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## Predicting Administrative Patent Challenges

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# Predicting Administrative Patent Challenges

Talia Bar\* and Brendan Costello†

## Abstract

*In this Article, we empirically study the use of administrative validity challenges by defendants in patent infringement suits. By requesting an administrative challenge, defendants can effectively bifurcate a patent infringement suit, staying district court proceedings while they challenge the validity of the patent at the patent office. Because of potential advantages in cost, speed, and legal standards, administrative challenge procedures like inter partes review appear facially attractive to defendants and have been heralded by scholars as a way to reduce litigation costs and improve the patent system.*

*Despite all of the potential benefits, we find that district court defendants requested an administrative challenge—inter partes reexamination or inter partes review—of less than ten percent of the approximately sixty thousand patents litigated between 2008 and 2015. Some of the low challenge rate can be explained by statutory ineligibility and changes in the standard for the joinder of multiple defendants. But much of the low challenge rate appears driven by speedy resolutions of the underlying dispute:*

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over fifty percent of the cases where defendants did not use a challenge settled or otherwise terminated within one year.

Our results have three important implications. First, we discover trends that can inform the design and evaluation of administrative challenge procedures. We find substantial evidence that the 2011 America Invents Act reform increased the use of administrative challenges by defendants. Still, the reform had heterogeneous, possibly unintended effects. Small entity patents, for example, are less likely to be challenged after the AIA than before. We also identify areas ripe for future reform. Despite growing policy concern over patent assertion entities (PAEs), for example, patents asserted by PAEs are currently less likely to face an administrative challenge than other similar patents. Second, we empirically test several predictions in a growing theoretical literature on the interaction between Article III courts and administrative venues. We confirm an important earlier result: a defendant's decision to request an administrative challenge appears highly sensitive to the district in which the defendant is sued. Pushing further, we also discover sensitivity to the particular judge assigned. Third, we caution that a growing empirical literature on the outcomes of inter partes review may be clouded by selection bias. We find some evidence that the cases where defendants use administrative challenges involve patents of particularly high value compared to other litigated patents, when the latter are not settled early. Our selection models provide a framework for future authors to consider and account for these selection effects.

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## I. INTRODUCTION

Over the past two decades, Congress has created procedures that allow third parties to challenge the validity of a granted patent at the patent office instead of an Article III court.<sup>1</sup> Such administrative patent challenges can be especially useful to district court defendants who seek to render infringement moot by proving that the asserted patent is invalid. By requesting an administrative challenge and an associated stay of litigation, defendants can effectively bifurcate the trial,<sup>2</sup> and take

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1. Congress first created inter partes reexamination (IPX) in 1999 and the 2011 Leahy-Smith America Invents Act replaced IPX with inter partes review (IPR), which took effect in 2012. American Inventors Protection Act of 1999, Pub. L. No. 106-113, codified at 35 U.S.C. § 312(a) (1999); Leahy-Smith America Invents Act, Pub. L. No. 112-29, codified at 35 U.S.C. § 311 (2011).

2. See generally Katrin Cremers et al., *Invalid but Infringed? An Analysis of the Bifurcated Patent Litigation System*, 131 J. ECON. BEHAV. & ORG. 218 (2016) (comparing the U.K. and German systems and calling for further research to investigate the effects of bifurcation in the U.S.).

advantage of substantially decreased cost,<sup>3</sup> increased speed,<sup>4</sup> and more favorable legal standards at the patent office.<sup>5</sup> Scholars have trumpeted the potential of administrative challenges to “fix patent office errors”<sup>6</sup> and yield billions of dollars of welfare gains by invalidating bad patents and avoiding litigation costs.<sup>7</sup>

As the number of administrative challenges requests has increased dramatically in recent years,<sup>8</sup> a growing body of empirical work has emerged to analyze the use of the most popular administrative challenge: inter partes review.<sup>9</sup> In an important early contribution, Professors Vishnubhakat, Rai, and Kesan provide a high-level look at the use of inter partes review during its first three years.<sup>10</sup> They find that while a

3. Median civil litigation costs range from \$650,000 to \$2.5 million, which is substantially greater than the estimated costs of inter partes reexamination (\$128,000) or inter partes review (\$487,000). *Economics and Logic of Patent Litigation Versus Post Grant/Inter Partes Patent Review*, RATNERPRESTIA, <https://www.ratnerprestia.com/2012/10/03/economics-and-logic-of-patent-litigation-versus-post-grantinter-partes-patent-review/> (last visited Mar. 20, 2020) (citing the 2011 AIPLA report); *IPRs: Reality Amid the Pyrotechnics*, RPX CORPORATION, <https://www.rpxcorp.com/2015/07/02/iprs-reality-amid-the-pyrotechnics/> (last visited Mar. 20, 2020).

4. See *infra* Part II.

5. *Id.*

6. See, e.g., Joseph Farrell & Robert P. Merges, *Incentives to Challenge and Defend Patents: Why Litigation Won't Reliably Fix Patent Office Errors and Why Administrative Patent Review Might Help*, 19 BERKELEY TECH. L.J. 943, 968–969 (2004).

7. See generally Stuart J.H. Graham & Dietmar Harhoff, *Separating Patent Wheat from Chaff: Would the U.S. Benefit from Adopting a Patent Post-Grant Review?*, 43 RES. POL'Y 1649 (2014) (concluding that the U.S. may benefit from adopting the post-grant review if the costs are controlled).

8. Compare U.S. PATENT & TRADEMARK OFFICE, INTER PARTES REEXAMINATION HISTORICAL STATISTICS (Dec. 2017), [https://www.uspto.gov/sites/default/files/documents/inter\\_parte\\_historical\\_statistics\\_roll\\_up.pdf](https://www.uspto.gov/sites/default/files/documents/inter_parte_historical_statistics_roll_up.pdf) (noting 168 IPX filings in fiscal year 2008), with U.S. PATENT & TRADEMARK OFFICE, TRIAL STATISTICS (June 2018), [https://www.uspto.gov/sites/default/files/documents/trial\\_statistics\\_20180630.pdf](https://www.uspto.gov/sites/default/files/documents/trial_statistics_20180630.pdf) (noting 1,117 IPR filings in fiscal year 2018).

9. See, e.g., Brian J. Love, Shawn P. Miller & Shawn Ambwani, *Determinants of Patent Quality: Evidence from Inter Partes Review Proceedings*, 90 COLO. L. REV. 67 (2019) (looking at outcomes of inter partes review); Saurabh Vishnubhakat, Arti K. Rai & Jay P. Kesan, *Strategic Decision Making in Dual PTAB and District Court Proceedings*, 31 BERKELEY TECH. L.J. 45 (2016) (providing a high-level look at filings in district court and IPR for the period from 2011 to 2015); Brian Love & Shawn Awbani, *Inter Partes Review: An Early Look at the Numbers*, 81 U. CHI. L. REV. DIALOGUE 93 (2014) (looking at statistics of the first two years of IPR).

10. Vishnubhakat, Rai & Kesan, *supra* note 9.

majority of inter partes review requests are filed by district court defendants, only a small minority of district court defendants file such challenges.<sup>11</sup> In this Article, we build on this foundational work by constructing a comprehensive database of all administrative challenges filed over a decade. We expand the scope of the earlier study to include three more years of inter partes review requests (through 2018) and also consider earlier administrative challenges—inter partes reexamination requests—filed between 2008 and 2012. This allows us to observe broad trends in administrative challenge use over time and any changes that occurred after the passage of the American Invents Act of 2011 (AIA).<sup>12</sup> Importantly, we also expand the depth of the analysis to consider not just challenge filings but also important characteristics of the district court cases that usually precede administrative challenges. We collect data on parties, judges, and patents in order to identify which characteristics best predict whether a defendant will use an administrative challenge in a given case.

Our comprehensive study into the use of administrative challenges by district court defendants has implications in three broad areas of policy. First, understanding how defendants actually use administrative challenge procedures can help inform the design, evaluation, and refinement of these procedures. Empirical work can identify, for example, whether cases of particular policy interest are using administrative procedures. In particular, administrative patent review systems could have differential effects on small entity inventors, which may be particularly sensitive to the cost of litigation and have been shown to be “at a significant disadvantage in protecting their patent rights.”<sup>13</sup> The rise of patent assertion entities (PAEs)—firms that profit from acquiring patents and enforcing patent rights instead of using them to make actual products—

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11. *See id.* at 69 (finding that from 2011 to 2015, 86.7% of patents challenged in IPR (or the more rarely used covered business method review) were also being litigated in the federal courts, but that only “15.2% of litigated patents were also being challenged at the PTAB”); *see also id.* at 46 (finding that seventy percent of IPR petitioners follow the “standard model” where district court defendants subsequently bring an IPR).

12. Leahy-Smith America Invents Act, Pub. L. No. 112-29, codified at 35 U.S.C. § 311 (2011).

13. *See, e.g.,* Jean O. Lanjouw & Mark Schankerman, *Protecting Intellectual Property Rights: Are Small Firms Handicapped?* 47 J.L. & ECON. 45 (2004) (finding that “small patentees are at a significant disadvantage in protecting their patent rights” compared to patentees with a large portfolio of patents).

has generated significant concern.<sup>14</sup> Policymakers might want to design the system in a way that encourages defendants in suits brought by PAEs to challenge the asserted patent.

Most concretely, Congress passed a major reform to the administrative patent challenge system under the AIA. The AIA replaced the system of administrative challenges that had existed since 1999—inter partes reexamination—with an entirely new procedure called inter partes review.<sup>15</sup> Empirical study of the use of these procedures could determine whether this reform had its intended effects, or whether it altered the use of administrative challenges in unexpected ways. Our study informs each of these elements of policy design and evaluation: we separate out small entity patents, PAE cases, and the periods before and after the AIA for particular scrutiny.

Second, understanding a defendant's choice of venue is important in its own right. A separate literature has emerged to consider "strategic decision making" between administrative challenges and Article III courts.<sup>16</sup> Some scholars and practitioners have theorized about when litigants should request an administrative challenge. Perhaps most notably, existing literature has stressed the interplay between administrative challenges and settlement negotiations, arguing that actually filing a challenge might counterintuitively reduce a defendant's leverage when the parties are looking to settle.<sup>17</sup> Scholars have suggested that defendants behave differently when before a particular court or presiding judge,<sup>18</sup> and that defendants are better off before the patent office when the patent or the prior art "involves complex technology."<sup>19</sup> However, few if any of these theories have been compared with observed behavior. In this

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14. See, e.g., Christopher A. Cotropia et al., *Unpacking Patent Assertion Entities (PAEs)*, 99 MINN. L. REV. 649, 651 (2014) (surveying concerns associated with PAEs).

15. American Inventors Protection Act of 1999, Pub. L. No. 106-113, codified at 35 U.S.C. § 312(a) (1999); Leahy-Smith America Invents Act, Pub. L. No. 112-29, codified at 35 U.S.C. § 311 (2011).

16. We borrow this phrase from one of the most important existing studies on this topic. See generally Vishnubhakat, Rai & Kesan, *supra* note 9.

17. Cf. Roger Shang & Yar Chaikovsky, *Inter Partes Reexamination of Patents: An Empirical Evaluation*, 15 TEX. INTELL. PROP. L.J. 1 (2006). Note that this suggestion is based in the IPX regime, where challenges are much more difficult to terminate than in IPR. This is one of the reasons that IPR might be more appealing than IPX, which we discuss further in Part II.

18. See *id.* at 21–22. (discussing judge and jury-dependent considerations that a defendant might take into account in a patent action).

19. *Id.*

paper, we test these hypotheses, asking how these factors are associated with challenge rates in the real world.

Third, our Article helps to provide needed context to existing empirical literature. While important, the growing body of empirical work has primarily focused on observed challenges, noting that both procedures have invalidated the vast majority of patent claims before them,<sup>20</sup> with only high-quality patents managing to survive.<sup>21</sup> To accurately understand the *effects* of administrative challenge procedures, we must first understand when and *how* they are used. The fact that defendants only rarely use administrative challenges<sup>22</sup> raises the question of whether observed challenges are at all representative of the broader world of patent disputes.<sup>23</sup> Would high invalidation rates be surprising if only the lowest quality patents were challenged at the patent office?<sup>24</sup> Does the observation that certain patents fare better or worse in administrative challenges hinge on these patents being over- or under-represented relative to district court litigation? Questions of selection bias thus pose a serious hurdle to the evaluation of administrative review procedures.<sup>25</sup> In this Article, we attempt to model these selection

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20. See, e.g., Love & Ambwani, *supra* note 9; Shang & Chaikovsky, *supra* note 17.

21. See, e.g., Love, Miller & Ambwani, *supra* note 9, at 68 (finding empirical results that “suggest that inter partes review is, as Congress intended, eliminating patents that appear to be of relatively low quality”).

22. See Section II *infra*.

23. Cf. George L. Priest & Benjamin Klein, *The Selection of Disputes for Litigation*, 13 J. L. STUD. 1 (1984) (examining the differences between cases resolved in the settlement process and those that are litigated to a definite verdict).

24. See Colleen Chien, Christian Helmers & Alfred Spigarelli, *Inter Partes Review and the Design of Post-Grant Patent Reviews*, 33 BERKELEY TECH. L.J. 817, 844 (2018) (arguing that “any invalidation rates must be understood in context, as the share of invalidated patents among all patents whose validity was challenged is the result of a number of selection mechanisms, both as imposed by the U.S. tribunal in the case of the institution decision and by the parties, through their decisions to settle”).

25. See, e.g., Love, Miller & Ambwani, *supra* note 9, at 161 (“[W]e nonetheless acknowledge that our findings likely reflect some degree of selection bias . . .”). A notable exception is Talia Bar & Brendan Costello, *Patent Validity Challenges and the America Invents Act* (U.Conn. Dep’t Econ. Working Paper Series, Working Paper 2017-21R, 2018), a companion paper to this piece. In that work, we employ a selection model to control for selection bias in an evaluation of IPX and IPR outcomes. That paper only deals with selection bias incidentally, using a small sample of cases to mechanically control for selection bias in a narrow window around the AIA policy change. Here, by contrast, we substantively engage with the question of selection: presenting the legal

effects, so that future literature on the effects of inter partes review can understand and account for them.

The remainder of this Article proceeds as follows. In Part II, we provide background information on the system of administrative patent challenges, compare these procedures with litigation, and survey existing literature. In Part III, we draw upon that background to formulate several hypotheses about the ways in which defendants use administrative challenges. We argue that the district and judge in the infringement case are likely to have a substantial effect on the decision to request an administrative challenge. Further, we expect that cases leading to administrative challenges are those cases that are unlikely to settle early. As a corollary, we expect cases involving PAEs to result in challenges less frequently. Because the AIA introduced both changes that are appealing to potential challengers, and changes that are unappealing to potential challengers, we argue that certain cases should have been far more impacted by the reform than others.

In Part IV, we present the methodology of our study and a preliminary look at the rate of administrative challenge use. The base of our dataset is sixty thousand patents litigated between 2008 and 2015. Each observation is a patent-case, meaning that if a number of patents were asserted under one case number, we split them into separate observations for each asserted patent. We then match each patent-case to any inter partes reexamination or inter partes review requests of the same patent filed by one of the parties to litigation within eighteen months. We find that *less than ten percent of cases* lead to a challenge. A portion of this low rate can be explained by statutory ineligibility: removing patents litigated during the pre-AIA period that were ineligible for inter partes reexamination by statute, we find that the rate of challenges rises slightly among eligible cases, but still remains fewer than one in ten. We also find that the raw statistics are misleading due to changes in defendant joinder under the AIA, which tend to separate what would have usually been one case into multiple cases. Controlling for joinder changes, our best estimate of the challenge rate rises to just eleven percent, or just over one in ten.

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theories underlying selection between an Article III court and an administrative challenge, and testing each theoretical prediction against a sample several times larger, in order to generalize about selection patterns across a broader era.

Still, the rate of challenge use appears to be increasing over the sample period.

Our data does not allow us to disaggregate the reasons why defendants decline to file administrative challenges in nine of every ten cases. As a theoretical matter, not every defendant will have a colorable challenge to validity that falls within the scope of an IPX/IPR petition; the rate of challenge within the set of cases with reasonably strong validity challenges might be considerably higher. Further, our data lends support for one simple explanation for why many cases do not lead to challenges: over half of the non-challenged cases in our sample settled or otherwise terminated early within one year.

In Part V we consider the effect of the infringement suit venue on the decision to request an administrative challenge. We find significant heterogeneity across districts. Even within the top twenty-five most common districts, challenge rates range from about one in five to two out of every hundred. Importantly, these differences persist even within a district, as there are significant differences in challenge rates across particular judges. Part of this effect could be explained by differences in docket management, where certain judges deter challenges by moving quickly or pushing the parties into an early settlement.

In Part VI we look deeper into the patents at-issue in cases that result in administrative challenges. We find that both intrinsic and acquired characteristics of the underlying patents are important predictors of administrative challenge. In particular, we find some support for the idea that challenged patents are of especially high value when compared to other litigated patents, when the latter patents remain in district court litigation for at least a year. We find that both small entity patents and patents asserted by PAEs are less likely to be challenged administratively. However, both of these results can be explained by early settlements.

Finally, in Part VII we find some empirical evidence to support the visual observation of increased administrative challenges since the passage of the America Invents Act. Controlling for observed patent characteristics, we find that patents that were litigated after September 16, 2012, when the AIA took effect, were more likely to be challenged administratively. This suggests that parties to litigation are more willing to use inter partes review than they were to use inter partes reexamination. Further, we find evidence that not only the prevalence but also the selection of administratively challenged patents changed in the post-AIA period.

## II. THE PROS AND CONS OF ADMINISTRATIVE CHALLENGES

In this Part, we provide a background on the venues of validity challenge in the United States, from district court, to inter partes reexamination, and concluding with inter partes review. We consider the benefits and drawbacks to use of each procedure by litigants, with a particular emphasis on alleged infringers (defendants in an infringement suit). Along the way, we also survey the existing literature and note relevant empirical findings. In the Appendix, we present a summary of the information described in this Part as Table A1.

