

Prior Art in Inter Partes Review

Stephen Yelderman*

ABSTRACT: This Essay is an empirical study of the evidence the Patent Trial and Appeal Board relies upon when cancelling patents in inter partes review. To construct our dataset, we collected every final written decision invalidating a patent claim over a twelve-month period. We coded individual invalidation events on a reference-by-reference, claim-by-claim basis. Drawing on this dataset, we report a number of details about the prior art supporting patent cancellation, including the frequency with which U.S. patents, foreign patents, and printed publications were cited, the frequency with which the invalidating prior art would have been amenable to a pre-filing prior art search, and whether the invalidating prior art was known at the time of examination.

I.	INTRODUCTION.....	2706
II.	BACKGROUND	2709
III.	METHODOLOGY	2715
	A. COLLECTION AND CODING.....	2715
	B. SELECTION EFFECTS.....	2717
IV.	RESULTS.....	2719
	A. ANTICIPATION VS. OBVIOUSNESS	2719
	B. CATEGORIES OF PRIOR ART.....	2721
	C. PRINTED PUBLICATIONS	2723
	D. U.S. PATENTS AS PRIOR ART.....	2726
	E. FOREIGN PATENTS.....	2729
V.	IPR'S RELATIONSHIP TO EXAMINATION	2730
VI.	CONCLUSION	2733

* Professor of Law, Notre Dame Law School. I am deeply indebted to my research assistant for this project, John Sabacinski. I would also like to thank the other participants in this Symposium for their many helpful comments and suggestions.

I. INTRODUCTION

In 2011, Congress created a new procedural tool—inter partes review (“IPR”)—for the express purpose of making it cheaper and easier to contest the validity of issued patents in an adversarial proceeding.¹ The first IPR petitions were accepted in 2012,² and the first Final Written Decisions (“FWDs”) issued in late 2013.³

In terms of cost and ease of access, IPR has undoubtedly been a success. Several years after IPR’s launch, practitioners reported that the cost of litigating an IPR to a final written decision was about \$324,000, which pales in comparison to the \$1–2 million reported cost of litigating a patent in court.⁴ The volume of patent invalidations has expanded as well. Whereas district courts previously invalidated about 80 patents a year on prior art grounds,⁵ the Patent Trial and Appeal Board (“PTAB”) now invalidates about 280 patents a year through IPR.⁶ Largely due to this new procedure, the number of patents invalidated based on prior art increased by at least 400% between 2011 and 2017.⁷

But these numbers hint at a counterintuitive counterpoint: that the introduction of IPR may have actually *increased* the total number of dollars spent adjudicating patents annually. While individual invalidity events are cheaper in IPR than in district court, the sheer volume of IPR activity could more than offset these lower unit costs. And though confounding factors

1. See Leahy–Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284, 299 (2011) (“AIA”) (codified at 35 U.S.C. §§ 311–319 (2012)); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144 (2016) (discussing the purposes of the AIA amendments); Joe Matal, *A Guide to the Legislative History of the America Invents Act: Part II of II*, 21 FED. CIR. B.J. 539, 600–04 (2012) (summarizing the legislative history of the AIA).

2. See *Garmin Int’l Inc. v. Cuozzo Speed Techs., LLC*, No. IPR 2012-00001 (P.T.A.B. Sept. 16, 2012) (Petition for Inter Partes Review Under 37 C.F.R. § 42.100), available at <https://ptabdata.uspto.gov/ptab-api/documents/395242/native> (last visited June 8, 2019).

3. See *Garmin Int’l Inc. v. Cuozzo Speed Techs., LLC*, No. IPR 2012-00001 (P.T.A.B. Nov. 13, 2013) (Final Written Decision—35 U.S.C. § 318(a) and 37 § C.F.R. 42.73), available at <https://ptabdata.uspto.gov/ptab-api/documents/340330/native> (last visited June 8, 2019).

4. See AM. INTELLECTUAL PROP. LAW ASS’N, 2017 REPORT OF THE ECONOMIC SURVEY I-162, I-115 (2017) [hereinafter, AIPLA SURVEY]. Note that the reported expense of litigated a patent in district court changes dramatically depending on the amount at issue in a case. The numbers above are reported medians for mid-range cases, with stakes in the \$10 million to \$25 million range.

5. See Stephen Yelder, *Prior Art in the District Court*, 95 NOTRE DAME L. REV. (forthcoming 2019) (manuscript at 5) (currently on file at Notre Dame Law Sch. Legal Studies Research, Paper No. 1858, 2018), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3286022.

6. See *infra* text accompanying note 53 (observing 283 distinct patents invalidated over a 12-month period).

7. In 2016 and the first half of 2017, district courts were on pace to invalidate about 40 distinct patents per year on grounds of prior art. See Yelder, *supra* note 5. Combined with about 280 distinct patents invalidated per year in IPR, about 320 patents are invalidated per year in one forum or the other—compared with about 80 per year in district court in the early 2010s. The increase is at least 400%, because these numbers do not include invalidation in post-grant review.

complicate the story, there is no evidence that the new procedures have reduced the rate of district court litigation. Whether compared in terms of number of patent cases filed or patents invalidated, the work of district courts actually increased from 2011 to 2017.⁸ In sum, the new IPR procedures have dramatically increased the number of patents subjected to adversarial scrutiny. But all this additional process has come at a significant cost—easily exceeding half a billion dollars a year.⁹

Whether this additional process is worth its costs depends on the public benefits afforded by IPR. And there are many ways that increased scrutiny of patents could plausibly benefit the public. For example, in some cases, cancelling a patent in IPR may increase competition in a product market, resulting in lower prices for consumers.¹⁰ As another example, a second-stage review process like IPR could help the U.S. Patent and Trademark Office

8. According to data from Lex Machina, 3,596 patent suits were filed in district courts in 2011; in 2017, the number was 4,043. According to data we collected for a prior project, courts invalidated 109 unique patents in 2011; they were on track to invalidate 254 unique patents in 2017. *See Yelderman, supra* note 5, at 43. To be fair, the 2017 invalidations may be less costly per patent, as the grounds relied upon in district court changed significantly between 2011 to 2017. *See id.* But, on the other hand, it is possible that parties are incurring costs in district court while IPR cases are pending, only to have those cases end once PTAB finds the patent invalid. All of this makes it unclear whether the total cost of district court litigation went up or down since the advent of IPR.

9. This rough estimate is based on Lex Machina data regarding the disposal of IPR petitions filed in calendar year 2016. In that year, 761 of IPR petitions filed were either denied or settled prior to an institution decision. AIPLA data suggests the median cost of attorneys' fees for filing a petition is \$124,000, so these cases costed about \$94 million altogether. *See AIPLA SURVEY, supra* note 4, at I-164. (This number is likely low, since some of the patent owners in these cases would have incurred costs responding to the petition.) An additional 158 petitions were granted but resulted in IPRs that settled prior to a final institution. The attorneys' fees for these petitions would vary based on the timing of the settlement, so we conservatively estimate that each side incurred costs equal to the cost of filing a petition, or \$248,000 per case in this category, for a total of \$39 million. The remaining 515 petitions resulted in final written decisions, which AIPLA data suggests would involve attorneys' fees of about \$648,000 per case, for a total of \$334 million. *See id.* Approximately 146 of the cases in this final category were appealed to the Federal Circuit. *See Jason Rantanen, Administering Patent Law*, 104 IOWA L. REV. 2299, 2311 (2019). AIPLA data suggests a Federal Circuit appeal adds \$254,000 to the total costs of an IPR, for an additional \$37 million. Thus, total attorneys' fees related to IPR would come to at least \$504 million. To this estimate, one must add the PTAB's cost of administering the IPR program—accepting filings, ruling on petitions, holding trials, and issuing final written decisions. These costs are difficult to estimate. For reference, however, in its Fiscal Year 2019 Budget Request, the USPTO justified \$86 million of its total budget request based on the PTAB's operations. *See U.S. PATENT & TRADEMARK OFFICE, FISCAL YEAR 2019 CONGRESSIONAL JUSTIFICATION* 36 (2018), http://www.osec.doc.gov/bmi/budget/FY19CBJ/USPTO_FY19_President%E2%80%99s_Budget-FINAL.pdf (last visited Apr. 15, 2019). Though the PTAB hears other kinds of proceedings as well, IPRs have constituted the vast majority of the PTAB's published work in recent years.

10. *See generally* Stephen Yelderman, *Do Patent Challenges Increase Competition?*, 83 U. CHI. L. REV. 1943 (2016) (analyzing the pro-competitive effects of patent challenges).

(“PTO”) ensure that it is consistently applying patentability rules across a complex bureaucracy.¹¹

This Essay focuses on one potential public benefit in particular—that revoking invalid patents can increase inventors’ incentives to create legitimately patentable inventions in the future. As the theory goes, the power of the patent bargain depends both on the likelihood that inventors will receive patent rights when they deserve them *and* the likelihood that inventors will not receive patent rights when they do not deserve them.¹² By subjecting patents to additional adversarial scrutiny, IPR has the potential to enforce the patent bargain in doubtful cases, thereby strengthening incentives to comply with the substantive demands of patent law in the future.

However, the availability of this particular benefit depends on the reason that a particular patent is revoked. Some patent doctrines are designed to be bargain-enforcing, while others are not.¹³ In the case of the two doctrines at issue in IPR—anticipation and obviousness—whether or not a revocation is bargain-enforcing depends on the prior art at issue.¹⁴ In some cases, it may be—such as when the inventor knew or should have known about the prior art that rendered her patent invalid. But in other cases, revoking patents in IPR may not be bargain-enforcing at all—such as when the inventor loses her patent on the basis of facts she simply could not have known. In short, without knowing something about the prior art underlying those determinations, we cannot say whether IPR is increasing incentives for future inventors to do what patent law demands of them, or is simply revoking patents from inventors whose only fault was a stroke of bad luck.

