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Patent Law and the Emigration of Innovation

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PATENT LAW AND THE EMIGRATION OF INNOVATION

Gregory Day & Steven Udick*

Abstract: Legislators and industry leaders claim that patent strength in the United States has declined, causing firms to innovate in foreign countries. Because, however, patent law is bound by strict territorial limitations, one cannot strengthen patent protection by innovating abroad; as a result, scholarship has largely dismissed the theory that foreign patents have any effect on where firms invent. In essence, then, there is a debate pitting industry leaders against scholarship about whether firms can use offshore innovation to secure stronger patent rights, influencing the rate of innovation.

To resolve this puzzle, we offer a novel theory of patent rights—which we empirically test—to dispel the positions taken by both scholarship and industry leaders. Given that technology is generally developed in one country, the innovation process exposes the typical inventor to infringement claims only in that jurisdiction. In turn, we demonstrate that inventors have powerful, counterintuitive incentives to develop technology where patent rights are weaker and enforcement is cheaper. Specifically, it typically costs more to defend a patent infringement claim in the United States than to lose one in another country (the cost to litigate a patent in the United States averages about $3.5 million and royalty awards have surpassed $2.5 billion). Our findings suggest that industry advocates and patent scholars overestimate how much innovation strong patent protection generates while underestimating the deterrent effect of these high costs of patent enforcement. This empirical research contributes to the theoretical understanding of patent rights by shedding new light on this important, yet largely dismissed, dimension of where innovation takes place.

We received invaluable support from international research organizations and patent attorneys working for top-tier law firms. Notably, the Global IP Project, a multinational research group spearheaded by Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, the leading global intellectual property law firm, and Darts-ip, an international organization dedicated to the study of global IP litigation, provided proprietary data.

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This enabled us to explore whether firms optimize value by placing research and innovation in countries with "better" patent laws. To verify our models, we interviewed notable patent attorneys practicing in the United States, Europe, and Asia.

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INTRODUCTION

Policymakers and industry leaders are sounding alarms about the declining strength of U.S. patent rights, which they claim is eroding innovation in the United States. According to the former Director of the U.S. Patent and Trademark Office, David Kappos, firms are increasingly electing to innovate in Asia instead of the United States, reflecting dismay over U.S. patent protection.[1] The *Wall Street Journal* reported that American companies are spending greater portions of their research and development (R&D) budgets in foreign markets rather than the United States.[2] Likewise, the former Chairman of the Federal Trade Commission, Maureen Ohlhausen, insisted the United States should return to stronger patent protection to prevent the deterioration of U.S. innovation.[3] Even the Supreme Court of the United States has suggested that U.S. patent laws might be hastening the exodus of innovation from the country.[4] In response, the U.S. Senate debated the STRONGER Patents Act of 2017,[5] as did the U.S. House of Representatives in 2018,[6] which would grant inventors stronger patent rights as a means of reversing the expatriation of innovation.[7]

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1. Nicole Neily, *US Is Losing the Innovation War—to China*, HILL (Dec. 27, 2016, 4:30 PM), http://thehill.com/blogs/pundits-blog/technology/311930-us-is-losing-the-innovation-war-to-china [https://perma.cc/PR7M-B32W].

2. Joe Light, *More Companies Plan to Put R&D Overseas*, WALL STREET J. (Feb. 22, 2011, 12:01 AM), http://www.wsj.com/articles/SB10001424052748703803904576152543358840066?mg=id-wsj (last visited Jan. 26, 2019).

3. Maureen K. Ohlhausen, Acting Chairman, Fed. Trade Comm'n, Speech at the Free Market Forum: Strong Patent Rights, Strong Economy (Oct. 17, 2017), https://www.ftc.gov/system/files/documents /public_statements/1264483/ohlhausen_-_hillsdale_speech_10-13-17.pdf [https://perma.cc/JU7C-VD3F].

4. Transcript of Oral Argument at 6–7, Life Techs. Corp. v. Promega Corp., 580 U.S. __, 137 S. Ct. 734 (2017) (No. 14-1538); *see also* Classen Immunotherapies, Inc. v. Biogen IDEC, 659 F.3d 1057, 1074 (Fed. Cir. 2011) (stating that the patent eligibility doctrine encourages behaviors that "add to the cost and complexity of the patent system and may cause technology research to shift to countries where protection is not so difficult or expensive").

5. Support Technology and Research for Our Nation's Growth and Economic Resilience Patents Act of 2017 ("STRONGER Patents Act of 2017"), S. 1390, 115th Cong. (2017).

6. H.R. 5340, 115th Cong. (2018); Steve Brachman, *STRONGER Patents Act Introduced in House, Seeks to Strengthen a Crippled Patent System*, IPWATCHDOG (Mar. 26, 2018), https://www.ipwatchdog.com/2018/03/26/stronger-patents-act-house/id=95188/ [https://perma.cc/VUC7-U42A].

7. *See* Brian Pomper, *Senators Coons and Cotton Introduce STRONGER Patents Act of 2017*, IPWATCHDOG (June 21, 2017), http://www.ipwatchdog.com/2017/06/21/senators-coons-cotton-introduce-stronger-patents-act-2017/id=84956/ [https://perma.cc/QXP4-RA2Y] (supporting the STRONGER Patents Act by claiming that "weakening of U.S. patent rights has led innovation—and the jobs and economic growth that go with it—to increasingly move overseas").

The empirical record might support the alarmists' claims. Despite the United States' unrivaled capacity to generate innovation—as the home to nineteen of the world's top twenty-five universities,[8] most Fortune 500 companies,[9] and one of the top-spending consumer bases[10]—American R&D efforts have fallen outside the top echelon in terms of both investment and production, lagging behind countries such as South Korea, Israel, Taiwan, and Denmark.[11] In other words, the United States is a wealthy, educated, and business-friendly country, yet firms are choosing to innovate elsewhere.[12] Given this evidence, as well as the opinions of industry experts, the American patent system may be poorly designed to incentivize innovation occurring *in the United States*.[13]

There are, however, excellent reasons to doubt that patent rights have any effect on where companies choose to innovate. Principally, an item's location of invention is thought to have little relationship with the patent protection it receives. The U.S. patent system—like most other patent systems—operates under strict territorial limitations.[14] To protect an invention from unauthorized use in the United States, one must receive a

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8. *Best Global Universities*, U.S. NEWS & WORLD REPORT, http://www.usnews.com/education/best-global-universities/rankings?int=a27a09 (last visited Jan. 26, 2019).

9. Jack B. Jacobs, *The Reach of State Corporate Law Beyond State Borders: Reflections Upon Federalism*, 84 N.Y.U. L. REV. 1149, 1160 (2009) (explaining that a majority of the Fortune 500 is incorporated in Delaware alone).

10. *Country Comparison: GDP (purchasing power parity)*, INDEX MUNDI, https://www.indexmundi.com/g/r.aspx?t=10&v=65 [https://perma.cc/4G6T-JM9C] (listing the United States as having the world's second largest purchasing power parity).

11. *Gross Domestic Spending on R&D*, OECD, https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm (last visited Jan. 26, 2019); OECD, SCIENCE, TECHNOLOGY AND INDUSTRY SCOREBOARD: BUSINESS R&D INTENSITY ADJUSTED FOR INDUSTRIAL STRUCTURE (2013) (on file with author).

12. *See* Denis Hughes, *The Latest Lure from Abroad for U.S. Firms*, WALL STREET J. (Nov. 9, 2015, 7:34 PM), http://www.wsj.com/articles/the-latest-lure-from-abroad-for-u-s-firms-1447115694?mg=id-wsj (last visited Jan. 26, 2019) (discussing that U.S. firms may be exporting IP and research abroad, though for reasons unrelated to patent law).

13. The latter quality about whether the patent system incentivizes innovation "in the United States" has almost uniformly been taken for granted. Most inquiries have sought to determine the U.S. patent system's capacity to incentivize innovation, assuming the innovation will occur in the United States. *See, e.g.*, Qin Shi, *Patent System Meets New Sciences: Is the Law Responsive to Changing Technologies and Industries?*, 61 N.Y.U. ANN. SURV. AM. L. 317, 318 (2005) ("[D]oes the existing United States patent system remain competent to provide incentives for innovation and promote industrial application of scientific discoveries?").

14. Carnegie Mellon Univ. v. Marvell Tech. Grp., 807 F.3d 1283, 1306 (Fed. Cir. 2015) ("We begin with the governing law. The Supreme Court has confirmed that the patent laws, like other laws, are to be understood against a background presumption against extraterritorial reach."), *reh'g en banc denied in part*, 805 F.3d 1382 (Fed. Cir. 2015).

patent from the U.S. Patent and Trademark Office.[15] Because foreign patents have no legal effect in the United States, an inventor who would like to prevent unauthorized copying in the United States cannot improve their patent protection by inventing under the laws of another country.[16] In fact, an inventor must obtain a patent in each country where protection is sought, divorcing the strength of one's patent rights from the country in which the device was innovated.[17] Because patent protection is unrelated to where an inventor creates technology, scholarship has generally dismissed the hypothesis that patent law influences the location of innovation.[18]

In essence, industry is deeply divided from scholarship about whether innovative firms seek out jurisdictions offering stronger patent rights, thereby affecting the rate of innovation. Scholarship's current model assumes a closed universe wherein a firm's chief decision is whether to increase or decrease its creative activity based on the quality of patent protection available within that system. However, if the patent system's efficacy depends upon *where* firms choose to invent, then scholarship has ignored a critical function of patent law. So beyond being an empirical puzzle—i.e., whether or not industry experts are correct that increasing U.S. patent protection would boost American innovation—it raises an important theoretical question about how inventors strategically interact with patent incentives in determining not only whether to innovate but in which jurisdiction to do so.

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15. Curtis A. Bradley, *Territorial Intellectual Property Rights in an Age of Globalism*, 37 VA. J. INT'L L. 505, 522 (1997) (providing the law governing the presumption against extraterritoriality in the intellectual property context).

16. Advanced Cartridge Techs., LLC v. Lexmark Int'l, Inc., No. 8:10-cv-486-T-23TGW, 2010 WL 3222100, at *2 (M.D. Fla. Aug. 16, 2010) (stating that foreign patents have no effect in the United States).

17. William Hubbard, *The Competitive Advantage of Weak Patents*, 54 B.C. L. REV. 1909, 1912 (2013) ("Nevertheless, the incentive effect of U.S. patent law often provides U.S. innovators with little advantage over foreign rivals because inventors worldwide can obtain U.S. patents. Indeed, because only U.S. patents can be asserted in the United States and because the U.S. economy is the largest market in the world, foreign inventors are obtaining U.S. patents in record numbers." (footnotes omitted)).

18. *See, e.g.*, James R. Farrand, *Territoriality and Incentives Under the Patent Laws: Overreaching Harms U.S. Economic and Technological Interests*, 21 BERKELEY TECH. L.J. 1215, 1260–61 (2006) (discussing the lack of a relationship between patent strength, the incentivizing effect of patents, and the location of innovation: "A timing consideration further undercuts any protection Section 271(f) might seem to offer in foreign markets. The incentivizing effects of the patent laws must operate at the early inventive and investment stages of innovation if they are to bear any fruit. Possible monetary returns, and the need for effective patent protection, in contrast, come years later. Thus, the patent laws can incentivize innovation only if meaningful protection appears likely to be available *some years after* the initial inventive efforts and associated investments.").

This Article is one of the first dedicated to the hidden incentives of patent law shopping.[19] Using data provided to us from the Global IP Project[20] Darts-ip,[21] our analysis explores whether firms optimize value by placing R&D and innovation in countries with "better" patent laws. To verify our models, we interviewed notable patent attorneys practicing in the United States, Europe, and Asia.

Our hypothesis is that foreign patent environments offer inventors meaningful options influencing where they choose to innovate but not in the expected ways. We find that inventors are heterogeneous with contrasting preferences depending on their stage of innovation.[22] Entrenched patent owners value stronger patent rights—reflected by sizeable royalty awards, treble damages, and equitable remedies—to deter and punish acts of infringement.[23] Inventors during the innovation stage, on the other hand, have incentives to develop technology where patent rights are *weaker*. This is because the innovation process exposes the typical inventor to liability if the inventor's R&D has unwittingly (or intentionally) incorporated another's patented technology without permission.[24] Increasing this issue's saliency, there are both practicing and non-practicing entities that, in asserting meritless patent infringement claims, exploit the high costs of U.S. patent litigation; this strategy is typically meant to either extract rents from inventors or frustrate efforts to develop competing technology, which may lead early stage innovators to seek out foreign patent regimes.[25] As a partner at an international law firm

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19. *But see* Pamela Samuelson, *Intellectual Property Arbitrage: How Foreign Rules Can Affect Domestic Protections*, 71 U. CHI. L. REV. 223, 226–27 (2004) (discussing how, in certain instances, foreign IP rules could incentivize firms to reverse engineer innovation abroad).

20. *See, e.g.*, MICHAEL ELMER & STACY LEWIS, MANAGING INTELLECTUAL PROP., WHERE TO WIN: PATENT FRIENDLY COURTS REVEALED (2010), http://www.finnegan.com/files/upload/Articles%20and%20other%20Resources%20-%20PDF%20Files/Managing_Intellectual_Property_Where_to_win_patent_friendly_courts_revealed_09_10.pdf [https://perma.cc/92XF-V2RR] (providing information about the costs and risks of patent litigation).

21. *About Us*, DARTS-IP, http://www.darts-ip.com/ [https://perma.cc/LMR3-QAVP].

22. *See infra* Section II.B (discussing the heterogeneous preferences of patent owners).

23. Keith Bradley, *The Design of Agency Interactions*, 111 COLUM. L. REV. 745, 780 (2011) (stating that inventors have interests in, and hope to benefit from, strong patent rights).

24. *See, e.g.*, Roche Prods., Inc. v. Bolar Pharm. Co., 733 F.2d 858 (Fed. Cir. 1984) (holding that a company's use of another's patented drug during the R&D process was an infringing use).

25. Maayan Perel, *From Non-Practicing Entities (Npes) to Non-Practiced Patents (Npps): A Proposal for a Patent Working Requirement*, 83 U. CIN. L. REV. 747, 756 (2015) ("Critics argue that because the patents acquired by NPEs are of low quality, NPEs are nuisances that extract rents from those who would rather avoid the expenses of litigation. Meritless infringement lawsuits filed by NPEs burden the legal system and increase costs causing manufacturers to invest time and resources defending themselves in court. Having less productive resources, manufacturers charge their consumers more for purchasing their goods." (footnotes omitted)).

confirmed to us, patent litigation is a common strategy used against upstart companies who have "stepped on the toes" of dominant players.[26] Another practitioner witnessed "egregious" examples of large companies "steamrolling" smaller inventors using patent litigation.[27] Given the average cost to defend an infringement lawsuit in the United States is roughly $3.5 million[28] and royalty awards have surpassed $2.5 billion[29]—which inventors can potentially mitigate by innovating almost anywhere but the United States—this may explain why the United States has reportedly lost innovation.

Our results generate novel empirical and theoretical insights into the way patent rights incentivize innovation. According to our quantitative analysis, some firms avoid the litigation risks of U.S. patent law by developing technology in countries that have lessened the costs and risks of patent enforcement (i.e., all the costs borne from the patent assertion and litigation processes).[30] We deduce, then, that a critical and generally ignored element of patent law's ability to promote innovation concerns where the resulting innovation takes place. It seems industry advocates and patent scholars overestimate how much innovation strong patent *protection* generates, while underestimating the deterrent effect of the high costs associated with patent *enforcement*. So, contrary to popular logic, recent congressional efforts, and industry advocates,[31] our findings indicate that the increasingly common proposal to strengthen patent rights would have the opposite effect of diminishing innovation in the United States.

Based upon these findings, we identify strategies to reform procedural and substantive aspects of U.S. patent law to make the United States a more attractive venue in which to invent.[32] Specifically, we argue in favor of expanding the experimental use exception and the enactment of a more efficient staging process to litigate infringement claims. By modestly

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26. Telephone Interview with a Partner in an Asian office of an international law firm (Jan. 23, 2018).

