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# Patent Validity and Litigation: Evidence from US Inter Partes Review

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## Abstract

We analyze how new information about the validity of a patent impacts the settlement of patent infringement litigation. A party accused of patent infringement in the United States may—in parallel with defending itself in court—challenge the validity of the allegedly infringed patent by petitioning the Patent Trial and Appeal Board (PTAB), an administrative tribunal in the US Patent and Trademark Office. Review by PTAB generates new information about the validity of challenged patents, and we study empirically the resulting effect on settlement of an accused infringer's decision to file a petition to challenge a patent's validity and, conditional on the filing of a petition, the PTAB's initial decision to grant or deny the petition on the basis of its assessment of a reasonable likelihood of invalidity. We find that both decision points have large, positive effects on the settlement of parallel court proceedings.

## 1. Introduction

Parallel legal proceedings are a common feature of adjudication because a single legal dispute may simultaneously fall within the ambit of multiple decision makers, jurisdictions, or fields of law. In addition to ubiquitous examples of overlapping litigation (for example, state and federal or civil and criminal litigation stemming from the same alleged acts), other contexts give rise to more diverse sets of contemporaneous proceedings that may include both public and private decision makers or both judicial and administrative review (Weismann 2012). Among other examples, transnational disputes regularly give rise to both national litigation and international arbitration (Whytock 2008), labor disputes may lead to concurrent arbitration and agency action (see, for example, Anderson 1970), and

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both securities and antitrust law enforcement commonly involve concurrent administrative and judicial proceedings (see, for example, Cox, Thomas, and Kiku 2003; Nazzini 2004).

Despite the diversity of circumstances under which they arise, parallel proceedings are almost uniformly characterized in the literature as substitutes that are inefficient, if not also opportunistic, in nature. Contemporaneous transnational proceedings are seen as the result of international forum shopping by litigants searching for the procedural climate most favorable to their side of the dispute (Whytock 2022). This can lead to an inefficient “race to the bottom” (Contreras 2019) and reduce global economic welfare in ways analogous to discriminatory tariff and tax policies (Sykes 2008). Similarly, parallel efforts to enforce securities or antitrust law are commonly said to represent wasteful or opportunistic piling on. For example, Choi, Erickson, and Pitchard (2017) conclude that US shareholders’ state-level derivative suits opportunistically follow parallel federal proceedings in an effort to recover additional attorneys’ fees from corporate defendants without providing additional relief to shareholders.

However, redundancy is not an inherent characteristic of parallel proceedings. In principle, concurrent proceedings can also be complementary in nature, particularly where the flow of information across venues supports *de facto* or *de jure* specialization and coordination. Nonetheless, there is little empirical evidence on the potential flow of information among parallel proceedings. While some descriptive accounts suggest that information generated by one proceeding can affect others—for example, a small literature discusses private litigation that piggybacks on information gleaned from contemporaneous agency investigations (see, for example, Erickson 2000)—empirical evidence concerning the interplay of concurrent legal proceedings is rare (Cox, Thomas, and Kiku 2003; Erickson 2011; Choi, Erickson, and Pitchard 2017).

To address this gap in the literature, we study a setting that arises in the context of patent enforcement. In response to concerns about the fallibility of patent examination, jurisdictions around the world have established administrative procedures through which the public may ask a patent office to reassess the validity of granted patents (Hall and Harhoff 2004; Chien, Helmers, and Spigarelli 2018). While such procedures are typically available to challenge any unexpired patent, patents that have been asserted in court are disproportionately likely to be challenged by firms sued for infringement (Vishnubhakat, Rai, and Kesan 2016). Accordingly, administrative patent challenges commonly proceed in parallel with patent infringement litigation involving the same patents and parties. We take advantage of this setup to empirically assess whether information generated in administrative patent proceedings impacts the settlement of parallel patent suits.

Our analysis focuses on the interplay between patent litigation in US district courts and parallel *inter partes* review (IPR) proceedings before the Patent Trial and Appeal Board (PTAB) of the US Patent and Trademark Office (USPTO). Our data cover all US patent suits filed during 2011–16 and all parallel IPRs initiated

during 2012–17.<sup>1</sup> We use the data to study two decision points in the IPR process that may affect the settlement of parallel litigation: the accused infringer’s decision to file a petition to initiate a parallel IPR and, conditional on the filing of a petition, PTAB’s initial assessment of a patent’s validity in its decision to grant (that is, “institute”) or deny the petition.

Both decisions reveal information that otherwise would not become available (if at all) until much later in the course of litigation. In addition to setting the IPR process in motion, an accused infringer’s petition for an IPR reveals the party’s best arguments that the challenged patent is invalid, including the most relevant pieces of prior art (prior publications or patents that call into question the challenged patent’s novelty or nonobviousness) that the party is able to locate in preparation for defending the case. Moreover, an accused infringer’s decision to initiate an IPR reveals a willingness to incur the substantial expense of pursuing an additional proceeding,<sup>2</sup> which in turn may reveal information about the accused infringer’s assessment of the case’s value or the strength of its invalidity defense. In a more straightforward manner, PTAB’s decision whether or not to institute (hereafter, institution decision) could affect settlement because it reveals a neutral, skilled third party’s determination of whether the arguments presented in the petition demonstrate a reasonable likelihood that the patent is at least partially invalid.<sup>3</sup>

To analyze the effect of filing a petition for IPR, we use a fuzzy regression discontinuity approach, which allows us to address the endogeneity inherent in an accused infringer’s decision to initiate an IPR. By statute, a party sued for infringement must file an IPR to challenge the allegedly infringed patent within 1 year of receiving the complaint alleging infringement. We show empirically that the likelihood of an IPR filing spikes shortly before this exogenously mandated deadline, and we use this discontinuity to isolate an IPR petition’s impact on settlement.

Our results indicate that the filing of an IPR petition has a large, positive effect on the settlement of parallel litigation. Cases with a parallel IPR petition were more likely than cases without a parallel IPR petition to settle within the same window of time following the date of petition. While these results compare across cases that did and did not generate a parallel IPR, we caution that they do not allow us to compare the present legal regime with a counterfactual in which ad-

<sup>1</sup> Inter partes review (IPR) and two other proceedings became available in September 2012, 1 year after passage of the Leahy-Smith America Invents Act (AIA) (Pub. L. No. 112-29, 125 Stat. 284 [2011]). While the IPR process has proved to be very popular, postgrant review and covered business method patent review have been used relatively infrequently largely because of greater restrictions on their availability. Yet another preexisting challenge—*ex parte* reexamination—survived the AIA but has also been used sparingly since the introduction of IPR.

<sup>2</sup> Median legal fees required to pursue an IPR to a final decision are estimated to exceed \$300,000 (American Intellectual Property Law Association 2019, pp. I-183, I-187).

<sup>3</sup> Final decisions by the Patent Trial and Appeal Board (PTAB) overwhelmingly confirm the initial assessment of invalidity announced in institution decisions. To date, about 82 percent of instituted claims that were the subject of a final written decision were invalidated (Unified Patents, Outcomes for Instituted Claims [<https://portal.unifiedpatents.com/ptab/analytics/claim-level/by-outcome>]).

ministrative patent challenges are not available. Thus, our finding that IPR petitions induce settlement in parallel cases does not necessarily imply that the introduction of the IPR process to the US patent system increased the settlement rate.

To analyze the effect of receiving an IPR institution decision, we construct two instrumental variables, both of which rely on exogenous variation driven by the quasi-random assignment of IPRs to administrative patent judges (APJs). First, to assess the effect of receiving a decision generally (that is, regardless of outcome), we must confront the endogeneity inherent in the litigants' choice not to preempt that decision through settlement—that is, their choice to allow the IPR to continue to an institution decision. To address this issue, we capitalize on the fact that PTAB must (again by statute) decide whether to institute an IPR petition within 6 months of the petition's filing date. We compute the average time taken by each APJ to produce an institution decision within the window of time afforded by statute and rely on exogenous variation in the speed of the decision (driven by quasi-random APJ assignment) to isolate the effect of the issuance of an institution decision (regardless of outcome) on the settlement of parallel litigation. Second, to assess whether the outcome of an institution decision (that is, whether PTAB decided to institute or deny the petition) affects settlement, we must address the possibility that both settlement and outcomes are correlated with unobservable characteristics of cases. To do so, we follow the literature's extensive use of judge-specific leniency for identification (for an overview, see Frandsen, Lefgren, and Leslie 2019) and construct a measure of an APJ's propensity to institute—that is, the likelihood that a given APJ panel will grant a given IPR petition—to instrument for the outcome of institution decisions.

