

**The 2018 FTC Hearings on IP & Innovation:
Key Testimony, Economic Learnings, and Recommendations for Further Study §**
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Introduction

The U.S. Federal Trade Commission (FTC) has a lengthy history of studying and offering recommendations on intellectual property (IP) law and policy issues. These efforts have included hearings to examine a variety of IP topics and reports with recommendations to courts and Congress. For example, in 2003, the Commission issued a report entitled, *To Promote Innovation: The Proper Balance of Competition and Patent Law and Policy*, in which it examined how best to balance competition and patents to achieve consumer welfare and provided a number of recommendations on issues such as how to improve patent quality.² In 2011, the FTC issued a report entitled, *The Evolving IP Marketplace: Aligning Patent Notice and Remedies with Competition*, in which it made numerous recommendations, including on the appropriate standards for granting injunctive relief and methods to calculate patent damages.³

Most recently, on October 23-24, 2018, the FTC held hearings on IP and innovation as part of its broader hearings on Competition and Consumer Protection in the 21st Century.⁴ The hearings were designed to examine the role and importance of IP protection in promoting innovation, and whether there is a role for the FTC and other governmental bodies in advancing or supporting innovation and, if so, what role. To this end, the hearings included panels on how modern empirical and theoretical work view the relationship between IP rights and innovation; the role of IP in business and investment decisions; emerging trends in patent quality and litigation; and industry and economic perspectives on current U.S. IP and innovation policy, including evaluations of the FTC's existing policy work in this area.⁵

This article provides a summary of some of the key testimony from these hearings, followed by insights from the economics literature and recommendations for future study.

I. The Role and Importance of IP Rights in Promoting Innovation

Several panelists discussed the common thinking that IP rights incentivize innovation by conferring upon an IP holder the right to exclude others from practicing its invention. With respect to patents in particular, U.S. Patent and Trademark Office (PTO) Commissioner for Patents Drew Hirshfeld testified that, "I think we all recognize that the patent system creates incentives for inventors" by providing the right to exclude for a limited period of time during which "inventors can reap those incentives" (presumably referring to the ability not only to recoup costs, but also the opportunity to earn profits).⁶ Panelists also noted other possible social benefits of patents, including public disclosure; facilitating commercialization and the sale and licensing of IP; and serving as signals of value of holding companies, which may facilitate investment. Hirshfeld testified that disclosure, "which you get in return for your patent right, . . . helps others see your invention and, of course, that also fosters competition."⁷

In economic terms, IP rights can mitigate the classic “public goods” problem whereby easily appropriated information will be under-produced in a free market. As Dr. Jorge Padilla, Judge Douglas Ginsburg, and Koren Wong-Ervin explained in a recent article, “[t]he problem is that the social value of innovation typically exceeds the private value of innovation. This is mainly due to the so-called ‘appropriability problem,’” which “opens a wedge between the private and social returns to innovation and leads to underinvestment.”⁸ IP rights “exist to stimulate innovation by increasing the return on costly investments in research and development (R&D).”⁹ Without the right to exclude, “people would tend to wait for others to incur the costs and risks of innovation and then free ride on the resulting creations.”¹⁰

Panelists discussed the various ways in which societies have sought to address the appropriability problem, including IP protection, prizes, subsidies, and government procurement. Professor Thomas Cotter testified that there is a role for all of these approaches, yet none should supplant patent rights. My own view is that, given the critical role that innovation has in promoting economic growth,¹¹ it seems ill-advised to cut off any of the numerous paths or incentives to innovation. That said, several panelists noted that patents also come with potential costs—such as transaction costs for follow-on innovation and the static deadweight loss associated with monopoly power—and cautioned that patent systems should be designed to minimize these costs.

Panelists such as Professor Michael Frakes testified that whether the patent system has in fact incentivized innovation is difficult to measure. Frakes explained that, any attempt to test empirically whether this goal has materialized encounters “notable obstacles,” perhaps the most challenging of which is the construction of the necessary counterfactual.¹² While acknowledging these difficulties, panelists such as Dr. Anne Layne-Farrar testified that the empirical literature taken as whole suggests that the relationship between IP and innovation is likely an inverted-U shape—i.e., either too little or too much IP protection lowers innovation.