### A. THE BASELINE: DISTRICT COURT

Several patent systems in the world allow third parties to challenge the validity of granted patents as one measure aimed at improving patent quality.<sup>26</sup> For most of its history, the United States was not one of them. After a patent was deemed valid and issued in the original examination process, the role of the patent office was largely over.<sup>27</sup> Challenges to the validity of issued patents were instead made in the district courts.<sup>28</sup> Of course, the set of patents that are litigated in district courts is likely to be heavily selected. Earlier studies have shown that both acquired<sup>29</sup> and intrinsic<sup>30</sup> characteristics of patents are

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26. The most notable example is the European Patent Office (EPO). For background and an empirical study on the use of so-called patent opposition at the EPO, see Dietmar Harhoff & Markus Reitzig, *Determinants of Opposition Against EPO Patent Grants—The Case of Biotechnology and Pharmaceuticals*, 22 INT'L J. INDUS. ORG. 443 (2004).

27. One notable exception was the existence of reissue patents, where the validity of the patent again became the subject of inquiry for the patent office, and third parties could submit evidence of invalidity during the reissue examination. See, e.g., *In re Hall*, 781 F.2d 897, 897 (Fed. Cir. 1986) (“A protest was filed during prosecution of appellant’s reissue application which included [invalidating prior art].”).

28. In the typical case we consider here, the parties seeking invalidation are the defendants in an infringement suit. It is, of course, possible for these parties to be the plaintiff if they begin a lawsuit for declaratory judgment.

29. See generally Colleen V. Chien, *Predicting Patent Litigation*, 90 TEX. L. REV. 283 (2011) (investigating factors that predict whether a particular patent will be litigated and discovering that the important predictors of litigation include so-called “acquired characteristics” of a patent that are realized after its issuance, such forward citations and assignment). Note that Professor Chien’s article inspired the title for this Article.

30. See generally Jean O. Lanjouw & Mark Schankerman, *Characteristics of Patent Litigation: A Window on Competition*, 32 RAND J. ECON. 129 (2001) (finding that significant predictors of litigation include both intrinsic

important in predicting litigation; these characteristics tend to suggest that litigated patents are of broader scope and higher value relative to all issued patents.<sup>31</sup>

When dragged into district court by a patent holder, a defendant may counter with a common defense to infringement: that the patent claims at-issue are invalid.<sup>32</sup> For hundreds of years, the judicial branch has been in the business of invalidating patents.<sup>33</sup> The Patent Act explicitly contemplates this defense.<sup>34</sup> One district court, in considering the bar for defending on ground of invalidity, argued that “[n]o federal court of appeals has considered how the *Twombly* and *Iqbal* decisions apply to patent invalidity counterclaim or affirmative defense pleadings” and that “[d]istrict courts . . . have reached conflicting results.”<sup>35</sup> By contrast, one study has found that most courts typically do apply *Iqbal* and *Twombly* in cases of counterclaims, but concedes that there is less clarity on which standards apply to defenses.<sup>36</sup> In any event, it appears clear that

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characteristics, including claims, and acquired characteristics that describe the patent owner); Alan C. Marco & Richard D. Miller, *Patent Examination Quality and Litigation: Is There a Link?*, 26 INT’L J. OF ECON. OF BUS. 65, 87 (2019) (finding evidence that broader patents are more likely to be involved in litigation, identifying several examination markers that help predict litigation, and finding that several of the “most impactful variables are defined prior to any examination”).

31. See Marco & Miller, *supra* note 30, at 82, 87.

32. Of course, the defendant could also argue non-infringement, or allege a number of other affirmative defenses created by statute or the courts. See PETER MENELL, MARK A. LEMLEY & ROBERT P. MERGES, *INTELLECTUAL PROPERTY IN THE NEW TECHNOLOGICAL AGE* 404 (2017) (noting the existence of other court-recognized defenses such as experimental use).

33. See, e.g., *Consol. Elec. Light Co. v. McKeesport Light Co.*, 159 U.S. 465 (1895) (holding in an infringement suit for an electric light patent in broader Edison-Sawyer/Mann contest that a patent by Sawyer-Mann was invalid because its description was too broad to enable someone to create the bulb without “painstaking experimentation”); see also B. Zorina Khan, *Property Rights and Patent Litigation in Early Nineteenth-Century America*, 55 J. ECON. HIST. 58, 70–85 (1995) (providing a general discussion of patenting and the legal system in the United States).

34. See 35 U.S.C. § 282(b) (listing “invalidity of the patent . . . on any ground specified in part II as a condition of patentability” as one of the “defenses in any action involving the validity or infringement of a patent”).

35. *Graphic Packaging Int’l, Inc. v. C.W. Zumbiel Co.*, No. 1:10-cv-3008-AT, 2011 U.S. Dist. LEXIS 135675 (N.D. Ga. Aug. 1, 2011). See generally *Ashcroft v. Iqbal*, 556 U.S. 662 (2009); *Bell Atl. Corp. v. Twombly*, 550 U.S. 554 (2007).

36. Conrad Gosen & Tasha Francis, *The Confusing and Often Contradictory World of Pleading Defenses and Counterclaims in Patent Cases*, IPO L.J. (2015). See also Sarah E. Jack, Note, *Restoring Equilibrium: Why Twombly and Iqbal Should Apply to All Pleadings in Patent Cases*, 103 IOWA L.

the standard applied will be less than or equal to *Iqbal* and *Twombly*.

Assuming the case has now survived a motion to dismiss, under whatever standard the court applies, the burden now falls on the defendant to prove invalidity.<sup>37</sup> This burden can be substantial, as patents challenged in the district court are presumed valid by statute.<sup>38</sup> Further, the standard for proof is “clear and convincing evidence”—higher than the typical preponderance of the evidence standard in civil litigation.<sup>39</sup> Still, defendants attempting to prove invalidity have ample opportunities to do so. The set of invalidating evidence at this stage can generally relate to any ground that would have been a condition of patentability.<sup>40</sup> And, as in any civil action, the parties often engage in significant discovery, and can retain experts to testify.

Of course, this evidence is rarely presented at trial, because trials rarely occur. Consistent with litigation generally, the vast majority of patent suits settle before a decision on the merits can be reached.<sup>41</sup> Even when a decision on the merits is reached, it need not be at trial. Rather, the court might decide issues of validity by summary judgement. In fact, when courts do reach a decision on validity, they typically do so at an earlier procedural stage than infringement.<sup>42</sup> Still, we note that this reality does not necessarily undermine our claims regarding cost.<sup>43</sup> Kesan

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REV. 1301 (2018) (finding that “[c]ourts only inconsistently apply plausible pleading to counterclaims and affirmative defenses”).

37. See 35 U.S.C. § 282(a) (“The burden of establishing invalidity of a patent or any claim thereof shall rest on the party asserting such invalidity.”).

38. See *id.* (“A patent shall be presumed valid.”).

39. MENELL ET AL., *supra* note 32.

40. See 35 U.S.C. § 282(b) (One defense is “invalidity of the patent . . . on any ground specified in part II as a condition of patentability”). See also MENELL ET AL., *supra* note 32, at 209 (examining assertions of invalidity by particular grounds, including utility, obviousness, double-patenting, and inappropriate inventorship).

41. See Jay P. Kesan & Gwendolyn G. Ball, *How Are Patent Cases Resolved—An Empirical Examination of the Adjudication and Settlement of Patent Disputes*, 84 WASH. U. L. REV. 237, 259 (2006) (noting that “approximately 80% of patent cases settle”).

42. See *id.* at 277 (finding that “rulings of invalidity tend to occur at an earlier procedural stage compared with rulings of infringement”).

43. Recall that an inordinate amount of expenses are still realized even if a case settles or ends in summary judgement immediately after discovery. See AM. INTELLECTUAL PROP. L. ASS’N, REPORT OF THE ECONOMIC SURVEY 37 (2015) [hereinafter AIPLA REPORT], <http://files.ctctcdn.com/e79ee274201/b6ced6c3-d1ee-4ee7-9873-352dbe08d8fd.pdf> (comparing median

and Ball explicitly caution that early does not mean cheap: “obtaining a pre-trial ruling—particularly pertaining to invalidity—can be very expensive in patent cases.”<sup>44</sup>

All told, district courts appear to rarely invalidate patents—only about two percent of cases result in the invalidation of one or more patent claims.<sup>45</sup> This is largely driven by the fact that courts rarely adjudicate validity at all; Lemley and Allison find that when ruling, courts hold patents valid 54 percent of the time.<sup>46</sup> Because the court fails to adjudicate validity in a vast majority of cases, we might expect that many invalid patents are left in the economy.

## B. INTER PARTES REEXAMINATION

Aware of the tremendous cost of litigating a patent dispute in the district courts, Congress has acted over the last four decades to create a series of administrative alternatives to determine validity.<sup>47</sup> In 1999, the American Inventors Protection Act (AIPA) created inter partes reexamination (IPX), an administrative proceeding that could be used to adjudicate validity.<sup>48</sup> Compared to existing ex parte reexamination, this new procedure allowed more participation by the requesting party.<sup>49</sup> While the AIPA created IPX to run alongside the ex

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patent infringement litigation costs through mediation, discovery, and all costs).

44. *Id.*

45. Kesan & Ball, *supra* note 41, at 275 (citing data from cases in 1995, 1997, and 2000).

46. Mark A. Lemley & John R. Allison, *Empirical Evidence on the Validity of Litigated Patents*, 26 AIPLA Q.J. 185, 205 (1998).

47. In 1980, Congress created ex parte reexamination to allow parties to challenge the validity of a patent in a “relatively inexpensive” way. *See* Farrell & Merges, *supra* note 6, at 965 (citing congressional transcripts to show that Congress was apprised of high-cost district court litigation and its intention was for reexamination to be a “relatively inexpensive” alternative to adjudicate patent validity). In 1999, this initial procedure was supplemented by the creation of inter partes reexamination (IPX). *Id.*

48. *See* United States Patent and Trademark Office, Manual of Patent Examining Procedure (MPEP) § 2601 (9th ed., rev. Jan. 2018) (“The reexamination statute was amended on November 29, 1999 by the American Inventors Protection Act of 1999 (the AIPA), Public Law 106-113. The AIPA expanded reexamination by providing an ‘inter partes’ option; it authorized the extension of reexamination proceedings via an optional inter partes reexamination procedure in addition to the existing ex parte reexamination procedure.”).

49. *See* United States Patent and Trademark Office, MPEP § 2609 (8th ed., rev. Aug. 2012) (“[A] third party requester may participate throughout the proceeding . . .”).

parte system, their relative features made it likely that IPX will be the preferred mechanism for third parties, while ex parte requests would be used predominantly by patent owners themselves seeking to test their patents.<sup>50</sup>

A party who wished to institute an IPX must first overcome the threshold question of whether they raised a “substantial new question of patentability.”<sup>51</sup> IPX was denied rarely, only about ten percent of the time.<sup>52</sup> Further, IPX petitioners could not raise the full range of grounds for invalidity and supporting evidence. They must only rely on documentary prior art to question novelty and nonobviousness.<sup>53</sup> Professor Janis notes that this restriction practically guaranteed that IPX would “never serve as a fully effective alternative to validity litigation,” because it excludes invalidity theories like on sale and public use.<sup>54</sup>

Once an IPX was instituted, it proceeded before patent examiners, similar to the original prosecution, with third parties having a right to participate via written comments.<sup>55</sup> The patent office at this stage considered the validity of the granted claims. Once started, this train was difficult to stop. Parties were not formally able to settle an IPX midway through—once instituted, IPX challenges continued to completion.<sup>56</sup> Of course, third

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50. See Mark D. Janis, *Inter Partes Patent Reexamination*, 10 FORDHAM INTELL. PROP., MEDIA & ENT. L.J. 481, 484 (2000) (“Nevertheless, it seems likely that the ex parte provisions will become almost exclusively the domain of patent owner-initiated reexaminations, and the inter partes provisions will become almost exclusively the domain of third-party initiated reexaminations.”).

51. See MPEP § 2616 (“Under 35 U.S.C. 312 and 313, the Office must determine whether ‘a substantial new question of patentability’ affecting any claim of the patent has been raised.”); see also 35 U.S.C. § 312(a) (1999) (providing the statutory requirements for petition).

52. See Bar & Costello, *supra* note 25, at 13 (finding IPX denials to be about 8 percent of all IPX outcomes in a window of time pre-AIA, and 13 percent of all outcomes in the last year of IPX before the switch to IPR).

53. See MPEP § 2609 (“Prior art considered during reexamination is limited to prior patents or printed publications applied under the appropriate parts of 35 U.S.C. § 102 and 103 . . . .”); see also MPEP § 2660 (“In rejecting claims for want of novelty or for obviousness, the examiner must cite the best references at his or her command.”). Note, § 102 refers to novelty and § 103 refers to obviousness.

54. Janis, *supra* note 50, at 487.

55. *Id.* at 490; See also MPEP § 2609 (“[A] third party requester may participate throughout the proceeding . . . .”).

56. See Shang & Chaikovsky, *supra* note 17 (“Once a reexamination request is filed, the challenger cannot revoke it, and the PTO will examine the patent to the finish regardless of settlement status. Therefore, once the request is filed, the challenger’s promise to stop participating in

parties could settle and then withdraw from participation, reducing the IPX to effectively a limited ex parte request.<sup>57</sup> Our related research on the outcomes of patent challenges indicates that over two-thirds of eventual IPX outcomes include at least some claims cancellations.<sup>58</sup> Our related research also indicates that about a quarter include at least some claims confirmations, and another quarter include some form of amendment or added claims.<sup>59</sup>

All told, the IPX procedure was relatively cheap in terms of pecuniary cost,<sup>60</sup> but could still be very costly in terms of time. The median pendency of an IPX from filing to a final reexamination certificate is over three years.<sup>61</sup> Still, this measure is probably biased upwards somewhat due to the fact that the certificates are only issued after any appeals. Parties could appeal an IPX decision to the Board of Patent Appeals and Interferences, and patent owners could appeal further to the Federal Circuit.<sup>62</sup>

While IPX could be used as a standalone procedure for parties to adjudicate the validity of a patent, its potential for use alongside litigation was quickly realized. The AIPA includes a provision that states that district courts “may” obtain a stay “unless the court before which such litigation is pending determines that a stay would not serve the interests of justice.”<sup>63</sup> Professor Janis has noted that this provision appears unnecessary, as courts already had inherent authority to stay litigation in such cases.<sup>64</sup> In any event, this provision at least

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reexamination will have no settlement value for ex parte proceedings, and limited value for inter partes proceedings.”). *But see* Scott McKeown, *Settlement Agreements and Patent Reexamination*, ROPES & GRAY: PATENTS POST-GRANT (Jan. 5, 2012) <https://www.patentspostgrant.com/settlement-agreements-patent-reexamination/> (arguing that in theory settling parties may be able to stop an IPX by obtaining a consent order in district court that could trigger IPX estoppel, but conceding that “[i]n practice, defendants rarely agree to such a consent order . . .”).

57. *See id.* (“Without the challenger, the inter partes proceeding effectively resembles an ex parte proceeding . . .”).

58. Bar & Costello, *supra* note 25, at 38.

59. *Id.*

60. *See* RATNERPRESTIA, *supra* note 3.

61. U.S. Patent & Trademark Office, *Inter Partes Reexamination Filing Data* (Sept. 30, 2017), [https://www.uspto.gov/sites/default/files/documents/inter\\_parte\\_historical\\_statistics\\_roll\\_up.pdf](https://www.uspto.gov/sites/default/files/documents/inter_parte_historical_statistics_roll_up.pdf).

62. MPEP *supra* note 48.

63. 35 U.S.C. § 318 (1999); Janis *supra* note 50, at 497.

64. Janis, *supra* note 50 at 498.

confirms the possibility of bifurcated trials: where pending infringement suits are stayed to adjudicate validity at the patent office before returning to the district court to determine infringement. Gardella and Berger discuss the use of reexamination as a strategic tool by alleged infringers to stay pending litigation.<sup>65</sup> They predict that success in the reexamination system will cause patent holders to file narrower patents that are less likely to be invalidated in these proceedings.<sup>66</sup>

Of course, adjudicating validity at the patent office would be less meaningful if the parties could then return to the district court and have a second bite at the apple. To prevent this, Congress attached an estoppel provision meant to prevent challengers from “re-litigating a validity issue in court following an unsuccessful effort to invalidate through reexamination,” or vice versa.<sup>67</sup> Rightfully, this estoppel exempts challenge grounds that were outside of IPX’s scope by limiting it to arguments the requestor “raised or could have raised during the inter partes proceedings.”<sup>68</sup> Still, Professor Janis categorizes the language of the estoppel provisions as overly broad, noting that “the estoppel provisions alone may convince many patent owners to avoid inter partes reexamination.”<sup>69</sup>

Published USPTO statistics indicate that IPX was initially slow to be used, but its use steadily grew.<sup>70</sup> Only twenty-six inter partes reexaminations were filed in its first four years.<sup>71</sup> The next four years saw a still low 282 filings.<sup>72</sup> At least part of IPX’s slow start can be explained by statutory restrictions on its use. Parties are only able to request IPX on patents filed on or after

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65. See generally Greg H. Gardella & Emily A. Berger, *United States Reexamination Procedures: Recent Trends, Strategies and Impact on Patent Practice*, 8 J. MARSHALL REV. INTELL. PROP. L. 381, 381 (2009) (“Some are filing more reexamination requests in an effort to circumvent the high cost of United States patent litigation; this strategy is enabled by the willingness of many districts courts to postpone litigation while the reexamination is pending.”).

66. *Id.* at 382.

67. Janis *supra* note 50, at 492.

68. *Id.* (emphasis omitted).