27. Email Interview with an Of Counsel in the Tokyo office of an international law firm (Jan. 18, 2018).

28. *See infra* Section III.A (providing an analysis of the cost to defend a patent infringement lawsuit in the United States).

29. Debra Cassens Weiss, *$2.5B Verdict Is Largest Patent Infringement Award in US History; Will Award Be Tripled?*, ABA J. (Dec. 19, 2016, 10:36 AM), http://www.abajournal.com/news/article/2.5b_verdict_is_largest_patent_infringement_award_in_us_history_will_award [https://perma.cc/5KXF-4GNC].

30. *See infra* Part IV.

31. *See, e.g.*, Charles Sauer, *The Bipartisan Stronger Patents Act Will Protect America's Perpetual Motion Machine: Innovation*, WASH. EXAMINER (June 21, 2017, 10:40 AM), http://www.washingtonexaminer.com/the-bipartisan-stronger-patents-act-will-protect-americas-perpetual-motion-machine-innovation/article/2626618 [https://perma.cc/PEB7-F3DV].

32. *See infra* Part V.

reforming existing institutions, the costs and risks of patent enforcement can be abated without harming patent protection. These measures should help the U.S. patent system to incentivize innovation relative to more cost-effective international patent laws.

This Article is organized into five parts. Part I describes the patent system's purpose of fostering innovation and economic growth, giving special attention to the debate over optimal patent strength. Part II discusses the reasons why U.S patent law is seldom thought to influence where firms innovate. It then rebuts this orthodoxy by explaining that upstart inventors encounter powerful incentives to place their R&D programs in jurisdictions with weaker patent rights, effectively exporting the most socially valuable aspects of the innovation process. Part III discusses the determinants of innovation on a more granular level, exploring the comparative costs of (1) litigating a patent claim, (2) losing the lawsuit, and (3) inventing within a patent thicket. Then, Part IV empirically examines the extent to which companies value patent laws when deciding where to innovate, using a dataset constructed with, and in consultation with, data provided by the Global IP Project and Darts-ip. The results offer new insights into the inner mechanics of patent law and the strategic behaviors of innovative firms. Part V uses these empirical findings to suggest policy reforms to procedural and substantive aspects of patent enforcement, including the expansion of the experimental use exception and the creation of a more efficient staging process to patent enforcement.

I. R&D, INNOVATION, AND THE PATENT SYSTEM

A primary catalyst of economic growth is innovation, which the patent system is meant to promote. Scholars disagree, however, about the optimal strength of patent protection to achieve this goal. On one hand, stronger patent rights are commonly thought to best reward and incentivize innovation, but on the other hand, strengthening patent protection beyond a certain point could overly burden competition and, as a result, invention. This debate about patent strength illustrates the importance of innovation as well as properly calibrating the patent system to achieve this end.

A. *The Economic Theory of Patent Rights, Innovation, and Economic Growth*

Backed by a near-unanimous chorus of economists who characterize innovation[33] as the primary determinant of development, most nations prioritize innovation.[34] A recent report by the Organization for Economic Co-operation and Development (OECD) stated as much, remarking "[i]t is taken as axiomatic that innovative activity has been the single, most important component of long-term economic growth."[35] Robert Solow's seminal research, for which he was awarded the Nobel Prize, found that a country's rate of economic growth is determined by the productivity of its labor and capital, both of which are enhanced by innovation.[36]

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33. Innovation lacks a universally accepted definition, existing on more of an "I know it when I see it" basis. For the scholars who have tried, the following are some of the results. Doris Estelle Long, *Crossing the Innovation Divide*, 81 TEMP. L. REV. 507, 510–11 (2008) ("Like every good watchword, 'innovation' has no precise meaning. It has been defined as everything from 'introducing something new' to 'a *scientific* approach for finding newer better ideas and solutions to problems, which make life easier and simpler to live.' In the arena of economics, Joseph Schumpeter defined innovation as '[t]he introduction of a new good . . . a new method of production . . . [t]he opening of a new market . . . [t]he conquest of a new source of supply . . . [and] [t]he carrying out of the new organisation of any industry.' A report by the Task Force on Science, Technology and Innovation of the U.N. Millennium Project similarly emphasizes the entrepreneurial foundations of innovation and its critical role in helping transform countries from reliance on the exploitation of natural resources to technological innovation as a basis for development. This emphasis on technology and entrepreneurship is reflected in the Oslo Manual on Guidelines for Collecting and Interpreting Innovation Data ("Oslo Manual") produced by the Organization for Economic Co-Operation and Development. The Oslo Manual defines innovation as 'the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.'" (alteration in original) (footnotes omitted)); *see also* David McGowan, *Innovation and Liability for Contributory Copyright Infringement*, 8 NW. J. TECH. & INTELL. PROP. 38, 41 (2009) ("An innovation is a change in the status quo that (i) allows one to do something one could not do before or (ii) allows one to do something already possible while using fewer resources than were required before."). In contrast, "research and development" tends to refer to the creatives activities and programs undertaken by companies and inventors to create innovation.

34. *See, e.g.*, *Innovation Union*, EUR. COMMISSION, http://ec.europa.eu/research/innovation-union/index_en.cfm [https://perma.cc/96QE-DBE5] (detailing the European Commission's efforts to bolster innovation in Europe); OECD, INNOVATION AND GROWTH: RATIONALE FOR AN INNOVATION STRATEGY 7–9 (2007), https://www.oecd.org/sti/inno/39374789.pdf [https://perma.cc/WEE4-EK8A] (describing efforts among developed and developing countries to promote innovation); WORLD INTELLECTUAL PROP. ORG., WORLD INTELLECTUAL PROPERTY REPORT 9 (2015) [hereinafter WIPO REPORT], https://www.wipo.int/edocs/pubdocs/en/wipo_pub_944_2015.pdf [https://perma.cc/FWX2-82SW] (detailing the litany of positive externalities derived from innovation).

35. NATHAN ROSENBERG, OECD, INNOVATION AND ECONOMIC GROWTH 1 (2004), https://www.oecd.org/cfe/tourism/34267902.pdf [https://perma.cc/53DG-CT28].

36. Robert M. Solow, *Technical Change and the Aggregate Production Function*, 39 REV. ECON. & STAT. 312, 320 (1957) (attributing increases in labor productivity to "technical change"); *see also* Michael J. Graetz & Rachael Doud, *Technological Innovation, International Competition, and the*

In fact, R&D's importance extends beyond the goods it produces, triggering local and systemic benefits, known as "spillover effects," from the activity itself.[37] For example, the sophisticated nature of innovation creates demand for well-educated and highly skilled labor.[38] In addition, local populations working for innovative firms receive training and experience, which increases human capital and boosts society's capacity to establish increasingly advanced technology companies.[39] And because such activities require capital, programs that promote innovation tend to generate investment.[40] Scholars agree that policy must promote R&D and, just as importantly, avoid incentivizing local firms to innovate abroad.[41]

Innovation may, however, struggle to blossom in a vacuum, as it often needs a patent system.[42] Without patent protection, the market would offer inadequate incentives to innovate because free-riders could copy another's original device, thereby avoiding the costs of inventing it.[43] Since a free-rider may then undersell the inventor, the difficulty of profiting from one's R&D investment would stifle innovation. To prevent

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Challenges of International Income Taxation, 113 COLUM. L. REV. 347, 349 (2013); Kristian Uppenberg, *Innovation and Economic Growth*, *in* 14 EIB PAPERS: R&D AND THE FINANCING OF INNOVATION IN EUROPE 10, 13 (Hubert Strauss ed., 2009), http://www.eib.org/attachments/efs/eibpapers/eibpapers_2009_v14_n01_en.pdf [https://perma.cc/244A-L6JG] ("Output (Y) is a function of fixed capital (K), labour (L) and 'knowledge' (A). In essence, what this function says is that aggregate output can be expanded either by increasing the amount of labour or fixed capital used in production, or through an expansion of the stock of knowledge.").

37. Graetz & Doud, *supra* note 36, at 361 (describing the nature and benefits of R&D's spillover effects).

38. *See generally* Orly Lobel, *The New Cognitive Property: Human Capital Law and the Reach of Intellectual Property*, 93 TEX. L. REV. 789 (2015).

39. WIPO REPORT, *supra* note 34 at 10.

40. *Id.* at 9 ("Firms invest in new capital equipment based on the future income they expect those investments to generate. The introduction of new technologies can raise investment returns and lead firms to undertake new investments. Historically, the introduction of major breakthrough technologies has often unleashed investment booms, driving expansions in economic output.").

41. *See, e.g.*, Ben S. Bernanke, Chairman, Bd. of Governors of the Fed. Reserve Sys., Speech at the Conference on "New Building Blocks for Jobs and Economic Growth" (May 16, 2019), https://www.federalreserve.gov/newsevents/speech/bernanke20110516a.htm [https://perma.cc/WNJ9-6N76] (discussing the important role of promoting R&D through government policy); Graetz & Doud, *supra* note 36, at 349–50 (noting that R&D is underproduced without government policy, and that public returns from R&D can be multiple times greater than private returns).

42. *See* Michael A. Carrier, *Resolving the Patent-Antitrust Paradox Through Tripartite Innovation*, 56 VAND. L. REV. 1047, 1050 (2003) (outlining the logic of innovation and intellectual property).

43. Richard S. Gruner, *Better Living Through Software: Promoting Information Processing Advances Through Patent Incentives*, 74 ST. JOHN'S L. REV. 977, 1001 (2000) ("The potential threat of 'free riders' may deter innovative efforts for a number of reasons. First, innovators might not want to incur large research expenses where there is no guarantee that they will have a chance to recover those expenses out of profits from exclusive opportunities to market the resulting products.").

the free-rider problem, Congress exercised its constitutional authority to enact the Patent Act,[44] granting inventors the exclusive right to exclude others from exploiting their new, useful, and non-obvious creations.[45] A related utility of the patent system is to entice inventors with the reward of monopoly rights and monopoly profits.[46] In exchange, inventors must disclose their technology to the public, contributing to innovation as a whole and progressing the sciences.[47] Thus, the patent system should ideally encourage actors to invest a greater sum of resources in innovation than would naturally occur.

B. Patent Strength Questions

Having decided to enact a patent system, the next question concerns the optimal strength of patent rights. Patent strength refers to the degree of control that patentees enjoy to use and license—or not to use and

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44. U.S. CONST. art I, § 8, cl. 8 ("To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."); 35 U.S.C. § 101 (2018) ("Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title."); Quanta Comput., Inc. v. LG Elects., 553 U.S. 617, 626 (2007).

45. *See* Polymer Techs., Inc. v. Bridwell, 103 F.3d 970, 976 (Fed. Cir. 1996) ("The right to exclude others from a specific market, no matter how large or small that market, is an essential element of the patent right."); Amelia S. Rinehart, *Patents as Escalators*, 14 VAND. J. ENT. & TECH. L. 81, 88 (2011) ("[P]atent owners obtain the right to exclude others from practicing the invention, which provides the ability, in many cases, to exceed free-market levels of private return.").

46. Renata B. Hesse, *Remarks from the 5th Annual Antitrust Law Leaders Forum - Antitrust: Helping Drive the Innovation Economy*, 21 J. TECH. L. & POL'Y 1, 8 (2016) ("Patents, once obtained, can confer a type of market (or monopoly) power on the patent holder for the length of the exclusivity period. We are okay with that, and allow patent holders to earn those profits, because we want to reward the investment and the ingenuity that goes into creating the patented invention and encourage the innovations that can now be built on top of it. What we do not do is take away those monopoly profits if earned lawfully.").

47. The U.S. patent system's requirements of enablement and written description serve to ensure the inventor has met their half of the agreement, and ensure the invention is disclosed so that others may practice the patent without undue experimentation. Incentivizing this behavior brings inventions to the rest of the innovative community to build upon, instead of locked tight in a safe, never to see the light of day. *See* Kali Murray, *Constitutional Patent Law: Principles and Institutions*, 93 NEB. L. REV. 901, 920 (2015) ("This insight is not particularly different from the previous characterizations of the patent bargain, but Robinson refined the metaphor of the patent bargain by stressing that the patent holder had a duty to disclose the full content of the patented invention through the specification and the claims. Robinson, thus, centered his theory on the *obligation* of the patent holder." (footnote omitted)).

license[48]—their inventions.[49] Although the reward of stronger patent rights can increase the incentives to innovate, a chief concern is that too much exclusion hinders competition and, in some instances, innovation.[50] The optimal balance between competition and innovation has generated a vibrant debate about the policy choices made in granting patent rights.[51]

Stronger patent protection is thought to foster innovation by increasing the profits an inventor may receive from developing patentable technology.[52] Because infringement chips away at the patentee's revenue, remedies conferred by stronger patent rights tend to impose significant costs on infringers to compensate the patentee for infringing uses, protect the government-granted monopoly, and deter future unauthorized acts.[53] Notably, the U.S. Patent Act may remedy instances of infringement with monetary awards that far exceed the patentee's actual damages as a means of punishing the infringing party.[54] The grant of stronger patent rights is therefore designed to incentivize innovation by not only reducing the rate

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48. Dana W. Hayter, *When a License Is Worse than a Refusal: A Comparative Competitive Effects Standard to Judge Restrictions in Intellectual Property Licenses*, 11 BERKELEY TECH. L.J. 281, 301 (1996) (stating that patent holders have no duty to actually use or market their inventions to enforce the patent); Herbert Hovenkamp, *Antitrust and the Movement of Technology*, 19 GEO. MASON L. REV. 1119, 1141 (2012) ("The same rules largely apply to intellectual property rights. As a general proposition, the owner of a patent or copyright has no duty to license it to a rival or anyone else.").

49. Although there is no universal definition or measure of strong patent rights, this concept generally refers to the degree to which the patentee may prevent unauthorized use. *See* Sarah R. Wasserman Rajec, *Tailoring Remedies to Spur Innovation*, 61 AM. U. L. REV. 733, 778 (2012) (citing Smith & Nephew, Inc. v. Synthes, 466 F. Supp. 2d 978, 985 (W.D. Tenn. 2006), for the proposition that "the public interest is considered to favor a strong patent system with the strong remedy of an injunction to support it").

50. *See infra* Section III.B (discussing hyper compensatory remedies available under U.S. patent law).

51. *See, e.g.*, Deming Liu, *Now the Wolf Has Indeed Come—Perspective on the Patent Protection of Biotechnology Inventions in China*, 53 AM. J. COMP. L. 207, 236 (2005) (discussing two policy considerations: the experimental use exception and compulsory licensing of patents).

52. *See, e.g.*, Benjamin N. Roin, *The Case for Tailoring Patent Awards Based on Time-to-Market*, 61 UCLA L. REV. 672, 702 (2014) (discussing the benefits of strong patent rights to innovation in the pharmaceutical industry).

53. FED. TRADE COMM'N, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION 23 (2011), https://www.ftc.gov/sites/default/files/documents/reports/evolving-ip-marketplace-aligning-patent-notice-and-remedies-competition-report-federal-trade/110307patentreport.pdf [https://perma.cc/LM6F-9D84] (stating patents are meant to deter infringement and promote innovation).

54. *See* Gregory Day, *Competition and Piracy*, 32 BERKELEY TECH. L.J. 775, 778 (2017) (presenting instances in which courts awarded patent and copyright holders damages that exceeded the actual damages suffered).

of infringement but also increasing the profits an inventor may derive from another's infringing use.[55]

On the other hand, stronger patent rights might frustrate innovation by overly excluding competition.[56] Each patent increases the "anticommons," which refers to areas of industry the public may not use.[57] For example, a patented drug is part of the anticommons because others cannot make, use, or sell the drug without the patentee's permission. The problem is that the most significant forms of innovation tend to be cumulative[58] in that many inventions incorporate, or even require, pre-existing patented technologies.[59] Bluetooth, for instance, relies on the inventions of over 30,000 patent holders.[60] The multilayering of patents allows entrenched inventors to obstruct downstream innovation by refusing to license a critical patent or creating a "hold up" situation whereby the fee charged to license the blocking patent is elevated to an extortionary level.[61] In turn, stronger patent rights may impede downstream innovation if patentees impose overwhelming costs on inventors endeavoring to build off earlier works.[62]

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55. *See* John Dubiansky, *The Role of Patents in Fostering Open Innovation*, 11 VA. J.L. & TECH. 1, 28 (2006) (stating that strong patent rights increases innovation because patent holders receive greater assurance that they may use their patented inventions without having their rights infringed).