The results of our analysis at the institution stage indicate that receipt of an institution decision has a large, positive effect on the settlement of parallel litigation. Patent suits with a parallel IPR that received an institution decision were more likely to settle compared with those that remained undecided during the same window of time. To be clear, the institution-stage results do not compare across cases that do and do not have copending IPRs because, as we explain in greater detail below, the analyses are limited to cases with parallel IPRs. We further find that the effect at this stage is driven by settlements that follow PTAB's decisions to institute the accused infringer's petition for an IPR. This result suggests that accused infringers may be able to induce settlement by leveraging the threat of an eventual final decision invalidating the challenged patent. It also highlights the ambiguous welfare implications of settlements in this context. While IPR settlements reduce the parties' litigation expenditures, they also preempt the issuance of final PTAB decisions that would benefit third parties by clarifying the disputed validity of challenged patents.<sup>4</sup>

<sup>4</sup> Because an invalidated patent cannot be enforced against other potential infringers (*Blonder-Tongue Laboratories Inc. v. University of Illinois Foundation*, 402 U.S. 313 [1971]), invalidation of a patent generates positive externalities for market participants (including the accused infringer's competitors) that otherwise may have paid to license or challenge the patent in the future (Farrell and Merges 2004; Miller 2014).

Collectively, our findings indicate that the revelation of information at different stages of the IPR process affects the resolution of parallel district court litigation (albeit with unclear overall welfare effects). Accordingly, we provide empirical evidence of the complementary effect that parallel proceedings can have on one another, an effect that to date has largely been overlooked in the literature. Our results therefore contribute to a richer understanding of the potential interplay among concurrent legal proceedings and suggest further study of potential interaction and complementarity among related proceedings that arise in other areas of law.

Furthermore, by linking the revelation of information and settlement, our results also have relevance to the literature on legal discovery and asymmetric information in litigation. While there are a number of theoretical (Mnookin and Wilson 1998; Schrag 1999; Lee and Bernhardt 2016) and experimental (Loewenstein and Moore 2004) studies of discovery's effect on litigation, the empirical evidence is scarce (Farber and White 1991; Huang 2009). Similarly, although a large theoretical literature examines the impact of asymmetric information on settlement (Png 1983; Bebchuk 1984; Reinganum and Wilde 1986; Nalebuff 1987; Meurer 1989), relevant empirical work has thus far been limited to analyzing the effect of motions practice (Boyd and Hoffman 2013; Cooper 2017), pleadings and hearings (Bielen, Grajzl, and Marneffe 2017), and experts' assessments of personal injury claims (Fenn and Rickman 2014).

Finally, our results contribute to ongoing policy debates about the proper role of administrative proceedings in the patent system. While the IPR process was created with the express goal of increasing the speed and reducing the cost of resolving patent disputes,<sup>5</sup> opponents argue—in line with the broader literature on concurrent proceedings—that IPRs are, to the contrary, inefficient and potentially opportunistic (for example, Abbott et al. 2017). Our results help inform this debate and confirm empirically that the IPR process reveals information about patent validity that affects the resolution of copending patent infringement disputes.

## 2. Inter Partes Review

Legislation establishing PTAB was enacted in 2011, and IPR became available on September 16, 2012. The IPR process begins when a patent challenger files a petition arguing that there is a reasonable likelihood that at least one of the patent's claims is invalid (35 U.S.C. sec. 314[a]; 37 C.F.R. sec. 42.108). While anyone can file an IPR petition, the vast majority of challenges are brought by parties that have been sued for allegedly infringing the challenged patent (Vishnubhakat, Rai, and Kesan 2016). A petitioner accused of infringing a challenged patent must file its petition within 1 year of the day on which it was "served with a complaint

<sup>5</sup> The AIA's legislative history states, for example, that PTAB proceedings will serve as "quick and cost effective alternatives to litigation" (H.R. Rep. No. 112-98, p. 48 [2011]) that "will allow invalid patents that were mistakenly issued by the USPTO to be fixed early in their life, before they disrupt an entire industry or result in expensive litigation" (157 Cong. Rec. S1326 [2011]).

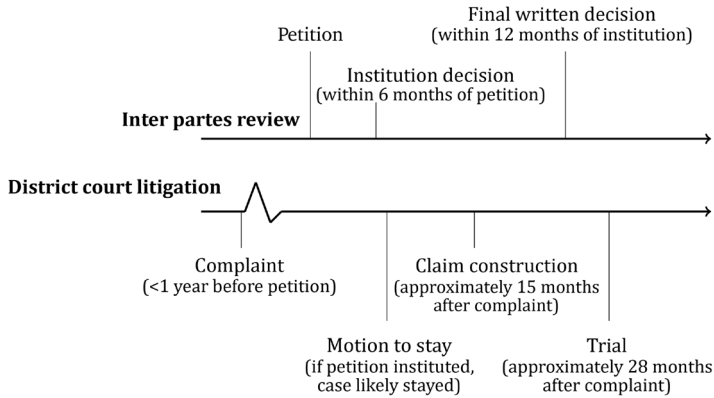


Figure 1. Timeline of inter partes review and district court litigation

alleging infringement” (unless the petition requests joinder with an earlier filed petition challenging the same patent on similar grounds) (35 U.S.C. sec. 315[b]). Petitions filed more than 1 year after service of process of infringement allegations was served are (unless joined with another pending challenge) categorically barred by statute.

Figure 1 summarizes the IPR timeline. Once a petition is filed, it is assigned a notice of accord filing date from which subsequent deadlines are calculated. Once the petition is assigned a filing date, the owner of the challenged patent is given 3 months to prepare and file a preliminary response to the petition, but the patentee is not required to do so (35 U.S.C. sec. 313; 37 C.F.R. sec. 42.107). If a preliminary response is filed, PTAB must decide whether to institute the petition—that is, whether the petition has established a reasonable likelihood of success that warrants further review<sup>6</sup>—within 3 months of the response’s filing date (35 U.S.C. sec. 314[b][1]). If no response is filed, PTAB must issue its institution decision within 6 months of the petition’s assigned filing date (35 U.S.C. sec. 314[b][2]).

Institution decisions are made by a panel of APJs who are assigned to petitions on a quasi-random basis conditional on a small number of factors set forth in PTAB’s Standard Operating Procedures.<sup>7</sup> However, APJs are not assigned immediately upon a petition’s filing, and a panel’s composition is generally not disclosed until an institution decision is made (or a preinstitution termination is granted).

<sup>6</sup> Prior to April 2018, PTAB institution decisions individually addressed each challenged claim, so petitions were sometimes partially instituted for further review of a subset of challenged claims. To comply with *SAS Institute Inc. v. Iancu* (138 S. Ct. 1348 [2018]), PTAB now grants a petition in its entirety if the petition demonstrates a reasonable likelihood of invalidating at least one challenged claim. Because of this change in procedure, our analysis does not incorporate the number or share of challenged claims that were instituted. Instead, we distinguish only between petitions that were instituted for at least one claim and petitions that were completely denied.

<sup>7</sup> US Patent and Trademark Office, Patent Trial and Review Board, Standard Operating Procedure 1 (Revision 15): Assignment of Judges to Panels (<https://www.uspto.gov/sites/default/files/documents/SOP%201%20R15%20FINAL.pdf>).

Until that time, parties to an IPR correspond with USPTO trial paralegals, who handle preinstitution filings.

Institution decisions are final and nonappealable (*Cuozzo Speed Technologies LLC v. Lee*, 136 S.Ct. 2131 [2016]). Thus, if PTAB decides to institute the petition, the IPR process continues uninterrupted. Otherwise, the IPR is terminated. In addition, just as in litigation, the parties to an IPR are free to settle on confidential terms at any time (35 U.S.C. sec. 317; 37 C.F.R. sec. 42.74).<sup>8</sup>

Absent settlement, PTAB must issue a final written decision on the validity of instituted patent claims within 1 year of the institution decision, and thus within 18 months from the petition's filing date. By contrast, a litigant is unlikely to receive a substantive ruling on validity from a court until at least several months later<sup>9</sup> and often much, much longer.

### 3. Data

#### 3.1. Data Sources

Our analysis uses data collected from the dockets of IPRs and US patent suits. Petition-level data for IPRs filed from September 16, 2012, through the end of 2017 were sourced from Unified Patents' public database of PTAB dockets and filings.<sup>10</sup> This data set includes the filing date of each petition, the identities of each challenger and patent owner, the patent challenged, the date when each petition was assigned a notice of accord filing date, and the date (if any) on which the patent owner filed a preliminary response to the petition. We additionally collected information about institution decisions, preinstitution terminations, and motions for joinder. Data on petitions litigated to an institution decision include the date of the decision, the APJs who made the decision, and whether the decision granted or denied the petition. Data on petitions that ended because of a preinstitution settlement include the date of dismissal and the APJs who granted the motion to terminate. Finally, we identified all groups of petitions that were joined for consolidated consideration.

