal) fees, issuance fees, and maintenance fees and assumes large entity status and 20-year term. Excludes translation fees. Sources: Patent Office Websites

³¹⁴ Frederick M. Scherer, *Nordhaus' Theory of Optimal Patent Life: A Geometric Reinterpretation*, 62 AM. ECON. REV. 422, 427 (1972)

³¹⁵ *Id.* at 6.

³¹⁶ See USPTO Fee Schedule, available at <http://www.uspto.gov/learning-and-resources/fees-and-payment/uspto-fee-schedule> (July 1, 2015) (\$280 filing fee, \$600 search fee, \$720 examination fee, \$960 issue fee, \$1,600 renewal fee due by 3.5 years, \$3,600 renewal fee due by 7 years, \$7,400 renewal fee due by 11.5 years)

³¹⁷ EPO Schedule of Fees and Expenses, available at <http://www.epo.org/law-practice/legal-texts/official-journal/2014/etc/se3/p1.html> (2014).

(Official Fees Country), IMF (2014 GDP values), Park 2010 (legal fees), IMF (global inflation rates).

For all of these reasons, renewal fees should be set with social welfare considerations in mind. Long-standing policy doesn't fully permit the USPTO to do so, however, specifying that fee collections are required to be dictated by the principle of cost recovery.³¹⁸ As a historical study documents, consistent with the US patent system's emphasis on accessibility and affordability, from the beginning, "[patent] payments were not intended to exact a price for the patent privilege or to raise revenues for the state... rather, they were imposed to merely cover the administrative expenses of the office."³¹⁹ For most of the PTO's history, the Office has been funded primarily with taxpayer revenues through annual appropriations legislation, not fees.³²⁰

Since 1990, Congress has required the USPTO to be self-funded.³²¹ Initially, Congress set most fees, and the USPTO was only authorized to set relatively minor fees, and make adjustments to reflect changes in the Consumer Price Index.³²² This changed with the America Invents Act, as Congress was seen as relatively poor steward of USPTO charges.³²³ Though the total collection must still be limited to those needed to cover the "aggregate estimated costs to the Office for processing, activities, services and materials,"³²⁴ the USPTO now has much greater freedom to determine fee levels.³²⁵ To its credit, the USPTO has made the sorts of adjustments, directionally, that align patent fees with social welfare. It has lowered examination fees but made up the difference in increases to maintenance fees.³²⁶ It has also explored, through its Chief Economists, the idea of limiting continuation practice by raising fees.³²⁷

Within this ambit, if the USPTO decided to invest significantly more in upfront examination, for example, it could pass these expenses on to applicants, at the examination

³¹⁸ Section 10(A)(b) of the America Invents Act (AIA) specifies "(2) FEES TO RECOVER COSTS.—Fees may be set or adjusted under paragraph (1) only to recover the aggregate estimated costs to the Office for processing, activities, services, and materials relating to patents (in the case of patent fees) and trademarks (in the case of trademark fees), including administrative costs of the Office with respect to such patent or trademark fees (as the case may be)." This represents greater authority over the setting of all patent and trademark fees charged under Title 35 of the U.S. Code and the Trademark Act of 1946.

³¹⁹ B. Zorina Kahn "Looking Backward: Founding Choices in Innovation and Intellectual Property Protection," in *Founding Choices: American Economic Policy in the 1790s* 315, 332 (Douglas A. Irwin & Richard Sylla eds. 2011).

³²⁰ Glenn J. McLoughlin, U.S. Patent and Trademark Office Appropriations Process: A Brief Explanation, *Congressional Research Service* (2014).

³²¹ Omnibus Budget Reconciliation Act of 1990, PL 101-508, 104 Stat. 1388 (Nov. 5, 1990)

³²² 35 USCS § 41 (1982).

³²³ House Committee Report from PL 112-29, H.R. Rep. No. 112-98, 112th Cong., 1st Sess. 49 (June 1, 2011) ("History has shown that [having Congress set fees] does not allow the USPTO to respond promptly to the challenges that confront it. The USPTO has argued for years that it must have fee-setting authority to administer properly the agency and its growing workload.")

³²⁴ Leahy-Smith America Invents Act, PL 112-29, § 10(a), 125 Stat 284 (Sept. 16, 2011) (patent fees must recover patent costs).