This Essay provides an early look at the prior art used to invalidate patents in IPR. Drawing on public records, we reviewed every FWD issued in an IPR by the PTAB between March 2017 and February 2018. In these documents, we observed 6,976 claim-level invalidity events affecting 283 distinct patents. We then coded the prior art reference(s) relied upon in each of those invalidation events, observing a total of 822 distinct prior art references.

This data reveals that the incentivizing power of IPR compares poorly with that of district court litigation. A common weakness of both tools is a reliance on prior U.S. patent applications that the inventor could not possibly have known about, because a federal statute made them secret at the time she filed her application. This category of art is even more common in IPR than it is in district court. Moreover, IPRs frequently rely on another category of obscure prior art that is refreshingly rare in district court opinions:

11. See generally Michael D. Frakes & Melissa F. Wasserman, *Patent Trial and Appeal Board’s Consistency-Enhancing Function*, 104 IOWA L. REV. 2417 (2019).

12. Stephen Yelder, *The Value of Accuracy in the Patent System*, 84 U. CHI. L. REV. 1217, 1248 (2017).

13. See *id.* at 1283.

14. See *id.* at 1277.

“publications” that meet the legal definition of prior art, but that would not be discovered in a traditional prior art search. A substantial number of IPR invalidations can be characterized as cases in which a person with ordinary skill in the art would have found it obvious to combine something she likely would not have found with something she was legally prohibited from finding. The bargain-enforcement theory appears to be weakly realized in practice.

To be sure, enforcing the patent bargain to create incentives for future inventors is only one potential benefit offered by IPR. Further study will be necessary to fully understand the costs and benefits of this newly created procedure. Nonetheless, there is value in exploring this particular theory of benefit in detail, for two reasons. First, formal study of IPR is in its infancy, and there is presently no single theory of benefit that has been shown to justify the procedural costs of IPR in all cases.¹⁵ If, as seems likely, the balance of the costs and benefits of IPR depends on the specifics of how IPR operates in practice, then it is important to understand when and how IPR delivers its theorized benefits. Second, even if the overall benefits of IPR as a procedural tool exceed its overall cost, there may be additional gains to be had by directing this tool to the individual cases in which the greatest benefits are available. Unlike litigation, which may generally be invoked as of right by anyone with a qualifying dispute, IPR is a discretionary proceeding before an administrative agency.¹⁶ The PTO therefore has the opportunity to steer public and private resources to those disputes which might yield the greatest public benefits.

Because this project is only a first step towards specifying the public benefits of IPR, its conclusions will necessarily be preliminary. We cannot (and do not) say whether IPR is on net helpful or harmful, or even whether the PTO ought to employ its discretion differently. Instead, our focus is limited to whether the IPRs decided during our study period delivered just one of several potential benefits. While the answer to that question turns out to be discouraging, this should not be misunderstood as a conclusive judgement about IPR.

II. BACKGROUND

Before turning to the methodology of this study, it will be helpful to briefly explain why the error-correction value of IPR turns on the prior art at issue in a case. Moreover, it is important to distinguish this theory of benefit

15. For example, while the pro-competitive benefits of cancelling a patent can be substantial, IPR may not be equipped to reliably deliver these benefits in all cases. *See* Yelderman, *supra* note 10, at 1960, 1997–2004.

16. *See* 35 U.S.C. § 314 (2012); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2140 (2016) (“[T]he agency’s decision to deny a petition is a matter committed to the Patent Office’s discretion.”).

from others that might obtain, but that simply depend on a different set of considerations.¹⁷

Courts and scholars have long heralded the public benefits of patent litigation. For nearly a century, the public's "paramount interest" in ensuring that patents are "free from fraud" and "kept within their legitimate scope" has been stated as a self-evident proposition requiring neither proof nor elaboration.¹⁸ Today, courts, commentators, and litigants often cite the public benefits of patent litigation as if they are an accepted fact.¹⁹

Upon closer examination, there are at least two analytically distinct ways that patent cases may serve the public interest. The first theory is that revoking a patent can reduce or eliminate market power, thereby increasing competition and freeing the public from the burden of a "patent monopoly."²⁰ The second theory is that revoking a patent denies the patent holder the benefit of something she did not deserve, thus sharpening incentives for inventors to comply with the substantive demands of patent law.²¹ The first theory is about reducing the costs of individual patents; the second is about enforcing the patent bargain to improve ex ante incentives.

The first theory is important, but it is not the subject of this paper. As I have shown in earlier work, the possibility that a patent challenge may increase competition is highly case-specific, depending on factors such as who

17. For a similar exploration of the potential benefits that might flow from district court patent litigation, see Yelderman, *supra* note 5, at Section I.A.

18. See *Precision Instrument Mfg. Co. v. Auto. Maint. Mach. Co.*, 324 U.S. 806, 816 (1945); see also *Pope Mfg. Co. v. Gormully*, 144 U.S. 224, 234 (1892) ("It is as important to the public that competition should not be repressed by worthless patents, as that the patentee of a really valuable invention should be protected in his monopoly."); Yelderman, *supra* note 10, at 1951–58 (collecting similar claims).

19. See, e.g., *Oil States Energy Servs., LLC v. Greene's Energy Grp., LLC*, 138 S. Ct. 1365, 1374 (2018) ("[T]he public's paramount interest in seeing that patent monopolies are kept within their legitimate scope." (quoting *Cuozzo Speed Techs.*, 136 S. Ct. at 2144)); *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1363 (2018) (Breyer, J., dissenting) (same); see also FTC, TO PROMOTE INNOVATION: THE PROPER BALANCE OF COMPETITION AND PATENT LAW AND POLICY 11 (Oct. 2003), available at <http://perma.cc/D4DC-WGC7>; Michael J. Burstein, *Rethinking Standing in Patent Challenges*, 83 GEO. WASH. L. REV. 498, 538–39 (2015); Einer Elhauge & Alex Krueger, *Solving the Patent Settlement Puzzle*, 91 TEX. L. REV. 283, 293–95 (2012); Joseph Farrell & Robert P. Merges, *Incentives to Challenge and Defend Patents: Why Litigation Won't Reliably Fix Patent Office Errors and Why Administrative Patent Review Might Help*, 19 BERKELEY TECH. L.J. 943, 946 (2004); Jay P. Kesan & Andres A. Gallo, *Why "Bad" Patents Survive in the Market and How Should We Change?—The Private and Social Costs of Patents*, 55 EMORY L.J. 61, 76–77, 90–92 (2006); Christopher R. Leslie, *The Anticompetitive Effects of Unenforced Invalid Patents*, 91 MINN. L. REV. 101, 127, 179 (2006); Anup Malani & Jonathan S. Masur, *Raising the Stakes in Patent Cases*, 101 GEO. L.J. 637, 657 (2013); Matthew Sag & Kurt Rohde, *Patent Reform and Differential Impact*, 8 MINN. J.L. SCI. & TECH. 1, 9–11 (2007); R. Polk Wagner, *Understanding Patent-Quality Mechanisms*, 157 U. PA. L. REV. 2135, 2140–45 (2009); Robert C. Dorr, Note, *Patent Law—Patent Validity: The Public Is the Third Party*, 51 DENV. L.J. 95, 113 (1974).

20. See Yelderman, *supra* note 10, at 1951–54 (summarizing this theory).

21. See Yelderman, *supra* note 12, at 1221 n.13, 1281–84.

wins, how quickly the case is resolved, whether there are other intellectual property rights at play, and other details about the patent-in-suit and the structure of the relevant market.²² Because the prior art used to invalidate a patent is not usually relevant to the competition question, this theory will be largely set aside for purposes of the following discussion, keeping in mind that it may justify the costs of IPRs in some cases in which the second theory does not.

The other reason we might want to encourage patent challenges is that revoking undeserved patents can sharpen incentives for future inventors—and this theory *is* the subject of this Essay. As my prior work explores in detail, the incentivizing power of any promise depends both on the accurate reward of benefits when they are deserved and on the accurate denial of those benefits when they are undeserved.²³ Revoking an undeserved patent fulfills the negative promise implicit in the rewards scheme, thus increasing the power of the offered rewards in the future.²⁴ In this way, successful patent challenges serve the public interest by denying the benefits of patents to those who did not hold up their end of the patent bargain.

Like the first, this theory is case-specific. Some patent disputes center on conduct that the patent system actively seeks to encourage or discourage—such as a claim that the supposed “inventor” had in fact stolen the invention from someone else.²⁵ But other patent cases aren’t like that. Instead, they are really just fights over technicalities that do not strongly implicate the patent bargain—such as pinning down exactly how difficult it would have been for a hypothetical researcher to find a particular undergraduate thesis on the shelf of a university library.²⁶ When an inventor fails to satisfy the patentability requirements in a case like that, revoking the patent does not sharpen incentives to behave differently in the future: The inventor has done everything patent law demanded of her, yet she is denied patent protection all the same. This second theory of benefit justifies patent litigation only in cases in which the inventor faced a mutually exclusive choice and made a decision contrary to the aims of patent law.²⁷

The power of this incentives-based theory is that it can significantly reduce the range of plausibly optimal error rates in the patent system. With some basic assumptions about the observability of errors, the incentives-based theory can show that patents should be awarded only when there is at least a 50% chance that they are actually deserved.²⁸ This, in turn, provides qualified

22. See Yelderman, *supra* note 10, at 1960–61.

23. See Yelderman, *supra* note 12, at 1221.

24. *Id.* at 1247–48.

