

HARVARD BUSINESS LAW REVIEW

PATENT ENFORCEMENT, SHAREHOLDER VALUE, AND FIRM INNOVATIONS: EVIDENCE FROM THE SUPREME COURT RULING IN TC HEARTLAND (2017)

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Abstract

This paper studies the impact of patent enforcement on shareholder value and firms' innovation patterns. Using the landmark U.S. Supreme Court case TC Heartland LLC v. Kraft Foods Group Brands LLC (2017), which significantly constrained forum shopping practices in patent litigation, we find that the weakening of patent holders' ability to enforce intellectual property protection leads to more negative stock return reactions for firms that are more innovation-intensive before the ruling. We further find that weakened enforcement of patent protection shifted firms' innovation patterns. While innovation-intensive firms do not reduce their overall R&D investment, they choose to keep their innovation outputs as trade secrets and apply for patents significantly less frequently. Our findings shed new light on the current debate on intellectual property protection.

Keywords: Patent Enforcement; Shareholder Value; Firm Innovation Activities

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I. Introduction

Patenting has long played an important role in protecting intellectual property rights and regulating the flow of proprietary knowledge across firms.¹ Holding a patent gives a firm the exclusive right to monetarize the value of a new invention. Enforcing patent protection thus increases the value of the patent and likely also the value of the firm holding it. How strictly should intellectual property rights be enforced?² Do shareholders of innovation-intensive firms benefit from a stricter enforcement of patent law?³ Does relaxing patent protection discourage such firms from allocating more resources for innovation activities?⁴ These are very pressing questions in today's knowledge-based economy. Despite the importance of these issues, the literature contains little empirical evidence that focuses on patent enforcement and the impact on firm shareholder value and innovation activities. In the paper, we empirically study whether and how the change of patent enforcement affects firm shareholder value and innovation activities by focusing on the Supreme Court's recent landmark ruling on patent enforcement in *TC Heartland LLC v. Kraft Foods Group Brands LLC*.⁵

This Supreme Court ruling significantly alters forum shopping behavior in patent litigation and weakens patent holders' ability to enforce intellectual property protection. Instead of the previous system in which patent-holding firms could freely choose any district court to file a patent infringement claim against another firm,⁶ the ruling restricts where lawsuits can be filed to the defendant's legal or physical residence. A more restricted choice of patent litigation venues as a result of *TC Heartland* significantly reduces firms' ability to pick friendly court venues, weakening patent protection enforcement and decreasing the value of patents.

In this paper, we focus on how the change of patent enforcement affects firm shareholder value and innovation activities. We can postulate a few different reactions for firms that engage in patenting and, relatedly, research and development (R&D) activities. First, shareholder value may decrease in innovation-intensive firms that possess more patents. Holding a patent gives these firms the exclusive right to extract future cash flow from it; a decline in the patent value thus can be detrimental to shareholder value. Second, such firms might be less incentivized to file patent applications given the decline in patent value if enforcement were to loosen. Third, the weakening in patent protection may change innovation-intensive firms' investment in R&D activities over time, in addition to the patent applications. On the one hand, the weakening in patent protection

¹ See generally Petra Moser, *How Do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World's Fairs*, 95 AM. ECON. REV. 1214 (2005).

² Interestingly, a public opinion survey shows that a majority of people (73%) supports the abolition of intellectual property rights. See SHOULD INTELLECTUAL PROPERTY RIGHTS BE ABOLISHED?, <http://www.debate.org/opinions/should-intellectual-property-rights-be-abolished> (last visited Apr. 9, 2021).

³ Studies show that the enforcement of knowledge protection leads to firm innovation. See, e.g., Josh Lerner, *The Empirical Impact of Intellectual Property Rights on Innovation: Puzzles and Clues*, 99 AM. ECON. REV. 343, 345–48 (2009); Minyuan Zhao, *Conducting R&D in Countries with Weak Intellectual Property Rights Protection*, 52 MGMT. SCI. 1185, 1194–98 (2006).

⁴ Other studies argue that knowledge spillover within industry clusters is necessary, as it benefits firms and contributes to regional economic growth. See, e.g., Paul M. Romer, *Increasing Returns and Long-Run Growth*, 94 J. OF POL. ECON. 1002, 1020 (1986); PAUL R. KRUGMAN, *GEOGRAPHY AND TRADE* 52-55 (1991).

⁵ *TC Heartland LLC v. Kraft Foods Group Brands LLC*, 137 S. Ct. 1514 (2017).

⁶ The previous system hence incentivized the selection of a court known to be historically plaintiff-lenient. See, e.g., Lauren Cohen, Umit G. Gurun & Scott Duke Kominers, *The Growing Problem of Patent Trolling*, 352 SCI. 521, 521 (2016).

may discourage these firms to invest heavily in R&D that ultimately leads to a patent. On the other hand, moving away from patent filings, which require publicly disclosing details of an invention to industry peers, may allow these firms to continue their research activities but keep trade secrets in-house.

Consistent with our expectation, we document more negative stock return reactions to the Supreme Court ruling in *TC Heartland* for firms that invested more heavily in R&D or knowledge assets, and firms that were granted more patents, in the year before the ruling. Moreover, we find that innovation-intensive firms significantly decreased their patent applications relative to the rest of patent-holding firms more in the post-ruling quarters. Interestingly, these innovation-intensive firms, actually increased their R&D investment relative to other patenting firms in the quarters after the Supreme Court ruling. Therefore, although the weakened enforcement of patent protection does not discourage R&D investment of the innovation-intensive firms, following *TC Heartland* these firms choose to keep their innovation outputs as trade secrets and apply for patents significantly less frequently. Such a post-ruling reduction in patenting activities by innovation-intensive firms relative to other firms means that more innovations will stay in the dark as opposed to being disclosed to the public, impeding positive knowledge externalities that are crucial for the development of the innovation ecosystem.⁷

Our study contributes to the literature on intellectual property protection. Enforcing patent protection helps motivate innovators⁸ and is considered an important determinant of economic growth.⁹ Without the ability to enforce and protect intellectual property rights, economic agents may underinvest in knowledge production and innovation.¹⁰ However, many argue that stricter enforcement of intellectual property rights can suffocate subsequent scientific R&D, harming long-run economic growth and social welfare.¹¹ Moreover, patents are probabilistic and uncertain intellectual property rights which are enforced through litigation.¹² Enforcing patent rights has also contributed to the emergence of non-practicing entities (that is, patent trolls), entities that do not directly use their patents to produce products or provide services. Although significant

⁷ Lerner, *supra* note 3, at 1.

⁸ See, e.g., Steven Shavell & Tanguy van Ypersele, *Rewards versus Intellectual Property Rights*, 44 J.L. & ECON. 525, 527 (2001); WILLIAM M. LANDES & RICHARD A. POSNER, *THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW* 395 (2003).

⁹ See, e.g., David Gould & William Gruben, *The Role of Intellectual Property Rights in Economic Growth*, 48 J. DEV. ECON. 323, 324 (1996); Walter G. Park & Juan Carlos Ginart, *Intellectual Property Rights and Economic Growth*, 15 CONTEMP. ECON. POL'Y 51, 51 (1997); Rod Falvey, Neil Foster & David Greenaway, *Intellectual Property Rights and Economic Growth*, 10 REV. DEV. ECON. 700, 700–01 (2006).

¹⁰ See, e.g., Richard Nelson, *The Simple Economics of Basic Scientific Research*, 67 J. POL. ECON. 297, 306 (1959); Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, in *THE RATE AND DIRECTION OF INVENTIVE ACTIVITY* 609, 615 (Richard Nelson ed., 1962); Richard Gilbert & Carl Shapiro, *Optimal Patent Length and Breadth*, 21 RAND J. ECON. 106, 106 (1990).

