

Patent Privateering

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Abstract

In a patent privateering strategy, a firm sells a patent to a non-practicing entity (NPE) with the implicit or explicit understanding that the NPE will initiate a patent infringement lawsuit against the firm's rivals. We examine whether firms under competitive pressure that face barriers to suing directly are more likely to sell patents to NPEs, also known as patent trolls, and if so, whether those patents are subsequently used in litigation against competitors. We find that firms facing greater technological competition and retaliation risk are more likely to sell patents to NPEs, and these patents are significantly more likely to be used in litigation against the original owner's competitors within three years. Patent sales to trolls are more pronounced among firms that are more likely to benefit from enforcing patent rights via a third party rather than directly, including firms that operate in technology areas with frequent litigation or high collaboration. Privateering motivated patent sales are also concentrated among well-resourced firms, contrary to the notion that small firms are using NPEs to enforce patent rights against larger industry players. After patents are sold to trolls, peers file fewer patents and the number of peers filing patents decreases, suggesting a privateering strategy can effectively change the competitive landscape. As a strategic disclosure response, peers are less likely to cite a patent after it has been sold to a troll in an apparent attempt to reduce the likelihood they become targets of a troll-initiated infringement lawsuit. Our results highlight an overlooked player in the policy debate about patent trolls, namely the practicing entities that "feed" the trolls in the first place.

Key words: Technological competition, Patent market, Innovation

JEL codes: D23, M40, M41, O30, O31, O32, O34, O39

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In the late 16th century, Queen Elizabeth I of England commissioned Francis Drake to sail for America. The Queen asked him to plunder Spanish vessels on its way there. Francis Drake became a pirate commissioned by the crown. This type of “legal” pirate was called a “privateer.” They allowed nations to attack one another without the risk to be counterattacked, because the identity and the nationality of these pirates’ employer were kept secret.

Today, the spirit of those pirates is reborn. Called “patent troll,” they now act for high-tech companies by “patent privateering” others.

- Thibault Schrepel, LLM

1. Introduction

The past two decades have seen a sharp rise in patent litigation in the United States brought about by non-practicing entities (NPEs). While NPEs only accounted for about 30% of patent litigation in the early 2000s, they recently have been found to assert patents in a majority (60%) of patent litigation (Miller et al. [2018]). NPEs acquire patents not to develop commercial products, but to seek licensing fees or pursue infringement litigation related to their patent portfolios.¹ The rise of NPEs has sparked debate on NPEs’ controversial impact on innovation.

Proponents argue that NPEs serve as valuable intermediaries enforcing intellectual property rights, especially for small inventors, who might otherwise see their patents infringed by well-funded firms (Federal Trade Commission [2011]). Conversely, critics argue that NPEs hinder innovation through frivolous litigation that inflicts significant financial losses on both large and small companies (The U.S. Congress [2013]). Empirical evidence increasingly supports the critics’ view. It shows that NPEs tend to target cash-rich firms, irrespective of actual patent infringement (Cohen et al. [2016, 2019]), negatively impact defendants’ R&D activities, and harm small firms’ ability to grow, create jobs, innovate, and raise capital (Chien [2012], Appel et al. [2019]). While extensive research documents NPEs’ downstream impact on litigation targets, relatively little is known about the entities that *supply* patents to NPEs and their strategic motivations. We examine

¹ NPEs are often referred to as patent assertion entities (PAE) or “patent trolls”. We use NPEs, PAEs, and patent trolls interchangeably in this paper.

whether firms facing competitive pressure strategically supply patents to NPEs, and if so, whether those patents are subsequently used in litigation against their competitors, a strategy known as patent privateering.

Firms facing competitive pressure may enforce patents against rivals to reshape the competitive landscape. However, directly suing a competitor often triggers countersuits, a strategy frequently advised by lawyers counselling defendants in infringement suits (McDaniel and Matthews [2024]). These countersuits can reduce the expected benefits of direct enforcement by giving the infringing party leverage to negotiate smaller settlements. Patent privateering offers an alternative strategy: selling patents to NPEs who then pursue infringement claims against competitors. This approach allows the original owner to distance itself from the litigation while competitors become embroiled in legal disputes that may force them to redirect resources away from R&D and other strategic initiatives (Chien [2012], Appel et al. [2019], Kim et al. [2025]).

As competitive pressure intensifies, firms increase efforts to improve their own profitability and find ways to sabotage their rivals (Kim et al. [2020], Bloomfield et al. [2023]). Enforcing patent rights is one means to both increase the firm's own revenue and increase competitor costs via licensing fees. Compared to direct enforcement, privateering—selling patents to NPEs for enforcement—offers three potential advantages. First, if the sales agreement also includes a provision to share future licensing revenues with NPEs (see Appendix B for an example), a privateering strategy can increase the seller's revenue.² Second, even in the absence of a revenue sharing agreement, selling to an NPE allows a firm to distance itself from litigation while increasing the expected value of infringement lawsuits, as rivals cannot countersue an NPE for patent infringement given NPEs do not produce products using patented technologies. Even if

² Kesana, Laye-Farrar, and Schwartz (2019) find cases of NPEs that have explicit revenue-sharing agreements with patent seller, though they note the underlying agreements are typically confidential and unobservable at large scale.

competitors identify the privateering strategy, any retaliatory lawsuit against the original seller forces the rival to manage two costly litigation proceedings simultaneously. Third, privateering helps mitigate regulatory scrutiny (Cohen et al. [2016], Appel et al. [2019]). When NPEs litigate on behalf of the original patent owner, the Federal Trade Commission (FTC) and Department of Justice (DOJ) may be less likely to investigate the lawsuit as a potential antitrust violation.

We conjecture that firms facing heightened technological competition and a reluctance to enforce patents directly are more likely to engage in patent privateering to change the competitive landscape. Specifically, our first hypothesis predicts that firms experiencing greater technological competition from litigious rivals have privateering incentives and will sell more patents to trolls. While firms sell patents for various reasons, such as portfolio rebalancing, liquidity needs, or meeting earnings targets (Kim and Valentine [2024]), we anticipate that privateering-motivated patent sales are more likely to lead to increases in patent litigation against the seller's rivals. Our second hypothesis posits that privateering-motivated patent sales are associated with subsequent increases in patent infringement lawsuits targeting the focal firm's technological peers rather than non-peers, consistent with strategic attempts to influence the competitive environment.

Leveraging the USPTO patent assignment data and the Stanford NPE litigation database, we test our predictions with a sample of 117,413 firm-years from 2003 to 2021, including both private and public firms with at least one patent sale and one patent litigation. We proxy for privateering incentives using the ratio of peers' patent stock to the focal firm's patent stock, where peers' patent stock is weighted by the similarity between the peer's and focal firm's technologies as well as peers' propensity to file retaliatory patent infringement lawsuits. The intuition is that a firm's privateering incentives increase with 1) the competitive threat from its peers' technological advancements (captured by peers' patent stock relative to the firm's own patent stock), weighted

by technological proximity, and 2) the costs of direct enforcement as proxied by peers' retaliatory lawsuit propensity. An advantage of using a patent-based measure of privateering incentives is that we can consider the activity of private as well as public competitors. We count the number of patents sold to patent trolls as our primary dependent variable.

We find a significant positive relationship between privateering incentives and the number of patents sold to NPEs. Specifically, a one interquartile increase in privateering incentives corresponds to a 4.14% increase in patents sold to NPEs. We next examine whether these increased sales prompt more lawsuits targeting selling firms' peers. We find that subsequent patent infringement litigation *disproportionately* targeting the focal firm's technological peers increases with privateering sales. This result holds after controlling for the number of seller-initiated infringement lawsuits, suggesting that the privateering effect is incremental to the latent level of patent infringement.

To provide stronger evidence that the patents sold to trolls are subsequently used in litigation against the sellers' peers, we perform a *matched patent-sample* analysis. We use nearest-neighbor matching to pair each patent (Patent A) sold by a focal firm to a troll with a similar patent (Patent B) sold by another firm to the same troll. We create two types of comparisons: (1) holding the peer group constant (seller A's peers) while varying timing by comparing litigation around Patent A's actual sale date versus Patent B's sale date, and (2) holding the time period constant while varying the peer group by comparing litigation targeting seller A's peers versus seller B's peers around the same period. We find that trolls are more likely to use Patent A to target seller A's technological peers relative to expectations using either benchmark, suggesting that the incremental increase in NPE litigation targeting the selling firm's peers is likely attributable to the specific patent transfer rather than NPEs' general tendency to target firms in similar technology

spaces. Furthermore, NPEs' propensity to sue the seller's peers using recently purchased patents is stronger when greater privateering incentives are present. Taken together, the evidence is consistent with the practice of patent privateering, where firms strategically transfer patents to NPEs to increase the likelihood that their technological competitors become entangled in costly infringement litigation.

Next, we investigate cross-sectional variation in the effect of privateering incentives on patent sales to trolls. We find that such sales are more pronounced among firms with incentives to pursue litigation via a third party, namely those operating in technology sectors characterized by frequent litigation and where collaborative relationships are highly valued. Furthermore, privateering incentives affect patent sales only when the seller and troll have a repeated relationship, but not for one-time sales to trolls. In subsample analyses, we find that large firms and those with substantial financial resources, which likely have greater antitrust scrutiny concerns, are more likely to sell patents to trolls. This challenges the notion that NPEs help level the playing field between large and small firms, and instead suggests that more sophisticated actors strategically leverage patent sales to trolls for competitive advantage.

We recognize that unobservable factors may influence both privateering incentives and patent sales to trolls. For example, greater competition can prompt both increased patent infringement and liquidity-motivated sales to trolls, potentially creating a positive association between sales to trolls and litigation against competitors absent a privateering strategy. Our main analyses address this concern by controlling for the latent level of patent infringement. Additionally, the result that sales to trolls are stronger when there is greater intra-industry collaboration and litigation as well as existing relationships between sellers and trolls support the argument that firms increasingly sell to trolls as suing directly becomes more costly. Finally, our

cross-sectional results suggest larger firms with lower leverage and higher cash balance (among public firms) are more likely to engage in privateering-motivated sales to trolls. These findings are more consistent with a privateering strategy and less consistent with liquidity-motivated sales.

To further address potential endogeneity, we use state- and federal-level R&D tax policies to construct an instrumental variable for the technological competition component of privateering incentives (Bloom et al. [2013], Arora et al. [2021]). The idea is that state-level R&D tax credits stimulate R&D activity and thereby increase patenting by peer firms headquartered in the affected states, leading to exogenous changes in a focal firm's perceived competition. The peer patent stock predicted by R&D tax credits is thus correlated with the focal firm's perceived competition and privateering incentives, but should not directly affect patent sales to NPEs. Our inferences remain robust using this instrumental variable approach.

We next examine whether patent privateering is successful in changing the competitive landscape and, if so, whether peer firms respond accordingly. We find that patent sales to trolls are negatively associated with peer firms' patent filings in overlapping technology areas and the number of unique firms filing patents, suggesting the strategy appears to be curbing competition. We then investigate whether peers respond to this change in competition. First, we establish that firms whose patent filings cite patents owned by trolls are more likely to be targets of NPE infringement lawsuits, even after controlling for technological similarity. This finding suggests that citing a troll-owned patent increases a firm's litigation risk. Given this context, we find that after a patent is sold to a troll, peer firms cite the patent less frequently in future inventions, presumably to mitigate the risk of being targeted by trolls.

We perform three sets of additional analyses to further validate the robustness of our results. First, we consider two alternative measures for our dependent variable: 1) a binary

indicator for patent sales to trolls, which focuses solely on the presence of a transfer; and 2) the number of sales to trolls as a percentage of the total number of patent sales for the year, which directly controls for a firm's overall propensity to sell patents. Second, we test an alternative definition of privateering incentives by including only peer firms with above-median patent portfolio similarity to the focal firm, addressing concerns that competition from technologically distant firms may not drive strategic patent sales. We also examine alternative measures for peer firms' retaliatory propensity. Our results remain robust across these alternative specifications. Finally, we perform falsification tests by randomly shuffling our proxy for privateering incentives within firms and within years and find no significant effects.

