THE HIDDEN COST OF UNIVERSITY PATENTS

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ABSTRACT

Universities are encouraged to undertake research through grants from government agencies, foundations, and other organizations. The Bayh-Dole Act reinforces this incentive structure by allowing universities to take ownership of the resultant patents. Included in these rights is the ability to generate income by licensing patents and bringing patent infringement lawsuits. Undoubtedly, exercising these rights to financially benefit the university is economically rational. But might such actions also impose a cost on the public despite the fact that these very patents arose from public research subsidies?

This study examines the relationship between a university's research expenditures and its likelihood to litigate patent infringement claims. It finds that research expenditures increase litigation frequency, suggesting that universities may use funds earmarked for research and innovation on patent litigation. We argue that patent rights provided by the Bayh-Dole Act may motivate this phenomenon—which encourages universities to seek rents, rather than pursue innovation. Our study adds to the extant literature about firm behavior, describing universities as vertical integrators as well as horizontal coordinators. It further suggests that these coordinations inure to a university's private benefit—but not necessarily the benefit of the public, for which universities are ostensibly organized.

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INTRODUCTION

Universities control many different kinds of intellectual property rights, including patents granted by the United States Patent and Trademark Office (USPTO). Patents are designed to encourage researchers generally (and universities specifically) to innovate[4]—by producing new research, making discoveries, and translating those discoveries into patentable technologies. Of course, this innovation is also incentivized by research subsidies from private and public grants.

One of the largest sources of grant funding for university research is the federal government. The National Institutes for Health and the National Science Foundation, among others, apportion grants for innovative research through competitive processes.[5] These grants represent public decisions to incentivize research in particular areas,[6] which in turn are the lifeblood of university research.[7] Without such funding, the frontiers of innovation might be foreclosed to universities because they cannot directly monetize their inventions, as they are non-practicing entities (NPEs) in all relevant markets.[8]

Universities are NPEs because they typically lack the ability to integrate their innovations into commercial products. Furthermore, they do not manufacture or sell any resultant wares. That is why universities rely on third-party producers to manufacture their patented technologies, or else they obtain royalties through intermediaries that license their patents—ostensibly to market the technologies to firms that can commercialize the inventions.[9]

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[4] Miriam Marcowitz-Bitton & Emily Michiko Morris, *Unregistered Patents*, 95 WASH. L. REV. 1835, 1836 (2020) ("Patent law, for example, is designed to encourage technological innovation by granting qualified inventors the exclusive rights to make, use, sell, or license their inventions against all others for a period of twenty years." (citations omitted)).

[5] Fisher v. Vassar Coll., 852 F. Supp. 1193, 1203 (S.D.N.Y. 1994), as *amended by* (June 30, 1994), *aff'd in part*, *vacated in part*, 70 F.3d 1420 (2d Cir. 1995), on *reh'g in banc*, 114 F.3d 1332 (2d Cir. 1997), and *rev'd*, 114 F.3d 1332 (2d Cir. 1997) ("Research grants are awarded by the NIH and NSF under extremely competitive circumstances and only after intensive review by a panel of expert peers in the scientific discipline of the person submitting the grant." (citation omitted)).

[6] *See* Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents–Prizes Debate*, 92 TEX. L. REV. 303, 320–21 (2013).

[7] But they are just one way governments incentivize research and innovation. The United States and state governments "offer many billions of dollars of support each year through direct grants and contracts, innovation prizes, regulatory exclusivity, and [research and development] tax incentives . . . ." Lisa Larrimore Ouelette, *Patentable Subject Matter and Nonpatent Innovation Incentives*, 5 U.C. IRVINE L. REV. 1115, 1118 (2015).

[8] Layne S. Keele, *Res"Q"Ing Patent Infringement Damages After Resqnet: The Dangers of Litigation Licenses as Evidence of A Reasonable Royalty*, 20 TEX. INTELL. PROP. L.J. 181, 231 (2012) ("NPEs can include institutions, such as universities, whose research may create new, patentable inventions, even though the institution does not market the invention." (citing eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 393 (2006)).

[9] Scott Shane, *Encouraging University Entrepreneurship? The Effect of the Bayh-Dole Act on University Patenting in the United States*, 19 J. BUS. VENTURING 127, 130–31 (2004) ("Universities differ from private firms in the ways in which they can appropriate private economic returns from the invention of new technology. Universities do not manufacture goods or provide services other than education, making it difficult for them to profit financially from inventions that must be incorporated into products or services before

Given this economic backdrop, it is unsurprising that universities have every incentive to pursue research grants that allow them to develop patentable discoveries that will eventually lead to marketable products from which they can derive revenue or licensing royalties.[10] But this incentive structure can promote negative externalities.

Perhaps university policies encourage the filing of too many patent applications by guaranteeing a higher percentage of revenue to individual researchers at the expense of reinvestment of patent proceeds into scientific research and education.[11] Further, universities may encourage applied research because of the possibility that it will generate revenue—the next blockbuster patent—at the expense of pursuing basic research that will yield general knowledge, a less-profitable commodity.[12] In a similar vein, universities may use patents as a sword (e.g., to extract rents), rather than as a shield to protect their innovations. Finally, public funds (in the form of public research grants) are probably being co-opted not only to support research produced through the grant, but also to generate private benefits for universities in the form of patent royalties.[13] That hidden cost of subsidizing university patents is the central focus of our study.

This research presents empirical evidence that universities with relatively greater research expenditures are more likely to bring patent infringement lawsuits. It is notable that our findings do not merely represent a lockstep increase wherein universities who do more research receive more patents and therefore bring a proportionately larger number of lawsuits. Rather, we find that university patent litigation rates *increase faster than the growth rate of research expenditures*.

This article proceeds in four parts. Part I provides an overview of how universities generate intellectual property portfolios by securing patents. This section probes how pursuing patents has become part of the university business model,

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they can be sold."); David Orozco, *Assessing the Efficacy of the Bayh-Dole Act Through the Lens of University Technology Transfer Offices (TTOs)*, 21 N.C. J. L. & TECH. 115, 141 (2019) (Universities "lack the traditional strategic complementary assets that companies possess such as logistics, manufacturing, sales, marketing, and distribution."); Sara Jeruss, Robin Feldman & Joshua Walker, *The America Invents Act 500: Effects of Patent Monetization Entities on Us Litigation*, 11 DUKE L. & TECH. REV. 357, 369 (2012) ("Although universities do not manufacture products, their core activity involves education and academic research, rather than monetization of rights.").

[10] *But see* Ouelette, *supra* note 7, at 1115 (arguing that patentable- subject-matter debates are "not just about economics, and nonpatent incentives might help ease the tension between utilitarian and moral considerations"); Brian J. Love, *Do University Patents Pay Off? Evidence from A Survey of University Inventors in Computer Science and Electrical Engineering*, 16 YALE J. L. & TECH. 285, 329 (2014) (recognizing that some assert that "university administrators who lack the expertise to properly value and manage technology encourage their institutions to file as many patent applications as possible in hopes of creating a sustainable revenue stream"). *See generally* Andrew P. Morriss & Roger E. Meiners, 12 NYU J. INTELL. PROP. & ENT. L. 52, 101 (2022) ("Universities have changed how they approach research commercialization as a result of Bayh-Dole.").

[11] *See* Lisa Larrimore Ouellette & Andrew Tutt, *How Do Patent Incentives Affect University Researchers?*, 61 INT'L REV. L. & ECON. 1, 6 (2020).

[12] *See id.*

[13] Derek Bok, UNIVERSITIES IN THE MARKETPLACE 12 & 200 (2009).

including how litigation is one modern strategy to fund university research and technology transfer. Part II examines the role that both universities and patents play in the public sphere and reaches the conclusion that both are inherently producers of public goods. However, this part of the article also likens university patenting to rent-seeking, as defined in the classical economic sense.

