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Can firms avoid tough patent examiners through examiner-shopping? Strategic timing of citations in USPTO patent applications

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Abstract

Research summary: We claim that, because patent citations influence examiner selection, firms disclose citations strategically to influence which examiner is assigned to their application ("examiner-shopping"). Specifically, firms are more likely to cite patents reviewed by "lenient" examiners in their original information disclosure statement (IDS) (sent before the examiner has been selected), and delay citations to patents reviewed by "tough" examiners to subsequent IDS (sent once the examiner has been selected). We propose this strategy will be implemented by those firms who benefit the most (firms that face patent thickets and are developing high strategic-stakes technologies) but only when the costs are low (when firms face a low probability of patent litigation). We find support to our theory in a sample of 9,763 United States patent and trademark office (USPTO) patent applications during 2000 to 2006.

Managerial summary: We find that firms facing patent thickets and developing high strategic stakes technologies try to get more "lenient" examiners to increase the probability of patent approval. The cost of this strategy is that "lenient" examiners usually grant weaker patents that are more likely to be litigated and

invalidated. Firms overcome this by using "examiner-shopping" mainly in fields where litigation is relatively infrequent. This behavior has relevant implications: fields where property rights are rarely challenged tend to become "denser" and populated by weaker patents. Our study's discussion of the limitations within the United States patent and trademark office (USPTO) that seem to provide the opportunity to implement "examiner-shopping" strategies provides a path to address this from a policy standpoint.

KEYWORDS

examiner-shopping, innovation, patent strategy, property rights, regulatory systems

1 | INTRODUCTION

Intellectual property rights provide a strong competitive advantage (Ceccagnoli, 2009; Somaya, 2012), which is why firms are highly motivated to obtain patent protection for their inventions (Cockburn & MacGarvie, 2011; Cohen, Nelson, & Walsh, 2000; Somaya, 2012). Yet, gaining patent protection is not automatic since patents are granted by independent examiners in national Patent Offices, like the United States patent and trademark office (USPTO) in the United States (Choudhury & Haas, 2018; Cockburn, Kortum, & Stern, 2003; Marco, Sarnoff, & Charles, 2019). Against this backdrop, some studies propose that firms can increase the chances of obtaining a patent by picking their patent examiner, that is, "examiner-shopping" (e.g., Hegde, Mowery, & Graham, 2009). These studies build on extant evidence that certain examiners are more "lenient" than others (Cockburn et al., 2003; Feng & Jaravel, 2020; Sampat & Williams, 2019) to propose that firms try to pick the most benevolent examiners for their applications (Hegde et al., 2009; Lemley & Moore, 2004; Quillen & Webster, 2001).

While the idea that firms engage in examiner-shopping is relatively accepted among practitioners (Mehrle, 2019), the logic proposed in these studies is problematic for several reasons. First, they argue examiner-shopping could be done through the filing of a continuation application. This restarts the patent review process, providing an opportunity for the application to be re-assigned to a different examiner (Hegde et al., 2009; Lemley & Moore, 2004; Quillen & Webster, 2001). Yet, filing a continuation application is unlikely to help firms pick more lenient examiners since firms have no control over the assignment of the application, and continuation applications are almost always assigned to the same examiner who evaluated the original application—a policy precisely designed to prevent examiner-shopping (Lemley & Moore, 2004). Second, prior studies overlook the fact that picking lenient examiners comes at a cost: patents granted by lenient examiners are, in average, weaker and more prone to invalidation (Feng & Jaravel, 2020). Given these drawbacks, it is unclear whether examiner-shopping can be done and whether firms are willing to implement such a strategy in the first place.

In this article, we propose firms do engage in examiner-shopping in the USPTO (although not through continuation applications) and show when firms are more likely to do it

(accounting for the benefits and the costs of such strategies). Specifically, we identify a novel examiner-shopping strategy that is based on the *timing* at which firms report citations to prior art. Firms can submit their citations at different points in time during the patent examination (Kuhn, Younge, & Marco, 2020): in the original information disclosure statement (IDS)—submitted with the application before the examiner has been selected—or in subsequent IDS'—submitted during examination after the application has been assigned to an examiner. We argue that, by including citations to patents reviewed by lenient examiners in the original IDS, and delaying citations to patents reviewed by tough examiners to subsequent IDS', firms increase the probability they are assigned a lenient examiner. The reason, we claim, is that applications are more likely to be assigned to those examiners who are cited in the original IDS because a citation signals an examiner is familiar with the technologies covered in the application.

However, we argue that, depending upon our proposed examiner-shopping strategy's benefits and costs, certain firms are more likely to implement this strategy than others. First, we propose that firms facing "patent thickets" and developing technologies with high "strategic stakes" are more likely to do examiner-shopping. Firms facing patent thickets—i.e., multiple patents owned by different firms (Hall & Ziedonis, 2001; Shapiro, 2000; Ziedonis, 2004)—can only be successful when they themselves have patents which they can use in cross-licensing negotiations (Cockburn & MacGarvie, 2011; Onoz & Giachetti, 2021), and firms developing high "strategic stakes" technologies—i.e., technologies that are central to the firm (Somaya, 2012)—need to develop overlapping patent rights that help to create "patent fences" against competitors (Blind, Cremers, & Mueller, 2009; Granstrand, 1999; Somaya, 2003, 2012). Thus, firms in these circumstances will benefit the most from a higher chance of patent approval and will, therefore, have a greater incentive to implement our examiner-shopping strategy. Second, we argue firms in fields with intense litigation are less likely to use examiner-shopping. The reason is that picking lenient examiners poses certain risks: these examiners usually grant weaker patents that are more likely to be invalidated if litigation takes place (Feng & Jaravel, 2020). Therefore, we claim firms facing patent thickets and developing high strategic stakes technologies will be more likely to implement examiner-shopping strategies only when the risk of litigation is low—i.e., in technological fields where there is a low probability that a patent is challenged and thus re-evaluated in court (Lanjouw & Schankerman, 2004).