25. See *id.* at 1266.

26. See *In re Cronyn*, 890 F.2d 1158, 1160–61 (Fed. Cir. 1989).

27. See Yelderman, *supra* note 12, at 1242–43.

28. See *id.* at 1251–56.

support for longstanding policies designed to increase rates of patent adjudication.²⁹ But there is a limit. When a patent is revoked for reasons beyond the inventor's control, the inventor faced no relevant mutually exclusive choice, and the inventor-incentivizing benefit is unavailable. In those cases, revoking an invalid patent may actually be *disincentivizing*, since it reduces the correlation between conduct and outcome, thereby weakening the power of the patent promise. This does not mean these cases necessarily lack value; they may still be justified on some other grounds. But as far as the inventor-incentivizing theory goes, the benefits of revocation are limited to cases in which inventors lose patent rights as a result of things they could have plausibly controlled.³⁰

Litigation involving some patentability doctrines will reliably satisfy this condition. For example, the enablement requirement is specifically designed to coerce patent applicants to teach the public how to use the invention.³¹ When an applicant fails to sufficiently disclose an invention and her patent is consequentially taken away, the fault is entirely her own. No extrinsic factors or moral luck intercedes between the conduct patent law seeks to influence and the outcome patent law provides. Provided they are observable, these are reliably inventor-incentivizing error corrections.

For the two patentability doctrines that can be invoked in IPR (anticipation and obviousness), however, the path from conduct to outcome is more roundabout. When a patent is revoked on these grounds, the inventor's culpability in having originally sought that patent turns significantly on the nature of the prior art itself.

To see why, consider the anticipation doctrine (sometimes called the "novelty" requirement).³² A patent claim is anticipated only when all of the elements of the claim can be found in a single prior art reference. Critically, a factfinder may not combine multiple references to establish anticipation.³³ For that reason, the anticipation inquiry is quite straightforward. The factfinder simply compares the prior art to the patent claim to see if there is a match.³⁴

29. See *id.* at 1281–83.

30. Cf. Louis Kaplow, *The Value of Accuracy in Adjudication: An Economic Analysis*, 23 J. LEGAL STUD. 307, 313–14, 332 (1994) (observing that greater accuracy in adjudication can be a waste of resources if actors lack the same information at the moment of their decision-making).

31. See Yelderman, *supra* note 12, at 1263–65.

32. See 35 U.S.C. § 102 (2006) (amended 2011). Note that § 102 was reorganized and substantively changed in several ways by the AIA. Unless otherwise noted, references to § 102 refer to the pre-AIA version of the statute, which was the applicable law for 99% of the invalidations in our dataset.

33. See *Atlas Powder Co. v. Ireco Inc.*, 190 F.3d 1342, 1346 (Fed. Cir. 1999).

34. To be sure, and in ways that are not relevant here, this seemingly simple comparison can become more complicated. For example, the court may need to first determine what the challenged claim means, whether the asserted prior art reference has any undisclosed but

The value of commissioning that comparison depends greatly on what, exactly, we are asking the factfinder to compare the claim to. For example, a patent can be anticipated because the inventor published her idea long before patenting, sat on the sideline for years, and then sought patent protection only after the idea caught on. This behavior creates serious hold-up problems for the public and is something patent law very much seeks to discourage.³⁵ Catching such cases, therefore, is a strongly incentivizing form of error correction. In addition, even in cases where the inventor didn't actually know about the prior art at the time, denying patent protection based on reasonably discoverable prior art encourages future inventors to seek out existing solutions before wastefully reinventing the wheel.³⁶ So when the inventor could have discovered the anticipating prior art with a reasonable amount of searching, revoking her patent is a strongly incentivizing form of error correction.

But anticipation can also rely on obscure prior art, things which the inventor didn't know about and couldn't *possibly* have found—such as an unpublished illustration discoverable only by travelling in person to the Canadian patent office.³⁷ Invalidations like these are not an incentivizing form of error correction: The inventor cannot seriously be blamed for failing to travel to every patent office in the world. The inventor is perhaps unlucky, but has done nothing that patent law affirmatively seeks to discourage.³⁸ In cases of anticipation, the difference between valuable enforcement of the patent bargain and an infringer escaping on a technicality is entirely a question of the prior art.

The other way prior art can invalidate a claim is through the obviousness doctrine. Even in cases in which the claimed invention is not anticipated, a patent may be invalid “if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious.”³⁹ As the Supreme Court has explained, “[t]he nonobviousness requirement extends the field of unpatentable material beyond that which is [anticipated], to include that which could readily be deduced from publicly available material by a person of ordinary skill in the pertinent field of endeavor.”⁴⁰ Thus even if the claimed invention cannot be found in any single

“inherent” features, and whether the asserted prior art reference is enabled. *See id.* at 1346–47 (discussing claim construction and inherency); *see also* Rasmussen v. SmithKline Beecham Corp., 413 F.3d 1318, 1325–26 (Fed. Cir. 2005).

35. *See* Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 63–64 (1998).

36. *See* ROBERT PATRICK MERGES & JOHN FITZGERALD DUFFY, PATENT LAW AND POLICY: CASES AND MATERIALS 401–02 (6th ed. 2013); Yelderman, *supra* note 12, at 1267.

37. *See* Bruckelmyer v. Ground Heaters, Inc., 453 F.3d 1352, 1353 (Fed. Cir. 2006) (Newman, J., dissenting from denial of petition to rehear en banc).

38. *See* Yelderman, *supra* note 12, at 1272–76.

39. *See* 35 U.S.C. § 103 (2012 & Supp. 2017).

40. *See* Bonito Boats, Inc. v. Thunder Craft Boats, Inc., 489 U.S. 141, 150 (1989).

prior art reference, the claim may still be invalid because it would have been obvious in light of all the prior art that existed at the time of the invention.⁴¹

As with cases of anticipation, the incentivizing effects of enforcing the obviousness doctrine depend greatly on the prior art behind the legal conclusion. In some cases, obviousness may be a tool for handling near-miss cases of anticipation, causing the value of enforcing both doctrines to closely track each other. For example, filing a patent claim on a trivial derivative of something that has long been in the public domain should be discouraged for the same reason that filing a claim on *exactly* what has long been in the public domain should be discouraged—the inventor should have known that the invention was already available to the public, and not wasted everyone’s time by seeking patent protection for it.⁴² Likewise, seeking subsequent protection for simplistic variants of one’s own prior inventions (also known as “patent evergreening”) is a wasteful, unproductive activity that patent law seeks to discourage.⁴³

But obviousness also extends to combinations of things that fall well beyond widespread knowledge or the inventor’s own prior work. All of the obscure or secret references that qualify as prior art for purposes of anticipation qualify as prior art for purposes of obviousness too.⁴⁴ And the risk of low-value error correction is even greater when an obscure reference is the basis for obviousness. For example, if there is little incentivizing benefit in revoking a patent because of an unpublished piece of paper sitting in Canada,⁴⁵ the benefit is even smaller when it comes to revoking a patent because that Canadian document could have been combined with some *other* information found in a different (and perhaps equally obscure) location. As others have critically observed, the obviousness doctrine’s “person of ordinary skill” comes programmed with a superhuman amount of knowledge, which can result in an unrealistic standard of invention when obscure prior art is at issue.⁴⁶ Thus, as with anticipation, the incentivizing power of revoking obvious patents depends on the prior art supporting that conclusion.

To be clear, the fact that expansive prior art rules sometimes cause inventors to lose patents for reasons beyond their control does not mean the

41. See *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18 (1966). Under the AIA, the question is whether it would have been obvious at the time of filing, not invention. See 35 U.S.C. § 103 (2012).

42. See Timothy R. Holbrook, *Patent Anticipation and Obviousness as Possession*, 65 EMORY L.J. 987, 1027–29 (2016).

43. See Dmitry Karshedt, *The More Things Change: Improvement Patents, Drug Modifications, and the FDA*, 104 IOWA L. REV. 1129, 1154–55 (2019).

44. See *Hazeltine Research, Inc. v. Brenner*, 382 U.S. 252, 255–56 (1965).

45. See *Bruckelmyer v. Ground Heaters, Inc.*, 453 F.3d 1352, 1353 (Fed. Cir. 2006).

46. See Daralyn J. Durie & Mark A. Lemley, *A Realistic Approach to the Obviousness of Inventions*, 50 WM. & MARY L. REV. 989, 1016–17 (2008); Michael Ebert, *Superperson and the Prior Art*, 67 J. PAT. & TRADEMARK OFF. SOC’Y 657, 657–68 (1985).

rules themselves are substantively flawed. As noted above, for purposes of this discussion, we are exploring only one particular theory of how IPRs might benefit the public—by sharpening inventor incentives to uphold the patent bargain in the future. So even outcomes which are plainly *not* incentivizing may nonetheless be justified on other grounds, such as preserving the public domain or reducing the costs of patent protection.⁴⁷

That said, the other potential benefits of IPR are *also* case-specific, so one cannot assume that some other theory will always be there to justify IPR when this one fails. Each theory will need to be explored individually to determine whether IPR's benefits exceed its costs.

III. METHODOLOGY

To shed light on these questions, we examined a year's worth of FWDs in which patent claims were invalidated in IPR. Section III.A describes our methodology for collecting and coding these documents. Section III.B then addresses several potential questions about reproducibility and selection effects.