Part III empirically explores how universities arguably engage in rent-seeking. To do so, it analyzes the university patent system and explains how university patents encourage universities to pursue patent litigation. Our primary contribution to the literature lies in our finding that research expenditures drive legal expenditures by a given university in a given year. This suggests that public funding of university research not only yields a heightened frequency of litigation, which contributes to patent thickets, but also produces private benefit to universities at the public's expense. Finally, this paper concludes with a summary of our contribution to the literature and future research that may extend this line of investigation.

I. UNIVERSITY PATENTING & PATENT LITIGATION

A. AN OVERVIEW OF UNIVERSITY PATENTING

The Bayh-Dole Act is agnostic. In theory, any university can patent any invention or discovery it produces. But in reality, only research universities pursue patents.[14] This is not to say that universities that are not designated by the Carnegie Classification of Institutions of Higher Education as a "research university" do not engage in the same kind of research, but they tend to do so on a smaller scale, if at all. One important commonality among most universities is that they tend to pursue research that leads to patents.[15] Incentives matter.

Research universities file more patent applications every year.[16] Several factors have contributed to this increase. The most important consideration is the pressure for universities to find new sources of revenue.[17] Everyone knows patents are valuable,

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[14] *See, e.g.*, Michael T. Nietzel, *University of California Ranks First among Universities Worldwide for Patents Granted*, Forbes (Sept. 7, 2022), https://www.forbes.com/sites/michaeltnietzel/2022/09/07/university-of-california-ranks-first-among-universities-worldwide-for-patents-granted/?sh=79ea8ec21866; Todd Schoellman & Vladimir Smirnyagin, *The Growing Importance of Universities for Patenting and Innovation*, SSRN Working Paper (Sept. 27, 2021), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3911375.

[15] Joshua R. Nightingale, *The Researcher Rat's Culture and Ease of Access to the Publication Lever: Implications for the Patentability of University Scientific Research*, 113 W. Va. L. Rev. 521, 524 (2011) ("[U]niversities today encourage professors to pursue patents and patentable research."); Jed Scully, *The Virtual Professorship: Intellectual Property Ownership of Academic Work in A Digital Era*, 35 MCGEORGE L. REV. 227, 238 (2004).

[16] Lisa Larrimore Ouellette & Rebecca Weires, *University Patenting: Is Private Law Serving Public Values?*, 2019 MICH. ST. L. REV. 1329, 1336 (2019).

[17] Love, *supra* note 10, at 292 ("Despite the negative attention recent suits have brought, there is good reason to believe that aggressive university patent assertion is here to stay. Nationwide, university administrators face mounting pressure to find new sources of revenue, and patent assertion on the whole has never been more popular." (citations omitted)).

including university administrators.[18] So, it is unsurprising that administrators implement policies to encourage the filing of patent applications.[19] This trend is notable because the patents that result from these applications often cover fundamental elements of nascent technologies due to the university's role in basic scientific research.[20]

Changes in national patent policy have also encouraged universities to file more patent applications.[21] As Professor Lee observed, an increase in the breadth of patentable subject matter necessarily expanded the scope of university research that might be patentable.[22] In addition, the creation of the Federal Circuit—"a strong champion of patentholder rights"—made it easier to get patents.[23]

As a result of this increase in patent activity, nearly all major universities, and particularly research universities, have technology transfer offices to manage their patent portfolios.[24] These offices are clearinghouses for university patent activity, acting as centralized hubs for their innovative enterprises. In part, technology transfer offices help university researchers secure patents from the USPTO.[25] Once granted, technology transfer offices coordinate commercialization of the underlying invention.[26] Often, in concert with offices of sponsored programs, they organize grant investment spent on research and development within a university. These offices likewise work with attorneys to litigate patent infringement cases.[27] Further, they deal with licensees and manage patent revenue derived from licensees.[28] On occasion, these entities even take title to patents generated from university-created research.

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[18] Jacob H. Rooksby, *When Tigers Bare Teeth: A Qualitative Study of University Patent Enforcement*, 46 AKRON L. REV. 169, 175 (2013) ("Universities that own patents are not treated differently from other patent owners under prevailing interpretation of patent law.").

[19] Love, *supra* note 10, at 292 (2014).

[20] Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 614 (2008) ("[M]ore and more university patents are patents on the very earliest stages of technology. It is universities, perhaps not surprisingly given their role in basic research, who are patenting the basic building blocks in new technologies.").

[21] Peter Lee, *Patents and the University*, 63 DUKE L.J. 1, 33 (2013); Jacob H. Rooksby, *University Initiation of Patent Infringement Litigation*, 10 J. MARSHALL REV. INTELL. PROP. L. 623, 629 (2011)

[22] Lee, *supra* note 21, at 33.

[23] *Id.* (quoting David C. Mowery, Richard Nelson, Bhaven Sampat & Arvids Ziedonis, IVORY TOWER AND INDUSTRIAL INNOVATION: UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER BEFORE AND AFTER THE BAYH-DOLE ACT IN THE UNITED STATES 103 (2004)).

[24] *See, e.g.*, Orozco, *supra* note 9, at 129.

[25] *See, e.g.*, Jorge L. Contreras, *Association for Molecular Pathology v. Myriad Genetics: A Critical Reassessment*, 27 MICH. TECH. L. REV. 1, 14 (2020) ("Like many universities, the University of Utah established a Technology Transfer Office ('TTO') to obtain and manage patents on university research.").

[26] Randi B. Isaacs, *Inside a University's Technology Transfer Office Purposes and Goals for Protecting a University's Intellectual Property*, 8 LANDSLIDE 30 (2016).

[27] Cynthia L. Dahl, *Did the America Invents Act Change University Technology Transfer?*, 29 TEX. INTELL. PROP. L.J. 1, 36 (2021).

[28] Linara Axanova, *U.S. Academic Technology Transfer Models: Traditional, Experimental and Hypothetical*, 47 LES NOUVELLES 125 (2012) ("The primary mission of U.S. academic technology transfer offices (TTOs) has historically been to protect intellectual property (IP), find licensees and negotiate licenses."); Peter Lee, *Transcending the Tacit Dimension: Patents, Relationships, and Organizational Integration in Technology Transfer*, 100 CAL. L. REV. 1503, 1522 (2012).

The proliferation of university technology transfer offices can be directly traced to the Bayh-Dole Act—an important piece of federal legislation that allowed universities to claim ownership of patents arising from government funded research.[29] Before Bayh-Dole, few universities had technology transfer offices.[30] At present, more than 700 universities have such an office, though their existence seems uncorrelated to university patent profitability.[31]

Most university technology transfer offices, and the patents they manage, are unprofitable.[32] There are, however, a handful of technology transfer offices that generate considerable profits.[33] Based on figures from 2006, 189 universities generated a total of more than $1.5 billion from their intellectual property portfolios, the vast majority of which came from patent licensing royalties.[34] But the overwhelming majority of that revenue went to only a few of those universities. More recent figures–from 2016–suggest that over 83 percent of all university patent revenues went to just twenty universities.[35] That is, return on investment for research and development among higher education institutions is highly stratified.