We test our theory on a sample of 9,763 patent applications to the USPTO during 2000 to 2006 and find broad evidence in support of our examiner-shopping strategy. First, we find that patents reviewed by the most lenient examiners are more likely to be included in the original IDS compared to patents reviewed by the toughest examiners. Second, we show how strategic timing of citations is mainly used by firms facing patent thickets and developing high strategic stakes technologies. Finally, we show how the presence of thickets and high strategic-stakes technologies increase the probability firms implement examiner-shopping strategies mainly in low-litigation fields.

Our findings contribute to several literatures. First, we contribute to research exploring firms' strategic behavior during patent prosecution by showing how firms use the timing of citations as an examiner-shopping strategy. Our model unveils a more effective and practical examiner-shopping strategy than the use of continuation applications suggested in prior work (Hegde et al., 2009; Lemley & Moore, 2004) and accounts for both benefits and costs of examiner-shopping, which allows us to identify when firms are more likely to implement such strategy. Second, we contribute to research looking at the strategic use of patents in the competitive landscape (Cockburn & MacGarvie, 2011; Harhoff, Graevenitz, & Wagner, 2016;

Somaya, 2012; Ziedonis, 2004) by showing how firms are more likely to obtain patent protection for high strategic stakes technologies and when facing patent thickets, as long as they are in low-litigation fields. Our study's finding that fields where property rights are rarely challenged tend to become "denser," and thus, populated by weaker patents, contributes to the debates around: the detrimental impact of patents on innovation (Bessen & Meurer, 2008; Shapiro, 2000; Wen, Ceccagnoli, & Forman, 2016), the creation of a resource-wasting "arms race" among competitors (Hall & Ziedonis, 2001), and the inefficiencies of the patent system more generally (e.g., Torrisi et al., 2016). Finally, our study challenges prior work's assumption that examiners are assigned randomly (Farre-Mensa, Hegde, & Ljungqvist, 2020; Hegde, Ljungqvist, & Raj, 2021; Melero, Palomeras, & Wehrheim, 2020; Sampat & Williams, 2019), questioning the appropriateness of using examiner leniency as an exogenous determinant of patent approval.

2 | EVALUATION OF PATENT APPLICATIONS BY THE USPTO

The first step to obtaining a patent from the USPTO is submitting a patent application that consists of three elements: (a) a description of the invention the applicant wishes to protect, (b) a list of claims, and (c) an IDS with a list of prior art (Lemley & Shapiro, 2005). The description of the invention needs to meet the "enablement requirement," which states that "any reasonably skilled person in that art must be able to make and use the invention claimed in the patent." The purpose of the list of claims is to define the scope of the patent, so it must include all the novel elements of the invention. Finally, the IDS must include citations to other patents that are relevant to the invention (Marco et al., 2019).

After the patent application is submitted, a specialized classification branch sorts each application to an Art Unit—administrative divisions that cover different technologies (Cockburn et al., 2003; Marco et al., 2019). Each Art Unit is managed by a supervisory patent examiner (SPE), who is responsible for assigning patent applications to examiners in that Art Unit (Simmons, 2017). SPEs assign applications to those examiners in the Art Unit who are the most familiar with the technologies covered in those applications and thus provide a greater fit (Lemley & Sampat, 2012; Righi & Simcoe, 2019). To assess who provides the strongest fit, SPEs usually look at the similarity between the focal application and the examiners' prior evaluations. The goal, as the SPEs at the USPTO we interviewed explained, is that "incoming applications are compared to all examiners' portfolios" and thus "applications will be routed to examiners based on an examiner's work history." For that, SPEs need to carefully analyze the application, identify the technologies the invention builds on, and compare such technologies with those in each examiner's prior reviews.[1]

Sometimes, however, SPEs lack the necessary time and technical expertise to implement these tasks. SPEs handle many applications—around 50 per month, with some having hundreds of pages of highly dense technical language (Van Zeebroeck, de la Potterie, & Guellec, 2009)—on top of being responsible for other administrative duties within their Art Units (GAO, 2010; Simmons, 2017). Moreover, SPEs frequently have limited expertise in the

[1]Relying on class-subclass categorization to assess what technologies an examiner is familiar with represents an alternative method, but it has limitations. As Righi and Simcoe (2019, p 141) report, "patent examiners specialize in particular technologies, even within fine-grained USPC technology subclasses".

technologies covered in their Art Units (GAO, 2008, 2010).[2] Therefore, to overcome these limitations, SPEs often rely on an alternative source of information to make their decisions: the list of citations included in the application's original IDS. When a patent reviewed by a particular examiner is cited in the original IDS, SPEs interpret this as a signal of examiner-application fit. The SPEs we interviewed acknowledged that "information gleaned from the prior art citations could be relied upon for [assignment] decisions." All this suggests that those examiners who are more intensively cited in the original IDS are more likely to be assigned to a particular patent application.