On this topic, several panelists pointed to the work of Dr. Petra Moser, who studied historical variation in patent laws across Northern Europe in the 19th century—a time when several countries had not yet adopted patent laws or had abolished them for political reasons.¹³ As Frakes explained in his testimony, because this “heterogeneity is what economists would call plausibly exogenous as it was perhaps driven by various political traditions rather than by characteristics of the innovation environment,” it allowed Moser to compare innovative activity across regimes.¹⁴

Moser relied on data she collected from records of innovation exhibits at two of the major world fairs at the time, finding “no evidence that patent laws increased levels of innovative activity,” while finding evidence that high-quality innovations were slightly more likely to be patented.¹⁵ She also found:

strong evidence that patent systems influenced the distribution of innovative activity across industries. Inventors in countries without patent laws concentrated in industries where secrecy was effective relative to patents, e.g., food processing and scientific instruments. These results suggest that introducing strong and effective patent laws in countries

without patents may have stronger effects on changing the direction of innovative activity than on raising the number of innovations.¹⁶

In other words, as Frakes noted, patents do seem to play a role in shaping the direction of technological growth.

Frakes cautioned that, while Moser's works are important contributions, she examines data from a "very long time ago." As Moser herself points out, "[h]istorical accounts suggest that variation in the effectiveness of secrecy, as an alternative to patents, was instrumental in determining variation in the use of patents," and that "[s]cientific breakthroughs, which lowered the effectiveness of secrecy, may be one important factor that determines inventor's propensity to patent."¹⁷ Moser listed the creation of the periodic table as an example of a scientific breakthrough that reduced the effectiveness of secrecy (which comes with costs of its own, most notably lack of disclosure), leading inventors in chemistry to rely more on patents.

Frakes also noted that Moser's work focuses on innovation in broad terms as opposed to cumulative innovation, the latter of which likely characterizes much of today's innovation. While there is a significant theoretical literature on the effects of patents on cumulative innovation, more empirical research is needed. Frakes discussed two recent empirical studies. The first is a 2015 study by Drs. Bhaven Sampat and Heidi Williams, in which the authors used administrative data on successful and unsuccessful patent applications submitted to the PTO to investigate whether patents on human genes have affected follow-on scientific research and product development.¹⁸ The authors concluded that their analyses "suggest that gene patents have not had quantitatively important effects [either negative or positive] on follow-on [innovation]."¹⁹ In other words, the authors found no evidence for the prior belief that patents were deterring follow-on work on human genes.

The second study highlighted by Frakes, authored by Drs. Alberto Galasso and Mark Schankerman in 2014, examines the impact on cumulative innovation of patent invalidity findings by the U.S. Court of Appeals for the Federal Circuit—patents that the authors describe as "a selective sample of highly valuable patents."²⁰ The authors made three key empirical findings:

First, invalidation leads to a 50 percent increase in subsequent citations to the focal patent, on average. Second, the impact of patent invalidation is highly heterogeneous, with large variation across patents and technology fields in ways that are consistent with the blocking effect of patents arising from bargaining failure between upstream and downstream innovators. Third, we find that this effect is concentrated in patents owned by large firms that appear to block small innovators.²¹

With respect to the first two findings, the authors found that, for most patents, the marginal treatment effect of invalidation is not statistically different from zero. "The positive impact of invalidation on citations is concentrated on a small subset of patents that have unobservable characteristics that are associated with a lower probability of invalidity (i.e., stronger patents). There is also large variation across broad technology fields [with effects] concentrated in areas

that are characterized by . . . complex technology and high fragmentation of patent ownership.”²² Specifically, patent invalidation had a significant impact on cumulative innovation only in the fields of computers and communications, electronics, and medical instruments (including biotechnology)—and here only for large patent holders. “This finding is consistent with predictions of the theoretical models that emphasize bargaining failure in licensing as the source of blockage.”²³ For example, Jerry Green and Suzanne Scotchmer showed that upstream patent rights will not impede value-enhancing, follow-on innovation as long as bargaining between the parties is efficient.²⁴

With respect to Galasso and Schankerman’s third finding, the authors found no statistically significant effect of patent rights on later citations when the invalidated patents were owned by small or medium sized firms. Overall, the authors concluded that, “our findings indicate that patent rights block cumulative innovation only in very specific environments and this suggests that government policies should be targeted at facilitating more efficient licensing in those environments.”²⁵ They went on to explain that, “[t]he fact that we see no statistically significant blocking effect for most size categories suggests that bargaining failure among upstream and downstream innovators is not widespread.”²⁶ Lastly, they emphasized “that our findings do not imply that removal of patent rights in these areas would necessarily be beneficial,” explaining that “invalidation of one patent in a regime with patent rights is very different from a regime without patent rights.”²⁷ For one thing, without patent rights, we would expect “rents in the form of product market monopoly profits and licensing royalties from follow-on innovators” to largely disappear without patent rights, which would reduce incentives to conduct R&D.²⁸