We contribute to the literature on technological competition and firms' strategic behavior. Prior work finds that firms can use disclosure to deter or even sabotage competitors (Glaeser and Landsman [2021], Kim, Verdi, and Yost [2020], Valentine, Zhang, and Zheng [2024], Zhang [2024]). We complement this evidence by demonstrating that a real action, namely patent sales, can also be a means of changing the competitive environment. Prior literature has found that firms' creation of patent thickets can change innovation in the area (Galasso and Schankerman [2010]; Noel and Schankerman [2006]; Ziedonis [2004]) and that firms can use acquisitions to quash competitor technologies (Kepler, McClure, and Stewart [2024]). We contribute by documenting patent privateering as a strategy to influence firms' relative position among technology peers.

We also contribute to the emerging literature that examines the implications of innovation-oriented firms' patent sales to non-practicing entities that own patents without producing commercial products or providing services. Existing research primarily focuses on the behavior of patent trolls, particularly their litigation patterns against practicing companies and the negative consequences for the targeted firms. For example, prior studies find that patent trolls often target

firms with substantial financial resources, such as large firms with good performance and significant cash holdings (Cohen et al. [2019]). Extant work also finds that patent trolls impair the ability of targeted firms to innovate and grow (Tucker [2014], Cohen et al. [2019], Appel et al. [2019], Mezzanotti [2021]). Our paper complements these studies by investigating the actors enabling these trolls and their strategic motives. We reveal that, in many cases, it is the competitors of the targeted firms who instigate these patent attacks.

2. Institutional Background and Hypothesis Development

2.1 Institutional Background

In 2019, industries relying on intellectual property accounted for 41% of U.S. economic output and 44% of employment (Toole, Miller, and Rada [2019]). Furthermore, intangible assets account for an increasing share of firm value over time (Corrado and Hulten [2010], Eisfeldt and Papanikolaou [2013], Srivastava [2014]). Given the importance of intellectual property to the broader economy and to individual firms, there are important incentives for firms to properly manage their intellectual property portfolio, including patents. Patent holders have exclusivity rights for a specified period of time but must be prepared to sue for patent infringement in order to enforce those rights.

In a regime with clearly defined and transparent intellectual property rights, innovators can avoid *ex post* infringement lawsuits by identifying the technologies required before making an investment decision. If a patented technology exists that is necessary for the firm to develop its invention, it can enter into a licensing agreement with the patent holder *ex ante*. However, in practice it can be difficult to identify the legal boundaries for an invention due to the inherent subjectivity in defining intellectual property rights (relative to physical property, for example) and the sheer volume of granted patents (Bessen and Meurer [2013]). This uncertainty opens the

possibility that firms invest in a technology only to find *ex post* that it infringes on another's patent. If so, a firm could "come clean" to the technology developer about its unwitting infringement and attempt to negotiate a licensing agreement *ex post*, risk willful infringement in the hope of going undetected, or attempt to invalidate the related patent in litigation (Bessen and Meurer [2006]).

Patent litigation is a lengthy and costly process that favors well-resourced firms with large patent portfolios (Bessen and Meurer [2013], Lanjouw and Schankerman [2004]). The median time to trial for patent litigation is over two-and-a-half years (PriceWaterhouseCoopers [2018]). Lanjouw and Schankerman [2004] find that firms with larger patent portfolios are less likely to be sued for infringement. They argue that a large patent portfolio allows firms to settle disputes before going to court for two reasons. First, firms with large patent portfolios may be more able to enter into cross-licensing agreements. In practical terms, when firms with large patent portfolios are sued for infringement, they have a deeper bench of patents to draw from to threaten to countersue for infringement, thus bringing the other party to the negotiating table. If it is determined that both firms are infringing on each other's patents, they can negotiate cross-licensing agreements.

Second, larger firms can anticipate more repeated interactions with technology developers and are thus more incentivized to cooperate. Related firms can have repeated business interactions with each other, including via licensing agreements, customer-supplier relationships, or joint ventures and co-patenting. The existence of repeated interactions can make firms reticent to sue each other (Lanjouw and Schankerman [2004]) and in some cases, licensing agreements may explicitly include a covenant not to sue.

Given that patent litigation favors larger, well-resourced firms, non-practicing entities can potentially play an important role in aiding small entities to enforce their patent rights. As litigation specialists, NPEs are likely better equipped to take on large infringing firms than original, smaller

patent owners. The PwC 2018 Patent Litigation Study found that NPEs have median damages awards more than three times that of practicing entities over the 2013 to 2017 time period, highlighting their expertise. However, it is also possible that large firms can use patent trolls to engage in patent privateering, a strategy that could allow well connected firms with larger patent portfolios to have their cake and eat it too – i.e., be able to maintain relationships with competitors with whom they have repeated interactions and be able use a third-party to enforce patent rights and thereby increase their competitors' costs.

2.2 Hypothesis Development

In the presence of competition, a firm can seek to improve its relative position in the industry by increasing the profitability of its own operations and/or by taking actions to decrease competitors' profitability. Specifically, a firm can endeavor to increase its own revenues (decrease competitor revenues) and/or decrease its own expenses (increase competitor expenses). Enforcing patent rights can result in higher licensing fees, thereby increasing the firm's own profitability. Furthermore, engaging technology competitors in patent litigation can increase competitor expenses in the short run as lawsuits progress and potentially result in settlements or damage awards. In the long run, successful deterrence can also decrease competitors' revenues if they exit profitable technology spaces, thereby increasing the focal firm's relative market share.³

However, companies may not always be in a position to openly pursue patent infringement lawsuits against their competitors. Firms may be deterred from initiating such legal actions due to strategic business relationships (for example, existing cross-licensing agreements) and concerns

³ Of course, a firm trades off the expected litigation costs of bringing a patent infringement lawsuit against a competitor with the net benefits of harming the competitor's profitability. The direct costs of lengthy litigation proceedings can increase a firm's own expenses in the short run. Industry reports suggest that for the average patent lawsuit, costs are \$1.6M through the discovery stage and \$2.8M in total. As discussed further below, in addition to the direct costs of litigation, suing competitors for patent infringement could also potentially expose the firm to potential retaliation.

about drawing antitrust scrutiny. Thus, selling a patent to a third party who will likely sue a competitor can achieve the same competitive goal while mitigating the costs of direct legal action.

Thibault Schrepel, an Associate Professor of Law at the Vrije Universiteit Amsterdam and a Faculty Affiliate at Stanford University, defines patent privateering as “strategy where a [non-practicing entity] acquires/buys patents [from] its original holder and then engage in a lawsuit against companies, in most cases the rivals of the original holder. The troll and the original holder then share the booty. It could be either licensing royalties, litigation settlements or damage awards.” We define patent privateering more broadly to also include cases where the original owner sells a patent to an NPE simply to increase the likelihood that a competitor is sued, rather than requiring an explicit agreement between the NPE and the original owner to share in the benefits.

The benefits of patent privateering via an NPE potentially include: 1) increasing the firm’s licensing revenues when there is a revenue sharing agreement with an NPE, 2) distancing the firm from litigation proceedings, which can increase the expected benefits of having a competitor targeted in an infringement suit even without a revenue sharing agreement, and 3) protecting the firm from antitrust allegations. First, a seller can enter into an explicit revenue sharing arrangement with an NPE, though the vast majority of selling agreements are private. Kesan, Laye-Farrar, and Schwartz (2019) find cases of NPEs that have explicit financial agreements for revenue sharing with the seller via public court cases, news articles or press releases, substantiating that the practice exists. **Appendix B** includes one such example.

Second, even in the absence of an explicit revenue sharing agreement, using an NPE to sue a competitor rather than suing directly can increase the litigation costs borne by a rival, and may reduce the likelihood of competitor retaliation. If a firm directly sues a competitor for

infringement, the rival will often retaliate with a countersuit for infringement of another patent. This countersuit gives the competitor bargaining power and reduces the expected benefits of the original infringement lawsuit to the focal firm. If instead a firm sells a patent to an NPE that sues a competitor, the competitor cannot countersue for infringement given an NPE is not in the business of using or developing technologies. Thus, the typical strategy for a competitor to mitigate an infringement lawsuit via a countersuit is rendered ineffective, making a separate retaliatory lawsuit more costly (see **Figure 1**).

If a competitor chooses to initiate a separate infringement lawsuit against the seller as a retaliatory action, the competitor is still left to contend with the NPE lawsuit and must manage two lawsuits simultaneously. Furthermore, if a competitor accuses the seller of privateering, the seller can credibly hide behind the argument that they only sold the patent to the troll to rebalance their innovation portfolio or for liquidity reasons.

Third, suing competitors through a patent troll can allow a firm to avoid antitrust scrutiny from regulators. Antitrust concerns are particularly pronounced when the lawsuit is perceived as an attempt to stifle competition or create monopolistic advantages. The Antitrust Division of the US Department of Justice (DOJ) and the Federal Trade Commission (FTC) closely monitor large patent transactions and any subsequent patent infringement lawsuits, especially when firms with significant market share are the plaintiffs (Schrepel [2014]). When large tech firms with significant market power aggressively enforce patents, antitrust authorities often become concerned about using intellectual property rights as a means to maintain monopoly power or exclude competition unlawfully. For instance, the FTC sued Qualcomm for anticompetitive patent licensing practices, arguing that its “no license, no chips” policy for essential cellular patents violated antitrust laws (New York Times 2019). Similarly, Google faced antitrust scrutiny for aggressively enforcing

Motorola's standard-essential patents after acquiring the company, resulting in the FTC's 2013 consent decree that limited Google's patent enforcement tactics (New York Times 2013). The DOJ may also challenge patent acquisitions that create or enhance monopoly power, as demonstrated when it prevented Microsoft from acquiring Novell's patents to which Microsoft already had a license (Gross [2011]).⁴

The relative benefits of suing via an NPE increase with 1) the extent of competition faced by the firm, when increasing the firm's own revenue and/or increasing competitors' costs becomes more important, and 2) the costs of suing directly. First, as competition increases, selling to an NPE with a revenue sharing agreement for any licensing fees can increase the firm's own profitability while simultaneously increasing competitors' costs. Even in the absence of a revenue sharing agreement, enforcing patent rights via an NPE can increase expected competitor costs relative to suing directly. Additionally, regulatory scrutiny is likely heightened as competition increases. For example, Section 5 of the Federal Trade Commission Act prohibits "unfair methods of competition in or affecting commerce".

Second, as the costs of directly suing a competitor increase, we expect firms to use an NPE to enforce patent rights more often. An important cost of suing a competitor for infringement is the commonly used defensive strategy of countersuing for patent infringement. A countersuit reduces the expected benefits of patent enforcement by providing the defendant with an important bargaining chip in any settlement or licensing agreement.⁵ Thus, as competitors become more aggressive in engaging in retaliatory lawsuits, we expect the costs of direct enforcement to increase and the attractiveness of privateering strategies to rise. Taken together, we consider both

⁴ <https://www.pcworld.com/article/490637/article-1284.html>

⁵ Another strategy a peer could use when sued for infringement is to attempt to invalidate the asserted patent. As this strategy is equally applicable to direct infringement lawsuits as well as infringement lawsuits using an NPE as a third-party enforcer, we find it unlikely to be a significant factor in determining privateering incentives.

technological competition and peer firms' retaliation propensity to be important factors in a firm's privateering incentives.

Based on the preceding discussion, we make the following predictions stated in the alternative:

H1: Privateering incentives increase a firm's patent sales to patent trolls.

H2: Privateering motivated patent sales to trolls increase future patent troll lawsuits targeting rivals.

There are several reasons why we may not observe the predicted effects. First, selling a patent means the loss of future royalty payments and loss of control over how the technology is developed. Second, a seller could be required to pay royalties to the buyer to continue to use the patented invention. Even if the patent sale includes a non-exclusive, royalty-free license for the seller to continue using the technology, the sale could make it more difficult for a firm to build on that technology in the future given the often-blurry lines demarking intellectual property rights.⁶ Third, once a firm sells its patent to a troll, it loses control over litigation-related decisions, such as whether to bring suit, settle, or pursue a trial. Each of these factors could become more important as technological competition and rivals' litigiousness increase (i.e., when privateering incentives are higher).