Once the application has been assigned to an examiner, a "negotiation" between the applicant and the patent examiner takes place to determine which claims are maintained and which ones are removed (Lemley & Moore, 2004; Marco et al., 2019). During this process, new prior art is added by both the applicant and the patent examiner. After submission, the applicant is allowed to bring subsequent IDS with prior art that was not included in the original IDS (Kuhn et al., 2020), and examiners also bring new citations that they believe are relevant (Alcácer, Gittelman, & Sampat, 2009; Cotropia, Lemley, & Sampat, 2013). While adding new citations in subsequent IDS does not lead to any sanction to the applicant, failing to include known relevant prior art in the final granted patent may lead to accusations of inequitable conduct and declaring the patent unenforceable.[3] Once the lists of claims and citations are settled, the examiner decides whether the patent is granted or not.

3 | THEORY AND HYPOTHESES

3.1 | Timing of citations as an examiner-shopping strategy

As explained above, SPEs are likely to rely on the list of citations included in the original IDS as a way to assess examiner-application fit. We claim this provides firms an opportunity to influence who will be assigned as their patent examiner. Citing an examiner in the original IDS should increase the chance that examiner is assigned to the application and, conversely, omitting a citation to a particular examiner in the original IDS should help the firm avoid that examiner. The question becomes: which examiners would firms prefer?

In principle, firms should be indifferent. The USPTO tries to define objective criteria on the requirements for patent approval, for example, novelty and non-obviousness, in order to standardize the decision-making process and eliminate human bias. However, the way these requirements are defined leaves space for subjective interpretation (Cockburn et al., 2003). The novelty condition, for instance, requires that "no single prior art reference discloses all the components that form the claimed invention." Yet, whether two components in two different inventions are exactly the same or not is often unclear. Similarly, the nonobviousness requirement dictates that "a person having ordinary skill in the art would not know how to solve the problem the invention focuses on given the prior art available at the time of the invention." Again, it is unclear what "a person having ordinary skill in the art" means.

[2]Due to high attrition rates at the USPTO, there is a limited pool of experienced examiners that can be promoted to SPE, meaning there might be no candidates who are familiar with the technologies covered in a particular Art Unit (GAO, 2008). Thus, SPEs often find themselves being "the person who is the least knowledgeable about the art" in the Art Unit (Kim & Kubota, 2011).

[3]Section 1.56 of Title 37 of the Code of Federal regulations requires a duty of candor and good faith in dealing with the USPTO.

Given these ambiguities, it is unsurprising that the same patent application may be approved by one examiner but rejected by another (Frakes & Wasserman, 2017). This is why extant evidence documents significant differences among examiners (Cockburn et al., 2003). Prior studies show how examiner idiosyncratic characteristics explain a significant portion of the existing variance in approval decisions (Feng & Jaravel, 2020), leading innovation scholars to conclude that "there may be as many patent offices as there are patent examiners" (Cockburn et al., 2003). Particularly, extant evidence shows that an examiner's prior decisions (past approval rate), what has been termed as examiner "leniency," is a strong predictor of patent approval (Sampat & Williams, 2019). Consequently, we argue firms will prefer to be assigned to the most "lenient" examiners and prefer to avoid the "toughest" ones. Thus, since citing an examiner in the original IDS increases the chances the application is assigned to that examiner, we argue firms are more likely to include cites to "lenient" examiners and omit cites to "tough" examiners in their original IDS.

The problem with this examiner-shopping strategy is that, in principle, omitting a relevant citation is something firms should be unwilling to do (Steensma, Chari, & Heidl, 2015). Firms are required to disclose all relevant art related to their invention since Section 1.56 of Title 37 of the Code of Federal regulations requires a duty of candor and good faith in dealing with the USPTO. Failing to do so increases the risk the firm is accused of inequitable conduct (Steensma et al., 2015). Interviews with a patent lawyer with more than 20 years of experience in patent prosecution confirmed the risks associated with withholding relevant prior art. This lawyer defined the breach of duty of candor as the "nuclear bomb of patent prosecution"[4] and pointed out that "unlike invalidation, which is at the single patent level, finding that the applicant voluntarily omitted material prior art leads to the whole patent family to be declared unenforceable."

However, the examiner-shopping strategy, we propose can be implemented without triggering accusations of inequitable conduct. As Kuhn et al. (2020) outline, firms are allowed to disclose prior art at different points in time during patent prosecution. Firms first disclose prior art in the original IDS, a statement they provide together with all the other documents associated with the application before the SPE has assigned the application to a particular examiner. Afterwards, firms are allowed to submit subsequent IDS during the patent examination process once the patent examiner has already been selected. Since all the relevant citations end up being included, the firm bears no risk of inequitable conduct. Therefore, this provides firms the opportunity to both influence who their examiner is and avoid accusations of inequitable conduct by being strategic with the timing in which they disclose citations: firms can cite "lenient" examiners in the original IDS and delay citations to "tough" examiners to subsequent IDS.

This means that firms have the *motivation* to use the timing of citations as an examiner-shopping strategy. Yet, firms also need to have the *ability* to implement this strategy, that is, the ability to identify which examiners are more lenient. The lawyer we interviewed explained that it is "the company's patent prosecution lawyers who are responsible for deciding when to file each IDS."[5] Thus to the extent that these lawyers have access to such information from their

[4]A term often used, see Aventis Pharma S.A. v. Amphastar Pharm., Inc., 525 F.3d 1,334, 1,349 (Fed. Cir. 2008).