In light of the above findings, when examining how patents on existing technologies affect follow-on innovation, one key policy question is whether any blocking effects are larger than the original incentive effect, to understand the net effect of patent rights on innovation. Another question is whether blocking patents incentivize creative work-arounds, which could create entire new branches in the innovation tree upon which other incremental innovations may grow.

With respect to the hearing testimony characterizing the relationship between IP and innovation as likely an inverted-U shape, the key under this paradigm is knowing where on the inverted U a given country currently is. However, given that there is very little empirical study on the effects of reducing IP protection in developed countries, it is extremely difficult to predict the effect of such reforms, yet this is a crucial question for proponents of rolling back IP rights.

It is important to keep in mind that IP protections are both substitutes and complements. As certain protections fail (e.g., copyright and patents for software), inventors move to other forms of protection (e.g., trade secrets). These different protection methods are also complements, both over time (e.g., secrecy to patents) and at any given time (e.g., patents plus trademarks for brand goods). As such, the choice is not to select “the best” form of protection, but rather to get the mix right. This makes intuitive sense given that innovation is hugely complex, and thus, there is no reason to think that any one form of protection is always superior, or that any one form can be done away with.

With respect to areas for future study, it would be helpful to consider ways to test the impact on innovation of reduced IP protection, perhaps with time-series analysis. Overall, future research should consider the difficulties with measuring innovation (e.g., patent counts and citations can be noisy measures of innovation). In addition, weaknesses of cross-sectional regressions include omitted variable bias and poor identification because selection of treatment is endogenous. In other words, cross-sectional comparisons of patent strength and innovation could show up in data because high innovation countries adopt patent systems, and not the other way around. One possible solution is to search for natural experiments such as a one-time change that varies in magnitude across patents (e.g., changes in patent strength, duration, and scope). As several hearing panelists noted, recent legislative changes and court rulings provide ample opportunities for empirical study, which should help to inform any policy choices.

II. The Role of IP in Business and Investment Decisions

Panelists discussed recent changes and trends in patent law, including: U.S. Supreme Court decisions restricting patent eligible subject matter (2012 *Mayo* and 2014 *Alice* decisions)²⁹ and weakening patentees' ability to obtain injunctive relief (2006 *eBay* decision)³⁰; the high invalidity rate of patents following the 2011 American Invents Act (AIA) and its creation of post-grant challenges through the Patent Trial and Appeal Board (PTAB) (which has discretion to institute serial challenges against the same patents); and the general trend towards lower patent damages awards.

Several panelists raised concerns about recent developments. For example, Intertrust Technologies Chief Executive Officer Talal Shamon testified that "a lot of the points that have happened over the last years are actually somehow impeding innovation in the United States and directly harming consumers."³¹ Venture advisor Greg Raleigh of New Enterprise Associates testified that, while investment has increased in recent years, the nature of investment has changed in response to recent developments. According to Raleigh, today's inventors typically need to invest between \$100-300 million and spend seven to ten years in order to develop an invention to profitability—levels that require an outcome of \$0.5-1.0 billion to "make sense." Raleigh pointed to difficulties in obtaining injunctive relief and low damages awards as "no longer justify[ing] investment risks" in patent-intensive industries. Raleigh testified that, following the Supreme Court's 2006 decision in *eBay*, "injunctions are granted to patent owners in only about 15% of cases where patents are valid and infringed—with many of these injunctions being temporary. Given an 85% chance of failure, the investment assumption is injunction is not possible."³² Other empirical work has found that permanent injunctions have been denied in approximately one-third of patent cases post-*eBay*,³³ and that the overall rate of preliminary and permanent injunctions, as a percentage of the total number of patent cases filed, has decreased eight-six and sixty-six percent, respectively post-*eBay*, primarily due to fewer plaintiffs seeking injunctive relief.³⁴