¹¹ See, e.g., Fiona Murray & Scott Stern, *Do Formal Intellectual Property Rights Hinder the Free Flow of Scientific Knowledge? An Empirical Test of the Anti-commons Hypothesis*, 63 J. ECON. BEHAV. & ORG. 648, 651 (2007); Kenneth G. Huang & Fiona E. Murray, *Does Patent Strategy Shape the Long-Run Supply of Public Knowledge? Evidence from Human Genetics*, 52 ACAD. MGMT. J. 1198, 1213 (2009); Heidi L. Williams, *Intellectual Property Rights and Innovation: Evidence from the Human Genome*, 121 J. POL. ECON. 1, 24 (2013); Alberto Galasso & Mark Schankerman, *Patents and Cumulative Innovation: Causal Evidence from the Courts*, 130 Q.J. ECON. 317, 322 (2015).

¹² Mark A. Lemley & Carl Shapiro, *Probabilistic Patents*, 19 J. ECON. PERSPS. 75, 80–81 (2005).

heterogeneity exists among different patent holders in patent lawsuits,¹³ patent lawsuits launched by patent trolls can be particularly harmful to the innovation activities of defendants.¹⁴ Thus, patent protection enforcement should consider the tradeoffs between economic costs and benefits.^{15, 16} We contribute to this literature by documenting the impact of a landmark change in patent protection enforcement—the U.S. Supreme Court ruling on patent litigation forum shopping—on firm shareholder value and innovation activities.

Our study also contributes to the law and finance literature. Better investor protection via enhancing law enforcement is shown to facilitate the development of financial markets and increase firm value.¹⁷ Legal and regulatory systems that better protect creditors, enforce contracts, and promote disclosure transparency are also shown to relate to financial intermediary development and long-run economic growth.¹⁸ Previous research further shows that stronger intellectual property protection via the adoption of the inevitable disclosure doctrine benefits firm shareholders, incentivizes firm knowledge assets investment,¹⁹ and increases firm leverage.²⁰ Our findings suggest that weakened patent protection enforcement due to *TC Heartland* may harm shareholder value of innovation-intensive firms, likely because they have less freedom to choose a friendly venue to sue potential infringers of their innovations. Our evidence indicates that although such firms do not reduce their innovation activities as a result of the ruling, they opt for keeping their innovation outputs in the dark rather than disclosing them via patent applications, which may impede the positive externality of innovations. These findings shed new light on the debate on how strictly intellectual property rights should be enforced.

The rest of the paper proceeds as follows. Part II discusses the legal background on the recent Supreme Court ruling and the related data and measurement. Part III reports the findings. Part IV concludes.

¹³ See Christopher A. Cotropia, Jay P. Kesan & David L. Schwartz, *Heterogeneity Among Patent Plaintiffs: An Empirical Analysis of Patent Case Progression, Settlement, and Adjudication*, 15 J. EMP. LEGAL STUD. 80, 85 (2018).

¹⁴ See, e.g., Colleen Chien, *Startups and Patent Trolls*, 17 STAN. TECH. L. REV. 461, 474 (2014); Lauren Cohen, Umit G. Gurun & Scott Duke Kominers, *Patent Trolls: Evidence from Targeted Firms*, 65 MGMT. SCI. 5461, 5462 (2019).

¹⁵ See, e.g., Douglas Lichtman & Mark A. Lemley, *Rethinking Patent Law's Presumption of Validity*, 60 STAN. L. REV. 101, 101, 103–04 (2007); Joseph Farrell & Carl Shapiro, *How Strong Are Weak Patents?* 98 AM. ECON. REV. 1347, 1361–62 (2008); Mark A. Lemley, *Ignoring Patents*, 19 MICH. ST. L. REV. 19, 25 (2008).

¹⁶ For a survey of intellectual property protection via alternative mechanisms (e.g., patenting and the use of secrecy), see generally Bronwyn Hall, Christian Helmers, Mark Rogers & Vania Sena, *The Choice between Formal and Informal Intellectual Property: A Review*, 52 J. ECON. LITERATURE 375 (2014).

¹⁷ See, e.g., Rafael LaPorta, Florencio Lopez-de-Silanes, Andrei Shleifer & Robert W. Vishny, *Law and Finance*, 106 J. POL. ECON. 1113, 1116 (1998); Rafael LaPorta, Florencio Lopez-de-Silanes, Andrei Shleifer & Robert Vishny, *Investor Protection and Corporate Valuation*, 57 J. FIN. 1147, 1147 (2002).

¹⁸ See, e.g., Ross Levine, *Law, Finance, and Economic Growth*, 8 J. FIN. INTERMEDIATION 8, 8 (1999).

¹⁹ See Buhui Qiu & Teng Wang, *Does Knowledge Protection Benefit Shareholders? Evidence from Stock Market Reaction and Firm Investment in Knowledge Assets*, 53 J. FIN. & QUANTITATIVE ANALYSIS 1341, 1341–43 (2018).

²⁰ See Sandy Klasa, Hernán Ortiz-Molina, Matthew Serfling & Shweta Srinivasan, *Protection of Trade Secrets and Capital Structure Decisions*, 128 J. FIN. ECON. 266, 268 (2018).

II. Legal Background and Data

A. Legal Background on the Supreme Court's Enforcement on Patent Litigation

In the United States, a patent provides its proprietor with the right to exclude others from practicing the invention claimed in that patent or benefiting from the invention. A company that benefits from that patented invention without the permission of the patent holder infringes that patent and is subject to a patent lawsuit. Because these lawsuits are generally handled by the federal judiciary, the U.S. Supreme Court has the ultimate power to interpret patent legislation, including matters related to the enforcement of patents.

The patent venue statute, as enacted by the U.S. Congress in 1948, stipulates that “any civil action for patent infringement may be brought in the judicial district *where the defendant resides, or where the defendant has committed acts of infringement and has a regular and established place of business.*”²¹ In *Fourco Glass Co. v. Transmirra Products Corp.*, the Supreme Court concluded that for purposes of § 1400(b) a domestic corporation “resides” only in its state of incorporation.²²

In 1988, Congress amended the general venue statute § 1391(c) to stipulate that “for purposes of venue under this chapter, *a defendant that is a corporation shall be deemed to reside in any judicial district in which it is subject to personal jurisdiction at the time the action is commenced.*”²³ In *VE Holding Corp. v. Johnson Gas Appliance Co.*, an appeals court ruled that “[o]n its face, § 1391(c) clearly applies to § 1400(b), and thus redefines the meaning of the term ‘resides’ in that section.”²⁴ Since the ruling of this precedent-setting case, a plaintiff (patent owner) in patent enforcement litigation was allowed to sue the defendant (accused patent infringer) in virtually any judicial district she chose.

For more than two decades since the establishment of the precedent-setting case, a new pattern of patent lawsuits—“forum shopping”—has become popular.²⁵ Under the legal framework governed by the aforementioned statutes, a patent owner who wished to enforce his patents via litigation (that is, the plaintiff) could freely choose a plaintiff-friendly venue to file a patent infringement lawsuit. With the absence of constraints on forum shopping in patent litigation, around 40% of the patent lawsuits were filed in the Eastern District Court of Texas due to the venue’s very plaintiff-friendly reputation.²⁶ In fact, of the top ten patent litigation venues, the number of lawsuits handled by the Eastern District Court of Texas was larger than the next nine venues combined.²⁷

²¹ 28 U.S.C. § 1400(b) (emphasis added).

²² *Fourco Glass Co. v. Transmirra Products Corp.*, 353 U. S. 222, 226 (1957).

²³ 28 U.S.C. § 1391(c) (emphasis added).

²⁴ *VE Holding Corp. v. Johnson Gas Appliance Co.*, 917 F.2d 1574, 1578 (Fed. Cir. 1990).

²⁵ See *supra* text accompanying note 6.

