

Patents & Legal Expenditures

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I. INTRODUCTION

Universities are engines of innovation. To encourage further innovation, the federal government and charitable foundations give universities grants in order to enable university researchers to produce the inventions and discoveries that will continue to fuel our knowledge economy. Among other things, the Bayh-Dole Act of 1980 was supposed to encourage additional innovation by enabling universities to patent inventions and discoveries produced using federal funds and to license those patents to private companies, rather than turning their patent rights over to the government. The Bayh-Dole Act unquestionably encouraged universities to patent inventions and license their patents. Since the passage of the Act, all major research universities have increased their presence in the patent sector and created technology transfer offices to manage their patent portfolios. While the Bayh-Dole Act can be viewed as successful in this regard, the Act and other patent policy changes since 1980 may have also created perverse incentives to which universities have responded.

It appears that university patents also make universities increase their legal expenses. We present a preliminary empirical study of the relationship between university patents and university legal expenses. Our findings show that increases

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in university patent applications, patent grants, and research expenditures are associated with increases in legal expenses. Particularly, our analysis demonstrates that relatively small increases in university research expenditures are associated with much larger increases in legal expenses.

A. A Brief History of University Patents

Universities seldom held patents prior to the 20th Century. Throughout the 19th century, universities typically made the inventions and discoveries produced by university researchers freely available for public use. Universities were supposed to advance the public good, and they tended to see the free exchange of information and ideas as intrinsic to that mission. And, if sharing exciting new inventions and discoveries helped increase institutional prestige, all the better.¹ Thus, the history of university patents really begins in the early 20th century.

B. The Origin of University Patents

In the early 20th century, some universities and researchers began to question the conventional wisdom and begin pursuing patent protection. Most notably, when Frederick Gardner Cottrell of the University of California invented a method of controlling industrial pollution in 1907, he decided to patent his invention and use the proceeds to fund scientific research. Cottrell created the Research Corporation to acquire and license patents for inventions and discoveries produced by university researchers and then use the licensing proceeds to fund basic scientific research.²

But university patents remained unusual and often unavailable. Many universities and researchers avoided patenting inventions and discoveries, and others were precluded from applying for patents. Although the federal government began to provide modest research funding to universities, it stipulated that universities could not patent any federally-funded inventions and discoveries, unless they had an approved technology transfer system.³

Universities soon became dependent on government research funding. But, after the First World War and during the Great Depression, federal funds gradually dried up, and many universities struggled to find alternative sources of funding.⁴

The advent of the Second World War made scientific research a national priority once again. Suddenly, federal research funding to universities began to

1. See STUART LESLIE, *THE COLD WAR AND AMERICAN SCIENCE: THE MILITARY-INDUSTRIAL-ACADEMIC COMPLEX AT MIT AND STANFORD* 4 (1993).

2. See *id.* at 4 (noting that the Research Corporation was the precursor to modern technology transfer offices and still exists today).

3. Gary Pulsinelli *Share and Share Alike: Increasing Access to Government-Funded Inventions Under the Bayh-Dole Act*, 7 MINN. J.L. SCI. & TECH. 393, 400–01 (2006).

4. See LESLIE, *supra* note 1, at 18.

flow quite liberally, especially for research with potential military applications.⁵ In 1940, President Roosevelt created the National Defense Research Committee (“NDRC”) to coordinate federal research funding programs as a response to concerns that military research funding programs were too conservative. The NDRC directed a significant proportion of federal research funding to universities hoping that its investment in basic scientific research would produce inventions and discoveries with military applications. As a result of NDRC funding, top research universities attracted some of the most promising scientists and engineers.⁶

When the Second World War ended, the future of federal research funding was initially unclear. But pressure from academic, political, and military leaders—especially General Dwight Eisenhower—prompted the federal government to continue funding university research. Among other things, government agencies observed that university research had been critical of the war effort and argued that continued investment in the sciences would advance national security goals.⁷ Under President Truman, the federal government further increased research funding, not only to improve national defense, but also to encourage innovation and economic growth.⁸

While robust federal research funding continued throughout the Cold War, universities lacked any private incentive to invest in the production or commercialization of federally-funded research. Government policy required universities to transfer title to any inventions or discoveries produced by federally-funded research to the federal government, which eventually became the custodian of thousands of patents. Unfortunately, the government largely failed to commercialize its rapidly growing patent portfolio. Many people believed government ownership of those patents was the culprit and argued that universities could facilitate the commercialization of patents more effectively than the government.⁹

Thus, in the 1970s, the federal government began considering how to increase the commercialization of its patents. President Carter created the Office of Science and Technology Policy (“OSTP”) in order to study the innovation sector and determine how to encourage cooperation between universities and private companies.¹⁰ The OSTP observed that universities might disclose and license

5. *Id.* at 20.

6. Some of those universities had enormous federal research budgets. The MIT research program rivaled the Manhattan Project in size and funding with a staff of 4,000 and an annual budget of \$13 million. *Id.* at 21–23.

7. *Id.* at 25.

8. Vanessa Bell, *The State Giveth and the State Taketh Away: Patent Rights Under the Bayh-Dole Act*, 24 S. CAL. INTERDISC. L.J. 491, 503 (2015).

9. Robert M. Yeh, *The Public Paid for the Invention: Who Owns It?*, 27 BERKELEY TECH. L.J. 453, 471 (2012). The federal government licensed fewer than 5 percent of over 28,000 federally owned patents out of over 28,000. Of course, many of the patents owned by the federal government covered military technology excluded from commercialization.