Raleigh presented investment trends, explaining that investment has moved from sectors such as wireless cellular technologies like 4-5G to industries that do not require patents. Specifically, venture capital (VC) funding for Internet/wireless networking, Internet software, operating system software, semiconductors, pharmaceuticals, drug discovery, and surgical/medical devices—all sectors that rely on patents—has declined from 20.95% in 2004 to

3.22% in 2017 as a percentage of total VC funding. At the same time, VC funding for social network platforms, software applications, consumer apparel and accessories, food products, restaurants/hotels/leisure, consumer finance, and financial services in general has increased as a percentage of total VC funding from 11.4% in 2004 to 36.3% in 2017.³⁵

According to Raleigh, “we are at the end of a 15-year cycle that started with a group of lawyers at a big tech company that have invented the term ‘patent troll’” in order to increase profit margins by paying lower patent royalties; and the result is that “we are now in a regime where we have influenced where we are making investments. Big inventions that require patent protections are far harder to justify an investment in today.”³⁶ This is harmful for society because, among other things, it is the fundamental inventions that allow new entrants to displace large incumbents.³⁷ With respect to “what the FTC can do to restore incentives,” Raleigh recommended that “FTC policy and programs can address [patent-assertion entity (PAE)] behavior without destroying patent rights,” by penalizing “‘real troll’ behavior while supporting injunction and the possibility of fair damage awards for important inventions,” which “would help restore incentives for US invention.”³⁸

On the topic of PAEs, Dr. Layne-Farrar presented a recent co-authored study in which the authors found that empirical evidence does not support the contention that hybrid non-practicing entities (NPEs)—i.e., NPEs that obtain patent enforcement rights from practicing entities, assert those patents in litigation or licensing, and then share the earnings with the original patent holder—present a “tax on innovation” by enforcing frivolous or poor quality patents.³⁹ Instead, the authors found that various quality measures (forward citations, number of claims, originality, and generality) were all higher than average for hybrid NPE-held patents. Overall, the authors conclude that hybrid NPEs “increase the possibility of successfully monetizing the patents they acquire by choosing objectively valuable patents with a broad scope of protection.”⁴⁰

Other panelists, such as Expa General Counsel Michal Rosenn, testified that, while the “AIA is not perfect” recent developments such as the *inter partes review* (IPR) process (under which any person at any time can challenge the validity of a patent on the basis that its claims are obvious or unoriginal based on prior art) and Supreme Court decisions “are a step in the right direction and [the] FTC should continue to build upon those recent developments.”⁴¹

With respect to business decisions, Professor Arti Rai testified that data indicates that, since the 1990s, with the exception of the biotech and pharmaceutical industries, the private sector has shifted from spending on research to spending on development. According to Rai, this trend could be seen as either worrisome or as merely representing more efficient research efforts, yet she concludes that the change is “worrisome.”⁴² While Rai stated that she was “reluctant” to draw conclusions about the cause of this trend, she did note that, since the 1990s, “patent law has shifted significantly from being extremely generous towards patents towards perhaps being less generous [to patents].”⁴³ Yet, given that patents can be a “double-edged sword” for innovation, her ultimate view is that this recent shift is “not likely a major factor or cause of this trend” on spending. Rai also testified that she shares the concerns raised by many about the Supreme Court’s decisions on patent subject matter eligibility, particularly with respect to medical diagnostics. On the question of “how to fix this,” Rai noted the “challenge” of drafting “good statutory language” suggesting that “perhaps judicial evolution is the way to go.”⁴⁴

As to the U.S.'s ranking internationally, Patrick Kilbride from the U.S. Chamber of Commerce presented findings from the Chamber's Annual Global IP Index for 2018. The report lists the United States as placing first overall (in large part due to improved scores in copyrights and trademarks), yet placing twelfth out of fifty for patent protections and rights.⁴⁵