56. Mark A. Lemley, *Industry-Specific Antitrust Policy for Innovation*, 2011 COLUM. BUS. L. REV. 637, 645 (2011) (explaining that strong patent rights impede downstream innovation by blocking competition).

57. *See, e.g.*, Matthew Poulsen, *Jurisprudential and Economic Justifications for Gene Sequence Patents*, 90 NEB. L. REV. 196, 199 (2011) (explaining the tragedy of the anticommons).

58. Gaia Bernstein, *Incentivizing the Ordinary User*, 66 FLA. L. REV. 1275, 1315 (2014) (describing the effects of strong patent rights on the barriers to innovation); *see also* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1619–20 (2003) ("The theory of cumulative innovation starts by rejecting the proposition that invention is an activity engaged in by a single inventor or company acting in isolation. Rather, cumulative innovation is an ongoing, iterative process that requires the contributions of many different inventors, each building on the work of others.").

59. *See* Courtney C. Scala, *Making the Jump from Gene Pools to Patent Pools: How Patent Pools Can Facilitate the Development of Pharmacogenomics*, 41 CONN. L. REV. 1631, 1641 (2009).

60. Evan Engstrom, *So How Many Patents Are in a Smartphone?*, ENGINE (Jan. 19, 2017), http://www.engine.is/news/category/so-how-many-patents-are-in-a-smartphone [https://perma.cc/PC56-BFAX].

61. James Boyle, *Open Source Innovation, Patent Injunctions, and the Public Interest*, 11 DUKE L. & TECH. REV., 30, 32–33 (2012) (discussing how the nature of a patent hold up enables the patent holder to extract above-market rents); *see also* Scala, *supra* note 59, at 1641 (explaining the proliferation of patents resulting in an "anticommon" which impedes downstream innovation).

62. *See* Bryan J. Cannon, *The Travesty of Patent Opinion Use: Advancing the AIA to Fix the Misguided Patent Infringement Enhanced Damages Framework*, 22 GEO. MASON L. REV. 439, 466 (2015) (explaining an instance in which the costs of infringement may deter infringement).

Since scholars describe patent rights as a tradeoff between encouraging innovation and impeding competition,[63] the U.S. Patent Act must balance the rights of inventors against their competitors.[64] Although stronger protection might *seem* to benefit patentees and innovation, it could also exclude the types of competition that lead to efficient markets, reflected by the market's ability to generate competitively priced, innovative goods.[65]

It is important to recognize that the debate about optimal patent strength tends to view the patent system's efficacy as a function of how much innovation it incentivizes—e.g., a higher price to invent is likely to cause parties to spend fewer resources on innovation.[66] As one commentator explained this orthodoxy, "increases in the level of patent protection have two primary effects: they increase the incentives for innovators to innovate due to the potential for greater supracompetitive profits (thus increasing innovation activity) and simultaneously reduce incentives to innovate due to the grant of greater exclusive rights to others . . . ."[67] But perhaps firms have another option: instead of restricting their innovative output, they could invent under the patent laws of countries offering more desirable patent environments. The next Part discusses the reasons that few scholars have considered foreign patent environments to entail a

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63. *See generally* Gideon Parchomovsky & Peter Siegelman, *Towards an Integrated Theory of Intellectual Property*, 88 VA. L. REV. 1455, 1500 (2002) ("Patent policy embodies a tradeoff between dynamic and static efficiency. On the one hand, if innovations can be freely copied, innovators will have no way of appropriating any of the gains they generate, nor of recovering the costs they have incurred in research and development. On the other hand, however, the prices of the innovations would be low, and every consumer who values the product at more than its cost would be able to purchase it. In the absence of patents, then, there would be essentially no static deadweight loss, but society would incur serious dynamic inefficiencies by eliminating much of the incentive to innovate.").

64. Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 146 (1989) ("The Patent Clause itself reflects a balance between the need to encourage innovation and the avoidance of monopolies which stifle competition without any concomitant advance in the 'Progress of Science and useful Arts.'").

65. *Id.*

66. *See, e.g.*, Dennis D. Crouch, *Nil: The Value of Patents in a Major Crisis Such as Influenza Pandemic*, 39 SETON HALL L. REV. 1125, 1133 (2009) ("Patent law operates under the assumption that the promise of strong patent rights provides an incentive to innovate. If the law offers weaker rights, a potential innovator will presumably feel marginally less inclined to pursue the innovation." (footnote omitted)).

67. Gregory N. Mandel, *Leveraging the International Economy of Intellectual Property*, 75 OHIO ST. L.J. 733, 747 (2014) (stating further that "[s]tarting from a point of no patent protection, so long as the marginal benefit of greater incentives outweighs the marginal cost of greater exclusion, increasing patent protection will increase incentives to innovate overall. As patent rights increase, however, the marginal benefit of increased incentives will tend to get smaller due to decreasing returns to scale, while the marginal cost of exclusionary rights will tend to increase due to the increased transaction costs of the network effects of greater exclusivity. As a result, the relationship between a given level of patent protection and the corresponding net incentives or value of innovation produced by that level of propertization will have an inverted-U form" (footnotes omitted)).

meaningful alternative and why the United States should rethink this orthodoxy. The U.S. patent system might, in fact, poorly incentivize innovation within the United States.

II. THE U.S. PATENT SYSTEM AND THE DECISION OF WHERE TO INNOVATE

Scholarship has seldom explored whether the patent system influences the rate of innovation by affecting *where* innovation occurs—and for good reason. Because U.S. patent law is the exclusive source of patent protection in the United States, inventors cannot strengthen those exclusionary rights by innovating abroad. But as will be explained, powerful incentives nudge firms to offshore their innovation programs to jurisdictions offering certain types of patent environments and not others. The key lies in the conflicting preferences dividing upstart innovators from entrenched patent holders. Our theory—supported by interviews with notable patent attorneys as well as our empirical analysis in Part IV—indicates that the U.S. patent system is poorly constructed to generate innovation in the United States.

A. Patent Law's Territorial Limitation

In theory, patent laws should rarely affect where inventors develop technology because the strength of an item's patent protection is unrelated to where it was invented. If an inventor would like to sell patentable technology in the United States, the inventor cannot acquire additional or stronger patent rights by inventing in another country.[68] This is because the presumption against extraterritoriality limits the reach of most U.S. patent laws to the United States' sovereign borders, and likewise, foreign patent laws have no effect in the United States.[69] So regardless of whether the patented item was researched or manufactured domestically or abroad, the exclusive source of patent protection in the United States is the U.S. Patent Act.[70] Additionally, because an inventor who would like to deter infringement in the United States is limited to the remedies available

68. *See* Timothy R. Holbrook, *Should Foreign Patent Law Matter?*, 34 CAMPBELL L. REV. 581 (2012) (discussing the effects of foreign patents in the United States).

69. Microsoft Corp. v. AT&T, 550 U.S. 437, 454–55 (2007) ("The presumption that United States law governs domestically but does not rule the world applies with particular force in patent law. The traditional understanding that our patent law 'operate[s] only domestically and d[oes] not extend to foreign activities,' is embedded in the Patent Act itself, which provides that a patent confers exclusive rights in an invention within the United States." (alteration in original) (citations omitted)).

70. *Id.*

under U.S. patent law, the strength of foreign patent laws is thought to have very little, or no, effect upon where inventors choose to develop patentable technology.[71]

For the same reasons, an American-based inventor who would like patent protection in another country must obtain an individual patent in that country. The U.S. Supreme Court explained this principle in *Microsoft v. AT&T Corp.*,[72] stating "[f]oreign conduct is generally the domain of foreign law, and in the patent area, that law may embody different policy judgments about the relative rights of inventors, competitors, and the public."[73] As applied to *Microsoft*, the Court held that foreign patent laws govern the unauthorized use of goods overseas: "If AT&T desires to prevent copying abroad, *its remedy lies in obtaining and enforcing foreign patents*."[74] An American inventor who would like to protect their invention in France, for example, must do so via the French patent system.[75] This further unmoors the strength of patent rights from the location of innovation since an inventor must obtain a patent in whichever countries protection is sought. Unfavorable aspects of U.S. patent protection, or any patent scheme for that matter, should have little influence upon where a firm invents because one's patent protection remains the same despite the technology's location of development.

B. Patent Incentives to Research and Develop (Elsewhere)

Despite the fact that patent schemes should have little influence upon where a firm invents, this Article argues that patent laws affect where

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71. *Id.*; *see, e.g.*, Gregory N. Mandel, *Proxy Signals: Capturing Private Information for Public Benefit*, 90 WASH. U. L. REV. 1, 57 (2012) ("A society that is a heavy net producer of innovation, which can be commercialized extraterritorially, will not favor artificially high domestic intellectual property protection *because intellectual property laws are national*. Having stronger United States patent law will not help American industry profit from foreign innovation sales because the ability to profit from innovation overseas largely depends on foreign countries' intellectual property laws, not domestic laws. This circumstance may (and apparently does) cause domestic industry to advocate for stronger patent protection abroad, but not domestically." (emphasis added) (footnotes omitted)).

72. 550 U.S. 437 (2007).

73. *Id.* at 439.

74. *Id.* (emphasis added).

75. *Protecting Intellectual Property Rights (IPR) Overseas*, USPTO, https://www.uspto.gov/patents-getting-started/international-protection/protecting-intellectual-property-rights-ipr [https://perma.cc/RYW4-UBS9] ("Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in other countries must apply for a patent in each of the other countries or in regional patent offices. Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country, in accordance with the requirements of that country.").

firms physically research and produce goods *before* technology becomes marketable. Due to the territorial limitations of patent law, inventors are subject to claims of infringement in the countries they have made, used, or sold infringing products.[76] Since technology is generally developed in one country, the innovation process exposes the typical inventor to infringement claims only in that country. For example, an inventor in the innovation stage whose entire R&D process exists in the United States can be sued for infringement in, and only in, the United States before a single sale is made.[77] As a result, firms subject their innovation and R&D programs to risk—both in terms of royalty damages and potential injunctive relief—in the countries they research, test, and develop patented methods and devices.

The territorial limitations on exposure to litigation and infringement liability encourage inventors to prefer disparate patent systems depending upon their stage of innovation. Although most patentees desire meaningful patent protection, dominant firms—which tend to possess market power and entrenched patents—are likely to prefer stronger patent rights and laws that remedy acts of infringement with hyper-compensatory and punitive remedies.[78] By raising the costs of infringement, stronger patent rights help entrenched firms to deter potential infringers from threatening their market power.

In fact, a dominant firm can preserve or increase its market power by using its patent portfolio to wage patent litigation against smaller competitors.[79] Because patent litigants tend to incur significant costs even if they prevail at trial,[80] entrenched firms, which are more capable of spending three million dollars on litigation, may threaten patent infringement against less-resourced firms as a means of imperiling their ability to innovate or redirecting their research efforts away from the

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76. *See supra* Section II.A.

77. 35 U.S.C. § 271(a) (2018) ("[W]hoever without authority *makes*, *uses,* offers to sell, or sells any patented invention, *within the United States* or imports into the United States any patented invention during the term of the patent therefor, infringes the patent." (emphases added)). *But see id.* § 271(e)(1) (Safe Harbor Provision of the Hatch-Waxman Act).

78. *See* Mandel, *supra* note 71, at 21 (suggesting that dominant patentees who may extract monopoly profits are likely to advocate for strong patent rights).

79. *See* Charles Duhigg & Steve Lohr, *The Patent, Used as a Sword*, N.Y. TIMES (Oct. 7, 2012), http://www.nytimes.com/2012/10/08/technology/patent-wars-among-tech-giants-can-stifle-competition.html [https://perma.cc/PZ2Y-D33N] [hereinafter *The Patent, Used as a Sword*] (providing the example of a company that was unable to innovate due to an infringement lawsuit allegedly initiated to impede the company's innovation).

80. Jonathan L. Moore, *Particularizing Patent Pleading: Pleading Patent Infringement in a Post-*Twombly *World*, 18 TEX. INTELL. PROP. L.J. 451, 459 (2010).

patentee's market.[81] Indeed, nearly every scholar interviewed for this Article remarked that the rise of frivolous patent litigation harms American business and innovation. As a consequence, the rewards of maintaining market dominance have shown to incentivize U.S. patent holders to exploit the costs of patent litigation, even with meritless lawsuits.[82]

On the other hand, given that upstart inventors are more likely to defend an infringement lawsuit than to initiate one, they prefer patent laws that minimize the costs of patent enforcement and litigation.[83] As previously stated, a dominant firm's ability to initiate a lawsuit against an upstart's R&D program—even if no actual infringement has occurred—depends upon the patent system in which the upstart has chosen to invent. To mitigate these risks, we argue that inventors in the R&D stage have incentives to stash their innovation and creative processes in countries that make defending an infringement lawsuit cheap and expeditious, forsaking countries with stronger patent rights such as the United States. After all, it typically costs more to litigate an infringement claim in the United States *than to lose one* in any other country.[84]

This framework might render U.S. firms less competitive than foreign firms in the global marketplace.[85] Consider a U.S. company that innovates and manufactures in the United States but sells abroad. If the U.S. company competes against foreign firms that entirely manufacture and invent abroad, then only the U.S. company bears the risk of infringement in a U.S. court for activities undertaken during the R&D stage.[86] Considering the incredible costs of enforcement (which is discussed in

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81. *See infra* note 118 (detailing the average costs of patent litigation in the United States); Moore, *supra* note 80, at 461–62 (explaining how the costs of infringement can deter innovation).

82. Kurt M. Saunders & Linda Levine, *Better, Faster, Cheaper—Later: What Happens When Technologies Are Suppressed*, 11 MICH. TELECOMM. & TECH. L. REV. 23, 50 (2004) ("Sham litigation, involving predatory patent infringement suits or threats of suits, may lead a competitor to withhold an innovation when it cannot afford to defend the case. Such litigation and threats are made in bad faith, with the intent to suppress the patented invention and competition. Larger firms have an advantage in developing and promoting new innovations and an ability to intimidate smaller firms through legal challenges to the validity of their patents. Smaller firms may have no choice but to settle." (footnotes omitted)).

83. *See The Patent, Used as a Sword*, *supra* note 79 (describing the manner in which an inventor can become subject to a patent infringement suit during the R&D stage).

84. *See infra* Sections III.A, III.B (presenting the costs associated with patent enforcement and litigation).

85. *See* Hubbard, *supra* note 17, at 1912 (asserting that the stronger patent rights in the United States have rendered U.S. firms less competitive against international firms).

86. Bernard Chao, *Patent Imperialism*, 109 NW. U. L. REV. ONLINE 77, 89–90 (2014) ("It is simply bad policy for the United States to force their own companies to endure such exposure when companies with foreign facilities do not.").

Part III), U.S. firms could become more competitive by offshoring their R&D and manufacturing—i.e., the most socially and economically valuable components of the supply chain.[87]

This scenario is not purely of imagination either. Vlingo, for example, was in the business of developing voice recognition technology until it was imperiled by patent litigation.[88] Rival firms sought to acquire Vlingo and its R&D program once Vlingo appeared capable of developing successful technology.[89] After Vlingo rebuffed these overtures, one competitor, Nuance, changed course and filed a lawsuit alleging that Vlingo infringed patents owned by Nuance.[90] According to Vlingo, this lawsuit was meant to obstruct its R&D programs by shifting the company's resources away from innovation and toward litigation.[91] Although a jury found Vlingo not liable of infringement, the costs of defending the lawsuit frustrated Vlingo's ability to fund further research.[92] Nuance eventually purchased Vlingo and incorporated its technology into Apple's Siri software.[93] In retrospect, Vlingo's folly may have been its willingness to invent in the United States because, had it innovated in a country offering a cheaper and quicker process to litigate patent disputes, Vlingo might have survived.[94]

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87. *See* Hubbard, *supra* note 17, at 1935.