Despite the stratification evidenced by the fact that the overwhelming majority of the revenue from licensing university patents goes to a very small number of research universities, many consider the Bayh-Dole Act to be successful.[36] Absent its passage, fewer universities would have sought patent protection for the intellectual property their research pursuits yield, and fewer still might have engaged in the type of innovative research required to receive a patent. It is indisputable that, in some instances, university revenue from patent licenses spurs them to make greater investments in research from which society can benefit. And it affords a considerable benefit to the higher education sector, which is a public-facing enterprise, even if it primarily benefits elite research institutions.[37]

The motivation behind the Bayh-Dole Act was to encourage the

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[29] 35 U.S.C. §§ 200–212; Madey v. Duke Univ., 413 F. Supp. 2d 601, 610 (M.D.N.C. 2006).
[30] Orozco, *supra* note 9, at 129 ("Prior to the Bayh-Dole Act, there were only a handful of TTOs at universities.").
[31] 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, 355 (2009).
[32] Jason Rantanen & Madison Murhammer Colon, *Can Public Universities Patent Their Research?: The Tension Between Open Records Laws and Patentability*, 69 DRAKE L. REV. 117, 177 (2021) ("While there are stories of blockbuster breakthroughs and highly profitable TTOs, there are many more that struggle to break even."); Jay P. Kesan, *Transferring Innovation*, 77 FORDHAM L. REV. 2169, 2188 (2009) ("The vast majority of university TTOs are unprofitable or barely profitable in real terms.").
[33] This in turn skews the averages and totals regarding patent revenues.
[34] Llewellyn Joseph Gibbons, *Tech Transfer: Everything (Patent) Is Never Quite Enough*, 48 U. LOUISVILLE L. REV. 843, 850 (2010).
[35] Dave Merrill, Blacki Migliozzi & Susan Decker, *Billions at Stake in University Patent Fights*, BLOOMBERG (May 24, 2016), https://www.bloomberg.com/graphics/2016-university-patents/.
[36] Vladimir Lozan, *Open for Trouble: Amending Washington's Open Public Meetings Act to Preserve University Patent Rights*, 86 WASH. L. REV. 393, 412 (2011) ("[M]any consider the Bayh-Dole Act a success.").
[37] *See* Gibbons, *supra* note 34, at 850.

commercialization of university research.[38] Arguably, this goal is only possible when universities receive exclusive patent rights in order to commercialize innovation.[39] The statute was meant to remedy any possible "first-commercializer disadvantage."[40] This is the concern that commercialization will only occur when a party can recover costs associated with designing a commercial product yielded from university research. The theory continues that no such activity will be undertaken where–absent patent protection–competitors can free-ride and produce their own versions of the new product. These competitors have not incurred the cost of product design and, thus, can sell at the marginal cost of production. Such competition would prevent the original party from recovering the cost of product design and therefore no rational party would invest in the initial product design.[41]

But exclusivity may not be strictly necessary for commercialization to occur.[42] Where this is the case, granting patent rights is unnecessary to encourage commercialization, and doing so results in economic inefficiency. In theory, if university inventions are placed in the public domain and the cost to create new products embodying those technologies is low, competition to commercialize the innovation would increase, and the market price of products yielded from the research would go down.[43]

Beyond questioning the necessity of university patent ownership to drive commercialization, there are arguments that creating incentives to pursue these patents can result in the overproduction of patentable research and stockpiling of often worthless patents.[44] As an example of this phenomenon, Professor Ritchie de Larena cited one major research institution that spent nearly $2 million developing a patent portfolio around one professor's research, despite the fact that the portfolio did not lead to any income generating licenses.[45] This over-production of university patents can compound the problem of "patent thickets" [46] (i.e., many overlapping patents

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[38] Jasmine Daniel, *Square Peg in A Round Hole: Manipulating Patent Law to Reduce the Prices of Pharmaceutical Products*, B.C. INTELL. PROP. & TECH. F., March 18 2021, at 1, 14 ("The Bayh-Dole Act was enacted to motivate recipients of government funding to patent resulting research and translate it to products that would better society.").

[39] *See* Walter D. Valdivia, *University Start-ups: Critical for Improving Technology Transfer*, CTR. FOR TECH. INNOV. AT BROOKINGS 6 (Nov. 2013).

[40] Ian Ayres & Lisa Larrimore Ouellette, *A Market Test for Bayh-Dole Patents*, 102 CORNELL L. REV. 271, 288 (2017); Michael Abramowicz & John F. Duffy, *Intellectual Property for Market Experimentation*, 83 N.Y.U. L. REV. 337, 378 (2008).

[41] Ayres & Ouellette, *supra* note 40, at 288.

[42] *See, e.g.*, Brian L. Frye & Christopher J. Ryan, Jr., *Technology Transfer and the Public Good*, in THE RESEARCH HANDBOOK ON INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER (ed. Jacob H. Rooksby) (2020).

[43] *See* Tanya S. Gillis, *A Slippery Slope: The Future of Patents from Government-Funded R&D*, 96 J. PAT. & TRADEMARK OFF. SOC'Y 210, 217 (2014) (citing a congressional report to the contrary).

[44] Emily Michiko Morris, *The Irrelevance of Nanotechnology Patents*, 49 CONN. L. REV. 499, 502 (2016).

[45] Lorelei Ritchie de Larena, *The Price of Progress: Are Universities Adding to the Cost?*, 43 HOUS. L. REV. 1373, 1422 (2007). The article likewise cites to another university official who asserted that it was proper to file patent applications for "faculty recruitment and retention," regardless of commercial value. *Id.*

[46] Gary Pulsinelli, *Freedom to Explore: Using the Eleventh Amendment to Liberate Researchers at State Universities from Liability for Intellectual Property Infringements*, 82 WASH. L. REV. 275, 359 (2007).

owned by multiple parties covering a single invention).[47] But more broadly, the pursuit of patents may distract universities from their core mission: the provision of education and the dissemination of knowledge.[48] These illustrations are but a few of the hidden costs associated with state-funded patent subsidies—from which public investment is never recouped by society.

B. THE UNIVERSITY PATENT BUSINESS MODEL

For the better part of eight decades, university research has had significant backing from the federal government. This state sponsorship began in earnest during the Second World War, when it arguably helped win the war and build the military industrial complex.[49] Public support of research continues to this day. For example, in fiscal year 2021, the National Institutes for Health (NIH) awarded more than $25.28 billion in university research grants.[50] Additionally, the National Science Foundation (NSF) has contributed more than $5.21 billion in university research grants each fiscal year since 2017.[51] Thus, the federal government remains the largest single source of university research and development grant funding[52] as shown below:[53]

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[47] Kimberly A. Moore, *Worthless Patents*, 20 BERKELEY TECH. L.J. 1521, 1523 fn. 6 (2005).

[48] Katherine J. Strandburg, *Curiosity-Driven Research and University Technology Transfer*, 16 ADVANCES STUDY ENTREPRENEURSHIP INNOVATION & ECON. GROWTH 93, 94, 108 (2005); Dirk Czarnitzki et al., *Heterogeneity of Patenting Activity and Its Implications for Scientific Research* 22 (Ctr. for European Econ. Research, Discussion Paper No. 07-028, 2007), https://perma.cc/YQ8W-BY3D.

[49] Christopher J. Ryan, Jr. & Brian L. Frye, *Patents & Legal Expenditures*, 51 U. PAC. L. REV. 577, 579 (2020); Robert Knowles, *Delegating National Security*, 98 WASH. U.L. REV. 1117, 1154 (2021); Albert P. Cardarelli & Stephen C. Hicks, *Radicalism in Law and Criminology: A Retrospective View of Critical Legal Studies and Radical Criminology*, 84 J. CRIM. L. & CRIMINOLOGY 502, 507 (1993); and *see, generally,* Stuart W. Leslie, THE COLD WAR AND AMERICAN SCIENCE: THE MILITARY-INDUSTRIAL-ACADEMIC COMPLEX AT MIT AND STANFORD (1994).

[50] Data on file with the authors. *See NIH Awards by Location & Organization*, NATIONAL INSTITUTES OF HEALTH, https://report.nih.gov/award/index.cfm?ot=DH,27,47,4,52,64,41,MS,20,16,6,13,10,49,53,86,OTHDH&fy=2021&state=&ic=&fm=&orgid=&distr=&rfa=&om=n&pid=.