Case-level data for US patent suits filed from 2011 to 2016 were sourced from MaxVal's Litigation Databank.<sup>11</sup> The data include the date on which each case was filed, the court in which it was filed, the parties to the lawsuit, and the patent(s) enforced in each suit. We also determined whether each case was terminated as of June 2020 and, if so, when and on what basis it was terminated (including by settlement).

<sup>8</sup> Technically, PTAB has discretion to proceed with its determination of validity despite a settlement, but in practice it has done so only a handful of times. The patent owner can also end the review unilaterally by canceling the challenged claims.

<sup>9</sup> In US patent cases filed during 2012–16, the median time to summary judgment exceeds 2 years (Docket Navigator).

<sup>10</sup> See Unified Patents, Case List ([https://portal.unifiedpatents.com/ptab/caselist?sort=-filing\\_date](https://portal.unifiedpatents.com/ptab/caselist?sort=-filing_date)).

<sup>11</sup> MaxVal, Litigation Databank (<https://www.maxval.com/litigation-databank/>).



### 3.2. *Parallel Proceedings*

Our analysis requires the identification of parallel proceedings, that is, patent assertions with related, concurrent IPRs. We consider a case and an IPR to be parallel if they involve the same patent, were litigated by the same parties,<sup>12</sup> and take place contemporaneously, with the IPR petition following the lawsuit. To identify pairs of related copending proceedings, we merged the two data sets described above by patent number, identified the IPR-case pairs that shared a patent and overlapped for some period of time, and (for each pair identified) reviewed by hand the US district court case docket and the PTAB petitions docket to determine whether the two legal proceedings also had a common petitioner-defendant.

To further refine the analysis and account for procedural complexities inherent in litigation, we expanded the parallel IPR and case data to the patent-party level. Because court cases commonly involve multiple patents and/or multiple accused infringers, the effect of a single IPR pursued by a single party may be obscured when settlement data are examined at the case level. Similarly, because multiple companies may join forces to file a single petition for an IPR but thereafter settle separately at different times, institution decisions are not uniformly applicable to all copetitioners. To overcome these challenges, we collected additional court and IPR data to track each unique combination of patent and accused infringer from filing to termination.

This required us to expand of the petition-level IPR data set to the petitioner level. While the majority of IPRs were brought by a single petitioner (and thus already represent patent-party-level data), a sizeable minority were filed jointly by two or more copetitioners. In still other IPRs, a single petitioner was joined with another following a granted motion for joinder. For all IPRs involving copetitioners, we reviewed the PTAB docket to determine whether any petitioner settled with the patent owner prior to the IPR's final termination.

Similarly, for all cases identified as parallel to at least one PTAB challenge, we expanded our case-level data to the patent-party level, which means that if a case involved three patents asserted against two alleged infringers, we collected data for all six patent-party pairs. As with the IPR data, we expanded case consolidations and identified and merged the data across the instances in which a case was reassigned a new case number following an intermediate procedural termination—that is, instances in which a case was transferred, severed, or dismissed (voluntarily or on a procedural technicality) and subsequently refiled in substantially identical form. We similarly identified and merged all pairs of mirror-image cases—that is, instances in which the patent owner filed an infringement action and the accused infringer filed a separate action of its own seeking a declaration of noninfringement and invalidity. Accordingly, the data allow us to follow each

<sup>12</sup> We made this determination at the business group level to capture, for example, petition-case pairs in which a corporate parent challenged a patent asserted against its subsidiary.

patent-party infringement allegation across multiple case numbers and identify the initial filing date, the final termination type and date, and all other relevant data aggregated across intervening case dockets.

With both sets of data expanded to the patent-party level, we are able to link all copending IPR-assertion pairs at the patent-party level. Therefore, in expanded form, our data allow us to track and compare—for each patent-party pair that faced off in court and in an IPR—all important litigation events that took place in both venues.

### 3.3. *Dates*

To ensure that the settlement timing data reflect the parties' actual time of agreement as accurately as possible, we consider a case settled (or partially settled if there is more than one patent or party) on the earliest date supported by the docket. Typically, this means that a case is considered settled on the date that the relevant party or parties moved the court to dismiss the case (or to dismiss claims asserting a particular patent or alleging infringement against a particular party). In other cases, the relevant party or parties notified the court of a forthcoming settlement on an even earlier date, for example, in the context of moving the court to stay a deadline or cancel a hearing pending an imminent motion to dismiss. Moreover, when the data indicate that a patent-party assertion settled in court and at PTAB, we examined both dockets to ensure that the two sets of data reflect the earliest settlement date supported by case filings in either docket.<sup>13</sup>

We also collected the data necessary to calculate IPR deadlines with complete accuracy. Because the 1-year deadline to file an IPR petition begins when the accused infringer is served with the complaint (not when the complaint is filed with the court), we reviewed the dockets of parallel cases by hand to identify with as much precision as possible when each patent-party infringement allegation was served. Similarly, because PTAB's 6-month deadline to issue an institution decision begins once the petition is formally assigned a filing date (not when the petition is filed with PTAB) and, moreover, may shift slightly if the petitioner files a response to the petition, we reviewed by hand the dockets of the parallel IPRs to identify precisely when the notice of accord filing date was filed in each docket and whether (and if so, on what date) the patent owner filed a preliminary response.

### 3.4. *Variables*

Variables that control for litigant-, case-, and patent-specific characteristics are defined in Table 1. We use the Stanford NPE Litigation Database to categorize the owner of each challenged patent as an operating technology company or a non-practicing entity, that is, a patent holder that focuses on enforcing patent rights

<sup>13</sup> Very rarely—just 10 times in the data—we observed an IPR-assertion pair in which the IPR settled but the patent assertion in court did not. We drop those pairs from the analysis.

rather than producing or selling products or services.<sup>14</sup> In addition, among parallel court cases, we distinguish between cases that were and were not stayed pending the outcome of the accused infringer's PTAB challenge and cases in which the accused infringer did or did not file at least one motion to dismiss on patent eligibility grounds or motion for summary judgment. Similarly, to control for IPR characteristics, we include a variable measuring the time that passed between suit and petition and distinguish between IPRs in which the patent owner did or did not file a preliminary response to the accused infringer's petition. To control for patent characteristics, we use data from Baron and Pohlmann (2018) to identify patents that were declared essential to a standard-setting organization, and we include a number of standard patent characteristics, namely, the size of each patent's family of related applications, the number of times a patent has been cited by other patents, the number of prior-art patents and publications cited during a patent's examination, the number of applicants and inventors listed on the patent filing, and the number of independent claims (sourced from Marco, Sarnoff, and deGrazia 2019) as a measure of a patent's breadth. To ensure that the results are robust to recent US cases restricting the patentability of software business methods (see *Alice Corp. v. CLS Bank International*, 573 U.S. 208 [2014], and its progeny), we also identify all business method and software patents as defined by Chung et al. (2015).

Finally, we obtained from Semet (2022) biographical information for each APJ, including his or her legal and technical education and work experience. A complete list of characteristics is in Table OB1 in the Online Appendix. We use these data to account for APJs' characteristics in our instrumental-variable approach described in Section 4.2.

### 3.5. Description of the Sample

The sample of parallel IPR-case pairs comprises 7,063 IPRs and 1,479 district court cases that collectively share 2,410 patents. The 1,479 court cases account for about 6 percent of all US patent suits filed during the period of the study.<sup>15</sup> Figure OA1 in the Online Appendix shows that only about 60 percent of cases with a parallel IPR end in settlement. The relatively low rate of settlement among parallel cases may reflect the increased likelihood that such cases will be quickly resolved on the merits (by PTAB invalidity rulings) and that parallel cases tend to have higher stakes and thus greater litigation intensity.

<sup>14</sup> See Stanford Law School, Stanford Program in Law, Science and Technology, NPE Litigation Database (<https://npe.law.stanford.edu/>). Our definition of a nonpracticing entity excludes universities, patent-holding entities controlled by operating companies, and preproduct start-ups.

<sup>15</sup> If we focus on US patent suits that were litigated for at least 1 year (the deadline for filing a parallel IPR), the share with a parallel IPR increases to almost 18 percent.