88. *See The Patent, Used as a Sword*, *supra* note 79.

89. *Id.*

90. Nuance Commc'ns Inc. v. Vlingo Corp., No. 09-11414-RWZ, 2010 WL 1416138, at *1 (D. Mass Apr. 2, 2010); *see* Peter Cohan, *5 Reasons to Scrap Our Patent System: #1 Apple's Siri*, FORBES (Oct. 8, 2012), https://www.forbes.com/sites/petercohan/2012/10/08/5-reasons-to-scrap-our-patent-system-1-apples-siri/#7dd122ee28a6 [https://perma.cc/MR7D-TVBE] (reviewing litigation against Vlingo over voice recognition technology).

91. *See The Patent, Used as a Sword*, *supra* note 79 ("Mr. Ricci issued an ultimatum: Mr. Phillips could sell his firm to Mr. Ricci or be sued for patent infringements. When Mr. Phillips refused to sell, Mr. Ricci's company filed the first of six lawsuits. Soon after, Apple and Google stopped returning phone calls. The company behind Siri switched its partnership from Mr. Phillips to Mr. Ricci's firm. And the millions of dollars Mr. Phillips had set aside for research and development were redirected to lawyers and court fees.").

92. Dante Cesa, *Nuance Gobbles up Vlingo, Yearns to Transcribe Its Own Announcement*, ENGADGET (Dec. 21, 2011), https://www.engadget.com/2011/12/21/nuance-gobbles-up-vlingo-yearns-to-transcribe-its-own-announcem/ [https://perma.cc/8EJA-KYJB] ("Apparently, if you can't (legally) beat them, you buy them. Such is the thinking over at Nuance, who has decided to acquire its competitor and former courtroom dance partner, Vlingo.").

93. *See* Robin Wauters, *After Years of Patent Litigation, Nuance Acquires Vlingo*, TECHCRUNCH (Dec. 20, 2011), https://techcrunch.com/2011/12/20/after-years-of-patent-litigation-nuance-acquires-vlingo/ (last visited Jan. 26, 2019) (describing the sale of Vlingo to Nuance which used Vlingo technology and incorporated it into Siri).

94. *See, e.g.*, Bernard Knight & Goud Maragani, *It Is Time for the United States to Implement a Patent Box Tax Regime to Encourage Domestic Manufacturing*, 19 STAN. J.L. BUS. & FIN. 39, 41

To confirm whether Vlingo's experience should have been expected, we conducted interviews with IP attorneys stationed in several countries working for prominent law firms. These attorneys confirmed that the extraordinary costs of U.S. patent law.[95] One patent attorney working in the Tel Aviv office of an international law firm lamented about the costs of U.S. patent enforcement, expressly remarking that clients should be advised to manufacture under the laws of countries offering less burdensome patent environments.[96] A common sentiment is that the costly nature of American patent litigation subjects small inventors to abuse by dominant companies.[97] While additional patent attorneys expressed similar views,[98] a few lawyers described U.S. patent enforcement as the extraordinary cost of doing business in the United States.[99]

As for other global implications mentioned by interviewees, the dangers of entanglement in patent litigation seem to have caused firms to station manufacturing, production, and other aspects of the supply chain in foreign countries.[100] Our interviews also suggested that some firms resist selling finished products in the United States to avoid being taxed by dominant firms; this is especially problematic if such lawsuits impede input technology from entering the United States, frustrating downstream innovation.[101] Indeed, the defense of a patent claim imposes such costs that, not only does it incentivize predatory litigation, but it may also cause firms to innovate under the patent laws of foreign countries.

C. *The Perils of Inventing in the United States, as Told by* Marvell Technology Group

In *Carnegie Mellon University v. Marvell Technology Group, Ltd.*,[102] one firm's willingness to invent in the United States caused it to suffer unimaginable liability, prompting major technology companies to opine

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(suggesting that companies are more likely to conduct R&D in countries that have implemented a "patent box").

95. *See infra* notes 96–99.

96. Email interview with an Of Counsel in the Tel Aviv office of an international law firm (Jan. 17, 2018) (on file with author).

97. *See* Email Interview with an Of Counsel of the Tokyo office of an international law firm (Jan. 18, 2018) (on file with author); Telephone Interview with a Partner of an Asian office of an international law firm (Jan. 23, 2018).

98. Telephone Interview with a Partner in the Taipei office of an international law firm (Mar. 13, 2018).

99. Telephone Interview with a Partner in the Palo Alto office of an international law firm (Apr. 2, 2018).

100. Telephone Interview with a Partner in the Taipei office of an international law firm (Mar. 13, 2018).

101. *Id.*

102. 807 F.3d 1283 (Fed. Cir. 2015), *reh'g en banc denied in part*, 805 F.3d 1382 (Fed. Cir. 2015).

that U.S. patent law incentivizes them to offshore innovation and R&D. Carnegie Mellon University (Carnegie Mellon or CMU) sued Marvell in 2014 in the U.S. District Court for the Western District of Pennsylvania for infringement of patents invented by José Moura, a CMU professor, and Aleksandar Kavcic, a then-doctoral student.[103] At issue were CMU patents related to noise filtering methods associated with the reading and writing of magnetic hard disks.[104] During trial, Carnegie Mellon provided evidence that Marvell conducted research in the United States and that Marvell used CMU's patented method each time it ran software conveniently titled "kavcic.c."[105] After CMU provided sufficient evidence to prove that Marvell had infringed, the issue before the court became the appropriate royalty rate to compensate CMU.

The question of how to measure CMU's award proved critical. Marvell manufactured the unauthorized products overseas and then imported *some* of the infringing products into the United States while others remained exclusively abroad.[106] Recall that courts strictly construe the U.S. patent system's territorial limitations, awarding damages only for acts of infringement taking place inside the United States.[107] This called into question whether a U.S. court could measure CMU's damages with Marvell's foreign sales of goods that had never entered the United States. CMU argued that because Marvell's R&D took place in the United States using CMU's patented method, Marvell's worldwide sales were derived from the domestic use of CMU's invention.[108] The royalty base should, CMU insisted, include *all products entirely made and sold abroad*.[109] The jury agreed, as did the district court, awarding the CMU a $1.17 billion

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103. Torsten Ove & Bill Schackner, *Financial Windfall for CMU After Settling Patent Infringement Suit*, PITT. POST-GAZETTE (Feb. 17, 2016), http://www.post-gazette.com/local/city/2016/02/17/CMU-computer-chip-maker-resolve-7-year-old-patent-infringement-suit/stories/201602170232 [https://perma.cc/76A6-FMJ4].

104. *See Marvell*, 807 F.3d at 1289 (describing the patented technology at issue).

105. Carnegie Mellon Univ. v. Marvell Tech. Grp., No. 2014-1492, 2014 WL 183212, at *9 (W.D. Pa. Jan. 14, 2014) ("At his deposition, Dr. Kavcic testified that he learned from former Marvell employees (Peter Kou and another individual whose name he could not recall) in 2004 'that Marvell has a routine in their detector with my name on it, kavcic.c.'"), *aff'd in part*, *vacated in part*, *rev'd in part*, 807 F.3d 1283 (Fed. Cir. 2015).

106. *Marvell*, 807 F.3d at 1302 (discussing the issue of how to calculate damages and the related extraterritoriality of the damages award).

107. Deepsouth Packing Co. v. Laitram Corp., 406 U.S. 518, 531 (1972) ("Our patent system makes no claim to extraterritorial effect; 'these acts of Congress do not, and were not intended to, operate beyond the limits of the United States' . . . .").

108. *Marvell*, 807 F.3d at 1291–92 (establishing that the jury awarded CMU $1,169,140,271 as a reasonable royalty based upon Marvell's worldwide sales).

109. *See id.* at 1305.

royalty—one of the largest patent damages award in history at that time.[110] Carnegie Mellon and Marvell eventually settled their dispute for $750 million before exhausting appeals,[111] which assuredly included compensation for foreign sales.

Notably, *Marvell* illustrates the risks of innovating where patent rights are stronger, as well as the willingness of firms to relocate their R&D programs to avoid these costs. CMU amplified Marvell's exposure to litigation and liability by pinning Marvell's worldwide sales to its California laboratories.[112] Had Marvell innovated outside of the United States, a U.S. court could have only compelled Marvell to pay damages on domestic sales.[113] For foreign acts of infringement, CMU must sue Marvell in each jurisdiction where the activity occurred using that jurisdiction's patent laws. And in any of those countries, the costs of litigation and damages would have been a slight fraction of the U.S. settlement.[114]

As for the industry's response to *Marvell*, an amicus brief filed by several major technology companies—including Dell, Google, Hewlett-Packard, and Broadcom—signaled their willingness to extract their research and innovation from the United States as means to limit their exposure to liability under U.S. patent law[115]:

> If this Court affirms this result, it would encourage companies to relocate research, development, and testing activities outside this country to avoid exposure to enormous damages awards such as the one here. Why would a company test and validate samples in

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110. *Id.* at 1288; Klint Finley, *Chip Maker Vows to Fight Record-Breaking $1.17B Patent Award*, WIRED (Dec. 27, 2012, 6:34PM), https://www.wired.com/2012/12/marvell-patent-award/ [https://perma.cc/94GA-8EJV].

111. *See* Ryan Davis, *Marvell, Carnegie Mellon Reach $750M Deal to End Patent War*, LAW 360 (Feb. 17, 2016, 5:06 PM), https://www.law360.com/articles/760331/marvell-carnegie-mellon-reach-750m-deal-to-end-patent-war (last visited July 3, 2017).

112. Carnegie Mellon Univ. v. Marvell Tech. Grp., Ltd., 986 F. Supp. 2d 574, 634–35 (W.D. Pa. 2013) (discussing CMUs's theory linking worldwide activity to its domestic practices), *aff'd in part, vacated in part, rev'd in part*, 807 F.3d 1283 (Fed. Cir. 2015).

113. *Id.* at 635.

114. *See infra* Part III (explaining the elevated costs of patent enforcement in the United States).

115. Brief for Broadcom Corp. et al. as Amici Curiae Supporting Appellants at 3, Carnegie Mellon Univ. v. Marvell Tech. Grp., 807 F.3d 1283 (Fed. Cir. 2015) (No. 2014-1492), http://www.cmu.edu/patent-lawsuit/images/timeline/2014-08-11-MarvellCompanyBrief.pdf [https://perma.cc/QQR7-2XEM] (arguing that "allowing U.S. patentees to base damages on worldwide sales would threaten massive liability and encourage innovative companies to move research, development, and testing activities abroad"); *see also* Chao, *supra* note 86, at 88 (arguing that liberalizing the orthodox approach to the extraterritorial limits to patent law would harm domestic industry by causing it to relocate to other countries: "Given a sufficiently hostile patent environment, companies may well decide to move their research, development and sales facilities offshore as well.").

> this country, for example, when doing so could expose it to a damage award based on worldwide sales? As discussed above, technology industries are highly international, and *companies will be tempted to transfer as many activities as possible to jurisdictions that will not impose such draconian worldwide patent liability*—even though it otherwise would be inefficient to do so.[116]

III. THE ATTRIBUTES OF PATENT LAW INFLUENCING WHERE FIRMS CHOOSE TO INNOVATE

A company considering where to innovate must consider the likelihood of defending an infringement lawsuit and the risks associated with the same.[117] The aspects of patent law that are most likely to affect the location of R&D cluster around three areas: (1) the cost of litigation, (2) the remedies available, and (3) the odds of ending up in litigation.

A. Cost of Litigation

The cost of litigating an infringement dispute in the United States might generate more grievances than any other aspect of U.S. patent law. A 2015 report by the American Intellectual Property Law Association[118] found that the median cost to litigate a single-patent infringement claim through trial was about five million dollars for cases with more than twenty-five million dollars at risk.[119] The data compiled by our project determined similarly that the expense to defend an infringement lawsuit in the United States, regardless of the amount at risk, hovers around three million dollars.[120] Notably, litigants must typically bear this extraordinary expense *even if they prevail at trial*.[121]

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116. Brief for Broadcom Corp. et al. as Amici Curiae Supporting Appellants at 27, *Marvell*, 807 F.3d 1283 (No. 14-1492) (emphasis added).

117. *See supra* notes 1–7 and accompanying text (providing public statements suggesting that U.S. innovation is moving abroad due to U.S. patent law).

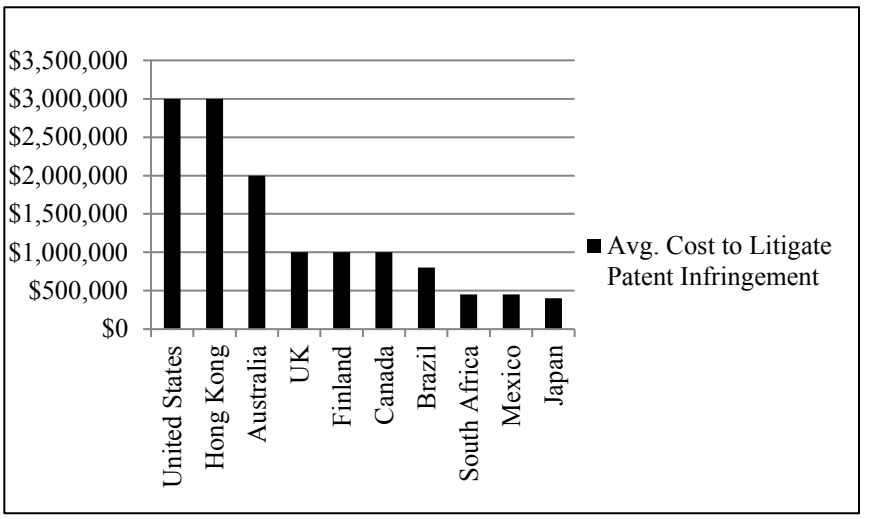
118. Every other year, the American Intellectual Property Law Association (AIPLA) conducts an economic survey, gathering data from AIPLA members at firms and corporate legal departments. From that data, the AIPLA publishes *The Report of the Economic Survey*, which includes information related to the costs of patent litigation. AM. INTELLECTUAL PROP. ASS'N, 2015 REPORT OF THE ECONOMIC SURVEY 1–3, 37 (2015) [hereinafter AIPLA SURVEY].

119. *Id.* at 37. Note, this median represents all costs associated with litigation and all proceedings, including *inter partes* review proceedings, ANDA litigation, and ITC section 337 actions.

120. Please contact the authors for information concerning general patent infringement damages in the United States.

121. 35 U.S.C. § 285 (2018) ("The court in exceptional cases may award reasonable attorney fees to the prevailing party."); Octane Fitness, LLC v. ICON Health & Fitness, Inc., 572 U.S. 545, 553,

Figure 1:
Top Ten Most Expensive Jurisdictions to Litigate a Patent Infringement Claim by Average Cost[122]



Why then is U.S. patent litigation so expensive? The answer lies in the numerous and lengthy procedural steps to litigate a patent in a U.S. court. In the typical patent case, half the costs accrue by the end of discovery, including early motion practice, infringement and invalidity contentions, written discovery, claim construction, depositions, and expert reports.[123] During the discovery phase, the costs are mainly divided among document production and review, depositions, and fees for both technical and damages experts.[124] In many cases, reports can exceed $125,000 per expert.[125] As for the second half of expenses, the bulk of costs occur in the week leading up to trial and the trial week: a litigant must decamp a war room, hire experts for eight to ten days, and employ a cadre of attorneys working from morning until night to staff the trial.[126]

554 n.6 (2014) (noting that the prevailing party in an infringement case can only recoup attorney's fees and costs in extraordinary circumstances, and a significant factor tipping towards such a finding is whether the case brought by the losing party was frivolous).

122. This figure was generated using confidential data collected by *Darts-ip* (2000–2013). Please contact the authors for more information.

123. This information is derived from the author's personal experience litigating both the plaintiff and defendant sides of patent infringement litigation.