³²⁵ Subject to statutorily specified discounts available for small and micro-entities (Leahy-Smith America Invents Act, PL 112-29, § 10(b)).

³²⁶ See 78 FR 4212 (Jan. 18, 2013). (estimating that "the routine fees to obtain a patent (i.e., filing, search, examination, publication, and issue fees) will decrease by at least 23 percent" while the maintenance fees were increased).

³²⁷ Graham and Marco, ____.

phase, or patentees, in the maintenance phase. However, it would have to move cautiously when doing so, as there are several procedural hurdles that the USPTO would need to overcome in order to increase fees. Any new fee proposals must be submitted to the Patent Public Advisory Committee,³²⁸ and the USPTO must engage the Committee at least forty-five days before publishing the proposed rule and give the Committee thirty days to consider the proposal.³²⁹ The Committee must then hold a public hearing and produce written recommendations, which the USPTO must consider.³³⁰ At this point, the Director must notify Congress of the proposed change and publish the proposed fee in the Federal Register, along with a description of the reasons for the fee.³³¹ Next, there is a public comment period of forty-five days, after which the fee can be published; forty-five days following publication, the rule can go into effect absent a congressional override.³³²

There are other problems with further skewing USPTO reliance towards maintenance, rather than examination fees. Already, the USPTO subsidizes examination with maintenance fees, and small and micro-entity fees, with large entity fees.³³³ Wasserman and Frakes have found that these distortions cause the PTO, in times of urgency, to overgrant patents to large entities that are more likely to renew their patents.³³⁴ The USPTO is not the only governmental agency that is vulnerable to criticisms, at times grave, that its revenue-making authority interferes with fairly carrying out its mission.³³⁵ Nor is it the only government agency that has to

³²⁸ Leahy-Smith America Invents Act, PL 112-29, § 10(d), 125 Stat 284 (Sept. 16, 2011).

³²⁹ Leahy-Smith America Invents Act, PL 112-29, § 10(d)(1),(2)(A), 125 Stat 284 (Sept. 16, 2011).

³³⁰ Leahy-Smith America Invents Act, PL 112-29, § 10(d)(2)(B), (d)(3), (d)(4), 125 Stat 284 (Sept. 16, 2011).

³³¹ Leahy-Smith America Invents Act, PL 112-29, § 10(e)(4), 125 Stat 284 (Sept. 16, 2011).

³³² Leahy-Smith America Invents Act, PL 112-29, § 10(e)(3), (e)(4), 125 Stat 284 (Sept. 16, 2011).

³³³ Frakes & Wasserman, Agency Funding, at 69. (documenting how, patent examination fees cover less than one-third of the examination costs, and issuance fees cover an even smaller percentage of examination costs, leaving maintenance fees to make up the difference.)

³³⁴ Id.

³³⁵ Take for example, civil forfeitures, actions in which the police take the assets of people who are “suspected” of a crime; no warrant is needed to seize the assets, and it is not necessary to charge anyone with a crime in order to retain the assets. In fact, most civil forfeitures are simply seizures of cash, frequently on interstate highways. Since 1984, local law enforcement agencies have been allowed to keep the majority of the profits from civil forfeitures (the “Equitable Sharing Program”), and the amount of assets seized has risen considerably. (See Tamara R. Piety, *Scorched Earth: How the Expansion of Civil Forfeiture Doctrine Has Laid Waste to Due Process*, 45 MIAMI L.R. 911, 975 (1991)) The amount of revenue derived from civil forfeitures is huge; since 2001, “police have seized \$2.5 billion [in cash] since 2001 from people who were not charged with a crime and without a warrant being issued.” (Michael Sallah, Robert O’Harrow Jr., & Steven Rich, *Stop and Seize: Aggressive Police Take Hundreds of Millions of Dollars from Motorists not Charged with Crimes*, Washington Post (September 6, 2014) available at <http://www.washingtonpost.com/sf/investigative/2014/09/06/stop-and-seize/?hpid=z3>.) Two former United States Department of Justice Asset Forfeiture Office directors called for the abolition of the Equitable Sharing Program in a *Washington Post* Op-ed, stating, “Law enforcement agents and prosecutors began using seized cash and property to fund their operations, supplanting general tax revenue, and this led to the most extreme abuses: law enforcement efforts based upon what cash and property they could seize to fund themselves, rather than on an even-handed effort to enforce the law.” John Yoder and Brad Cates, *Government Self-Interest Corrupted a Crime-Fighting Tool into an Evil*, Washington Post (September 18, 2014), available at http://www.washingtonpost.com/opinions/abolish-the-civil-asset-forfeiture-program-we-helped-create/2014/09/18/72f089ac-3d02-11e4-b0ea-8141703bbf6f_story.html?wpmk=MK0000203. Another example, is the red light camera program in Chicago, in which the City of Chicago shortened the time of its yellow lights, leading to an additional \$8 million in revenue per year (David Kidwell, “City’s Yellow Light Change Caught 77,000 drivers,” *Chicago Tribune*, October 10, 2014, <http://www.chicagotribune.com/news/chi-yellow-light-standard-change-20141010-story.html>), but also,