**Table 1**  
**Definitions of the Variables**

	Description	Source
District court: Court Proceedings Stayed	Equals one if the district court stayed the case (or relevant patent-party-level assertion) pending the outcome of the parallel inter partes review (IPR) and zero otherwise	Docket Navigator
Motion to Dismiss	Equals one if the accused infringer filed a decided motion to dismiss the case (or relevant patent-party-level assertion) on patentable subject matter grounds and zero otherwise	Docket Navigator
Motion for Summary Judgment	Equals one if the accused infringer filed a decided motion for summary judgment of noninfringement and/or invalidity of the relevant patent and zero otherwise	Docket Navigator
District court and Patent Trial and Appeal Board: Filing Lag	Number of days from service of process of a relevant infringement allegation to filing of petition for an IPR and zero otherwise	MaxVal, Litigation Databank; Docket Navigator
Preliminary Response	Equals one if the patent owner filed a preliminary response to the accused infringer's petition for an IPR and zero otherwise	Docket Navigator
Software or Business Method	Equals one if the patent was assigned to US Patent Classification main class 341, 345, 370, 380, 382, 700-707, 710, 711, 713-15, 717, 726, or 902 and zero otherwise	Chung et al. (2015)
SEP	Equals one if the patent was declared essential to a technology standard and zero otherwise	Baron and Pohlmann (2018)
Plaintiff NPE	Equals one if the plaintiff is a nonpracticing entity and zero otherwise	Stanford NPE Litigation Database
Family Size	Number of patent family members	Patstat
Forward Citations	Number of forward citations within the first 3 years of earliest publication	Patstat
Backward Citations	Number of backward citations	Patstat
NPL Citations	Number of backward citations to nonpatent literature	Patstat
Applicants	Number of applicants	Patstat
Inventors	Number of inventors	Patstat
Independent Claims	Number of independent claims	Marco, Sarnoff, and deGrazia (2019)

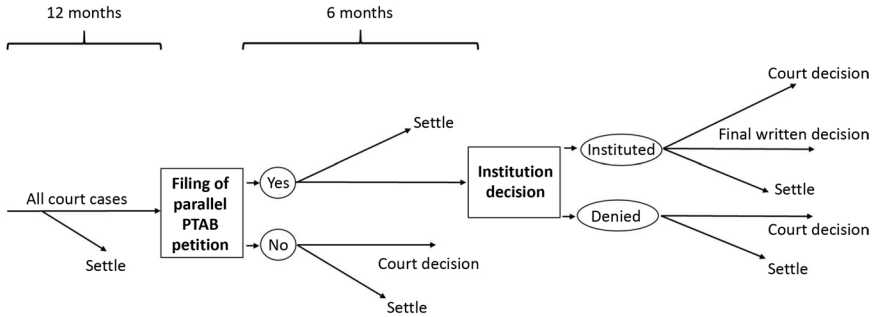


Figure 2. Parallel process of litigation and Patent Trial and Appeal Board (PTAB) review

#### 4. Effects on Settlement

Using our sample of parallel IPR-case pairs, we analyze whether the likelihood of settlement in district court cases is affected by parallel IPRs. Figure 2 shows the two critical steps in a parallel IPR that could impact settlement decisions. First, the accused infringer must decide within 1 year of being served with the lawsuit whether to pursue a parallel IPR, which requires filing a petition explaining why the challenged patent is invalid. Second, once a petition for an IPR is filed, PTAB must decide within 6 months whether the petition demonstrates a reasonable likelihood that the challenged claims are indeed invalid.

##### 4.1. Filing of Petitions

We begin by analyzing whether the accused infringer’s decision to file a parallel validity challenge triggers settlement of the underlying court case.<sup>16</sup> The filing of a parallel IPR could affect settlement for at least two reasons. First, the petition sets in motion a process that can lead to the invalidation of the patent asserted in court. Invalidation would not only terminate litigation but also eliminate the patent altogether, which would foreclose the possibility of future assertions and royalties. Second and more immediately, an accused infringer’s petition for an IPR reveals a great deal about that party’s plans to defend against the patent owner’s allegations of infringement. The mere act of filing a petition demonstrates the accused infringer’s willingness to incur the substantial expense of pursuing a PTAB proceeding, which in turn may reveal important information about its assessment of the case’s value or the strength of its invalidity defense. In addition, the petition’s contents reveal a significant portion of the accused infringer’s defensive strategy and evidence, including the most relevant prior-art patents and publications that it was able to locate while preparing to defend the case and its proposed interpretation of key terms and phrases used in asserted patent claims. To assess

<sup>16</sup> Note that we conduct this part of the analysis at the case level because, as a practical matter, we can generate patent-party-level data only for parallel cases (see Section 3). Thus, the analysis is limited to observing whether cases as a whole settle close in time to parallel challenges.

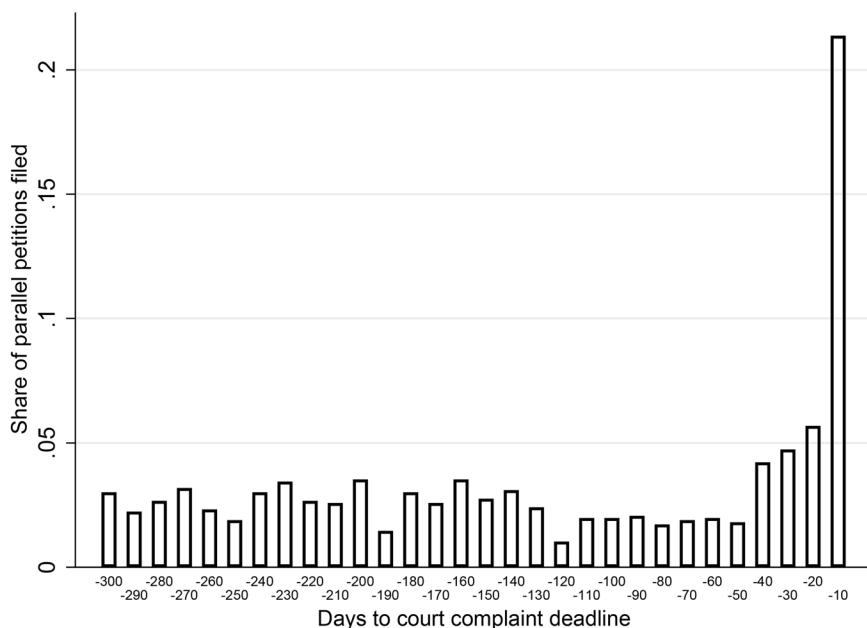


Figure 3. Timing of filing a parallel review petition

the impact of the filing of an IPR, we determine whether there is a change in the likelihood of settlement of a given parallel court case—compared with the population of cases without a parallel challenge—after a parallel IPR petition is filed.

An empirical challenge for this approach is potential bias from selection into filing a parallel validity challenge at PTAB (Bar and Costello 2020). For example, accused infringers facing larger potential damages awards may be more likely to pursue a parallel validity challenge. If so, endogeneity is likely to bias our estimates downward; that is, nonparallel cases are more likely than parallel cases to settle as a result of their (unobservable) characteristics.

We address endogeneity by leveraging the fact that parallel challenges must be filed within 1 year of serving the complaint. Figure 3 shows the share of parallel petitions filed within 300 days of the 1-year deadline (in 10-day intervals). In addition to confirming that the deadline is binding (that is, all parallel petitions were filed before the cutoff), Figure 3 reveals a large increase in petitions filed close to the cutoff. Approximately 21 percent of parallel petitions were filed during the final 10 days.