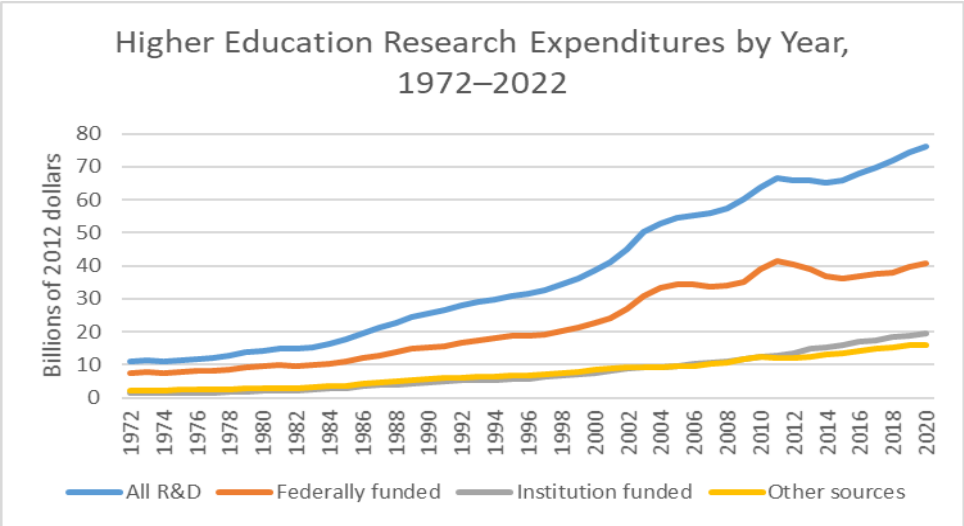
[51] *See* Michael T. Gibbons, *NSF Statistics*, NATIONAL INSTITUTES OF HEALTH, https://www.nsf.gov/statistics/2020/nsf20302/overview.htm.

[52] *See, e.g.*, Brenda M. Simon, *Preserving the Fruits of Labor: Impediments to University Inventor Mobility*, 89 TENN. L. REV. 1, 35 (2021) ("Although federal government spending on basic research has fallen to less than 50% of the funds spent on basic research, it is still the largest funder of basic research and an important source of university research funding.").

[53] *Higher Education Research and Development Survey*, NATIONAL CENTER FOR SCIENCE AND ENGINEERING STATISTICS, https://ncses.nsf.gov/pubs/nsf22312 ("Data View" under Figure 1). Note that this Figure is a recreation of "Figure 1" on the cited NSF page. The NSF further notes with regard to this data:

> Because of rounding, detail may not add to total. Includes all institutions surveyed in the fiscal years shown. Prior to FY 2003, totals did not include R&D expenditures in non-science and engineering fields. Other sources include R&D expenditures funded from state and local governments, businesses, nonprofit organizations, foreign governments, foreign or U.S. universities, and gifts designated by the donors for research.

Id.



Yet, the share of total university research and development accounted for by federal spending has decreased in recent years—accounting for about 50 percent of expenditures.[54] During the 1960s, the federal government funded nearly 70 percent of university research and development.[55] In contrast, in 2020 the government funded just over $40 billion of the nearly $80 billion universities spent on research and development.[56] The balance of university research and development funding came from an assortment of private institutional sources as well as state and local funding.[57] But even as federal funding has decreased as a proportion of overall university research and development expenditures, total university spending on research has dramatically increased.[58] Much of this has been driven by the advent of the in-house offices of technology transfer and related enterprises universities have created to patent and license their research and development. In fact, between 2000 and 2018, universities accounted for over 13 percent of aggregate spending on research and development

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[54] *Academic Research and Development*, NATIONAL SCIENCE BOARD, https://ncses.nsf.gov/pubs/nsb20202/academic-r-d-in-the-united-states ("The federal government is the largest funder of academic R&D, providing more than half (53%, or around $42 billion) of total funds in 2018.").

[55] James T. Y. Yang, *Collaboration Between Nonprofit Universities and Commercial Enterprises: The Rationale for Exempting Nonprofit Universities from Federal Income Taxation*, 95 YALE L.J. 1857, 1878 (1986). *See also* Clark D. Asay & Stephanie Plamondon Bair, *Innovation in Adversity*, 49 FLA. ST. U. L. REV. 825, 875 (2022) ("The National Science Foundation defines basic research as 'activity aimed at acquiring new knowledge or understanding without specific immediate commercial application or use.'" (citation omitted)). Basic research is differentiated from applied research, which is designed to solve a direct problem or provide a specific commercial application. Regardless, federal funding has fallen for both types of research as a proportional amount. *See* Science, *Data Check: U.S. Government Share of Basic Research Funding Falls Below 50%*, SCIENCE MAGAZINE, (Mar. 9, 2017, 1:15 PM), http://www.sciencemag.org/news/2017/03/data-check-us-government-share-basic-research-funding-falls-below-50.

[56] NATIONAL CENTER FOR SCIENCE AND ENGINEERING STATISTICS, *supra* note 53. *See also* Figure 1, *infra*.

[57] *Id.*

[58] National Center for Science and Engineering Statistics, *supra* note 53. *See also University Patent Count & Expenditures*, OPEN DATA PORTAL @ USPTO, https://developer.uspto.gov/visualization/university-patent-count-expenditures (last visited Sept. 28, 2022).

and over 53 percent of aggregate spending on basic scientific research in the United States.[59]

But what is this massive annual spending on research and development going toward? The answer, for some, lies in the competition for human capital and assets. Restated, university research spending "is driven by competition for tuition and talented students," as well as faculty and researchers, in the market for higher education.[60] This would be the economically rational answer in a competitive market. And even if this behavior crowds out other players within the market, it may indeed advance the public benefit—to the extent that it results in greater knowledge production yielded from the sector by its competitive nature. The answer, for others, is greater disclosure of scientific knowledge towards the enrichment of society.[61] This is a noble pursuit that undoubtedly redounds to the public benefit. However, the answer for most lies in private gain that universities can achieve via intellectual property protection of their research—specifically, the pursuit of patent ownership. But universities long for something more than garden-variety patent ownership. Universities seek the holy grail: the blockbuster patent, resulting from sponsored research, which generates considerable revenue.[62] Lyrica and Gatorade are examples, produced at Northwestern University and the University of Florida, respectively. Lyrica, a nerve-pain treatment pharmaceutical, generated approximately $1.4 billion in licensing revenues for Northwestern.[63] And since 1973, Gatorade has earned the University of Florida more than $281 million.[64] Both were funded by the federal government.[65]

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[59] Titan Alon, Damien Capelle & Kazushige Matsuda, *University Research and the Market for Higher Education*, Working Paper (Sept. 2021), at 1, *available at* https://cigs.canon/uploads/2022/01/05_Mr.Matsuda_paper.pdf.

[60] *See id.* The authors of this study use an empirical model to test this claim, finding that "increasing research output today enables a university to charge higher tuition in the future." *Id.* at 2. Thus, the perverse incentives to which universities respond in the pursuit of their research can be observed through several mechanisms.

[61] Jennifer Carter-Johnson, *Intellectual Property Revenue Sharing As A Problem for University Technology Transfer*, 49 AKRON L. REV. 647, 652 (2016).

[62] Valdivia, *supra* note 39, at 11–12 ("Stories of blockbuster patents have fueled the ambition of TTO heads and university administrators alike and have also played a role in their anxiety for landing a 'blockbuster' patent"); Jerry G. Thursby & Marie C. Thursby, *University Licensing*, 23 OXFORD REV. ECON. POL'Y 620, 630 (2007) ("One explanation for universities continuing to operate TTOs that are money-losing operations is the fact that a university can 'hit the jackpot' with a single invention.").