III. Emerging Trends in Patent Quality and Litigation

Professor Alan Marco (former PTO Chief Economist) set the stage by proposing the following potential definition for a high quality patent: (1) the patent adheres to the legal standards of patentability in terms of validity (i.e., novel, useful, and nonobvious); (2) the patent adheres to the legal standards in terms of appropriate scope (i.e., its claimed scope matches the inventive contribution or point of novelty); and (3) the patent clearly articulates 1 and 2 (i.e., the patent clearly discloses both what the invention is and its scope).⁴⁶ Marco then examined possible "policy levers" to increase patent quality, including: institutional resources (namely, the time spent examining patent applications and other resources put into examination); examiner and applicant incentives (e.g., examiners may have certain quantity incentives that play a role in quality, while the process may incentivize broad claims by applicants); pre- and post-grant error-correction (e.g., allowing applicants to make post-grant amendments); technology (e.g., new search systems, the possibility of using machine learning, and changes to the way data is collected to ensure text-searchability); statutory and/or institutional reforms; and court decisions. He presented data showing that applicants responded to higher fees for requests for continued examination by narrowing claims *ex ante* in patent applications; examiners performed higher quality examinations when being considered for promotion to primary examiner; and continuations tended to be broader than new applications, and were more frequently the subject of litigation.

In a recent paper, Marco and Richard Miller noted that those expressing concerns about patent quality have tended to point to the increase in patent litigation as a possible symptom of low patent examination quality.⁴⁷ Marco and Miller analyzed the relationship between certain patent-related characteristics and the likelihood that a patent will be the subject of a patent infringement lawsuit. The authors conclude that:

The most compelling result from the litigation matched case-control study is that most of the highest-impact variables are those over which the USPTO has little control, and which are not directly related to the examination process itself. Three of the four most important variables concern entity size, foreign origin, and government interest.⁴⁸

The authors also found that patents with more independent claims and shorter independent claims (proxies for broader patents) are more likely to be involved in subsequent litigation. In other words, patents with greater scope are more likely to be litigated. Other important patent examination-related characteristics included the signatory authority of the allowing examiner, whether the applicant received a decision on an appeal during examination, the number of information disclosure statement filings, the number of examiner interviews, and whether the patent was allowed without receiving a previous rejection. Overall, the authors conclude that

more research is needed, including “to determine whether the narrowness and clarity of scope is a function of the examination quality or whether it is inherent to the specific invention for which patent protection is sought.”⁴⁹

With respect to the new post-grant challenge procedures, Professor Greg Reilly described the PTAB (a term he used broadly to refer to the various related procedures created by the AIA) as likely “the most significant trend in patent quality in recent years,”⁵⁰ and one that “is largely recognized as having had a significant impact in terms of invalidating patents.”⁵¹ PTAB Acting Chief Judge Scott Boalick testified that the PTO is “seeking balance in the system to achieve strong, reliable, predictable patent rights,” explaining that “[i]t was always contemplated that there would be iterations in order to achieve this balance.”⁵² He went on to say that the PTO has “undertaken many such iterations,” and is looking “forward to the input of the public” as well as to “future iterations to achieve that balance.”⁵³

Panelists also discussed recent litigation trends, including the *Mayo* and *Alice* decisions discussed above, in which the Supreme Court expanded the judicial exceptions to patent subject matter eligibility. Several panelists, including American Intellectual Property Law Association Vice President Barbara Fiacco, expressed concern that these precedents, along with abuses of the PTAB process, have resulted in uncertainty as to the patentability and value of certain types of inventions.⁵⁴ This is a trend that some academics and industry participants contend has resulted in less investment in these types of technologies.⁵⁵ Fiacco recommended legislation that would create an objective test for patent eligibility and remove the criteria of inventiveness from the U.S. Patent Law Section 101 inquiry. Others, such as Computer & Communications Industry Association Vice President for Law & Policy Matt Schruers testified that the AIA and *Alice* have improved the innovation landscape while providing significant patent litigation cost reductions. According to Schruers, objections to recent developments are unfounded as patent protections remain robust.⁵⁶

In a recent paper, Dr. Layne-Farrar concluded that, based on the available data, while IPR proceedings at the PTAB typically cost less and are faster than the typical district court patent infringement case, the PTAB proceedings have largely failed to achieve the Congressional intent of substituting them for district court litigation.⁵⁷ According to 2017 statistics, eight-five percent of patents challenged in an IPR also are litigated in federal courts.⁵⁸ In addition, according to a special report by the PTO, approximately fifteen percent of patents with an IPR face two or more petitions, sixteen percent of multiple petitions are filed after the PTAB decides to institute the first IPR, and approximately five percent of multiple petitions face multiple rounds of PTAB instituting the case.⁵⁹ Similarly, a 2017 study found that, out of 5,173 petitions filed with the PTAB, 2,555, or forty-nine percent, reflect “serial petitions,” meaning a second (or higher) petition filed by the same petitioner.⁶⁰ On a per-patent basis, out of 3,460 patents with an IPR challenge filed, 842 (twenty-four percent) were “serially petitioned patents.”⁶¹ Among the patents with three or more IPR challenges, the serial petitions involved an overlap in claims, an overlap in the prior art asserted, or both.⁶²