[5]The lawyer we interviewed said in cases where firms use external lawyers, in-house and external lawyers collaborate in the patent prosecution process. This lawyer noted that external lawyers will have the same incentive as in-house lawyers to implement this strategy given the "strong benefits and the little risks." This corresponds to prior work on how patent attorneys' incentives are aligned with those of the firm (Chari, Steensma, & Connaughton, 2020).

prior experience (or their peer's experience), and also given that information about each examiner's prior decisions is publicly available (Cockburn et al., 2003), a firm's patent prosecution lawyers are likely able to identify who the most lenient examiners are among those who evaluated the patents they need to cite in their applications. Accordingly, since firms have both the motivation and ability to implement our proposed strategy, we claim they are likely to include cites to "lenient" examiners in the original IDS and delay cites to "tough" examiners to subsequent IDS:

Hypothesis (H1). *The probability a citation is included in the original IDS, rather than subsequent IDS, will increase with the citation's examiner's leniency.*

3.2 | Examiner-shopping in the presence of patent thickets and high strategic stakes technologies

We now propose that, the larger the benefits of getting a lenient examiner (i.e., higher probability of patent approval), the more likely firms will implement our proposed examiner-shopping strategy around the timing of citations. Specifically, we argue that the firms that will benefit the most are those facing patent thickets—that is, large numbers of patents with overlapping claims owned by multiple players (Hall & Ziedonis, 2001; Shapiro, 2000; Ziedonis, 2004)—and those developing high strategic stakes technologies—that is, central to the firm's innovation strategy (Somaya, 2003, 2012).

Prior work shows firms have severe difficulties commercializing new technologies in fields with strong patent thickets (Ceccagnoli, 2009; Cockburn & MacGarvie, 2011; Onoz & Giachetti, 2021) since firms need to obtain licenses from many other competitors, and a single one can block a firm's entry (Shapiro, 2000). Only firms that obtain a patent for their new product or technology can successfully enter these fields, since they have a way to overcome patent thickets thanks to their own intellectual property rights, for example, reaching cross-licensing agreements with their rivals (Cockburn & MacGarvie, 2011; Onoz & Giachetti, 2021). Moreover, obtaining a patent is especially useful when it allows to build "patent fences" around technologies with high "strategic stakes" (Blind et al., 2009; Somaya, 2003). Through the development of overlapping and complementary patent rights, firms can preempt others from inventing around such important technology (Granstrand, 1999; Somaya, 2003), creating legal fences that can be highly effective (Hall, Jaffe, & Trajtenberg, 2005). Therefore, firms facing patent thickets and developing high strategic stakes technologies have the strongest incentives to obtain patent protection for their innovations. We expect, then, that such firms will be more likely to implement our proposed examiner-shopping strategy. This leads to our next two hypotheses:

Hypothesis (H2a). *The positive effect of examiner leniency on the probability a citation to that examiner is included in the original IDS, rather than subsequent IDS, will increase in the presence of patent thickets.*

Hypothesis (H2b). *The positive effect of examiner leniency on the probability a citation to that examiner is included in the original IDS, rather than subsequent IDS, will increase for high strategic-stakes technologies.*

3.3 | The risks of examiner-shopping: Weak patents and field litigiousness

While in principle firms prefer lenient examiners, it is important to acknowledge that getting lenient examiners poses certain risks. As Feng and Jaravel (2020) show, patents reviewed by "lenient" examiners are usually weaker and, thus, pose a greater risk of invalidation.[6] Therefore, using citations as an examiner-shopping strategy may lead to property rights that cannot be enforced in the future.[7] Thus, obtaining patent protection to overcome patent-thickets or protect high strategic stakes technologies may be useless if the newly obtained patents are weaker and end up being invalidated. Not only will the firm lose patent protection but it will have to cover litigation costs and experience a loss in reputation. Accordingly, this represents an important boundary condition: only when this risk is sufficiently low, we should see firms facing patent thickets and developing high strategic stakes technologies use examiner-shopping strategies.

We argue that the risk that a patent will be challenged and re-examined in court is not homogeneous across technological fields Lanjouw and Schankerman (2004). While in certain fields property rights are frequently challenged and patent litigation is customary—for example, pharmaceutical and biotech industries—there are other fields where this rarely happens (Lanjouw & Schankerman, 2004). In other words, certain fields are comparatively more litigious than others. Consequently, building on the logic outlined above, we expect that the effects proposed in our previous two hypotheses should be weaker the more litigious the field is. This leads to our final two hypotheses:

> **Hypothesis (H3a).** *The positive moderating effect of patent thickets on the relationship between examiner leniency and the probability a citation to that examiner is included in the original IDS will be less positive the greater the field litigiousness.*

> **Hypothesis (H3b).** *The positive moderating effect of strategic-stakes technologies on the relationship between examiner leniency and the probability a citation to that examiner is included in the original IDS will be less positive the greater the field litigiousness.*

4 | METHODS

4.1 | Data and sample

The foundation of our data comes from the USPTO Public Patent Application Information Retrieval system (Public PAIR) (Graham, Marco, & Miller, 2015). These data provide

[6]To test this assumption, we estimate the probability that a patent is litigated as a function of an examiner's leniency using the Patent Litigation Dataset provided by the USPTO. We find that patents granted by lenient examiners have a greater probability of being litigated (available in Appendix S1).