69. *Id.*

70. See U.S. Patent & Trademark Office, *supra* note 61 (showing that one inter partes reexamination was filed in 2001 and 530 were filed in 2012 with an increase every year).

71. See *id.* (showing zero filed in 2000, one filed in 2001, four filed in 2002, and twenty-one filed in 2003).

72. *Id.*

November 29, 1999.<sup>73</sup> Therefore, for the first few years of IPX, the set of eligible patents was quite small. Filings appeared to be on an upward climb before IPX was discontinued in 2012 by the AIA. There were 1,081 IPX filings between 2008 and 2011, and 530 in 2012 alone.<sup>74</sup>

### C. INTER PARTES REVIEW

In 2011, Congress took another shot at reforming administrative challenge procedures with the Leahy-Smith America Invents Act.<sup>75</sup> First, the AIA changed the standard for granting a request for reexamination, raising the bar from a “substantial new question of patentability” to “a reasonable likelihood that the requester will prevail with respect to at least one claim,”<sup>76</sup> which is expected to increase the rate of reexamination denials.<sup>77</sup> This standard took effect for the final year of IPX and remains in effect for IPR.<sup>78</sup>

Most notably for our purposes, the AIA discontinued IPX effective September 16, 2012.<sup>79</sup> In its place, the AIA created a tripartite system of inter partes review, post-grant review, and

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73. MPEP § 2609 (“Any third party requester can request inter partes reexamination at any time during the period of enforceability of the patent (for a patent issued from an original application filed on or after November 29, 1999) . . .”).

74. See U.S. Patent & Trademark Office, *supra* note 61.

75. Leahy-Smith America Invents Act, Pub. L. No. 112-29 (2011). Note that this law also had many other effects besides those recounted for administrative challenge systems, such as changing to a first-to-file regime.

76. 35 U.S.C. § 314(a) (“The Director may not authorize an inter partes review to be instituted unless the Director determines that the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.”).

77. See, e.g., Matthew Phillips & Kevin Laurence, *Changes to Reexamination Under the America Invents Act*, INTELL. PROP. TODAY (Nov., 2011), <https://www.stoel.com/StoelRives/files/93/9383d92d-ed13-4b0f-8c33-4a38039fcf2f.pdf>.

78. *Id.*

79. MPEP § 2601 (“The Leahy-Smith America Invents Act (the AIA) . . . was enacted September 16, 2011. Section 6(c) of the AIA replaced the inter partes reexamination process, effective September 16, 2012, with a new inter partes review process, such that on or after September 16, 2012 the Office no longer entertains requests for inter partes reexamination but instead accepts petitions to conduct inter partes review.”).

covered business method patent review.<sup>80</sup> For this study, we focus on IPR, as the primary successor to IPX.<sup>81</sup>

Compared to IPX, IPR appears closer to litigation and farther from original patent prosecution. Unlike IPX, IPR allows for the deposition of witnesses and other associated discovery, as well as an oral hearing with administrative patent judges.<sup>82</sup> Stahl and Heckenberg explain that “[t]he new review proceedings may also be more enticing to a patent challenger since they make available to the accused infringer more procedures analogous to those available in patent litigation.”<sup>83</sup> Most notably, the AIA has mandated that IPR proceed expeditiously, with an expected overall timing of eighteen months, half the time expected of IPX.<sup>84</sup> Additionally, in IPX only patents filed after November 29, 1999, could be reexamined while in IPR this restriction was lifted, expanding the set of patents that can be challenged.<sup>85</sup> Finally, parties can seek to settle their dispute and formally end the IPR process.<sup>86</sup>

However, not all changes are beneficial to the requestor. Challenges under the AIA have become substantially more expensive.<sup>87</sup> Furthermore, the estoppel described above has

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80. See 35 U.S.C. § 311–319 (outlining inter partes review); American Invents Act § 18 (outlining covered business methods).

81. The vast majority of cases in our later-constructed sample are filed more than nine months after the patent’s issuance, and are thus ineligible for PGR. In some of our analysis, we match on patent class, which should somewhat obviate the possibility of CBM within our non-challenged group.

82. See *IPX vs. IPR—A Cheat Sheet*, STERN KESSLER GOLDSTEIN FOX, <https://web.archive.org/web/20140402045337/http://ptoligationcenter.com/wp-content/uploads/2009/08/ipx-v-ipr.pdf>. (outlining the differences between hearing characteristics in IPX and IPR).

83. Lawrence A. Stahl & Donald H. Heckenberg, *The Scope and Ramifications of the New Post-Grant and Inter Partes Review Proceedings at the USPTO* 6 (2011), <https://s3.amazonaws.com/documents.lexology.com/e4bd1e8a-651e-40e2-9f7d-f45e80b9deab.pdf> D (last visited May 2, 2020).

84. IPR is given statutory time restrictions: six months to reach an institution decision (grant or deny), split into a three-month period for patent owner response (37 C.F.R. § 42.107) followed by another three-month period for USPTO decision (35 U.S.C. § 314). Then another twelve months to reach a final determination (cancel, confirm, etc.) (35 U.S.C. § 316). Limited six-month extensions can be granted “for good cause shown.” Thus, we would expect most IPRs to reach a final decision within eighteen months, or 1.5 years.

85. See *IPX vs. IPR—A Cheat Sheet*, *supra* note 82, at 1 (stating the differences between reexamination criteria in IPX and IPR).

86. *Id.*; see also Erik Hovenkamp & Jorge Lemus, *Delayed Entry Settlements at the Patent Office*, 54 INT’L REV. L. & ECON. 30 (2018) (examining IPR settlements).

87. See RATNERPRESTIA, *supra* note 3.

become more restrictive under IPR. Estoppel now binds earlier (before appeals), and restricts both district court and future PTO actions.<sup>88</sup>

Perhaps even more so than IPX, Congress appears to have contemplated IPR as a way to bifurcate litigation. The AIA prohibits parties from filing an IPR if they were served with an infringement complaint more than one year ago.<sup>89</sup> This incentivizes parties to avoid redundancy between the district court and the patent office by requiring them to quickly file an IPR before the district court proceedings has moved too far along.

In one early empirical contribution, Professors Chien and Helmers trace the path of a typical inter partes review.<sup>90</sup> They note, importantly, that the headline number of invalidations in IPR must be understood “in context,” as many challenged claims are denied review before reaching a final decision.<sup>91</sup> In another recent contribution, Professors Vishnubhakat, Rai, and Kesan provide an important study on the strategic use of IPR by parties in litigation.<sup>92</sup> They find that the majority (seventy percent) of inter partes review validity challenges are brought by district court defendants.<sup>93</sup> They also note that the Eastern District of Texas has a reluctance to grant stays, but that parties from there (as well as the District of Delaware and Northern District of California) see a disproportionate number of IPR petitions.<sup>94</sup> In our study, we attempt to expand on this foundational work in three ways: (i) by focusing explicitly not just on the court cases that led to IPR, but also those that chose not to use it, (ii) by using patent characteristics to predict which cases will use IPR, and (iii) by including not just IPR filings but IPX filings which allows us to examine whether the AIA policy change affected the use of administrative proceedings to challenge patent validity.

Finally, we note as a measure of stakes that the IPR process has already generated significant controversy. Its very constitutionality was questioned before the Supreme Court,

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88. See *IPX vs. IPR—A Cheat Sheet*, *supra* note 82, at 2 (outlining the differences between estoppel in IPX and IPR).

89. 35 U.S.C. § 315(b).

90. See generally Chien, Helmers & Spigarelli, *supra* note 24.

91. *Id.* at 844. This important insight, however, has no bearing at this study, as we look at the filing of an IPR and not its final conclusion.

92. See generally Vishnubhakat, Rai & Kesan, *supra* note 9.

93. *Id.* at 49.

94. *Id.* at 80.

though it eventually survived.<sup>95</sup> Likewise, it has been criticized on policy grounds, having been referred to as a patent “death squad,” accused of having anti-patent slant and harming innovators.<sup>96</sup> Still, our early research investigating the effect of the policy change has found no evidence that the policy change introduced a negative bias against the patentee in reexamination.<sup>97</sup> Controversy aside, IPR seems to be becoming increasingly popular. IPR surpassed three thousand requests in its first three years—over one thousand requests more than IPX in its entire thirteen-year tenure.<sup>98</sup>

### III. SELECTION HYPOTHESES: WHO MIGHT PREFER WHAT?

In the last Part, we have shown that litigation, IPX, and IPR differ in important respects. Here, we summarize the key differences and hypothesize why parties in certain cases may or may not choose to use administrative review.

First, we expect that the rates of administrative challenge will vary considerably by district. Other work has shown that there is significant evidence of “court shopping” going on in patent cases.<sup>99</sup> If plaintiffs select into districts depending on their litigation strategies, plaintiffs that select into a particular district may litigate in particular ways that would push defendants toward or away from using an administrative challenge. Of course, particular tendencies of the courts might also have an effect on defendants’ willingness to request an administrative challenge. Districts that are especially hostile to stay requests or especially proficient in patent litigation, for

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95. See *Oil States Energy Serv., LLC v. Greene’s Energy Grp., LLC*, 138 S. Ct. 1365, 1369 (2018) (holding that inter partes review does not violate article III of the U.S. Constitution).

96. See, e.g., Brian Mahoney, *Software Patent Ruling a Major Judicial Failure, Rader Says*, LAW360 (Oct. 25, 2013), <https://www.law360.com/articles/482264> (quoting Chief Judge Rader, who used the “death squad” language in a speech). See also Paul Morinville, *How the Patent Trial and Appeal Board Harms Inventors*, IPWATCHDOG, (Sept. 13, 2016), <http://www.ipwatchdog.com/2016/09/13/how-the-patent-trial-and-appeal-board-harms-inventors/id=72554/> (presenting comments describing this view of the PTAB).

97. See Bar & Costello, *supra* note 25.

98. See U.S. PATENT & TRADEMARK OFFICE, PATENT TRIAL AND APPEAL BOARD STATISTICS (Sept. 30, 2015), <https://www.uspto.gov/sites/default/files/documents/2015-09-30%20PTAB.pdf>.

99. See, e.g., J. Jonas Anderson, *Court Competition for Patent Cases*, 163 U. PA. L. REV. 631 (2015).

example, might deter use of an administrative challenge.<sup>100</sup> This latter effect might also persist with respect to individual judges. Even within a certain court, a particular judge might have a penchant for speedy docket management, or an aversion to granting stays.<sup>101</sup> We test for differential effects of courts and judges in Part V.

Of course, while particular districts and judges can provide constraints on case management, there is still room for substantial heterogeneity in litigating strategies. Certain classes of plaintiffs might be able to deter administrative challenges. Put another way, defendants might be more or less willing to use an administrative challenge depending on the type of party accusing them of infringement. One obvious factor is the desire of parties to reach quick settlements. Cases that settle quickly do not meaningfully challenge validity in any venue. And, on the other side of the coin, parties that intend to settle quickly might not actually request an administrative challenge, preferring instead to hold it in front of the plaintiff's nose as leverage.<sup>102</sup> Therefore, we might expect that a substantial portion of our non-challenged cases were those that simply settled quickly. We test this finding in Section IV.D.

A corollary is that we might expect plaintiffs who wish to settle early to deter the filing of an administrative challenge. PAEs immediately come to mind, as they have been theorized in other work to potentially have “a greater willingness . . . to settle litigation.”<sup>103</sup> The same might be true of small entity patents, but for a different reason. Small entity patentees are those who qualified for reduced filing fees at the time of examination, and thus might be uniquely unable to bear the costs of litigation. They might also, therefore, seek early settlement, and the litigation might cease prior to the filing of an administrative challenge by defendants. Of course, this presumes that the plaintiff asserting the patent was the original patentee—in Section VI we test for the small entity and PAE effects alongside an indicator for patent re-assignment prior to litigation.

There is also good reason to expect that characteristics of the patent at-issue might affect the decision to challenge the patent's validity in district court versus at the patent office. One

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100. See Shang & Chaikovsky, *supra* note 17, at 23–24.

101. *Id.* at 23.

102. *Id.* at 26.

103. Mazzeo et al., *Do NPEs Matter? Non-Practicing Entities and Patent Litigation Outcomes*, 9 J. COMP. L. & ECON 879, 881 (2013).

paper suggests that the patent office would be preferred when the patent or the relevant prior art “involves complex technology.”<sup>104</sup> While certain inventions in any technology area can, of course, be very complex, or very simple, this advice would tend to suggest differences across technology categories in the rate of administrative challenge use. A defendant might find it easier to explain, for example, a mechanical invention to a generalist judge or lay jury rather than a complex algorithm. By contrast, areas that might fit particularly well to jury nullification—such as invalidating the patent for an expensive drug—might seem more favorable to challenge in the district court. In Section VI, we test for differential challenge rates across patent technology categories.

As we have seen, there are several benefits and drawbacks to IPR as compared with IPX. In particular, IPR is more advantageous to parties sensitive to the cost of time, but less preferred by parties particularly sensitive to pecuniary costs. Clearly, the bar for instituting an administrative challenge is higher than the low bar for alleging invalidity in the district court; this difference is even more pronounced post-AIA. Parties who seek to challenge validity simply to leverage a settlement, without strong grounds of actual invalidity, may prefer to remain in district court, rather than apply for IPX/IPR and get denied. Further, parties who expect to settle may have been unlikely to request IPX, as it restricted the ability of settlement to end the dispute. This concern is limited in IPR, which allows settlements. All else equal, we would expect this shift to increase the number of parties requesting IPR compared with IPX.

Clearly, though, one takeaway is that IPR is not universally beneficial to all defendants relative to IPX. Parties may be especially sensitive to one of its beneficial or detrimental provisions. Therefore, we might expect to see highly heterogeneous effects of the AIA, with certain parties and types of cases more quickly flocking to IPR than others.

#### IV. HOW MANY CASES RESULT IN CHALLENGES?

##### A. METHODOLOGY

The base of our dataset is patent litigation filings. We collected data on litigation from DocketNavigator,<sup>105</sup> searching

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104. See Shang & Chaikovsky, *supra* note 17, at 22.

105. DOCKETNAVIGATOR, <http://docketnavigator.com>.

for all U.S. district court cases that involve a complaint for infringement.<sup>106</sup> DocketNavigator compiles data on every electronically available patent complaint dating back to 2008.<sup>107</sup> Our dataset therefore starts with cases filed on January 1, 2008; we extend the analysis through December 31, 2015.<sup>108</sup> Our unit of analysis is patent-case, meaning that each observation is one case filed in district court for a unique patent. Put another way, each observation in our database is a single litigated patent. If the same patent is subject to two different lawsuits, we will have two observations in our dataset. Likewise, if one lawsuit involves multiple patents, we will have a separate observation for each patent involved in the suit.<sup>109</sup> Our analysis focuses on utility patents.<sup>110</sup>

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106. Specifically, we searched for all cases that contained document types “complaint–infringement” “complaint–infringement–ANDA” or “complaint–infringement–BPCIA.” Of course, the patents involved in any particular case were not necessarily raised in the original infringement complaint. They may have been brought up, for example, in a counterclaim for infringement. But, we expect such cases to be somewhat uncommon, and further when they are present, they should fit well into our mold. They themselves are patent assertions, and would be separated out into separate patent-case observations, to be matched with any IPX or IPR that is filed by a litigation party (in this case, the original plaintiff).

107. PATENT LIBRARY SCOPE OF DATA, <https://compass.docketnavigator.com/help/scope.html> (explaining how DocketNavigator has some data all the way back to 2000, but we use variables for which they only have comprehensive data from 2008 onwards).

108. Technically, DocketNavigator has cases much more recent than 2015, but our end date was set by two constraints. First, as detailed later, we needed to stop collection of litigation cases at some point earlier than our IPR end date to avoid truncation. That is, we wanted every litigation case in our sample to have sufficient time to observe whether an IPR was filed. Second, the dataset on patent assertion entities—a core part of our analysis—only spans through 2015, meaning we would have dropped any litigation cases past 2015 in our eventual analysis anyway.

109. When splitting a single case into multiple observations for every patent at issue, our dataset imputes the date of the initial complaint on each patent. Because patents may be added to one case at different times, this date might not be representative of the actual date that each particular patent was asserted in litigation. We noticed that in a few percent of our cases, the attributed litigation date was earlier than the issue date of the patent. Looking at a sample of docket sheets, this tended to happen when a patent was under review when the litigation was filed, but added to the litigation shortly after it was issued. We correct for this by replacing the case “filing date” with the issue date of the patent whenever the issue date is later than the case filing date.

110. We drop patents with “D” or “P” in the name, to focus on utility patents. As a practical matter, many of these patents would be excluded from our later analysis in any case due to a lack of covariates that cover these patents in the datasets that we use.

Next, we construct a dataset of administrative patent challenges. For the purposes of this study, we focus only on inter partes reexamination and inter partes review. IPX filings are identified via the PatEx database,<sup>111</sup> where they are coded as children in the “Continuity Data” dataset, with the prefix “95.” This source gives us the filing date of each IPX and its associated patent. We collected data on IPRs from DocketNavigator, in a similar method to that used by Vishnubhakat *et al.*<sup>112</sup> This provides us with the patent number and filing date for each IPR challenge.<sup>113</sup> Our available data spans all IPX and IPR challenges filed between January 1, 2008 and December 31, 2018.

The core question we seek to answer is which litigation cases led to the filing of an IPX or IPR challenge, and which did not. Therefore, for each district court patent-case we look to see if we can match it with an IPX or IPR involving the same parties. This matching process may not always be one-to-one. A single district court case may well lead to several administrative challenges—perhaps each defendant files her own challenge, or one defendant files multiple challenges.<sup>114</sup> On the other hand, defendants in multiple cases might band together to file one IPR.<sup>115</sup> To handle this complexity, we first generate each pairwise match of district court and IPX/IPR based on the patent at issue. For example, imagine patent A was litigated three times—cases 1, 2, and 3—and was challenged twice, once each in IPX and IPR. Our pairwise matching would first generate six “potential matches”: case1–IPX, case1–IPR, case2–IPX, case2–IPR, case3–IPX, and case3–IPR. Therefore, we identify every

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111. PatEx is a comprehensive database with a range of bibliographic data on public patents. Public patents are those released in Public PAIR, a subset of the private PALM. This is a dataset of over nine million patents, through December 2014. See Stuart J.H. Graham, et al., *The USPTO Patent Examination Research Dataset: A Window on Patent Processing*, 27 J. ECON. & MGMT. STRATEGY 554 (2018).