Professor Colleen Chien presented findings from her analysis of recent data, concluding that, since the recent patent law changes have come into effect, there have been fewer patent assertions by NPEs; an increase in the amount of detail provided in patent infringement

complaints (particularly with respect to claim charts); a narrowing of software patent claims submitted to the PTO; and an increase in the number of “unique words” included in patent specifications.⁶³

Professor David Schwartz discussed the limits of the available data pointing out that most patent lawsuits settle and most settlements are confidential. Schwartz testified that he has heard anecdotal evidence that, following the recent changes in patent law, accused infringers are less willing to offer meaningful settlement offers based on their belief that, not only is the law now less favorable to patent holders, but significant delays also work in favor of alleged infringers. According to Schwartz, while the underlying negotiation positions between patent holders and alleged infringers may have changed following the recent reforms, litigation data (e.g., on win rates) “don’t tell the full story.”⁶⁴

Conclusion

The recent FTC hearings provided helpful insights on the relationship between IP and innovation, as well as on some of the possible effects of recent changes in U.S. patent law.

With respect to the role of patents in incentivizing innovation, my takeaway is that the proper question is not whether innovation incentives would be zero if there were no patents, but rather, what policy choices bring us closest to the optimal level of innovation. In other words, the inquiry should not be an all or nothing proposition, and we should rely on combinations of policy tools. It is also worth noting that alternatives to IP protection do not facilitate economic exchange.⁶⁵ IP rights facilitate the sale and licensing of IP by defining the scope of property right protection, lowering transaction costs, and producing incentives to develop alternative technologies, improvements, and other derivative uses. Given the vast (still little understood) complexity of innovation incentives and processes, including the lack of understanding on causality, we need multiple spurs to invent. We also need to recognize the importance not just of inventing, but of commercializing inventions.

With respect to the possible effects of recent patent law changes, the FTC should be commended for taking a step back to ask whether it should play a role in this debate and, if so, what role, and whether its existing enforcement and policy decisions have struck the right balance. As part of this inquiry, the Commission should reexamine its prior policy positions—including its recommendations on patent quality, the availability of injunctive relief, and methodologies for calculating patent damages—in light of the testimony and economic evidence discussed above and the areas proposed for further study.

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² FED. TRADE COMM’N, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND POLICY (Oct. 2003), www.ftc.gov/sites/default/files/documents/reports/promote-innovation-proper-balance-competition-and-patent-law-and-policy/innovationrpt.pdf.

³ FED. TRADE COMM’N, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION (Mar. 2011), www.ftc.gov/sites/default/files/documents/reports/evolving-ip-marketplace-aligning-patent-notice-and-remedies-competition-report-federal-trade/110307patentreport.pdf.

⁴ *FTC Hearing #4: Competition and Consumer Protection in the 21st Century*, FED. TRADE COMM’N, www.ftc.gov/news-events/events-calendar/2018/10/ftc-hearing-4-competition-consumer-protection-21st-century. !

⁵ The hearings and consultation also cover copyright law, which is outside the scope of this article. !

⁶ 10/24/18 FTC Hearing Transcript at 5, Fed. Trade Comm’n, Competition and Consumer Protection in the 21st Century (Oct. 24, 2018),

www.ftc.gov/system/files/documents/public_events/1415062/ftc_hearings_session_4_transcript_day_2_10-24-18.pdf [hereinafter 10/24/18 Transcript]. !

⁷ *Id.* at 6. !

⁸ See, e.g., Jorge Padilla, Douglas H. Ginsburg, & Koren W. Wong-Ervin, *Antitrust Analysis Involving Intellectual Property and Standards: Implications from Economics*, GEO. MASON L. REV. (forthcoming 2018) (manuscript at 8, ! 6), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3119034. !

⁹ *Id.* at 7. !

¹⁰ *Id.* at 8 (citing Richard J. Gilbert & Carl Shapiro, *An Economic Analysis of Unilateral Refusals to License Intellectual Property*, 93 PROC. NATL. ACAD. SCI 12749-12755 (1996), ! www.pnas.org/content/pnas/93/23/12749.full.pdf).