[63] Peter Kotecki, *In Focus: As Lyrica Profits Dry Up, Northwestern Seeks Another 'Blockbuster' Drug*, DAILY NORTHWESTERN (Apr. 10, 2016), https://dailynorthwestern.com/2016/04/10/featured-stories/in-focus/in-focus-as-lyrica-profits-dry-up-northwestern-seeks-another-blockbuster-drug/; Merrill et al., *supra* note 35.

[64] *See* April F. Lacey, *UF Celebrates 50 Years of Gatorade*, UF NEWS (Sept. 28, 2015), http://news.ufl.edu/articles/2015/09/uf-celebrates-50-years-of-gatorade.php;
Mark Dent, *Why the University of Florida Gets a ~$20m Cut of Gatorade Profits Every Year*, THE HUSTLE (Sept. 16, 2021), https://thehustle.co/why-the-university-of-florida-gets-a-20m-cut-of-gatorade-profits-every-year/ ("In 2015, Florida announced it had accumulated ~$250m from the royalties. Its annual take over the last few years [as of 2021] has been ~$20m, according to the university.").

[65] Rachel Barenie, Jonathan Darrow, Jerry Avorn & Aaron S. Kesselheim, *Discovery and Development of Pregabalin (Lyrica): The Role of Public Funding*, 97 NEUROLOGY 1653 (2021); Patricia E. Campbell, *University*

Given its ubiquity and market share, it is counterintuitive that the latter invention would have earned the university that produced it substantially less than the former, but the reason for the disparity is simple: the invention of Gatorade occurred before the passage of the Bayh-Dole Act.[66] This fact underscores the tremendous boon that Bayh-Dole has been for universities in pursuing the blockbuster patent–indeed all patent-seeking research. But these blockbuster patents are the exception and not the rule.[67]

Most university patents never make it to market for public consumption, and many university-produced and university-held patents have no real practical application that would make them commercially successful.[68] Recent estimates peg commercially-licensed patents around 5 percent of the typical university patent portfolio.[69] If this is true, the American university patent portfolio is wildly under-commercialized and presents an opportunity for universities to pursue other strategies to extract profit from their patents that lack value.

To say nothing of their inability to commercialize their inventions, universities–as NPEs–lack the infrastructure and know-how to manufacture them.[70] Universities and their technology transfer offices must rely on intermediaries to do both. This is an example of deadweight cost on two levels.

First, universities' reliance on intermediaries theoretically increases expenses for university patent funding. On the one hand, universities never internalize the costs associated with the manufacture and commercialization of the products they patent. But more importantly, on the other hand, they must settle for licensing fees instead of reaping the full benefit of manufacturing and bringing a product to market. Knowing this, it is possible that universities seek greater indirect costs (university-speak for "overhead") in grant funding to hedge against anticipated losses when dealing with these intermediaries. That is, universities may inflate proposed costs of research in

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Inventions Reconsidered: Debunking the Myth of University Ownership, 11 WM. & MARY BUS. L. REV. 77, 98 (2019).

[66] For a more in depth discussion of history behind the terms which the university settled for in the Gatorade case, *see* Frye & Ryan, Jr., *supra* note 42, at 236. "[T]he principal inventor of Gatorade had been funded by the federal government for research involving salt and water metabolism between 1962 and 1967, the federal government originally sought to take away these benefits accruing to the university and the inventors of Gatorade. The university also tried to acquire full rights to the invention, but the principal inventor never signed the standard licensing agreement, which would have granted them rights in the invention; thus, the university eventually settled for 20 percent of the royalties." (footnotes omitted). *Id.* at 243.

[67] Scott Andes, *Technology Transfer 2.0: Finding Economic Value in University R&D*, BROOKINGS, June 7, 2016, *available at* https://www.brookings.edu/blog/metropolitan-revolution/2016/06/07/technology-transfer-2-0-finding-economic-value-in-university-rd/; *see also* Valdivia, *supra* note 39.

[68] *See* Chris Nicholson, *Maximizing the ROI of Intellectual Property*, UNIVERSITY BUSINESS (Sept. 29, 2014), https://www.universitybusiness.com/article/maximizing-roi-intellectual-property.

[69] *See* Heidi Ledford, *Universities Struggle to Make Patents Pay: Surfeit of Unlicensed Intellectual Property Pushes Research Institutions Into Unseemly Partnerships*, NATURE, (Sept. 24, 2013), https://www.nature.com/news/universities-struggle-to-make-patents-pay-1.13811.

[70] Lemley, *supra* note 20, at 611.

their funding proposals to account for the deadweight loss of indirect costs. This would further drive not only the costs associated with research and development but also impact the fiscal outlay for funding such activity.

Second, technology transfer offices themselves are a deadweight cost; most universities do not earn enough from patent licensing revenue to cover the expenses of their technology transfer offices.[71] Just 11 percent of university technology transfer offices operate at a profit.[72] A direct cause of this is that university research and development–whether publicly funded or not–commonly never results in an invention with value that offsets the cost of the technology transfer offices. To offset these losses, these organizations are incentivized to resort to other means of revenue generation to justify their existence–including patent assertion litigation.

C. UNIVERSITY PATENT LITIGATION

Keeping pace with other trends in the field, university patent litigation is on the rise.[73] Estimates vary, but university-filed patent lawsuits appear to have increased substantially in the last two decades.

Consider the overall patent litigation trajectory since the passage of the America Invents Act (AIA) in 2011.[74] While it has only increased marginally–net of fluctuations–between 2011 and 2017, its rate of growth nearly tracked with contemporaneous increases in patent grant rates between 1998 and 2017.[75] Although nearly 6,500 patents were granted to universities in 2012, just 4,000 were issued in 2017.[76] Over roughly the same time period (2011–17) the volume of patent infringement claims filed only grew, starting at around 4,000 in 2011 and peaking at nearly 7,000 in 2013, with a regression toward earlier figures by 2017.[77] All the same,

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[71] *See* Andes, *supra* note 67.

[72] *See id.*

[73] *See generally* Maria Teresita Barker, *Patent Litigation Involving Colleges and Universities: An Analysis of Cases from 1980-2009*, Dissertation, *available at* https://iro.uiowa.edu/esploro/outputs/doctoral/Patent-litigation-involving-colleges-and-universities/9983776642502771.

[74] *See* Leahy-Smith America Invents Act, 112 P.L. 29 (2012).

[75] *See* Landan Ansell, Ronen Arad, Doug Branch, Hye Yun 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 (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 also* 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/ (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/.

[76] *See* Ansell, Arad, Branch, Lee, Pasha & Robinson, *supra* note 75 (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).

[77] *See id.*

patent litigation is more active since the passage of the AIA than it has ever been.

While this growth represents larger trends within the patent sector, a disproportionate part of this growth comes from universities and their assignees. These parties account for an increasingly larger proportion of patent lawsuits as time moves on.[78] For example, patent litigation more than doubled between 1995 and 2007, but university involvement in patent litigation during that period increased by nearly four-fold.[79] This trend has prompted scholars to investigate, only relatively recently, the participation of universities in the present surge in patent litigation.[80]

Research from scholars at Stanford University places the issue in bright relief. Examining data from patent litigation lawsuits between 2000–15, they found that universities and associated entities comprised the second largest group of NPEs within their dataset, trailing only inventors themselves.[81] And universities and associated entities were one of just two groups with increased patent infringement filings, amidst a host of other categories of filers.[82] Within NPE-involved cases from 2000-17, universities (along with non-profits) were the most likely to succeed in their claims and received the greatest damage awards when successful.[83]

Attempting to quantify the aggregate number of university-filed patent lawsuits, another study found that, between 1980 and 2009, 568 patent litigation cases involved universities.[84] This may seem like a small volume of cases for universities to be involved with in a thirty-year time band. But considering that over 90 percent of patent cases settle before trial, each of these cases represents scores more that never made it to trial.[85]

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[78] *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).

[79] *See* 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 (noting that "[a]lmost every major university has a lawsuit or two in process."); Barker, *supra* note 73, at 144.