A. COLLECTION AND CODING

Collecting and analyzing invalidity in IPR involved three basic steps. First, we collected the FWDs in which invalidity occurred. Second, we reviewed these documents to determine the legal basis and prior art supporting the PTAB decision. Third, we gathered contextualizing information about the IPR, patent, and cited prior art from a number of secondary sources.

To obtain all relevant FWDs, we ran a search on Lex Machina for IPR proceedings with a decision rendered between March 1, 2017, and February 28, 2018.⁴⁸ We then filtered these results to exclude FWDs in which no claims were found invalid. This yielded a list of 342 PTAB Trial Numbers

47. Indeed, some patentability doctrines may be justified out of concerns for ex post costs alone. For example, the Supreme Court has rooted the patentable subject matter requirement exclusively in concerns about costs; revocations on these grounds are *not* intended to discourage future inventors from exploring abstract ideas or natural phenomenon. Yelderman, *supra* note 12, at 1270–72.

48. We chose these dates to ensure a recent, 12-month study period. We closed the study period at the end of February 2018, to avoid capturing any short-term effects in the wake of *SAS Institute, Inc. v. Iancu*. See generally *SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348 (2018) (holding, in April 2018, that PTAB must decide the patentability of all claims challenged in a petition if IPR is instituted).

corresponding to IPRs in which one or more claims were found invalid.⁴⁹ We then downloaded the FWDs themselves directly from PTAB's data portal.⁵⁰

For each qualifying FWD, we coded the legal determinations of anticipation and/or obviousness at a claim level, identifying the reference(s) supporting the invalidity decision.⁵¹ Redundant rationales for claim invalidity were coded as distinct invalidity events. For example, if the PTAB found the same claim both anticipated and obvious, we recorded one observation for the anticipation conclusion and another observation for the obviousness conclusion. Likewise, if the PTAB found the same claim anticipated by two distinct references, we recorded one observation for anticipation based on the first reference and another observation for anticipation based on the second reference. We recorded only conclusions that a claim was invalid; there are no failed validity challenges in our dataset. Our coding was based exclusively on the decisions of the initial PTAB merits panels; we did not observe the outcomes of appeals or rehearings.⁵²

In total, we observed 6,976 claim-level invalidity events, affecting 4,248 distinct claims and 283 distinct patents. These cancellations relied on 822 distinct prior art references. As required by the IPR statute, all of these invalidations were based on either novelty or obviousness, and cited either patents or printed publications.⁵³

Every step of this coding process was a straightforward matter of data entry. Unlike some district court patent opinions, the PTAB decisions we read were models of clarity. Helpfully, many FWDs concisely summarized the legal

49. Our original Lex Machina search returned an additional 15 PTAB Trial Numbers, which did not in fact correspond to a unique IPR in which a claim had been invalidated. These were IPRs that had either been joined to another IPR proceeding, or which did not actually invalidate any claims (i.e., they appear to have been erroneously coded by Lex Machina). We therefore exclude them from the following discussion.

50. The PTO should be commended for making PTAB dockets and unsealed documents freely available through a straightforward API. See *Patent Trial and Appeal Board (PTAB) Bulk Data*, USPTO, <https://ptabdataui.uspto.gov> (last visited June 8, 2019).

51. Because IPR challenges are limited to anticipation or obviousness, we only observed invalidity on these grounds. PTAB does sometimes apply other legal doctrines when considering whether a proposed amended claim would be patentable. We coded only PTAB's conclusions about previously issued claims, not proposed amendments.

52. As a result, it is likely that at least a few of the invalidations in our dataset were later reversed. Conversely, there are likely some cases in which PTAB did not find a particular claim invalid, but the Federal Circuit did so on appeal. These invalidation events would be absent from our dataset. We chose to focus on the work of PTAB because: (a) doing so permits us to study more recent invalidation events (appeals and rehearings can drag on for years) and (b) a PTAB determination of invalidity is often a legally and economically significant event in its own right, even if it is later reversed or modified on appeal. We cannot predict how our results would change if we tracked outcomes over the complete IPR lifecycle. But given the high rate of affirmance of PTAB decisions, we expect that any effect would be small. See Jason Rantanen, *Administering Patent Law*, 104 IOWA L. REV. 2299, 2306 (2019).

53. See 35 U.S.C. § 311(b) (2012).

basis and prior art relied on to invalidate each claim in a tidy table at the end of the document. Moreover, the FWDs we reviewed consistently included bibliographic information for all cited references near the beginning of the document.

The final step of our coding process was to gather contextualizing information about the invalidated patents and prior art references from a number of secondary sources. For example, we consulted PTO databases to collect a number of data points relating to filing date, prosecution history, and priority claims.⁵⁴ In a few instances, we also searched the online catalog of Notre Dame's primary research library for additional information about printed publications cited in IPR.

Though time-intensive, this methodology is highly reproducible. Our choice to code invalidity events at the level of individual claims is an essential feature in this regard. Because a single FWD may reach different conclusions for different claims, or invalidate the same claim for multiple reasons, coding at a higher level of granularity would have required subjective judgments about which aspects of the FWD were the most significant.⁵⁵ We avoided these judgments by simply coding everything.

B. SELECTION EFFECTS

Finally, a quick word about selection effects. Our population of interest is invalidation events in IPR, which we have observed directly from the underlying PTAB documents. This dataset allows us to report a number of things about how and why patents are invalidated in IPR proceedings. It does not, however, permit us to make inferences about patent quality more generally. Only a very small fraction of issued patents are ever the subject of

54. In particular, at various steps of this project we employed the PTO's Public PAIR Research Dataset, the PTO's Assignment Database, and the PTO's Historical Patent Data Files. See generally Stuart J.H. Graham et al., *The USPTO Patent Examination Research Dataset: A Window on the Process of Patent Examination* (U.S. Patent & Trademark Office, Working Paper No. 2015-4, 2015), <https://ssrn.com/abstract=2702637> (describing these resources); Alan C. Marco et al., *The USPTO Historical Patent Data Files: Two Centuries of Innovation* (U.S. Patent & Trademark Office, Working Paper No. 2015-1, 2015), <http://ssrn.com/abstract=2616724> (same).

55. Cf. John R. Allison & Mark A. Lemley, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 232 n.87 (1998) (describing "difficult judgment[s]" in determining which references were "primarily" relied upon by the courts).

an IPR petition.⁵⁶ The PTAB itself determines which petitions to institute.⁵⁷ And a significant number of IPRs settle, either before or after the institution decision.⁵⁸ These various gatekeeping decisions—to petition for IPR, to institute, to settle—may affect the mix of prior art that ultimately appears in FWDs.

To illustrate, suppose that a very small percentage of observed FWDs rely on foreign patents. From this fact, it may be tempting to conclude that very few of the millions of U.S. patents in circulation are invalid based on foreign patents, and perhaps even to discourage the USPTO from searching foreign patents.⁵⁹ This inference, however, would be unsupported. It could be the case that millions of U.S. patents are invalid as a result of foreign patents, but that litigants typically settle these cases before PTAB can reach a decision on the merits. Or, conversely, it is possible that litigants never settle such cases (perhaps because they are especially cheap to litigate). Observed IPR outcomes could either understate or overstate the importance of a prior art category in terms of patent quality overall. Therefore, this data can only be used to answer questions about why patents are invalidated in IPR, not why patents might be invalid in general.⁶⁰

Note, however, that for purposes of assessing the public benefits of IPR, these selection effects are a feature, not a bug. In fact, they are the point. If litigants typically settle cases involving a particular kind of prior art, that tendency directly affects the value of the cases that *are* litigated to a decision, and should be taken into account when measuring the benefits of IPR. And if

56. According to data from Lex Machina, 1,723 petitions for IPR were filed in 2017, and 1,608 were filed in 2018. Not all of these petitions were directed at distinct patents. See David P. Ruschke & William V. Saindon, PowerPoint Presentation at Chat with the Chief: An Analysis of Multiple Petitions in AIA Trials, at slide 5 (Oct. 24, 2017), available at https://www.uspto.gov/sites/default/files/documents/Chat_with_the_Chief_Boardside_Chat_Multiple_Petition_Study_20171024.pdf (reporting that the 7,168 PTAB petitions filed through June 2017 involved 4,376 distinct patents). But even if we counterfactually assume that each petition *was* directed at a distinct patent, 1,700 challenged patents a year would pale in comparison to the rate of new patent issuance. In 2015 alone, the PTO granted nearly 300,000 patents. See U.S. PATENT STATISTICS CHART CALENDAR YEARS 1963–2015, USPTO (June 15, 2016), https://www.uspto.gov/web/offices/ac/ido/oeip/taf/us_stat.htm.

57. See 35 U.S.C. § 314. Though the statute gives the PTO Director the authority to institute IPR, that authority has been delegated to the PTAB. See 37 C.F.R. § 42.108 (2012).

58. See *supra* note 9 and accompanying text.

59. See Dennis Crouch, *How Many US Patents are In-Force?*, PATENTLY-O (May 4, 2012), <https://patentlyo.com/patent/2012/05/how-many-us-patents-are-in-force.html> (estimating, in 2012, that 2.1 million U.S. patents were currently in force).

60. Furthermore, certain kinds of prior art are categorically excluded from consideration in IPR. Compare 35 U.S.C. § 102(a) (defining categories of invalidating prior art), with 35 U.S.C. § 311(b) (establishing scope of IPR proceedings). This only reinforces the potential fallacy of attempting to make inferences about patent quality from IPR invalidation data. By dint of 35 U.S.C. § 311(b), 0% of IPR invalidations involve prior uses or sales; this obviously does not imply that *no* patents are ever invalid as a result of prior uses or sales.

by chance there are no selection effects—if patents subjected to an FWD *are* representative of patents overall—then the same point stands. Understanding the factual bases of these decisions directly informs whether the inventor incentivization theory can justify the costs of these proceedings.