10. Dov Greenbaum, *Academia to Industry Technology Transfer: An Alternative to the Bayh-Dole System for Both Developed and Developing Nations*, 19 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 311, 350 (2009).

patents more efficiently than the federal government.¹¹

The Bayh-Dole Act of 1980 was intended to encourage innovation and commercialization by allowing universities to patent many of the inventions and discoveries produced by federally-funded research.¹² The Act worked, at least insofar as it encouraged universities to apply for patents and try to license the patents they received. Almost immediately, universities began creating technology transfer officers to manage their patent applications and burgeoning patent portfolios.¹³ Between 1990 and 2000, invention disclosures by university technology transfer offices increased by 79%, patent applications by universities swelled by 253%, patents granted to universities grew by 131%, and start-up companies based on university research increased by 92%.¹⁴

The growth trend continued despite the 2008 recession.¹⁵ And, after the America Invents Act (“AIA”) of 2011, universities began to file even more patent applications.¹⁶ In 2014 alone, the Patent Office issued 5,990 university patents, more than double the 2,293 it issued in 1996.

C. University Patenting as a Function of Patent Policy Incentives

Since Bayh-Dole, the number of patents granted to universities has increased more than thirtyfold from just 240 in 1980 to over 7,500 in 2016.¹⁷ Many people point to the enormous growth in university patents issued as evidence of the effectiveness of the Bayh-Dole Act. But critics argue that Bayh-Dole negatively impacted the innovation sector by reducing core goals of the patent law regime, especially disclosure. Historically, scholars who produced inventions or discoveries immediately published their research findings. Today, universities and their technology transfer offices encourage—or even require—scholars to delay publication until a patent is filed, or sometimes even longer.¹⁸ This shift away from disclosure marked a departure from long-held disciplinary norms. In 1966, 50% of biologists were comfortable with sharing their current research with others,

11. Bell, *supra* note 8, at 495.

12. Llewellyn Joseph Gibbons, *Tech Transfer: Everything (Patent) Is Never Quite Enough*, 48 U. LOUISVILLE L. REV. 843, 848 (2010).

13. *See, e.g.*, Christopher J. Ryan, Jr. & Brian L. Frye, *An Empirical Analysis of University Patent Activity*, 7 N.Y.U. J. INTEL. PROP. & ENT. L. 5351 (2018).

14. *See* LESLIE, *supra* note 1, at 20.

15. Arvids Ziedonis, *Empirical Analyses Related to University Patenting*, 2 HANDBOOK OF THE ECON. OF INTEL. PROP. L. 1 (July 23, 2017); *University Patent Count & Expenditures*, USPTO, <https://developer.uspto.gov/visualization/university-patent-count-expenditures> (last visited Feb. 1, 2020) (on file with *The University of the Pacific Law Review*).

16. Ryan & Frye, *supra* note 13.

17. *See, e.g.*, Gerald Barnett, *Government Interest Patent Activity 1976-2016, Part 1*, RES. ENTERPRISE (Feb. 22, 2017), <https://researchenterprise.org/2017/02/22/government-interest-patent-activity-1976-to-2016-part-1/> (on file with *The University of the Pacific Law Review*); *Id.*; Ziedonis, *supra* note 15; *University Patent Count & Expenditures*, *supra* note 15; AUTM U.S. Licensing Survey: FY 2004, AUTM 2 (2004).

18. Margo A. Bagley, *Academic Discourse and Proprietary Rights: Putting Patents in Their Proper Place*, 47 B.C. L. REV. 217, 218 (2006).

compared with only 26% in 1998.¹⁹

Critics of the Bayh-Dole Act also argue that the law creates incentives for universities to pursue patents for the sake of generating revenue, often at the expense of the public good. For example, in the early 1980s, researchers at Harvard University and the University of California, San Francisco collaborated on the development of a genetically-designed mouse for cancer research, which came to be known as the OncoMouse.²⁰ The Harvard technology transfer office recognized the enormous commercial potential of the OncoMouse and patented it in 1988.²¹ Harvard then licensed the patent to Dupont, which limited access to the OncoMouse to researchers willing and able to pay Dupont for it, even though researchers otherwise could have produced the OncoMouse themselves much more inexpensively.

Similarly, researchers at the University of Utah isolated the BRCA1 and BRCA2 genes, which are genetic markers for breast cancer, and the university patented the discovery.²² The university then granted an exclusive license to the patent to Myriad, a company founded by the University of Utah professor who led the research team that isolated the BRCA genetic markers.²³ The patent ultimately generated more than \$1 billion in revenue for Myriad and the university.²⁴ But that revenue came at the expense of breast cancer patients, who had to pay more for BRCA-based tests, and the patent may have limited innovation in breast cancer research.²⁵

D. The Business of University Patenting and Technology Transfer

University patents and technology transfer offices have produced a considerable amount of income for some universities. In 2006, patents owned by 189 universities produced a total of more than \$1.5 billion in revenue.²⁶ By 2016, university patents generated more than \$2.2 billion, nearly a 47 percent growth in one decade.²⁷ However, more than 80 percent of the revenue generated by

19. *Id.*

20. JACOB ROOKSBY, *THE BRANDING OF THE AMERICAN MIND: HOW UNIVERSITIES CAPTURE, MANAGE, AND MONETIZE INTELLECTUAL PROPERTY AND WHY IT MATTERS 1* (2016).