²⁶ See Ron Abrams, *Supreme Court Decision Deals Blow to ‘Patent Trolls’ and the ‘Best Little’ East Texas Towns That Thrive on Patent Litigation*, IPWATCHDOG, (June 11, 2017), <https://www.ipwatchdog.com/2017/06/11/supreme-court-blow-patent-trolls-east-texas-towns-patent-litigation/id=84314/>.

²⁷ The second most popular venue for patent litigation before the Supreme Court ruling in *TC Heartland* was the District Court of Delaware, which handled around 12% of lawsuits. See Parithosh K. Tungaturthi, *2017 Patent Litigation: A Statistical Overview*, BIOLOQUITUR, (Jan. 17, 2018), <https://www.bioloquitur.com/2017-patent-litigation-statistical-overview/>.

On May 22, 2017, this litigation framework was overturned after the Supreme Court’s landmark ruling on a patent enforcement case restricted the number of venues in which patent litigation could be filed. By overturning *VE Holding Corp. v. Johnson Gas Appliance Co.*,²⁸ the Court ruled in *TC Heartland* that “[a]s applied to domestic corporations, ‘reside[nce]’ in § 1400(b) refers only to the State of incorporation. The amendments to § 1391 did not modify the meaning of § 1400(b) as interpreted by *Fourco*. Pp. 3-10.”²⁹ That is, *TC Heartland* redefined “residence” as the corporate defendant’s state of incorporation. As the plaintiff can now sue the defendant only in the state where the defendant is incorporated or “where the defendant has committed acts of infringement and has a regular and established place of business,” this ruling significantly limits patent plaintiffs’ ability to choose any venue for legal action (that is, forum shopping) and weakens patent protection enforcement.³⁰ Consequently, patent lawsuits decreased significantly in the Eastern District Court of Texas, while lawsuits filed in other venues significantly increased after *TC Heartland*.

B. Data and Variables

We construct two datasets, one to analyze how stock prices react to the ruling and the other to analyze the effect of the ruling on firms’ innovation activities. The former includes firm-level characteristics, such as stock returns, financial and legal information, location, and industry. The latter includes information on firms’ innovation activities, financial characteristics, location and industry.

To analyze the stock price reactions, we obtain daily stock returns of all common stocks listed on NYSE, AMEX, and NASDAQ from the Center for Research in Security Prices.³¹ We obtain financial data from Compustat. We measure firms’ stock price reactions around the 2017 Supreme Court ruling to capture the impact of the ruling on firm shareholder value. We then link firms’ stock price reactions to firms’ characteristics *prior to* the ruling event to study the cross-sectional variation in stock price reactions to the ruling.

We construct variables that reflect the degree to which firms are innovation-orientated, such as firm R&D intensity (*Rnd_sales*), firm SG&A intensity (*Sga_sales*),³² and firm patenting

²⁸ *VE Holding Corp.*, 917 F.2d 1574.

²⁹ *TC Heartland LLC v. Kraft Foods Group Brands LLC*, 137 S. Ct. 1514, 1515 (2017) (emphasis added) (second alteration in original).

³⁰ *TC Heartland*, 137 S. Ct. at 1516.

³¹ We filter the stocks selected to CRSP share codes 10 or 11. *CRSP US Stock Databases*, CENTER FOR RESEARCH IN SECURITY PRICES, LLC, <http://www.crsp.org/products/research-products/crsp-us-stock-databases>.

³² SG&A expenses include R&D expenses, employee training costs, IT investment, consulting, advertising and marketing expenses, information systems investment, and distribution channel investment, which are expenses aimed at improving the firm’s body of proprietary knowledge. *See, e.g.*, Baruch Lev & Suresh Radhakrishnan, *The Valuation of Organization Capital*, in MEASURING CAPITAL IN THE NEW ECONOMY 73, 79 (Carol Corrado, John Haltiwanger & Dan Sichel eds., 2005); Baruch Lev, Suresh Radhakrishnan & Weining Zhang, *Organization Capital*, 45 ABACUS 275, 279 (2009); Rajiv D. Banker, Rong Huang & Ramachandran Natarajan, *Equity Incentives and Long-Term Value Created by SG&A Expenditure*, 28 CONTEMP. ACCT. RES. 794, 798 (2011); Andrea L. Eisfeldt & Dimitris Papanikolaou, *Organization Capital and the Cross-Section of Expected Returns*, 58 J. AM. FIN. ASS’N, 1365, 1380–81 (2013); Kai Li, Buhui Qiu & Rui Shen, *Organization Capital and Mergers and Acquisitions*, 53 J. FIN. & QUANTITATIVE ANALYSIS 1871, 1878 (2018); Buhui Qiu & Teng Wang, *Does Knowledge Protection Benefit Shareholders? Evidence from Stock Market Reaction and Firm Investment in Knowledge Assets*, 53 J. FIN. & QUANTITATIVE ANALYSIS 1341, 1343 (2018).

intensity (*Patent_granted_sales*).³³ These three variables capture the innovation intensiveness of firms. Firms that are more innovation-intensive should have higher values for those variables. We further obtain the hand-collected patent litigation dataset of Cotropia, Kesan, & Schwartz (2014),³⁴ which contains all U.S. patent lawsuit cases in 2010 and 2012.³⁵ We manually identify patent plaintiffs and defendants from the patent litigation dataset with CRSP firms through name matching and cross-checking with company websites. We construct two variables, *Plaintiff* and *Defendant*, which measure the number of patent lawsuits in which a firm in our sample is involved as a plaintiff or a defendant, respectively. Firms that have been involved in patent lawsuits may react differently to the Supreme Court ruling on patent enforcement than those that have not. We further collect location information on firms' headquarters and control for the state fixed effects in the analysis for firms' stock price reaction accordingly.

To analyze the effect on firms' innovation activities, we construct three variables by quarter: ratio of R&D to sales (*R&D / Sales*), ratio of patent applications to sales (*Applications / Sales*), and ratio of patent applications to R&D (*Applications / R&D*). We include the following lagged time-varying, firm-level control variables: the natural logarithm of firm total assets (*Ln_Total_Assets*), market-to-book equity ratio (*Market_to_book*), past stock returns (*Past_stock_return_DID*), leverage ratio (*Leverage*), cash ratio (*Cash*), and profitability (*ROA*). We further include the following lagged time-varying, state-level variables to control for the firm's headquarter-state economic conditions: the level of economic development (*Per capita state income*), market size (*Total state income*), and growth perspective (*Total state income growth*).

Appendix B provides the detailed definition and data source for each of the variables used in the study and Appendix C provides the summary statistics. The correlation matrix is shown in Table 2. All continuous variables are winsorized at the 1st and 99th percentiles to limit the influence of outliers.

III. Stock Price Reactions of Innovation-Intensive Firms To The Supreme Court Ruling In *TC Heartland*

We use event-study methodology to investigate the heterogeneous stock price reactions to the change in the Supreme Court's enforcement of patent litigation. We conjecture that stock prices of innovation-intensive firms may react negatively to the Supreme Court ruling.

A. Cumulative Abnormal Return at the Supreme Court Ruling

We calculate cumulative abnormal returns during the 2-day event window (that is, *CAR* ($0, 1$))—the day of and the day after the Supreme Court ruling. We use both the market-adjusted model and the market model to calculate cumulative abnormal returns with the CRSP value-

³³ We collected patent data from the United States Patent and Trademark Office (USPTO) in April 2019 and matched the names of patent assignees with names of public firms covered by CRSP. In total, we obtained 696,641 patents for CRSP firms from 2015 to 2018.

³⁴ See Christopher A. Cotropia, Jay P. Kesan & David L. Schwartz, *Unpacking Patent Assertion Entities (PAEs)*, 99 MINN. L. REV. 649, 654 (2014).

³⁵ The data is publicly available at <http://npedata.com/data/>. Christopher Cotropia, Jay P. Kesan & David L. Schwartz, *Data, NPE DATA | NON-PRACTICING ENTITY DATA* (Oct. 28, 2013), <http://npedata.com/data/>. We thank the authors for generously sharing the data.

weighted stock market returns (including dividends) as the market portfolio returns. The estimation window for the market model is (-200, -60) before the event date.