IV. RESULTS

A. ANTICIPATION VS. OBVIOUSNESS

Obviousness makes up the vast majority of invalidations in IPR. Of the 6,976 claim-level invalidity events we observed during our one-year study period, 5,787 (about 83%) were rooted in obviousness. At a patent level, the imbalance was slightly smaller, but still significant. Approximately 76% of patent-level invalidity events were based on obviousness.

This is a potentially important distinction between IPR and district court litigation as error correction tools. For at least a decade, the balance between anticipation and obviousness invalidations in district courts has held very close to even.⁶¹ This appears to be true whether measured at the level of claims or patents.⁶² By contrast, obviousness clearly dominates the error correction performed in IPR.

Though there are many potential explanations for this difference, one obvious candidate is the exclusion of “activity” prior art (prior invention, uses, and sales) from IPR. Because district court anticipation invalidations disproportionately draw on art in this category,⁶³ one would expect that excluding activity prior art would naturally lead to a higher percentage of cases rooted in obviousness. This turns out to be an incomplete explanation:

Table 1

Claim-level invalidity events	D. Ct. (all cases)	D. Ct. (excluding cases citing activity prior art)	IPR
Anticipation	50%	40%	17%
Obviousness	50%	60%	83%

61. See Yelderman, *supra* note 5, at 24 chart 1; see also John R. Allison et al., *Understanding the Realities of Modern Patent Litigation*, 92 TEX. L. REV. 1769, 1785 tbl.2 (2014) (reporting 31 successful motions for summary judgment on the basis of anticipation and 31 successful motions for summary judgment on the basis of obviousness).

62. Yelderman, *supra* note 5, at 25.

63. See *id.*

As shown in Table 1, excluding district court invalidations relying on activity prior art does increase the percentage of invalidations rooted in obviousness, but it does not eliminate the gap between district court patent litigation and IPR. Once invalidity based on activity is excluded, obviousness comprises 60% of district court invalidity events. Even accounting for this difference in prior art rules, obviousness remains significantly more common in IPR.

Beyond this obvious but inadequate explanation, any number of theories are conceivable.⁶⁴ The cause of the discrepancy could plausibly turn on IPR institution rates, the likelihood of success on the merits, incentives to settle (or not) at any point in the IPR process, incentives to settle (or not) at various stages of district court litigation, and the standards of proof that apply in each process. The data do not permit us to accept or reject any hypotheses along these lines.

For purposes of assessing the benefits of IPR, however, the cause of IPR's frequent reliance on obviousness is irrelevant. Instead, it is the fact of it that matters. While obviousness invalidations can certainly benefit the public, their error correction value is often harder to discern, at least compared to anticipation. A claim can be invalidated for anticipation only if that exact invention already existed in a qualifying prior art reference.⁶⁵ Because of this requirement of equivalence, anticipation often constitutes a direct vindication of the public domain—a direct rebuke of an inventor who sought to claim what had already been disclosed to the public.⁶⁶

Obviousness can serve a similar function, but the path is more complicated. Typically, a finding of obviousness suggests that the exact invention could not be found in a single prior art reference—otherwise, the

64. Several other straightforward explanations also fail to explain this result. For example, some readers might wonder if the high percentage of obviousness invalidations is simply a result of our decision to code each prior art combination as a distinct invalidation event. *See supra* notes 51–52 and accompanying text. If obviousness lends itself to more distinct prior art combinations, then it may appear more common in our dataset than it really is in practice. But we can test this theory by dropping invalidations that cite different prior references but are otherwise redundant (same IPR, patent, claim, and legal basis), and the numbers do not change very much: Still 80% of the remaining invalidations are rooted in obviousness, while only 20% are rooted in anticipation. Another possible explanation is that perhaps PTAB tends to “backstop” anticipation findings by also holding the same claim to be obvious—for example, to make it more likely that one finding or the other will survive appeal. If every anticipated claim is automatically held to be obvious, but not every obvious claim is necessarily anticipated, we would expect to see obviousness findings overrepresented in the data. But this explanation also fails to survive scrutiny. If we further drop all obviousness invalidations that are redundant with an anticipation invalidation (same IPR, patent, and claim), and treat these as *only* anticipation events, we still find a significant imbalance: 78% of IPR invalidations were based on obviousness, with only 22% based on anticipation. Therefore, our decision to code redundant claim invalidations accounts for a very small amount of the imbalance between anticipation and obviousness.

65. *See Atlas Powder Co. v. Ireco Inc.*, 190 F.3d 1342, 1346 (Fed. Cir. 1999).

66. *See Pfaff v. Wells Elecs., Inc.*, 525 U.S. 55, 63–64 (1998).

fact-finder could have simply relied on anticipation. The error correction story for obviousness relies on faulting the inventor for seeking to patent something that *was* new, but that was insufficiently inventive in light of one or more qualifying prior art references.

Moreover, the vast majority of obviousness invalidations in IPR relied on this doctrinal freedom to cite multiple references:

Chart 1. Number of References Cited (§ 103)

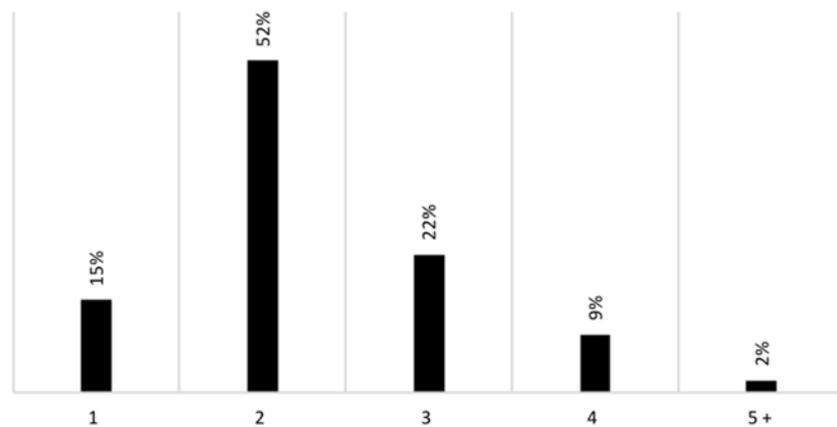


Chart 1 illustrates the percentage of IPR obviousness invalidations relying on a specified number of references. As Chart 1 shows, 85% of these invalidations relied on two or more prior art references to establish the prima facie case of obviousness. The average number of references cited was 2.3; the most cited was 7.0.

To be clear, revoking an obvious patent can certainly benefit the public. But when it comes to incentivizing inventors to change their conduct, it is debatable whether cancelling a patent because it would have been obvious to combine multiple references enforces a mutually exclusive choice.⁶⁷ And the vast majority of IPR claim cancellations appear to fall into that category.

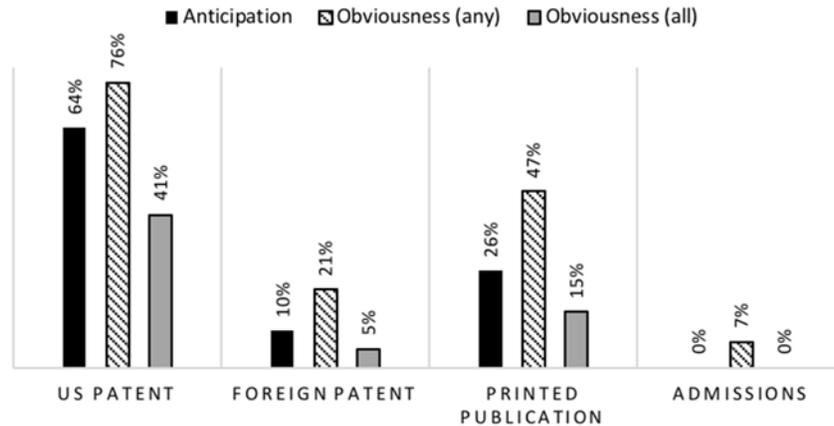
B. CATEGORIES OF PRIOR ART

At the highest level, we classified invalidating prior art using four categories: U.S. patents (including U.S. patent applications), foreign patents (including applications to foreign patent offices and applications filed under

67. See Yelderman, *supra* note 12, at 1258–62 (discussing conflicting views as to whether the decision to invent something obvious is a mutually exclusive choice).

the Patent Cooperation Treaty), printed publications, and admissions.⁶⁸ Chart 2 illustrates the percentage of claim-level invalidity events relying on each category of prior art:

Chart 2. Basis for Invalidity



The prior art for anticipation events is straightforward to interpret. Represented by the solid black columns, the majority of anticipation invalidations (64%) relied on U.S. patents and patent applications. Printed publications constituted a distant second, providing support for 26% of claim-level anticipation events. Reliance on foreign patents was quite rare, constituting just 10% of observed anticipation events. There were no cases in which PTAB found a claim anticipated by the applicant's own admissions.

These non-U.S. patent categories are particularly insignificant when one considers how infrequently IPRs invoked anticipation in the first place. As a percentage of *all* invalidity events, anticipation by printed publications and foreign patents constituted just 4.4% and 1.6%, respectively.

The prior art relied upon for obviousness invalidations is more complicated, since PTAB typically relied on more than one reference to support that conclusion. For this reason, the prior art behind obviousness invalidations is presented in two ways. First, the hashed columns indicate the percentage of obviousness events that drew on *any* references in that category. Second, the gray columns indicate the percentage of obviousness events that drew *entirely* on references in that category.⁶⁹

68. Admissions include statements made in the patent application itself or during prosecution regarding the state of the prior art.