21. *Id.* at 2.

22. *Id.* at 122. The Supreme Court later reversed the patent grant as the researchers had only discovered the gene and not invented anything. *See id.* at 127.

23. *Id.* at 123.

24. *Id.* at 124.

25. *Id.* at 124–25.

26. Gibbons, *supra* note 12, at 850.

27. Dave Merrill, Blacki Migliozi & Susan Decker, *Billions at Stake in University Patent Fights*, BLOOMBERG (May 24, 2016), <https://www.bloomberg.com/graphics/2016-university-patents/> (on file with *The University of the Pacific Law Review*). In fact, estimates during this time indicate that universities may derive between \$2.2 and \$2.6 billion from their patent portfolios and hold nearly 25 percent of all patents issued by the USPTO. Maria Teresita Barker, *Patent Litigation Involving Colleges and Universities: An Analysis of Cases from 1980 – 2009*, DISSERTATION AT THE UNIV. OF IOWA 5 (July 2011), available at <https://ir.uiowa.edu/cgi/viewcontent.cgi?article=2585&context=etd> (on file with *The University of the Pacific*

university patents goes to about 20 universities.²⁸ While a few university patents are extremely valuable, the vast majority are basically worthless.²⁹ At universities with large patent portfolios, less than 10 percent of the patents typically generate 85 percent or more of the revenue. While university patents appear to be an attractive way for universities to diversify their revenue stream, in reality, they are more of a risky gamble than a sure investment.³⁰ Indeed, many universities have created unsuccessful patent programs that ultimately generate little revenue or even lose money.³¹

Overinvestment in university patents is a problem because most university research is supported by federal funding.³² In fact, in the 1960s, federal agencies provided more than 70% of the total funding for university research.³³ While the proportion of university research funded by federal agencies has gradually decreased, 26 federal agencies and their subsidiaries still provide more than 60% of the funding for all university research, providing more than \$30 billion in federal research grants in 2017 alone.³⁴ Two of the largest federal granting agencies funding university research are the National Institutes of Health (“NIH”) and the

Law Review).

28. Gibbons, *supra* note 12, at 850.

29. On average, over the last 20 years, 87 percent of technology transfer offices at universities operated in the red. In part, this operating deficit is due to universities netting only a third of the licensing revenue they collect while paying for operating expenditures of their technology transfer offices. Typically, one of patent licensing revenue collected by transfer offices goes to the inventors, one third to the lab, and the final one third to the university. *Id.* In addition, the current system favors the universities at the top of the federal funding lead tables, each of which have a 30 percent chance of having a blockbuster patent, as compared with the 100th best-funded university, which has a less than 5 percent chance of landing a lucrative patent. Walter D. Valdivia, *University Start-Ups: Critical for Improving Technology Transfer*, CTR. FOR TECH. INNOV. AT BROOKINGS 6 (Nov. 2013).

30. See, e.g., Brian L. Frye & Christopher J. Ryan, Jr., *Technology Transfer and the Public Good*, in RESEARCH HANDBOOK OF INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER (forthcoming 2019).

31. See *id.*; Ziedonis, *supra* note 15, at 24; *University Patent Count & Expenditures*, *supra* note 15.

32. *R&D at Colleges and Universities*, AAAS (2018), available at <https://www.aaas.org/programs/r-d-budget-and-policy/rd-colleges-and-universities> (on file with *The University of the Pacific Law Review*). The remainder of university research funding typically comes from the university itself, the state or local government, industry, and other private organizations. See generally, Greenbaum, *supra* note 10, at 350.

33. See ROOKSBY, *supra* note 20, at 125.

34. See *id.*; see also, *Grant-Making Agencies*, GRANTS.GOV (2019), available at <https://www.grants.gov/web/grants/learn-grants/grant-making-agencies.html> (on file with *The University of the Pacific Law Review*) (detailing the following non-exhaustive list of federal agencies that fund university research directly or through their subsidiaries: U.S. Agency for International Development (USAID); Corporation for National and Community Service (CNCS); U.S. Department of Agriculture (USDA); U.S. Department of Commerce (DOC); U.S. Department of Defense (DOD); U.S. Department of Education (ED); U.S. Department of Energy (DOE); U.S. Department of Health and Human Services (HHS); U.S. Department of Homeland Security (DHS); U.S. Department of Housing and Urban Development (HUD); U.S. Department of the Interior (DOI); U.S. Department of Justice (DOJ); U.S. Department of Labor (DOL); U.S. Department of State (DOS); U.S. Department of Transportation (DOT); U.S. Department of the Treasury (TREAS); U.S. Department of Veterans Affairs (VA); Environmental Protection Agency (EPA); Institute of Museum and Library Services (IMLS); National Aeronautics and Space Administration (NASA); National Archives and Records Administration (NARA); National Endowment for the Arts (NEA); National Endowment for the Humanities (NEH); National Science Foundation (NSF); Small Business Administration (SBA); and Social Security Administration (SSA)).