¹¹ In 1987, Robert Solow won the Nobel Prize in economics for demonstrating that gains in wealth are due primarily ! to innovation—not to marginal improvements in the efficiency of what already exists. See Press Release (Oct. 21, ! 1987), <https://www.nobelprize.org/prizes/economic-sciences/1987/press-release/>.

¹² 10/24/18 Transcript, *supra* note 6 at 234-35. !

¹³ Petra Moser, *Patents and Innovation: Evidence from Economic History*, 27 J. OF ECON. PERSPECTIVES 23 (2013) ! [hereinafter Moser (2013)].

¹⁴ 10/24/18 Transcript, *supra* note 6, at 235. !

¹⁵ Petra Moser, *How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World Fairs*, 95 AM. ! ECON. REV. 1214, 1214 (2005). !

¹⁶ *Id.* *

¹⁷ Moser (2013), *supra* note 13, 29-31. !

¹⁸ Bhaven Sampat & Heidi L. Williams, *How do patents affect follow-on innovation? Evidence from the human genome* (Feb. 12, 2015), <http://economics.mit.edu/files/9778>. The authors linked the exact gene sequences claimed ! in each patent application with data measuring gene-related scientific research (publications) and commercial ! investments (clinical development).

¹⁹ *Id.* at 4.

²⁰ Alberto Galasso & Mark Schankerman, *Patents and Cumulative Innovation: Causal Evidence from the Courts* 4 (Nat’l Bureau of Econ. Res., Working Paper No. 20269, 2014), www.nber.org/papers/w20269.pdf [hereinafter Galasso & Schankerman].

²¹ *Id.* at 37.

²² *Id.* at 4. !

²³ *Id.* *

²⁴ Jerry Green & Suzanne Scotchmer, *On the Division of Profit in Sequential Innovation*, RAND J. OF ECON. 1995;26 (1) :20-33, https://scholar.harvard.edu/files/green/files/on_the_division_of_profit_in_sequential_innovation.pdf. !

²⁵ Galasso & Schankerman, *supra* note 20, at 5. !

²⁶ *Id.* at 29. !

²⁷ *Id.* at 36. !

²⁸ *Id.* at 36-37. !

²⁹ In *Mayo Collaborative Services v. Prometheus Laboratories, Inc.*, the Supreme Court limited patent-eligible subject matter by holding that certain processes involved in a diagnostic medical test were unpatentable laws of nature. 566 U.S. 66 (2012). In *Alice Corp. Pty. Ltd. v. CLS Bank International*, the Court further limited subject matter eligible for a patent by concluding that certain claims regarding computer-implemented inventions were ! unpatentable abstract ideas. 134 S. Ct. 2347 (2014).

³⁰ In *eBay Inc. v. MercExchange, L.L.C.*, the Court overruled the general rule, unique to patent disputes, providing that permanent injunctions would automatically issue once infringement and validity were found, and instead held !

that the traditional four-factor test applied by courts of equity when considering whether to award permanent ! injunctive relief applies to disputes arising under the Patent Act. 547 U.S. 388 (2006).

³¹ Transcript at 147, Fed. Trade Comm'n, Competition and Consumer Protection in the 21st Century (Oct. 23, 2018), www.ftc.gov/system/files/documents/public_events/1415062/ftc_hearings_session_4_transcript_day_1_10-23-18.pdf [hereinafter 10/23/18 Transcript]. !

³² Fed. Trade Comm'n, Hearing #4 on Competition and Consumer Protection in the 21st Century 25 (Oct. 23, 2018), ! www.ftc.gov/system/files/documents/public_events/1415062/cpc-hearings-cc_for_1023.pdf [hereinafter 10/23/18 ! Slides].

³³ See, e.g., Paul R. Michel & Matthew J. Dowd, *Understanding the Errors of eBay*, 2 CRITERION. J. ON ! INNOVATION 21, 27 (2017) (citing Christopher B. Seaman, *Permanent Injunctions in Patent Litigation After * eBay: An Empirical Study*, 101 IOWA L. REV. 1949, 1982-84 (2016) (reporting pre-eBay injunction grant rate of over 80 percent and a post-eBay grant rate of approximately 68 percent)).

³⁴ Kirti Gupta & Jay Kesan, *Studying the Impact of eBay on Injunctive Relief in Patent Cases* (Hoover IP2 Working ! Paper Series No. 17004, Jan. 10, 2017), <https://hooverip2.org/wp-content/uploads/ip2-wp17004-paper.pdf>.