[7]The other costs associated with delaying cites to subsequent IDS are not meaningful. First, the risk that the patent prosecution process will take longer because the firm may need to file a continuation application is very low as the patent lawyer we interviewed acknowledged: "it is very rare that the process will be delayed for this reason." Second, the fees the firm needs to pay for filling subsequent IDS amount to just a few hundreds of dollars (Title 37 § 1.97 of the Code of Federal Regulations).

information on patent applications, which Art Unit the application was assigned to, and which patent examiner was given the application to examine. In addition, we obtain data on each patent application's class from PatentsView (www.patentsview.org), which includes class information of published applications (Righi & Simcoe, 2019). We then match patent applications to firm identifiers using the NBER patent database (Hall, Jaffe, & Trajtenberg, 2001). Finally, we obtain data on the patent citations made in each application from two sources: (a) the patent citations database of the Patent Data Project at the NBER and (b) the database provided by Kuhn et al. (2020) which includes the date in which each citation was added allowing us to identify the timing of the citations (whether they were included in the original or subsequent IDS). Consistent with Righi and Simcoe (2019), our sample includes applications from 2000 until 2006, since this is the time period for which we have data on all the key variables. In addition, we restrict our sample to utility patent applications, remove continuing applications since these are almost always assigned to the same examiner (Lampe, 2012), and only look at applications where firms submit an original IDS *and* an subsequent IDS. Our final sample includes 9,763 applications, which were reviewed by 2,647 unique examiners within 343 Art Units.[8]

4.2 | Measures

4.2.1 | Dependent variable

Our dependent variable is whether a particular citation was added by the firm in the original IDS or in subsequent IDS. The unit of analysis, therefore, is at the application-citation level. We thus need to look at the date each citation was included (Kuhn et al., 2020), to distinguish which citations were added in the original IDS (the first list of citations for that application) and which were added in subsequent IDS. Since our argument is that firms *knowingly* delayed a citation for later in the process, we only look at citations that the firm already knew about. To do this, we follow Lampe (2012) and only look at citations that the firm has previously cited before the current application. This leaves three types of citations in our risk set: (a) those added by the firm in the original IDS, (b) those added by the firm in subsequent IDS, and (c) those added by the examiner that the firm knew about.[9] We create the binary variable citation is in the original IDS that takes the value of 1 if the firm included that cite in the first IDS and 0 if it is a citation added by the firm in subsequent IDS or a citation known by the firm which is added by the examiner. The final sample consists of 83,647 observations from 9,763 patent applications submitted between 2000 and 2006, with an average of about nine citations per application.

4.2.2 | Independent variables

Our main variable, examiner leniency, is calculated by taking the percentage of applications the examiner approved before the submission of the focal patent application (Farre-Mensa

[8]Our sample is smaller than that of prior studies (e.g., Righi & Simcoe, 2019) because we only have data on the timing of citations for a subsample of applications (from Kuhn et al., 2020). We compared the selected sample of applications and the sample of applications for which data on timing of citations is missing and found no significant differences in terms of the total number of citations and the proportion of citations added by the examiner.

[9]We tried an alternative approach where we did not include the citations added by the examiner and the results provide similar support to our theory (available upon request).

et al., 2020; Melero et al., 2020; Sampat & Williams, 2019). In Hypothesis 2a, we explore how the effect of examiner leniency on whether a citation is in the original IDS is moderated by the level of patent thickets. We use two different measures which capture different aspects of patent thickets. First, we look at how crowded the field is in terms of other firms through patent thickets: assignees, which we capture looking at the number of assignees included in the list of citations in the same patent class as the application (Cockburn & MacGarvie, 2011). Next, we look at how crowded the technological field is through patent thickets: technology, which looks at the average number of forward citations of the cites per active patents in the same patent class as the application (Cockburn & MacGarvie, 2011). In Hypothesis 2b, we explore how the effect of examiner leniency on whether a citation is in the original IDS is moderated by the need to develop patent fences around high strategic stakes technologies. We follow prior work and capture this construct by looking at the number of self-citations included in the focal application (Hall et al., 2005; Somaya, 2003). Finally, in Hypotheses 3a and 3b, we look at the level of litigation in a given field, that is (field litigiousness). We measure this by dividing the number of patent litigation cases[10] over the number of patents in the applications' patent class, averaged over the previous 5 years.

4.2.3 | Control variables

First, we control for examiner characteristics that may affect both, whether the examiner is assigned to the focal application and citation patterns (Lemley & Sampat, 2012). We control for the natural logarithm of the number of patents the examiner has evaluated so far (examiner experience) (Cockburn et al., 2003). In addition, we control for the examiner familiarity with the technologies covered in each application by looking at the similarity between the applications reviewed by the examiner and the focal application, which is captured through the average Jaccard index between the text of the application and the text of the last 10 patents the examiner has evaluated (Arts, Cassiman, & Gomez, 2018). In addition, we add the natural logarithm of the number of pending decisions as a control for examiner workload (Kim & Oh, 2017). Second, we control for characteristics of the cited patent to account for temporal and technological heterogeneity in citation patterns. We add a control for the similarity between the focal application and the cited patent (cited patent similarity), which is calculated through the Jaccard index between the text of the application and the text of the cited patent (Arts et al., 2018). In addition, we control for the natural logarithm of the number of days since the cited patent was approved (cited patent age) (Steensma et al., 2015). Moreover, we add a dummy variable that captures whether the patent application and a particular citation belong to the same patent class-subclass (cited patent same class-subclass). Finally, we control for the number of claims of the cited patent to capture its breadth (cited patent number of claims) (Lampe, 2012).