[80] *See, e.g.,* Ayres & Ouellette, *supra* note 40, at 288; Lee, *supra* note 21, at 33.

[81] Ansell, et al., *supra* note 75, at 2. *See also* Miller et al., *supra* note 78, at 253–57 (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).

[82] *See* Miller, et al., *supra* note 78, at 254, 257.

[83] Ansell, et al., *supra* note 75, at 10.

[84] *See* Barker, *supra* note 73, at 81.

[85] *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.

Such lawsuits represent considerable monetary outlays borne by universities—in terms of attorneys' fees and other costs associated with litigation—all in the pursuit of revenue generation. Of course, this is not to say that all infringement lawsuits are illegitimate, but many are motivated by the pursuit of revenue to recoup the cost of research and development investment. And whether or not universities win these suits, they impose cost in terms of time. On average, patent assertion lawsuits involving production companies take 443 days until termination.[86] Yet, patent assertion lawsuits involving universities or the government take an average of 604 days to terminate—the longest time to termination for any litigant group studied.[87]

With the passage of each week in litigation, the cost associated with litigation only grows. The fact that universities are wary of terminating patent assertion lawsuits in lockstep with other litigant groups ultimately costs them time and money, but it also poses a reputational hazard. It takes universities further afield of their educational and research missions towards potentially fruitless pursuits.[88] That is, universities respond to modern business realities of the litigation process in ways that not even producers in the patent sector do, revealing not only their preference for revenue extraction but also for deadweight loss expended on the same.

Indeed, some recent trends in university patent litigation have led researchers to compare their cases to "patent troll" lawsuits. In 2008, Professor Mark Lemley addressed the issue, concluding that universities are not patent trolls, though they share some characteristics with them (if we define a "troll" broadly).[89] More recent empirical research produced in 2018 by Professors Firpo and Mireles, reached a similar conclusion—finding that "universities and non-profits are exhibiting some similar behavior to certain categories of entities that are considered so-called patent trolls" such that universities should be "carefully monitored" to ascertain if they are behaving in rent-seeking (i.e., "troll-like") manners. [90]

This study dives head-on into these considerations, just as the above discussion raises the possibility of strategic use of the patent system by university actors. The following parts of our study will situate this possibility within the realm of rationally behaving university administrators responding to market incentives within the patent system. Part II begins by discussing the university's role as knowledge producer and is followed by analysis of its behavior in the patent market.

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[86] *See* Miller et al., *supra* note 78, at 251–59.

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

[88] *See* Ryan, Jr. & Frye, *supra* note 49, at 588. ("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." (citations omitted)).

[89] Lemley, supra note 20, at 629.

[90] Teo Firpo & Michael S. Mireles, *Monitoring Behavior: Universities, Nonprofits, Patents, and Litigation*, 71 SMU L. REV. 505, 568 (2018).

II. PATENT STRUCTURE AND PERVERSE INCENTIVES

A. UNIVERSITY PATENTS AS PUBLIC GOODS

Universities are engaged in a public-facing enterprise: the creation and dissemination of new knowledge. Clearly, they do this through their educational mission; they educate and credential students for success in the workforce—an example of a public good through human capital creation. And because of their organization as charitable corporations, universities rely on altruism, a nod to the fact that they produce a public good, in recognition of their educational mission. But they also, theoretically, create public good in pursuit of patents via disclosure. Yet, where universities rely on altruism as charitable corporations, their technology transfer model also relies on profits from their patent portfolio. This juxtaposition makes technology transfer offices the corporate beachhead embedded within the university, while also tangentially aligned with a university's mission of encouraging innovation.

And innovation, itself, is a public good.[91] It is non-rival.[92] That is, the use of innovative ideas and products does not reduce their supply.[93] And it is theoretically non-exclusionary, except when patent protections disallow profit-seeking uses of disclosed innovative ideas.[94] But, as with all public goods, market failures can occur, particularly when users of innovations do not pay the marginal costs of production of the innovation.[95] In these cases, the government may step in to correct market failures by providing direct subsidies for innovation via grants and other direct payments.[96]

But direct government subsidies cannot always solve market failures in innovation, because information costs prevent the government from allocating direct subsidies efficiently. For one thing, the government does not always know which potential innovations to subsidize. It may under-subsidize valuable research and over-subsidize worthless endeavors. Politics also creates information costs. Political actors decide what to subsidize, and their decisions may be influenced by factors other than efficiency (including self-interest).

Accordingly, the government uses patents to solve these "government failures" by subsidizing innovation indirectly. At least in theory, innovators have better information about which potential innovations are likely to be valuable and which ones are not. Patents give innovators a financial incentive to invest in potential innovations

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[91] Brett Frischmann, *Innovation and Institutions: Rethinking the Economics of U.S. Science and Technology Policy*, 24 VT. L. REV. 347, 349 (2000).
[92] Vincenzo Denicolò & Luigi Alberto Franzoni, *The Contract Theory of Patents*, 23 INT'L REV. L. & ECON. 365, 366 (2003).
[93] Keith E. Maskus, *Using the International Trading System to Foster Technology Transfer for Economic Development*, 2005 MICH. ST. L. REV. 219, 233 (2005).
[94] Upendra Roy et al., *Global Assessment of Patents, R&D Investment and Economic Output Part 2--Cross-Country Comparisons at the Industry Sector Level*, 79 J. PAT. & TRADEMARK OFF. SOC'Y 157, 177 (1997).
[95] Jacob Nussim & Anat Sorek, *Theorizing Tax Incentives for Innovation*, 36 VA. TAX REV. 25, 31 (2017).
[96] Sapna Kumar, *Innovation Nationalism*, 51 CONN. L. REV. 205, 232 (2019).

they believe will be valuable by granting them certain exclusive rights in those innovations. Rather than paying for the innovation directly by issuing a research grant, the public pays for it indirectly by paying higher prices for innovative products and services protected by patents.

The Bayh-Dole Act was created to spur university investment in research with commercial potential. Its provisions allow universities to take title to patents originating from government-subsidized investment in university research, where previously the government held such rights to pursue patent protection for innovations produced by universities stemming from government-subsidized research. Initially, the Bayh-Dole Act seemed like a terrible idea. If the government's goal is to solve market failures in innovation, why would it pay for the innovation twice, directly subsidizing it with a grant and then indirectly subsidizing it with a patent? And maybe it is a terrible idea. But the premise of the Bayh-Dole Act was that the goal of innovation policy is commercialization, and patented research is more readily commercialized than unpatented research. In other words, the hope was that by giving universities the right to patent research funded by government grants would encourage universities to pursue commercialization of that research, and thereby ultimately benefit the public. After all, unused innovation does not benefit anyone.

The Bayh-Dole Act has been successful in encouraging universities to pursue patents. And it has also carried unintended consequences. It has encouraged universities, and university researchers, to over-invest in the kind of research that is likely to produce an innovation that could yield a patent—at the expense of research that does not result in the same outcome but still pushes the frontiers of innovation. Moreover, universities are not commercial entities with specialized knowledge of what kinds of patents are more valuable to actual commercial firms. As such, they continue to pursue patents for their research regardless of its commercial value. Although a few university-produced patents hold considerable commercial value, most are effectively worthless. This, of course, adds to patent thickets and makes university patents a gamble, not always a worthwhile investment.

Additionally, there are concerns about the effect of the Bayh-Dole Act's incentive structure on consumers. Before the passage of the Bayh-Dole Act, the government often ceded its patent rights in publicly-funded research to the public domain, allowing any inventor to use the innovation produced from publicly-funded research to create commercially valuable products. After the passage of the Bayh-Dole Act, the public has had to pay for innovation twice: first, when the government funds research at universities; and second, when–upon universities licensing their patents to commercial entities–the commercial entity with the university patent license charges monopolistic prices to consumers to generate profit from their license.