National Science Foundation (“NSF”). In 2017, the NIH awarded over \$18.3 billion in research grants,³⁵ and the NSF awarded over \$5.13 billion in research grants.³⁶ In other words, the public pays for most university research in the form of federal research grants, and the public should benefit from the fruits of that research. When universities license patents to private businesses for the purpose of commercialization, the public is paying twice.³⁷

The Bayh-Dole Act effectively encourages universities to ignore the public interest in the disclosure and dissemination of the inventions and discoveries produced by publicly-funded university research. Rather than spurring universities to disclose inventions and discoveries and make them freely available, the Act incentivizes universities to focus on recouping their investments in human capital and other expenses by licensing patents.³⁸ Unlike private businesses, universities typically lack the capacity to commercialize their patents and must license them to private businesses, including patent assertion entities.³⁹ Ironically, universities are “non-practicing entities,” almost by definition, and their behavior often reflects the pathologies associated with non-practicing entities. Many private industries view universities as “‘crack addicts’ directed by ‘small minded tech transfer offices,’” primarily because universities often demand patent licensing fees that far exceed market rates.⁴⁰

Moreover, universities often simply assign their patents to patent assertion entities. The United States Patent and Trademark Office (“USPTO”) recently released data showing that universities assign their patents at considerably higher rates than other entities. In fact, in the first two months of 2019, four of the five highest-volume patent assigning entities were universities.⁴¹ And, patents

35. *NIH Awards by Location & Organization*, NIH REPORT (2018), available at <https://report.nih.gov/award/index.cfm> (on file with *The University of the Pacific Law Review*). Leading all universities in 2017, Johns Hopkins University received \$651,844,903 of funding from the NIH to support research. See *id.* Incidentally, Johns Hopkins University has among the largest patent portfolios in the country. See *University Patent Count & Expenditures*, *supra* note 15.

36. *Award Summary: by Top Institutions*, NSF (2018), available at <https://dellweb.bfa.nsf.gov/Top50Inst2/default.asp> (on file with *The University of the Pacific Law Review*) (noting that the universities at the top of the lead tables for NSF funding in 2017 were Oregon State University, receiving \$167,469,000, and University of Illinois, receiving \$147,742,000).

37. See U.S. CONST. ART. I, § 8 (containing the famous clause that patents should “promote the progress of science and useful arts”).

38. See ROOKSBY, *supra* note 20, at 1, 136; see also David Winickoff, *Private Assets, Public Mission: The Politics of Technology Transfer and the New American University*, 54 JURIMETRICS J. 1 (2013). While the invention rights typically vest in the inventor, universities are able to require their employees to assign their invention rights to the university if substantial university resources were used in the research and development of the invention. Some universities define substantial cost based on a base amount (for example \$15,000) while others tend to leave the definition more undefined. See *R&D at Colleges and Universities*, *supra* note 32.

39. Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611 (2008).

40. In fact, university licensing fees exceeded standard market rates for licensing fees by as much as 60 percent. See *id.* (citing Mark A. Lemley, *Patenting Nanotechnology*, 58 STANFORD L. REV. 601 (2005)).

41. Stefania Fusco, Francesco Lissoni, Catalina Martinez, and Valerio Sterzi, *Monetization Strategies of University Patents Through PAEs: An Analysis of US Patent Transfers*, SSRN Working Paper, 1 (2019), available

ultimately may not even be the most profitable strategy for many universities. Technology transfer offices often assume that a total return strategy—profiting the university at the cost of disclosure—eventually makes the university’s research and development expenditures profitable and socially valuable.⁴² However, data from the past several decades shows that the most economically successful innovation ventures are those that bring new technology to the market, rather than license patents.⁴³

Most economists studying the innovation sector believe that the American economy is fundamentally based on knowledge and that the primary driver of economic growth is innovation, rather than capital accumulation.⁴⁴ Likewise, the USPTO, under its current director Andrei Iancu, has stated that it wants to clarify and streamline patent examination and post-grant procedures to produce higher quality patents in the hope of catalyzing further innovation.⁴⁵ This important shift in patent policy may reflect a realization that existing patent doctrine not only protects innovators from imitators but also inhibits improvements that build on existing innovation—externalities that negatively impact competition and increase the likelihood of litigation.⁴⁶

E. Trends in Patent Litigation

Patent litigation has consistently increased since the enactment of the AIA in 2011. In general, the growth rate in patent litigation exceeded the rate at which

at

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3410086&dgcid=ejournal_html_email_intellectual:property&patent:law:ejournal_abstractlink (on file with *The University of the Pacific Law Review*) (noting that the four universities are: University of Pennsylvania, University of Alabama, University of Michigan and University of Colorado).

42. Brian Krumm, *Regulatory Policy in the Trump Era and its Impact on Innovation*, 70 *MERCER L. REV.* 685, 687 (2019).

43. *Id.* (mentioning Kodak, who were the first to invent the digital camera but chose not to commercialize the invention in order to preserve their film business and filed for bankruptcy in 2012 after Sony brought digital cameras to market in 1981 destroying Kodak’s business).

44. *Id.* at 691 (arguably deregulation can promote innovation by allowing entities to focus more on incentives as opposed to adhering to regulatory standards).

45. *Id.* at 697 (by clearly defining test to obtain patents it is believed this greater clarity will see the patent grant system as more reliable).