112. See Vishnubhakat, Rai & Kesan, *supra* note 9, at 59–60 (discussing inter partes review). We further collapse any IPR filings that were filed on the same date, requesting the review of the same patent, and filed by the same party to one observation. This eliminates double counting of any challenges that were split up into separate filings, for example, to skirt the page limit.

113. *Id.*

114. See *id.* at 47 (noting that “multiple petitions against a patent may be filed by the same or different parties”).

115. See *id.* (noting that “a single petition may be filed or joined by multiple parties”).

possible match combination of district court cases and administrative challenges.

Of course, not every possible combination is a true match that we care about. Instead, we want to limit to the case where one party asserts a patent in district court, and a defending party then challenges the patent in IPX or IPR. As a preliminary matter, we drop any possible matches where the administrative challenge in question was filed prior to the matched district court case.<sup>116</sup> Next, we compare the parties in each case directly. For IPX, data on challengers are not electronically available. Instead, we examine over 1000 potential matches by hand, reading the IPX docket to identify the challengers. IPR parties, by contrast, are electronically available in the DocketNavigator data, so we can make use of electronic matching.<sup>117</sup> In either case, we code a match whenever *at least one* of the parties requesting an administrative challenge is also a party to the district court litigation.

Figure 1 plots the lag (in days) between the filing date of the district court case<sup>118</sup> and the filing date of the administrative challenge for cases with matched parties.<sup>119</sup> Unsurprisingly, we see large spikes in the days leading up to 365, or one year. IPR challenges, by statute, must be filed within one year of a party being sued in district court. Still, approximately fifty percent of

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116. While it is possible that sometimes in one unique dispute the IPX or IPR could come first—by an alleged infringer anticipating or prompting a later infringement suit, Vishnubhakat et al. suggest that such cases are rare. See Vishnubhakat, Rai & Kesan, *supra* note 9, at 76. More often, cases where the administrative challenge precedes the litigation case are likely to simply be false positive matches—unrelated cases.

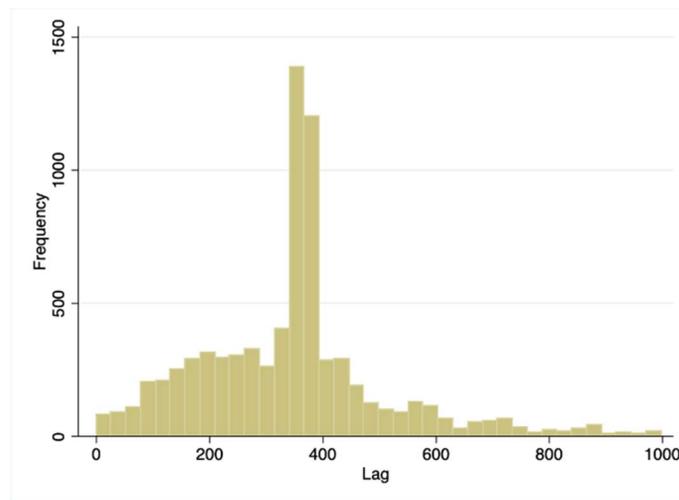
117. We use exact matches, under the theory that party names are consistently written in the DocketNavigator database, which is also the source of our litigation data. To test this, we also perform a “fuzzy match” by identifying a subset of cases that have partial character matches, and then matching those by hand. In our test, we identify an extremely small false negative match rate—around two percent—so we use the exact matching for the whole set.

118. We make one small modification to the case filing date when we move from case to patent-case observations. The case filing date is constant for each patent within a case number, even though patents might be added to the case at varying times. In the unlikely case where a case was filed prior to the issuance of the patent, we know that the patent was not actually asserted in district court until after it was issue, so we recode the effective case filing date to be the patent issue date.

119. A small number (about ten percent) of matches had extremely high lags—over one thousand days. We omitted these observations from the histogram to get a better view of the shape of most of the distribution—but we discuss those observations with high lags in the following sentences.

our matches have a lag greater than 365 days. As Vishnubhakat *et al.* note, some of this is likely due to parties requesting IPR later than one year by virtue of latching on to an earlier case.<sup>120</sup> In our dataset, though, most of this is likely due to IPX matches, which have no such one-year restriction. Still, nearly ninety percent of our matches had lags of eighteen months or fewer.

Figure 1: Lag Between District Court and IPX/IPR Filing for Cases with Matched Parties



At some point, of course, lags become so high that it is hard to consider the litigation case and the administrative challenge as part of the same dispute, even if they involve the same parties. Parties may litigate one case to completion, and then years later may request an administrative challenge as part of another case, or in the absence of a case. In one extreme case, we found that parties to litigation requested an administrative challenge nearly ten years after the litigation complaint was filed. To increase our confidence that the administrative challenge is part of the same dispute, we restrict to matches with lags equal to or less than eighteen months, which allowed us to

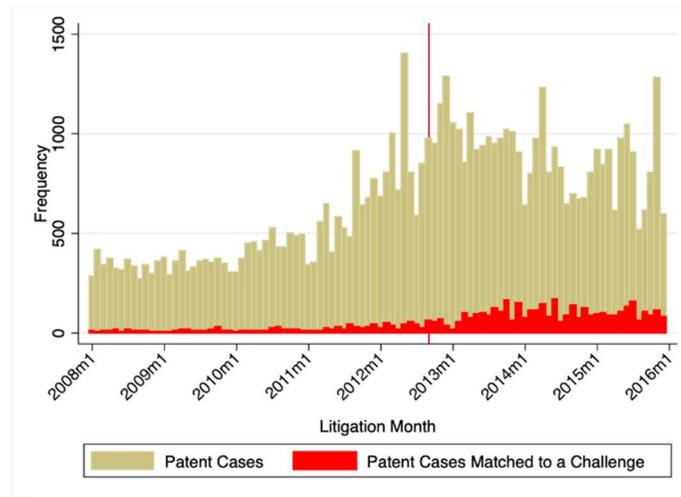
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120. See Vishnubhakat, Rai & Kesan, *supra* note 9, at 78 (noting that “challenges filed more than one year after the last federal court lawsuit . . . are likely to reflect either non-standard petitioners and/or petitioners seeking joinder to earlier petitions”).

retain eighty-seven percent of our matches as occurring within the same dispute.

Next, we merge our identified matches back with our broader litigation sample.<sup>121</sup> As constructed, there are 63,006 patent-case observations in our dataset. In total, 7.5 percent of district court patent-cases actually led to an administrative challenge filing. Figure 2 plots the frequency of cases in our sample over time. Overlaid on this chart is the frequency of cases where we determined that an administrative challenge was filed by the parties (a confirmed match). The vertical line indicates the date of the AIA policy change: the switch from IPX to IPR.

Figure 2: Litigation Filings With and Without an Administrative Challenge over Time



The number of litigation cases increased dramatically in our sample period. The shape of administrative challenge curve appears to loosely follow the litigation curve. The fraction of cases where an administrative challenge is used over the entire period is about eight percent. We are interested to see whether this fraction is about even over the period or changes over time. Table 1 breaks down the rate of administrative challenge by

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121. Recall, some litigation cases may have led to more than one confirmed IPX or IPR match. Because we care about litigation level data for this study, we collapse these to a binary indicator of whether or not the case led to at least one administrative challenge.

year. We test the difference between the fraction of challenges each year, and the fraction in 2008.

Table 1: Rate of Administrative Challenge by Year

Year	Percent of Cases with an Administrative Challenge	Total Cases
2008	3.09%	4,016
2009	3.43%	4,174
2010	3.30%	5,308
2011	3.82% **	6,889
2012	4.00% ***	11,194
2013	9.58% ***	11,718
2014	12.81% ***	9,688
2015	12.02% ***	10,019
2008–2015	7.49%	63,006

\*, \*\*, \*\*\* indicate that the value is statistically different from 2008 at 10%, 5%, and 1% respectively.

The rate of administrative challenge remains between three and four percent of cases between 2008 and 2012, but then more than doubles in 2013. The stars in Table 1 indicate statistical significance of tests of proportion equality between 2008 and each subsequent year. While no significant differences are observed for 2009 or 2010; each year following that date: 2011, 2012 (the IPR transition year) and each IPR year is significantly different from 2008.<sup>122</sup> Indeed, at least facially, the use of administrative challenges seems to have increased dramatically in recent years. Still, we hesitate to tell any sort of causal story based solely on this graph. These results could be driven by changes in other determinants of administrative challenge—that is, the types of patents litigated after 2012 could be

122. The difference in the IPR transition year might be driven by increased challenges in IPR, but in fact there were few IPR challenges in 2012. In fact, the rate of IPX appears to have increased in this year, perhaps because parties were aware of the switch from IPX to IPR, and some desired to request IPX before the policy change.

somehow systematically different from those litigated before. We attempt to separate these underlying characteristics from the AIA regime switch using multivariate regression in Part VII, *infra*.

#### B. CASES WHERE CHALLENGES ARE UNAVAILABLE BY STATUTE

Because we care about the *choice* to use post-grant administrative challenges, we also separate out cases where an administrative challenge was legally unavailable. During the IPX regime, patents that were filed before November 29, 1999, could not be challenged.<sup>123</sup> These patents could, however, be challenged in the newer IPR regime.<sup>124</sup> Therefore, we isolate cases where a lawsuit was filed before the IPR regime (September 16, 2012)<sup>125</sup> and the patent at-issue was filed before November 29, 1999. In these cases, at the time that the defendant was hauled into court, she was not able to request an administrative challenge.<sup>126</sup> Over seventeen percent of cases in our sample meet these criteria. That means that in nearly one-fifth of cases where patent defendants did not request an administrative challenge, *they were statutorily ineligible to do so*.

Table 2 presents a revised yearly challenge rate restricting only to eligible cases. When considering only cases that were eligible for an administrative challenge, the use of administrative challenges appears slightly larger: 9.4 percent of eligible cases involved an administrative challenge.<sup>127</sup> Still, the general trend remains: the fraction of eligible cases with an administrative challenges nearly doubles between 2008 and

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123. See MPEP § 2601, *supra* note 48.

124. See *IPX vs. IPR—A Cheat Sheet*, *supra* note 82.

125. See MPEP § 2601 *supra* note 48.

126. Of course, there is a nuance here: If a party was sued between September 16, 2011 and September 15, 2012, the party would not have been eligible for any existing administrative challenge at the time of the complaint, but would have become eligible for IPR within the one-year time bar once IPR became effective. For purposes of statutory ineligibility, we focus on the fact that at the time the case was filed, administrative challenges were not an option for the defendants. Without having the challenge tool at its disposal at the start of the lawsuit, a party might start down a different path that makes it irrelevant if that tool appears later on. Further, we observe that IPR was barely used at all in its first few months of operation, suggesting that litigants actually in this position did not flock to IPR in large numbers immediately after it popped up. See U.S. PATENT & TRADEMARK OFFICE, *supra* note 98, at 13. We discuss the possible implications of this nuance on any interpretation of an AIA effect more generally in Section VII.A.

127. See Table 2 *infra*.

2015.<sup>128</sup> For the remainder of this analysis, we restrict to only cases where defendants were statutorily eligible to request an administrative challenge at the time of the case filing.

Table 2: Rate of Administrative Challenge by Year for Eligible Cases

Year	Percent of Eligible Cases with an Administrative Challenge	Total Eligible Cases
2008	6.39%	1,941
2009	6.34%	2,254
2010	5.45%	3,213
2011	6.17%	4,263
2012	5.18% **	8,651
2013	9.58% ***	11,718
2014	12.81% ***	9,688
2015	12.02% ***	10,019
2008–2015	9.12%	51,747

\*, \*\*, \*\*\* indicate that the value is statistically different from 2008 at 10%, 5%, and 1% respectively.

### C. THE SKEW FROM DEFENDANT JOINDER

When looking at “case-level” data, one other wrinkle bears noting. The patent-case observations are defined as a unique patent litigated in a unique case number. That is, if a patent is simultaneously litigated against five defendants under one case number, it is treated as one observation. On the other hand, if that same patent is simultaneously litigated against those same five defendants—but under five different case numbers—it will be treated as five observations. This technical change can yield

128. Interestingly, the rate of administrative challenges was actually slightly lower in 2012 than 2008. One possible contributing factor is that once the IPR effective date (September 16, 2012) was hit, the denominator—the number of eligible litigation cases—likely increased due to the removal of the statutory restriction.

very different case numbers and challenge rates for situations that are actually quite similar. If one defendant in the first example requests an IPR, then the challenge rate is 1/1, or 100 percent. If the same defendant requests a challenge in the second situation, the challenge rate is only one-fifth, or twenty percent. This difference is particularly pronounced given one change in the America Invents Act. Section 299 of the Act requires a higher standard to join multiple defendants in one case than that they are simply accused of infringing the same patent.<sup>129</sup> This raises the bar from the earlier, often loosely interpreted, standard for joining defendants under Rule 20 of the Federal Rules of Civil Procedure.<sup>130</sup> The expected effect, of course, is more case numbers after the AIA.

The challenge behavior of co-defendants may well affect the behavior of a particular defendant. That is, if another defendant in a swatch of simultaneous infringement actions decides to request an IPR, you may benefit from their challenge, and decide not to request your own. There are positive externalities to administrative challenges for co-defendants—if one defendant manages to invalidate a patent at the PTO, it is invalid and thus unenforceable against all defendants. In the pre-AIA system, defendants tended to be clumped together under one case number, while post-AIA each defendant more likely appears under a separate case number. Therefore, to compare challenge rates more meaningfully, we ask whether at least one defendant in the case requested a challenge.

In Table 3, we attempt to control for this change by collapsing together cases with simultaneous defendants.<sup>131</sup> That is, any cases where the same patent is asserted on the same day and in the same court are treated as one case. In the earlier example, this means that the patent asserted simultaneously against five defendants would count as one case, regardless of

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129. See *Multi-Defendant Joinder Under the America Invents Act: Much Ado About Nothing?*, JDSUPRA (Dec. 20, 2012), <https://www.jdsupra.com/legalnews/multi-defendant-joinder-under-the-america-97136/> (“Section 299 permits joinder only where the claims against the defendants arise out of ‘the same transaction . . . .’”).

130. See *id.* (“Prior to passage of the AIA, district courts typically applied Rule 20 of the Federal Rules of Civil Procedure to determine when permissive joinder was appropriate in a patent infringement suit.”). For the importance of considering and accounting for joinder on analyses of patent litigation that may be affected by the AIA change, and support for the proposition that this change lead to increased numbers of cases as defendants were sued separately, see *Cotropia et. al.*, *supra* note 14.

131. See Table 3, *infra*.

whether each defendant was assigned her own case number. Administrative challenge by any of the five defendants would yield a 100 percent challenge rate for that case. Table 3 also presents the deflation from this change—i.e., the percent by which our observations dropped when collapsing simultaneous patent assertions.<sup>132</sup>

Table 3: Rate of Administrative Challenge by Year Collapsing Simultaneous Defendants

Year	Percent of Eligible Cases with an Administrative Challenge	Total Eligible Cases	Percent Case Deflation
2008	6.72%	1,829	5.77%
2009	6.49%	2,173	3.59%
2010	6.09%	2,873	10.58%
2011	7.07%	3,593	15.72%
2012	7.10%	5,383	37.78%
2013	13.52% ***	6,570	43.93%
2014	16.26% ***	5,955	38.53%
2015	16.03% ***	5,753	42.58%
2008–2015	11.29%	34,129	34.05%

\*, \*\*, \*\*\* indicate that the value is statistically different from 2008 at 10%, 5%, and 1% respectively.

132. See Table 3, *infra*. Note that deflation is calculated relative to the dataset just before patent assertions on the same day and in the same court are collapsed. Thus, it is the percent difference between the case numbers in Table 2 and Table 3.

Overall, the size of the dataset decreases by about one-third.<sup>133</sup> While a full causal evaluation of the effect of the AIA switch from the Rule 20 standard is beyond the scope of this paper, the composition of the caseload is consistent with its expected effect. Treating simultaneous assertions as one case only reduced the general caseload in 2008 by about five percent; in 2013 this change decreased the caseload by over forty percent.<sup>134</sup> Indeed, the incidence of simultaneous assertion under separate case numbers appears much greater post-AIA than before.<sup>135</sup> Still, the general rise of administrative challenges—while elevated in magnitude when collapsing cases—follows roughly the same pattern. The difference from 2008 becomes statistically significant the same year we see the largest rise—nearly a doubling—from 2012 to 2013.<sup>136</sup>

Because we seek in part to compare pre- and post-AIA periods, we maintain this collapsed level of observations for the remainder of our analysis.<sup>137</sup> Further, this level of analysis helps by making sure that the non-challenged case numbers of a challenged patent do not mask its status as a challenged patent. To be clear—for the remainder of the analysis, we no longer refer to a case as a unique patent-case combination. Instead, when we say “case,” we refer to a unique patent, litigated in one court, against any number of parties, on a unique date.

#### D. SETTLEMENTS

Cases that result in an administrative challenge might be different from other cases because they chose an administrative challenge rather than a court challenge, or because the defendants attempted to adjudicate validity *at all* as opposed to settling early. As established in other literature, most patent cases do not reach a final determination on the merits.<sup>138</sup> Therefore, cases with an administrative challenge occupy a

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133. See Table 3, *supra*.

134. *Id.*

135. *Id.* See also Cotropia et. al, *supra* note 14, at 666 (finding that a difference between 2,520 patent infringement lawsuits in 2010 and 5,187 patent infringement lawsuits in 2012 “is largely explained by the AIA change in joinder rules”).