3. Research Design

3.1 Data and Sample Selection

We obtain information on patent sales from the USPTO patent assignment data, patent characteristics from PatentsView, and NPE litigation data from the Stanford NPE Litigation Database. The USPTO patent assignment dataset includes information such as the buyer and seller

⁶ The USPTO grant patents that essentially overlap with existing patents 30% of the time: <https://www.thisamericanlife.org/441/transcript>

names, the number of patents included in the sale, the sale execution date, and a brief description of the reason for the patent trade. PatentsView allows us to observe patent information for both public and private firms, such as technology class, the number of figures included in the patent filings, and forward citations received. Finally, the Stanford NPE Litigation Database provides comprehensive records of patent lawsuits filed in the U.S. district courts from 2003 to 2022, identifying each patent plaintiff as either a practicing entity or as one of eleven types of NPEs.

Table 1 illustrates our sample construction process. We combine the above three databases to create a sample with a firm-year unit of observation. We begin with all firm-years between 2003 and 2021 in PatentsView, totalling 5,677,295 observations. We select this sample period because 2000 marks the earliest year for which the Stanford NPE Litigation data is available, and we require three years of data to measure the retaliation likelihood component of *PrivateeringIncentives*. Furthermore, we examine all litigation occurring in the subsequent three years, making 2021 the final year of our sample period. To ensure the firms in our sample participate in the secondary patent market and are involved in intellectual property litigation, we require firms in our sample to have at least one patent sale and one patent litigation within this period, resulting in 145,217 observations. Additionally, each firm-year must have been granted at least one patent in the past 20 years to ensure active engagement in patenting. This process yields a final sample of 117,413 firm-year observations, representing 7,643 unique firms. Among these, 6,200 are private firms and 1,443 are publicly traded firms.

3.2 Key Measures

3.2.1 Key Dependent Variable: Patent Sales to Troll

We define our key measure of patent trades, *No. Patent Sales to Trolls*, as the inverse hyperbolic sine (IHS) transformation of the total number of patents sold to patent assertion entities

(PAEs) or trolls by a firm in year t , following Kim and Valentine [2024]. We apply the IHS transformation to this variable to address issues associated with skewed distribution and accommodate zero values and then multiply by 100 for ease of interpretation.

Given that the patent market, particularly patent sales to trolls, is relatively underexplored in the literature, we provide some descriptive context in this subsection. As illustrated in **Table 2, Panel A**, of the 117,413 firm-year observations, 20,462 (17.43%) have at least one patent sale. Of these, 2,041 firm-years (1.74%) involve patent sales to trolls, suggesting such transactions are relatively rare. However, among the 7,643 unique firms in our sample, 1,206 (15.78%) have sold a patent to a troll at least once. Notably, more than half of those firms (659 out of 1,206, or 54.6%) have their sold patents subsequently involved in patent troll litigation. Taken together, these summary statistics suggest that while patent sales to trolls are less common, such transactions may be strategically motivated given the high probability of subsequent litigation.

Table 2 Panel B lists the top ten patent technology classes with the highest number of patents sold to patent trolls, along with the percentage of patents in each technology class sold to these entities. The categories of Electric Communication, and Computing, are at the top of the list, perhaps due to overlapping and broadly defined patents in these technology areas making litigation a profitable strategy (Boyfield [2013]).

Table 2 Panel C compares the characteristics of patents sold to trolls with those sold to other parties, and those that were never sold. Compared to sales to other parties, transfers to trolls typically involve a larger number of patents per transaction. Overall, patents that are sold to trolls tend to be more valuable, as indicated by their scientific value (proxied by forward citations) and have greater scope (measured by the number of independent claims). These patents are generally older and exhibit less transparency in their disclosures (as indicated by fewer patent figures) and

involve fewer inventors. These observations are consistent with the findings in the literature that patents employed by trolls that originate from operating firms are of higher-quality, and as such can have a more significant impact on the competitive landscape (Schrepel [2013]). Finally, relative to patents sold to others, patents sold to trolls are less likely to be core patents.⁷ Given the observed differences, we control for these characteristics in our subsequent multivariate analysis.

3.2.2 Key Independent Variable: *PrivateeringIncentives*

We capture privateering incentives by considering the intensity of technological competition faced by the focal firm as well as peer firms' retaliation propensity. The intuition is that as both competition and the costliness of direct litigation increase, the incentive to use a privateering strategy increases. We calculate our measure as follows:

*PrivateeringIncentives*_{*i,t*}

$$= \sum_{j \neq i} [(\omega_{i,j} \times PatentStock_{j,t}) \times (1 + \%Retaliation_{j,\{t-3,t-1\}})] / PatentStock_{i,t}$$

Our measure has four components: (1) peer *j*'s patent stock at the beginning of year *t*, *PatentStock*_{*j,i*}; (2) the closeness of peer *j* to sample firm *i* in the technology space, $\omega_{i,j}$, which we proxy for using the distribution of firms' patent stock across CPC subclasses⁸; (3) retaliatory litigation propensity of peer firm *j*, $\%Retaliation_{j,\{t-3,t-1\}}$; and (4) firm *i*'s own patent stock at the beginning of year *t*, *PatentStock*_{*i,t*}.

We measure a firm's patent stock as the number of patents granted over the past 20 years, with a decay rate of 15%: $PatentStock_{j,t} = \sum_{n=1}^{20} [PatentGrant_{j,t-n} \times (1 - 15\%)^n]$ (see Bloom et al. [2013], Cao et al. [2022]). $\omega_{i,j}$ is calculated as the cosine similarity of the peer

⁷ CoreClass is an indicator variable that equals one if a patent is from the firm's core class (i.e., the technology subclass where the firm has filed the most patents in the recent 20 years).

⁸ Specifically, we use the Cooperative Patent Classification (CPC) system at the subclass level of aggregation (e.g., A63B), which has 657 distinct patent technology classes. **Online Appendix 1** provides more details about the calculation of $\omega_{(i,j)}$ with some examples.

firm's and the sample firm's patent distributions for fiscal year t across CPC 4-digit subclasses. Intuitively, firms with a similar patent distribution across technology subclasses are considered closer technological competitors and pose a greater threat to each other.

$\%Retaliation_j$ measures the retaliatory litigation propensity of peer firm j , calculated as the total number of lawsuits filed by firm j against firms that previously sued firm j in the three years prior to year t , divided by the total number of lawsuits targeting firm j over the same period. We use $(1+\%Retaliation)$ to adjust for the influence of zero values in our analysis. The idea is that peer firms with high retaliation propensity make direct litigation risky for focal firms, thus increasing the attractiveness of privateering as an alternative strategy. Finally, we scale peers' weighted patent stock and retaliation risk by the firm's own patent stock to account for the focal firm's preparedness to face the competitive threat.

Our measure is an adaption of the Bloom et al. [2013] and Cao et al. [2018] R&D-based measure for product market competitors to the patent domain, adjusted for peers' retaliation likelihood. Bloom et al. [2013] create a measure using the sum of peer firms' cumulative R&D investments, weighted by their closeness to the focal firm, based on the idea that a firm's technological threat comes from its peers' technological advances as proxied by R&D investments. Cao et al. [2018] refine this measure by using the firm's own R&D investments as the scalar, thus incorporating the focal firm's relative patent strength. The technological competition measure from Cao et al. [2018] reflects the aggregate technological investments of a firm's *product market* peers relative to the firm's own investments. We measure technological competition in the *patent* domain specifically and then account for peers' retaliation likelihood in the event a focal firm were to sue directly. The resultant *PrivateeringIncentives* variable is increasing in both the intensity of technological competition faced by the focal firm and the focal firm's reluctance to directly pursue

litigation against peer firms due to the peers' retaliation propensity. Importantly, our measure allows us to capture competitive forces and retaliation risk for both private and public patenting firms, rather than restrict our sample to only public firms, thereby strengthening our inferences (Ali et al. [2009], Ali et al. [2014]).⁹

3.2.3 Descriptive Statistics

Table 3 provides summary statistics on patent sales, subsequent litigation, *PrivateeringIncentives*, and control variables, for our sample firms. The top panel of this table shows the distribution of the two sets of dependent variables. Consistent with our previous observations, the mean values for *No. Patent Sales to Trolls* (untransformed) is 0.595 and for *Patent Sales to Trolls (dummy)* is 0.017. Regarding subsequent litigation, on average, our sample firms experience 0.242 cases where patents sold to trolls lead to infringement lawsuits initiated by these trolls against other parties in the subsequent three years. These descriptive statistics likely understate the full impact of NPEs as we cannot observe the effects of demand letters. In practice, NPEs often send demand letters to numerous potential targets, threatening to sue unless licensing agreements are reached. To the extent that demand letters result in NPEs garnering licensing fees without initiating formal infringement lawsuits, our results likely understate the overall privateering effect.

Turning to control variables, firms in our sample, on average, sell 6.088 patents to other parties (untabulated) and initiate 0.539 patent lawsuits in the 3-year window (untabulated). Each firm-year observation has an average patent stock of 106.713(untabulated). The average age of

⁹ Ali et al. [2009] suggest that proxies for product market competition using COMPUSTAT data, which covers only public firms in an industry, exhibit significant measurement error for the actual level of competition. Based on this argument, Ali et al. [2014] develop new proxies for product market concentration based on the U.S. Census data.

these patents is 8.315 years and a scientific value of 40.438 (untabulated). Additionally, these patents average 3.182 independent claims, 12.225 figures, and 2.309 inventors (untabulated).

4. Regression Model and Results

4.1 Privateering Incentives and Patent Sales to Trolls

To test our main hypothesis on whether privateering incentives motivate firms' decision to sell patents to trolls, we estimate the following regression at the firm-year level:

Eq. (1):

*No. Patent Sales to Trolls*_{*i,t*}

$$= \beta_1 \text{PrivateeringIncentives}_{i,t} + \text{Controls} + \text{Firm FE} + \text{Year FE} + \epsilon_{i,t}$$

For firm *i*, year *t*, the dependent variable in Eq. 1 is the number of patents sold to trolls and *PrivateeringIncentives*_{*i,t*} measures technological competition and retaliation risk, as previously defined. A positive coefficient on *PrivateeringIncentives*_{*i,t*} suggests that as competition increases and firms fear retaliation, there is a positive effect on the focal firm's decision to sell patents to patent trolls, with the expectation that the NPE will deploy them to pursue litigation against competitors.

We include a vector of time-varying control variables for firm-year-level characteristics that may impact the decision to sell patents to trolls. Specifically, we first control for firm-level factors related to the supply of patents and firms' tendency to sell patents. These factors include the number of patents the firm sold to parties other than trolls, the focal firm's patent stock, and the average age of patents in its patent portfolio.

Following Kim and Valentine [2024], we also include control variables that capture the quality of the patents, such as patent scientific value, and the transparency of patent disclosure, measured by the number of patent figures and the number of inventors listed on the patents.

Additionally, we include two litigation-related characteristics of patent portfolio: the number of independent claims and the level of patent portfolio diversification. Patents with more independent claims are broader and, therefore, easier to litigate, which may increase the likelihood of patent sales to trolls. The influence of patent diversification on patent sales to trolls is less clear. While a firm with a diverse patent portfolio might be more likely to sell its non-core patents to trolls, the firm’s overall complexity may make active privateering less feasible. Such firms might prefer to use non-core patents defensively rather than selling to trolls. Ultimately, patent portfolio diversification could either increase or decrease the propensity to sell patents to trolls. In all our main analyses, we include firm and year fixed effects and cluster standard errors at the firm level.