To study the heterogeneous stock price reactions to the Supreme Court ruling, we use the following regression specification:

$$CAR(0, 1)_i = \alpha + \beta_1 X_i + \beta_2 Firm\ Controls_i + \beta_3 State\ Controls_i + Industry\ and\ State\ Fixed\ Effects + \epsilon_i, (1)$$

where X is a variable of interest (that is, *Rnd_sales*, *Sga_sales*, *Patent_granted_sales*, *Plaintiff*, or *Defendant*) and i represents a firm. We include standard firm-level control variables (that is, *Firm_size*, *Market_to_book*, *Past_stock_return*, *Leverage*, *Cash*, and *ROA*). We further control for both (2-digit SIC) industry and headquarter-state fixed effects to allow for heterogeneous reactions of firms operating in different industries or located in different states. Given that the standard errors of stock returns are likely to be correlated during one single event, we calculate the standard errors through bootstrapping 1,000 samples from our regression sample and estimating the regression coefficients 1,000 times.³⁶

Table 1 reports the regression results. We focus on the results with cumulative abnormal returns calculated using the market-adjusted model as the dependent variable. Results using the market model are qualitatively very similar to the reported results.

³⁶ Using clustering-robust standard errors will likely underestimate the size of standard errors. Bertrand, Duflo, and Mullainathan (2004) and Gormley suggest that a lot of clusters (that is, ten or above) are needed when one uses clustered standard errors to correct for the bias in estimating standard errors due to within-cluster correlations. See Marianne Bertrand, Esther Duflo & Sendhil Mullainathan, *How Much Should We Trust Differences-In-Differences Estimates?*, 119 Q.J. ECON. 249, 273 (2004); Todd A. Gormley, *FNCE 926 Empirical Methods in CF: Lecture 11 – Standard Errors & Misc.* 55–56, http://www.gormley.info/uploads/8/6/8/3/86834336/11_--_standard_errors___miscellaneous.pdf. Given that stock returns of all firms are likely cross-sectionally correlated around the Supreme Court ruling day, we instead use bootstrapping to obtain more robust standard error estimates. Nevertheless, our results are qualitatively similar (more significant statistically) if we instead use standard errors clustered at the (2-digit SIC) industry level.

Table 1. Firms' abnormal stock returns during events of ruling on forum shopping of patent cases using bootstrapped standard errors

The table reports the results of OLS regressions that investigate the influence of different variables of interest on firms' 2-day cumulative abnormal returns ($CAR(0, 1)$) during an event window surrounding the Supreme Court's ruling on forum shopping of patent cases. A detailed description of the variables is presented in Appendix B. The dependent variable is $CAR(0, 1)$ estimated using the market-adjusted model. This panel reports the results of OLS regressions of the influence of firm-level variables of interest on $CAR(0, 1)$ during the Supreme Court's ruling on forum shopping of patent cases. Robust standard errors are bootstrapped using 1,000 iterations and are shown in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep. Var.:	CAR (0, 1)				
	(1)	(2)	(3)	(4)	(5)
<i>Firm-level variables</i>					
Rnd_sales _{t-1}	-0.049*** (0.014)				
Sga_sales _{t-1}		-0.391*** (0.148)			
Patent_granted_sales _{t-1}			-0.700* (0.404)		
Plaintiff _{t-1}				-0.035 (0.023)	
Defendant _{t-1}					-0.027 (0.020)
<i>Controls</i>					
Firm_size _{t-1}	0.115*** (0.044)	0.100** (0.040)	0.082** (0.037)	0.118*** (0.034)	0.120*** (0.040)
Market_to_book _{t-1}	-0.013 (0.012)	-0.007 (0.015)	-0.016* (0.009)	-0.012 (0.012)	-0.012 (0.012)
Past_stock_return _{t-1}	0.005 (0.004)	0.005* (0.003)	0.007 (0.005)	0.005 (0.004)	0.005 (0.003)
Leverage _{t-1}	-0.116 (0.291)	-0.165 (0.450)	0.044 (0.400)	-0.114 (0.331)	-0.114 (0.337)
Cash _{t-1}	0.089 (0.448)	-0.119 (0.498)	-0.082 (0.659)	-0.202 (0.432)	-0.197 (0.371)
ROA _{t-1}	-0.061 (0.447)	-0.147 (0.639)	0.155 (0.585)	0.025 (0.277)	0.023 (0.212)
State Headquarters FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes
Obs.	2,793	2,793	2,692	2,793	2,793
Adj. R ²	0.018	0.020	0.022	0.013	0.014

We find that the regression coefficients of firm R&D intensity (*Rnd_sales*), firm SG&A intensity (*Sga_sales*), and firm patent count (*Patent_granted_sales*) are all negative and statistically significant at the 1%, 5%, and 10% level, respectively.³⁷ For example, a one standard deviation increase in *Rnd_sales*, *Sga_sales*, or *Patent_granted_sales*, on average, leads to a decrease in *CAR* (*0, 1*) by 0.27%, 0.31%, or 0.18%, respectively. For an average firm in our sample (with a market capitalization of \$612.78 million), a one standard deviation increase in *Rnd_sales*, *Sga_sales*, or *Patent_granted_sales* translates into a decrease in shareholder value by \$1.1 million to \$1.9 million.

The results in Table 1 further show that the number of past patent lawsuits, in which the firm is involved as a plaintiff (*Plaintiff*) or defendant (*Defendant*), is insignificantly related to *CAR* (*0, 1*). In terms of control variables, firm size is positively related to *CAR* (*0, 1*), suggesting that shareholder value of small firms reacts less favorably than that of large firms to the Supreme Court ruling (likely because small firms have less resources to protect their patents than do large firms), while the coefficients of the other control variables are generally insignificant.

Overall, the results show that the Supreme Court ruling in *TC Heartland* that relaxes patent protection enforcement may harm shareholder value of innovation-intensive firms, since they now have less freedom to choose a friendlier venue to sue potential infringers of their innovations.

B. CAR (-159,-1) Before the Supreme Court Ruling

The Supreme Court granted certiorari to review (that is, decided to look at) the case *TC Heartland* on December 14, 2016. Few would have expected the Supreme Court to overturn the precedent-setting *VE Holding Corp.* ruling. As a placebo test, we calculate cumulative abnormal returns during the 159-day event window (that is, *CAR* (-159,-1)) between the day when the Supreme Court decided to look at the case until the day before the Supreme Court ruling and re-estimate Equation (1) using *CAR* (-159,-1) as the dependent variable. The control variables are similarly measured prior to the start of the 159-day event window. The results are reported in Table 2.

³⁷ Greater values of these variables indicate the firm is more innovation-intensive.