136. See Table 3, *supra*.

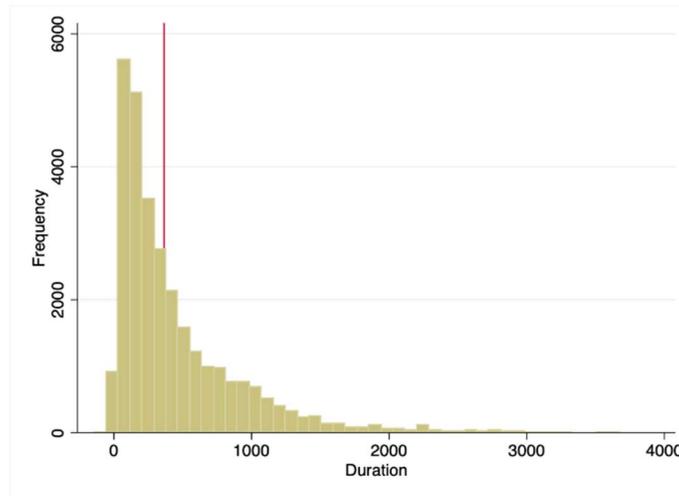
137. When collapsing in this way, nearly all patent covariate will stay the same because they do not change across observations that share a patent, litigation date, and court. To the extent that these cases have multiple judges, the judge from the case listed first in the dataset is chosen.

138. See Kesan & Ball, *supra* note 41.

portion of a special subset of cases that proceed meaningfully toward a validity challenge.<sup>139</sup> As a next step, it is important to ask whether cases with administrative challenges differ further from cases that did move meaningfully toward adjudication, but remained in the district court.

We look now to each case’s duration: the time between a case’s filing date and the date of its eventual termination (in days). While we are not able to identify the precise outcome for our cases—settlement, dismissal, or otherwise—we can compare those cases that ended quickly, versus those that lasted longer. Figure 3 presents a histogram of the case duration for our non-challenged but eligible cases.

Figure 3: Time Between Case Filing and Termination for Non-Challenged Cases



Any attempt to draw a line between “early” and “non-early” termination is inevitably somewhat arbitrary, but we use one year as the divider for a key reason. Because IPR requests must be filed within one year of the litigation date,<sup>140</sup> cases that continue on beyond one year have presumably chosen to

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139. Note that the filing of an IPX challenges should usually result in a validity determination. By contrast, an IPR petition may itself settle, and may not always lead to a decision on validity. Still, parties who chose to file an IPR clearly took some steps towards adjudicating the validity of a patent, while parties who settle very early may have taken none at all.

140. 35 U.S.C. § 315(b).

continue the case in district court, instead of requesting an administrative challenge. By contrast, cases that terminate in one year—without requesting an administrative challenge—settled or otherwise resolved the case before a decision had to be made on requesting an administrative challenge. For IPX, the lines are less clear-cut, but the general principle remains; we also use one year as our threshold for cases in the IPX period for consistency.

Over half (fifty-eight percent) of our cases that did not lead to an administrative challenge were resolved early. That is, many cases do not lead to a challenge request simply because the cases are not long in dispute—they settle quickly or resolve quickly. Because only a minority of cases continue beyond one year to even begin to seriously adjudicate validity, the proportion of cases that use administrative challenges, conditional on attempting to adjudicate validity at all, is higher than the unconditional proportion.

In the remainder of this piece, we seek to identify how various characteristics are associated with the decision to request an administrative challenge in litigation. Along the way, we check for robustness of results within this more narrowly-defined subset of cases that did not terminate quickly. That is, for some future analyses, we restrict our “non-challenged” set to only those cases that proceeded on in the district court for longer than one year.

In closing, we note that while this adjustment is aimed primarily at settlements, it may also help to reduce other sources of potential complication and redundancy in the dataset. As the previous subsections have demonstrated, litigation data can be extremely complicated and interconnected; what we might substantively consider a single “case” could appear as many observations in our initial dataset. To the extent that these multiple observations use the same filing date and appear within the same court, the adjustment in Section IV.C can mitigate this issue. But further complexity could arise if cases appear multiple times upon being transferred from one court to another, if multiple cases appear both independently and consolidated, and any other technical changes that could further lead to repetition. The alternate dataset created in this Section (and used in some of the later analysis) could at least partially reduce the effect of these complications, by removing “non-

challenged” cases that are marked with early termination dates due to transfer or consolidation.<sup>141</sup>

## V. HOW MUCH DOES THE INFRINGEMENT VENUE MATTER?

### A. VARIATION BY COURT

Our data on litigation filings includes the district that the lawsuit was filed in. The distribution of cases among districts is highly concentrated. There are ninety-two unique districts represented in our sample. If cases were uniformly distributed, we would expect to see just over one percent of the total cases occurring in each district. This is not the case. The vast majority of districts in our sample see an extremely small fraction of patent cases. Only twenty-four districts see greater than one percent of the cases. Two districts alone hear over one quarter of all challenge-eligible patent cases; the District of Delaware and the Eastern District of Texas each heard about fifteen percent of the cases in our sample.

An interesting question, of course, is whether there are substantial differences in administrative challenge rates across districts. Table 4 presents the challenge rate for each of the twenty-five most common districts in our sample.

Table 4: Rate of Administrative Challenge by District

Court	Number of Cases	Challenge Rate
DED	5,465	13.52% ***
TXED	5,128	15.00% ***
CACD	2,255	10.69%
NJD	2,223	7.24% ***
CAND	1,861	17.62% ***

141. Note that the dataset restriction in this Section only applies to the set of cases that are not matched to a challenge within 18 months. Because our goal is to identify all cases where a challenge was filed, dropping cases that are matched to a challenge because the district court case also terminated early would exclude many challenges from our analysis. It would also have the paradoxical result of dropping from the analysis challenges where a defendant quickly requests a challenge, puts forth strong evidence of invalidity, perhaps leading to the institution of an IPR, and the plaintiff subsequently drops the infringement suit. Still, in the context of reducing dataset complexity and redundancy, this approach leads to a limitation. Cases that are transferred quickly but also lead to a challenge, for example, could still appear twice in the dataset, and would be coded both times as having led to a challenge.

ILND	1,777	7.71% ***
NYSD	1,043	5.56% ***
FLSD	912	2.63% ***
VAED	750	13.07%
CASD	739	11.91%
MAD	718	16.16% ***
UTD	640	7.50% ***
FLMD	567	8.47% **
MND	546	12.82%
TXND	509	10.02%
MIED	477	11.95%
MOWD	422	1.66 ***
NVD	416	9.38%
GAND	407	9.34%
TXWD	364	17.03% ***
OHND	347	8.07% *
COD	345	5.51% ***
WAWD	332	5.72% ***
WIWD	314	14.65% *
TXSD	306	16.99% ***
National Average	34,129	11.29%

\*, \*\*, \*\*\* indicate that the value is statistically different from the national average at 10%, 5%, and 1% respectively.

The variation in administrative challenge use across districts is substantial. While the Northern District of California sees administrative challenges in nearly one out of every five cases, the Western District of Missouri sees challenges in fewer than one out of every fifty. The District of Delaware and the Eastern District of Texas—by far the two most common districts in our sample—both have rates of administrative challenges that are slightly higher than the national average. As shown in Table 5, we regress all districts on whether or not each case involved a challenge. Using an F-test, we can strongly reject the hypothesis that all court coefficients are jointly equal to zero. That is, we find evidence of heterogeneity in challenge rates across courts.

Table 5: F-Test for Joint Significance of Courts

	Test (Num., DoF)	F-Statistic
Court FE	F(91, 34037)	8.05 ***

Notes: An OLS model was run where the dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e., had no such IPX or IPR within 18 months). The model included dummies for 91 courts (one was omitted to run the regression) and a constant. \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

But who would really expect differences across courts to be driven by random chance? On the contrary, a growing body of scholarship has documented the phenomenon of “court shopping.”<sup>142</sup> Therefore, the parties and cases that select into a particular court might be quite different from those who select another. For example, patentees who choose to bring their infringement suits in district X might be particularly eager to settle the case, preempting any administrative challenge. These differences in selection might lead to a higher or lower challenge rate not because of anything the court did, but simply by virtue of the types of cases the court attracts.

Still, characteristics of a particular court may well affect a defendant’s decision to bring suit. In IPR the decision of whether to grant a stay of the district court action is discretionary. Courts that are particularly hostile to stays might see fewer administrative challenges filed for their cases. Likewise, courts that are known to have a particular competency or speed for handling patent cases might obviate the need to go to the patent office to get a fair and speedy validity decision. In any event, the effects of the court’s policies from the selection effects are difficult to disentangle. In the next subsection we tackle this problem by focusing not on courts, but on particular judges—where there is likely high heterogeneity in practices but lower selection bias.

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142. See, e.g., Anderson, *supra* note 99.

## B. VARIATION BY JUDGE

While “court shopping” in patent litigation is substantial, “judge shopping” appears to be largely nonexistent. As Professor Anderson has noted, most districts have put in place some procedures to reduce or eliminate a party’s ability to select a particular judge.<sup>143</sup> With the possible exception of the Eastern District of Texas—where procedures may actually *encourage* judge shopping—litigants file an infringement suit without knowing who their judge is going to be.<sup>144</sup> Therefore, we are relatively less worried that observed differences in administrative challenge rates across judges are driven by differences in the cases to which they are assigned. Of course, this is conditional on the court—we are interested in differences in judges within the same court; differences in judges from different courts would be marred by the same “court shopping” selection bias as before.

We test this hypothesis by running a series of F-tests of the joint significance of judge dummies within each of the most common 25 courts. Because the composition of courts changes over time, we also control for litigation quarter to reduce the concern that any significance of judge dummies might be attributable solely to changes in the challenge rate over time. As shown in Table 6 below, we can strongly reject the hypothesis that all judge coefficients are jointly equal to zero for all but two courts. That is, even within a particular district, the judge assigned is associated with the odds that a defendant requests an administrative challenge. This is also true for the Eastern District of Texas—lending questions as to whether or not judge selection plays a role in challenge decisions. Some patentees who are particularly opposed to administrative challenges, for example, might file in the Eastern District and select the judge most opposed to stays.

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143. See J. Jonas Anderson, *Judge Shopping in the Eastern District of Texas*, 48 LOY. U. CHI. L.J. 539, 544 (2016) (describing how random assignment usually limits judge shopping).

144. See *id.* at 546 (explaining that the Eastern District of Texas has modified its assignment procedure so as to “create a means of judge shopping”).

Table 6: F-Test for Joint Significance of Judges Within Various Courts

	Test (Num., DoF)	F-Statistic
DED	F(27, 5394)	7.01 ***
TXED	F(20, 5070)	8.33 ***
CACD	F(48, 2173)	1.57 ***
NJD	F(28, 2102)	4.17 ***
CAND	F(37, 1753)	5.03 ***
ILND	F(51, 1672)	1.96 ***
NYSD	F(52, 959)	2.40 ***
FLSD	F(28, 852)	1.89 ***
VAED	F(17, 701)	6.76 ***
CASD	F(17, 688)	2.96 ***
MAD	F(24, 647)	5.39 ***
UTD	F(16, 589)	1.74 ***
FLMD	F(27, 507)	2.77 ***
MND	F(15, 493)	7.99 ***
TXND	F(12, 460)	3.04 ***
MIED	F(30, 407)	2.93 ***
MOWD	F(12, 388)	28.40 ***
NVD	F(13, 371)	1.992 **
GAND	F(19, 356)	1.67 **
TXWD	F(16, 314)	1.66 *
OHND	F(16, 299)	3.12 ***
COD	F(21, 293)	2.01 ***
WAWD	F(12, 288)	4.46 ***
WIWD	F(5, 277)	0.34
TXSD	F(15, 258)	3.42 ***

Notes: Each row reflects the result of an F-test for the joint significance of judge dummies in an OLS model that was run using only the observations associated with each court. The dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e., had no such IPX or IPR within 18 months). Each model included quarterly FE, judge FE and a

constant. \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

Still, many judges in other districts—presumably those who were assigned to the parties at random—have differences in the rate at which their cases use administrative challenges that are unlikely to be explained by random variation. These differences could be explained by the broad power judges have over their cases and the many different ways they might push litigation defendants into particular strategies. As Professor Anderson notes, experienced trial litigators know that the judge assigned is extremely important.<sup>145</sup> Now, we dig deeper to test potential sources of this observed heterogeneity among judge assignment. Put simply, we seek to shed light on the following question: why does the particular judge assigned matter to defendants?

One explanation could be the judge's propensity to grant stays. If a certain judge is especially hostile toward granting a stay, we might expect that defendants would be less likely to request an administrative challenge for fear of having to incur duplicate costs as both proceedings move forward. It is difficult to empirically test for the effect of a judge's stay propensity for two reasons. First, there is data sparsity: because administrative challenges are rare, motions for stay pending IPX or IPR are also relatively rare, and thus many judges would see few if any such motions. Second, such analysis would likely suffer from a reverse causality problem: higher stay grant rates might imply higher challenge rates, but the request of each challenge could drive up the judge's grant rate.

Still, much of the difference might not be specific to administrative challenge stays, or even to patent law. Instead, whether a defendant chooses to request an administrative challenge might be informed by the judge's general docket management. A particular judge might move extremely quickly, pushing parties into quick settlements, or resolving key issues on early motions to dismiss. Such judges might not take kindly to delays of any kind, including stays pending patent office review of validity.

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145. See, e.g., Anderson, *supra* note 143, at 544 (“Litigators report that the judge assigned to a case can be the key to winning that case.”).

## VI. HOW MUCH DOES THE PATENT AT-ISSUE MATTER?

Most variables of interest to us are patent-specific; we make use of several other datasets to gain information on the patent at-issue in each observation. To obtain data on each patent, we combine data from a variety of databases, each of which is put out by the USPTO. For example, Patent Examination Research Dataset (PatEx)<sup>146</sup> provides basic information such as filing date, patent grant date, and patent class.<sup>147</sup> We separate out two characteristics for future analysis: patents issued to small entities and patents owned by PAEs.

### A. INTRINSIC CHARACTERISTICS

First, we focus on characteristics that are present at the time of a patent's issuance, and that do not change throughout a patent's life. These are often referred to as "intrinsic characteristics" in the literature.<sup>148</sup> Table 7 describes the intrinsic characteristics of the patents at-issue in our constructed challenged and non-challenged case samples. We also perform tests comparing the means between the challenged and non-challenged subsets.<sup>149</sup> In every observable category, the patents at-issue in cases that led to an administrative challenge are significantly different from those in non-challenged cases.

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146. See Graham, et al., *supra* note 111.

147. See generally NBER PATENT DATA PROJECT, <https://sites.google.com/site/patentdataproject/Home/downloads/patn-data-description> (providing a system, used by this paper, which accounts for changes in patent classes using "six NBER Technology categories," because "the USPTO continually revises the technology classes").

148. See, e.g., Chien, *supra* note 29.

149. More specifically, we perform two-sample two-tailed t-tests of equality for continuous variables (e.g. citations), and similar tests of proportion equality for binary variables (e.g. small entity status).

Table 7: Intrinsic Characteristics of Challenged Patents

	Non-Challenged	Challenged	p-value
Total claims	27.872	30.129	0.000 ***
Independent claims	3.910	4.246	0.000 ***
Min. word in ind. claims	125.373	128.723	0.020 **
Back citation per claim	2.704	2.954	0.014 **
Prosecution per claim (days)	79.595	67.773	0.000 ***
Chemical	0.045	0.039	0.099 *
Computer & Comm.	0.425	0.514	0.000 ***
Drugs & Medical	0.205	0.135	0.000 ***
Electrical & Electronic	0.097	0.148	0.000 ***
Mechanical	0.095	0.056	0.000 ***
Others	0.133	0.108	0.000 ***

We obtain data on patent claims from the Patent Claims Research Dataset.<sup>150</sup> This dataset provides the number and word count statistics for both independent and dependent claims. Following the researchers who created this dataset, we focus primarily on the number of independent claims and the

150. *Patent Claims Research Dataset*, USPTO, <https://www.uspto.gov/learning-and-resources/electronic-data-products/patent-claims-research-dataset>.

minimum word count in independent claims.<sup>151</sup> Their theory is that patents with more independent claims and a smaller minimum word count should be of broader scope.<sup>152</sup> This makes intuitive sense. We would expect additional claims to add additional scope of protection. Likewise, there is good reason to believe that claims with few words are broader than claims with more words. Just as “a paper” is a broader description than “a law review paper.” For completeness, we also use a measure of total claims in some of our analysis, which we generate by summing the dependent and independent claim counts. Challenged cases involve patents with, on average, two more claims and 0.3 more independent claims. While this tends to imply patents of greater breadth, challenged patents tend to also have a greater minimum number of words in their independent claims, which might conversely signify a narrower scope.

The USPTO Patentsview Database<sup>153</sup> allows us to find the number of backward citations, which is commonly used as a proxy for patent value.<sup>154</sup> From this database, we extract files detailing every time one patent cites another patent. Backward citations are generated by tabulating, for a particular patent, the number of other patents it cites.<sup>155</sup> Following Lanjouw and Shankerman,<sup>156</sup> we generate per-claim variants for backward citations, as well as for prosecution time. Challenged patents spend less time in their initial examination—eight fewer days per claim—but also cite a greater number of prior art patents in the examination process.

The breakdown of technology categories is also quite different between the two groups. Challenged cases involve a greater fraction of computer & communication patents, and electrical & electronic patents. The opposite is true for chemical, drugs & medical, mechanical, and other patents.

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151. See Alan C. Marco, Joshua D. Sarnoff & Charles deGrazia, *Patent Claims and Patent Scope*, 48 RES. POL'Y 103790 (2019).