46. See Silvana Krasteva, Priyanka Sharma, & Chu Wang, *Patent Policy, Imitation Incentives, and The Rate of Cumulative Innovation*, SSRN WORKING PAPER, 26, 28 (2019), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3411158&dgcid=ejournal_html_email_intellectual:property&patent:law:ejournal_abstractlink (on file with *The University of the Pacific Law Review*) (noting that for low levels of patent validity, a longer patent is more desirable while that is not the case for patents with high validity; also finding that longer patent terms also increase the inventor’s payoff and stimulate innovation, but they also tend to increase the size of expected damages and therefore drive-up litigation costs, further stifling innovation as newer innovators are deterred through fear of high damage awards in litigation); see also, Irina Manta & Mattias Ottervik, *Blunting the Later-mover Advantage: Intellectual Property and Knowledge Transfer*, 52 *AKRON L. REV.* (forthcoming 2019) (noting that nations with nascent intellectual property protections mimic earlier movers, like the United States, and as a result may overprotect inventions at the expense of innovation).

patents were granted from 1996 to 2017.⁴⁷ Considering the time period between 1998-2017, the number of patents has grown every year, except for 2002, and the periods between 2003 and 2009.⁴⁸ During this same time, the compound annual growth rate of patents granted has exceeded the rate of patent case filings in all years—except 2010—between 1998 and 2013.⁴⁹ Since that time, the compound annual growth rate of patent litigation has exceeded the rate at which patents were granted. In 2012, nearly 6,500 patents were granted, but in 2017, just over 4,000 patents were granted.⁵⁰ During the same timeframe—between 2012 and 2017—the number of patent cases filed has grown from over 275,00 to nearly 350,000.⁵¹ While patent cases filed used to trend similarly to number of patents granted, recently, the number of cases filed in the district courts began a downward trend after they hit their peak in 2011, but a larger proportion of these cases now count universities or their assignees as patent litigants.⁵²

Moreover, the top ten largest initial adjudicated damage awards from patent infringement judgements between 1998–2017 illustrate how lucrative patent litigation can be. For example, the average monetary award among these judgments was \$1.11 billion, with an award range between \$482 million and \$2.54 billion.⁵³ While the annual median award for patent infringement suits has increased linearly since 1998, excluding summary and default judgements, the median damage awards are trending upward: \$6.5 million on average in 60 cases between 1998 and 2002; \$7.8 million in 128 cases between 2003 and 2007; \$7.9 million in 124 cases between 2008 and 2012; and \$9.2 million in 173 cases

47. See Landan Ansell, Ronen Arad, Doug Branch, HyeYun Lee, Adil Pasha, & Paul Robinson, *2018 Patent Litigation Study*, PRICEWATERHOUSECOOPERS 2 (2018), available at <https://www.ipwatchdog.com/wp-content/uploads/2018/09/2018-pwc-patent-litigation-study.pdf> (on file with *The University of the Pacific Law Review*) (noting that not every university led lawsuit is successful for universities, however. In 2012, the University of California had a patent covering web browsers invalidated.); see Joe Mullin, *Texas Jury Strikes Down Patent Troll's Claim to Own the Interactive Web*, WIRED (Feb. 9, 2012), <https://www.wired.com/2012/02/interactive-web-patent/> (on file with *The University of the Pacific Law Review*) (detailing that also in 2000, the University of Rochester employed an eight-figure legal fund to keep a well-noted maker of a drug, Celebrex, from infringing on their patent for an arthritis drug, which the court invalidated as being too generic); see Goldie Blumenstyk, *Federal Court Dismisses U. of Rochester's that Sought Billions for Patent Infringement*, CHRONICLE OF HIGHER EDUC. (Mar. 21, 2003), <https://www.chronicle.com/article/Federal-Court-Dismisses-U-of/25122/> (on file with *The University of the Pacific Law Review*).

48. See Ansell, Arad, Branch, Lee, Pasha, & Robinson, *supra* note 47.

49. See *id.* (noting that the compound annual growth rate (CAGR) for patents granted in the US is 4.4 percent per annum, while the CAGR for patent case filings trails at 3.4 percent per annum).

50. *Id.* (explaining that this is largely a function of the fact that the America Invents Act created a first-inventor-to-file incentive, replacing the previous first-to-invent system); see P.L. 112-29 (2012).

51. See *id.*

52. See *id.*; see also Shawn P. Miller, Ashwin Aravind, Bethany Bengfort, Clarisse De La Cerda, Matteo Dragoni, Kevin Gibson, Amit Itai, Charles Johnson, Deepa Kannappan, Emily Kehoe, Hyosang Kim, Katherine Mladinich, Roberto Pinho, John Polansky & Brian Weissenberg, *Who's Suing Us? Decoding Patent Plaintiffs Since 2000 with the Stanford NPE Litigation Dataset*, 21 STAN. TECH. L. REV. 235, 260 (2018) (noting a spike in lawsuits around the passage of the America Invents Act (AIA) in 2011 with a decline afterwards leading into 2014).

53. Ansell, Arad, Branch, Lee, Pasha, & Robinson, *supra* note 47, at 3.

between 2013 and 2017.⁵⁴ These descriptive findings indicate the notable growth of and incentives for patent litigation in the last two fiscal decades, but the role of university participation in patent litigation has largely been understudied until recently.