We take a fuzzy regression discontinuity approach that uses the predeadline spike in parallel IPR petition filings as an instrument for the endogenous decision to file a parallel petition. The identifying variation comes from a discontinuous change in the probability of filing a parallel PTAB petition shortly before the exogenously mandated 1-year deadline. Figure 4 shows the discontinuity in the

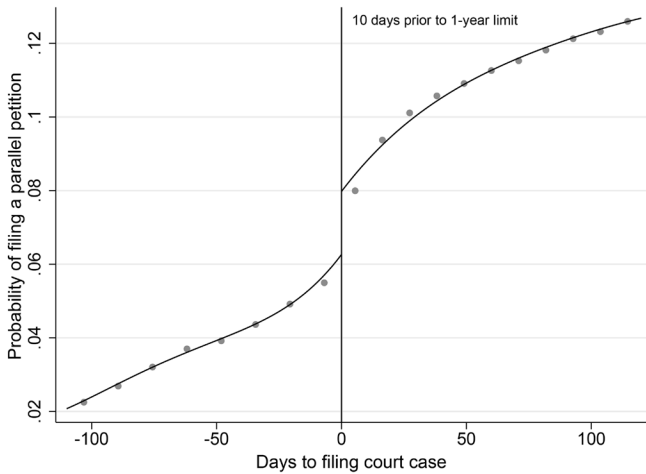


Figure 4. Fuzzy regression discontinuity analysis of filing probability

likelihood of filing a parallel petition when we use the 10-day period prior to the year-from-service filing deadline is the threshold. The probability of filing a parallel petition increases at the threshold from .054 to .079, a 46 percent increase. For the jump in the probability of a parallel PTAB challenge shown in Figure 4 to act as a valid instrument, it must be independent of unobservables that could drive the decision to file a PTAB challenge. While it is possible that the timing of a parallel PTAB challenge is correlated with some unobservables that drive settlement (for example, unobservable characteristics of the patent), the potential impact of such confounders is mitigated by the inclusion of patent characteristics among the regressors. Moreover, our regression discontinuity approach focuses on three narrow windows around the threshold:  $\pm 120$  days,  $\pm 90$  days, and  $\pm 60$  days. We estimate the following two-step local linear specification:

$$\text{IPR Filed}_{it} = \alpha_0 + \alpha_1 \text{After}_{it} + \alpha_2 D_t + \alpha_3 D_t \times \text{After}_{it} + \alpha_4 \mathbf{X}_{it} + \varepsilon_{it} \quad (1)$$

and

$$\text{Settled}_{it} = \beta_0 + \beta_1 \widehat{\text{IPR Filed}_{it}} + \beta_2 D_t + \beta_3 D_t \times \text{After}_{it} + \beta_4 \mathbf{X}_{it} + u_{it}, \quad (2)$$

where  $\text{Settled}_{it}$  denotes settlement of case  $i$  at time  $t$ ,  $\text{IPR Filed}_{it}$  is equal to one if an IPR petition is filed in parallel with case  $i$  at time  $t$  and remains equal to one thereafter,  $\text{After}_{it}$  captures the discontinuity in the likelihood of a petition's filing by switching to one during the 10-day period prior to the 1-year filing cutoff,  $D_t$  denotes a linear time trend (as suggested by Figure 4) that captures the distance to the threshold, and  $\mathbf{X}_{it}$  is the set of covariates in Table 1. Equation (2) is the second stage in which we estimate the effect  $\beta_1$  of filing an IPR as predicted by the first stage on settlement ( $\text{Settled}_{it}$ ).

Table 2 reports the two-stage least squares estimates of the regression discontinuity approach for the three windows (for descriptive statistics, see Table OB2 in the Online Appendix). For estimation, we use a local linear approach with a triangular kernel. The coefficient on  $\text{After}_{it}$  is positive and highly statistically significant in each set of first-stage results. The large  $F$ -statistic for each specification also indicates that the instrument is highly informative. In the second-stage results, the filing of a parallel PTAB challenge increases the likelihood of settlement across the three windows, with the magnitude of the effect ranging from 11 to 23 percent.

For comparison, Table OB3 in the Online Appendix presents the naive ordinary least squares (OLS) results, which ignore the endogeneity of the decision to file. In contrast to the regression discontinuity results in Table 2, the coefficients on the PTAB filing dummy are negative and statistically significant (though close to 0 in magnitude). This indicates that the bias from ignoring the endogeneity is negative; that is, unobservables that are negatively correlated with the decision to challenge validity in parallel PTAB proceedings are positively correlated with the decision to settle (Bar and Kalinowski 2019). Indeed, the bias is sufficiently large to reverse the sign of the coefficient on the filing dummy.

#### 4.2. Institution Decision

We next ask whether receipt of an institution decision affects the settlement of parallel litigation. Conditional on the filing of an IPR petition, PTAB must issue its institution decision within 6 months of the date on which the petition is accorded an official filing date (or within 3 months of the patent owner's preliminary response, if any). If PTAB determines that at least one challenged claim is likely invalid, the IPR continues to a final written decision. If not, the IPR terminates. Importantly, this is the first time that PTAB provides an assessment of the merits of the validity challenge. This provides objective information about the patent's validity to both parties, albeit in a preliminary, nonbinding form. Despite its tentative nature, an instituted IPR may confer substantial leverage in settlement negotiations. In addition to strengthening the position of the accused infringer in court, it creates strong incentives for the patentee to settle so that the IPR terminates before the (potential) invalidation of the challenged patent in a final written decision. This suggests that there should be an increase in settlements following receipt of an institution decision, with this effect driven by decisions that institute the petition. At the same time, patent owners also have incentive to avoid the release of an institution decision, since the decision will become public information, and the existence of a granted petition may make it more difficult to license or assert the patent moving forward.

Compared with our analysis of the decision to file a petition, our analysis here is different in three important respects. First, the sample is narrower but deeper because the data are derived from parallel court cases and analyzed at the patent-party level, which allows us to track each patent-party combination from filing



Table 2  
Effect of Filing a Parallel Petition on Settlement: Fuzzy Regression Discontinuity

	[-120, 120] Days		[-90, 90] Days		[-60, 60] Days	
	First Stage	Second Stage	First Stage	Second Stage	First Stage	Second Stage
Petition Filed		.114* (.051)		.155* (.068)		.232* (.116)
After 1-Year Deadline	.030** (.001)		.027** (.001)		.024** (.001)	
District court:						
Court Proceedings Stayed	.244** (.022)	-.026* (.013)	.240** (.023)	-.035* (.017)	.235** (.024)	-.054* (.028)
Motion to Dismiss	.019 (.017)	-.004 (.004)	.019 (.018)	-.005 (.004)	.024 (.019)	-.007 (.007)
Motion for Summary Judgment	.023 (.014)	-.014** (.003)	.022 (.015)	-.017** (.003)	.023 (.017)	-.023** (.005)
Patent characteristics:						
Software or Business Method	.002 (.005)	.0007 (.001)	.002 (.005)	.0003 (.001)	.002 (.006)	-.00004 (.002)
SEP	.048* (.020)	-.018** (.004)	.052* (.021)	-.021** (.005)	.054* (.022)	-.025** (.008)
In Family Size	-.003 (.002)	-.003** (.0005)	-.003 (.002)	-.002** (.0006)	-.003 (.002)	-.002** (.0009)
In Forward Citations	-.001 (.001)	-.001** (.0003)	-.001 (.001)	-.001** (.0004)	-.001 (.001)	-.001** (.0005)

In Backward Citations	.001 (.001)	.00006 (.0004)	.001 (.002)	-.0002 (.0005)	.001 (.002)	-.0006 (.0008)
In NPL Citations	.0004 (.001)	.0009** (.0003)	.0005 (.001)	-.0007* (.0004)	.0007 (.001)	-.0006 (.0005)
In Applicants	.009* (.004)	-.002 (.001)	.010* (.005)	-.002* (.001)	.010* (.005)	-.002 (.002)
In Inventors	.007 (.005)	-.003** (.001)	.008* (.005)	-.003* (.001)	.010* (.005)	-.004* (.002)
In Independent Claims	-.068** (.011)	.009* (.004)	-.071** (.012)	.012* (.005)	-.072** (.012)	.019* (.009)
Plaintiff NPE	-.038** (.004)	.010** (.002)	-.039** (.004)	.011** (.003)	-.041** (.005)	.013** (.005)
F-statistic	258.112		231.456		165.931	
N	213,579	213,579	153,746	153,746	95,518	95,518

**Note.** Values are from two-stage least squares estimates of the impact of filing a parallel Patent Trial and Appeal Board inter partes review (IPR) petition on settlement. The instrument is the discontinuous increase in the probability of filing a parallel IPR petition in the 10 days before the 1-year deadline. The dependent variable in the first stage equals one if a parallel IPR petition was filed; the dependent variable in the second stage equals one if the court case settled. All regressions include a constant, fixed effects for technology, a time trend, and an interaction of the time trend and After. Robust standard errors are clustered at the case level.

\* Significant at the 10% level.

\* Significant at the 5% level.

\*\* Significant at the 1% level.