152. *Id.*

153. PATENTSVIEW, <http://www.patentsview.org/web/#viz/comparisons>.

154. See, e.g., Dietmar Harhoff, Federic M. Scherer & Katrin Vopel, *Citations, Family Size, Opposition and the Value of Patent Rights*, 32 RES. POL'Y 1343 (2003).

155. We manually set the value of backward citations to zero for any patent with no record of citations.

156. See Lanjouw & Shankerman, *supra* note 30, at 134.

## B. ACQUIRED CHARACTERISTICS

In Table 8, we present a similar analysis for “acquired” characteristics of the patent at the time of litigation.

Table 8: Acquired Characteristics of Challenged Patents

	Non-Challenged	Challenged	p-value
Age (days)	1959.151	2004.376	0.128
Annual forward citations per claim	0.206	0.229	0.022 **
Assigned	0.529	0.563	0.000 ***

First, we define age as the number of days between the date that a patent is issued and the date it is litigated. There is no significant difference in age between patents in cases with or without an administrative challenge. Next, we create a measure of forward citations by summing the number of times a particular patent is cited by another patent.<sup>157</sup> Forward citations are recorded as the total citations that accrued as of a particular date (December 26, 2017). This creates a truncation issue with forward citations since older patents have had more time to accrue citations. To alleviate this problem we normalize the number of citations by the number of years between the patent’s issue date and the date we collected forward citations.<sup>158</sup> The combination of these two transformations results in the new

157. This data is also pulled from the PatentsView database. We manually set the value of forward citations for any patent with no record of citations, as this database is comprehensive for patents issued from the 1970s through the end of 2015.

158. There seems to be no perfect way to correct for truncation. See Bronwyn H. Hall, Adam B Jaffe & Manuel Trajtenberg, *The NBER Patent Citation Data File: Lessons, Insights, and Methodological Tools* (NBER Working Paper No. 8498, 2001) (illustrating limitations of different methods, including the “fixed window” approach). Our data only includes total citations on a specific date, which is why we correct for truncation by finding the annual average. If citations increase at an increasing rate, we might be somewhat underestimating annual citations for younger patents. This concern is alleviated in our analysis because we later match patents using filing date and patent class.

forward citations variable “annual citations per claim.” Challenged patents have, on average, slightly higher forward citations. This might indicate that they are of particularly high value.<sup>159</sup>

Finally, we seek to determine whether or not a patent was assigned prior to litigation. In earlier work, Professor Chien found that assignment was an important predictor of litigation.<sup>160</sup> We seek here to see whether it is also an important predictor of administrative challenge. We merge our existing dataset with the Patent Assignment Dataset which records the assignment dates for patents.<sup>161</sup> Our ability to determine the identity of the assignee is very limited. We narrow down as best we can to those assignments that appear to most closely resemble a true sale of a patent to another entity. We exclude any assignments tagged as name changes, government or security interests, corrections, and mergers. Likewise, we exclude any assignment that the PTO has flagged as likely from an individual inventor to her employer. Over half of all cases in our sample dealt with patents that had been assigned prior to litigation. Cases where there was an administrative challenge dealt with a greater share of patents that were assigned.

### C. MULTIVARIATE REGRESSION ANALYSIS

While the t-tests for comparisons of means presented in this and the previous section offer some insights for how these groups differ, each of the variables in that table is compared independently of other variables. Now we perform more rigorous analysis using multivariate regression that accounts for possible correlations between the variables. Specifically, we use these regressions to identify the variables that predict whether a particular litigated patent will also be administratively challenged. The dependent variable takes the value 1 for our challenged group (patent-cases that are matched to an administrative challenge within eighteen months) and 0 for the control patents (patent-cases eligible for an administrative

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159. See, e.g., John R. Allison et al., *Extreme Value or Trolls on Top? The Characteristics of the Most-Litigated Patents*, 158 U. PENN. L. REV. 1, 28 (2009); Harhoff, Scherer & Vopel, *supra* note 154, at 1345.

160. Chien, *supra* note 29, at 303–04.

161. See Alan C. Marco et al., *The USPTO Patent Assignment Dataset: Descriptions and Analysis* (USPTO Economic Working Paper No. 2, 2015), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=2849634](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2849634).

challenge but with no such challenge filed within eighteen months).

Unlike some previous literature that looks at the characteristics of litigated patents using matching techniques,<sup>162</sup> we are able to make use of our full sample, and with a smaller control set, finding good matches to all challenges might not be feasible. Matching is useful in cases where a binary outcome is rare, which could introduce bias in certain kinds of statistical analysis, as well as making data gathering and computation costly.<sup>163</sup> When comparing litigated patents to the millions of unlitigated patents, the former dwarfs the latter: indicating that matching is necessary.<sup>164</sup> By contrast, we compare challenged cases to other litigated cases, which are decidedly less rare. About eleven percent of the cases in our sample are challenged, which is about five to ten times greater than the proportion of patents that are litigated.<sup>165</sup> Where the previous authors also used their matching technique to control for cohort and class effects,<sup>166</sup> we instead use fixed effects to control for these effects over the entire sample.

In Table 9, we present the results of this exercise, using a linear probability model (ordinary least squares regression on a binary outcome). All columns use fixed effects for the district court.<sup>167</sup> Column (1) uses the intrinsic patent characteristics as

162. See, e.g., Lanjouw & Shankerman, *supra* note 30; Chien, *supra* note 29.

163. See generally Gary King & Langche Zeng, *Logistic Regression in Rare Events Data*, 9 POL. ANALYSIS 137 (2001) (examining techniques for statistical analysis of rare events).

164. See Chien, *supra* note 29, at 309 (citing King, *supra* note 163, at 138). (“I used these sets, rather than a random sample drawn from patents generally, because the application of statistical analysis to rare events like patent litigation tends to distort and understate the probability that the events will occur.”).

165. See Ansell et. al., *2018 Patent Litigation Study*, PWC (2018), <https://www.ipwatchdog.com/wp-content/uploads/2018/09/2018-pwc-patent-litigation-study.pdf> (figure 1, showing that the ratio of number of patent cases filed each year to the number of patents granted in that same year is about 1:50 to 1:100 during the period of our study).

166. See, e.g., Lanjouw & Shankerman, *supra* note 30, at 133.

167. We cluster our standard errors at the district court level and at the patent level (some patents appear multiple times in our sample). For examples of clustering in similar contexts, see generally Alma Cohen & Crystal S. Yang, *Judicial Politics and Sentencing Decisions*, 11 AM. ECON. J.: ECON POL’Y 160, 173 (2019) (using bootstrapped standard errors stratified by district court for various models with court or judge fixed effects, and noting that “results are robust to clustering standard errors at the district level”); Will Dobbie et al., *The Effects of Pre-Trial Detention on Conviction, Future Crime, and Employment: Evidence from Randomly Assigned Judges*, 108 AM. ECON. REV.

well as dummies for the patent filing year and NBER technology category to control for possible cohort and technology area effects. Column (2) adds in the acquired patent characteristics. Column (3) adds indicators for small entity patents and PAE plaintiffs, which are discussed in more detail in the following subsections. Finally, Column (4) adds fixed effects for district court judges. In the Appendix, Table A2 repeats the analysis of Table 9, but replaces NBER categories with USPC classes to more granularly control for class effects. Table A3 repeats the analysis of Table 9, but removes from the set of non-challenged cases those cases that terminated early.

In general, many of the bivariate differences between challenged and non-challenged cases that we saw in the preceding sections do not appear as significant in the multivariate models. For example, in some specifications, independent claims or minimum words in independent claims show up significant or marginally significant (and in a direction that would support a positive relationship between broader scope and challenges), but this result is more often insignificant. We believe that much of this disparity between the bivariate and multivariate statistics can be attributed to systematic selection across courts and time.<sup>168</sup> That is, while the broad pool of challenged patents has indicators of higher value or broader scope via claims and citation metrics compared to the broad non-challenged pool, our models suggest that this is substantially

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201 (2018) (using court by time fixed effects along with a judge instrument and two-way clustering by judge and individual); Crystal S. Yang, *Have Interjudge Sentencing Disparities Increased in an Advisory Guidelines Regime? Evidence from Booker*, 89 N.Y.U. L. REV. 1268, 1342 (2014) (using district-court fixed effects and noting that “[a]ll standard errors are clustered at the district courthouse level to account for serial correlation”). In implementing the models with several levels of fixed effects and clustering on two variables, we use the estimator described by Correia. See Sergio Correia, *Linear Models with High-Dimensional Fixed Effects: An Efficient and Feasible Estimator* (Working paper 2017), <http://scoreia.com/research/hdfe.pdf>. In addition to the package by Correia, our analysis (performed in Stata 14) and the creation of the tables and figures presented throughout this Article were aided by several specialized packages. See Ben Jann, *Making Regression Tables Simplified*, 7 THE STATA J. 227 (2007); Michael Stepner, *BINSCATTER: Stata Module to Generate Binned Scatterplots*, Statistical Software Components S457709, Boston College Department of Economics (2013); Roy Wada, *OUTREG2: Stata Module to Arrange Regression Outputs into an Illustrative Table*, Statistical Software Components S456416, Boston College Department of Economics (2014).

168. We found claims and citations results, in particular, to be sensitive to the addition of time and court fixed effects and appropriately clustered errors.

driven by where and when the patent is litigated. Therefore, caution is needed when interpreting the bivariate results.

Our results that might speak to patent quality do so ambiguously. On the one hand, we find that patents with a greater number of backward citations—which could indicate a more diligent search effort—are more likely to be challenged, although their significance is reduced in several models, particularly when controlling for USPC classes.<sup>169</sup> On the other hand, the amount of time (per claim) that a patent spent being prosecuted at the patent office appears negatively associated with challenges. If we believe that more time at the patent office is associated with a more thorough examination of the patent, we might expect that the patents with higher prosecution times are of higher quality.<sup>170</sup>

Compared to other patents, litigated drugs & medical patents are significantly less likely to be challenged in most specifications, as are mechanical patents, though the latter loses significance in the face of judge fixed effects. On the other hand, litigated computers & communications and electrical & electronic patents are significantly more likely to be challenged. This might indicate that norms have been established in various industries—or their respective bars—for how patent disputes will play out. Another important factor could be differences in the original patent examination process by technology class. Certain areas might have differences in how likely prior art is to be found during the examination process. This result might also indicate the perceived incremental benefit of Administrative Patent Judges (APJs) as decision makers in various contexts. Defense attorneys might worry more about the prospect of explaining a computer or electronic invention to a generalist district court judge or jury than the same for a drug or mechanical patent. Or, on the flipside, APJs in the former two fields might be perceived as especially fair or skilled.

Importantly, Table A3 shows that the majority of the results above still hold when comparing challenged cases to only cases

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169. Another possible interpretation of backward citations is that a smaller number of backward citations may indicate that “the invention is in a relatively new technology area,” which would imply here that patents in new technology areas are less likely to be challenged. See Lanjouw & Schankerman, *supra* note 30, at 141.

170. Note, however, that one study found that examination time is not a significant predictor of Federal Circuit patent validity decisions. See Ronald J. Mann & Marian Underweiser, *A New Look at Patent Quality: Relating Patent Prosecution to Validity*, 9 J. EMP. L. STUD. 1, 19–21 (2012).

that did not terminate early. In other words, the effects of many patent characteristics cannot be explained by differences in settlement rates. Even compared to cases that proceed meaningfully toward adjudication in the district court, patents involved in challenged cases tend to cite more prior art, spend less time under prosecution, are less likely to be drug or mechanical patents, and are more likely to be electrical patents. Still, when restricting the set of non-challenged patents, we also see several different results. Compared to the set of longer-lasting non-challenged patents, challenged patents are less likely to be chemical patents but no more or less likely to be computer patents. They are also more likely to be younger, and to have been assigned at the time of litigation.

Most notably, when removing those non-challenged patents that settled or otherwise terminated within one-year, annual forward citations per claim are positively associated with the probability of challenge, and statistically significant at the 5 percent level. While earlier work has shown that litigated patents are of higher value compared to the overall population of U.S. patents,<sup>171</sup> our analysis here further suggests that patents concurrently challenged at the patent office tend to be even more valuable than other litigated patents, when the latter continue on in the district court beyond one year. Because the set of litigated patents that continue in district court beyond one year is meant to exclude those patents that settled early (choosing neither adjudication at the patent office nor meaningful adjudication in the district court), we believe this comparison is well suited to address the core substitution hypothesis<sup>172</sup> that underlies much of the possible welfare effects from administrative challenges. That is, this model is focused on patents for which it seems most likely that the parties faced a choice to adjudicate validity at the patent office versus at the district court, potentially saving cost and time.<sup>173</sup>

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171. See, e.g. Chien, *supra* note 29, at 326 (“All other things equal, valuable patents are more likely to be litigated.”).

172. See generally Vishnubhakat, Rai & Kesan, *supra* note 9.

173. Of course, this interpretation rests on several large assumptions. First, we assume that both those cases where an administrative challenge is filed and those cases that are pending in the district court for more than one year reflect a meaningful step toward adjudication of validity. Recall that we do not drop any challenged patents, even if the district court case that they arose from terminates within one year. The theory behind this differential treatment is that the substantial work that goes into filing an IPX or IPR petition represents a meaningful step toward challenge to validity that is more analogous to a court

This result could have several interesting implications for policymakers. The increased value of these patents likely also indicates that there is more “at stake” in the dispute.<sup>174</sup> On its face, if policymakers hoped to push the validity challenges in especially high-stakes disputes from the courts to the patent office, they appear to be succeeding. And, as the costs of litigation increase with the amount at stake,<sup>175</sup> having the highest value patents bifurcating their trials to utilize the lower cost validity determination procedure could maximize the cost differential, and thus the cost savings, from these procedures.<sup>176</sup>

Further, our results suggest important implications for overall patent quality. If we believe that the patent office is a more accurate judge of patent quality than the district courts, it might be comforting to know that the most valuable patents are being reviewed there. In addition, because evidence suggests that administrative review results in more decisions on validity than in the district court,<sup>177</sup> we might expect the overall quality of the granted patent pool to rise. In short, policymakers might be relieved to discover that our findings lend some support to the

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case that proceeds for longer than one year. By contrast, we expect that many cases that terminate within one year would reflect quick settlement without incurring significant litigation costs, and thus a switch from the usual district court outcome to an administrative challenge could actually increase cost. Of course, we also assume that challenges are associated with cost savings at the district court. These assumptions would weaken substantially to the extent that (i) many of the administratively challenged cases are subsequently settled or dropped, which would make them more analogous to the early settled district court cases, (ii) many of the cases that proceed beyond one year in district court incur few costs or make no meaningful efforts toward adjudicating validity, or (iii) stays are not granted or requested, meaning that the challenged cases in our sample continue to run in parallel with their associated district court case and incurring both sets of costs.

174. Talia Bar & Jesse Kalinowski, *Patent Validity and the Timing of Settlements*, 67 INT’L J. OF INDUS. ORG. (2019). (showing that when an infringer expects higher damages she would exert more effort searching for prior art in an attempt to invalidate a patent). One possible explanation for our observation that challenged patents are more likely to have more forward citations than other litigated patents is that a patent’s increased value is an indication of higher expected damages.

175. AIPLA REPORT, *supra* note 43, at 37–41.

176. This, of course, depends on the counterfactual of those cases which were selected into these challenges. It is possible that had administrative review not been available, the parties might have not adjudicated validity in the district courts at all, but rather settled. In this case, use of patent office challenges might be increasing the dispute costs borne on the parties. Further investigation into settlements is needed to shed light on this question.

177. See Love, Miller & Ambwani, *supra* note 9, at 110.

idea that administrative patent procedures may be diverting especially high value patents away from the district court.

Table 9: Patent Determinants of Administrative Challenge

VARIABLES	(1)	(2)	(3)	(4)
	Intrinsic Patent Characte ristics	Add Acquired Characte ristics	Add Small Entity and PAE	Add Judges
Independent claims	0.001 (0.001)	0.001 (0.001)	0.001* (0.001)	0.001 (0.001)
Min. word in ind. Claims/100	-0.001 (0.003)	-0.002 (0.003)	-0.002 (0.003)	-0.004 (0.003)
Back citations per claim	0.001** (0.001)	0.001* (0.001)	0.001** (0.001)	0.001* (0.001)
Prosecution per claim (years)	-0.017*** (0.006)	-0.024*** (0.007)	-0.025*** (0.007)	-0.025*** (0.007)
Chemical	-0.005 (0.018)	-0.005 (0.018)	-0.010 (0.019)	-0.014 (0.017)
Computer & Comm.	0.027** (0.012)	0.024** (0.012)	0.033*** (0.012)	0.030*** (0.011)
Drug & Medical	-0.026 (0.016)	-0.027* (0.016)	-0.036** (0.016)	-0.037** (0.018)
Electrical & Electronic	0.052*** (0.018)	0.050*** (0.018)	0.050*** (0.019)	0.049*** (0.017)
Mechanical	-0.023**	-0.023**	-0.020**	-0.014

	(0.010)	(0.010)	(0.010)	(0.011)
Age (years)		-0.002	-0.002	-0.003
		(0.003)	(0.002)	(0.002)
Forward Citations per year per claim		0.010	0.010	0.009
		(0.006)	(0.006)	(0.006)
Assigned		0.004	0.014	0.012
		(0.008)	(0.009)	(0.008)
Small entity indicator			-0.024**	-0.021**
			(0.011)	(0.010)
PAE			-0.040***	-0.035***
			(0.008)	(0.009)
Constant	-0.084***	-0.041	-0.026	-0.018
	(0.021)	(0.060)	(0.055)	(0.053)
Patent Filing Year FE	Y	Y	Y	Y
District Court FE	Y	Y	Y	Y
Litigation Quarter FE	Y	Y	Y	Y
Judge FE	N	N	N	Y
Observations	33,459	33,459	33,459	33,095
R-squared	0.049	0.050	0.053	0.128

Notes: Dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e., had no such IPX or IPR within 18 months). All models are linear probability models. Standard errors, clustered by district court and patent, in parenthesis; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

## C. SMALL ENTITY PATENTS

Small-scale inventors and their relative standing compared to larger firms can have important implications for innovation.<sup>178</sup> Earlier studies have shown, however, that small patentees are disadvantaged when it comes to protecting their patent rights.<sup>179</sup> Professors Lanjouw and Schankerman find that patentees with small patent portfolios run a higher risk of litigation.<sup>180</sup> Professors Schankerman and Galasso show that invalidation of patents owned by large firms induces more follow-on innovation by small firms,<sup>181</sup> and further show that a loss of patent rights significantly increases the likelihood that small firms stop patenting.<sup>182</sup>

As a preliminary matter, cases involving small entity patents made up over one-quarter (28.3 percent) of all cases with challenges. This number is slightly smaller than the proportion of small entity patents in non-challenged cases (32.7 percent); this difference is significant at the one percent level. In Column (3) of Table 9, we add to the model a dummy variable that indicates whether the patentee claimed small entity status. We find that cases involving small entity patents are significantly less likely to see concurrent administrative challenges. It is interesting that the patents that are shown to have a higher risk of litigation still have a lower risk of administrative challenge. It is also worth noting that because our dataset uses infringement suits, small entity patentees (to the extent the party asserting the patent is the same party that filed the patent) are likely to be the plaintiffs in the litigation case, and not the defendants. Therefore, defendants may be making strategic decisions to challenge small entity patents in the district court instead of at the patent office. Perhaps this implies that the types of challenges made to small entity patentees are those more amenable to district court challenge (i.e., challenges other than novelty or nonobviousness). Or, perhaps defendants

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178. See, e.g., Lanjouw & Schankerman, *supra* note 13, at 46 (noting that a disparity between large and small patent firms “will have implications for the industrial organization of innovative activity”).