balance competing revenue pressures. However, the USPTO does appear to lack a number of the safeguards that others have to reduce the need to balance revenues and expenses on an annual basis. For example, the EPO, like the US, subsidizes examination renewal fees, and the office is also self-funded. But the European Patent Office also owns substantial financial assets that are sometimes used to supplement the funding derived from patent fees.³³⁶ In addition, the European Patent Convention states that the Contracting States of the EPO must finance any deficit that the office faces,³³⁷ an important backup source of revenue. In addition, some other permitting agencies receive significant funding as part of the Federal Budget, such as the Environmental Protection Agency (EPA), which requested \$9 billion in funding in 2012,³³⁸ and brought in just \$252 million in fines in 2012.³³⁹ The USPTO's ledger, in contrast, is substantially balanced. To enable the USPTO to operate in a way that is dictated by its mission, rather than its finances Congress should consider creating such buffers as well.

B. Redesigning Renewal Fees

Despite these challenges, we believe there are at least two ways that US maintenance fees should be reconsidered. First, in line with considerations of equity, the USPTO should consider raising US fees to historical and global norms, and using the balance to improve patent quality in examination. Second, the US should consider adopting the practice of other jurisdictions of requiring maintenance fees to be paid yearly, rather than periodically. Right now, for example, to keep a European patent in force for 20 years not only costs roughly double what is costs to keep a US patent in force,³⁴⁰ but, because maintenance fees are due yearly, also requires the patentee to make 17 separate decisions to keep a patent in force, and to make 17 payments. In contrast, because in the US, the compared to making only 3 affirmative decisions to keep a US patent in force. The systems therefore set different defaults – in the US, for example, once the third payment is made, the patent defaults to staying in effect for the remaining 5+ years of its term.³⁴¹ In the EPO, if the patentee does nothing, the patent will naturally expire, unless, each of the remaining years in its life, the patentee pays a fee. The behavioral science literature has documented the power of defaults.³⁴² When workers were automatically enrolled in savings plans, their participation increased from 49% to 86%.³⁴³ Defaults have also shown to be effective

significantly more car accidents (David Kidwell, “Experts: Chicago's Short Yellow Light Times, Red Light Cameras a Risky Mix,” *Chicago Tribune*, December 23, 2014, <http://www.chicagotribune.com/news/watchdog/redlight/ct-yellow-light-timing-met-20141223-story.html#page=1>)

³³⁶ Michaelangelo Temmerman, *The Structure of Patent Costs and Patent Offices Funding: The (Missing) Link to Patent Quality*, Swiss National Centre of Competence in Research (2013).

³³⁷ *Id.*

³³⁸ “Environmental Protection Agency Budget,” *Office of Management and Budget*, http://www.whitehouse.gov/omb/factsheet_department_epa (2013).

³³⁹ “Enforcement Annual Results for Fiscal Year 2012,” *United States Environmental Protection Agency*, <http://www2.epa.gov/enforcement/enforcement-annual-results-fiscal-year-2012> (2013).

³⁴⁰ Described in Part III *supra*.

³⁴¹ Assuming that the patent takes 2-2.5 years to be granted, giving it an effective term of 17.5-18 years.