124. *Id.*

125. *Id.*

126. *Id.*

The second largest bump in post-discovery expenses stems from the major briefing exchanges of *Daubert* and summary judgment motions.[127] Adding to the already sizeable bill is the possibility of a concurrent inter partes review proceeding,[128] which typically costs between $300,000 and $500,000, including expert fees and filing expenses.[129]

Due to the extraordinary costs of litigating a patent infringement claim in an American court, some firms have sought to initiate patent infringement lawsuits against innovators as a means to extract rents.[130] As discussed earlier, dominant firms use litigation costs to impede new entrants from developing competing technology[131] while others have initiated infringement claims—even if lacking merit—to pressure the patentee-defendant to settle out of court for a lower dollar amount than the cost of litigation.[132] In other words, the mere threat of spending millions of dollars on litigation has induced firms to pay significant settlements despite whether their adversaries are likely to prevail at trial. Considering the number of *active* patent holders who employ this strategy or contract other firms to do so—a practice known as patent privateering[133]—nuisance patent lawsuits in the United States have been unfairly attributed solely to non-practicing entities (NPEs, also pejoratively known as "patent trolls").[134] As a result, lawsuits and licensing agreements tend to be detached from the value of technology and, instead, pinned to the higher costs of litigation.

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127. *Id.*; *see* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 589 (1993).

128. *See infra* Section V.B.I. (explaining inter partes review).

129. AIPLA SURVEY, *supra* note 118, at 38.

130. *See* Emily H. Chen, *Making Abusers Pay: Deterring Patent Litigation by Shifting Attorneys' Fees*, 28 BERKELEY TECH. L.J. 351, 354 (2013) (explaining the economics of nuisance and abusive patent infringement lawsuits attributable to the American rule).

131. *See* James Bessen & Michael J. Meurer, *The Private Costs of Patent Litigation*, 9 J.L. ECON. & POL'Y 59, 87–93 (2012) (analyzing indirect costs of patent litigation, such as market capitalization and investment level costs, or "how much litigation 'taxes' investment in innovation"); Kurt M. Saunders & Linda Levine, *Better, Faster, Cheaper-Later: What Happens When Technologies Are Suppressed*, 11 MICH. TELECOMM. & TECH. L. REV. 23, 50 (2004) (describing the manner in which some firms use "sham litigation" to deter competitors from innovating).

132. Stijepko Tokic, *The Role of Consumers in Deterring Settlement Agreements Based on Invalid Patents: The Case of Non-Practicing Entities*, 2012 STAN. TECH. L. REV. 2, 3–7 (describing the NPE business model).

133. *See generally* Matthew Sipe, *Patent Privateers and Antitrust Fears*, 22 MICH. TELECOMM. & TECH. L. REV. 191 (2016).

134. *See, e.g.*, Jim Kerstetter, *Daily Report: Apple Hurls the 'Patent Troll' Insult at Nokia*, N.Y. TIMES (Dec. 23, 2016), https://www.nytimes.com/2016/12/23/technology/daily-report-apple-hurls-the-patent-troll-insult-at-nokia.html?mcubz=3 [https://perma.cc/2PMR-NHJ4] (discussing Nokia's alleged use of patent litigation to extract rents).

In comparison to the price of litigating a patent claim in the United States, an infringement suit in Austria costs about $100,000.[135] The price of doing the same in China is only $125,000.[136] In fact, the cost of patent litigation is typically under one million dollars in every European nation—and even cheaper in developing nations.[137] Australia and Hong Kong are the only jurisdictions that equal or approximate U.S. litigation expenses.[138] In light of this, firms have strong incentives to minimize exposure to patent litigation by developing technology overseas.

B. Remedies / Damages Awards

Because even accidental copying constitutes infringement, firms must consider not just the expense of defending an infringement claim, but also the costs of losing the lawsuit. This concern is particularly salient in the United States where patent owners have received damages awards that far exceed the injuries suffered.[139] In fact, the types of remedies a plaintiff may seek—including monetary damages, injunctive relief, and punitive damages—affect the risks of innovation in the United States, which firms can lessen by developing technology in countries providing weaker patent rights.

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135. This figure was drawn from confidential data collected by *Darts-ip* (2000–2013). Please contact the authors for more information.

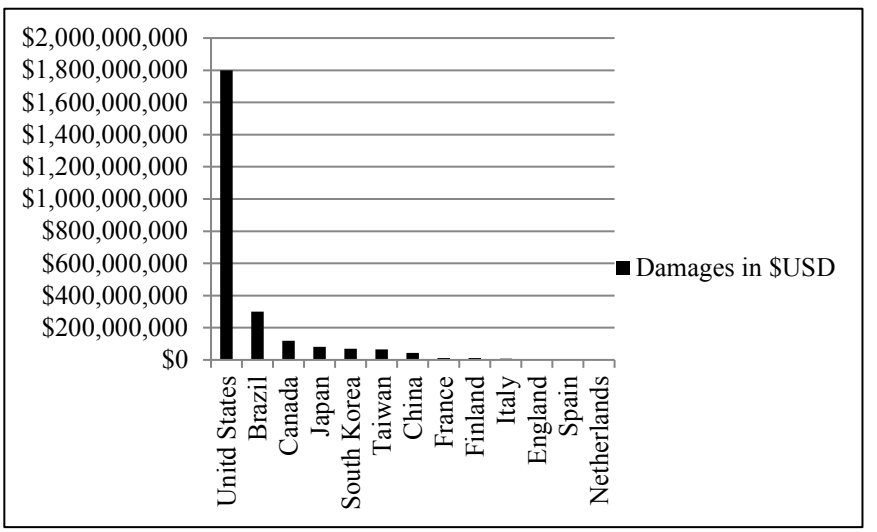
136. *Id.*

137. *Id.*

138. *Id.*

139. *See infra* text accompanying notes 146–149 (discussing the substantial royalty damages that a U.S. court may issue).

Figure 2:
Single Largest Damages Awards by Country[140]



The primary remedy available under U.S. patent law is monetary damages.[141] In general, patentees may either pursue a reasonable royalty, lost profits, or a combination thereof.[142] To calculate a reasonable royalty, the courts imagine a hypothetical negotiation between a willing licensor and licensee at the time of the infringement.[143] Even though only practicing entities may receive lost profits,[144] interestingly, NPEs tend to

140. This figure was generated using confidential data collected by *Darts-ip* (2000–2013). Please contact the authors for more information.

141. 35 U.S.C. § 284 (2018) (monetary damages are designed to "compensate for the infringement, but in no event less than a reasonable royalty for the use made of the invention by the infringer").

142. Schneider (Europe) AG v. SciMed Life Sys., 852 F. Supp. 813, 857 (D. Minn. 1994) ("It is permissible to award damages containing a combination of lost profits and a reasonable royalty." (citing State Indus., Inc. v. Mor-Flo Indus., Inc., 883 F.2d 1573, 1577 (Fed. Cir. 1989), *aff'd*, 60 F.3d 839 (Fed. Cir. 1995)).

143. Aqua Shield v. Inter Pool Cover Team, 774 F.3d 766, 770 (Fed. Cir. 2014) ("The 'value of what was taken'—the value of the use of the patented technology—measures the royalty. A traditional heuristic for assessing this market value is to posit a 'hypothetical negotiation' between the patentee and adjudicated infringer and to 'attempt[] to ascertain the royalty upon which the parties would have agreed had they successfully negotiated an agreement just before infringement began.'" (alteration in original) (citations omitted)).

144. Although any plaintiff can elect reasonable royalties, only practicing entities are able to receive lost profits since non-practicing entities, by definition, do not profit from using their patent portfolios. Oskar Liivak, *When Nominal Is Reasonable: Damages for the Unpracticed Patent*, 56 B.C. L. REV. 1031, 1040 (2015) ("This understanding of patent damages is critically important for non-

obtain larger royalty awards from courts than their practicing counterparts.[145] And if a court finds that the infringement was willful, it may treble (i.e., triple) the damages as a punitive measure—a remedy that became easier to assert after the *Halo Electronics, Inc. v. Pulse Electronics Inc.*[146] decision.[147] Under the current test, the plaintiff must show that the infringer's conduct was egregious in order to prove willfulness.[148] So given that a U.S. court may compensate the patentee with triple the actual damages,[149] a finding of infringement can generate a windfall award for the patentee.

Aside from monetary damages, patentees might carry an even bigger stick against defendants: preliminary and full injunctive relief.[150] Injunctive relief requires a showing of irreparable harm.[151] Where the patentee practices the patent, a permanent injunction is a strong deterrent against infringement—and perhaps innovation—because its issuance from a U.S. court bars inventors from making, using, or selling the

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practicing patentees. Such patentees, who generally may not avail themselves of lost profits or lost established royalties, must rely on a reasonable royalty for their measure of damages.").

145. Since 2006, NPEs have obtained nearly threefold greater median damages awards. Most noticeably, from 2011 to 2015, the median damages award for an NPE was $13.3 million, while the practicing entity median award was only $4.9 million. LANDAN ANSELL ET AL., PRICEWATERHOUSECOOPERS, 2016 PATENT LITIGATION STUDY 10 (2016), https://www.pwc.com/us/en/forensic-services/publications/assets/2016-pwc-patent-litigation-study.pdf [https://perma.cc/FJ63-B5WH].

146. 579 U.S. __, 136 S. Ct. 1923 (2016).

147. In 2016, the U.S. Supreme Court decided *Halo*, which overruled the long-prevailing Federal Circuit standard for willfulness damages set forth in *In re Seagate Technology, LLC*, 497 F.3d 1360 (2007). *Seagate* required that a patentee show both an objective prong and subjective prong to establish willfulness. *See Halo*, 136 S. Ct. at 1928. The Court rejected the objective prong of *Seagate* and held that only the subjective intent is relevant to show willfulness. *Id.* at 1932–33; *see also* John M. Golden, *Reasonable Certainty in Contract and Patent Damages*, 30 HARV. J.L. & TECH. 257, 261 (2017) (stating that prior to *Halo*, the test was "overly restrict[ive]").

148. *Halo*, 136 S. Ct. at 1935 ("Section 284 gives district courts the discretion to award enhanced damages against those guilty of patent infringement. In applying this discretion, district courts are 'to be guided by [the] sound legal principles' developed over nearly two centuries of application and interpretation of the Patent Act. Those principles channel the exercise of discretion, limiting the award of enhanced damages to egregious cases of misconduct beyond typical infringement." (quoting Martin v. Franklin Capital Corp., 546 U.S. 132, 139 (2005) (alteration in original)).

149. 35 U.S.C. § 284 (2018) ("[T]he court may increase the damages up to three times the amount found or assessed.").

150. *See* Ebay v. MercExchange, 547 U.S. 388, 393 (2006) (explaining the availability of injunctive relief for practicing patent, but not for NPEs); Christopher B. Seaman, *Permanent Injunctions in Patent Litigation After eBay: An Empirical Study*, 101 IOWA L. REV. 1949, 1952 (2016) (finding that NPEs "rarely" receive injunctions after *eBay*).

151. Injunctive remedies have been all but restricted to practicing entities (and in some instances, universities). *Ebay*, 547 U.S. at 393.

unauthorized good anywhere in the United States.[152] If the practicing entity is asserting patent rights against one who imports the accused products, the patentee has another effective tool to receive an injunction in its arsenal: a section 337 proceeding before the International Trade Commission (ITC).[153] In turn, considering that inventors during the R&D stage are often unaware or unsure of whether their art infringes upon another's technology, an injunction can deprive even good faith inventors of any means to recoup the sunk costs of innovation and can curtail their business entirely.[154]

In comparison to other countries, remedies in the United States tend to be substantially more punitive and expensive for multiple reasons. First, the United States is one of the only countries that may subject damages awards to trebling.[155] Second, a number of OECD countries issue almost exclusively equitable remedies against infringers, avoiding the imposition of monetary damages.[156] In light of these differences, the United States'

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152. Illumina, Inc. v. Qiagen, N.V., 207 F. Supp. 3d 1081, 1094–95 (N.D. Cal. 2016) (enjoining the sales of infringing goods in the United States).

153. Tarriff Act of 1930, 19 U.S.C. § 1337(a)(2) (2018) ("[I]ndustr[ies] in the United States, relating to the articles protected by the patent, copyright, trademark, mask work, or design concerned, exists or is in the process of being established."). The ITC is authorized to issue exclusion orders enforced by the U.S. Customs and Border Protection, barring the infringing articles from import into the United States. *Id.* § 1337(a)(3) (To receive an exclusion order, the complainant must show that there is "(A) significant investment in plant and equipment; (B) significant employment of labor or capital; or (C) substantial investment in its exploitation, including engineering, research and development, or licensing."); *see* Taras M. Czebiniak, *When Congress Gives Two Hats, Which Do You Wear? Choosing Between Domestic Industry Protection and IP Enforcement in Section 337 Investigations*, 26 BERKELEY TECH. L.J. 93, 102 (2011) ("The most important ITC remedy today is the exclusion order. U.S. Customs and Border Protection enforces ITC exclusion orders at the border, a system meant to prevent infringing articles from entering the United States without further action by the complainant. Exclusion orders come in two varieties: limited and general. The default exclusion order is of limited scope (limited exclusion order, or 'LEO'), and it applies only to those parties noticed as respondents to a particular complaint filed at the ITC. The default scope of the order is limited because of public notice concerns regarding an exclusion order's potential effect on unnamed parties." (footnotes omitted)). Proceedings before the ITC are known to be exceedingly short yet still expensive. When combined with an action in district court, the threat of de facto injunctive relief via a section 337 action makes the ITC a strong, and unique, pressure point in patent litigation in the United States. *See* James E. Daily & F. Scott Kieff, *Benefits of Patent Jury Trials for Commercializing Innovation*, 21 GEO. MASON L. REV. 865, 869 (2014).

154. *See* Jeanne C. Fromer, *The Layers of Obviousness in Patent Law*, 22 HARV. J.L. & TECH. 75, 80–81 (2008) ("Collectively, this patent thicket will decrease innovation and increase social costs both by imposing significant licensing fees upon anyone working in the field and by potentially generating expensive litigation based on accidental infringement.").

155. *See supra* notes 146–149.

156. Adam Mossoff, *The Rise and Fall of the First American Patent Thicket: The Sewing Machine War of the 1850s*, 53 ARIZ. L. REV. 165, 167 (2011) (discussing the economics of patent thickets and noting that "according to economic theory, the problem of such excessive fragmentation of ownership

patent scheme imposes costs on infringers that, on average, exceed every other nation. For example, U.S. courts have confirmed patent infringement awards of $2.5 *billion*,[157] compared to China which has never issued more than the equivalent of $7.5 million in damages.[158] One of the largest non-U.S. awards was levied in Canada when a pharmaceutical company was ordered to pay $180 million in damages—however, even that amount would fail to crack the top ten largest damages awards in the United States.[159] Since the act of innovation exposes inventors to infringement claims in that jurisdiction, it stands to reason that innovators would prefer to develop technology where the costs of infringement are relatively less expensive—if so, this would incentivize innovation in countries other than the United States.

C. Patent Grants, Density, and Thickets

Could patent density in the United States explain the hesitancy of companies to center their R&D in the states? The chance of litigation mounts when the market is saturated with patents—known as a patent thicket.[160] This is because, as a primary concern, a large volume of patents in an industry increases the odds that an inventor may accidentally infringe one of them.[161] For example, approximately 250,000 *active* patents are used in the modern smartphone, ignoring the dormant patents that can also form the basis of an infringement lawsuit.[162] Even if an

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interests is straightforward: it increases transaction costs, accentuates hold-out problems, and precipitates costly litigation").

157. Barry Herman, *Lessons from the Largest Patent Damages Award in History*, LAW360 (Jan. 20, 2017, 10:42 AM), https://www.law360.com/articles/882857/lessons-from-the-largest-patent-damages-award-in-history (last visited Jan. 31, 2019).

158. Fromer, *supra* note 154, at 80–81 (noting the problems of accidental infringement borne to patent thickets); Pauline Booth, *Latest Decision: Highest Damages Award in the Specialized IP Court in Beijing of $7.5 Million – Also Awarded Attorney Fees Charged by Hour*, DUFF & PHELPS (Dec. 23, 2016), http://www.duffandphelps.com/insights/publications/litigation-and-disputes/highest-damages-award-in-the-specialized-ip-court-in-beijing [https://perma.cc/NN6T-MP8Z].