4.2 Privateering Patent Sales and Litigation Through Trolls

If patent sales to trolls are intended to deter competition by equipping PAEs with patents to increase the likelihood that competitors are plagued with litigation, we would expect to observe an increase in the number of infringement lawsuits, filed against focal firms’ competitors in the years following a patent sale to a troll. We examine whether patent sales to trolls motivated by high privateering incentives lead to an increase in patent infringement litigation initiated by trolls against peer firms in subsequent years. Specifically, we estimate the following regression model:

Eq. (2):

$$\begin{aligned} \text{No. Troll Litigations Targeting Peers}_{i,\{t+1,t+3\}} \\ = \beta_1 \text{PrivateeringSales}_{i,t} + \text{Controls} + \text{Firm FE} + \text{Year FE} + \epsilon_{i,t} \end{aligned}$$

where the dependent variable can be one of two variables: 1) the number of patent lawsuits initiated by patent trolls in the future three years (from t+1 to t+3) using patents acquired from an operating firm that target peer firms competing in the same patent class as the focal firm (*No. Troll Litigations Targeting Peers*_{*i*,{*t*+1,*t*+3}}). We apply the inverse hyperbolic sine (IHS)

transformation to this variable to address issues associated with zero values and then multiply it by 100 for ease of interpretation; or 2) the number of patent lawsuits that target the focal firm's technological peer firms in the next three years scaled by the number of direct lawsuits the focal firm brings against peers in the next three years ($\%Troll\ Litigations\ Targeting\ Peers_{i,\{t+1,t+3\}}$). $PrivateeringSales_{i,t}$ represents the number of privateering patent sales, calculated as the number of patents sold to a troll by firms with above-median privateering incentives.

The control variables are largely consistent with those used in Eq. 1, with one exception. In the determinants model of patent sales to trolls, we control for the number of patents the firm sold to parties other than trolls. For Eq. 2, we replace that variable with the number of patent lawsuits initiated by the focal firm during the same time period ($No.\ Direct\ Litigations\ Targeting\ Peers_{i,\{t+1,t+3\}}$), to control for the latent level of patent infringement.¹⁰ If $PrivateeringSales_{i,t}$ indeed captures sample firms' strategic patent sales to trolls designed to deterred competitors through patent infringement lawsuits, we expect β_1 to be positive. We control for firm- and year-fixed effects and cluster standard errors at the firm level.

4.3 Empirical Results

Table 4 presents the results of estimating Eq. 1 (H1). Columns (1) through (3) present results with fixed effects and with progressively adding different combinations of control variables. Across all three columns, the coefficients on $PrivateeringIncentives$ are positive and significant at the 1% level. Specifically, **Panel A**, Column (1) of **Table 4** shows a significant positive association between $PrivateeringIncentives$ and $No.\ Patent\ Sales\ to\ Troll$, after controlling

¹⁰ We note that the expected sign on this variable is unclear. On one hand, it captures the latent level of infringement and is therefore positively correlated with the number of patent litigations through trolls (the correlation between these two variables in our overall sample is significantly positive). On the other hand, for a given firm (we control for firm fixed effects), outsourcing patent litigation to trolls decreases the number of litigations initiated by the focal firm. These two effects offset each other.

for the overall tendency to sell patents, the stock of granted patents, patent age, and firm and year fixed effects (coefficient = 0.592; t-stat= 2.63). Columns (2) and (3) indicate that this effect persists when additional controls are included: Column (2) considers patent characteristics such as patent scientific value, number of patent figures, and number of patent investors while Column (3) includes litigation-related characteristics of patent portfolios. In terms of economic significance, the coefficient of 0.694 in Column (3) suggests that, one interquartile increase in *PrivateeringIncentive* is associated with a 4.14% increase in patent sales to patent trolls per firm-year, indicating that the effect is economically meaningful.¹¹

Table 5 presents the results of estimating Eq. 2, where the dependent variable is the number of litigations through troll that target peers (*No.Troll Litigations Targeting Peers_{i,{t+1,t+3}}*) in Column (1), and the percentage of such litigations targeting the focal firm’s technology peer firms (*%Troll Litigations Targeting Peers_{i,{t+1,t+3}}*) in Column (2). We find the coefficient on *PrivateeringSales* is significantly positive when *No.Troll Litigations Targeting Peers_{i,{t+1,t+3}}* (coefficient = 0.130; t-stat = 9.26) and *%Troll Litigations Targeting Peers_{i,{t+1,t+3}}* (coefficient = 0.067; t-stat = 10.97) are the dependent variables.¹²

Collectively, these results suggest that after our sample firms sell their patents to trolls in response to increased technology threats from their peers, these trolls tend to leverage patents to

¹¹ To compute the economic effects, we first multiply the regression coefficient (e.g., 0.694 in Column (3) of Table 4) to the change in our independent variable going from the 25th to the 75th percentile: $0.694 \times 3.035 = 2.10629$. We use this value to derive the implied change in our dependent variable relative to its (untransformed) mean value (i.e., 0.595) in the following way: $100 \times (\text{IHS}(0.595 \times (1+r)) - \text{IHS}(0.595)) = 2.10629$ and solve for r to assess the economic effect of the coefficient relative to the mean value of our dependent variable. In this example, $r = 4.14\%$. Unless otherwise noted, the economic magnitudes of other analyses are computed analogously throughout.

¹² We note that the expected sign *No. Direct Litigations Targeting Peers* in column 1 is unclear. On one hand, the variable captures the latent level of infringement and is therefore positively correlated with the number of patent litigations through trolls (the correlation between these two variables in our overall sample is significantly positive). On the other hand, for a given firm (we control for firm fixed effects), outsourcing patent litigation to trolls decreases the number of litigations initiated by the focal firm. These two effects offset each other.

to disproportionately target the focal firms' technology peers. The coefficients on *PrivateeringSales* are 0.130 and 0.067 in Columns (1) and (2), respectively. In economic terms, one standard deviation increase in *PrivateeringSales* is linked to a 12.74% increase in the number of patent lawsuits targeting any firm (Column 1) 96.83% increase (relative to the sample mean of 1.589%) in the proportion of such litigations specifically targeting the focal firm's technology competitors (Column 2).

Our main dependent variable captures infringement litigations within *three years* following the year when *PrivateeringSales* is assessed. In untabulated results, we also estimate Eq. 2 for litigations in years $t+1$, $t+2$, and $t+3$ separately. The coefficient on *PrivateeringSales* is positive and statistically significant at the 1% level for each of the three years, although it exhibits decreasing economic and statistical significance over time.

While our firm-level evidence on litigation, as presented in **Table 5**, provides evidence that trolls are likely to sue focal firms' competitors after a patent sale, it does not answer the question on whether the trolls *precisely* use acquired patents to sue the competitors, as a privateering strategy would imply. To examine this implied relation, we use a more granular approach by examining litigation behavior at the *patent* level. Specifically, we employ a nearest-neighbor matching approach to pair each patent (patent A) sold by a focal firm to a troll with another, characteristically similar patent (patent B) sold by another firm to the *same* troll. We expect that a troll will be more likely to *specifically* use patent A to target firm A's technological competitors relative to that of patent B and consider two benchmarks for this analysis.

First, for Patent A that was sold to a troll, we examine the number of litigations targeting peers of seller A in the three years around the actual sale to the number of litigations targeting peers of seller A in the three years around the sale of Patent B that was sold to the same troll in a

different period. This comparison holds constant the peer group (all peers of seller A) and exploits variation in whether the period of the patent sale was the true selling date or a counterfactual selling date to the same troll (i.e., Patent B's actual sales date). Second, for Patent A that was sold to a troll, we examine the number of litigations targeting peers of seller A in the three years around the actual sale to the number of litigations targeting peers of seller B for the same period (where Patent B was sold to the same troll in a period different from Patent A). This comparison holds constant the time period and exploits variation in the peer group (see Figure 2). This design isolates the effect of the strategic patent sale from NPEs' general tendency to sue technologically similar firms.

Table 6 presents the results of the patent-level litigation analysis. Panel A reports the average effects of all patent sales to trolls, regardless of privateering incentives. Consistent with our expectations, Column (1) shows that trolls are more likely to target peer firms specifically using patents acquired from a focal firm, relative to patents acquired from another firm. As a falsification test, Column (2) shows that trolls are not more likely to target non-peer firms of the selling focal firm. **Panel B** presents a subsample analysis based on privateering incentives. Consistent with a patent privateering mechanism, we find that the increased frequency of litigation targeting the seller's peer firms specifically using the seller's patents is stronger when the seller faces higher privateering incentives (i.e., the estimate in **Table 6 Panel B** Column (2) is statistically greater than that of Column (1)). Taken together, our results support the idea that technological competition and retaliation risks motivate our sample firms to sell patents to trolls, which then in turn specifically use those patents to sue the seller's competitors.

4.4 Mechanism Tests

We next exploit three sets of cross-sectional variation in the degree to which firms prefer to use a proxy to sue their competitors. One advantage of using patent trolls for litigation rather

than asserting patents directly is that it decreases the likelihood of retaliation by competitors. This is because any infringement lawsuit the rival brings against the seller is a separate lawsuit to manage rather than a countersuit that reduces the rivals' cost of the initial infringement suit. While our *PrivateeringIncentives* variable captures peer firms' propensity to retaliate, we next examine two sources of cross-sectional variation in retaliation concerns. First, if a firm operates in technology spaces with frequent litigation, the ex-ante likelihood of a retaliatory lawsuit increases. Second, for firms innovating in highly collaborative technological spaces, maintaining good relationships with peers is crucial. As a result, these firms are more likely to shadow sue their peers through patent trolls, rather than initiating litigation directly. Even though a sued peer can observe the sale to a troll in the assignment data, the seller could argue they only sold the patent to a troll for portfolio rebalancing or liquidity reasons.

Given that the majority of our sample firms are private firms for which we do not have financial statement data, we use patent portfolio characteristics to capture the aforementioned cross-sectional variables. Specifically, we capture litigation frequency and innovation collaboration intensity based on patent stock. **Appendix A** provides detailed variable definitions. We partition observations based on the sample median of each cross-sectional variable and estimate Eq. 1 for each sub-sample. We expect the effect of *PrivateeringIncentives* on *No. Patent Sales to Troll* to be more pronounced among firms operating in technology spaces with frequent litigation and in highly collaborative technological areas, as these sellers are more likely to benefit from distancing themselves from litigation via privateering.

Table 7 presents the results of this analysis: **Panel A** presents the results based on the litigation frequency and **Panel B** presents the results based on the innovation collaboration intensity. Consistent with our predictions, the effect of *PrivateeringIncentives* on sales to trolls is

more pronounced among firms innovating in litigious technology areas and in technology fields with high collaboration intensity. F-tests indicate that these differences are significant between each pair of subsamples.

Our next set of mechanism test focuses on the nature of firm-troll relationships. We distinguish between repeated transactions (multiple sales between the same firm-NPE pair over time) and one-time sales. Repeated firm-NPE relationships provide stronger evidence of strategic privateering partnerships, as sustained relationships suggest deliberate coordination where the selling firm maintains influence over litigation targets. In contrast, one-time sales could reflect opportunistic behavior by NPEs targeting vulnerable firms under competitive pressure. Additionally, using variation in the nature of the sales relationship is distinct from technology class characteristics, further triangulating inferences. We expect that privateering incentives are more strongly associated with sales from repeated firm-NPE relationships than one-time sales to a given NPE.

Table 8 Panel C presents the results of estimating Eq. 1 using two distinct samples: 1) repeated patent sales only and 2) one-time sales only.¹³ Column 1 presents the association between privateering incentives and the number of patent sales to troll where the firm-NPE match has only one transaction over the sample period. Column 2 shows the relation between privateering incentives and the number of patents sold to a troll where the firm and NPE have repeated transactions over the sample period. We find that the positive association between privateering incentives and patent sales to trolls is present only for sales representing repeated transactions between a seller-troll pair, consistent with these transactions tend to be strategically motivated.

¹³ Among 2,304 firm-NPE pairs with patent sales relationships in our sample, 1,314 engaged in only one transaction, 548 pairs conducted 2-5 transactions, and 13 pairs completed more than 50 such transactions.

4.5 Subsample Analysis

We next examine the characteristics of firms for whom patent trolls appear to be enforcing patent rights. We first examine firm size. On the one hand, small players in the technology area could turn to NPEs to enforce patent rights due to resource constraints, and thus patent trolls have the potential to level the competitive playing field. On the other hand, larger firms could be more concerned about antitrust scrutiny (Watts and Zimmerman [1986]). Large firms with significant market share are often more visible and have many competitors, making them more likely to attract antitrust scrutiny. Thus, larger firms could have greater incentives to use trolls as a means to sue competitors rather than suing directly and potentially be accused of anticompetitive behavior. In this test, we continue to control for the number of patents a firm has in its patent stock to account for the possibility that firms with larger patent holdings simply sell more patents to trolls.