4.3 | Analysis

We test our hypotheses using OLS regressions. Consistent with recent studies, we choose the linear probability model due to the sample size and the fixed-effects we use in our models

[10]Obtained through the USPTO Patent Litigation Dataset (Marco, Tesfayesus, & Toole, 2017).

(Righi & Simcoe, 2019) since OLS estimators are unbiased and consistent with binary variables (Greene, 2003). We include patent application fixed-effects to remove unobserved heterogeneity across applications, firms, and Art Units and estimate clustered standard errors at the application level to account for the potential dependence across the residuals of the observations that belong to the same application (Greene, 2003). This is a rather conservative test in that we look at differences across final citations within each application. Finally, for ease of interpretation, we multiply all coefficients in the tables by a hundred to see the impact in percentage terms.

5 | RESULTS

In Table 1, we provide descriptive statistics of our dependent, independent, and control variables, as well as correlations among all of them.

We report our main tests in Table 2. Model 1 only includes control variables, and shows that citations to similar patents (cited patent similarity) and older patents (cited patent age) are more likely to be included in the original IDS ($\beta = 0.214$; $p = 0.000$ and $\beta = 5.258$; $p = 0.000$, respectively). This is consistent with the idea that the firm has probably a greater confidence that such similar patents need to be cited and is more likely aware of patents that have been around for a longer time. In Model 2, we add our main explanatory variable, examiner leniency, and find a positive and highly significant effect on the probability that the citation is in the original IDS ($\beta = 10.104$; $p = 0.000$). These results suggest that the probability that a citation is in the original IDS is around 53% for the toughest examiners (examiner leniency equals 0) but around 63% for the most lenient examiners (examiner leniency equals 1).[11] This represents a roughly 20% increase in the probability that a IDS. We interpret this evidence as support to Hypothesis 1.

In Models 3 and 4, we test Hypothesis 2a by adding the interaction between examiner leniency and patent thickets: assignees and the interaction between examiner leniency and patent thickets: technology respectively.[12] We find the interaction with patent thickets: assignees is positive and significant ($\beta = 0.441$; $p = 0.003$), with the main effect of examiner leniency being positive and significant ($\beta = 5.712$; $p = 0.062$). Specifically, we find the most lenient examiners have a 32% greater probability that their citation is in the original IDS compared to the toughest examiners when there are strong patent thickets: assignees (1 *SD* above the mean) but only a statistically insignificant 11% greater probability for low levels of patent thickets: assignees (1 *SD* below the mean). We find a more drastic effect when considering how crowded the field is based on Patent Thickets: Technology. The interaction between examiner leniency and patent thickets: technology is positive and significant ($\beta = 0.104$; $p = 0.001$), with the main effect of examiner leniency being positive and insignificant ($\beta = 3.241$; $p = 0.344$). We find the most lenient examiners have a 30% greater probability that their citation is in the original IDS compared to the toughest examiners when there are strong patent thickets: technology (1 *SD* above the mean) but only a statistically insignificant 6% greater probability for low levels of patent thickets: technology (1 *SD* below the mean). This is consistent with Hypothesis 2a.

In Model 5, we test Hypothesis 2b by adding the interaction between examiner leniency and strategic stakes. We find a positive and significant interaction ($\beta = 0.282$; $p = 0.000$), with the

[11]We use post-estimation techniques at the mean of all our other variable to calculate the percentages for all of the effect sizes (Zelner, 2009). For a more complete explanation, see Appendix S1.

[12]The main effects of patent thickets: assignees, patent thickets: technology, and strategic stakes do not appear in our estimations because they are absorbed by application fixed-effects.

TABLE 1 Variable summary statistics and correlations

Variables	N	Mean	*SD*	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Citation is in the original IDS	83,647	0.63	—	0	1	1.00												
(2) Examiner leniency	83,647	0.89	0.08	0	1	0.01	1.00											
(3) Patent thickets: Assignees	83,647	11.26	14.63	0	94	0.14	0.09	1.00										
(4) Patent thickets: Technology	83,647	61.80	62.39	0	1,238	0.08	0.02	0.59	1.00									
(5) Strategic stakes	83,647	17.66	33.06	0	133	0.13	0.08	0.77	0.58	1.00								
(6) Field litigiousness	83,647	0.45	1.23	0	7.51	−0.03	−0.07	−0.08	0.12	−0.09	1.00							
(7) Examiner familiarity	83,647	2.77	2.41	0	72.76	−0.07	−0.02	−0.28	−0.16	−0.34	0.02	1.00						
(8) Examiner experience	83,647	6.56	1.01	0.69	8.23	0.10	0.08	0.15	0.02	0.19	−0.20	−0.10	1.00					
(9) Examiner workload	83,647	3.89	2.19	0	6.21	−0.07	0.15	−0.05	−0.01	−0.05	0.03	0.08	0.05	1.00				
(10) Cited patent similarity	83,647	7.50	6.47	0	100	0.02	0.01	0.02	0.02	0.07	−0.07	0.18	0.00	0.07	1.00			
(11) Cited patent age	83,647	7.70	0.73	0.69	9.23	0.14	−0.11	0.08	−0.04	0.07	−0.11	−0.13	0.37	−0.37	−0.25	1.00		
(12) Cited patent same class-subclass	83,647	0.08	—	0	1	−0.01	0.04	−0.00	−0.02	−0.03	−0.04	0.04	0.01	0.06	0.16	−0.09	1.00	
(13) Cited patent number of claims	83,647	3.44	2.85	0	53	−0.02	0.05	−0.04	0.02	−0.03	0.09	0.04	−0.06	0.05	−0.00	−0.08	0.00	1.00

Note: The variables examiner experience, examiner workload, cited patent age, and cited patent number of claims are transformed with the natural log plus one.