159. Steven Mason & David Tait, *Largest Patent Infringement Award in Canada Stands: Apotex Denied Leave to Appeal to the SCC*, LEXOLOGY (Apr. 14, 2016), https://www.lexology.com/library/detail.aspx?g=ea0edfd9-1ddc-4c2f-b937-cde716e74ede [https://perma.cc/EK24-EMJ2].

160. *See* Herman, *supra* note 157.

161. Fromer, *supra* note 154, at 80–81 (noting the problems of accidental infringement borne to patent thickets).

162. Mike Masnick, *There are 250,000 Active Patents that Impact Smartphones; Representing One in Six Active Patents Today*, INNOVATION (Oct. 18, 2012), https://www.techdirt.com/blog/innovation/articles/20121017/10480520734/there-are-250000-active-patents-that-impact-smartphones-representing-one-six-active-patents-today.shtml [https://perma.cc/7REM-6T29].

inventor detects each blocking patent, the existence of a thicket raises the costs of innovation by forcing the inventor to design around the anticommons.[163]

Patent thickets also create troublesome incentives to wage meritless litigation.[164] Some bad faith litigants have overwhelmed practicing entities by acquiring thousands of patents regardless of the patents' quality. This type of action allows an entity to essentially weaponize their own patent thickets:

> Their scale often enables them to license without litigation because defendants are reluctant to challenge an entire portfolio of patents. The patent aggregation model depends on patent intensity in an industry; it works because the patent aggregator has so many patents that read on a particular target that a challenge to the validity of the patents makes little sense.[165]

And because patent infringement is a strict liability tort, the question of whether an inventor accused of infringement was aware of the pre-existing patent, or made a good faith effort to find it, has no exculpatory value.[166] As a result, patent thickets can *ex ante* and *ex post* raise the costs of innovation, thereby discouraging R&D investment.[167]

The countries with the most patents in force are the most likely to be burdened by patent thickets. Historically, the United States has issued the most patents, which is attributable to the size of the American market; since both domestic and foreign inventors sell their technologies in the United States, inventors have sought to guard their market share by obtaining U.S. patents. Indeed, there are no requirements—in the United

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163. Mossoff, *supra* note 156, at 166–67 ("A 'patent thicket' exists when too many patents covering individual elements of a commercial product are separately owned by different entities. This concept is . . . based on Professor Michael Heller's theory of the anticommons in real property, which arises when there is excessive fragmentation of ownership interests in a single parcel of land. According to economic theory, the problem of such excessive fragmentation of ownership interests is straightforward: it increases transaction costs, accentuates hold-out problems, and precipitates costly litigation, which prevents commercial development of the affected property." (footnotes omitted)).

164. Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 368 (2010).

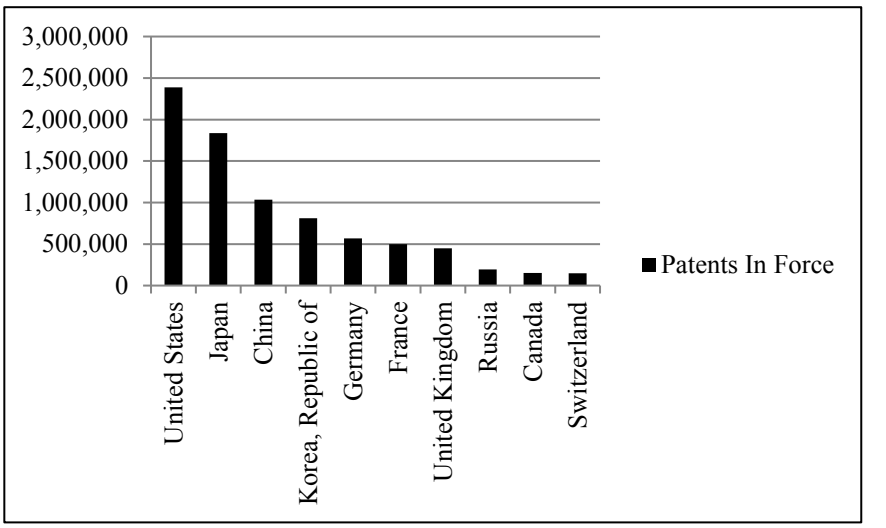
165. Mark A. Lemley & A. Douglas Melamed, *Missing the Forest for the Trolls*, 113 COLUM. L. REV. 2117, 2127 (2013).

166. Commil USA, LLC v. Cisco Sys., Inc., 575 U.S. __, 135 S. Ct. 1920, 1922 (2015) ("[T]he discussion here also refers to direct infringement, § 271(a), a strict-liability offense in which a defendant's mental state is irrelevant . . . .").

167. *See, e.g.*, Intellectual Ventures I LLC v. Symantec Corp., 838 F.3d 1307, 1329 (Fed. Cir. 2016) ("Eliminating generically-implemented software patents would clear the patent thicket, ensuring that patent protection promotes, rather than impedes, 'the onward march of science' and allowing technological innovation to proceed apace." (citation omitted)).

States, China, Japan, Europe, Korea, and most other nations—that a patent applicant reside in the country where the applicant seeks protection. As one may imagine, firms have not been bashful in applying for patents in their non-resident jurisdictions.[168] Despite the alarm expressed in some corners that the United States no longer receives the most patent *applications*, there are substantially more patents currently in force in the United States than anywhere else, sitting at a little over 2.5 million.[169]

Figure 3:
Top Ten Countries for Most Patents in Force in 2013[170]



As a result, firms intending to innovate in the United States face the largest existing base of patents blocking the item's potential use. In many situations, the patents in force create patent thickets that make entry into

168. U.S. PATENT & TRADEMARK OFFICE, U.S. PATENT STATISTICS CHART CALENDAR YEARS 1963-2015 (2016), https://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm [https://perma.cc/ZVL4-DYDZ].

169. According to data from the World Intellectual Property Organization, inventors are rushing to China to file their patent applications: of the roughly 2.68 million patent applications filed in 2014, 800,000 of those applications were to the State Intellectual Property Office of the People's Republic of China (SIPO). WORLD INTELL. PROP. ORG., WORLD INTELLECTUAL PROPERTY INDICATORS 23 (2014), https://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2014.pdf [https://perma.cc/8WD5-BM6N]. These 800,000 applications were more than the applications in the United States and Japan, combined. *Id.* So despite the increasing popularity of other countries as a place to file patents—and perhaps invent—it is unlikely that, any time soon, another nation will have a greater anticommons than the United States. *Id.* at 51.

170. This figure was generated using confidential data collected by *Darts-ip* (2000–2013). Please contact the authors for more information.

those markets risky and costly. If a company primarily intends to sell its invention abroad, developing technology where relatively fewer patents are in force makes sense. The next Part tests not only whether inventors prefer to innovate in countries that offer less costly and risky patent schemes, but also whether firms even care about foreign patent laws when making innovation decisions.

IV. EMPIRICAL ANALYSIS

This Part empirically tests whether patent scholarship has so far missed a critical element of innovation, namely whether firms avoid the costs and risks of innovation by developing technology in more hospitable patent environments. The results have substantial implications for the U.S. patent system, which we show is the world's costliest and most litigious. We expect firms to innovate in jurisdictions that (1) minimize the costs of litigating a patent infringement lawsuit, (2) issue relatively inexpensive damages awards, and (3) offer a less challenging anticommons. We also anticipate, contrary to popular logic, that research and innovation decisions are seldom influenced by the strength of patent *protection*.[171] If anything, we think inventors in the R&D stage prefer jurisdictions offering weaker patent rights.

A. Variables

In constructing our dataset, we are indebted to the *Global IP Project* and *Darts-ip* for their invaluable empirical support. Due to their contributions and guidance, we were able to analyze previously unavailable data. The dependent variable—i.e., the entity that we seek to explain—is the rate of innovation as measured by the annual amount of capital spent in a country on R&D lagged by one year.[172] *R&D Spending* is an appropriate dependent variable because research investment is a primary activity that patent laws endeavor to incentivize. *R&D Spending* also captures many of the local benefits generated by innovation. We measure *R&D Spending* using data available through the OECD.[173]

The first set of independent variables reflects different aspects of patent enforcement. Perhaps the most crucial factor is the average measure of damages issued by a national court because awards in one jurisdiction can

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171. *See, e.g.*, Crouch, *supra* note 66, at 1133 (stating that patent law "operates under the assumption" that rewarding inventors with stronger patent rights should encourage firms to innovate).

172. It is common to lag a variable by a year when you would expect the effects of the independent variables to be apparent in the following year.

173. *Gross Domestic Spending on R&D*, OECD, https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm [https://perma.cc/Y5L2-68K6].

be ruinous while negligible in another. Inventors must then consider the consequences of infringement, even if accidental. We measured *average general damages* using data provided to us by *Darts-ip*, which tracks and analyzes patent infringement awards issued by national courts.

The next variable is the *average cost of defending a patent infringement lawsuit* over a five-year period. This factor varies significantly by country. In some European countries, a firm can litigate a claim for under $50,000, as compared to the United States where commentators refer to patent litigation as "the sport of kings" due to its multimillion-dollar costs and high stakes nature.[174] The *Global IP Project*, which surveys patent infringement awards issued by the most active patent enforcement jurisdictions, graciously provided us data for litigation costs.[175]

We also test whether the number of patents in force in a country creates such a daunting anticommons that firms become more likely to invent where fewer pre-existing patents may form the basis of a lawsuit. Data for *the number of patents in force* by country are available from the World Intellectual Property Organization.[176]

A fourth component is the *strength of patent protection*. Although patent protection is thought to have little influence upon where firms innovate, there are countervailing practical considerations: piracy is most tenable in close proximity to a firm's R&D.[177] The locals staffing a project receive training and knowledge to replicate the patented device or method, encouraging firms to innovate where one's patent rights are protected from the most likely pirates.[178] Although this Article expects weaker patent rights to promote innovation, this assumes that patent protection is at least adequate. Patent protection is represented by a composite index compiled by Park and Grimarte.[179]

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174. *See* Todd Hixon, *For Most Small Companies Patents Are Just About Worthless*, FORBES (Oct. 4, 2013, 12:57 AM), https://www.forbes.com/sites/toddhixon/2013/10/04/for-most-small-companies-patents-are-just-about-worthless/#211b6ffe3ef3 [https://perma.cc/GMP9-PGZK] (describing patent litigation as the "sport of kings").

175. Please contact the authors about data for patent litigation.

176. WORLD INTELLECTUAL PROP. ORG., WORLD INTELLECTUAL PROPERTY INDICATORS (2015), http://www.wipo.int/edocs/pubdocs/en/wipo_pub_941_2015-part1.pdf [https://perma.cc/FWX2-82SW].

177. *See* Jeong-Yeong Lee & Edwin Mansfield, *Intellectual Property Protection and U.S. Foreign Direct Investment*, 78 REV. ECON. & STAT. 181, 181 (1996) (asserting that companies are likely to place their operations in countries that protect IP rights or, if a country does not protect IP rights, that it is likely to place older technology).

178. *Id.*

179. *See generally* Walter G. Park, *International Patent Protection: 1960-2005*, 37 RES. POL'Y 761 (2008).

The use of control variables in this study has a greater significance than usual.[180] Here, we utilize a number of *non-patent* variables known to affect the rate of innovation. If the control variables prove to be statistically significant while the patent variables are insignificant, this would strongly suggest that firms are almost entirely concerned with traditional business factors rather than patent laws in determining how and where to innovate. For instance, a jurisdiction's *corporate tax rate* has been theorized to have a salient influence on innovation.[181] We also include a variable for whether a country offers inventors a "patent box."[182] First established by Ireland in 2000, the patent box is a generous tax rate applied to profits accrued from patented devices and methods.[183] It is expressly intended to induce companies to commercialize technology *developed in that country*.[184] *Patent box* is a dummy variable, meaning that it is scored as either a 1 (1=patent box) or 0 (0=no patent box). Another variable is a country's *human capital* surplus.[185] Considering that a country's education level and technical experience are critical to its ability to perform high-level R&D, we measure *human capital* as reflecting the percentage of a country's population that is employed in a research sector.[186] *Gross Domestic Product* (*GDP) per capital* is also included because a country's wealth and market size are thought to be

180. Control variables protect against spurious correlations by accounting for the determinants that actually drive the studied relationship.

181. *See* Email with a Partner in the Dublin office of an international law firm (on file with author) (explaining that companies primarily consider a country's tax code when determining where to conduct R&D).

182. *See* Graetz & Doud, *supra* note 36, at 362–64 (describing the attributes of a patent box).

183. Fiona Reddan, *Ireland Jumps on to the Knowledge-Box Wagon Early*, IRISH TIMES (Apr. 4, 2016, 6:00 AM), http://www.irishtimes.com/sponsored/global-tax/ireland-jumps-on-to-the-knowledge-box-wagon-early-1.2558640 [https://perma.cc/FW2S-S8XR] (discussing Ireland's role as an innovator of the patent box).

184. *See* Bernard Knight & Goud Maragani, *It Is Time for the United States to Implement a Patent Box Tax Regime to Encourage Domestic Manufacturing*, 19 STAN. J.L. BUS. & FIN. 39, 41 (2013) (advocating for the United States to enact a patent box in order to attract innovation).

185. Potentially as important as a country's tax rate is its human capital endowment. Human capital is the collective skill, training, and education of a country's labor force. Countries with greater levels of human capital are more likely to attract R&D and innovation since scientists, managers, and other personnel can be found locally. For many firms, the human capital found abroad can produce superior goods than the personnel in the firm's home country. As a result, firms may increase their R&D capacity by inventing in countries offering high levels of human capital. Reddan, *supra* note 183.

186. *See* Knight & Maragani, *supra* note 184, at 41 (advocating for the United States to enact a patent box in order to attract innovation).

primary determinants of where firms innovate.[187] Considering the importance of *infrastructure*,[188] our treatment controls for the amount of electricity used per person, which is considered a reliable proxy for development and infrastructure.[189] This variable is derived from the World Development Indicators.[190] Since legal protections of property rights are paramount to those investing tangible assets in another country, there is a corresponding variable.[191] We also control for the passage of time since cross sectional events tied to time can distort the results.[192]

B. Statistical Models

We test our hypotheses by tracking the determinants of global R&D spending (our dependent variable) to see which patent and business variables predict the international spending and flow of capital on innovation. The dataset spans from the years 2000 to 2013 with a unique observation for each year that a country is observed; thus, the unit of analysis is country-year. The statistical treatment uses both random effects and ordinary least squares (OLS) analyses. Our concern is that time series data can skew the results if a phenomenon is clustered within the same period of time, as opposed to being randomly distributed. For example, the recession that struck the United States in the late 2000s generated similar effects during the same time period in other countries. In light of this, a random effects test is likely the more appropriate model than OLS since it can accommodate for common trends over time and country. We verify our results using OLS—even though OLS makes the assumption that observations are randomly distributed over time—because it is a

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187. *See* Eric C. Wang, *Determinants of R&D Investment: The Extreme-Bounds-Analysis Approach Applied to 26 OECD Countries*, 39 RES. POL'Y 103, 107 (2010) (controlling for GDP as a determinant of innovation).

188. Jeffrey L. Furman et al., *The Determinants of National Innovative Capacity*, 31 RES. POL'Y 899, 905 (2002) (noting the importance of physical infrastructure with respect to creating innovation).

189. *See, e.g.*, Michael W. Doyle & Nicholas Sambanis, *International Peacebuilding: A Theoretical and Quantitative Analysis*, 94 AM. POL. SCI. REV. 779, 789 (2000) (using electricity consumption per capita as a proxy for development).

190. *DataBank: World Development Indicators*, WORLD BANK, http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators (last visited Mar. 10, 2019).

191. Robert Bird & Daniel R. Cahoy, *The Impact of Compulsory Licensing on Foreign Direct Investment: A Collective Bargaining Approach*, 45 AM. BUS. L.J. 283, 284 (2008) ("As a result, industries that find the security of property rights lacking in a given nation may avoid engaging in foreign direct investment (FDI) with that nation.").