³⁵ 10/23/18 Slides, *supra* note 32, at 26. !

³⁶ 10/23/18 Transcript, *supra* note 31, at 145-46. !

³⁷ See *id.* *

³⁸ 10/23/18 Slides, *supra* note 32, at 28. !

³⁹ Jay P. Kesan et al., *Understanding Patent 'Privateering': A Quantitative Assessment*, J. OF EMPIRICAL LEGAL ! STUDIES (forthcoming 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3259458.

⁴⁰ *Id.* at 35. !

⁴¹ 10/23/18 Transcript, *supra* note 31, at 20. !

⁴² *Id.* at 21. !

⁴³ *Id.* *

⁴⁴ *Id.* 24. !

⁴⁵ U.S. CHAMBER OF COMMERCE, U.S. CHAMBER INTERNATIONAL IP INDEX, SIXTH EDITION 6, (Feb. 2018), ! www.uschamber.com/sites/default/files/023331_gipc_ip_index_2018_opt.pdf. !

⁴⁶ 10/24/18 Transcript, *supra* note 6, 20-22; see also Fed. Trade Comm'n, Hearing #4 on Competition and Consumer ! Protection in the 21st Century 7-11 (Oct. 24, 2018), ! www.ftc.gov/system/files/documents/public_events/1415062/cpc-hearings-cc_for_1024.pdf [hereinafter 10/24/18 ! Slides].

⁴⁷ Alan C. Marco & Richard Miller, *Patent Examination Quality and Litigation: Is There a Link?* (USPTO Econ. ! Working Paper No. 2017-09, 2017), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2995698. !

⁴⁸ *Id.* at 26. !

⁴⁹ *Id.* !

⁵⁰ 10/24/18 Transcript, *supra* note 6, at 30. !

⁵¹ *Id.* at 32. !

⁵² *Id.* at 78. !

⁵³ *Id.* *

⁵⁴ 10/23/18 Transcript, *supra* note 31, at 182. !

⁵⁵ See generally Kevin Madigan & Adam Mossoff, *Turning Gold to Lead: How Patent Eligibility Doctrine Is * Undermining U.S. Leadership in Innovation*, George Mason L.R. (forthcoming), <https://ssrn.com/abstract=2943431> ! (citing Joan Farre-Mensa, Deepak Hegde, and Alexander Ljungqvist, *The Bright Side of Patents*, USPTO Economic ! Working Paper 2015-5 (2016), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2704028 (finding causal ! connection between a startup's ownership of a patent and its ability to obtain venture capital funding, and thus ! finding a causal connection between patents and the ultimate market success of a startup company)).

⁵⁶ 10/24/18 Transcript, *supra* note 6, at 176. !

⁵⁷ Anne S. Layne-Farrar, *The Cost of Doubling Up: An Economic Assessment of Duplication in PTAB Proceedings * and Patent Infringement Litigation*, LANDSLIDE Vol. 10 No. 5 May-June 2018 (citing AM. INTELLECTUAL ! PROP. LAW ASS'N, 2015 REPORT OF THE ECONOMIC SURVEY 37, 43 (2015)).

⁵⁸ David P. Ruschke & William V. Saindon, U.S. Patent & Trademark Office, Chat with the Chief: An Analysis of ! Multiple Petitions in AIA Trials 10 (Oct. 24, 2017), ! https://www.uspto.gov/sites/default/files/documents/Chat_with_the_Chief_Boardside_Chat_Multiple_Petition_Study_20171024.pdf.

⁵⁹ *Id.* at 14-21. !

⁶⁰ Jay P. Kesan et al., Serial Petitioning at the PTAB: Joinder, Denial, Precedent and Finality, Presentation at the 7th Annual Patent Conference (PatCon7) 2 (Apr. 7, 2017).

⁶¹ *Id.* at 3. !

⁶² *Id.* at 7. !

⁶³ 10/24/18 Slides, *supra* note 46. !

⁶⁴ 10/24/18 Transcript, *supra* note 6, at 114. !

⁶⁵ See e.g., Henry E. Smith, *Intellectual Property as Property: Delineating Entitlements in Information*, 117 YALE L.J. 1742 (2007) (discussing the economic rationale behind IP's close relationship with other property).