Second, we explore whether firms with strong financial positions are more likely to sell patents to trolls in anticipation that they may otherwise be targeted for retaliatory infringement lawsuits because competitors know these firms can potentially pay substantial settlements or damages (Cohen et al. [2019]). Alternatively, financially constrained firms could be more likely to sell to NPEs for liquidity reasons and benefit from resource-rich trolls pursuing any infringement lawsuit. We measure firm size based on patent stock as it is applicable for both public and private firms in our sample. For the subsample of public firms, we assess financial positions using cash holdings and the leverage ratio.

Table 8 presents the results of this analysis: **Panel A** reports sub-sample results based on size and **Panel B** details results for leverage ratio and cash holdings. We find that the effect of *PrivateeringIncentives* on patent sales is more pronounced among large firms, firms with low leverage ratios and high cash holdings. F-tests indicate that these differences are significant

between each pair of sub-samples, except for firm size. Importantly, the F-test for firm size becomes significant when comparing firms in the top quintile with others, suggesting that only the largest firms are more likely to sell to trolls, perhaps due to concerns about antitrust scrutiny. These results are inconsistent with smaller, more resource constrained firms turning to patent trolls as a means to enforce their patent rights in the face of competition.

5. Identification

5.1 R&D Credits

This section provides instrumental variable estimations to alleviate endogeneity concerns. Specifically, we follow prior studies and use the firm-specific tax price of R&D to construct instrumental variables for peers' patenting, exploiting variations in federal and state-level R&D-related tax policies (Bloom et al. 2013; Arora et al. 2021). We then use the predicted level of peer firms' patent stock to instrument for *PrivateeringIncentives*. The idea is that state-level R&D tax credits promote R&D activity and patenting by peer firms located in the affected states and results in exogenous changes to a focal firm's technological competition; in addition, the federal tax system has firm-specific non-linear effects on a peer firm's tax-adjusted user cost of R&D capital and therefore their patenting (Hall 1993). While our privateering incentives variable also incorporates the propensity of peer firms to engage in retaliatory lawsuits when weighting a peer's patent stock, for purposes of this instrumental variable analysis we do not incorporate retaliation risk as our instrument only shocks peers' patent stock.

We follow Bloom et al. [2013] and Arora et al. [2021] and construct the instrumented *PrivateeringIncentives* measure in two steps. As a first step, we obtain firm-year-level R&D tax incentive measures from Bloom et al. [2013] and use the R&D tax incentives to predict each firm's number of patents. Bloom et al. [2013] construct two tax policy instruments: first, they use

Wilson's [2009] estimates of state-specific R&D tax prices, combined with the patent inventors' locations across states of each firm; second, they construct a firm-specific user cost using the federal rules with the firm-specific R&D base.¹⁴ Second, we use the predicted values of each peer firm's patents, weighted by their patent portfolio cosine similarity to the focal firm, as instruments for our *PrivateeringIncentives* measure in the second stage equations. Ultimately, the privateering incentive term is instrumented by the values of peer firms' tax prices, weighted by their overlap in the technology space with the focal firm.

The predicted *PrivateeringIncentives* (*PrivateeringIncentives_IV*) captures the increases in the patent stock of the sample firm's peers due to the exogenous regulatory changes. This variable is correlated with *PrivateeringIncentives* but should not directly affect the sample firm's patent sales to trolls. Therefore, it can serve as an instrument for estimating the relation between *PrivateeringIncentives* and patent sales to trolls.

Table 9 reports the results of estimating Eq. 1 using the predicted value of privateering incentives (*PrivateeringIncentives_IV*) with a reduced sample because information for calculating *PrivateeringIncentives_IV* is only available among public firms up to 2015. Column (1) presents the OLS results based on the same sample of public firms used in the IV analysis. Column (2) reports the first-stage results where we regress *PrivateeringIncentives* on the cosine-similarity-weighted sum of peer firms' predicted number of patents. Column (3) reports the second-stage regression results where we regress the number of patents sold to trolls on the instrumented value of privateering incentive (*PrivateeringIncentive_IV*). The fitted values of *PrivateeringIncentive_IV* demonstrate a positive association to *No. Patent Sales to Trolls*, suggesting robustness of our results.

¹⁴ We thank Arora et al. [2021] for sharing their data on firm-specific user costs of R&D and the predicted value of each firm's number of patents based on R&D user costs. The data is available for U.S. public firms from 1980 to 2015 at <https://zenodo.org/records/4320782>. The first-step regression is identical to the specification in Arora et al. [2021], and the estimation results are available in Online Appendix Table A2 of Arora et al. [2021].

6. Consequences, Competitors' Endogenous Response, and Robustness

6.1. Peer Firms' Patenting Activities

We first examine the effect of a firm's patent privateering practice on peer firms' patenting activities in overlapped technological spaces to explore whether a privateering strategy appears to be effective in shaping the competitive landscape. We estimate the following regression model using the same firm-year sample in our main analysis:

Eq. (3):

$$\begin{aligned} \text{Peer Firms' Patenting}_{i,\{t+1,t+3\}} \\ = \beta_1 \text{PrivateeringSales}_{i,t} + \text{Controls} + \text{Firm FE} + \text{Year FE} + \epsilon_{i,t} \end{aligned}$$

where $\text{Peer Firms' Patenting}_{i,\{t+1,t+3\}}$ is (1) peer firms' average number of patent filings across the overlapped technological classes with the focal firm, and (2) the average number of unique firms filing patent across the overlapped technological classes with the focal firm.

As shown in **Table 10**, we find that focal firms' patent sales to trolls significantly reduce both the patenting activity and the number of firms innovating in overlapping technology spaces in the subsequent three years. This evidence supports the view that patent privateering can impose costs on competing firms that manifest in their innovation outcomes, and thus be potentially harmful to the innovation ecosystem.¹⁵

6.2 Strategic Disclosure Response via Patent Citations

We also examine firms' strategic disclosures in their patent documents to avoid being targeted by patent trolls. As shown in **Table 11**, Panel A, we find that the number of patents in a firm's portfolio that cite patents held by trolls is positively associated with the number of lawsuits

¹⁵ In untabulated analysis, we find that, on average, after selling patents to a troll, focal firms do not decrease future patent filings in the same technological field. This evidence is inconsistent with focal firms relancing patent portfolios by completely exiting a technology space.

initiated by trolls against that firm, even after controlling for technological similarity between the firm's and the troll's patent portfolios. This finding suggests citing a patent owned by a troll increases the likelihood a troll brings an infringement lawsuit incremental to the similarity in the underlying technologies.

Given this heightened risk of a troll-initiated infringement lawsuit, we next examine whether firms strategically disclose relevant patent citations depending on the patent owner. To do so, we construct a transaction-patent-year level sample. For each patent sold, we track the number of citing patents filed from three years before to three years after the transaction. We then compare privateering sales with other sales. This specification includes technology class by year fixed effects to control for the time trend in patenting and citation behaviors that may occur around sales transactions. The results, presented in Panel B of **Table 11**, show that after privateering sales, the patent receives fewer citations from other firms in subsequent years, compared to other sales. These findings suggest that peers could strategically avoid citing patents held by trolls to reduce the risk of being targeted in litigation. This disclosure strategy notwithstanding, the results in **Table 10** suggest the costs are not fully mitigated.

6.3 Alternative measures for No. Patent Sales to Troll

In this section, we evaluate the robustness of our results to the use of alternative definitions of the dependent variable (*No. Patent Sales to Troll*). We consider two alternative measures: (1) *Indicator Variable for Patent Sales to Trolls*: Our main proxy is based on patent transaction counts, which reflects both the occurrence and frequency of patent sales to trolls. This approach makes the proxy more sensitive to firm-years with multiple sales. In contrast, the first alternative approach involves creating an indicator variable which equals one for firm-years with at least one patent sale to a troll. This approach focuses solely on the presence of such sales. (2) *% Patent Sales to Trolls*:

In our main analyses, we account for a firm’s overall tendency to sell patents by including the number of patent sales to other parties as a control variable. This approach allows privateering incentives to impact patent sales to others differently from patent sales to trolls. The 2nd alternative approach assumes the impact of technological competition on both sales to trolls and sales to others is the same and uses the percentage of patent sales to trolls relative to the total number of patent sales during the year as an alternative dependent variable. Columns (1) and (2) of **Table 12 Panel A** report the results of this exercise. The results employing these alternative definitions of *No. Patent Sales to Trolls* are consistent with our main findings.

6.4 Alternative measures for *PrivateeringIncentives*

We also assess the robustness of our results to alternative definitions of *PrivateeringIncentives* by altering the technological competition and retaliation risk components. First, we measure the technological competition component of *PrivateeringIncentives* using *High Similarity Peers*. Our main proxy includes patent competition threats from any firm that overlaps in any USPTO (CPC) patent classes as technology peers. For firms with diversified patent portfolios, this measure may overstate the competitive pressure from firms that do not directly compete with the focal firm. In this alternative approach, we restrict peer firms to those with above-median cosine similarity of patent stock with the focal firm.¹⁶ Second, in our main proxy we measure peer firms’ countersuit propensity using the percentage of time peer firms choose to countersue in the past three years. We modify the retaliation component of *PrivateeringIncentives* in two ways: 1) we use a simple count of countersuits; 2) we further scale this measure by the focal firm’s retaliation rate. Columns (3)-(5) of **Table 12, Panel A** report the results of estimating Eq.

¹⁶ **Table 3** reports the summary statistics for these alternative measures of *Privateering incentives*. As expected, the *Privateering incentives_High Similarity Peers* measure has lower values compared to the original *Privateering incentives*, due to the exclusion of firms that may not directly compete with the focal firm when aggregating peer threats.

(1) using *High Similarity Peers* and the two alternative retaliation risk measures. The results using these alternative definitions yield qualitatively similar results.

6.5 Placebo test

To provide further evidence that the extent of privateering is not attributable to unobservable firm characteristics or time trend, we perform two falsification tests. Specifically, we randomly assign the value of *PrivateeringIncentives* within each firm and each year, respectively. If unmodeled firm or time characteristics drive our results, we would expect to find similar results with these randomized *PrivateeringIncentives*. Specifically, we shuffle the value of *PrivateeringIncentives* within each firm and estimate Eq. (1). We repeat this exercise 1,000 times. Column (1) of **Table 12 Panel B** reports the average β_1 . The coefficients based on the randomly assigned samples are not significantly different from zero, while they differ statistically and economically from the results using the actual data. Column (2) presents the results using a within-year shuffled sample, which are consistent with those in Column (1). Overall, these results help rule out alternative explanations driving our results.

7. Conclusion

We examine whether firms facing technological competition are more likely to sell patents to NPEs when reluctant to directly sue for patent infringement, and if so, whether NPEs use those patents to sue the original owner's competitors, a practice known as patent privateering. We find that our measure of privateering incentives, which captures both technological competition and retaliation risk, is positively associated with the number of patent sales to trolls and that these patents are more likely to be asserted in infringement lawsuits targeting the rivals of the original patent owner in subsequent years. The increased sales to patent trolls are more pronounced for large firms, contrary to the potentially beneficial role of NPEs in enforcing under-resourced firms'

patent rights. The increased likelihood of selling to a troll is also greater when firms operate in litigious environments or in highly collaborative technological spaces, and when the firm and troll have a sustained business relationship.

We provide important insights about the motivations and characteristics of practicing entities that supply patents to patent trolls, who are frequently accused of hampering innovation and targeted by policymakers. Many practicing companies and industry groups have lobbied in favor of anti-patent troll legislation. However, our study reveals that practicing companies are often the very entities feeding patents to patent trolls in the first place. When confronted, these firms often blame the patent system, claiming they are forced to sell patents to trolls due to the high costs associated with maintaining large patent portfolios.¹⁷ Our evidence, however, suggests a different narrative: these firms sell patents to trolls and obtain a strategic benefit. We contribute to the debate on patent trolls by providing insights into patent privateering, which can be a first step in addressing these issues (Schrepel 2014).

¹⁷ <https://ipwatchdog.com/2013/05/01/is-patent-litigation-really-a-problem-for-big-tech/id=39325/>.