69. The numbers atop the hashed and gray columns do not sum to 1 because of obviousness invalidations citing multiple references.

Comparing the hashed columns to the gray columns reveals the prevalence of cross-category combinations. For example, over three quarters of obviousness invalidations (76%) cited at least one U.S. patent. But only 41% of obviousness invalidations drew *only* on U.S. patents. Likewise, almost half of obviousness invalidations (47%) cited a printed publication, but only 15% of obviousness invalidations relied exclusively on printed publications.

The final two categories—foreign patents and admissions—appear to largely play a supporting role in obviousness. Only 5% of obviousness invalidations relied exclusively on foreign patents, and there were no obviousness invalidations relying exclusively on admissions. However, art in these categories was cited as part of the prima facie case of obviousness with some regularity—21% of obviousness invalidations cited a foreign patent, and 7% of obviousness invalidations cited an applicant admission.

The following Sections will explore each of these categories in greater detail, beginning with printed publications.

C. PRINTED PUBLICATIONS

The incentivizing power of revoking a patent can vary significantly within these top-level categories. The printed publication category is perhaps the best example of this. At one extreme, an invalidation based on a printed publication can punish a fraudster who sought to claim an invention that was already widely known throughout an industry. Alternatively, a very similar invalidation could involve a piece of prior art which was not widely known, but that a reasonably diligent search would have revealed. Or, to go to the opposite extreme, an invalidation based on a printed publication could be a case of tough luck, where the inventor did everything right, but nonetheless was ensnared by an obscure publication neither she nor any of her peers had ever seen.⁷⁰

The incentivizing value of invalidating patents based on printed publications varies to these extremes in part because the Federal Circuit has interpreted the category so expansively.⁷¹ A publicly accessible document found anywhere in the world may qualify as prior art, even if it would have been extremely difficult to find at the time of invention.⁷² Indeed, under the Federal Circuit's *Klopfenstein* test, printed publication can include things that colloquially would not be understood as “publications” at all—such as slide shows, poster boards, and handouts displayed or distributed at conferences.⁷³

70. See Yelderman, *supra* note 12, at 1272–76.

71. See *In re Klopfenstein*, 380 F.3d 1345, 1350–52 (Fed. Cir. 2004).

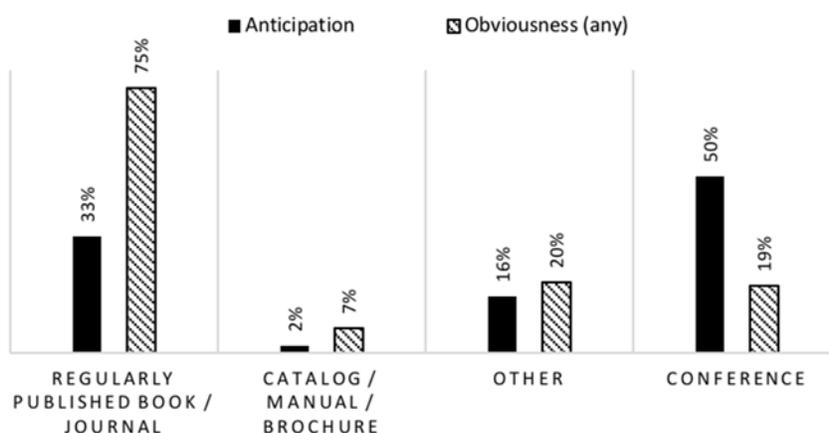
72. *Id.* at 1350.

73. *Id.* at 1350–52.

This approach has been criticized,⁷⁴ though its effects have not been previously quantified.

To determine whether the printed publications used in IPR typically fit the colloquial understanding of that term or exploit the fringes of *Klopfenstein*, we classified publications into a number of sub-categories. Chart 3 illustrates the percentage of claim-level anticipation and obviousness events relying on each sub-category of printed publications:

Chart 3. Basis for Invalidity—Printed Publications



The first category shown in Chart 3 is “regularly published books and journals.” These are traditional reference publications—the kind a library might collect and an interested researcher might access.⁷⁵ As Chart 3 shows, this category of publication was cited with some frequency. As a percentage of anticipation invalidations citing a printed publication, regularly published books and journals were cited about 33% of the time. Among obviousness invalidations citing a printed publication, at least one publication in this category was cited 75% of the time.

This leaves a long tail of invalidations based on publications that are *not* regularly published books and journals. The smallest of these was the “catalogs, manuals, and brochures” category—documents distributed to teach the public about the features or availability of a product. Though cited

74. See, e.g., Margo A. Bagley, *Academic Discourse and Proprietary Rights: Putting Patents in Their Proper Place*, 47 B.C. L. REV. 217, 221 (2006).

75. For purposes of classification, a book was in this category if its citation included the name of a publisher (distinct from the author) and a year of publication. A journal was in this category if its citation referred to a multi-volume periodical and a year of publication. This category also includes publicly available documentation describing industry or government standards.

infrequently (just 2% of an already small share of anticipation events citing a printed publication, and 7% of obviousness events citing at least one printed publication), these were conceptually interesting cases because they illustrate how the Federal Circuit's broad interpretation of "printed publication" can be used to expand the statutory scope of IPR. Under *Klopfenstein*, documents like these may qualify under the "publication" gate. But in practice, catalogs, manuals, and brochures are often evidence of prior uses and sales—a distinct category of prior art that Congress sought to exclude from IPR.⁷⁶ Publications in this category thus blur the line between the domain of IPR and the domain of other procedural tools for challenging validity.⁷⁷

The final two sub-categories shown in Chart 3 are even more obscure. We classified a publication as a "conference proceeding" if it was presented or distributed at an academic or industry conference, and did not otherwise meet the definition of a regularly published book or journal. Finally, we included a catch-all category, "other," for publications not falling into any of the aforementioned categories.

Documents in these latter three categories would often fail the colloquial understanding of "printed publication," but nonetheless qualify under *Klopfenstein's* interpretation of that term. To provide just a few examples, we observed publications consisting of product instructional videos, public requests for comments, proposals to standards bodies, early Internet posts, doctoral dissertations, industry white papers, and transcripts of regulatory briefings. The accessibility of these documents varies somewhat (and, in some cases, might be debatable), but all of them legally qualified as prior art without meeting our definition of a regularly published book or journal.

As Chart 3 shows, a substantial minority of obviousness invalidations relied on a printed publication in one or more of these non-traditional categories. Among obviousness invalidations citing a publication, about 37% relied on at least one publication that was not a regularly published book or journal.⁷⁸ (For purposes of anticipation, the percentage of non-traditional publication was even higher—67%—but cases of anticipation based on printed publications were rare to begin with.)⁷⁹ From the perspective of IPR

76. See 35 U.S.C. § 311 (b) (2012).

77. For example, the same act of Congress that created IPR also created a similar challenge mechanism called post-grant review, or "PGR." PGR operates much like IPR, but it permits challenges based on *any* kind of prior art and *any* patentability requirement. See 35 U.S.C. § 321 (b). The catch is that the window for PGR is time-limited—a petition may only be filed in the first nine months after a patent issues. 35 U.S.C. § 321 (c). Liberally permitting evidence of prior uses and sales to be cited in IPR as "printed publications" therefore risks thwarting the statutory design.

78. This number is less than the sum of the relevant hashed columns in Chart 3 (which sum to 46%) because some obviousness invalidations draw on non-traditional art in multiple categories.

79. Recall that anticipation based on printed publications constitutes only 4.4% of all IPR invalidation events. See *supra* Section IV.B.

invalidity overall, about 17% of invalidations cited at least one non-traditional publication.⁸⁰

IPR's routine reliance on this obscure category of prior art does not bode well for its ability to incentivize future inventors. In many cases, it would have been impractical (if not impossible) for the inventor to find the publication that would have rendered her invention obvious. For example, if it so happens that the inventor missed out on the conference or industry roundtable where the relevant publication was distributed or discussed, there may have been no realistic way for her to discover it after the fact. Likewise, even if a catalog or brochure was distributed widely when it was first produced, it may not have been amenable to search at the relevant time of invention. These do not appear to be inventor-incentivizing error corrections.

D. U.S. PATENTS AS PRIOR ART

The next category of prior art is U.S. patents—including both granted patents and published applications. Because of the highly structured and centralized nature of these documents, we have the richest data on them of all the prior art categories. For example, we know precisely what was filed, when, by whom, and when that information actually became visible to the public. There are also a few special legal rules about how U.S. patents are treated as prior art, so a bit of background will be helpful here.

It might seem that, as a category, U.S. patents and patent applications would be the easiest form of prior art for a prospective inventor to discover. Granted patents and published applications are stored in a single, centralized repository.⁸¹ They are written in English. They are text-searchable in a number of free, publicly accessible databases, including the PTO's own website.⁸² And each patent and application has been assigned a field classification, allowing a searcher to quickly narrow her inquiry to the documents most likely to be relevant.⁸³ All of this would suggest that invalidations based on U.S. patent

80. If one takes the error-correction value of IPR as a given, it is possible to see a silver lining in these cancellations based on non-traditional publications. Because these publications are not usually searchable, they are the kind of prior art that only an adversarial challenge procedure would be likely to uncover.

81. The PTO began publishing certain patent applications in the year 2000. *See* American Inventors Protection Act of 1999, Pub. L. No. 106-113, 113 Stat. 1501, 1501A-561 (1999) (amending 35 U.S.C. § 122).