192. The study uses time control variables that increases by one for each year of the study.

common approach employed by other studies explaining innovation by country, but we also included a control variable for time.[193]

C. Results

The results provide fresh insights into how patent laws influence where firms innovate, and it spells trouble for the U.S. Patent Act. According to the random effects and OLS analyses, firms strongly consider the nature of a country's patent enforcement system when deciding where to innovate.

For example, the random effects analysis in Model 1 indicates that firms are more likely to place their R&D operations in countries where the costs of losing an infringement lawsuit are minimized, as measured by the negative and statistically significant variable of *Average Damages*.[194] This result was expected by our research, as those innovating a patentable good are more likely to be sued by those owning pre-existing patented technology than to sue them. As such, we find that inventors prefer jurisdictions where the prospective damages a court may issue are lessened.

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193. *See, e.g.*, Jonathan P. Doh et al., *Foreign Research and Development and Host Country Environment: An Empirical Examination of U.S. International R&D*, 45 MGMT. INT'L REV. 121, 139–40 (2005) (using regression analysis to gauge the determinants of R&D spending over time); P.M. Rao et al., *R&D Offshoring in Multinational Enterprises*, 22 COMPETITIVENESS REV. 376, 386 (2012) (employing an OLS regression to analyze national innovation).

194. To interpret the results, a positive coefficient represents that the variable has a positive relationship with the dependent variable. This means that as the independent variable increases, so too does *R&D spending*. A negative coefficient represents the opposite—an inverse relationship—indicating that as the independent variable increases, *R&D spending* declines. Statistically significant variables are bolded with asterisks representing the level of significance.

Table 1:
Random Effects Analyses[195]

	Model 1	**Model 2**
R&D Expenditures		
Average Damages	**- 0.0010369*** (0.0005764)	
Costs of Defense		**- 0.0030835**** (0.0010823)
Patent Strength	763,756 (474,470)	452,050.1 (282,669.8)
Researchers/Capita	**99,003.02***** (18,919.47)	**(97,750.64)***** (11,932.52)
GDP	**0.0000000616***** (0.0000000128)	**0.000000703***** (0.0000000119)
Corporate Tax	- 1,372.011 (4,457.974)	- 5,240.221 (4,386.821)
Property Rights	- 47,728.45 (25,102.94)	- 13,528.09 (15,293.33)
Power	27.23743 (18.47236)	22.44285 (15.54419)
Constant	- 2,246,765 (2,011,454)	- 966,477.5 (1,237,379)
Prob. > F	**0.0000*****	**0.0000*****
Chi-Squared	166.65	181.91
Observations	80	168

Standard errors are given in parentheses; *p<0.10; **p<0.05; ***p<0.01.

A similar conclusion is that the actual cost of litigating the lawsuit—ignoring the size of the judgment and damages rendered—helps to determine where firms innovate. Model 2 illustrates the negative and statistically significant relationship that *average cost of patent litigation* has on *R&D Spending*. This finding indicates that the actual cost of defending a lawsuit deters innovation—or, more articulately, causes inventors to place their R&D in jurisdictions where patent litigation is less costly.

The OLS regressions produced similar results as the Random effects models. In Models 3 and 4, *average damages* was statistically significant and negative, as was *average cost to defend a lawsuit*, meaning that firms

195. This table was generated using confidential data collected by *Darts-ip* (2000–2013). Please contact the authors for more information.

are likely to resist spending on R&D in countries that impose high costs on innovation in terms of both litigation and damages.

These results have powerful implications for the U.S. patent system. Not only is the typical infringement lawsuit in the United States costly and drawn out, but bad faith litigants have devised ways to exploit these extraordinary costs, namely, by waging patent litigation as a means to extract settlements and impede competition.[196] In comparison, the cost of litigating a patent infringement lawsuit in other countries can be less than $50,000, which is only 2% of the cost in the United States. This explains why, as we have found, inventors place their R&D programs in countries with less costly patent enforcement regimes than the United States. If the United States would like to better incentivize and retain innovation, then reforms must be made to the litigious and expensive nature of patent enforcement.

196. *See supra* notes 79–84 and accompanying text.

Table 2:
OLS Regressions[197]

	Model 3	**Model 4**
R&D Expenditures		
Average Damages	**- 0.0054106**** (0.0025766)	
Costs of Litigation		**- 0.0105919**** (0.0033783)
Patent Strength	348,217.2 (270,320.6)	180,199.8 (146,549.4)
Researchers/Capita	**350.218***** (29.2877)	**(388.7775)***** (21.52344)
GDP	**0.0000000939***** (0.0000000133)	**0.000000116***** (0.0000000174)
Power	**- 36.56788***** (10.23803)	**- 23.06874**** (7.670417)
Corporate Tax	**- 21,826.88**** (10,545.2)	**- 16,306.19**** (6,801.04)
Property Rights	**150,623.1**** (46,953.86)	**71,247.12***** (31,646.88)
Time Control	5,920.489 (14,914.77)	- 4,084.688 (10,485.58)
Constant	- 1,239,234 (1,078,012)	- 271,114.6 (613,141)
R-Squared Observations	**0.8618***** 80	**0.8045***** 179

Standard errors are given in parentheses; *p<0.10; **p<0.05; ***p<0.01

We were surprised to find, though, that *patent density* seems to have scant independent effect on where firms decide to invent. This variable was statistically insignificant despite how we measured the dependent variable or analyzed the relationship: not only was the *number of patents in force* statistically unrelated to innovation in both the OLS and random effects models, but it did not matter whether the dependent variable were reflected by *R&D Spending*, *changes in R&D Spending*, or even the

197. This table was generated using confidential data collected by *Darts-ip* (2000–2013). Please contact the authors for more information.

number of patent infringement lawsuits initiated each year.[198] In retrospect, this makes sense. Firms appear to care less about the density of patents making a lawsuit more likely than the actual costs of defending or losing that lawsuit.[199]

Another interesting finding concerns the matter of *patent protection*. Although firms have no ability to increase their patent protection by inventing in a certain country, piracy is most easily achieved by those hired to perform the R&D in a close proximity to the operations. The results suggest that the strength of protection does not matter. Both the random effects and OLS models found a statistically insignificant relationship. It is our belief that firms are influenced by patent strength to the degree that the jurisdiction provides a baseline level of protection, which is the case in all advanced democracies. This finding has salient implications for recent industry and congressional calls to increase patent strength as a means to retain and incentivize innovation; our results suggest that efforts to increase the costs of enforcement would produce the opposite, undesirable result, so long as U.S. patent protection remains at least modestly effective.

The models also provide strong evidence that *non-patent factors* affect where firms innovate. Naturally, *tax rate* influences where inventors prefer to operate per the OLS models (though we found no evidence in an unreported model that patent boxes attract innovation).[200] For example, the decision by Apple and Google to offshore R&D to Ireland—which offers a 12.5% tax rate and, until 2015, a patent box—might have generated more tax benefits than any savings derived from patent protection.[201] The quality of *human capital* also made a substantial

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198. The additional models are unreported. Please contact the author for the results. *Changes in R&D Spending* was measured by taking the difference in the current year's R&D spending from the prior year. The number of infringement lawsuits initiated each year was gathered from data issued to us by *Darts-ip*.

199. *See supra* notes 130–134 and accompanying text (discussing the incentives to wage patent litigation based upon the high costs of defending a lawsuit).

200. Hughes, *supra* note 12 (explaining that corporate tax rates among other factors are drawing firms to conduct R&D abroad).

201. *See Apple Expanding Cork Operation and Putting € 1 Million in Research Fund*, RES. & INNOVATION (Nov. 11, 2015), http://www.researchandinnovation.ie/apple-expanding-cork-operations-and-putting-e1million-in-research-fund/ [https://perma.cc/8SWF-H9QK]; John Kennedy, *Ireland Is the Data Capital of Europe, Says Google*, SILICON REPUBLIC (Feb. 4, 2016), https://www.siliconrepublic.com/enterprise/google-ireland-data-capital-europe-crown [https://perma.cc/XV3M-UQPU]; Robert W. Wood, *How Google Saved $3.6 Billion Taxes from Paper 'Dutch Sandwich'*, FORBES (Dec. 22, 2016, 9:09 AM) https://www.forbes.com/sites/robertwood/2016/12/22/how-google-saved-3-6-billion-taxes-from-paper-dutch-sandwich/#5d41b491c190 [https://perma.cc/MN74-NRM3] (describing the tax savings achieved by Google and Apple in the Netherlands which exceed the largest patent royalty damages ever awarded).

difference. Similarly, wealthier countries with greater consumer purchasing power attract more innovation, which, again, should not be shocking.

In sum, the results indicate that firms strategically innovate where their exposure to patent enforcement and litigation is minimized. Because inventors prefer jurisdictions that lessen the costs of defending and losing an infringement lawsuit, we conclude the U.S. patent environment is poorly equipped to incentivize firms to develop technology domestically. The literature, though, due to the territorial nature of patent law, has heretofore underestimated or dismissed this dynamic. We also confirm that, contrary to industry advocates and congressional efforts, the strength of patent protection has little effect upon where firms innovate relative to patent enforcement. Although we find that conventional considerations—such as human capital, corporate taxes, and market power—influence the location of innovation, patent laws are a hidden and salient part of the decision. As a result, any proposed reforms to patent law must understand the incentives and preferences of inventors during the R&D stage, especially if the goal is to encourage and retain innovation in the United States. Based upon these empirical findings, the next Part proposes substantive and procedural reforms to U.S. patent law that should revive the incentives to innovate in the United States.

V. IMPLICATIONS AND SUGGESTIONS

The purpose of patent law is to promote innovation, yet scholarship has seldom considered where the resulting innovation takes place. This is despite statements by policymakers and industry lobbyists asserting that U.S. firms are increasingly likely to develop technology overseas due to a weakening of U.S. patent rights.[202] Our research confirms their fears that companies are innovating abroad to exploit foreign patent laws. However, contrary to prevailing wisdom, strengthening patent rights is *not* the answer. Instead, the beneficiary jurisdictions are those that offer a more efficient system to defend an infringement claim. Because we find that less burdensome patent *enforcement* is more conducive to attracting innovation than stronger patent *protection*, we propose substantive and procedural reforms to U.S patent law to lower the costs and risks of enforcement. We propose amending existing patent institutions to (1) expand the safe harbor for experimental research, (2) create a staged framework to more efficiently settle patent disputes, and (3) implement a

202. *See supra* notes 1–7 and accompanying text.

uniform "Track B" system in federal district courts to increase certain disclosures that promote private settlements.

A. Expanding the Experimental Use Exception

As Justice Story remarked when establishing the experimental use exception in 1823, "it could never have been the intention of the legislature to punish a man, who constructed such a machine merely for philosophical experiments, or for the purpose of ascertaining the sufficiency of the machine to produce its described effects."[203] Nor, as we argue, should the U.S. patent system levy punishment against those who, without profiting off another's invention, advance the patent system's goal of promoting innovation and the sciences in the United States. By expanding the experimental use exception—which is currently applied in only limited form—Congress could reduce the costs and risks endemic to the R&D stage that has caused firms to innovate overseas.

U.S. courts have significantly narrowed the experimental use defense since its inception during which time the critical inquiry was whether or not the defendant *profited* from the research.[204] Today, the lodestar is whether the research has a commercial element. In making this determination, the courts scrutinize whether the challenged research related to the defendant's business as opposed to "satisfy[ing] idle curiosity, or for strictly philosophical inquiry."[205] For example, the U.S. District Court for the District of Connecticut in *Applera Corp. v. MJ Research, Inc.*,[206] explained that the defense is unavailable to those whose research exhibits the "slightest commercial implication."[207] Guiding the court to this conclusion were prior failed uses of the defense. These included experiments conducted by Duke University, a non-profit educational institution, which incurred liability because the challenged research furthered Duke's business of academic research.[208] Indeed, the

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203. Whittemore v. Cutter, 29 F. Cas. 1120, 1121 (C.C.D. Mass. 1813).

204. Elizabeth A. Rowe, *The Experimental Use Exception to Patent Infringement: Do Universities Deserve Special Treatment?*, 59 ME. L. REV. 283, 289 (2007) ("Originally, the courts focused on whether the alleged infringer intended to profit from the use of another's patent. If he did, the experimental use exception did not apply.").

205. Madey v. Duke Univ., 307 F.3d 1351, 1362 (Fed. Cir. 2002) (ruling that research conducted at Duke University infringed another's patent); Peter Lee, *Contracting to Preserve Open Science: Consideration-Based Regulation in Patent Law*, 58 EMORY L.J. 889, 909 (2009) (discussing the current jurisprudence of the experimental use exception).

206. Applera Corp. v. MJ Research, Inc., 311 F. Supp. 2d. 293, 296 (D. Conn. 2004).

207. *Id.* (citing *Madey*, 307 F.3d at 1362).

208. *Id.*

courts have declared the exception to be "very limited," "very narrow," and "strictly limited."[209]

The need to expand the experimental use exception is well-illustrated by instances in which inventors have made good faith efforts to avoid infringing yet incurred liability anyway. In *Embrex v. Service Engineering Corp.*,[210] Service Engineering attempted to develop a device to inoculate eggs via the egg's chorioallantoic sac (CAS).[211] Targeting the CAS was imperative because a competitor, Embrex, had patented a device that vaccinated a different part of the egg.[212] The tests ran by Service Engineering were not only unsuccessful, but errantly injected vaccine into areas of the egg covered by the Embrex patent.[213] The district court held that the commercial purpose underlying Service Engineering's research negated the experimental use defense—despite the company's intent to avoid infringing and inability to produce a marketable device—culminating in a $500,000 damages award.[214] This result demonstrates the risks and disincentives of inventing in the United States: a firm can perform unsuccessful research that sought to preserve another's party's patent rights and still incur significant liability.

Accordingly, Congress should codify an expanded version of the experimental use exception in the U.S. Patent Act. Because, as we found, American firms are innovating abroad to avoid the costs and risks of the U.S. patent scheme, the experimental use exception should immunize research that in no way results in the sale or licensing of a good, or any other pecuniary benefit. Under this test, a court would examine whether the defendant profited from copying or using the pre-existing patent. The clearest example of an act failing to meet this threshold would entail research resulting in the defendant selling or licensing a product that benefitted from another's patented device or method.

Key to this new standard is broadly defining pecuniary gain. The benefit that a company receives from infringement does not always arise directly from a sale or license. For example, an institution's capacity to

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209. *Id.*; *see* Janice M. Mueller, *No "Dilettante Affair": Rethinking the Experimental Use Exception to Patent Infringement for Biomedical Research Tools*, 76 WASH. L. REV. 1, 24 (2001) ("Thus, after *Roche*, scientists engaged in research and development having more than negligible commercial purpose could no longer rely on the experimental use doctrine to exempt their experiments from patent infringement liability.").

210. 216 F.3d 1343 (Fed. Cir. 2000).

211. *Id.* at 1346.

212. *Id.*

213. *Id.* at 1347 ("According to the trial record, the Rosenberger tests showed that the injected embryos received little immunity, and that most injections penetrated beyond the CAS and into the amnion/yolk sac—areas covered by the '630 patent.'").

214. *Id.* at 1349.

raise funds or receive support is often attributable to successes in the laboratory; in that sense, when a firm has materially benefited from using or copying another's invention without permission, then a court may appropriately conclude the conduct not only benefited the researcher but also deprived the inventor of a sale or license. By increasing the scope of pecuniary gain to include all forms of benefit, firms would retain incentives to invent since others could not materially profit from misappropriating the device or method. And critically, by eliminating ruinous liability for most forms of good faith and non-injurious research, the disincentives that have discouraged firms from inventing in the United States would be partially mitigated.

It should be noted that broadening the experimental use defense beyond what currently exists would, to a degree, lessen the patentee's right to control the invention. But patent rights, as discussed earlier, are a *limited* monopoly.[215] Here, shielding types of experimental research would significantly bolster the incentives to invent as well as protect the public benefit represented by the patentee's disclosure of the invention. In fact, this is hardly a radical proposal; almost this identical reform exists in the Hatch-Waxman Act, which permits pharmaceutical companies to experiment with another's patented drug if the use is meant to gain FDA approval.[216] As result, because the extent to which an inventor is exposed to liability during the R&D stage is shown to diminish innovation, a broader research exception would benefit invention and discovery occurring in the United States without overly diminishing the rights of pre-existing patent holders.