Appendix A. Variable Definition

Variable	Definition
<u>Dependent variables</u>	
<i>No. Patent Sales to Troll</i>	The inverse hyperbolic sine (IHS) transformation of the number of patents sold to patent trolls by a firm in year t, multiplied by 100.
<i>No. Patent Sales to Troll (dummy)</i>	An indicator variable that equals 1 if a firm sells patents to patent trolls in year t.
<i>% Patent Sales to Troll</i>	The percentage of patents sold to patent trolls, relative to patents sold to any buyers by a firm in year t, multiplied by 100.
<i>No. Troll Litigations_Targeting Peers_{t+1,t+3}</i>	The inverse hyperbolic sine (IHS) transformation of the number of patent litigations initiated by patent trolls, targeting focal firms' technological peers, in years t+1 to t+3, using patents acquired from an operating firm.
<i>%Troll Litigations_Targeting Peers_{t+1,t+3}</i>	The number of patent litigations initiated by patent trolls, against non-peer firms of the focal firms during the years t+1 to t+3, using patents acquired from an operating firm, scaled by the total number of patent lawsuits.
<i>PatentFilings_Peers_{t+1,t+3}</i>	The inverse hyperbolic sine (IHS) transformation of the average number of patents filed by peer firms in each class across technological classes where the focal firm innovates from years t+1 to t+3, multiplied by 100.
<i>FilingFirms_Peers_{t+1,t+3}</i>	The inverse hyperbolic sine (IHS) transformation of the number of unique firms filing patents firms in each class across technological classes where the focal firm innovates from years t+1 to t+3, multiplied by 100.
<i>No. of Troll Litigations</i>	The inverse hyperbolic sine (IHS) transformation of the number of patent litigations initiated by patent trolls against the focal firm in year t, multiplied by 100.
<i>Citations to the Sold Patent</i>	The inverse hyperbolic sine (IHS) transformation of the number of patents filed in year t that cite the patent sold, multiplied by 100.
<u>Independent variables</u>	
<i>PrivateeringIncentives</i>	The inverse hyperbolic sine (IHS) transformation of the privateering incentive of a firm in year t. Privateering incentive = $[(\sum_{j \neq i} \omega_{i,j} \times Patent\ Stock_{j,t} \times (1 + \%Retaliation_{j,\{t-3,t-1\}}))] / Patent\ Stock_{i,t}$, where j represents firm i 's peer firm (any firm that overlaps with firm i in any CPC subclasses in their patent stock), t represents year t , $\omega_{i,j}$ is the cosine similarity between firm i 's patent stock and firm j 's patent stock, based on their percentage of patent stock in each CPC subclass. <u>$\%Retaliation_{j,\{t-3,t-1\}}$ is the percentage of litigations initiated by firm j during years $t-3$ to $t-1$ that target firms which had previously sued firm j.</u>

<i>PrivateeringIncentives (High Similarity Peers)</i>	The inverse hyperbolic sine (IHS) transformation of the privateering incentive of a firm in year t, with privateering incentive being calculated based on peers with above-median cosine similarity of patent stock with the focal firm.
<i>PrivateeringIncentives (Level of Retaliation)</i>	The inverse hyperbolic sine (IHS) transformation of the privateering incentive of a firm in year t, with privateering incentive being calculated based on the level of retaliations: Privateering incentive = $[(\sum_{j \neq i} \omega_{i,j} \times Patent\ Stock_{j,t} \times (1 + No.\ Retaliation_{j,\{t-3,t-1\}}))] / Patent\ Stock_{i,t}$.
<i>PrivateeringIncentives (Scaled by Focal Firm Retaliation)</i>	The inverse hyperbolic sine (IHS) transformation of the privateering incentive of a firm in year t, with privateering incentive being scaled by focal firm's retaliations: Privateering incentive = $[(\sum_{j \neq i} \omega_{i,j} \times Patent\ Stock_{j,t} \times (1 + \%Retaliation_{j,\{t-3,t-1\}}))] / Patent\ Stock_{i,t} \times (1 + \%Retaliation_{i,\{t-3,t-1\}}]$.
<i>PrivateeringSales</i>	The inverse hyperbolic sine (IHS) transformation of the number of patents sold to patent trolls by a firm in year t conditional on the firm's privateering incentive is above the sample median, multiplied by 100.
<i>No. Patents Citing Trolls_t</i>	The inverse hyperbolic sine (IHS) transformation of the number of patents in a firm's patent stock that cites patents held by patent trolls in year t, multiplied by 100.
<i>Troll</i>	An indicator variable that equals 1 if the purchaser of a patent is a patent troll.
<i>Post</i>	An indicator variable that equals 1 for the 3 years after the patent sales transaction.
<i>Predicted Peers' Patents_{t-20,t-1}</i>	The cosine-similarity-weighted sum of peer firms' predicted number of patents based on federal and state tax-based R&D user costs, following Bloom et al (2013) and Arora et al. (2021).

Control variables

<i>No. of Indep. Claims</i>	The inverse hyperbolic sine (IHS) transformation of the weighted average number of independent claims of patents granted to a firm in the past 20 years.
<i>No. of Patent Figures</i>	The inverse hyperbolic sine (IHS) transformation of the weighted average number of figures of patents granted to a firm in the past 20 years.
<i>No. of Patent Inventors</i>	The inverse hyperbolic sine (IHS) transformation of the weighted average number of inventors of patents granted to a firm in the past 20 years.
<i>No. Patent Sale to Others</i>	The inverse hyperbolic sine (IHS) transformation of the number of patents sold non-troll buyers by a firm in year t.
<i>No. Direct Litigations_Targeting Peers_{t+1,t+3}</i>	The inverse hyperbolic sine (IHS) transformation of the number of patent litigations initiated directly by a firm targeting the focal firm's technological peers, in years t+1 to t+3.

<i>Patent Stock</i>	The weighted average number of patents granted to a firm in the past 20 years, with a 15% annual depreciation rate.
<i>Patent Age</i>	The average number of years between the patent grant year and the current year for patents granted to a firm in the past 20 years.
<i>Patent Diversification</i>	The Herfindahl-Hirschman Index (HHI) of a firms' patent stock among CPC subclasses, multiplied by -1.
<i>Patent Scientific Value</i>	The inverse hyperbolic sine (IHS) transformation of the average number of forward citations of patents granted to a firm in the past 20 years.
<i>No. of Other Litigations</i>	The inverse hyperbolic sine (IHS) transformation of the number of patent litigations initiated by non-troll plaintiffs against the focal firm in year t, multiplied by 100.
<i>Patent Similarity to Troll</i>	The cosine similarity between a firm's patent stock and the portfolio of patents held by patent trolls in year t, based on their percentage of patent stock in each CPC subclass.

Cross-sectional variables

Patent Portfolio Size	The weighted average number of patents granted to a firm in the past 20 years, with a 15% annual depreciation rate.
Litigation Frequency	The average litigation frequency among all CPC subclasses within a firm's patent stock. The CPC subclass-level litigation frequency is measured by counting the litigation cases initiated based on patents in the corresponding subclass from 2000 to 2021.
Innovation Collaboration	The average innovation collaboration intensity among all CPC subclasses within a firm's patent stock. The CPC subclass-level innovation collaboration intensity is measured based on the percentage of patents that have multiple firms as co-applicants granted in the corresponding subclass over the past 20 years, with a 15% annual depreciation rate.
Leverage	Total debt scaled by total asset (Compustat items (DLTT+DLC)/AT).
Cash	Cash and cash equivalent scaled by total asset (Compustat items CHE/AT).

Appendix B. Example Revenue Sharing Agreement

SECTION 3. PURCHASE PRICE

3.1 Purchase Price for E Sub Patent Sale. In consideration for the Patents sold or to be sold by E Sub to UPLLC pursuant to the E Sub Patent Assignment Agreement and this Agreement, UPLLC hereby agrees to pay, and UP Subs hereby jointly and severally agree to cause UPLLC to pay, the purchase price in such amounts and payable in such manner as set forth in this Section 3.

3.2 Periodic Payment.

(a) UPLLC shall pay E Sub, in accordance with the provisions of this Section 3.2, the following portion of UPLLC's Cumulative Gross Revenue:

- (i) 20% of the amount of Cumulative Gross Revenue, until the Cumulative Gross Revenue equals \$100,000,000; plus
- (ii) 50% of the amount of Cumulative Gross Revenue in excess of \$100,000,000, until the Cumulative Gross Revenue equals \$500,000,000; plus
- (iii) 70% of the amount of Cumulative Gross Revenue in excess of \$500,000,000.

Notes: This is an excerpt from a master sale agreement between Ericsson (seller) and Unwired Planet (NPE) for a portfolio of patents that includes revenue sharing from licensing fees. Obtained from <https://www.sec.gov/Archives/edgar/data/1082506/000119312513012058/d466328dex102.htm>.

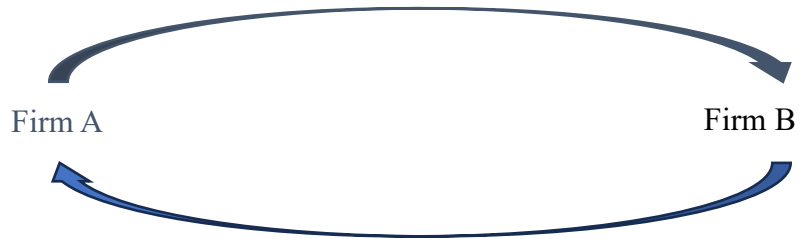
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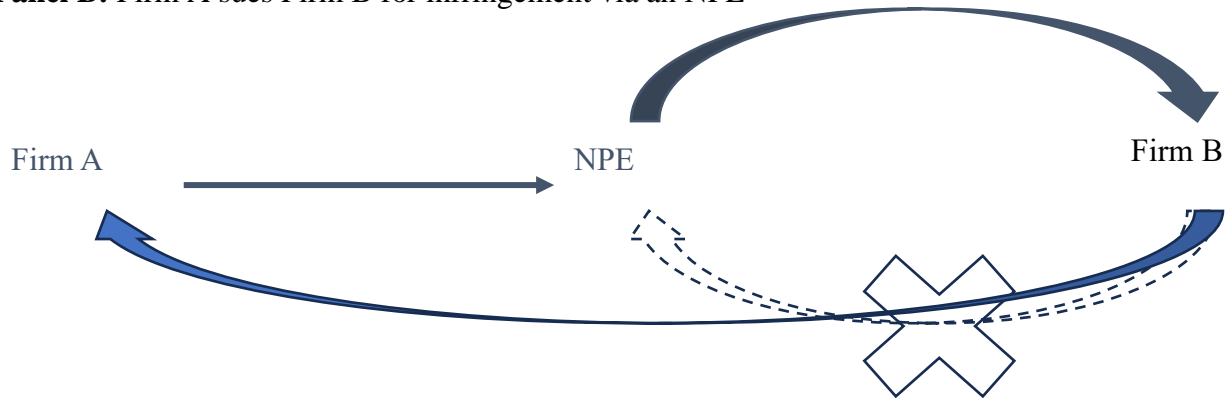
Figure 1. Litigation Strategy for Suing Directly versus through an NPE

Panel A: Firm A directly sues Firm B for infringement



Firm B's countersuit gives it leverage to mitigate the costs of Firm A's infringement lawsuit.

Panel B: Firm A sues Firm B for infringement via an NPE



Firm B cannot countersue an NPE for infringement, and any retaliatory lawsuit against Firm A means Firm B has to contend with two lawsuits simultaneously (plus a likely countersuit from Firm A in the second suit).

Figure 2. Matched Patent Research Design

		Post = 0			Sales Year (Excluded)	Post = 1				
Pair1	Patent A (Sold by Firm A)	2008	2009	2010	2011	2012	2013	2014	Treat = 1	Y = Litigations Targeting Firm A's Peers
	Patent B (Sold by Firm B)	2002	2003	2004	2005	2006	2007	2008	Treat = 0	
Pair2	Patent A (Sold by Firm A)	2008	2009	2010	2011	2012	2013	2014	Treat = 0	
	Patent B (Sold by Firm B)	2002	2003	2004	2005	2006	2007	2008	Treat = 1	

Table 1. Sample Selection

	#Firm-Year	#Firms
Universe of Public and Private Firms in PatentsView (2003-2021)	5,677,295	298,805
Require at least one patent sale and one patent litigation (2000-2021)	145,217	7,643
Require at least one patent granted in the past 20 years	117,413	7,643

Notes: This table presents the sample selection procedures.