82. *See, e.g., Search for Patents*, USPTO, <https://www.uspto.gov/patents-application-process/search-patents> (last visited June 8, 2019); GOOGLE PATENTS, <https://patents.google.com> (last visited Apr. 18, 2019).

83. *See* Manual of Patent Examining Procedure § 902.01 (a), USPTO [hereinafter MPEP], <https://www.uspto.gov/web/offices/pac/mpep/s902.html> (last visited June 8, 2019).

prior art will reliably constitute a valuable and highly incentivizing form of error correction.⁸⁴

But there is a catch. Under certain conditions, U.S. patents and patent applications can actually be impossible for a rival inventor to find at the time she prepares her own application. The reason has to do with special prior art timing rules that apply only to U.S. patents and patent applications. The timing rule that applies to all other categories of prior art is straightforward: A disclosure becomes legally effective as prior art on the day that information became available to the public.⁸⁵ But a different timing rule applies to U.S. patents and patent applications. Their disclosure qualifies as prior art on the day the underlying application was *filed*, provided that the application is later published or results in a granted U.S. patent.⁸⁶

What makes this tricky is that applications are legally protected as secret when they first arrive at the PTO.⁸⁷ They persist in this secret form until one of two things happens: (1) they are published (which typically occurs 18 months after filing, though an applicant can opt-out of this procedure);⁸⁸ or (2) they result in a granted patent (typically several years after filing).⁸⁹ Until one of those two triggering events occurs, pending applications are not prior art. But the moment one of those things *does* occur, the application springs back in time, and becomes retroactively effective as prior art. No other category of prior art is treated this way.⁹⁰

Because of this springing rule, U.S. patents and patent applications can be either the most obscure form of prior art *or* the most accessible. The difference comes down to timing. If the prior art patent was published or granted at the time the focal patent⁹¹ was filed, it is certainly the kind of thing a reasonable art search should have uncovered. But if it was not yet granted

84. If one reason for revoking patents is to encourage reasonably diligent art searches before inventing or filing a patent, that reasonably diligent search surely includes a trip to the PTO's own patent database. *See* Yelderman, *supra* note 12, at 1274; *see also* MERGES & DUFFY, *supra* note 36, at 398–402.

85. *See* 35 U.S.C. § 102(a). Patents also formally qualify for this timing treatment, though the preferential rules discussed momentarily will render this path superfluous in many situations. There are, naturally, a few complications. For example, an offer for sale can qualify as prior art as soon as the invention is “ready for patenting”—even if the offer itself does not disclose any specific information about the invention. *See* Pfaff v. Wells Elecs., Inc., 525 U.S. 55, 66–67 (1998).

86. *See* 35 U.S.C. § 102(e) (2006).

87. *See* 35 U.S.C. § 122 (2012).

88. *Id.*

89. *See* U.S. PATENT AND TRADEMARK OFFICE, FY 2018 PERFORMANCE AND ACCOUNTABILITY REPORT 57 (2018), <https://www.uspto.gov/sites/default/files/documents/USPTOFY18PAR.pdf> (reporting average total pendency for patent applications).

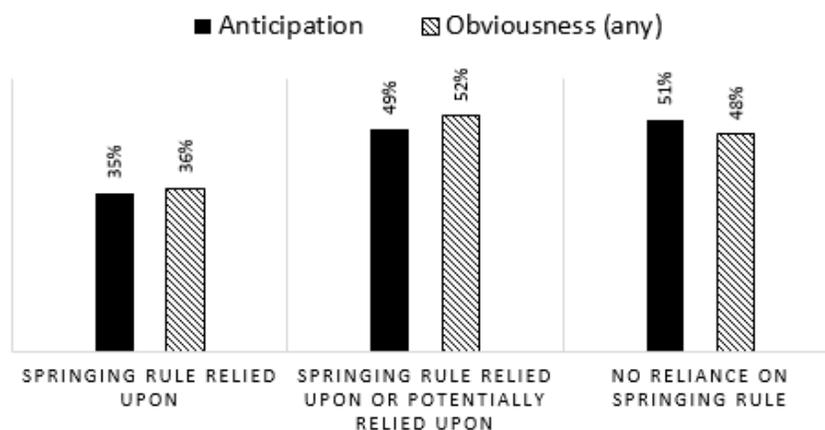
90. For an argument that printed publications ought to receive the same treatment, see Sean B. Seymore, *When Patents Claim Preexisting Knowledge*, 50 U.C. DAVIS L. REV. 1965, 1979 (2017).

91. The term “focal patent” refers to the patent that is the subject of the validity inquiry. In contrast, “cited patent” refers to the one that threatens to invalidate the focal patent.

or published, the prospective inventor would have had no way of discovering it, no matter how much she may invest in search.⁹²

To determine the frequency with which IPR invalidations rely on these rules, we supplemented our IPR dataset with various PTO datasets providing application filing, publication, and grant dates for all focal and cited patents. By comparing these dates, we were able to identify invalidity events for which the springing mechanism was necessary or potentially necessary for the cited patent to qualify as prior art:

Chart 4. U.S. Patent Prior Art



As Chart 4 illustrates, the springing mechanism of U.S. patents appears central to their use as prior art in IPR. Roughly 35% of the time a U.S. patent was the basis for invalidating the focal patent, it unambiguously could not have qualified as prior art without reliance on the springing rule.⁹³ Moreover, there were a significant number of ambiguous cases, in which the springing

92. This springing mechanism can even stymie patent examiners—though they have access to pending applications, they are not permitted to cite them until they become public. It is thus possible for a patent to be valid the day it is granted, but later become invalid as a result of subsequent events in the life of a different pending application. In practice, however, this very rarely explains why PTAB reached a different conclusion about validity than the line examiner. Among all IPR invalidations relying on U.S. patents, the prior art had become public by the time the focal patent issued in 98% of cases.

93. To qualify for the “certain reliance” category, the prior art patent could not have published or issued until a date *after* the focal patent’s priority date. For purpose of determining the priority dates of focal patents, we considered only the most reliable forms of priority claims—continuations, divisionals, reissues, and national entry from a Patent Cooperation Treaty application. We excluded priority claims that are more vulnerable to attack in litigation, such as foreign priority claims, provisionals, and continuations-in-part. This will tend to understate the number of cases in which the springing rules were necessary to qualify the patent as prior art.

prior art rules may or may not have played a role in qualifying the cited patent as prior art.⁹⁴ The springing prior rule was unambiguously unnecessary in only about half of invalidations based on U.S. patents.⁹⁵

The extent of IPR's reliance on the springing prior art rules only becomes greater when one remembers how frequently U.S. patents were cited in general—64% of anticipation events were based on U.S. patent prior art, and 76% of obviousness invalidations cited at least one U.S. patent as a reference.⁹⁶ In sum, between 26% and 38% of all IPR invalidations cited at least one patent or patent application that could not qualify as prior art without the benefit of the springing prior art rules.

These do not appear to be inventor-incentivizing error corrections. In cases like these, there was no lawful way for the inventor to discover the fatal prior art reference, no matter how hard she might have searched. While these invalidations might serve some other purpose, creating future incentives for inventors to break into the PTO to read secret applications isn't one of them.

E. FOREIGN PATENTS

Our final category is foreign patents. Though 10% of anticipation events cited a foreign patent, these accounted for an extremely small share—less than 2%—of IPR invalidity overall. Roughly 21% of obviousness invalidations cited a foreign patent, while about 5% of obviousness invalidations relied exclusively on foreign patents.

It is difficult to generalize about the obscurity of foreign patents. On one hand, they can be found in centralized repositories. On the other hand, the

94. The reason we could not always conclusively determine whether there was reliance on the springing prior art rule is that, in some scenarios, qualification as prior art would have depended on the focal patent's date of invention, which is distinct from its filing date. For example, if the cited patent granted or published less than a year before the focal patent was filed, its status as prior art (in a world without springing rules) would turn on when the invention of the focal patent was actually invented. Date of invention is a complex question for litigation, and one which the springing rule itself may have avoided the need to litigate. In these ambiguous cases, the springing mechanism made it easier to qualify the prior art, but we cannot say whether or not the same art would have qualified absent a springing mechanism.

95. To qualify for the "no reliance" category, the prior art needed to be published or issued more than one year prior to the focal patent's earliest domestic priority claim. In these cases, the challenger could rely on § 102(b), making the springing mechanism irrelevant. *See* 35 U.S.C. § 102(b) (2006).

We should emphasize that we have been extremely conservative in drawing the line between cases in which the springing rules certainly or possibly played a role in qualifying the patent as prior art. For example, a large number of anticipating patents would have moved into the "certain" column if we had assumed that the focal patent was entitled to the benefit of its provisional filing date. In these cases, the springing prior art rules made the provisional filing irrelevant. However, in a hypothetical world without the springing prior art rules, the focal patent's priority claim to that provisional *might* have failed, providing an alternative path for the art to qualify.

96. *See supra* Section IV.B.

ease of searching foreign patents can vary greatly depending on the country. In the majority of foreign patent offices, the proceedings are conducted in a language other than English. And, of course, there are a lot of patent offices—well over a hundred—spread all around the world.

The encouraging news here is that IPR's reliance on foreign patents appears limited to a tightly circumscribed group of patent offices. By searching in just four places—the Japan Patent Office, the European Patent Office, the Intellectual Property Office of the United Kingdom, and the World Intellectual Property Organization—one could uncover 96% of the foreign patents cited in IPR for purposes of anticipation and 98% of the foreign patents cited in IPR for purposes of obviousness. Moreover, the inventor cannot blame a springing prior art rule in these cases.⁹⁷ These are prior art references that a reasonably diligent search ought to have found.