TABLE 2 Results

	Dependent variable: citation is in the original IDS										
						Field litigiousness					
						Low			High		
	Base (1)	H1 (2)	H2a (3)	(4)	H2b (5)	(6)	(7)	H3a/b (8)	(9)	(10)	(11)
Examiner leniency		10.104 (.000)	5.712 (.062)	3.241 (.344)	6.043 (.024)	8.299 (.068)	1.089 (.833)	9.328 (.031)	8.837 (.042)	5.283 (.250)	9.281 (.014)
Examiner leniency × patent thickets: assignees			0.441 (.003)			0.723 (.000)			−0.081 (.795)		
Examiner leniency × patent thickets: technology				0.104 (.001)			0.271 (.000)			0.040 (.371)	
Examiner leniency × strategic stakes					0.282 (.000)			0.330 (.000)			−0.132 (.568)
Examiner familiarity	−0.318 (.039)	−0.332 (.031)	−0.329 (.032)	−0.331 (.033)	−0.322 (.036)	−0.288 (.220)	−0.276 (.240)	−0.275 (.241)	−0.193 (.336)	−0.194 (.335)	−0.195 (.330)
Examiner experience	0.245 (.204)	0.199 (.306)	0.156 (.435)	0.177 (.369)	0.121 (.551)	−0.648 (.039)	−0.687 (.028)	−0.672 (.032)	0.532 (.047)	0.535 (.045)	0.535 (.045)
Examiner workload	−0.087 (.253)	−0.115 (.130)	−0.117 (.121)	−0.115 (.130)	−0.116 (.126)	−0.088 (.374)	−0.083 (.405)	−0.090 (.368)	−0.119 (.301)	−0.118 (.305)	−0.121 (.294)
Cited patent similarity	0.214 (.000)	0.217 (.000)	0.216 (.000)	0.216 (.000)	0.214 (.000)	0.269 (.000)	0.268 (.000)	0.268 (.000)	0.021 (.715)	0.021 (.714)	0.022 (.709)
Cited patent age	5.258 (.000)	5.361 (.000)	5.369 (.000)	5.371 (.000)	5.379 (.000)	4.200 (.000)	4.221 (.000)	4.212 (.000)	7.496 (.000)	7.500 (.000)	7.494 (.000)
Cited patent same class-subclass	−2.960 (.000)	−3.001 (.000)	−3.036 (.000)	−3.015 (.000)	−3.047 (.000)	−3.411 (.000)	−3.418 (.000)	−3.405 (.000)	−2.424 (.024)	−2.422 (.024)	−2.424 (.024)
Cited patent number of claims	−0.048 (.387)	−0.057 (.305)	−0.056 (.306)	−0.057 (.305)	−0.058 (.291)	−0.152 (.050)	−0.152 (.050)	−0.154 (.047)	0.023 (.767)	0.023 (.764)	0.023 (.761)
Observations	83,647	83,647	83,647	83,647	83,647	41,838	41,838	41,838	41,809	41,809	41,809
R^2	0.458	0.458	0.458	0.458	0.458	0.444	0.444	0.444	0.468	0.468	0.468
Number of application fixed effects	9,763	9,763	9,763	9,763	9,763	4,771	4,771	4,771	4,992	4,992	4,992

Notes: For ease of interpretation, coefficients are in percent, that is, multiplied by 100. *p*-values in parentheses. Patent thickets: assignees, patent thickets: technology, and strategic stakes are omitted due to being perfectly correlated with application fixed effects.

main effect of examiner leniency being positive and significant ($\beta = 6.043$; $p = 0.024$). We find the most lenient examiners have a 39% greater probability that their citation is in the original IDS compared to the toughest examiners for high strategic stakes technologies (1 *SD* above the mean) but only a 11% greater probability for low strategic stakes technologies (1 *SD* below the mean). This supports Hypothesis 2b.[13]

Finally, we test Hypotheses 3a and 3b in Models 6 through 11. We replicate Models 3 through 5 for two different subsamples: Models 6 through 8 look at applications in low-litigation fields (field litigiousness below the median) whereas Models 9 through 11 look at applications in high-litigation fields (field litigiousness above the median). We find that all three interactions are only positive and significant for the subsample looking at low-litigation fields. The magnitude of the effects in this subsample is quite strong: the most lenient examiners have a 63%, 104%, 66% greater probability that their citation is in the original IDS compared to the toughest examiners, for high values of all three contingency variables (patent thickets: assignees, patent thickets: technology, and strategic stakes, respectively), but only 17%, 2%, 19% for low values of the contingency variables. This supports Hypotheses 3a and 3b.[14]

5.1 | Robustness tests

We implement a series of robustness tests to increase the reliability of our main conclusions (available in Appendix S1). These robustness tests (a) show that SPEs are indeed more likely to assign patent applications to those examiners cited in the original IDS, (b) confirm that the reason for this is that SPEs face time and expertise constraints to assess which examiner provides a better fit with an application, (c) explore the magnitude of our effects, (d) provide evidence of our proposed mechanism by showing how the effects in Hypothesis 1 are strongest for non-retired examiners and for applications where there is high variance in examiner leniency within an application, (e) show that lenient examiners are indeed more likely to approve subsequent applications, and (f) provide evidence that lenient examiners grant "weaker" patents.