Researchers at Stanford University conducted a study compiling data from patent litigation lawsuits between 2000–2015, categorizing involved parties into one of thirteen categories, with two categories comprised of universities or entities with university heritage or association.⁵⁵ While cases tied to a university (1.4 percent) or an entity historically tied to a university (0.2 percent) made up only 1.6 percent of the dataset and therefore the participants in patent litigation cases between 2000–2015, universities or their historical offshoots comprised the second largest group of non-practicing entities, after inventors themselves, involved in the 10,812 total cases analyzed.⁵⁶

Additional studies in this area indicate that litigated patents are more likely to be assigned to patent assertion entities.⁵⁷ While many scholars would point to patent trolls—or patent assertion entities (“PAEs”)—as the drivers of patent litigation, a large empirical study found that PAEs do not typically enforce poor quality patents.⁵⁸ Rather, PAEs increase the successful monetization of objectively valuable patents that would otherwise go underutilized.⁵⁹ This is not to say that PAEs meaningfully work to realize disclosure and other societal benefits. In fact, PAEs respond to the same perverse incentives that universities do. As such, they do not contribute meaningfully to the innovation economy because they are not incentivized to do so.

Universities do not shy away from litigation. Between 1980 and 2009,

54. *See id.* at 5.

55. *Id.* at 2.

56. *See* Miller, Aravind, Bengfort, De La Cerda, Dragoni, Gibson, Itai, Johnson, Kannappan, Kehoe, Kim, Mladinich, Pinho, Polansky & Weissenberg, *supra* note 52, at 253–57; *see also*, Ansell, Arad, Branch, Lee, Pasha, & Robinson, *supra* note 47; *see* Miller, et al., *supra* note 52, at 235–57 (discussing how the most litigated patent technologies in 2014 were those concerning computer and software or medical and pharmaceuticals, which comprised over 70 percent of the total litigated patent cases that year).

57. Jay P. Kesan, Anne Layne-Farrar, & David L. Schwartz, *Understanding Patent “Privateering”: A Quantitative Assessment*, 16 J. EMPIRICAL LEGAL STUDIES 343, 366–67 (2019).

58. *Id.* at 366.

59. *Id.* at 374; *see also* Gary A. Wagner & Jamie Bologna Pavlik, *Patent Intensity and Concentration: The Effect of Institutional Quality on the MSA Patent Activity*, 1–35, 20 (Apr. 3, 2019), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3365314 (on file with *The University of the Pacific Law Review*). Research has been done to see what economic measures increase patent productivity among citizens as many governments want to encourage innovation, as it can be a major economic driving force. The study ultimately concluded that most government measures to encourage innovation have had little effect. The report did find a minor correlation between economic freedom and a lower concentration of innovation in both firms and individuals. *Id.* at 21. The study ultimately concluded most government measures to encourage innovation have had little effect. However, the report did find a minor correlation between economic freedom and a lower concentration of innovation in both firms and individuals. *Id.* The innovative activity is spread out across a wider variety of firms and individuals who invent a wider variety of products when there is more economic freedom allowed by the government. *Id.*

universities were involved in 568 patent litigation cases.⁶⁰ In 171 of those cases, the defendant was a frequent competitor to the entities with which a research university had a licensing agreement.⁶¹ In one quarter of these cases, five universities were implicated, either as litigants or parties for whom the litigation had bearing, while 85 universities were only involved in one patent litigation case.⁶² While it may appear that only a few select universities are involved in patent litigation, between 90–97 percent of patent cases settle before trial, meaning that each incidence of a case that does make it to trial could represent a dozen others did not.⁶³ According to unpublished data from researchers at the University of Alberta, educational institutions file 40–50 patent related suits annually.⁶⁴ Moreover, the number of universities involved in patent litigation increased between 1985, when universities were involved in one patent litigation dispute per year, and 2002, when universities were parties to eleven or more patent litigation lawsuits decided by federal courts. And, this number precipitously increased in years during and immediately following the 2008 Recession.⁶⁵

Overall, patent litigation more than doubled from 1995 to 2007. However, university involvement in patent litigation during that same period saw an almost four-fold increase.⁶⁶ These suits are costly in terms of money and time. University and government patent assertion lawsuits take an average of 604 days to terminate, the longest time to termination, of any patent assertion case by litigant group. To put this figure in perspective, patent assertion cases in the next highest litigant

60. See Barker, *supra* note 27, at 81.

61. *Id.* at 82.

62. *Id.* at 94–95 (noting that the five universities were: The University of California (18 cases), Massachusetts Institute of Technology (16 cases), Stanford University (10 cases), Johns Hopkins University (6 cases), and the University of Texas (6 cases)).

63. *Id.* at 5 (stating that, for example, researchers at Carnegie Mellon University invented an improved method of storing electronic data, which revolutionized the computer industry. In 2016, the university settled a patent infringement case with Marvell Technologies for \$750 million of which the university would get \$250 million, after several years of litigation and appeals—the second largest technology patent settlement at the time); see Jonathan Stempel, *Marvell Technology to Pay Carnegie Mellon \$750 Million Over Patents*, REUTERS (Feb. 17, 2016), <https://www.reuters.com/article/us-marvell-technlgy-carnegiemellon-idUSKCN0VQ2YE> (on file with *The University of the Pacific Law Review*).

64. Andrew Chung, *Schools That Sue: Why More Universities File Patent Lawsuits*, REUTERS (Sept. 15, 2015), <https://www.reuters.com/article/university-patents/schools-that-sue-why-more-universities-file-patent-lawsuits-idUSL1N11G2C820150915> (on file with *The University of the Pacific Law Review*) (noting that “[a]lmost every major university has a lawsuit or two in process.”).