* * *

Putting all of this together, non-incentivizing error correction appears to constitute a substantial share of the work of IPR. Non-traditional publications and secret pending patent applications were the basis for somewhere between 42% and 53% of all IPR invalidations during the study period. These are cases in which an inventor lost her claim on account of prior art would have been difficult or impossible for her to find at the time of her invention. Indeed, around 21% of IPR obviousness invalidations appeared to rely on *multiple* obscure prior art references—essentially a conclusion that it would have been obvious for one of ordinary skill to combine one secret thing with another secret thing to arrive at the claimed invention.

To be clear, this is not to say that these cancellations lack value—we are exploring only one specific theory of how IPR might benefit the public. Still, on this front, the news is discouraging: The inventor-incentivizing benefit appears to be lacking in roughly half of all IPR cancellations.

V. IPR'S RELATIONSHIP TO EXAMINATION

This data can shed light on another set of questions as well, having to do with the relationship between IPR and the initial round of examination performed by the PTO. As the Supreme Court has observed, the purpose of

97. As always, there are complications. Technically, a subset of Patent Cooperation Treaty applications designating the United States are also eligible for springing treatment under 35 U.S. § 102(e). See MPEP § 706.02(f)(1)(I)(C), USPTO, <https://www.uspto.gov/web/offices/pac/mpep/s706.html> (last visited June 8, 2019) (explaining application of these rules). In practice, however, we found no cases of certain reliance on the springing prior art rules for foreign patents in this category, and only a small number of cases of potential reliance.

IPR is that it gives the PTO a chance to take a “second look”⁹⁸ at its own work, “to reconsider and cancel patent claims” that it should not have issued in the first place.⁹⁹ The prior art underlying IPR cancellation reveals something about the nature of this “second look.”

In all of the invalidations in our dataset, the adversarial scrutiny of IPR led the PTAB to determine that the line examiner’s initial decision to grant a claim had been in error. Though not necessarily the whole story,¹⁰⁰ the prior art supporting the ultimate conclusion of invalidity can shed some light on why the PTO might have reached a different decision upon reconsideration. For example, suppose that a claim is invalidated in IPR based entirely on prior art that was part of the examination record. In that case, the disagreement between the line examiner and PTAB is one of interpretation—the initial examiner failed¹⁰¹ to properly construe the claim, understand the prior art, correctly judge the novelty or nonobviousness of the claim in light of that art, or some combination of the above. By contrast, if a claim is invalidated in IPR on the basis of prior art that *wasn’t* known during examination, the disagreement may be rooted in something more fundamental. When new art is introduced in IPR, PTAB and the line examiner were drawing on different factual records. In a sense, they were simply answering different questions.

Moreover, the nature of the new art cited in IPR could also shed light on the procedure’s effectiveness as a supplemental form of patent examination. One of the reasons for offering an adversarial challenge procedure is that it may bring in prior art that would otherwise be unavailable to line examiners. As a practical matter, government employees sitting in Alexandria, Virginia, may have no way of accessing certain kinds of prior art. In theory, a third-party challenge mechanism like IPR creates a vehicle for the PTO to consider prior

98. *Oil States Energy Servs., LLC v. Greene’s Energy Grp., LLC*, 138 S. Ct. 1365, 1374 (2018) (quoting *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144 (2016)).

99. *Id.* at 1370.

100. For example, some of the claims invalidated as obvious in IPR may have been examined under a different legal standard. See *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 407 (2008) (rejecting Federal Circuit’s prior “teaching, suggestion, or motivation” test). As another example, in some future cases, the disagreement between the examiner and PTAB could be explained by differences in how claims are supposed to be interpreted during examination as opposed to IPR. See *Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board*, 83 Fed. Reg. 51,340, 51,342 (Oct. 11, 2018) (to be codified at 37 C.F.R. pt. 42). But this distinction cannot be blamed for any of the disagreement we observed, as PTAB applied the same “broadest reasonable construction” standard in IPR throughout the study period. See *Cuozzo Speed Techs.*, 136 S. Ct. at 2142.

101. Of course, to say that the examiner “failed” is to take a side in this intra-agency disagreement—that is, it presumes that PTAB was right and the line examiner was wrong. While this may not always be true as an epistemological matter, it holds as a legal proposition. Subject only to deferential review by the Federal Circuit, PTAB’s conclusion of invalidity will be treated as correct notwithstanding the line examiner’s conclusion to the contrary. See *Merck & Cie v. Gnosis S.P.A.*, 808 F.3d 829, 840–81 (Fed. Cir. 2015) (Newman, J., dissenting) (criticizing the Federal Circuit’s “highly deferential” standard of review).

art that examiners may be unable to find on their own. The art cited in FWDs reveals whether or not IPR is actually delivering this potential benefit.

We start by noting that the initial stages of IPR proceedings may create a bias in favor of challenges based on new art and away from challenges based on art that was part of the examination record. If patent challengers perceive (rightly or wrongly) that PTAB is less likely to institute an IPR based on art already known to examiners, they may shy away from mounting such challenges—perhaps even stretching to bring challenges on prior art that is objectively weaker but happens to look new. Moreover, if PTAB is *actually* less likely to institute an IPR based on art that was known during examination, that too will have an effect on the kinds of challenges than end up producing FWDs. Given these strategic considerations and selection effects, one might expect very few invalidations to be based entirely on prior art that was known during examination.

And yet, such cases do exist. Indeed, our data shows that 21% of all anticipation events were based on prior art that was already part of the original examination record. In cases of obviousness, 8% were rooted entirely on references that were already known.¹⁰² In the majority of cases, however, PTAB relied on multiple, previously uncited references:

Chart 5. Obviousness and Uncited Art

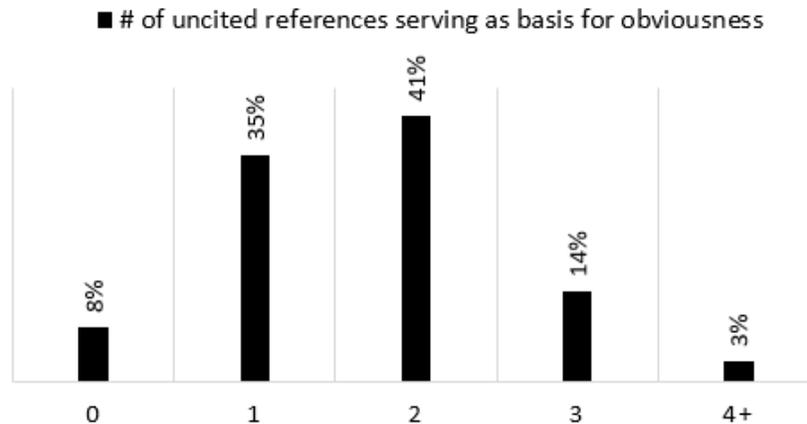


Chart 5 tabulates all claim-level obviousness events based on the number of references cited in IPR that were uncited in examination. For example, the

¹⁰². One might suspect that these cancellations were largely directed at patents examined before the Supreme Court revisited the obviousness standard in *KSR*. That suspicion would be wrong. Essentially all (98%) of the claims found obvious in light of art known during examination had been examined *after KSR* was handed down.

first column—o uncited references—corresponds to the 8% of obviousness events in which PTAB relied exclusively on prior art known to the PTO during examination. By contrast, 35% of obviousness events relied on a single reference unknown to the PTO, and 57% involved two or more such references.

Counting cases of either anticipation or obviousness, 89% of IPR invalidations relied on one or more references that were missing from the examination record. The majority of this previously unknown prior art was at least potentially discoverable through a traditional prior art search. For example, combining *only* U.S. patents and patent applications with the prior art already part of the examination record would yield the prior art necessary to sustain 51% of all IPR invalidations. Adding regularly published books and journals would yield the prior art necessary to sustain another 23%.

By contrast, previously unknown foreign patents and non-traditional printed publications were rarely the basis for cancellation in IPR. About 16% of our observed invalidations relied on a previously uncited foreign patent; only 12% relied on a previously uncited non-traditional publication. (These numbers sum to slightly more than 100% because of a small number of cases involving uncited references in multiple categories.)

To be clear, none of this data should be used to fault line examiners, or otherwise make inferences about patent quality in general. The fact that the majority of IPR invalidations drew exclusively on U.S. patents, applications, and art already in the record does not tell us anything about the examiner error rate in applying art in those categories. It can, however, shed light on how IPR is functioning in practice, and whether a different tool might be able to provide similar error correction at lower cost.

VI. CONCLUSION

In the years since its introduction, IPR has quickly become a popular mechanism for adjudicating patent validity. While this procedural tool may have a number of subtle effects on district court litigation and other aspects of the patent system, its most immediate impact has been to substantially increase the number of patents subjected to adversarial scrutiny.

Whether the benefits of this increased scrutiny justify its substantial cost is another question. The direct costs, at least, are straightforward to quantify—publicly available data indicates how many cases are brought to each stage every year, and at approximately what cost. The benefits, however, are harder to specify. While commentators have noted a number of potential benefits a procedural tool like this might deliver, the process of assessing whether IPR is indeed delivering those benefits has only begun.

This Essay explored one particular theory of how IPR might benefit the public—that revoking invalid patents will sharpen inventors' incentives to comply with the demands of patent law in the future. Unfortunately, this

potential benefit appears to be lacking in a substantial number of recent IPRs. Approximately half of the cancellations we observed in a one-year study period relied on prior art which would have been difficult or impossible for the inventor to discover at the time of the invention. To be clear, this is not to say they lack any public benefit. Rather, future study will be necessary to explore other theories of how invalidation can serve the public interest and whether these benefits obtain in IPR.