Table 2. Descriptive Statistics of Patent Sales**Panel A. Patent Sales and Litigation**

	Obs	% of Total
Total firm-year observations from 2003-2021	117,413	100.00%
Patent sales	20,462	17.43%
Patent sales to trolls	2,041	1.74%
Patent litigation	16,050	13.67%
Patent litigation through trolls	1,445	1.23%
Patent litigation through trolls in the future three years	2,805	2.39%
Unique firms from 2003-2021	7,643	100%
Firms that sell at least one patent to trolls	1,206	15.78%
Firms with patent litigation through trolls	659	8.62%

Panel B. Top 10 Technology Classes with Patents Sold to Troll

CPC_Class	#Patents sold to troll	%Patents sold to troll
H04 (Electric communication technique)	27,232	26.30%
G06 (Computing; calculating or counting)	18,155	17.54%
H01 (Electric elements)	12,385	11.96%
G11 (Information storage)	4,598	4.44%
A61 (Medical or veterinary science; hygiene)	4,027	3.89%
B60 (Vehicles in general)	3,644	3.52%
G01 (Measuring; testing)	3,531	3.41%
H03 (Electronic circuitry)	2,702	2.61%
F16 (Engineering elements and units; general measures for producing and maintaining effective functioning of machines or installations; thermal insulation)	2,490	2.40%
G02 (Optics)	2,184	2.11%
Total of Top 10	80,948	78.18%

Panel C. Descriptive Statistics of Patent Sales Transactions

	Sales to Troll		Sales to Others		Difference (Troll - Other)	Not Sold		Difference (Troll – Not Sold)
	N	Mean	N	Mean		N	Mean	
No. of Patents per Transaction	28,195	4.541	571,082	3.051	1.491***			
Patent Scientific Value	128,046	27.243	1,742,282	19.472	7.771***	4,703,392	13.296	13.947***
Patent Age	128,046	6.161	1,742,282	3.915	2.246***			
No. of Indep. Claims	128,046	3.227	1,742,282	2.869	0.358***	4,703,392	2.633	0.594***
No. of Patent Figures	128,046	13.974	1,742,282	14.531	-0.557***	4,703,392	11.720	2.254***
No. of Patent Inventors	128,046	2.611	1,742,282	2.870	-0.259***	4,703,392	2.638	-0.026***
CoreClass	128,046	0.198	1,742,282	0.203	-0.006***	4,703,392	0.179	0.019***

Notes: This table presents the descriptive statistics of patent sales. Panel A provides descriptive statistics for patent sales and patent litigations. Panel B lists the top 10 CPC 3-digit technological classes with the highest number of patents sold to patent trolls. Panel C provides descriptive statistics for patent characteristics and transaction sizes related to patent sales to patent trolls and other buyers, respectively. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively.

Table 3. Descriptive Statistics of Key Variables in Regression Sample

	(1)	(2)	(3)	(4)	(5)	(6)
	N	mean	sd	p25	p50	p75
Dependent Variables						
<i>No. Patent Sales to Troll (untransformed)</i>	117,413	0.595	27.601	0.000	0.000	0.000
<i>No. Patent Sales to Troll</i>	117,413	4.116	36.764	0.000	0.000	0.000
<i>No. Patent Sales to Troll (dummy)</i>	117,413	0.017	0.131	0.000	0.000	0.000
<i>% Patent Sales to Troll</i>	117,413	1.197	10.337	0.000	0.000	0.000
<i>No. Patent Litigations through Troll_Target Peers_{t+1,t+3}(untransformed)</i>	117,413	0.242	3.849	0.000	0.000	0.000
<i>No. Troll Litigations_Targeting Peers_{t+1,t+3}</i>	117,413	3.035	25.721	0.000	0.000	0.000
<i>%Troll Litigations_Targeting Peers_{t+1,t+3}</i>	117,413	1.589	12.271	0.000	0.000	0.000
<i>PatentFilings_Peers_{t+1,t+3}</i>	117,413	786.741	259.686	706.817	844.333	951.416
<i>FilingFirms_Peers_{t+1,t+3}</i>	117,413	662.311	206.512	620.658	711.114	786.160
<i>No. of Troll Litigations_t</i>	117,413	3.275	23.701	0.000	0.000	0.000
Independent Variables						
<i>PrivateeringIncentives</i>	117,413	9.287	2.194	7.757	9.247	10.792
<i>PrivateeringIncentives (High Similarity Peers)</i>	117,413	8.465	2.004	7.065	8.370	9.786
<i>PrivateeringIncentives (Level of Retaliation)</i>	117,413	8.576	2.055	7.132	8.455	9.916
<i>PrivateeringIncentives (Scaled by Focal Firm Retaliation)</i>	117,413	8.459	2.009	7.058	8.368	9.784
<i>PrivateeringSales</i>	117,413	1.688	22.964	0.000	0.000	0.000
<i>No. Patents Citing Trolls</i>	117,413	136.373	178.622	0.000	88.137	231.244
Control Variables						
<i>No. Patent Sale to Others</i>	117,413	0.403	1.101	0.000	0.000	0.000
<i>No. Direct Litigations_Targeting Peers_{t+1,t+3}</i>	117,413	10.038	39.460	0.000	0.000	0.000
<i>Patent Stock</i>	117,413	2.402	1.973	0.827	1.915	3.468
<i>Patent Age</i>	117,413	8.315	4.744	4.452	7.833	11.516
<i>Patent Scientific Value</i>	117,413	3.594	1.257	2.881	3.584	4.351

<i>No. of Indep. Claims</i>	117,413	1.788	0.415	1.532	1.815	2.020
<i>No. of Patent Figures</i>	117,413	2.905	0.829	2.552	2.993	3.380
<i>No. of Patent Inventors</i>	117,413	1.497	0.403	1.195	1.492	1.776
<i>Patent Diversification</i>	117,413	-0.559	0.328	-1.000	-0.503	-0.277
<i>No. of Other Litigations_t</i>	117,413	5.580	29.648	0.000	0.000	0.000
<i>Patent Similarity to Troll</i>	117,413	0.144	0.186	0.017	0.060	0.187

Notes: This table presents descriptive statistics for the variables used in our analyses, including the mean, standard deviation, and percentile values for our sample of 117,413 firm-year observations. Detailed definitions of all variables are provided in Appendix A.

Table 4. Privateering incentives and Patent Sales to Troll

	<i>No. Patent Sales to Troll_t</i>		
	(1)	(2)	(3)
<i>PrivateeringIncentives_t</i>	0.592*** (2.63)	0.604*** (2.67)	0.694*** (3.03)
<i>No. Patent Sales to Others_t</i>	1.770*** (7.33)	1.769*** (7.32)	1.766*** (7.32)
<i>Patent Stock_t</i>	2.115*** (6.70)	2.096*** (6.58)	2.343*** (6.63)
<i>Patent Age_t</i>	-0.074 (-1.21)	-0.060 (-0.93)	-0.048 (-0.74)
<i>Patent Scientific Value_t</i>		-0.389 (-1.12)	-0.358 (-1.03)
<i>No. of Patent Figures_t</i>		-0.231 (-0.56)	-0.185 (-0.45)
<i>No. of Patent Inventors_t</i>		-0.198 (-0.24)	-0.168 (-0.21)
<i>No. of Indep. Claims_t</i>			0.229 (0.34)
<i>Patent Diversification_t</i>			-1.772* (-1.78)
Observations	117,413	117,413	117,413
R-squared	0.197	0.197	0.197
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: This table presents regression results from the regression of the number of patents sold to patent trolls on privateering incentives. Column (1) includes the baseline regression with a vector of control variables and firm- and year-fixed effects. Columns (2) and (3) gradually expand the vector of control variables. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 5. Privateering Sales and Litigation Through Troll

VARIABLES	(1) <i>No. Troll Litigations Targeting Peers_{t+1,t+3}</i>	(2) <i>%Troll Litigations Targeting Peers_{t+1,t+3}</i>
PrivateeringSales_t	0.130*** (9.26)	0.067*** (10.97)
No. Direct Litigations Targeting Peers_{t+1,t+3}	0.003 (0.44)	
Patent Stock_t	0.958*** (3.49)	0.373*** (3.15)
Patent Age_t	-0.121* (-1.81)	-0.075** (-2.33)
Patent Scientific Value_t	0.224 (0.57)	-0.020 (-0.11)
No. of Indep. Claims_t	1.023 (1.58)	0.464 (1.46)
No. of Figures_t	0.189 (0.47)	-0.057 (-0.29)
No. of Patent Inventors_t	1.368 (1.50)	0.624 (1.52)
Patent Diversification_t	-1.836* (-1.85)	-0.320 (-0.70)
Observations	117,413	117,413
R-squared	0.382	0.366
Firm FE	Yes	Yes
Year FE	Yes	Yes

Notes: This table presents regression results from the regression of the litigations initiated through patent trolls using the focal firm's patents in the future 3 years on the focal firm's privateering sales in year t. Column (1) presents the results on the total number of litigations initiated through patent trolls in the future 3 years. Columns (2) report the results on the litigations initiated through patent trolls targeting peer firms scaled by litigations initiated by any party targeting peer firms. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 6. Do Trolls Specifically Use the Acquired Patents to Sue Seller's Competitors?

Panel A. Average Effects of Patent Sales to Trolls

	(1) <i>No. Troll Litigations Targeting Peers</i>	(2) <i>No. Troll Litigations Targeting Non-Peers</i>
<i>Treat</i> × <i>Post</i>	0.022** (1.97)	-0.016 (-1.60)
<i>Patent Litigations</i>	0.569*** (20.69)	0.688*** (22.73)
<i>Difference (Peer – Non-Peer)</i>		0.038** (2.54)
Observations	562,872	562,872
R-squared	0.919	0.942
Matching Pair×Patent FE	Yes	Yes
Matching Pair×Year FE	Yes	Yes

Panel B. Moderating Effects by Privateering Incentives

	(1)	(2)
	<i>No. Troll Litigations Targeting Peers</i>	
	Low Privateering Incentive	High Privateering Incentive
<i>Treat</i> × <i>Post</i>	0.001 (1.29)	0.044* (1.92)
<i>Patent Litigations</i>	0.762*** (22.71)	0.529*** (17.98)
High - Low		0.042* (1.86)
Observations	283,992	275,472
R-squared	0.958	0.913
Matching Pair×Patent FE	Yes	Yes
Matching Pair×Year FE	Yes	Yes

Notes: This table presents regression results from the regression of the litigations initiated through patent trolls using the focal firm’s patents. Specifically, our sample includes 6 years of observations for both treated and matched control patents, from 3 years prior to 3 years after when a treated patent is sold to a troll, excluding the sales year itself. A treated patent is defined as a patent sold by focal firm to a troll, whereas a control patent is defined as a patent sold by a different, but characteristically similar firm to the same troll. Panel A Column (1) presents the results using the number of litigations targeting the focal firm peers, whereas Column (2) reports the results using the number of litigations targeting non-peer firms, respectively. Panel B compares the effect of litigation a focal firm’s peer across high vs. low privateering incentives. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 7. Mechanism Tests

Panel A. Technology Field Litigation Frequency

	<i>No. Patent Sales to Troll_t</i>	
	(1)	(2)
	Low Litigation Freq.	High Litigation Freq.
<i>PrivateeringIncentive_t</i>	0.459* (1.75)	1.447*** (3.02)
<i>Difference (High - Low)</i>		0.988* (1.81)
Observations	58,707	58,706
R-squared	0.272	0.175
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes

Panel B. Technology Field Innovation Collaboration

	<i>No. Patent Sales to Troll_t</i>	
	(1)	(2)
	Low Collaboration	High Collaboration
<i>PrivateeringIncentive_t</i>	0.324 (1.23)	1.283*** (3.37)
<i>Difference (High - Low)</i>		0.959** (2.07)
Observations	58,707	58,706
R-squared	0.189	0.280
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes

Panel C. Repeated Transactions

	<i>No. Patent Sales to Troll_t</i>	
	(1)	(2)
	One-time	Repeated
<i>PrivateeringIncentive_t</i>	0.166 (1.20)	0.332*** (2.87)
<i>Difference (Repeated – One-time)</i>		0.165 (0.92)
Observations	116,443	116,110
R-squared	0.160	0.157
Controls	Yes	Yes
Firm FE	Yes	Yes
Year FE	Yes	Yes

Notes: This table presents regression results from the regression of the number of patents sold to patent trolls on privateering incentives within the corresponding subsample. Panel A presents the results for subsamples of firm-years based on the litigation frequency of technological subclasses within the firm's patent stock. Panel B presents the results for subsamples of firm-years based on the patent collaboration of technological subclasses within the firm's patent stock. Panel C presents the results on patent sales to trolls that have repeated transactions with the focal firm versus those that do not. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 8. Subsample Analysis

Panel A. Size

	<i>No. Patent Sales to Troll_t</i>			
	(1)	(2)	(3)	(4)
	Small (below median)	Large (above median)	Small (Q1)	Large (Q5)
<i>PrivateeringIncentive_t</i>	0.329 (1.32)	1.194* (1.84)	0.179 (0.57)	5.390* (1.91)
<i>Difference (Large - Small)</i>		0.865 (1.24)		5.211* (1.83)
Observations	58,707	58,706	24,485	23,482
R-squared	0.203	0.225	0.255	0.252
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Panel B. Financial Position

	<i>No. Patent Sales to Troll_t</i>			
	(1)	(2)	(3)	(4)
	Low Leverage	High Leverage	Low Cash	High Cash
<i>PrivateeringIncentive_t</i>	6.516** (2.48)	-1.641 (-0.75)	-0.099 (-0.07)	7.811* (1.86)
<i>Difference (High - Low)</i>		-8.157** (-2.38)		7.909* (1.78)
Observations	6,632	6,632	6,631	6,631
R-squared	0.394	0.273	0.363	0.285
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: This table presents regression results from the regression of the number of patents sold to patent trolls on privateering incentives within the corresponding subsample. Panel A presents the results for subsamples of firm-years based on patent portfolio size. Column (1) and (2) of Panel A split the sample based on sample median. Column (3) and (4) of Panel A split the sample based on sample quintiles. Panel B presents the results for subsamples of firm-years with financial constraints being above and below the sample median. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 9. R&D Credit as Instrumental Variable

VARIABLES	(1)	(2)	(3)
	<i>OLS</i>	<i>1st stage</i>	<i>2nd stage</i>
	No. Patent Sales to Troll _t	Privateering Incentive _t	No. Patent Sales to Troll _t
<i>PrivateeringIncentive(IV)_t</i>	2.244** (2.02)		6.666** (2.29)
<i>Predicted Peers' Patents_{t-20,t-1}(×1000)</i>		0.044*** (24.22)	
<i>Patent Sales to Others_t</i>	1.864*** (4.77)	0.003** (1.96)	1.833*** (4.71)
<i>Patent Stock_t</i>	4.688*** (3.51)	-0.946*** (-61.29)	8.487*** (3.21)
<i>Patent Age_t</i>	0.017 (0.06)	0.032*** (5.64)	-0.185 (-0.54)
<i>Patent Scientific Value_t</i>	-0.325 (-0.30)	0.127*** (2.97)	-0.760 (-0.63)
<i>No. of Patent Figures_t</i>	-0.213 (-0.10)	-0.074 (-1.12)	-0.058 (-0.03)
<i>No. of Patent Inventors_t</i>	-1.133 (-0.90)	-0.020 (-0.58)	-0.807 (-0.63)
<i>No. of Indep. Claims_t</i>	1.562 (0.66)	-0.032 (-0.42)	1.998 (0.82)
<i>Patent Diversification_t</i>	-8.615*** (-2.64)	0.560*** (5.89)	-12.608*** (-3.11)
Observations	23,828	23,828	23,828

R-squared	0.241	0.985	0.004
Firm FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: This table presents regression results from the regression of the number of patents sold to patent trolls on privateering incentives, where privateering incentive is instrumented by the predicted value of peer firms' number of patents, using peer firms' R&D tax credit as the instrument variable. Column (1) presents the OLS results based on the same sample of public firms used in the IV analysis. Column (2) reports the first-stage results from the regression of the privateering incentives on peer firms' predicted number of patents over the past 20 years, weighted by patent portfolio similarity. Peer firms' predicted number of patents is based on each firm's federal and state R&D tax credits and obtained from Arora et al. [2021]. Columns (3) reports the second-stage results on the number of patents sold to trolls. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 10. Peer Firms' Patent Filings

VARIABLES	(1) <i>PatentFilings_Peers_{t+1,t+3}</i>	(2) <i>FilingFirms_Peers_{t+1,t+3}</i>
PrivateeringSales_t	-0.036* (-1.67)	-0.041** (-2.25)
Patent Stock_t	-5.105*** (-3.56)	-4.085*** (-3.49)
Patent Age_t	-6.631*** (-14.13)	-5.176*** (-13.35)
Patent Scientific Value_t	4.280 (1.64)	2.380 (1.11)
No. of Indep. Claims_t	9.770** (2.00)	6.508 (1.62)
No. of Figures_t	0.902 (0.32)	-1.490 (-0.62)
No. of Patent Inventors_t	9.252 (1.51)	7.421 (1.51)
Patent Diversification_t	108.634*** (17.96)	87.877*** (17.60)
Observations	117,413	117,413
R-squared	0.893	0.882
Firm FE	Yes	Yes
Year FE	Yes	Yes

Notes: This table presents the results on the association between privateering sales and innovation activities of focal and peer firms. Columns (1) present the results on peer firms' number of patent filings in the future 3 years. Columns (2) present the results on the number of unique firms filing patents in the future 3 years. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 11. Peer Firms' Strategic Patent Citations**Panel A. Citation to Troll's Patents and Litigation**

VARIABLES	<i>No. of Troll Litigations_t</i> (1)
No. Patents Citing Trolls_t	0.010*** (6.60)
Litigations by Others _t	0.121*** (8.92)
Patent Similarity to Troll _t	11.970*** (4.95)
Patent Stock _t	0.798*** (3.30)
Patent Age _t	-0.081* (-1.83)
Patent Scientific Value _t	-0.131 (-0.43)
No. of Indep. Claims _t	-0.433 (-1.22)
No. of Figures _t	-1.193*** (-4.90)
No. of Patent Inventors _t	0.327 (0.73)
Patent Diversification _t	-3.963*** (-6.17)
Observations	117,400
R-squared	0.604
Firm FE	Yes
Year FE	Yes

Panel B. Patent Sales to Troll and Citations to the Sold Patent

VARIABLES	<i>Citations to the Sold Patent_t</i> (1)
PrivateeringSale_t×Post_t	-3.121** (-2.43)
PrivateeringSale _t	0.174 (0.08)
Post _t	1.828*** (5.55)
Patent Age _t	2.463*** (29.69)
No. of Indep. Claims _t	0.039*** (18.92)
No. of Figures _t	0.039*** (16.94)
No. of Inventors _t	0.025*** (11.99)
Observations	6,500,706
R-squared	0.201
Purchaser FE	Yes
TechClass×Year FE	Yes

Notes: This table presents the results of firms' strategic response to patent sales to trolls regarding patent citations behaviors. Panel A shows the relationship between the number of a firm's patents that cite troll-owned patents and the number of times the firm is sued by a troll, using a firm-year-level sample. Panel B presents the results on how citation patterns change around the sale of a patent to a troll, conditional on the seller's high competitive patent pressure, comparing the number of citations the sold patent receives from three years before to three years after the transaction. Patents sold to other buyers or sold to trolls when the seller faces low competitive patent pressure serve as the control group. The sample in Panel B is at the transaction–patent–year level. T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Table 12. Robustness Test
Panel A. Alternative Measures

	<i>No. Patent Sales to Troll_t</i>				
	(1)	(2)	(3)	(4)	(5)
	Alternative Dep. Variables		Alternative Indep. Variables		
<i>Indicator Variable for Patent Sales to Trolls</i>	<i>% Patent Sales to Trolls</i>	<i>High Similarity Peers</i>	<i>Level of Retaliation</i>	<i>Scaled by Focal Firm Retaliation</i>	
<i>PrivateeringIncentive_t</i>	0.002** (2.25)	0.123* (1.81)	0.419* (1.89)	0.762*** (3.40)	0.697*** (3.02)
Observations	117,413	117,413	117,413	117,413	117,413
R-squared	0.185	0.127	0.197	0.197	0.197
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Panel B. Pseudo Test

VARIABLE	<i>No. Patent Sales to Troll_t</i>	
	(1)	(2)
	Shuffled within each firm	Shuffled within each year
<i>PrivateeringIncentive</i>	-0.003545 (-1.078)	-0.000004 (-0.003)
Prob. $\beta_{1_shuffled} > \beta_{1_actual}$ data [p-value]	[<0.001]	[<0.001]

Notes: This table presents the results of robustness tests. Panel A reports the regression results of Eq. 1 using alternative measures of the dependent variables and independent variables, respectively. Column (1) uses an indicator variable that equals 1 if a firm sells patents to patent trolls in a year as the dependent variable. Column (2) uses patents sold to patent trolls as a percentage of total patents sold to any buyers as the dependent variable. Column (3) measures privateering incentives using patents from peer firms with above-median patent portfolio cosine similarity with the focal firm. Column (4) measures privateering incentives based on the level of peer firms' retaliations. Column (5) measures privateering incentives by weighting the denominator with focal firms' probability of retaliation. Panel B reports the pseudo-test results on the regression of the patent sales to patent trolls based on 1,000 random samples where *PrivateeringIncentive* is randomly shuffled within each firm (Column (1)) and each year (Column (2)). T-statistics, based on standard errors clustered at the firm level, are reported below the coefficient estimates in parenthesis. ***, **, * indicates statistical significance at 1%, 5%, and 10%, respectively (two-tailed). Detailed definitions of all variables are provided in Appendix A.

Online Appendix 1: *Privateering Incentives* and the closeness measure

The closeness, $\omega_{i,j}$, is calculated in the *technological space* spanned by CPC 4-digit subclasses. The more overlapping CPC subclasses between the patents of the two firms, the higher the closeness. Additionally, the higher the proportion of each firm's patents in the overlapping CPC subclasses, the greater the closeness. To illustrate, consider two firms, i and j , and three CPC subclasses: A, B, and C. In the first case, both firms have two-thirds of their patents in subclass B, one-third in subclass C, and none in subclass A. In the second case, firm i has two-thirds of its patents in subclass B and one-third in subclass C, while firm j has one-third of its patents in subclass B and two-thirds in subclass C. In the third case, firm i has one-third of its patents in subclass B and two-thirds in subclass C, whereas firm j has one-third of its patents in subclass B and two-thirds in subclass A. The two firms are closest in Case 1 and least close in Case 3. If the two firms do not overlap in any CPC subclass, then firm j is not a peer of firm i at all.

	Case 1			Case 2			Case 3		
CPC Subclass	A	B	C	A	B	C	A	B	C
Firm i	0	2/3	1/3	0	2/3	1/3	0	1/3	2/3
Firm j	0	2/3	1/3	0	1/3	2/3	2/3	1/3	0

We formally calculate $\omega_{i,j}$ by taking the cosine of the two firms' vectors (V_i and V_j) with the k^{th} element of each vector equal to the firm's proportion of its patent stock in the past 20 years with a 15% decay rate in CPC subclass k , where K is the total patent count for a given CPC subclass. The cosine of the vectors ($\emptyset_{i,j}$) has a geometrical interpretation as the similarity of the two vectors:

$$\omega_{i,j} = \cos(\emptyset_{i,j}) = \frac{\langle v_i, v_j \rangle}{\|v_i\| \|v_j\|} = \frac{\sum_{k=1}^K v_{ik} v_{jk}}{\sqrt{\sum_{k=1}^K v_{ik}^2} \sqrt{\sum_{k=1}^K v_{jk}^2}}$$

In our example, Case 1 has a cosine similarity of 1, Case 2 has a cosine similarity of 0.8, and Case 3 has a cosine similarity of 0.2.