65. Barker’s dissertation includes a helpful table in the appendix, listing each university involved in patent litigation, but the volume of universities involved in patent litigation from 1985 to 2009 are too many to include in this footnote. Despite the fact that 76 percent of universities nationally are private, private universities only accounted for 34 percent of the litigants in this study, while the 64 percent of the lawsuits analyzed involved public universities. This difference could be due to variable interest levels in research between public and private universities. Since universities generate a large number of new inventions and can strike deals with companies best poised to bring the invention to market, historically, the technology that universities developed was licensed before the patent was even filed. The practice of obtaining patent rights and then suing to enforce the rights or demand licenses is a latent approach by universities and is more likely to stagnate innovation. See Barker, *supra* note 27, at 83, 89.

66. See *id.* at 144.

group, production companies, took an average of 443 days to terminate, illustrating the substantial cost associated with university patent litigation.⁶⁷

In 2006, Stanford University and ten other top-tier research universities released a white paper urging universities to carefully consider their involvement as plaintiffs in patent litigation. The paper particularly stressed that the universities should be mindful of their primary mission to advance the public good with their patents and technological developments.⁶⁸ However, instead of directly heeding this advice, universities have sought a couple workarounds. While the average number of defendants per suit initiated by universities declined by one after the passage of the AIA, the number is still twice that of the average among lawsuits filed by other types of entities, suggesting that universities might be slightly less litigious than they once were in suits against multiple infringers working in concert.⁶⁹ Also, though there has been a marginal decrease in direct university participation in patent infringement lawsuits, this may trend may be tactical. Nearly fifty universities now have contractual agreements with Intellectual Ventures, a PAE.⁷⁰ These relationships between universities and PAEs, which bring infringement lawsuits on the universities' behalf, make the quantification of university-involved litigation particularly difficult.⁷¹

II. DATA AND ANALYSIS

University research is funded primarily by federal grants and charitable gifts, but university patents primarily benefit universities and the private companies that commercialize their patents, rather than the public. For better or worse, Bayh-Dole

67. Universities are spending big money on patent infringement lawsuits. In fact, universities have, on average, the longest—and therefore, most expensive—lawsuits by a wide margin). See Miller, Aravind, Bengfort, De La Cerda, Dragoni, Gibson, Itai, Johnson, Kannappan, Kehoe, Kim, Mladinich, Pinho, Polansky & Weissenberg, *supra* note 52, at 251–59.

68. Jacob H. Rooksby, *Innovation and Litigation: Tensions Between Universities and Patents and How to Fix Them*, 15 YALE J. L. & TECH. 312, 331 (2013).

69. See Miller, Aravind, Bengfort, De La Cerda, Dragoni, Gibson, Itai, Johnson, Kannappan, Kehoe, Kim, Mladinich, Pinho, Polansky & Weissenberg, *supra* note 52, at 259.

70. Two large PAEs—Intellectual Ventures and Intellectual Discovery—have acquired 70 percent of all the acquired university patents. See Fusco, Lissoni, Martinez, and Sterzi, *supra* note 41, at 3. An analysis of the patents transferred to PAEs shows that they are typically high-quality patents which demonstrates a trend of PAEs choosing strong patents for monetization. *Id.* Economic value was determined based on the amount of citations and number of claims associated with the patent. The study was further controlled to account for technological field, year of application, and country of the university. *Id.* More than 80 percent of the patents transferred to PAEs are in the high-tech sector, specifically those classified as Physics and Electricity, under International Patent Classification (IPC). *Id.* at 4.

71. See Rooksby, *supra* note 67, at 333. For example, the University of California, San Diego, alone, has agreements with five patent-assertion entities. *Id.* These relationships may be in place so that universities can nominally stay out of patent infringement litigation in order to avoid damage to their reputation. See *id.* at 337. In fact, approximately 12 percent of university patents have been transferred at least once, but only a small amount have been transferred to PAEs (less than 1 percent). See Fusco, Lissoni, Martinez, and Sterzi, *supra* note 41, at 3. This trend of transfers to PAEs has mostly occurred within the last 10 years, around 3.4 percent. *Id.* Most patents are never transferred more than once, with only 1.9 percent of patents subject to multiple transfers. See *id.* at 4.

created a bias in favor of patents. Universities have an incentive to encourage patentable research, pursue patents whenever possible, create technology transfer offices to manage their patent portfolios, license their patents to the highest bidder, and litigate patent infringement.

While studying university patenting and licensing practices, we noticed an apparent increase in university patent litigation in the years prior to the passage of the AIA. Noticing these dramatic increases to university patent litigation in the period of years between 2002 and 2012, we were concerned about the rate at which universities are engaging in litigating their patents—either directly or through PAE intermediaries—given that university research is publicly-supported. We conducted this study to determine whether that perceived increase was reflected in the data.

As such, we employed a proprietary dataset that merges data from the Association of University Technology Managers (“AUTM”) and the Integrated Postsecondary Education Data System (“IPEDS”) to investigate the link between federal funding and university patent litigation. This data set provides a rich set of institutional characteristics, which we used in the regression model as covariates. However, we do not report results for these covariates, such as enrollment and endowment fair market value, in the table below, because many of these covariates were not statistically significant in the full model but were statistically significant predictors of litigation spending before our independent variable of interest—research expenditures—was included in the model. Specifically, we used a regression analysis to answer the question: to what extent do increases in research funding, as proxied by research expenditures, result in greater litigation expenditures?⁷²

Our analysis uses fixed effects on institution and year to isolate the impact that institutional differences and year-to-year changes may have on patent applications, litigation, and research expenditures. We use fixed effects for two reasons. First, institution-specific fixed effects remove the differences between universities. Second, year fixed effects remove the noise from differences in annual research expenditures, which can be driven by factors external to the university and may impact the results. This also eliminates the bias caused by comparing universities that produce many patents with those that produce only a few patents.