This practice is concerning when considering that universities are charitable corporations with public-facing missions that are charged with generating public goods, like education and innovation.[97] This raises a difficult question: should

[97] Rooksby, *supra* note 21, at 634.

universities, as charitable organizations, utilize public funds to acquire patents that ultimately result in their, and commercial entities', private benefit?[98] It appears that the effect of the Bayh-Dole Act was to enable private firms to pass off research and development costs onto universities, which in turn have been subsidized by the public. Therein lies the rub; it seems that the Bayh-Dole Act's goal has, in effect, been hijacked by private industry without producing greater public benefit. In other words, the social contract on which public subsidy of university research relies is frustrated by a patent-trade triad–from state subsidy to university and from university to patent licensee (or worse, asserter), where the university is the nexus between public support and private benefit. But are these actions and actors independent, or are they coordinated, as they would be in a firm?

B. UNIVERSITIES AS FIRMS (AND RENT-SEEKERS?)

With a few exceptions, universities are non-profit entities, meaning that they have no duty to increase profitability to satisfy public shareholders. Rather, the wealth universities derive and control affords them the means needed to provide educational resources and pursue knowledge generation through research. Yet, universities are corporations of the non-profit variety. They have chartering instruments, and increasingly, their make-up resembles–structurally–the for-profit corporate model.

The concept of the corporate model, or firm, is well-established in the law and economic literature. Dating back over 85 years, Professor Coase defined the firm along the lines of several elements, among them: the boundaries of market actors and the markets in which they participate; structural organization; and heterogeneity of firm action.[99] Let us consider the application of each in turn to the university.

Higher education is a competitive market, and there is a lot of competition. Universities compete for students, faculty, staff, and administrators: their human capital. They also compete for resources, including the funding mechanisms that make their research possible.[100] While some universities have huge endowments that generate vast quantities of investment income, the overwhelming majority of universities are largely tuition-dependent, relying on this income to fund overall university expenditures, including research expenditures. And increasingly, universities compete for the same sponsors and pools of funding that further support their research. Taken together, these examples evidence competition for resources within the larger, competitive higher education market.

Similarly, firm boundaries in the higher education sector are also defined with respect to scale—size and output variety—in relation to the market. Many universities operate with a large footprint by vertically coordinating activities within their

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[98] Brian K. Krumm, *University Technology Transfer - Profit Centers or Black Holes: Moving Toward A More Productive University Innovation Ecosystem Policy*, 14 NW. J. TECH. & INTELL. PROP. 171, 184 (2016). *See also NIH Awards by Location & Organization*, NIH REPORT, https://report.nih.gov/award/index.cfm (last updated June 25, 2018).

[99] *See* Ronald Coase, *The Nature of the Firm*, 4 ECONOMICA 386, 386–405 (1937).

[100] *See* Alon et al., *supra* note 59, at 1–2.

organizational boundaries. Others occupy relatively small niches of the sector and rely on the market to transact through horizontal coordination, but examples of this form are vanishing in the construct that is the modern university. That is, for the most part, the university model has transformed in the last several decades to include enterprises seemingly unrelated to the provision of education and discovery of new knowledge. Instead of exclusively contracting for services, as they have done in the past, most universities have begun to internalize some market transactions by creating administrative units in-house to provide the same services once contracted-for. This not only augments the scale of the university footprint within the market but increases the output variety of universities.

Technology transfer offices are a prime example. By creating such offices to operate under university oversight, universities internalize some of the cost of market transactions for the commercialization of their research. Of course, a good deal of these costs still exist outside of the university ambit. But the acceleration of the existence of technology transfer offices reveals a preference by universities to mitigate the net market transaction costs by internalizing them. This is an illustrative example of what Professor Klein and other industrial organization economists would call "vertical integration" and, more broadly, what Professor Coase would call "firm behavior," in that it evinces a centralization of coordination activity within the locus of the firm.[101]

Likewise, the structure of university organization and governance has changed over time. Historically, universities were governed by boards of trustees and internally governed and administered by faculty. The first universities held administrators as firsts among equals; faculty served in roles of university administration in addition to teaching. Yet, the modern incarnation of the university is different, as the market in which universities operate has also changed. Universities are still governed by boards of trustees, but the composition of these boards has little relationship to the academic enterprise. Titans of industry and donors are overwhelmingly appointed to university boards.[102] Internally, universities are run by presidents and subordinate university officers that occupy executive seats. Increasingly, these administrators' positions mirror their private-sector counterparts. While historically the university was structured as one academic unit, they are now divided into separate, educational and administrative units. This evidences the diversity of the modern university's output, as well as the corporate firm organization of the modern university.

In turn, universities' component parts have taken on a commercial focus. They have commercial hubs, centers, spinoffs, and other ventures related to the university's mission but also unrelated to its central purpose.[103] Again, the technology transfer

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[101] Benjamin Klein, Robert G. Crawford & Armen A. Alchian, *Vertical Integration, Appropriable Rents, and the Competitive Contracting Process*, 21 J. L. & ECON. 297–326 (1978); Coase, *supra* note 99.

[102] *See* Christopher J. Ryan, Jr., *501(c): The Charitable Corporation Governance Model Meets Modern Business Realities in the United States*, in OXFORD HANDBOOK ON U.S. HIGHER EDUCATION LAW (ed. Peter F. Lake) (forthcoming 2023).

[103] *See* Christopher P. Loss, FRONT AND CENTER: ACADEMIC EXPERTISE AND ITS CHALLENGERS IN THE POST–1945 UNITED STATES (forthcoming 2023).

offices housed at universities serve as examples of both the former and the latter. They do serve a role in promoting the research endeavors of universities while also centering on the commercialization of this research in such a manner that takes universities afield of their central purpose and increases the heterogeneity of university action within multiple markets.

But, alternatively defined, and in a Coasean sense, "markets" may mean the contracting that firms engage in–specifically to avoid having to bear the cost of vertical integration, where the latter may exceed the transaction cost of entering into contracts with outside parties. Here, universities, while broadly purposed, regularly enter into contracts with intermediaries, especially in the intellectual property sector. And this is because the cost of production of their intellectual property output exceeds the cost of contracting with intermediaries.[104] This contracting function is the raison d'etre of technology transfer offices.

In a particular way, university technology transfer offices are associated with a quantification and monetization of university research. Their existence is justified by revenue generation from university research, which they derived from contracting with licensees. But, as discussed above, few technology transfer offices are actually profit centers. Most are revenue neutral or cost the university internally. Yet, technology transfer offices are the locus of the corporatization of the university, because they must respond to market imperatives for revenue generation. Often, they do this by extracting appropriable rents.[105]

One of the ways that universities, through their technology transfer offices, extract appropriable rents is in the form of licensing their patents to intermediaries. In turn, these intermediaries contract with product developers to bring the patentable product to market. All things considered, coordination of this chain of transactions by the university is not terribly nefarious on its own and is classic evidence of both economically rational and firm behavior. However, this hypothetical chain of transactions, wherein university research leads to commercial products via benign intermediaries, is oftentimes not the case. The vast majority of university patents have little marketable value by themselves. As such, they never make it to consumers, because the transaction costs of developing them into marketable products is too high, given the limited utility of the underlying patent. Thus, universities frequently look to similar but alternative methods of extracting appropriable rents for their research.

Through patent auctions, low-value patents can be "marketed" for low, low prices. This, again, represents significant losses on research and development investment. In turn, these discounted sales devalue the overarching patent market, harming the marketable prices of legitimate patents and negatively impacting the economic efficiency of the university patent sector. But these are not the only

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[104] *See* Armen A. Alchian & Harold Demsetz, *Production, Information Costs, and Economic Organization*, 62 AM. ECON. REV. 777–95 (1972).
[105] *See* Klein et al., *supra* note 101, at 297–326.

mechanisms universities deploy to extract appropriable rents in ways that yield potential harm.