6 | DISCUSSION

In this study, we propose that firms behave strategically during patent prosecution to get more "lenient" examiners, that is, "examiner-shop." We introduce a novel way firms examiner-shop by including cites to lenient examiners in their original IDS and delaying cites to tough examiners to subsequent IDS. Moreover, we find this strategic timing of citations to be more prevalent when firms have a large benefit to a patent, that is, when they face patent thickets and develop high strategic-stakes technologies. Finally, we show this is the case only when the risk of having weaker patents is comparatively lower, that is, in low-litigation fields.

[13]We cannot test a full model including interactions of both patent thickets and strategic stakes because of multicollinearity problems. However, full models with our moderators transformed into binary variables provide support for our predictions (available upon request).

[14]We provide a discussion about the magnitude of all the effects in Appendix S1.

6.1 | Contributions and practical implications

Our findings contribute to several literatures. First, our study contributes to the literature looking at how firms behave strategically during the patent prosecution process (Hegde et al., 2009). Specifically, our study joins recent efforts to understand how firms try to influence who their examiner will be (Hegde et al., 2009; Lemley & Moore, 2004; Quillen & Webster, 2001). Extant work's suggestion that continuation applications help engage in examiner-shopping is problematic since continuations are almost always assigned to the same examiner. We propose an alternative strategy built around the recent insight that firms submit IDS at different points in time (Kuhn et al., 2020): firms can influence who their examiner will be through the timing of citations. We believe our study provides a more plausible rationale for the use of strategic citations than prior studies' logic around patent scope (Chari et al., 2020; Lampe, 2012; Steensma et al., 2015), since it does not carry the risk of inequitable conduct and explains why firms decide not to include self-citations in their original IDS.

Second, we contribute to research looking at the strategic use of patents in the competitive landscape (Cockburn & MacGarvie, 2011; Harhoff et al., 2016; Somaya, 2012; Ziedonis, 2004) by showing how firms are more likely to obtain patent protection in fields characterized by strong patent thickets and when they need to build fences around high strategic stakes technologies. In addition, we account for the fact that "lenient" examiners usually grant weaker patents (Feng & Jaravel, 2020). Building on this, we show how firms are more likely to implement our proposed examiner-shopping strategy mainly in low-litigation fields, where there is a low risk a weak patent will be tested and thus invalidated. This has important implications: not only there is a tendency that patent thickets and high strategic stakes technologies become "denser," but also they are composed of "weak" patents that are less likely to be challenged. This finding reinforces recent concerns that the emergence of patent thickets and fences could be unnecessarily damaging innovation (Bessen & Meurer, 2008; Shapiro, 2000; Wen et al., 2016) and triggering a costly and inefficient "arms race" among competitors (Hall & Ziedonis, 2001), which speaks to recent debates around the inefficiencies of the patent system more generally (e.g., Torrisi et al., 2016).

Finally, our conclusions have key implications for studies that use examiner leniency as an instrumental variable (Farre-Mensa et al., 2020; Hegde et al., 2021; Melero et al., 2020; Sampat & Williams, 2019), building on the assumption that examiners are assigned randomly. While assignment could be random in certain cases, as pointed out in prior work (Feng & Jaravel, 2020; Lemley & Sampat, 2012), our study provides qualitative and quantitative evidence suggesting that assignment is not always random to the extent that firms are able to influence who their examiner will be. Overall, then, our study provides useful insights with respect to the appropriateness of the use of examiner leniency as an exogenous instrument.

As for our study's practical implications, there are several key conclusions. First, from a policy point of view, regulatory agencies such as the USPTO should do as much as they can to make sure SPEs' time and knowledge constraints are not providing applicants with an option to influence who evaluates their applications through strategic citations of prior innovations. Second, from a competitive perspective, firms should pay close attention to how their rivals obtained their patents. This could provide information about the actual strength of those competitors' IP rights.

6.2 | Limitations and future research

There are several limitations in our study that must be acknowledged. First, while our study focuses on examiners' approval rate, there are alternative conceptualizations of leniency related

to patent scope (examiners' tendency to remove and/or change claims) and prosecution time (examiners' examination speed) (Hegde et al., 2021). Second, there could be other aspects besides citations firms may use to influence the SPE's assignment decision, such as the text and wording used in the claims and description of the invention. Finally, firms may try to influence, not only who their examiner is but also which Art Unit their application is sorted to in the first place ("Art-Unit shopping"), a service provided by several newly founded consulting companies (e.g., www.patsnap.com or www.patentbots.com). We hope future research will be able to explore these possibilities.

Overall, we believe our study has taken important steps in understanding how applicants may be able to get lenient examiners and avoid tough evaluators through strategic citations. We hope that it would spur more research on how firms use patents strategically and the implications of such strategic behavior.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available at the USPTO and PatentView websites.

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SUPPORTING INFORMATION

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