The results of our analysis suggest that increases in patent applications, patent grants, and research expenditures are linked to increases in expenditures on legal representation and litigation. First, net of yearly changes and institutional differences, for every patent application a university files, it increases its expenditures on legal representation by 0.153 percent, at the highest statistically significant level ($p < 0.01$). Second, for every patent granted to a university, the university increases its expenditures on litigation by 0.645 percent, at the same

72. In our regression analysis, we logged the dependent variable: university patent litigation expenditures. All covariates appear as level (or non-logged) variables, except for primary independent variable of interest, university research expenditures, which we also logged.

highly statistically significant level. And third, for every 10 percent increase in a university's overall research expenditures, it increases its expenditures on legal representation by 5.89 percent, again at the same highly statistically significant level.

Each of these findings indicates the likely causal relationship that the number of patents granted to a university, the number of patent applications filed by a university, and the research expenditures made by a university all have on a university's litigation expenditures. First, for every patent application filed by a university, net of year and institutional differences, legal expenditures increase by 0.153 percent. Second, for every patent granted to a university, the university will increase its expenditures on legal fees to protect the expenditure by 0.645 percent, at the highest levels of statistical significance and net of yearly and institutional differences. This means that every patent granted to a university results in a marginal increase in its legal expenditures to protect the patent. These results relating to the association between patent applications and grants on litigation expenditures are intuitive and arguably justifiable. When universities engage in more research and development, they produce more patentable inventions and discoveries; and, when they apply for and receive patents for those inventions and discoveries, their legal expenditures increase.

But our final finding is less intuitive and more troubling. For every one percent increase in research and development funds expended by a university, most of which is coming from federal support, its legal expenditures increase by 0.587 percent,⁷³ net of year-to-year changes and differences between institutions. This increase may seem modest, but it suggests that, net of all other expenditures, even as a university's research and development expenditures increase marginally—regardless of the source of the funding—the university will increase its spending by nearly 60 percent as much as it increases its research expenditures to protect and litigate its right to the proceeds of its research. This relationship is concerning because it provides further evidence of an alarming trend that we have previously explored—that universities may in fact be contributing to patent hold-up.⁷⁴ If so, it poses ethical concerns for technology transfer officers to continue with business as usual, when the result of this firm behavior could have a chilling effect on innovation.

73. The reason for the reported difference in increases to university litigation expenditures is due to approximation of the independent variable coefficient in the model, which we have corrected by mathematically calculating the coefficient. "Since, $(1+x)^a \approx 1+ax$ for a small value of $|a|x$, therefore for a small change in the predictor variable we can approximate the expected ratio of the of the dependent variable by multiplying the coefficient by the ratio of the change in the predictor variable." *How Do I Interpret a Regression Model When Some Variables Are Log Transformed?*, INST. FOR DIGITAL RESEARCH & EDUC., available at <https://stats.idre.ucla.edu/other/mult-pkg/faq/general/faqhow-do-i-interpret-a-regression-model-when-some-variables-are-log-transformed/> (on file with *The University of the Pacific Law Review*). For example, we can say that for any one percent increase in university research expenditures, the expected ratio of the university litigation expenditure is approximately $1 + 0.01 \times \beta_4 = 1 + 0.01 \times 0.589 = 1.00589$. The exact value, however, is $(1.01)^{0.589} = 1.00587795264$. *Id.*

74. See Ryan & Frye, *supra* note 13, at 80.

Variables	Fixed Effects Model
Licenses/Options Generating \$1M in Licensing Income	0.00358 (0.0111)
Total US Patents Issued	0.00645*** (0.00110)
Total Patent Applications Filed	0.00153*** (0.000276)
Log (Research Expenditures)	0.589*** (0.0427)
Constant	1.573** (0.779)
Observations	1,348

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

III. CONCLUSION

The Bayh-Dole Act encouraged universities to patent the inventions and discoveries they produce and create technology transfer offices to manage their patent portfolios. Today, university patents and technology transfer offices have become part of the institutional strategy of all research universities. However, in the years since Bayh-Dole was enacted, changes to patent policy and doctrine have reinforced these incentives but also created new incentives that produce negative externalities. Universities' responses to these new incentives provide many reasons to be concerned that the ways universities pursue patent protection for their discoveries are inconsistent with the charitable purposes of universities. Because many university technology transfer offices are not profitable, universities may look to extract even modest returns to their research expenditures by litigating their patent portfolios—even when the economic benefit to universities for such litigation is limited, and the public benefit is non-existent.

This Article provides preliminary evidence that university patents are also inducing universities to invest additional resources in legal representation and litigation. In some cases, those expenditures may be an expected—if arguably unfortunate—side effect of university patent policy. But it may also be the case that some of those expenditures are inefficient and socially unproductive. Our research shows that nearly six-tenths of every one percent increase in university research expenditures is allocable to university legal expenditures, supporting a critical position that some university research expenditures may indeed be inefficient and socially unproductive. The findings discussed in this Article warrant further research into how university patent policy affects university legal expenditures. We also hope that this Article advances discussions about the relationship between university patents, technology transfer, and the public good.