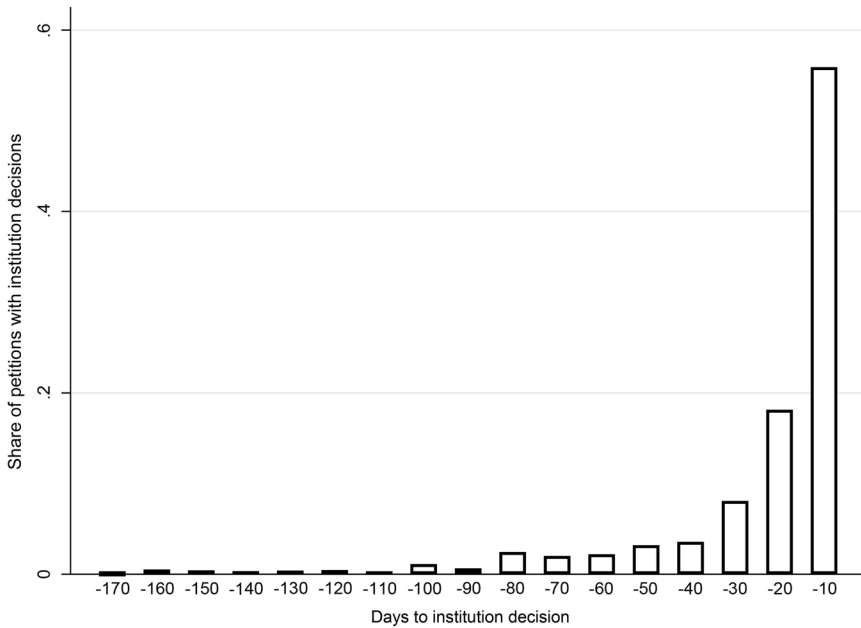


Figure 5. Timing of institution decisions

to disposal. Second, because the analysis is limited to data derived from parallel cases, we lack an obvious comparison group. While the (case-level) filing analysis incorporates settlement decisions in nonparallel cases, here we observe (patent-party-level) settlements before and after receiving the institution decision (see Figure 2). This limitation creates a challenge because all petitions that do not receive an institution decision settle, and all petitions that receive an institution decision settle (if at all) only after receiving that information. Finally, unlike the decision to file a PTAB petition, the timing of the institution decision cannot be influenced by the parties. The parties cannot request faster decisions, nor can they delay them. The only information they have is that the decision will be provided within 6 months of the accorded filing date (or 3 months from the preliminary response).

To analyze the impact of receiving the institution decision (regardless of its outcome) on settlement, we compare the distributions of settlement and decision timing. Figure 5 shows the share of institution decisions issued in parallel IPRs in 10-day intervals prior to the statutory deadline. As with petition filings (shown in Figure 3), there is a sharp increase in decisions just before the deadline. To get an idea of settlement behavior over time, we regress our settlement dummy variable on a set of time dummies that span the period 180 days before and after the institution deadline. The resulting coefficients are plotted in Figure 6, which shows that the likelihood of settlement increases substantially around the institution de-

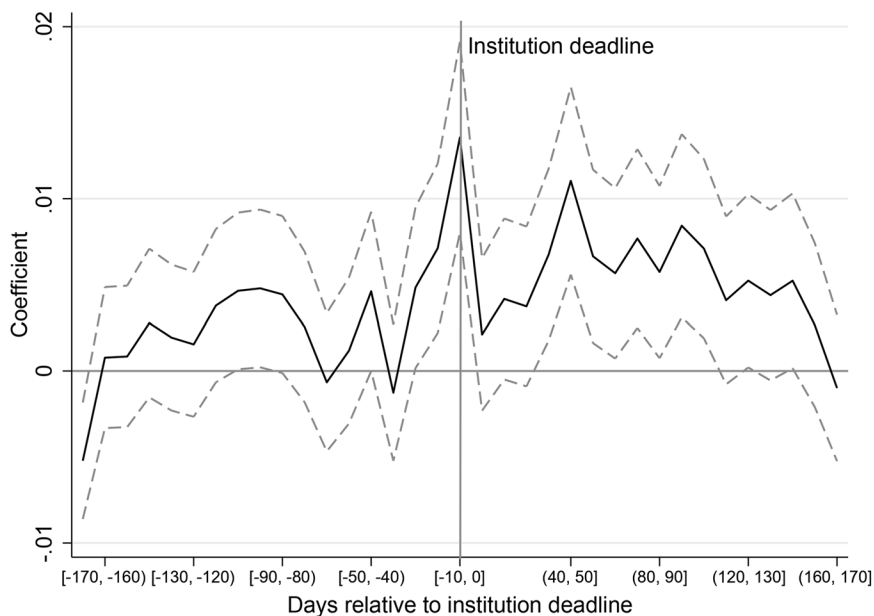


Figure 6. Settlement and institution decision deadline

cision deadline. In combination, Figures 5 and 6 suggest a strong correlation between institution decisions and settlements.

To analyze this association further, we must address the complication that litigants can avoid an institution decision by settling before the decision issues. To overcome this challenge, we compute for each petition  $i$  the average time taken by APJ  $a$  assigned to petition  $i$  across all other petitions  $i \neq j$  assigned to  $a$ . To construct this measure, we use data on IPRs filed during 2012–17 that were decided by judge  $a$ , not just parallel IPRs. While APJs must work within the 6-month time frame set by statute (and the parties are acutely aware of this), parties to an IPR are not initially aware of the identities of the APJs assigned to decide their challenge, and, as shown in Figure OA2, there is substantial variation in the average speed with which APJs release decisions. The average time to decision is 166 days (that is, 14 days before the deadline), with a standard deviation of 4.93 days. This variation, combined with parties' inability to anticipate it, suggests that IPRs assigned to APJs who tend to issue decisions relatively quickly should (all else being equal) settle less often because the parties (unwittingly) have less time to reach an agreement before an institution decision is issued.

For this instrument to satisfy independence, the average time to decision must be uncorrelated with any unobservables that cause selection into settlement. For example, the instrument would not be valid if APJs who decide faster on average do so because they are systematically assigned relatively simple petitions. In our

context, the quasi-random allocation of petitions to APJs alleviates this concern. The PTAB's Standard Operating Procedures provide the criteria used to allocate APJs across incoming petitions. The main criteria include avoiding potential conflicts of interest (that might arise, for example, as a result of APJs' prior work as lawyers), balancing each APJ's workload, and taking into account each APJ's technology focus.<sup>17</sup> To account for technology specialization, we assign the patents challenged in an IPR to USPTO art units and include art unit fixed effects to account for potential specialization across judges.<sup>18</sup> To control for other potential factors that might influence assignments, we include nine additional APJ-specific characteristics, including educational background, fields of prior work experience, and years of legal experience. A complete list of variables is in Table OB1.

This instrument's validity requires that the parties to an IPR be unaware of the assigned APJs prior to an institution decision or preinstitution settlement. If this were not the case, it is possible that settlement behavior would be influenced directly by the APJs' assignment; for example, parties that are aware of the identities of the APJs on their assigned panel and know them to be relatively quick decision makers could hasten their settlement negotiations in response. In our context, this concern is also alleviated by PTAB practice. Unlike court cases, which are publicly assigned to a judge shortly after filing, PTAB petitions are assigned to APJs both significantly after filing and on an (initially) nonpublic basis. In the early stages of an IPR, ministerial actions are performed not by APJs but by USPTO trial paralegals, and any accompanying filings are issued in a paralegal's name. Accordingly, as we have confirmed through multiple interviews with experienced PTAB practitioners, parties to an IPR first learn of the identities of the APJs on their panel (absent exceptional circumstances) only when the names of the judges are listed on the institution decision or decision granting a preinstitution motion to terminate. Using this instrument for average time to decision, we estimate the following two-step specification:

$$\begin{aligned} \text{Institution} - \text{Decision}_{it} = & \alpha_0 + \alpha_1 \text{Delay}_i + \sum_{\text{Art}} \alpha_{\text{Art}} \text{Art}_i + \alpha_2 A_i + \alpha_3 \mathbf{X}_{it} \\ & + \sum_T \alpha_t D_t + \varepsilon_{it} \end{aligned} \quad (3)$$

and

$$\text{Settled}_{it} = \beta_0 + \beta_1 \widehat{\text{Institution} - \text{Decision}}_{it} + \beta_2 \mathbf{X}_{it} + \sum_T \beta_t D_t + u_{it}, \quad (4)$$

where  $\text{Institution} - \text{Decision}_{it}$  is equal to one if case  $i$  receives its institution deci-

<sup>17</sup> As an exception, related IPRs (for example, those that challenge the same patent on the same grounds) are typically assigned to the same administrative patent judges (APJs). However, this does not create any problems for our instrument since related IPRs are typically joined (or dropped or dismissed) at the institution stage.

<sup>18</sup> According to the Standard Operating Procedures (Patent Trial and Appeal Board 2018, p. 6), APJs declare preferences for at least one of six aggregate technology areas (so-called technology centers): "biotechnology/pharma, business methods, chemical, electrical, [and] mechanical." Figure OA3 in the Online Appendix shows the distribution of IPRs across technology centers, distinguishing between instituted and denied IPRs. There is no significant difference in the distributions.

sion by PTAB at time  $t$  and remains equal to one thereafter,  $\text{Delay}_i$  is the log of the average time to decision for the APJ panel assigned to petition  $i$ ,  $\text{Art}_i$  is a group of art unit dummies,  $A_i$  denotes the APJs' characteristics,  $D_t$  denotes time dummies, and  $X_{it}$  denotes a set of covariates that includes a large set of fixed effects, including those for court, patent technology classification, patent filing year, and IPR petition filing year.