³⁴² Richard H. Thaler & Shlomo Benartzi, Save More Tomorrow™: Using Behavioral Economics to Increase Employee Saving, 112 J. POL. ECON. SI64, SI70-71 (2004)

³⁴³ James J. Choi, David Laibson, Brigitte Madrian, and Andrew Metrick. *For Better or for Worse: Default Effects and 401(k) Savings Behavior*, Persp. on the Econ. of Aging, edited by David A. Wise. Chicago: Univ. Chicago Press (for NBER), see also <http://qje.oxfordjournals.org/content/116/4/1149.abstract>

in encouraging energy conservation.³⁴⁴ Support for using behavioral science insights to effect positive social outcomes is now embedded into the federal government.³⁴⁵ It would be worth using this power to explore the consequences of the USPTO switching to a different fee schedule.

While there is substantially more work to do before the USPTO's renewal fee structure can be changed, we offer two other ways to reduce the offensive threats associated with particular patents while still preserving the value that patents add to their owners.

C. Removing Offensive Threats through Defensive Only Patents

Concerns about patents outliving their intended purpose have been particularly acute with respect to software patents. As Love and others have documented, suggestions of a shortened software patent term have sounded from diverse source ranging from academics, Federal Circuit Judge Pauline Newman, activists, and Jeff Bezos.³⁴⁶ There are practical problems with mandating that software patents be given shortened terms, however, including the difficulty of defining what a software patent is, and the international law mandate that “patents shall be available and patent rights enjoyable without discrimination as to...the field of technology.”³⁴⁷ The latter limitation, when viewed in juxtaposition with the EPO's ban on computer program patents per se, suggests that any restriction on software inventions should happen at the level of extending protection, not the duration of protection.³⁴⁸

One alternative to reducing the term of software patents is to offer holders of defensive patents, software or otherwise, the option to designate their patents as “defensive only.”³⁴⁹ “Defensive only” patents would be examined like ordinary patents. However, they would be enforceable only if a patent holder were the subject to an offensive threat, for example a demand letter or lawsuit. The patentholder could elect the “defensive only” designation at any time, entitling the owner to a discount off of any applicable fees, say 50%.³⁵⁰ Once the patent application or patent was designated as defensive, it would retain that status until lapsed. That way, a patentee could gain many of the advantages associated with holding a patent – signalling to the world innovative potential, providing a basis for financing (to some degree), and ensuring some measure of freedom of operation – without imposing much of the costs to society generally associated with patent holding. The cost savings would likely be appealing for those whose large patent portfolios require large payments to maintain and which pose the greatest threats to smaller companies. Some smaller companies may also find this option appealing in order to signal to their employees their commitment to open source sharing, or defensive intentions

³⁴⁴ Elisha R. Frederiks, Karen Stenner, and Elizabeth V. Hobman, *Household Energy Use: Applying Behavioural Economics To Understand Consumer Decision-Making And Behaviour*, 41 RENEWABLE AND SUSTAINABLE ENERGY REVIEWS 1385, 1388 (2015).

³⁴⁵ EXEC. ORDER 13707, Using Behavioral Science Insights to Better Serve the American People (2015).

³⁴⁶ Love, Research Handbook, *supra* note ____ at *5.

³⁴⁷ Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement), Chapter 27(1)

³⁴⁸ Colleen Chien, *Tailoring the Patent System to Work for Software and Technology Patents* (unpublished paper) (2013) available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2176520

³⁴⁹ This option is described in detail in Chien, Diffusionary and Exclusionary *supra* note __.,

³⁵⁰ *Id.*

though small companies may have a higher proportion of crown jewel and fewer “defensive” patents in their portfolios.

While this idea may sound radical, it is not. Under Germany’s “License of Right” (LOR) scheme, a patent owner that declares that anyone can practice the invention in return for reasonable compensation receives a 50% discount off their maintenance fees;³⁵¹ the UK has long featured a similar scheme.³⁵² In addition, a number of the most innovative companies in the world have already made public commitments to commit their patents to defensive uses only. Under the Inventor Protection Agreement (IPA) adopted by Twitter, the company has promised to its employees that it will only use their patents for “defensive purposes,”³⁵³ a commitment that has been used to attract talent and build culture at the firm.³⁵⁴ Tesla has made a similar commitment, to “open source” its patents over electric vehicles and battery storage technology and make them freely available except to those who assert their patents against the company.³⁵⁵ IBM, which has been the top filer for patents for years, as well as Sony, Google, LG Electronics, Canon, and about 2,050 other companies³⁵⁶ are signatories to the Open Invention Network’s (OIN) “non-aggression” pact, which commits them to granting royalty-free patent licenses over Linux technology to other signatories.³⁵⁷ These various pledges and promises demonstrate the strong interest in defensive uses of patents, as well as shortcomings with existing solutions – like other promises, one-way pledges are unenforceable in the absence of reasonable reliance.³⁵⁸