The next proposals, likewise, seek to incentivize innovation in the United States, but by reforming procedural aspects of patent litigation.

B. Procedural Reforms to Patent Law

From a procedural context, our research found that the multilayered and time-consuming nature of U.S. patent litigation creates an expensive process that firms have sought to avoid by inventing abroad. This finding indicates that the procedural nature of U.S. patent litigation should be modified to minimize these costs.

Patent litigation is fundamentally no different than any other litigation; most cases settle and, by applying basic economic theory, we can predict

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215. *See supra* Section I.B (explaining that patent rights can vary in strength, offering inventors differing levels of control over their patented devices).

216. 35 U.S.C. § 271(e)(1) (2018) (stating the research use of another drug is not an act of infringement if it is "solely for uses reasonably related to the development and submission of information under a Federal law which regulates the . . . use . . . of drugs").

at which point they settle and for how much. The noted flaw is the lack of mechanisms to ensure settlements are tethered to the value of the patent; the reality is that, in many cases, parties settle at dollar amounts reflecting the greater costs of litigating the dispute. We propose two remedies for this issue. First, understanding the maxim that one cannot infringe an invalid patent, the validity of the challenged patent should be tested early in litigation before the parties incur the full costs of discovery and trial. Second, the structure of patent litigation should inform both parties of their chances of success as well as the amount at risk during litigation's early stages, again, to encourage settlements before greater costs are incurred. Each of the following procedural steps would reduce litigation expenses without undermining the integrity of the process, remedying perhaps the primary disincentive of inventing in the United States.

1. Determining Patent Validity Through Phased Litigation Can Reduce Litigation Costs and Increase Innovation

U.S. patent litigation should separate the question of whether a patent is valid from whether it was infringed into bifurcated hearings. Where validity lies at the crux of a patent dispute, an abbreviated procedure to resolve this issue could eliminate most discovery and trial costs if the patent is found to be invalid. We propose capturing the spirit of the highly popular German bifurcated model by instituting a modest yet significant enhancement of the Inter Partes Review (IPR) system recently enacted by the U.S. Congress.[217]

In comparison to the United States, the Federal Patent Court in Germany (the *Bundespatentgericht*) offers an efficient model to resolve validity claims as a gatekeeper to extended litigation.[218] Typically in Germany, after a plaintiff initiates an infringement lawsuit, the defendant can claim the plaintiff's patent is invalid, oftentimes prompting the trial court to stay the proceedings until validity is determined in a separate hearing.[219] By trying validity in an initial stage, commentators note that bifurcation eliminates the full costs of discovery and trial if the patent was improvidently granted.[220] Or in instances the patent's validity is established, such a determination can encourage settlement or defer the

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217. Stuart J.H. Graham & Nicolas Van Zeebroeck, *Comparing Patent Litigation Across Europe: A First Look*, 17 STAN. TECH. L. REV. 655, 670–71 (2014).

218. *Id.*

219. *See id.* at 671–72.

220. Charleen Fei, *Justice Delayed Is Justice Denied? The Principle of Bifurcation in the German Patent Litigation System*, 14 WAKE FOREST J. BUS. & INTELL. PROP. L. 619, 638 (2014) (discussing the efficiency of the bifurcating patent litigation in the German context).

remaining expenses until the subsequent stage.[221] As a result, defending an infringement claim in Germany costs far below the United States: 50,000–250,000 euros in Germany compared to roughly three million dollars in the United States.[222]

A reasonable approach to achieve the savings and benefits of a bifurcated model would entail creating a limited mandatory stay at the district court level if a defendant timely challenges validity of a patent in dispute before the U.S. Patent Trial and Appeal Board (PTAB). The PTAB operates IPR, which the U.S. Congress enacted in 2011 to offer litigants a separate and more efficient venue to challenge a patent's validity.[223] In the typical hearing, the petitioner presents evidence to a three-person PTAB panel suggesting the art is obvious, not novel, or for some other reason, not patentable.[224] Due to the benefits of testing validity at the onset of litigation, some American courts routinely grant stays of litigation pending IPR. In doing so, these courts create a more efficient judicial economy, which litigants enjoy as well.[225]

We argue that the manner in which IPR has been used to de facto bifurcate validity and infringement should become the uniform American approach. Although IPR can potentially add an additional step and costs to the greater litigation process, scholars contend that only colorable disputes have so far tended to go to IPR, for all litigants involved have incentives to avoid such additional costs.[226] And by making validity a gatekeeper to litigation (if validity is in question), not only could defendants more efficiently dispatch infringement lawsuits, but also bad faith litigants would also be less likely to initiate them in the first place.[227]

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221. *See* Roger Allan Ford, *Patent Invalidity Versus Noninfringement*, 99 CORNELL L. REV. 71, 120 (2013) (noting that the system "put[s] off many costs associated only with infringement litigation–including particularly expensive costs like infringement experts and discovery about the defendant's product–until the second phase").

222. *See* Graham & Van Zeebroeck, *supra* note 217, at 667.

223. W. Michael Schuster, *Invalidity Assertion Entities and Inter Partes Review: Rent Seeking as a Tool to Discourage Patent Trolls*, 51 WAKE FOREST L. REV. 1163, 1166–67 (2017).

224. *See id.* at 1169 (explaining the nature of IPR).

225. *See, e.g.*, Stan Gibson, *District Court Stays Litigation Pending Inter Partes Review ("IPR") Over Defendant's Objection that Summary Judgment Motion Should Be Determined First*, PATENT LAW. BLOG (Sept. 13, 2016), https://patentlaw.jmbm.com/2016/09/district-court-stays-litigatio.html [https://perma.cc/8J64-9TFV] (describing how the court granted a stay to resolve validity issues).

226. Schuster, *supra* note 223, at 1181 (arguing that the costs of IPR is likely to incentivize parties to challenge primarily bad patents).

227. Consider that bad faith litigants are able to exert pressure on practicing entities to settle even meritless infringement lawsuits because the high costs of litigation increase the economic rationality of settling without a trial—despite the merits of the allegations. Notably, under the current framework, the strength of the nuisance plaintiff's patent tends to be irrelevant because parties must generally incur the full costs of litigation to contest the patent's validity. If validity could be tested quickly and

Creating a limited mandatory stay on district court proceedings is a realistic improvement on the current system that also enjoys the noted benefits of the German bifurcated system, but without significantly delaying patentees from pursuing an infringement claim.[228]

2. *Promoting Efficiency and Innovation by Informing Litigants of Risks and Exposure*

We also propose cutting the procedural costs of litigation by implementing mechanisms to promote information sharing during the early stages of patent litigation. There are a few district courts that, as a response to the growing number of infringement lawsuits, have adopted local rules meant to disclose infringement and validity theories at the onset of litigation. The benefit of disseminating information is that litigants can better measure their liability risk and, by increasing shared knowledge, narrow the gaps between their bargaining stances.[229] Not only should this promote out of court settlements but also help those settlements to reflect the underlying patent's value rather than the cost of litigation.

In 2014, the U.S. District Court for the Eastern District of Texas (E.D. of Texas) enacted a prominent example of such a procedure in the form of an alternate case management schedule called "Track B."[230] Track B is designed to front-load certain issues in patent disputes, especially damages and theories of infringement.[231] For example, within fourteen days of filing the case, the plaintiff must, in addition to making a "good

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cheaply, then bad faith litigants would be substantially less able to pressure practicing entities using a bad patent. This would not only reduce the rate of meritless litigation but also increase the rationality of contesting flawed lawsuits.

228. That said, instituting this approach without the STRONGER Patents Act of 2017 changes is not suggested as the current PTAB proceedings do not maintain the presumption of validity given to the patentee in district court proceedings. Gene Quinn, *Federal Circuit OKs PTAB Invalidating Patent Claims Prior Litigation Confirmed as Valid*, IP WATCHDOG (Apr. 4, 2017), http://www.ipwatchdog.com/2017/04/04/federal-circuit-oks-ptab-invalidating-patent-claims-prior-litigation-confirmed-as-valid/id=81796/ [https://perma.cc/2JYF-FXB4] (noting that PTAB does not assume validity).

229. Basic bargaining theory indicates that incremental increases of information create a mutual understanding among parties regarding costs and risks, making them more likely to resolve their dispute without suffering the greater costs of litigating. *See* John Yoo, *Rational Treaties: Article II, Congressional-Executive Agreements, and International Bargaining*, 97 CORNELL L. REV. 1, 30 (2011) (explaining the importance of information to settlements within bargaining theory).

230. General Order Regarding Track B Initial Patent Case Management Order, General Order 14-3 (E.D. Tex. Feb. 25, 2014), http://www.txed.uscourts.gov/sites/default/files/goFiles/14-03.pdf [https://perma.cc/4648-JBPB].

231. *Id.*

faith estimate" of expected damages, disclose "all licenses or settlement agreements concerning the patents-in-suit," both of which are reliable predictors of the damages a court is likely to award upon finding infringement.[232] Furthermore, the order limits aspects of discovery, including interrogatories and requests for production.[233] Similar to the E.D. of Texas's Track B schedule, in January 2017, the U.S. District Court for the Northern District of California (N.D. California) amended its local patent rules requiring litigants to disclose damages both early and often.[234] Such disclosures should not only help litigants to understand their exposure to liability, but also guide the court's oversight of discovery proportionality.[235]

We propose incorporating into the uniform set of patent rules N.D. California's manner of disclosing damages. Although E.D. Texas's Track B has, as an *optional* litigation route, found success providing parties—with typically less at risk—an ambitious fourteen-day schedule to disclose damages and infringement theories, this framework is much less realistic for complex patent litigants. As a *required* procedure for all patent litigants, we advocate in favor of replicating N.D. California's local rules, which mandate patent litigants to disclose and explain "non-binding, good faith estimates" during the initial case management conference; then within fourteen days of that conference, the plaintiff must disclose theories regarding the nature of the alleged infringement, as well as prior licenses of the patent.[236] After making these critical disclosures at the beginning of litigation, the plaintiff must announce her expected damages along with "factual support for those theories" within fifty days of receiving invalidity contentions.[237] This accelerated yet reasonable procedure should assist litigants in making efficient and informed decisions during the early stages about whether to incur elongated litigation, encouraging settlements. And by reducing the costs of litigation, we expect settlements to better reflect the value of the challenged patent as opposed to the greater costs of litigation. More

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232. *Id.*

233. *Id.*

234. *See* N.D. CAL. PATENT L.R. 2-1(b)(5), 3-2(h)–(i), 3-4(c)–(e), 3-8, 3-9.

235. *See* FED. R. CIV. P. 26(b)(1) and advisory committee's notes to the 2015 amendment ("Information is discoverable under revised Rule 26(b)(1) if it is relevant to any party's claim or defense and is proportional to the needs of the case.").

236. N.D. CAL. PATENT L.R. 2-1(b)(5), 3-2(h)–(i), 3-4(c)–(e), 3-8, 3-9; Robert F. McCauley III & Jacob A. Schroeder, *Revised Patent Local Rules for the Northern District of California*, FINNEGAN (Feb. 1, 2017), http://www.finnegan.com/ipupdates/pubdetail.aspx?pub=b835a596-8be3-4d35-8458-29ac267713a7 [https://perma.cc/F3HC-X5WA].

237. N.D. CAL. PATENT L.R. 2-1(b)(5), 3-9.

importantly, promoting greater procedural efficiencies should help to revive the incentives to innovate in the United States.

C. Non-Practicing Entities

The foregoing proposals to amend substantive and procedural aspects of patent litigation may have the added benefit of increasing the efficacy of NPEs. Currently, NPEs have incentives to indiscriminately threaten infringement lawsuits against practicing entities because the extraordinary costs of defending an infringement claim in the United States makes it rational for most defendant-patentees to settle without litigating; as a result, scholarship has tended to portray NPEs as parasitic litigants.[238] We argue, however, that NPEs could improve the efficiency of patent enforcement if they exclusively sought out and challenged bad patents. The patent system renders substantial costs on the public and markets because each patent removes technology from the public domain.[239] Although this system is thought necessary to promote innovation, scholars contend that improperly granted, or "bad," patents increase the anticommons without an attendant justification.[240] But if the cost of litigating a patent claim were reduced, then practicing entities would be more likely to defend *valid* patents against meritless lawsuits rather than settling. In this situation, NPEs would become more likely to seek out practicing entities enforcing *bad* patents because those parties would be more likely to settle than to have a court declare their patents invalid. In doing so, NPEs could assume a socially beneficial role of ferreting out bad patents and trimming the anticommons. And by lessening the rate of meritless lawsuits, innovation in the United States is likely to increase.

D. Understanding Why Firms Leave and Where They Go

In terms of implications, we are left with an especially salient question: Are patent laws the reason why innovative firms are leaving the United States? Although we may confidently conclude that firms are likely to place their R&D and innovation in countries where patent enforcement

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238. *See generally* Robert P. Merges, *The Trouble with Trolls: Innovation, Rent-Seeking, and Patent Law Reform*, 24 BERKELEY TECH. L.J. 1583 (2009) (discussing the perceived problems with NPEs, pejoratively described as "patent trolls").

239. Anna B. Laakmann, *The New Genomic Semicommons*, 5 U.C. IRVINE L. REV. 1001, 1023 (2015) (explaining the costs imposed by patent based anticommons).

240. W. Michael Schuster, *Rent-Seeking and Inter Partes Review: An Analysis of Invalidity Assertion Entities in Patent Law*, 22 MICH. TELECOMM. & TECH. L. REV. 271, 280–81 (2016) (noting that bad patents increase litigation costs which are imposed on consumers and also harm the efficacy of markets).

imposes fewer costs, we question whether patent laws are the root of why innovative firms are leaving the United States, or whether U.S. patent law is a negative factor considered by transient firms searching for a place to invent. Indeed, because the decision of where to go is different than the decision of whether to leave, it is critical to understand the impetus of why firms offshore their R&D.

A firm that chooses to innovate abroad accepts a substantial transaction cost, especially when the company must uproot its current operations. Accordingly, firms are likely biased towards staying local unless compelling reasons persuade them to relocate internationally. Although the foregoing analysis provides insights into which factors are salient in choosing an R&D home, it does not necessarily follow that all of these same factors drive the decision of whether to leave. In other words, firms searching for a place to innovate may be drawn to countries offering less expensive patent enforcement regimes even though few, if any, companies actually decide to leave because of their current patent regime's costs and risks.

Finding an answer to this question is imperative. It would provide insights into the strategic behavior of firms concerning the reasons why they offshore the most valuable qualities of the innovative process. This inquiry would also uncover strategies to increase the ability of U.S. patent law to incentivize and retain innovation.

CONCLUSION

The foregoing research provides some of the first evidence that the U.S. patent system is losing innovation to foreign jurisdictions due to the costly nature of patent enforcement and litigation in the United States. This trend suggests that, despite the territorial nature of patent law, inventors are strategic actors who offshore aspects of the innovation process to lessen the costs of developing technology. It also indicates that the literature has overly emphasized the role of patent protection as the primary catalyst of innovation, ignoring the critical role of patent enforcement. After all, firms have little ability to strengthen their patent protection but are instead tethered to the patent laws of whatever countries they seek protection despite where a good was researched or manufactured. However, firms can mitigate substantial costs by physically developing devices and methods in countries that offer more efficient and less expensive patent litigation schemes. This is problematic for the United States, which subjects inventors in the actual R&D process to the highest costs of litigation and damages awards in the world. Predictably, the result of this landscape is an exodus of innovation from the United States.

Our proposals offer practical solutions to this problem. We argue that U.S. patent law could unburden the actual R&D process by expanding the experimental use exception as well as better staging patent litigation. As for the first solution, creating an improved safe harbor for good faith inventors endeavoring to promote patent law's utilitarian goals without undermining the system's incentive to innovate would encourage firms to conduct research in the United States. Concerning procedural changes, we propose emphasizing IPR and Track B modifications to increase information sharing, encourage settlement of cases, and expeditiously resolve critical questions, all of which lower the costs of discovery and trial without undermining the quality of patent litigation.