179. *Id.* (finding that “small patentees are at a significant disadvantage in protecting their patent rights” compared to patentees with a large portfolio of patents).

180. *Id.*

181. See Alberto Galasso & Mark Schankerman, *Patents and Cumulative Innovation: Causal Evidence from the Courts*, 130 Q. J. ECON. 317 (2015).

182. Alberto Galasso & Mark Schankerman, *Patent Rights, Innovation and Firm Exit* 5 (Nat’l Bureau of Econ. Res., Working Paper No. 21769, 2015).

prefer to exploit the limited resources of small entity patentees by dragging out costly civil litigation instead of using the cheaper and faster administrative alternative so as to incentivize them to settle in terms favorable to the alleged infringers.

We find that small entity patents are less likely to be challenged by defendants. This result on small entity patents is curious in light of a result in other work: small entity patents are more likely to be invalidated at the patent office.<sup>183</sup> If small entity patents are easier to invalidate at the patent office than other patents, we might expect defendants to be challenging them much more frequently at the patent office. We could perhaps reconcile these results by the existence of settlements. Knowing that they face poor outcomes in administrative challenges, small entity patentees may be more likely to settle early and avoid the patent office altogether.

Indeed, Column (3) of Table A3 is consistent with this hypothesis. When comparing challenged cases to those that did not challenge but did not terminate early, small entity status is no longer a significant predictor of challenge requests. That is, the difference in challenge rates for small entity patents appears to be driven by those cases that terminate early, likely often by settlement. This result adds to our understanding of how small entity patentees behave in patent disputes.

#### D. CASES BROUGHT BY PATENT ASSERTION ENTITIES

Significant work has been published in academic journals in recent years on the question of patent assertion entities, or PAEs.<sup>184</sup> PAEs are often viewed to have different litigation strategies than other patent infringement plaintiffs.<sup>185</sup> These strategies might lead to a different rate of administrative challenge use for defendants.

We make use of the Stanford PAE dataset<sup>186</sup> to identify cases where the plaintiff was a patentasserter. We follow Miller

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183. See Bar & Costello, *supra* note 25, at 30.

184. See generally Mazzeo et al., *supra* note 103 (analyzing case outcomes to contribute data to this developing academic conversation).

185. *Id.*

186. We are grateful to Shawn Miller for sharing this data. Shawn P. Miller et al., *Introduction to the Stanford NPE Dataset* (Oct. 23, 2017) (draft) (on file with Stanford Law School) <https://law.stanford.edu/wp-content/uploads/2017/10/Introduction-to-the-Stanford-NPE-Litigation-Dataset-10.23.2017.pdf>.

*et al.*'s coding scheme and define PAE as a plaintiff that is a member of categories one, four, or five.<sup>187</sup> Because the data provided to us is a ninety percent sample of the total caseload over our period, we make one additional assumption to maximize our data availability. We code patents that are missing for one of our cases in the PAE dataset but asserted by a PAE at some other time in that dataset as PAE asserted. Likewise, we assume that patents never asserted by a PAE in the dataset—that is, patents that were never asserted by a PAE over a fifteen-year period—are not owned by PAEs.

As a preliminary matter, cases brought by patent assertion entities made up nearly one-third (31.9 percent) of all cases with challenges. This number is slightly smaller than the proportion of PAE patents in non-challenged cases (32.3 percent), but the difference is not significant. Thus, administrative challenges seem to be handling a significant number of PAE cases, though perhaps at a slightly lower rate than Article III courts are. To the extent that policymakers hoped for administrative challenges to serve as a second look at patents being asserted by PAEs, these tribunals appear to certainly be fulfilling that function.

That said, these numbers don't tell us if these cases are challenged with a lesser frequency because they are PAE patents. Rather, PAEs may own patents that are unrepresentative of the overall pool.<sup>188</sup> The patents they hold may be more or less likely to be challenged simply by nature of, for example, having more citations or being in a certain art category. In Column (3) of Table 9, we attempt to separate out these effects by adding in a dummy for PAE status alongside our other covariates. Controlling for other patent and case characteristics, cases that involve PAE assertors are *less likely* to lead to an administrative challenge.

One obvious explanation for this result is that PAE asserters might be more likely to force a quick settlement before adjudication proceeds at all.<sup>189</sup> That is, defendants in PAE cases might settle before they even consider whether to request an administrative challenge. The results in Column (3) of Table A3 are consistent with this theory. When restricting non-challenged cases to only those that last for longer than one year, the effect

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187. *Id.* at 6.

188. See Cotropia et al., *supra* note 14, at 650–54 (explaining the difficulty in categorizing PAEs and their impact on the patent landscape).

189. See, e.g., Love, Miller & Ambwani, *supra* note 9, at 73 n.19.

of PAE is no longer statistically significant. That is, like with small entities in the previous subsection, the difference in the PAE litigation rate appears primarily driven by cases that settle or otherwise terminate early.

## VII. HAVE SELECTION PATTERNS CHANGED SINCE THE AIA?

### A. THE AIA AND THE RATE OF CHALLENGE

The figures and descriptive tables in Section IV.A appear to show a significantly increased use of administrative review procedures in the latter half of our sample period. This begs an important question: did the America Invents Act and the shift to inter partes review make challenges more appealing to defendants? In the roughest of tests, we first divide our sample into two parts. First, defendants in cases that were filed prior to September 16, 2012 had inter partes reexamination available as a tool at the time the case was filed, but not inter partes review.<sup>190</sup> Cases filed after that date, however, were no longer eligible for IPX, but could make use of IPR. Within our window, the rate of administrative challenge after the AIA is about double that of the challenge rate prior to the AIA. Table 10 Column (1) presents the equivalent test in regression form, using an AIA dummy (IPR) and the usual court fixed effects.

Of course, this two-period comparison is far from sufficient to establish a causal story for a number of reasons. First, dividing the sample into two halves might simply reduce a continuous trend to a “high” and “low” period. That is, the latter years would have been significantly greater following a growing trend of challenge use, regardless of whether the AIA was put into effect.

Relatedly, litigation strategies can change over time. Indeed, the nature of our judicial system promotes changes in the backdrop of litigation over time as caselaw develops. Landmark cases may make it more difficult for challengers to introduce evidence of invalidity, or may make it more difficult to obtain stays. Therefore, there is good reason to believe that the decision to file for an administrative challenge depends on elements of the judicial system that are orthogonal to any

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190. *Supra* Section II.A. Cases filed before but close to this date in theory could have still used IPR before the one-year statutory bar took effect. Still, the vast majority of cases in the first sample would be unable to do so. *See also* text accompanying note 126, *supra*.

particular case.<sup>191</sup> In other words, the time at which a patent is litigated may affect the likelihood that an administrative challenge is filed. This could cast particular doubt on the interpretation of our IPR variable, since it is the only variable that changes with litigation timing. The variable, in particular, could just be capturing changes in baseline rates of administrative challenge, rather than any effect of the AIA in particular.

Visually, Figure 4 shows the rate of challenges for each quarter in our sample.<sup>192</sup> Separate trend lines are provided for the samples before and after the switch to the IPR regime. We see that the rate of challenges over the IPX period appears relatively constant over time, which is consistent with the lack of significant yearly differences from 2008 until 2013 in Table 3.<sup>193</sup> The IPR period, by contrast, is marked by a steeper slope of increasing challenge rates. Notably, the increase in the IPR period appears to level off after the first few quarters. As shown in Figure 5, if you remove the policy change quarter and two quarters before and after, the IPX and IPR periods appear to have very similar slopes, and the change appears to be a change in intercept. At the end of this Section, we discuss unique features of the quarters surrounding the policy change, and possible interpretations of the IPR effect as either a change in slope or a discontinuous jump with a several quarter delay.

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191. See, e.g., Anderson, *supra* note 99, at 635 (2015) (explaining factors that encourage forum shopping in district courts, despite uniform legal boundaries).

192. Note that Q3 2019 appears in this plot twice, separately for its IPX and IPR observations.

193. Note that this result is not in tension with the published statistics of increased yearly IPX filings over the same period, because they are measuring different things. See Section II.B, *supra*. Our analysis looks at the rates at which defendants file challenges, as a fraction of the total cases where the patent is statutorily eligible for an IPX challenge. To the extent that the number of IPX challenges increases, but there is also a corresponding increase in total eligible cases, the actual challenge rate may stay the same.

Figure 4: Challenge Rate by Litigation Quarter

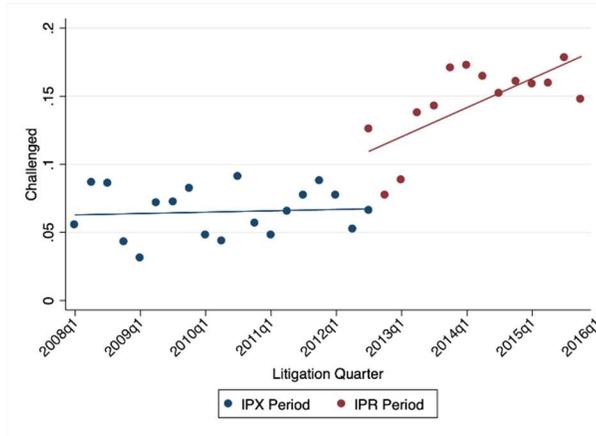
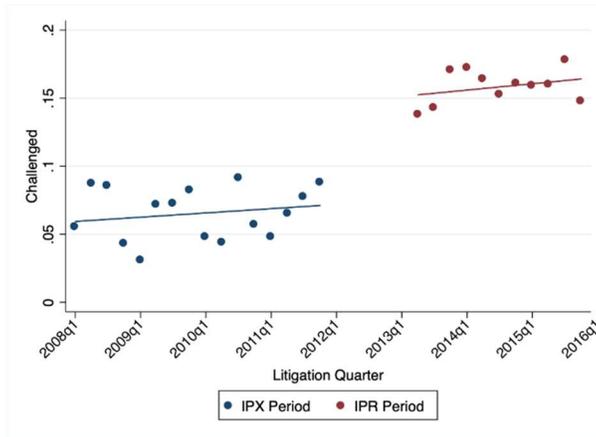


Figure 5: Challenge Rate by Litigation Quarter, Excluding Transition Quarters



While our earlier models from Section VI used quarterly fixed effects to control for changes over time, the use of these fixed effects alongside our AIA indicator would be inadvisable. Because our AIA indicator is effectively equal to an indicator for all cases filed in Q4 2019 or later, it is highly collinear with the set of time fixed effects.<sup>194</sup> Instead of fixed effects, Column (2) of

194. While the AIA indicator also extends slightly into Q2 2019, preventing perfect collinearity, the variance inflation factor on the indicator in a simple model with quarterly fixed effects is over 40. Models that attempt to use both

Table 10 adds to the model a linear time trend, as well as the time trend interacted with the AIA indicator to allow the trend to vary before and after the policy change.<sup>195</sup> In the full sample, both the AIA indicator and the interaction term are positive and significant, which suggests that the AIA is associated with both an increased challenge rate and an increased acceleration of the challenge rate (increased slope).

The other main issues with identifying an AIA effect can be broadly categorized under the heading of omitted variable bias. That is, the switch to AIA might have been correlated with changes in the set of patents or cases that were litigated. If, for example, the patents litigated after September 16, 2012, coincidentally had greater claims, the effect of greater claims (which is excluded in our first two columns) might be biasing the AIA effect upwards. This problem would be particularly pronounced if, for example, the AIA also changed the overall quality of the set of patents filed or patents litigated.

To at least partially correct for this problem, in Column (3) we control for the same observable patent characteristics as in Column (4) of Table 9. Even simultaneously controlling for observable patent characteristics, court and judge effects, and a time trend, we still find a positive and significant effect of the AIA dummy and the interacted slope of the time trend.

Appendix Table A4 presents results from additional models as robustness checks. Columns (1) and (2) reproduce Column (3) from Table 10 and mirror the earlier robustness checks set out in Appendix Tables A2 and A3. Even when replacing NBER categories with more granular patent classes or restricting the set of non-challenged cases to those that did not terminate early, the AIA dummy remains at least marginally significant and its interaction with time remains strongly significant.

Using a time trend over the entire eight year sample could present two disadvantages relative to using time fixed effects. First, the legal landscape that impacts challenges decisions in 2008 could be very different from the legal landscape in 2015, in

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the AIA indicator and quarterly fixed effects have varying significance on the AIA indicator and are sensitive to the inclusion of various controls and in particular the clustering of errors.

195. Of course, it is possible that using linear time trends could affect any AIA effect if the rate of challenges over time followed a higher order polynomial or non-parametric trend. We see little theoretical reason that over an eight-year period that challenge rates would remain relatively constant for about five years, increase rapidly coincidentally at the time of the switch from IPX to IPR, and then flatten out again.

ways that are not well captured by a time trend. Second, closer to the AIA policy change, the rate of challenges could have been growing at a steeper pre-existing trend that is not well fit by the time trend over the entire sample. In Columns (3)–(5) of Appendix Table A4, we restrict the sample to narrower windows around the policy change, starting with eighteen months (on either side of the switch to IPR) and then shrinking to twelve and six months, respectively. While the AIA dummy is no longer significant in the eighteen and twelve month windows, the interaction with the time trend remains strongly significant. In the narrowest 6 month window, neither the dummy nor the time trend come up significant

In Columns (1) and (2) of Table A5, we reproduce Columns (2) and (3) from Table 10, except that we replace the AIA dummy and time trend with a full set of quarterly fixed effects to observe more flexible patterns over time. With controls, the signs of the fixed effects in the IPX period are mixed, and *none* of the quarters are statistically significant (relative to a base quarter of Q1 2008). Starting in Q4 2012, the first full quarter in the IPR period, all quarterly fixed effects are positive and significant (at least at the 10 percent level). The magnitudes and significance of the coefficients increase notably in Q2 2013.

Taken together, the results of these models support the visual observations from Figure 4. We do not see evidence that the switch to IPR resulted in an immediate, discontinuous jump to a higher rate of challenges. Rather, we see support for a policy change that was either gradual or had a delayed effect. In the narrow windows right around the policy change, we see little discernable difference in the challenge rate. In the subsequent progression of months, however, we see that the use of challenges is increasing more quickly than the pre-policy trend.

We suggest two possible explanations for the timing of this effect. First, there are two reasons to believe that the effect of the policy indicator is clouded in the period surrounding the actual policy change. First, as noted earlier in this Section, while September 16<sup>th</sup>, 2012 was the first date on which a defendant would have IPR available the instant they are sued, defendants who were sued in the year prior to this date in theory could still request an IPR when it became available. Therefore, cases in the last few quarters of what we have coded as the IPX period can be linked to IPR, rather than IPX, challenges. Further, since parties were on notice for a full year that the change from IPX to IPR was coming, there might have been selection around the policy change. Certain plaintiffs may have timed their lawsuits,

for example, to fall before or after the policy change. Lastly, one of the AIA policy changes (the change in the denials standard) took effect a year before the switch to IPR, and thus a portion of the overall policy effect was already in place in the year prior to the IPR period.<sup>196</sup> Taken together, these factors might partially explain the lack of significance in the narrowest window in Table A4.

More broadly, defendants may have been hesitant to make use of IPR right after it became available. Risk averse defendants or their counsel may have preferred to observe the first few outcomes of IPR before making use of this new tool. Similarly, they may have preferred to observe whether certain courts would be willing to grant stays before instituting an IPR alongside their parallel litigation case. This could explain both a gradual adoption of IPR, as well as a dichotomous jump several periods after the policy change. The former would be consistent with parties having different thresholds of comfort with IPR, and the latter would be consistent with a tipping point where enough information on the outcomes or court treatment of IPR for parties broadly to respond to the policy change.

As discussed in Part II, the IPX regime differs from the IPR regime in many ways.<sup>197</sup> These changes were motivated at least in part by a desire to make administrative challenges more appealing to litigants.<sup>198</sup> The data presented in this Part suggests that this goal has been achieved. When subjected to more rigorous analysis, the visual observation of increasing filings post-AIA holds up to scrutiny. Despite an apparent delayed or gradual effect, rates of administrative patent challenges in the years following the switch to IPR are higher for patents litigated after the AIA took effect, even when controlling for a variety of other variables that predict these challenges. To the extent that policymakers hoped that the AIA would increase the use of administrative challenges, our results provided some evidence that they have succeeded.