Offering a defensive only patent option would enable sorting between high and low value (defensive only) patents. However, unlike gold-plating during examination, a defensive patent option would be available any time, including after the patent has been granted and more information about the patent’s value has emerged. It would not require development of a second, heightened tier of review. And though it should appeal most to companies that engage in defensive patenting, which are concentrated in the tech sector, it would be voluntary, thereby avoiding running afoul of bans on technological discrimination or the requirement of a 20-year patent term enshrined in international law.³⁵⁹

³⁵¹ Section 23 of the German Patent Act, described in Ilja Rudyk, *The License of Right, Compulsory Licensing and the Value of Exclusivity*, GOVERNANCE AND THE EFFICIENCY OF ECONOMIC SYSTEMS (2012), available at <http://www.sfbtr15.de/uploads/media/415.pdf>.

³⁵² <https://www.gov.uk/licensing-intellectual-property> (for “license of right” endorsed patents a patentholder must grant a license to anyone who wants one; annual renewal fees are cut in half)

³⁵³ Benjamin Lee, *Brewing our First IPA Patents, and New Adopters*, TWITTER BLOG (May 21, 2013), available at <https://blog.twitter.com/2013/brewing-our-first-ipa-patent-and-new-adopters>.

³⁵⁴ See, e.g., Joe Brockmeier, *Why Every Company Should Adopt Twitter's Innovator's Patent Agreement*, READWRITE, (April 17, 2012) (describing the recruiting benefits of Twitter’s move); <http://readwrite.com/2012/04/17/why-every-company-should-adopt>

³⁵⁵ Elon Musk, *All Our Patent Are Belong To You*, TESLA MOTORS BLOG (June 12, 2014), <http://www.teslamotors.com/blog/all-our-patent-are-belong-you>; *Patent Pledge*, TESLA MOTORS, <https://www.teslamotors.com/about/legal> (last visited ____) (defining what it means for a party to not act in good faith as asserting patents against Tesla, challenging Tesla patents, or knocking off Tesla’s trademark).

³⁵⁶ See OIN, *supra* note ____.

³⁵⁷ *OIN License Agreement*, OPEN INVENTION NETWORK (May 1, 2012), <http://www.openinventionnetwork.com/joining-oin/oin-license-agreement/> (last visited ____).

³⁵⁸ Jorge Contreras, *Patent Pledges* 47 Ariz. State L. J. 543 (2015)

³⁵⁹ See TRIPS, *supra* note ____.

According to surveys, 45-60% of companies acquire patents for defensive reasons, though even more obtain patents to prevent copying.³⁶⁰ But Tesla's experience is instructive. The company originally got patents, "out of concern that the big car companies would copy our technology." However, over time, Tesla discovered "[w]e couldn't have been more wrong. The unfortunate reality is the opposite: electric car programs [] at the major manufacturers are small to non-existent."³⁶¹ However, just because Tesla is abandoning the desire to prevent copying, it isn't abandoning its patents. Instead, it has used them to encourage adoption of its technology and for defensive purposes,³⁶² has also used its patents to secure financing.³⁶³ Though perhaps not the primary reason Tesla acquired patents, these non-exclusionary uses promote innovation at the company. In the same way, companies may hold their patents for non-defensive reasons, but then transition to a primarily defensive purpose over time.

D. Fixing the Marking Requirement³⁶⁴

I conclude this Part by considering one other fairly obvious, but largely overlooked way that the risks associated with patents staying in force can be reduced. Although patent law is a strict liability offense, the intuition that patentees have the obligation to let the world know about the patents they plan to enforce, so that others may avoid infringing, unawares, is enshrined in the law through a doctrine called patent "marking."