Table 2. Placebo test of firms' abnormal stock returns prior to the ruling on forum shopping of patent cases using bootstrapped standard errors

The table reports the results of OLS regressions that investigate the influence of different variables of interest on firms' 159-day cumulative abnormal returns ($CAR(-159,-1)$) prior to the Supreme Court's ruling on forum shopping of patent cases. A detailed description of the variables is presented in Appendix B. The dependent variable $CAR(-159,-1)$ is estimated using the market-adjusted model. This panel reports the results of OLS regressions of the influence of firm-level variables of interest on $CAR(-159,-1)$ during the Supreme Court's ruling on forum shopping of patent cases. Robust standard errors are bootstrapped using 1,000 iterations and are shown in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep. Var.:	CAR (-159,-1)				
	(1)	(2)	(3)	(4)	(5)
<i>Firm-level variables</i>					
Rnd_sales _{t-1}	-0.388*				
	(0.227)				
Sga_sales _{t-1}		0.110			
		(2.263)			
Patent_granted_sales _{t-1}			-0.481		
			(5.535)		
Plaintiff _{t-1}				-0.623	
				(1.007)	
Defendant _{t-1}					-0.150
					(0.307)
<i>Controls</i>					
Firm_size _{t-1}	0.129	0.133	0.141	0.182	0.165
	(0.594)	(0.468)	(0.474)	(0.515)	(0.392)
Market_to_book _{t-1}	-0.039	-0.041	0.008	-0.041	-0.041
	(0.048)	(0.032)	(0.046)	(0.041)	(0.040)
Past_stock_return _{t-1}	-0.024	-0.023	-0.020	-0.024	-0.023
	(0.023)	(0.020)	(0.017)	(0.017)	(0.015)
Leverage _{t-1}	-7.864	-7.841**	-6.061	-7.931*	-7.893**
	(5.535)	(3.971)	(4.458)	(4.140)	(3.069)
Cash _{t-1}	-3.329	-5.202	-1.011	-5.158	-5.141
	(5.740)	(6.621)	(6.172)	(7.786)	(6.718)
ROA _{t-1}	78.039***	82.853***	101.977***	82.656***	82.502***
	(24.021)	(22.114)	(18.321)	(22.655)	(21.593)
State Headquarters FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Intercept	Yes	Yes	Yes	Yes	Yes
Obs.	2,770	2,770	2,670	2,770	2,770
Adj. R ²	0.040	0.038	0.050	0.038	0.038

We find that although the regression coefficient of *Rnd_sales* is negative and marginally significant at the 10% level, the regression coefficients of *Sga_sales* and *Patent_granted_sales* are both insignificant. This finding generally suggests there was no ex-ante market expectation that the Supreme Court would relax patent protection enforcement.

IV. The Impact of the Supreme Court Ruling in *TC Heartland* on Innovation Activities

The Supreme Court ruling in *TC Heartland* naturally reduces the value of holding a patent. Thus, the ruling may discourage firms from applying for patents and investing heavily in R&D that ultimately leads to a patent. In this section, we further investigate how *TC Heartland* affects the patenting and R&D activities of lead innovator firms relative to other firms. We conjecture that innovation-intensive firms, relative to other firms, may reduce their patenting activities after the loosening of patent protection enforcement, because it is more difficult for lead innovators to choose a friendly venue to protect their patents after the ruling. The relative impact of *TC Heartland* on the R&D investment of innovation-intensive firms is less clear though. Loosening patent protection may discourage innovation-intensive firms to invest in R&D that ultimately leads to patents. However, such firms may choose to continue with their R&D activities, but move away from patenting to keeping their innovation outputs as in-house trade secrets.

To study the differential effects of the ruling on the patenting and R&D activities of innovation-intensive firms relative to other firms, we use the following firm-quarter difference-in-differences (DID) regression specification:

$$\begin{aligned} Dep\ Var_{i,t} = & \alpha + \beta_1 Innovation\ Intensive_i * Post\ Ruling_t + \beta_2 Lead\ Innovator_i \\ & + \beta_3 Post\ Ruling_t + \beta_4 Controls_{i,t} + \epsilon_{i,t}, \end{aligned} \quad (2)$$

where the dependent variable is a firm's R&D expenditure scaled by sales revenue in a quarter (*R&D / Sales*) or a firm's patent applications scaled by sales revenue in a quarter (*Applications / Sales*). We include patenting firms and use six quarters before and six quarters after the Supreme Court ruling in the estimation.³⁸ The indicator variable, *Innovation Intensive*, equals 1 for innovation-intensive firms and equals 0 otherwise. We define innovation-intensive firms (other patenting firms) as firms that are in the top 10% (bottom 90%) of patenting companies as measured by the total number of patents granted between 2013 and 2016.³⁹ The indicator variable, *Post Ruling*, equals 1 if the quarter is after the Supreme Court ruling in *TC Heartland* and equals 0 otherwise.

Robust standard errors are clustered at the firm level to control for within-firm correlations in patenting and R&D activities. The DID regression results are reported in Table 3.

³⁸ The ruling event quarter is excluded for each firm.

³⁹ Results are qualitatively similar if we use the top 20% versus the bottom 80% of patenting firms instead.

Table 3. Changes in firms' R&D and patenting activities

The table reports the results of DID regressions that investigate the influence of the Supreme Court's ruling on forum shopping of patent cases on dependent variables reflecting firms' research and patent application activities. A detailed description of the variables is presented in Appendix B. We define innovation-intensive firms as firms that are in the top 10% of companies as measured by the total number of patents granted between 2013 and 2016. We define control firms as firms that are in the bottom 90% of companies as measured by the total number patents granted between 2013 and 2016. Robust standard errors are clustered at the firm level and are shown in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	(1) R&D / Sales	(2) R&D / Sales	(3) Applications / Sales	(4) Applications / Sales
Innovation Intensive * Post Ruling	0.588* (0.310)	0.836* (0.427)	-0.011** (0.004)	-0.014*** (0.004)
Innovation Intensive		-0.224 (0.553)		0.021*** (0.005)
Post Ruling		-0.465** (0.226)		-0.015*** (0.002)
State Income $t-1$	-5.640 (8.830)	-0.381* (0.216)	-0.283*** (0.069)	0.001 (0.001)
State Income Growth $t-1$	0.138 (0.100)	-0.262** (0.120)	0.004*** (0.001)	0.002*** (0.001)
Per Capita State Income $t-1$	2.205 (9.819)	-0.687 (1.560)	-0.240*** (0.067)	-0.003 (0.005)
Ln_total_assets $t-1$	-0.475 (0.478)	0.170* (0.087)	0.002 (0.004)	-0.002*** (0.000)
Market_to_book $t-1$	0.045* (0.024)	-0.087*** (0.026)	0.000 (0.000)	-0.000 (0.000)
Past_stock_return_DID $t-1$	-0.004** (0.002)	-0.008*** (0.003)	-0.000 (0.000)	-0.000 (0.000)
Leverage $t-1$	-2.587* (1.370)	0.248 (0.762)	-0.012 (0.008)	-0.001 (0.004)
Cash $t-1$	1.750* (1.045)	12.664*** (1.719)	0.011 (0.012)	0.043*** (0.006)
ROA $t-1$	0.846 (1.839)	-25.600*** (3.657)	0.014 (0.016)	-0.025 (0.019)
Firm FE	Yes	No	Yes	No
Year-quarter FE	Yes	No	Yes	No
Intercept	Yes	Yes	Yes	Yes
Obs.	10,243	10,325	10,243	10,325
Adj. R ²	0.744	0.221	0.396	0.135

Column 1 (Column 2) of Table 3 reports the DID results with (without) firm fixed effects and year-quarter fixed effects, with the dependent variable being $R\&D / Sales$. Interestingly, the regression coefficient of $Innovation\ Intensive * Post\ Ruling$, our variable of interest, is significantly positive at the 10% level. This result suggests that innovation-intensive firms, relative to other firms, actually increased R&D expenditures after the Supreme Court ruling in *TC Heartland*. That is, there is no evidence that the ruling discourages the R&D activities of innovation-intensive firms. Columns 3 and 4 report the DID results with $Applications / Sales$ as the dependent variable. The regression coefficient of $Innovation\ Intensive * Post\ Ruling$ is significantly negative at least at the 5% level, which suggests that innovation-intensive firms, relative to other firms, significantly decreased their patent applications after the ruling. The economic magnitude is also significant. For example, the coefficient of $Innovation\ Intensive * Post\ Ruling$ for $Applications / Sales$ is -0.014, which is twice the size of the mean 0.006, suggesting that compared with other firms, an average innovation-intensive firm (with average sales of \$2.68 billion) decreased patent applications by 37.5 per quarter after the Supreme Court ruling.

Overall, the findings in Table 3 suggest that innovation-intensive firms, relative to other firms, do not decrease (and in fact, may actually increase) their R&D activities after the Supreme Court ruling in *TC Heartland* that relaxed patent protection enforcement. However, such firms changed the innovation pattern and chose to reduce their patenting activities to more frequently keep their innovation outputs as in-house trade secrets after the relaxation of patent protection enforcement.