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196. *Supra* Section II.C.

197. *See* Section II *supra*.

198. *Id.*; *See also* Vishnubhakat, Rai & Kesan, *supra* note 9, at 65 (“In general, the AIA’s legislative history indicates Congress wanted both IPRs and CBM reviews to serve as a substitute for Article III litigation over patent validity.”).

Table 10: AIA Effects

VARIABLES	(1) AIA Indicator	(2) Add Trend	(3) Add Controls
AIA	0.075*** (0.007)	0.034** (0.017)	0.040** (0.018)
AIA*Trend		0.000*** (0.000)	0.000*** (0.000)
Constant	0.068*** (0.004)	0.073*** (0.009)	-0.009 (0.053)
Patent Filing Year FE	N	N	Y
Patent Controls	N	N	Y
District Court FE	Y	Y	Y
Judge FE	N	N	Y
Time Trend	N	Y	Y
Observations	34,129	34,129	33,095
R-squared	0.034	0.037	0.126

Notes: Dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e., had no such IPX or IPR within 18 months). The “AIA” variable is an indicator that takes the value “1” if the patent case was filed after 9/16/2012, and “0” otherwise. Columns (2)–(3) include a linear time trend based on filing dates, in days and centered around 9/16/2012, as well as an “AIA\*trend” variable that interacts this trend and the “AIA” indicator. Column (3) includes the full set of controls from Column 4 of Table 9, excluding quarterly FE. All models are linear probability models. Standard errors, clustered by district court and patent, in parenthesis; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

#### B. THE AIA AND THE TYPES OF CHALLENGES

A more interesting question for policymakers is whether the AIA increased the use of administrative procedures evenly across the board, or if it instead made these challenges more attractive for certain types of patents. That is, the effects of patent-level variables may be different within the IPR regime

compared to the IPX regime. Characteristics that predict administrative challenge overall may be better or worse predictors within the IPR or IPX regimes. This could suggest that the AIA's changes to these procedures changed the type of patents that were selected into IPR versus IPX.

To investigate these effects, Table A6 reproduces the main model from Table 9, run separately on the subsamples before and after the policy change. We observe that several variables that are statistically significant predictors of challenges in the IPX period are not significant predictors of challenges in the IPR period, and vice versa. Indeed, the only variable that is significant at the 5 percent level in both subsamples is prosecution time, which is negatively related to the odds of challenge.

There is some evidence that patent scope, via the minimum word count measure, matters within the IPX period (in the direction of broader patents being more likely to be challenged), but the same effect is not significant within the IPR period. The same is true of mechanical patents, which are less likely than other patents to be challenged in the IPX regime. On the other side of the coin, computer & communication and electrical and electronic patents are significantly more likely to be challenged, but only in the IPR regime.

Importantly, the small entity effect—that small entity patents are less likely to be challenged administratively—is only significant in the IPR subsample. As one possible explanation, we consider the changes in the cost structure from IPX to IPR. The IPR process involves significant discovery and other trial-like expenses. To the extent that small entities might settle early to avoid the costs of administrative challenge, where they face poor outcomes, this effect might be more pronounced in IPR if it is relatively more costly overall. We note further that the PAE indicator, which retains its negative sign and strong significance in the IPR period model, is only marginally significant in the IPX period model (at the 10 percent level), which could indicate the PAE effect is driven primarily by the IPR period.

Taken together, these results suggest that the AIA may have altered the selection of patents into administrative challenge. To the extent that policymakers did not intend to change the composition of patents that are administratively challenged in this way, they should carefully investigate the mechanisms that led to this change.

## VIII. CONCLUSION

The use of administrative validity challenges, while still low relative to litigation, increased significantly in the years after the AIA took effect. Use of these procedures by district court litigants may have significant private benefits in the form of reduced cost and increased speed.<sup>199</sup> Likewise, these procedures promise substantial public benefits by fixing patent office errors, and increasing the quality of granted patents.<sup>200</sup> If policymakers seek to increase the use of administrative patent challenges or to evaluate their effects, they must first understand how they are currently used.

Other literature has well established that certain intrinsic and acquired characteristics of patents can predict litigation.<sup>201</sup> Because the vast majority of administrative challenges occur alongside litigation, it would not be surprising to find that these same characteristics predict administrative challenges compared to the overall pool of patents.<sup>202</sup> Instead, we show that intrinsic and acquired characteristics are good predictors of administrative challenge *even within the pool of already litigated patents*.<sup>203</sup> Compared to other litigated patents, litigated patents that are associated with an administrative challenge may be of even higher value (when considering only non-challenged litigated patents that are not settled early), are less likely to have been issued to small entities or held by PAEs, and are more likely to be computer or electronic patents and less likely to be drug patents.<sup>204</sup> And finally, we confirm, quantitatively, the obvious visual observation: litigated patents are more likely to be challenged at the patent office after the AIA, and the switch to IPR, than before.<sup>205</sup> But, the full story is more nuanced than an across-the-board increase: selection patterns appear to have changed in meaningful and heterogeneous ways.<sup>206</sup>

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199. See Section I *supra*.

200. *Id.*

201. See Chien, *supra* note 29.

202. See Section IV. See also Vishnubhakat, Rai & Kesan, *supra* note 9.

203. See Section VI *supra*.

204. See Section VII *supra*.

205. *Id.*

206. *Id.*

Table A1: Comparing Litigation, IPX, and IPR<sup>207</sup>

	Litigation	IPX	IPR
In Force	Entire Period	11/29/1999– 9/15/2012	9/16/2012– present
Venue	Various District Courts	USPTO	USPTO PTAB
Who Decides?	District Court Judges or Juries	Patent Examiners	Administrative Patent Judges
Standard to Institute Review	<i>Iqbal / Twombly</i> to Overcome Motion to Dismiss	Substantial New Question of Patentability (pre-9/16/2011); Reasonable Likelihood of Prevailing on at Least One Claim (9/16/2011-end)	Reasonable Likelihood of Prevailing on at Least one Claim
When Can a Patent be Challenged?	Anytime	Anytime	≥9 months post-issuance, and ≤1 year post-litigation
Restrictions On patent Filing Date?	None	Only patents filed After Nov. 1999	None
Presumption of validity?	Yes	No	No

207. The material in this table is cited appropriately when it is first presented. For clarity of the table, we do not include supra citations to each source again. This table was constructed by the authors. Still, it was inspired by similar tables constructed by other sources to compare these or different procedures. See *PX vs. IPR—A Cheat Sheet*, supra note 82 (providing a comparison of *inter partes* reexamination and *inter partes* review); See also *Reexamination and its Interplay with Litigation*, DICKSTEIN SHAPIRO LLP (March 2011), [https://web.archive.org/web/20160812134841/http://www.ryuka.com/home/uploads/pdf/Reexam\\_presentation.pdf](https://web.archive.org/web/20160812134841/http://www.ryuka.com/home/uploads/pdf/Reexam_presentation.pdf) (summarizing the procedural aspects of reexamination and a providing context and comparison to litigation and IPR procedures for invalidation).

Standard to prove invalidity	Clear and convincing evidence	Preponderance of the evidence	Preponderance of the evidence
Permissible invalidity grounds	Any	Novelty and nonobviousness on printed publications only	Novelty and nonobviousness on printed publications only
Formal settlement possible?	Yes	No	Yes
Appeals?	Federal Circuit	Board of Patent Appeals and Interferences; Federal Circuit	PTAB; Federal Circuit
Estoppel	Usual Civil Litigation Estoppel	Binds after appeals	Binds before appeals
Cost	High	Low	Medium
Time to decision on the merits	Lengthy	Lengthy	1.5 years by statute (2 years in exceptional cases) <sup>208</sup>

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208. See 37 C.F.R. § 42.100.

Table A2: Patent Determinants of Administrative Challenge  
Using Patent Classes

VARIABLES	(1)	(2)	(3)	(4)
	Intrinsic Patent Characte ristics	Add Acquired Characte ristics	Add Small Entity and PAE	Add Judges
Independent claims	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Min. word in ind. Claims/100	-0.004 (0.003)	-0.005 (0.003)	-0.005 (0.003)	-0.006*** (0.002)
Back citations per claim	0.001* (0.001)	0.001* (0.001)	0.001 (0.001)	0.001 (0.001)
Prosecution per claim (years)	-0.011* (0.006)	-0.017*** (0.006)	-0.016*** (0.006)	-0.018*** (0.006)
Age (years)		-0.003 (0.002)	-0.002 (0.002)	-0.003 (0.002)
Forward Citations per year per claim		0.008 (0.005)	0.007 (0.005)	0.006 (0.005)
Assigned		0.003 (0.007)	0.012 (0.007)	0.011 (0.007)
Small entity indicator			-0.028*** (0.009)	-0.024** (0.010)
PAE			-0.039*** (0.008)	-0.037*** (0.010)
Constant	-0.049** (0.020)	-0.001 (0.050)	0.016 (0.050)	0.019 (0.051)
Patent Filing Year FE	Y	Y	Y	Y
Patent Class FE	Y	Y	Y	Y
District Court FE	Y	Y	Y	Y

Litigation Quarter FE	Y	Y	Y	Y
Judge FE	N	N	N	Y
Observations	33,435	33,435	33,435	33,069
R-squared	0.092	0.092	0.095	0.164

Notes: Dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e. had no such IPX or IPR within 18 months). All models are linear probability models. Standard errors, clustered by district court and patent, in parenthesis; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

Table A3: Patent Determinants of Administrative Challenge:  
Excluding Non-Challenged Cases that Terminated Early

VARIABLES	(1)	(2)	(3)	(4)
	Intrinsic Patent Characteristics	Add Acquired Characteristics	Add Small Entity and PAE	Add Judges
Independent claims	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Min. word in ind. Claims/100	-0.006 (0.007)	-0.007 (0.007)	-0.007 (0.007)	-0.008 (0.006)
Back citations per claim	0.002** (0.001)	0.002** (0.001)	0.002** (0.001)	0.002** (0.001)
Prosecution per claim (years)	-0.037*** (0.009)	-0.054*** (0.011)	-0.054*** (0.012)	-0.056*** (0.013)
Chemical	-0.060* (0.031)	-0.060** (0.030)	-0.059* (0.030)	-0.065** (0.029)
Computer & Comm.	0.034 (0.022)	0.023 (0.022)	0.023 (0.022)	0.030 (0.022)

Drug & Medical	-0.097*** (0.032)	-0.101*** (0.032)	-0.099*** (0.030)	-0.109*** (0.034)
Electrical & Electronic	0.066** (0.030)	0.062** (0.030)	0.063** (0.031)	0.067** (0.030)
Mechanical	-0.066** (0.025)	-0.066** (0.025)	-0.066*** (0.025)	-0.062** (0.028)
Age (years)		-0.005*** (0.002)	-0.005*** (0.002)	-0.005*** (0.002)
Forward Citations per year per claim		0.024** (0.011)	0.025** (0.011)	0.025** (0.011)
Assigned		0.037*** (0.012)	0.036*** (0.013)	0.027** (0.013)
Small entity indicator			0.009 (0.016)	0.004 (0.017)
PAE			0.005 (0.011)	0.002 (0.013)
Constant	-0.101*** (0.037)	-0.024 (0.066)	-0.027 (0.065)	0.001 (0.068)
Patent Filing Year FE	Y	Y	Y	Y
District Court FE	Y	Y	Y	Y
Litigation Quarter FE	Y	Y	Y	Y
Judge FE	N	N	N	Y
Observations	15,769	15,769	15,769	15,507
R-squared	0.116	0.119	0.119	0.234

Notes: Dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e., had no such IPX or IPR within 18 months) and did not terminate before on year. All models are linear probability models. Standard errors, clustered by district court and patent, in parenthesis; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

Table A4: AIA Effects Robustness Checks

Variables	(1) Class	(2) Modified Non- challenged	(3) 540 Days	(4) 360 Days	(5) 180 Days
AIA	0.042** (0.017)	0.055* (0.030)	-0.000 (0.023)	0.018 (0.024)	0.024 (0.019)
AIA*Trend	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	0.000*** (0.000)	-0.000 (0.000)
Constant	0.033 (0.049)	0.034 (0.063)	0.021 (0.092)	-0.061 (0.111)	0.051 (0.134)
Patent Class FE	Y	N	N	N	N
Observations	33,069	15,507	15,772	10,830	5,593
R-squared	0.162	0.229	0.181	0.230	0.260

Notes: Dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e. had no such IPX or IPR within 18 months), except for Column 2 which follows Table A3 and excludes non-challenged cases that terminated within one year. The “AIA” variable is an indicator that takes the value “1” if the patent case was filed after 9/16/2012, and “0” otherwise. All columns include a linear time trend based on filing dates, in days and centered around 9/16/2012, as well as an “AIA\*trend” variable that interacts this trend and the “AIA” indicator. All columns also include the full set of controls and fixed effects from Column 4 of Table 9, excluding the quarterly FE. Column (1) replaces the NBER categories with a full set of patent classes.. Columns (3)–(5) restrict the sample to 540, 360, and 180 days on either side of 9/16/12 (total widths of three years, two years, and

one year respectively). All models are linear probability models. Standard errors, clustered by district court and patent, in parenthesis; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

Table A5: AIA Effects Robustness Checks

VARIABLES	(1) Quarters	(2) Add Controls
Q2 2008	0.033 (0.029)	0.032 (0.037)
Q3 2008	0.031 (0.037)	0.027 (0.042)
Q4 2008	-0.013 (0.016)	-0.003 (0.025)
Q1 2009	-0.016 (0.018)	-0.003 (0.023)
Q2 2009	0.018 (0.018)	0.032 (0.022)
Q3 2009	0.017 (0.023)	0.020 (0.030)
Q4 2009	0.032 (0.021)	0.037 (0.029)
Q1 2010	-0.008 (0.015)	-0.003 (0.024)
Q2 2010	-0.010 (0.019)	0.002 (0.028)
Q3 2010	0.035* (0.019)	0.039 (0.024)
Q4 2010	0.000 (0.020)	0.003 (0.024)
Q1 2011	-0.004 (0.018)	-0.002 (0.024)
Q2 2011	0.015 (0.020)	0.015 (0.023)
Q3 2011	0.028* (0.015)	0.043 (0.026)
Q4 2011	0.038* (0.020)	0.044 (0.031)
Q1 2012	0.024 (0.021)	0.027 (0.025)
Q2 2012	0.008	0.018

	(0.013)	(0.017)
Q3 2012	0.028 (0.022)	0.029 (0.028)
Q4 2012	0.023* (0.013)	0.043* (0.023)
Q1 2013	0.030* (0.017)	0.045* (0.024)
Q2 2013	0.078*** (0.022)	0.091*** (0.027)
Q3 2013	0.085*** (0.029)	0.089*** (0.027)
Q4 2013	0.115*** (0.017)	0.122*** (0.023)
Q1 2014	0.115*** (0.031)	0.126*** (0.035)
Q2 2014	0.107*** (0.022)	0.109*** (0.023)
Q3 2014	0.096*** (0.027)	0.108*** (0.030)
Q4 2014	0.107*** (0.028)	0.117*** (0.036)
Q1 2015	0.100*** (0.022)	0.117*** (0.035)
Q2 2015	0.108*** (0.018)	0.117*** (0.029)
Q3 2015	0.124*** (0.022)	0.121*** (0.029)
Q4 2015	0.090*** (0.020)	0.102*** (0.026)
Constant	0.055*** (0.014)	-0.018 (0.053)
Patent Filing Year FE	N	Y
Patent Controls	N	Y
District Court FE	Y	Y
Judge FE	N	Y
Observations	34,129	33,095
R-squared	0.040	0.128

Notes: Dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. The models include quarter dummies, the first full quarter in IPR is Q4 2012. Column (2) includes the full set of controls from Column 4 of Table 9. The

models are linear probability models. Standard errors, clustered by district court and patent, in parenthesis; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

Table A6: Patent Determinants of Administrative Challenge:  
Before and After AIA

VARIABLES	(1) IPX Period	(2) IPR Period
Independent claims	0.001 (0.001)	0.001 (0.001)
Min. word in ind. Claims/100	-0.006** (0.003)	-0.005 (0.004)
Back citations per claim	0.001* (0.001)	0.001 (0.001)
Prosecution per claim (years)	-0.022*** (0.008)	-0.032*** (0.009)
Chemical	0.001 (0.016)	-0.028 (0.031)
Computer & Comm.	0.006 (0.014)	0.051*** (0.017)
Drug & Medical	-0.022 (0.016)	-0.045 (0.034)
Electrical & Electronic	-0.004 (0.014)	0.088*** (0.030)
Mechanical	-0.030** (0.013)	-0.001 (0.016)
Age (years)	-0.006* (0.003)	-0.002 (0.003)
Forward Citations per year per claim	0.014* (0.008)	0.009 (0.006)
Assigned	0.002 (0.006)	0.017 (0.014)
Small entity indicator	0.002 (0.010)	-0.034** (0.016)

PAE	-0.016*	-0.053***
	(0.009)	(0.015)
Constant	0.058**	0.027
	(0.028)	(0.091)
Patent Filing Year FE	Y	Y
District Court FE	Y	Y
Litigation Quarter FE	Y	Y
Judge FE	Y	Y
Observations	13,596	19,390
R-squared	0.152	0.154

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Notes: Dependent variable is “challenged”; challenged cases are those where the litigated patent was matched to an IPX or IPR occurring within 18 months. “Non-challenged” cases are those that could not be matched (i.e., had no such IPX or IPR within 18 months). Column (2) covers cases filed on or after 9/16/2012, and Column (1) covers the remainder of our sample. All models are linear probability models. Standard errors, clustered by district court and patent, in parenthesis; \*, \*\*, \*\*\* indicate statistical significance at 10%, 5%, and 1% respectively.

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