According to this doctrine, to recover damages during the period of infringement, those who practice their inventions are required to put the world on notice by marking products or their packaging in order.³⁶⁵ Typically this comes in the form of a "Patent Number" listing. In the absence of marking, an infringer doesn't owe damages unless they have actual, legal notice. The purpose of the marking requirement is to prevent innocent infringement and encourage patentees to give notice of the existence of their patents.³⁶⁶ Over time, however, this important safeguard has been quietly eroded. A 1936 case ruled that, for practical reasons, the marking requirement did not to apply to those who did not practice their patented inventions³⁶⁷ or to process patents.³⁶⁸ As a result, those who might otherwise have notice of the patents that its holders seek to enforce,

³⁶⁰ See summary of surveys in Chien, *Diffusionary and Exclusionary*, *supra* note ____ at Part II.

³⁶¹ See Musk, *supra* note ____.

³⁶² *Patent Pledge*, TESLA MOTORS, <https://www.teslamotors.com/about/legal> (last visited ____) (defining what it means for a party to not act in good faith as asserting patents against Tesla, challenging Tesla patents, or knocking off Tesla's trademark).

³⁶³ Jack Ellis, *Despite the patent 'giveaway,' Tesla has been Monetising its Portfolio All Along*, IAM (June 27, 2014), <http://www.iam-magazine.com/Blog/Detail.aspx?g=b6ef62d3-99a7-4637-bea6-c696c61810b1> (last visited ____).

³⁶⁴ This suggestion is explored in greater depth in Chien, *Diffusionary and Exclusionary*, *supra* note ____, at ____.

³⁶⁵ 35 U.S.C. § 287(a) ("Patentees...may give notice to the public that the same is patented [by marking the patented product...] In the event of failure so to mark, no damages shall be recovered by the patentee in any action for infringement, except on proof that the infringer was notified of the infringement and continued to infringe thereafter, in which event damages may be recovered only for infringement occurring after such notice."). For an example of a marked item, see *False Marking: Lobbying against the Senate Bill*, PATENTLY-O (Mar. 21, 2010), available at <http://patentlyo.com/patent/2010/03/false-marking-lobbying-against-the-senate-bill.html>. (last visited ____)

³⁶⁶ *Nike Inc. v. Wal-Mart Stores*, 138 F.3d 1437, 1443 (Fed. Cir. 1998)

³⁶⁷ *Wine R. Appliance Co. v. Enterprise R. Equipment Co.*, 297 U.S. 387, 398 (1936) (the law does "not require a patentee who did not produce to give actual notice to an infringer before damages could be recovered").

³⁶⁸ *Bandag, Inc. v. Gerrard Tire Co.*, 704 F.2d 1578, 1581 (Fed. Cir. 1983)

or at least may seek to recover damages on – the only legal benefit that marking confers – no longer have the benefit of that notice in connection with process or unpracticed patents.

A restored marking requirement – which would require some sort of effort and notice to the world with respect to patents that the patentee seeks to enforce – would, in the same way as a defensive only option, or gold-plating enable the patentholder to differentiate between patents. Just as a defensive only patent would identify the patents that a patentholder does not intend to enforce, a “marked” patent would identify to the world the patents that the patentholder does intend to claim damages on. Knowing what patents have a higher chance of being enforced can limit the risks associated with poor patent quality. Just like the election of a “defensive only” patent option, the decision to mark a patent separates it from others, and enables the efficient allocation of resources towards the patents that matter. Follow on innovators can allocate more resources towards reviewing the validity of the patent, or designing around it, for example. Closing this loophole as others have called for,³⁶⁹ and restoring the notice requirement for all patents, would in this way reduce the risks associated with low patent quality.

³⁶⁹ See, e.g. Roger D. Blair & Thomas F. Cotter, *Strict Liability and Its Alternatives in Patent Law*, 17 BERKELEY TECH. L.J. 799, 808, 834-835 (2002) (calling the marking statute “incoherent” and “problematic” including because it leaves “innocent” infringers vulnerable to substantial damages liability); Christina Sharkey, *Strategic Assertions: Evading the Patent Marking Requirement*, 12 NW. J. TECH. & INTELL. PROP. 103 (2014) (calling for closing the process patent marking loophole); François deVilliers, *Curbing Trolls by Reforming the Patent Marking Statute*, PATENTLY-O (April 16, 2014) available at <http://patentlyo.com/patent/2014/04/curbing-reforming-marking.html> (last visited ____) (calling for removing the marking penalty against those who practice their patents)