To ensure that our results are not driven by differential trends in R&D and patenting activities between innovation-intensive firms and other patenting firms, we further conduct dynamic DID tests. Specifically, we include the ruling event quarter in the sample and construct quarter indicator variables to interact with the *Innovation Intensive* indicator; the earliest quarter (that is, quarter - 6) before the ruling event (that is, quarter 0) is used as the reference quarter. The firm-quarter dynamic DID regression specification is as follows:

$$\begin{aligned}
 Dep\ Var_{i,t} = & \alpha + \sum_{q=-5}^6 \beta_q Innovation\ Intensive_i * Event\ Qtr_q + \beta_7 Controls_{i,t} \\
 & + Firm\ and\ Time\ Fixed\ Effects + \epsilon_{i,t}, \quad (3)
 \end{aligned}$$

Table 4 reports the dynamic DID regression results. The dynamic DID results show that none of the interaction terms between *Innovation Intensive* and the indicators for the before-ruling quarters are significantly different from zero. The treatment effects of the Supreme Court ruling on $R\&D / Sales$ and $Applications / Sales$ start to show up only in or after the ruling event quarter. These results indicate that the trends in R&D and patenting activities are parallel between the innovation-intensive firms and other patenting firms before the ruling, and only start to diverge afterwards.

The dynamic DID results also show the patent truncation problem (that is, some patent applications are not yet observable at the time of our empirical investigation because they have not yet been granted) is unlikely to account for our findings. We have controlled for year-quarter fixed effects in the regression, which should help address the patent truncation problem. Moreover, if the patent truncation problem drives our results (that is, if innovation-intensive firms are more

subject to patent truncation than are control firms), we should see a systematically decreasing pattern in regression coefficients of the interaction terms between the quarter indicators and the *Innovation Intensive* indicator from quarter -5 to quarter 6 in Table 4, when *Applications / Sales* is the dependent variable. However, we do not observe such a pattern. In contrast, we find the interaction terms to be insignificant from quarter -5 to quarter 0 and only become significantly negative with stable magnitude from quarter 1 onwards, which is consistent with the treatment effect of the Supreme Court ruling in *TC Heartland*.

Table 4. Dynamic DID tests

The table reports the dynamic treatment results of DID regressions that investigate the influence of the Supreme Court's ruling on forum shopping of patent cases on dependent variables reflecting firms' research and patent application activities surrounding the event of the ruling. A detailed description of the variables is presented in Appendix B. We define innovation-intensive firms as firms that are in the top 10% of companies as measured by the total number of patents granted between 2013 and 2016. We define control firms as firms that are in the bottom 90% of companies as measured by the total number patents granted between 2013 and 2016. We use the earliest quarter (that is, quarter -6) before the ruling event (that is, quarter 0) as the reference quarter. Robust standard errors are clustered at the firm level and are shown in parentheses. ***, **, and * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Variables	(1) R&D / Sales	(2) Applications / Sales
Innovation Intensive * Event Quarter - 5 Quarter	0.207 (0.372)	-0.001 (0.005)
Innovation Intensive * Event Quarter - 4 Quarter	0.060 (0.419)	0.001 (0.005)
Innovation Intensive * Event Quarter - 3 Quarter	-0.006 (0.503)	0.003 (0.005)
Innovation Intensive * Event Quarter - 2 Quarter	0.243 (0.533)	-0.005 (0.004)
Innovation Intensive * Event Quarter - 1 Quarter	0.625 (0.505)	-0.005 (0.005)
Innovation Intensive * Event Quarter	0.526 (0.524)	-0.003 (0.005)
Innovation Intensive * Event Quarter + 1 Quarter	0.353 (0.588)	-0.010* (0.006)
Innovation Intensive * Event Quarter + 2 Quarter	1.106** (0.546)	-0.011* (0.006)
Innovation Intensive * Event Quarter + 3 Quarter	0.788 (0.545)	-0.013** (0.006)
Innovation Intensive * Event Quarter + 4 Quarter	1.046 (0.636)	-0.012** (0.006)
Innovation Intensive * Event Quarter + 5 Quarter	0.424 (0.659)	-0.011* (0.006)
Innovation Intensive * Event Quarter + 6 Quarter	0.927 (0.637)	-0.012* (0.006)

State Income $t-1$	-5.207 (9.380)	-0.292*** (0.072)
State Income Growth $t-1$	0.119 (0.099)	0.003*** (0.001)
Per Capita State Income $t-1$	1.839 (10.374)	-0.223*** (0.070)
Ln_total_assets $t-1$	-0.416 (0.501)	0.001 (0.004)
Market_to_book $t-1$	0.047* (0.026)	0.000 (0.000)
Past_stock_return_DID $t-1$	-0.004** (0.002)	-0.000 (0.000)
Leverage $t-1$	-2.495* (1.392)	-0.013 (0.008)
Cash $t-1$	2.095* (1.086)	0.009 (0.011)
ROA $t-1$	0.784 (1.976)	0.009 (0.017)
Firm FE	Yes	Yes
Year-quarter FE	Yes	Yes
Intercept	Yes	Yes
Obs.	11,153	11,153
Adj. R ²	0.750	0.400

Appendix A further compares research and patent application activities by innovation-intensive firms and control firms around the Supreme Court ruling in *TC Heartland*. The effect of *TC Heartland* on R&D activities is shown in Graph A; the effect on patent application activities is shown in Graph B. We use the earliest quarter (that is, quarter -6) before the ruling event (that is, quarter 0) as the reference quarter. We derive the effect of the Supreme Court ruling on firms' research and patenting activities from the regression coefficients of the quarter indicators in Equation (4), running on innovation-intensive firms and control firms separately:

$$Dep Var_{i,t} = \alpha + \sum_{q=-5}^6 \beta_q Event Qtr_q + \beta_7 Controls_{i,t-1} + Firm Fixed Effects + \varepsilon_{i,t}, \quad (4)$$

The figure also shows that the trends of R&D and patent application activities for innovation-intensive firms and control firms are parallel before the onset of the Supreme Court ruling in *TC Heartland* and the divergence occurs *only after the ruling quarter*. Thus, the parallel-trends assumption for the efficacy of the DID approach is satisfied and the documented treatment effects on firms' R&D and patenting activities are most likely driven by the Supreme Court ruling.

To summarize, results from the DID estimation and graphic analysis in this section suggest that the Supreme Court ruling in *TC Heartland* has a significant and likely causal effect on innovation-intensive firms' R&D and patenting activities. *TC Heartland* does not discourage R&D activities of the innovation-intensive firms relative to control firms, but it may make these firms more likely to keep their innovation outputs in the dark as trade secrets (as opposed to applying for patents) than before the ruling.

V. Conclusion

There is a debate on intellectual property protection enforcement in both public opinion and academic literature.⁴⁰ Enforcing intellectual property protection rewards innovators but may harm follow-up research and development by constraining positive knowledge externalities. There is little empirical evidence thus far on the effect of intellectual property protection enforcement on firm shareholder value and innovation activities. In this paper, we study the heterogeneous stock price reactions to the U.S. Supreme Court case *TC Heartland LLC v. Kraft Foods Group Brands LLC*, which significantly constrained forum shopping practices in patent infringement lawsuits. We document more negative stock price reactions to the ruling for firms that invested more heavily in R&D or knowledge assets, and firms that were granted more patents, in the year before the Supreme Court ruling in *TC Heartland*. Our empirical evidence suggests that the loosening of patent enforcement protection may harm shareholder value of innovation-intensive firms, as they may be less able to choose a friendly venue to sue potential patent infringers after the patent protection enforcement change.