Table OB4 presents the results of a balance test in which both the endogenous institution variable and the instrument are regressed on the set of case-, patent-, and party-specific characteristics. The results allow us to assess the possibility that our instrument might be correlated with unobservables, which would undermine its validity. Unsurprisingly, the results for the full sample show that many variables are significantly correlated with proceeding to an institution decision and that an  $F$ -test rejects the null hypothesis that the coefficients on the set of observable covariates are jointly equal to 0. By contrast, when we use the decision-speed instrument as the dependent variable, the results exhibit better covariate balance (as expected) and thus generally support our instrument's validity. Nonetheless, both regressions produce  $F$ -tests that reject the null hypothesis that the coefficients are equal to 0. To address potential concerns stemming from these results, we construct a matched sample of parallel petitions that did and did not receive an institution decision and use this subsample in the analyses that follow. To match petitions, we employ nearest-neighbor matching using APJs' characteristics and art unit dummies as predictors. The balance tests using this matched sample confirm that it is better balanced than the full sample. While receiving an institution decision remains correlated with a number of case, patent, and party characteristics in the matched sample, the regressions using the decision-speed instrument produce  $F$ -tests that no longer reject the null hypothesis.

As a final validity check, Figure OA2 explores whether the instrument satisfies the monotonicity assumption. The instrument is plotted against the predicted likelihood of receiving an institution decision (estimated using a nonparametric local linear regression of receiving an institution decision on the instrument while controlling for technology fixed effects). There is a negative, linear, monotonic relationship between APJs' average time to institution decision and the likelihood of receiving an institution decision.

The results of the two-step average decision-speed instrumental-variable approach (computed using the balanced sample of matched petitions introduced above)<sup>19</sup> are presented in Table 3. The OLS results ignore the potential endogeneity of the institution decision and indicate that the propensity to settle increases by 25 percent. In column 2, the instrument is highly statistically significant and negatively associated with the likelihood of receiving an institution decision, and the first-stage  $F$ -statistic is above 10, the rule-of-thumb cutoff established by Staiger and Stock (1997). These results confirm that petitions assigned to relatively slow APJs are more likely to settle and thus less likely to receive institution decisions. Column 3 reports the results of the second stage. Here again is a large,

<sup>19</sup> As shown in Table OB5, the results are robust to using the full sample.

**Table 3**  
**Effect of Institution Decisions on Settlement**

	Ordinary Least Squares (1)	Instrumental Variables			
		First Stage (2)	Second Stage (3)	First Stage (4)	Second Stage (5)
Institution Decision	.254** (.015)		.244** (.065)		.331** (.058)
ln Time to Institution Decision		-.416** (.038)		-.390** (.038)	
District court:					
Court Proceedings Stayed	-.010** (.001)	.002 (.002)	-.010** (.001)	.001 (.002)	-.010** (.001)
Motion to Dismiss	.007 (.007)	.006 (.010)	.007 (.007)	.006 (.010)	.007 (.007)
Motion for Summary Judgment	.016 (.012)	-.023* (.013)	.015 (.012)	-.023* (.013)	.017 (.012)
Patent Trial and Appeal Board:					
ln Filing Lag	.0004 (.001)	.003** (.001)	.0004 (.001)	.003** (.001)	.0001 (.001)
Patentee Response	-.015** (.003)	-.016** (.004)	-.015** (.003)	-.016** (.004)	-.013** (.003)
Patent characteristics:					
Software or Business Method	-.001 (.001)	-.009** (.002)	-.001 (.001)	-.008** (.002)	-.0009 (.001)
SEP	.008* (.004)	-.004 (.005)	.008* (.004)	-.006 (.005)	.008* (.004)
ln Family Size	-.002* (.0008)	.000 (.0009)	-.002* (.0008)	-.0004 (.0009)	-.002* (.0008)
ln Forward Citations	.0003 (.0004)	.0004 (.0006)	.0003 (.0004)	.0004 (.0005)	.0003 (.0004)
ln Backward Citations	.001* (.0007)	-.003** (.001)	.001* (.0008)	-.002** (.001)	.001* (.0008)
ln NPL Citations	-.0007 (.0005)	.001* (.0006)	-.0007 (.0005)	.001* (.0006)	-.0008* (.0005)
ln Applicants	-.001 (.001)	.001 (.002)	-.001 (.001)	.0003 (.002)	-.001 (.001)
ln Inventors	-.0007 (.001)	.0006 (.002)	-.0007 (.001)	.0008 (.002)	-.0008 (.001)
ln Independent Claims	-.0008 (.001)	-.002 (.001)	-.0008 (.001)	-.002 (.001)	-.0007 (.001)
Plaintiff NPE	-.002 (.002)	.003 (.002)	-.002 (.002)	.003 (.002)	-.003* (.001)
Administrative patent judge characteristics		No		Yes	
F-statistic		20.760		11.100	
Art unit fixed effects	N.A.	Yes	Yes	Yes	Yes
R <sup>2</sup>	.205	.635	.205	.636	.197

**Note.** Results are from estimates of the impact of receiving an institution decision (regardless of the outcome) on settlement. In the ordinary least squares and second-stage regressions, the dependent variable equals one if the Patent Trial and Appeal Board inter partes review (IPR) petition and parallel court case settled; in the first-stage regressions the dependent variable equals one if the IPR petition received an institution decision (regardless of the outcome). The matched sample uses nearest-neighbor matching between petitions that received an institution decision and those that did not using administrative patent judges' characteristics and art unit fixed effects as predictors. All regressions include a constant and fixed effects for court, International Patent Classification-4, patent filing year, IPR year, and time trend. Robust standard errors are clustered at the IPR group level.  $N = 46,284$ . N.A. = not applicable.

+ Significant at the 10% level.

\* Significant at the 5% level.

\*\* Significant at the 1% level.

positive, and highly statistically significant coefficient on the institution dummy variable, which indicates an increase of roughly 24 percent in the probability of settlement. Columns 4 and 5 include APJ's characteristics in the instrument set to rule out the possibility that the results are affected by an association between APJs' characteristics and assignment. In column 4 the coefficient decreases slightly in magnitude; nonetheless, it remains highly statistically significant. In the second stage the increase is 33.1 percent.

To explore what drives the observed increase in settlements following an institution decision, we next analyze the impact of the outcome reported in the decision. That is, we ask whether, conditional on having received the institution decision, IPRs that were instituted are more likely to settle shortly after institution compared with IPRs in which institution was denied.

In carrying out this analysis, we are again confronted with a potential endogeneity problem because some variables may be correlated with both the outcome of the institution decision and settlement. For example, cases asserting likely invalid patents may be more likely to generate an instituted IPR and more likely to settle.

To address this endogeneity, we construct a second APJ-based instrumental variable that, consistent with a large literature (see Frandsen, Lefgren, and Leslie 2019), relies on exogenous variation in APJs' propensity to institute an IPR. Assessing the validity of a patent requires (among other steps) the interpretation of inherently ambiguous language in claims. As has long been recognized by the literature, this process is uncertain and produces results about which seasoned experts and judges (guided, for example, by idiosyncratic heuristics or biases) regularly disagree (Lemley and Shapiro 2005; Schwartz 2008). To capture the variation across APJs introduced by this indeterminacy, we compute for each APJ  $a$  the leave-one-out share of instituted petitions  $s_i$  among all petitions decided by  $a$ <sup>20</sup> and, following Galasso and Schankerman (2015), aggregate these data at the panel level to determine the propensity of a given panel to institute petition  $i$  as follows:

$$APJIP_i = s_i^1 s_i^2 s_i^3 + s_i^1 s_i^2 (1 - s_p^3) + s_i^1 (1 - s_p^2) s_i^3 + (1 - s_p^1) s_i^2 s_i^3, \quad (5)$$

where  $APJIP_i$  denotes the APJ's propensity to institute  $IPR_i$  and  $s_i^a$  denotes the share of IPRs instituted by APJ  $a$ , excluding focal IPR  $i$ . Figure OA4 confirms that the data show substantial heterogeneity in APJs' propensity to institute.