We further find that innovation-intensive firms, relative to other patenting firms, significantly reduced their patent applications more in the post-ruling quarters. Interestingly, these firms, relative to other patenting firms, did not reduce their R&D investment after *TC Heartland*. That is, the weakened enforcement of patent protection does not discourage the innovation activities of the innovation-intensive firms. However, after the relaxation of patent protection enforcement, these firms are more likely to keep their innovation outputs as trade secrets and are less likely to apply for patents than before the patent protection enforcement change. The reduction in

⁴⁰ See *supra* notes 1, 2 and 3.

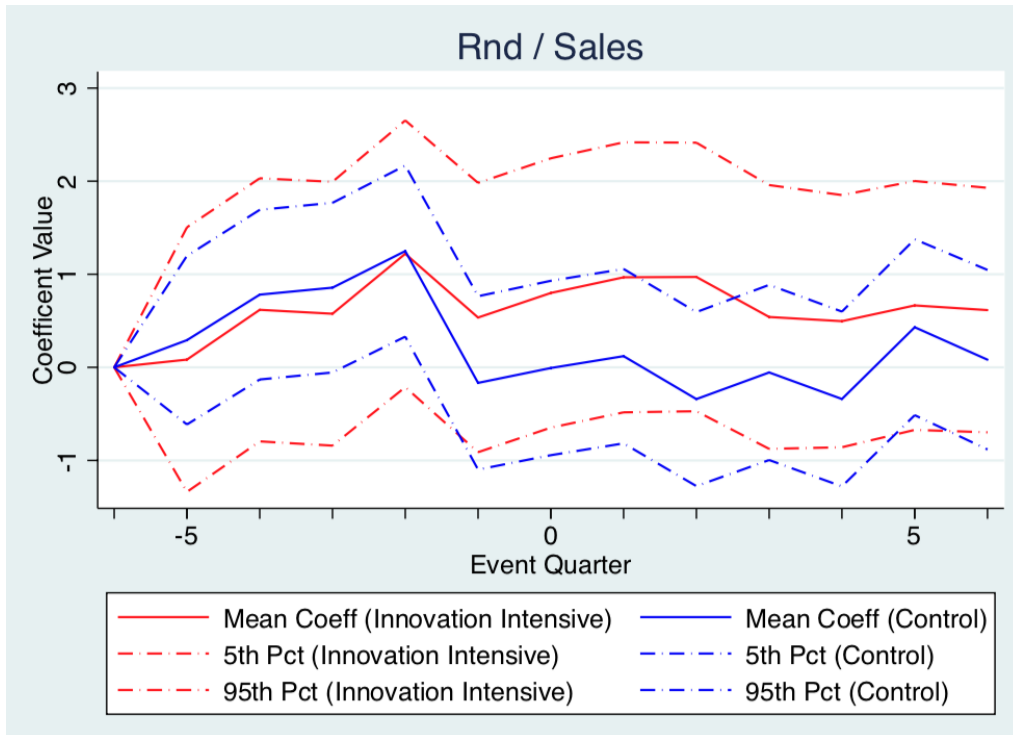
patenting activities by innovation-intensive firms implies that more innovations will remain in the dark as opposed to being disclosed to the public, constraining positive knowledge externalities that are beneficial for the development of the innovation ecosystem. Our findings shed new light on the longstanding debate on the role of patenting in protecting production-related knowledge, and the results may be of interest for practitioners, academics, and regulators.

VI. Appendices

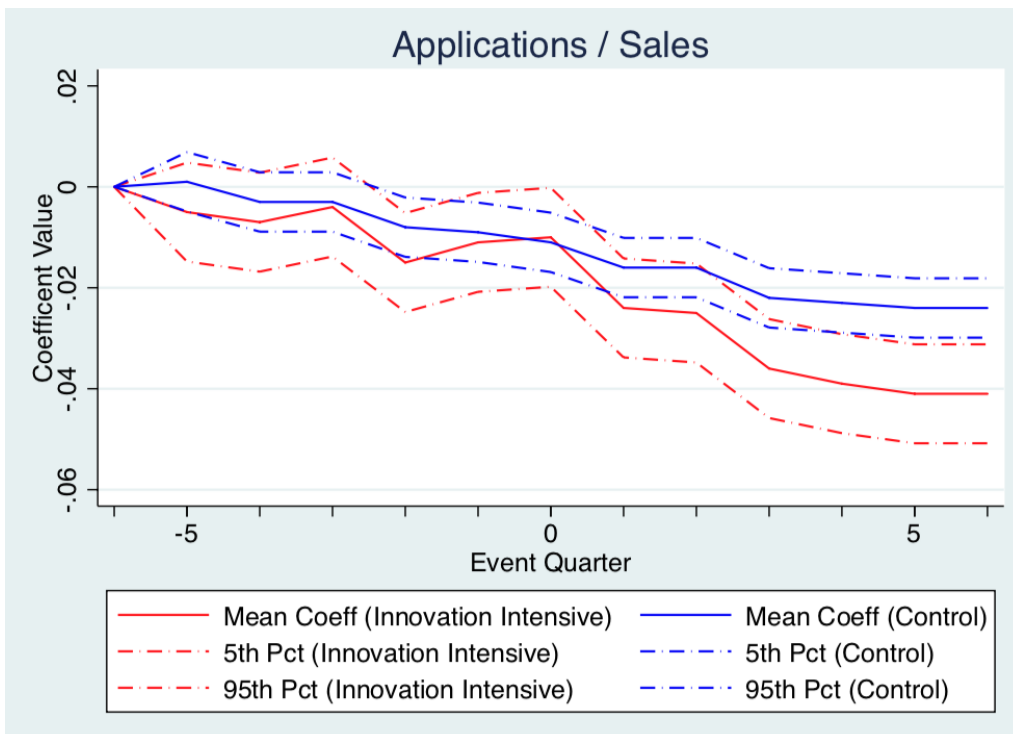
Appendix A. Firms' Research and Patent Application Activities Around the Supreme Court Ruling

This appendix compares research and patent application activities by innovation-intensive firms and control firms around the Supreme Court's ruling on forum shopping of patent cases. The effect of the Supreme Court ruling on R&D activities is shown in Graph A; the effect on patent application activities is shown in Graph B. We define innovation-intensive firms (red solid line) as firms that are in the top 10% of companies as measured by the total number of patents granted between 2013 and 2016. We define control firms (blue solid line) as firms that are in the bottom 90% of companies as measured by the total number of patents granted between 2013 and 2016. We use the earliest quarter (that is, quarter -6) before the ruling event (that is, quarter 0) as the reference quarter. We derive the effects of the Supreme Court ruling on firms' research and patenting activities from the regression coefficients of the quarter indicators in Equation (4), running on innovation-intensive firms and control firms separately. The graphs also provide 90% confidence intervals of the effect for innovation-intensive firms and control firms, respectively. Quarter 0 is the Supreme Court ruling quarter.

Graph A: R&D Activities Around the Supreme Court Ruling Quarter



Graph B: Patent Application Activities Around the Supreme Court Ruling Quarter



Appendix B. Variable Definitions
Panel A: Variables Used to Analyze Stock Price Reactions to the Ruling

Variable	Definition	Source
CAR (0, 1)	Cumulative abnormal return (in percentage) of the firm in the (0, 1) window, where day 0 is the date of the Supreme Court's ruling on forum shopping of patent cases; daily abnormal stock returns are calculated using the market-adjusted model and the CRSP value-weighted index with the estimation window being days (-200, -60) before the event date	CRSP
CAR (-159, -1)	Cumulative abnormal return (in percentage) of the firm in the (-159, -1) window, where day 0 is the date of the Supreme Court's ruling on forum shopping of patent cases; daily abnormal stock returns are calculated using the market-adjusted model and the CRSP value-weighted index with the estimation window being days (-360, -219) before the event date	CRSP
Rnd_sales	Ratio of firm's R&D spending to total sales	Compustat
Sga_sales	Ratio of firm's SG&A spending to total sales	Compustat
Patent_granted_sales	Number of firm's patents granted in the previous year divided by sales	Compustat, USPTO npedata.com
Plaintiff	Number of lawsuits in which the firm is a plaintiff in 2010 and 2012	npedata.com
Defendant	Number of lawsuits in which the firm is a defendant in 2010 and 2012	npedata.com
Firm_size	Natural logarithm of firm market capitalization	Compustat
Market_to_book	Market value of assets / book value of total assets	Compustat
Past_stock_return	The firm's buy-and-hold stock return in the (-210, -30) window, where day 0 is the date of the Supreme Court's ruling on patent cases forum shopping; buy-and hold abnormal stock return is calculated by subtracting the buy-and-hold CRSP value-weighted index return from the buy-and-hold stock return of the firm	CRSP
Leverage	Book value of debt / book value of assets	Compustat
Cash	Cash and cash equivalents on balance sheet scaled by book value of assets	Compustat
ROA	The firm's earnings before extraordinary items scaled by book value of assets	Compustat

Panel B: Variables Used to Analyze the Impact of the Ruling on Innovation Activities

Variable	Definition	Source
R&D / Sales	Ratio of firm's R&D spending to total sales	Compustat
Applications / Sales	Number of firm's patent applications divided by total sales	Compustat, USPTO
Ln_total_assets	Natural logarithm of firm total assets	Compustat
Market_to_Book	Market value of assets / book value of total assets	Compustat
Past_stock_return_DID	The firm's buy-and-hold stock return over the last twelve months	CRSP
Leverage	Book value of debt / book value of assets	Compustat
Cash	Cash and cash equivalents on balance sheet scaled by book value of assets	Compustat
ROA	The firm's earnings before extraordinary items scaled by book value of assets	Compustat
State Income	Natural logarithm of total income of the state which the firm's headquarters is located in	Bureau of Economic Analysis
State Income Growth	Percentage change in the total income of the firm's headquarter state from year t-1 to year t	Bureau of Economic Analysis
Per Capita State Income	Natural logarithm of per capita income of the state which the firm's headquarters is located in	Bureau of Economic Analysis
Innovation Intensive	Equals 1 if the firm is in the top 10% of patenting companies as measured by the total number of patents granted between 2013 and 2016 and equals 0 if it is in the bottom 90% of patenting companies	USPTO
Post Ruling	Equals 1 if the quarter is after the Supreme Court ruling and equals 0 otherwise	

Appendix C. Summary Statistics

The table reports descriptive statistics of our samples. The first sample consists of stock price reactions and firm characteristics on the day of the Supreme Court's ruling in *TC Heartland* (that is, May 22, 2017). The second sample consists of variables on firm innovation activities and firm-level and state-level characteristics. A detailed description of the variables is presented in Appendix B. All continuous variables are winsorized at the 1st and 99th percentiles. We report the means, medians, standard deviation, 25th percentile, 75th percentile, and numbers of observations for the variables used in our study.

Panel A: Variables Used to Analyze Stock Price Reactions to the Ruling

	N	Mean	Median	St.Dev	p25	p75
CAR (0, 1)	3093	-0.100	0.000	3.654	-1.324	1.172
CAR (-159, -1)	3027	-0.102	2.260	41.977	-13.459	16.498
Rnd_sales	3093	0.962	0.000	5.565	0.000	0.055
Sga_sales	3093	0.375	0.206	0.797	0.055	0.417
Patent_granted_sales	2962	0.053	0.000	0.264	0.000	0.002
Plaintiff	3093	0.095	0.000	1.147	0.000	0.000
Defendant	3093	0.251	0.000	1.968	0.000	0.000
Firm_size	3093	6.418	6.439	2.134	4.881	7.887
Market_to_book	2831	3.725	1.998	5.911	1.202	3.822
Past_stock_return	3093	10.817	11.942	30.782	-4.554	26.157
Leverage	3089	0.379	0.336	2.722	0.057	0.560
Cash	3055	0.211	0.094	0.261	0.033	0.275
ROA	3081	-0.098	0.010	0.638	-0.067	0.050

Panel B: Variables Used to Analyze the Impact of the Ruling on Innovation Activities

	N	Mean	Median	St.Dev	p25	p75
R&D / Sales	33992	1.174	0.000	6.801	0.000	0.069
Applications / Sales	33992	0.006	0.000	0.036	0.000	0.000
Ln_total_assets	36262	6.787	6.874	2.264	5.172	8.337
Market_to_Book	33583	4.150	2.140	6.632	1.323	4.131
Past_stock_return_						
DID	33933	8.209	6.257	46.704	-18.993	29.538
Leverage	36230	0.389	0.352	0.370	0.069	0.565
Cash	35705	0.221	0.093	0.273	0.032	0.301
ROA	36187	-0.027	0.002	0.092	-0.022	0.012
State Income	35454	13.415	13.273	0.921	12.750	14.280
State Income						
Growth	35454	2.219	1.976	1.491	1.326	3.113
Per Capita State						
Income	35454	10.827	10.835	0.146	10.718	10.950

Appendix D. Correlation Matrix

The table reports the correlations between different variables in our sample. The sample consists of stock-price reactions and state-, industry-, and firm-level characteristics on the day of the Supreme Court's ruling in *TC Heartland* (that is, May 22, 2017). A detailed description of the variables is presented in Appendix B.

Panel A: Variables Used to Analyze Stock Price Reactions to the Ruling

	CAR (0, 1)	CAR (-159, -1)	Rnd_sales	Sga_sales	Patent_grant ed_sales	Plaintiff	Defendant
CAR (-159, -1)	0.066						
Rnd_sales	-0.086	-0.100					
Sga_sales	-0.097	-0.029	0.185				
Patent_granted_sales	-0.065	-0.063	0.473	0.168			
Plaintiff	-0.002	-0.012	-0.011	0.005	-0.004		
Defendant	-0.001	-0.002	-0.019	-0.007	-0.013	0.330	
Firm_size	0.075	0.140	-0.140	-0.214	-0.148	0.108	0.168
Market_to_book	-0.034	-0.057	0.039	0.078	0.045	0.007	0.027
Past_stock_return	0.079	0.760	-0.120	-0.069	-0.080	-0.002	0.002
Leverage	0.018	0.006	0.032	-0.064	-0.022	-0.002	0.002
Cash	-0.050	-0.081	0.355	0.205	0.406	0.012	0.005
ROA	0.036	0.112	-0.234	-0.183	-0.155	0.018	0.026

	Firm_size	Market_to_book	Past_stock_return	Leverage	Cash
Market_to_book	0.145				
Past_stock_return	0.234	-0.071			
Leverage	0.043	0.178	0.036		
Cash	-0.251	0.181	-0.110	-0.026	
ROA	0.243	0.043	0.143	0.041	-0.261

Panel B: Variables Used to Analyze the Impact of the Ruling on Innovation Activities

	R&D / Sales	Application s / Sales	Ln_total_asset s	Market_to_Boo k	Past_stock_return_DI D	Leverag e
Applications / Sales	0.193					
Ln_total_assets	-0.205	-0.146				
Market_to_Book	0.044	0.059	-0.124			
Past_stock_return_DID	-0.087	-0.042	0.141	0.167		
Leverage	-0.113	-0.082	0.266	0.174	-0.053	
Cash	0.414	0.265	-0.504	0.204	-0.044	-0.313
ROA	-0.332	-0.145	0.504	-0.167	0.240	0.065
State Income	0.058	0.082	-0.137	0.074	-0.034	-0.074
State Income Growth	0.064	0.121	-0.152	0.056	-0.117	-0.063
Per Capita State Income	0.090	0.041	-0.135	0.070	0.016	-0.101
		Cash	ROA	State Income	State Income Growth	
ROA		-0.496				
State Income		0.208	-0.131			
State Income Growth		0.203	-0.135	0.343		
Per Capita State Income		0.269	-0.145	0.315	-0.010	