We again use a balance test to consider the possibility that this instrument could be correlated with additional unobservables. Table OB6 presents the results when the endogenous decision outcome measure (computed using the full sample and the matched sample) and the APJ-propensity instrument is regressed on case-, patent-, and party-specific characteristics. Regardless of the sample used, the results indicate (as expected) both that institution is significantly cor-

<sup>20</sup> Again, for the construction of the variable we use data for all IPRs decided by judge  $a$  that were filed between 2012 and 2017, not just parallel IPRs.



related with a variety of observables and that balance improves when the instrument is used as the dependent variable. While these results generally support the identifying assumption that APJs are assigned quasi-randomly (conditional on art unit fixed effects and APJs' characteristics) to petitions, only with the matched sample using the propensity instrument do  $F$ -tests fail to reject the null hypothesis that observables are jointly equal to 0. Accordingly, following our approach above we again use the matched sample.

Finally, we assess once more whether the effect of our instrument is monotonic across cases, such that (for example) cases instituted by relatively lenient APJs would also be instituted by relatively tough APJs (and vice versa for denials). Figure OA4 plots the predicted likelihood of institution (estimated using a nonparametric local linear regression controlling for technology fixed effects) against the APJ propensity measure and confirms that the likelihood of institution is monotonically and linearly increasing in the propensity measure. Using the propensity-to-institute instrument, we estimate the following two-step specification:

$$\text{Institution} - \text{Granted}_i = \alpha_0 + \alpha_1 \text{APJIP}_i + \sum_{\text{Art}} \alpha_{\text{Art}} \text{Art}_i + \alpha_2 A_i + \alpha_3 X_i + \varepsilon_i \quad (6)$$

and

$$\text{Settled}_i = \beta_0 + \beta_1 \widehat{\text{Institution} - \text{Granted}_i} + \beta_2 X_i + u_i, \quad (7)$$

where  $\text{Institution} - \text{Granted}_i$  is equal to one if petition  $i$  is instituted (as opposed to denied) and  $\text{Art}_i$  is a group of art unit dummies.

The results of the two-stage propensity-to-institute instrumental-variable approach (once again computed using the balanced sample of matched petitions)<sup>21</sup> are presented in Table 4. In column 1, which presents OLS results that ignore the potential endogeneity of the institution outcome, the coefficient is positive and statistically highly significant: it suggests a 7 percent increase in the likelihood of settlement if an IPR is instituted rather than denied. In column 2 the coefficient on the APJ propensity instrument is highly statistically significant, positive, and large in magnitude, and the  $F$ -statistic is close to 10. When the first stage is repeated with APJs' characteristics added (column 4), the coefficient on propensity decreases but remains highly statistically significant, positive, and large. These results confirm that relatively tough APJs are relatively more likely to institute a given petition. In column 3, which reports the results of the specification's second stage, there is a large, positive, and highly statistically significant coefficient indicating a roughly 26 percent increase in the probability of settlement following an institution decision that grants the petition. In the second stage with APJ characteristics added (column 5), the coefficient decreases to 10 percent but remains highly statistically significant.

The large positive effect on settlement of a decision to institute (rather than deny) an IPR petition suggests that patent owners may be especially willing to

<sup>21</sup> Yet again, as shown in Table OB7, the results are robust to using the full sample.

**Table 4**  
**Effect of Institution Outcome on Settlement**

	Ordinary Least Squares (1)	Instrumental Variables			
		First Stage (2)	Second Stage (3)	First Stage (4)	Second Stage (5)
Institution Granted	.070** (.019)		.259* (.121)		.101** (.094)
Propensity to Institute		1.018** (.156)		.871** (.163)	
District court:					
Court Proceedings Stayed	-.116** (.020)	.038 (.025)	-.124** (.020)	.044+ (.025)	-.117** (.019)
Motion to Dismiss	.049 (.061)	-.153* (.070)	.076 (.057)	-.147* (.070)	.053 (.058)
Motion for Summary Judgment	.130* (.062)	-.161* (.066)	.164** (.060)	-.160* (.065)	.135* (.060)
Patent Trial and Appeal Board:					
In Filing Lag	-.002 (.016)	-.049** (.018)	.006 (.017)	-.044* (.018)	-.0009 (.016)
Patentee Response	-.115** (.035)	-.127** (.035)	-.091* (.037)	-.126** (.035)	-.111** (.035)
Patent characteristics:					
Software or Business Method	-.022 (.029)	-.027 (.033)	-.016 (.029)	-.028 (.033)	-.021 (.028)
SEP	.133* (.078)	-.072 (.084)	.144* (.071)	-.089 (.084)	.135* (.072)
ln Family Size	-.044** (.013)	.036* (.014)	-.051** (.013)	.035* (.014)	-.045** (.013)
ln Forward Citations	.001 (.007)	.011 (.009)	-.0004 (.007)	.008 (.008)	.001 (.007)
ln Backward Citations	.020 (.013)	-.027+ (.014)	.025* (.012)	-.023 (.014)	.021* (.012)
ln NPL Citations	-.005 (.008)	.012 (.009)	-.007 (.008)	.009 (.010)	-.005 (.008)
ln Applicants	-.036 (.025)	.015 (.031)	-.040+ (.023)	.001 (.031)	-.037 (.023)
ln Inventors	-.005 (.025)	-.030 (.030)	.0009 (.025)	-.036 (.030)	-.004 (.024)
ln Independent claims	-.016 (.018)	-.025 (.021)	-.011 (.018)	-.023 (.021)	-.015 (.017)
Plaintiff NPE	-.057* (.029)	.085* (.032)	-.070* (.028)	.082* (.032)	-.059* (.028)
Administrative patent judge characteristics		No		Yes	
F-statistic		8.727		5.263	
Art unit fixed effects	N.A.	Yes	Yes	Yes	Yes
R <sup>2</sup>	.290	.266	.255	.276	.289

**Note.** Values are estimates of the impact of a granted institution decision (as opposed to denied) on settlement. In the ordinary least squares and the second-stage regressions, the dependent variable equals one if the Patent Trial and Appeal Board inter partes review petition and parallel court case settled; in the first-stage regressions the dependent variable is equal to one if the IPR petition was instituted (as opposed to denied). The matched sample uses nearest-neighbor matching between petitions that received an institution decision and those that did not using administrative patent judge characteristics and art unit fixed effects as predictors. All regressions include a constant and fixed effects for court, International Patent Classification-4, patent filing year, and IPR year. Robust standard errors are clustered at the IPR group level.  $N = 2,696$ . N.A. = not applicable.

+ Significant at the 10% level.

\* Significant at the 5% level.

\*\* Significant at the 1% level.

settle to avoid the eventual invalidation of their claims in a final written decision. During the sample period, final written decisions issued in IPRs overwhelmingly confirm the institution decision's preliminary assessment of (at least partial) invalidity. Assuming that patent owners recognize the high likelihood of invalidation following a petition's institution, the results indicate that patent challengers can leverage a favorable institution decision (and the concrete threat of invalidation that comes with it) to nudge patent owners to settle. A patent owner may prefer such a settlement because the institution decision merely provides a preliminary assessment and has no direct legal effect on the challenged patent. By settling at that stage, the patent owner can avoid the (very likely) invalidation of the patent, which would foreclose future licensing opportunities and potentially interrupt existing royalty streams (and thus have broader consequences beyond the parallel court case presently at issue).

## 5. Conclusion

In this paper, we present an empirical analysis of the interplay between closely related, parallel proceedings. We analyze the impact of administrative patent validity challenges filed in response to district court infringement actions and the timing of settlements in parallel court cases.

While the nascent literature on concurrent legal proceedings emphasizes the potential inefficiency and opportunism that may result when disputes fragment across venues, we study instead the potential complementary effect that may result when information flows from one concurrent proceeding to another. Our findings indicate that both events—the filing of an IPR petition and PTAB's subsequent decision to institute or deny the petition—increase the likelihood of settlement. Accordingly, our analysis suggests that an IPR provides information to litigants in parallel district court cases, and the revelation of that information can affect the resolution of the litigation. While the availability of both litigation and the IPR process has been attacked (like many other contexts in which parallel proceedings arise) as inefficient and opportunistic, our results confirm that IPRs can have a complementary effect on litigation, as Congress hoped at the time of the IPR system's creation.

While we show that the IPR process can facilitate settlement, it is unclear what net effect those settlements have. At the institution stage, our results are driven by an increase in settlements following PTAB decisions to grant a petition and continue (absent settlement) to a final decision that will at least partially invalidate the challenged patent with high probability. This result suggests that accused infringers are able to leverage the threat of a binding invalidity decision to induce the patent enforcer to settle. While such early settlements are optimal from the private perspective of the litigants, they nonetheless mean that the IPR process allows patentees to avoid final invalidations that would stand to benefit nonparties to the instant dispute.

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