Worse still, universities license or sell patents to entities that would use the patent as a tool to do far more damage.[106] Enter non-university patent aggregators and patent assertion entities. These firms buy rights to patents in order to seek out potential infringers, sue them, and extract revenue via the patent infringement litigation process.[107] We mentioned earlier that, on average, nearly 95 percent of a given university's patent portfolio is not commercially licensed. This dramatic lacuna of commercial licensing incentivizes technology transfer offices to recoup some of the university's research investment by licensing or selling low-value patents at terms well below research and development costs. This ability to purchase patents at discounted rates allows aggregators to pursue their business model. And it makes universities among the most prime of targets for the sustainment of such a business model, given the glut of under-commercialized patents universities hold.

Regardless of whether universities engage in these transactions (and they do), they undeniably rent-seek via patent litigation. If one "follows the money"–from the federal fisc, to universities, to patent assertion–one can observe that all constitute a firm: an interrelated set of transactions where the costs of the transactions are unified in one nexus,[108] the university. Thus, whether or not they explicitly desire to be, universities are firms. And their horizontal coordination with state sponsorship and private industry—to extract revenue from the patents they are issued by virtue of state-sponsored subsidy—makes those parties necessary components of the university *qua* firm. But, with respect to the incentives to which universities respond within the bounds permitted by the current patent regime, universities can be said to fuel and even occupy part of the underbelly of the patent sector. To the extent that they partner with patent aggregators, transact with other intermediaries, or go it alone, they participate in rent extraction by engaging in patent litigation. We seek to test the extent to which these firm behaviors result in universities' greater propensity to engage in patent litigation by examining various determinants of university patent litigation through an empirical lens.

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[106] *See* Brian J. Love, Erik Oliver & Michael Costa, *U.S. Patent Sales by Universities and Research Institutes*, in THE RESEARCH HANDBOOK ON INTELLECTUAL PROPERTY AND TECHNOLOGY TRANSFER (ed. Jacob H. Rooksby) (2020).

[107] Colleen Chien, *Presentation to the DOJ/FTC Hearing on Patent Assertion Entities: Patent Assertion Entities*, at slide 23 (Dec. 10, 2012), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2187314 (reporting that 61% of patent lawsuits filed from January 1 to December 1, 2012, were filed by patent assertion entities).

[108] *See* Oliver E. Williamson, *The Economics of Organization: A Transactions Cost Approach*, 87 AM. J. SOCIOLOGY 548–77 (1981). But if the university, as a firm, is just a collection of contracts between private parties, we must ask, as others have, "what has it received from the public…and what could it owe to the public?" *See* Sanjukta Paul, *Antitrust as Allocator of Coordination Rights*, 67 UCLA L. REV. 4, 26 (2020). Notably, Professor Paul states that "coordination rights have a public character when they are exercised *beyond* firm boundaries, and that they must be allocated and regulated accordingly." *Id. See also* David Ciepley, *Beyond Public and Private: Toward a Political Theory of the Corporation*, 107 AM. POL. SCI. REV. 139, 146 (2013) (espousing a claim about the public nature of legal privileges granted to corporations conferred from the corporate law).

III. EMPIRICAL ANALYSIS
A. RESEARCH QUESTIONS

In our earlier studies of the technology transfer sector, we empirically identified a handful of firm behaviors undertaken by universities. Our first work in this area presented evidence that universities—like for-profit corporate entities—and their licensees seek judicial fora that historically tend to enforce their ownership rights against alleged infringers.[109] In our next study, we uncovered evidence that universities change their patent acquisition strategy in economically rational ways as a result of changes to the patent law regime.[110] We found that research universities and early entrants into the technology transfer sector were among the most responsive to anticipated changes to the patent law regime.[111] An example of this behavior was holding out on seeking patents until the law afforded them greater ownership protection or filing more applications for patent protection when patent filing standards were changed by the passage of the America Invents Act.[112]

In our penultimate study of technology transfer, we investigated the relationship between a university's federal research appropriations and its patent litigation expenditures, finding that for every $1.00 of federal research support it receives, a university will increase its litigation expenditures by nearly $0.60—net of year-to-year changes and differences between institutions.[113] We argued that these behaviors contribute to patent hold-up and do not redound to the public's benefit, even though a university's technology transfer activities is largely funded through public appropriation and grants.[114]

Our prior research in this field reveals that academic institutions exhibit firm behavior in relation to patent incentives at the expense of social welfare. Thus, in this study, we seek to expand our understanding of the firm behaviors of universities in the technology transfer sector through new methods and a new set of research questions. This study asks whether and to what extent a university's research expenditures and legal expenditures—as well as several other important factors indicating its level of technology transfer activity—impact:

(1) its likelihood to litigate an infringement claim for a patent it owns; and
(2) the frequency with which it will choose to litigate such a claim.

To answer these questions, this study analyzes data on the population of academic institutions that were involved in litigation for one or more patents between

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109 *See* Brian L. Frye & Christopher J. Ryan, Jr., *Fixing Forum Selling*, 25 U. MIAMI BUS. L. REV. 1–27 (2017).
110 *See* Christopher J. Ryan, Jr. & Brian L. Frye, *An Empirical Study of University Patent Activity*, 7 NYU J. INTELL. PROP. & ENT. L. 51–84 (2017).
111 *See id.*
112 *See id.*
113 *See* Ryan & Frye, *surpa* note 49*,* at 575–90.
114 *See* Frye & Ryan, *supra* note 42.

January of 2000 and August of 2021.[115] Notably, because of the date-range limitation in our underlying data, this study does not and cannot determine the extent to which the patterns in our results hold true since 2021. However, it can help explain how academic institutions have historically exhibited firm behavior through their involvement in infringement litigation.

B. DATA AND METHODS

Our dataset originates from three sources. First, we employed a proprietary dataset from the Association of University Technology Managers ("AUTM"), containing a host of information about university technology transfer.[116] This allowed us to investigate links between federal funding and research expenditures with patent litigation trends.[117] Included in this dataset was information about patent filing, licensing data, and legal expenditures[118] by university by year. The AUTM data embodied the primary covariates employed in our study.

To improve the model fit and expand the list of control variables, we merged this information with data from the Integrated Postsecondary Education Data System ("IPEDS"), which contains variables specific to each university in a given year.[119] In

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115 These lawsuits were associated with AUTM data for the year preceding the lawsuit.

116 This data included reported information through the end of 2020 from AUTM's STATT database. "AUTM is a nonprofit organization representing IP managers at the TTOs of over three hundred universities, research institutions, and teaching hospitals. AUTM conducts an annual survey about patenting and licensing activity, and responses are compiled in the Statistics Access for Tech Transfer (STATT) database." Ouellette & Tutt, *supra* note 11, at 6. *See also STATT: Statistics Access for Technology Transfer Database*, AUTM, https://autm.net/surveys-and-tools/databases/statt (containing "a myriad of data on licensing activity and income, start-ups, funding, staff size, legal fees, patent applications filed, royalties earned and more.").

117 As germane to our study, the data from the AUTM dataset contain school-specific and year-specific information about the number of licenses a university holds that generate revenue in excess of $1 million, the number of cumulative active licenses a university holds, the number of patents that the US Patent and Trademark Office issued the university, the number of patents for which the university applied, the amount of legal expenditures the university paid, the amount of legal fees reimbursed to the university, the amount of federal research funds that the university received, and the amount of independent research contributions the university received.

118 It is notable that legal fees include "the amount spent by an institution in external legal fees for patents and/or copyrights." *AUTM Licensing Survey Definitions*, AUTM, https://autm.net/AUTM/media/Surveys-Tools/Documents/Licensing-Survey-Definitions.pdf. These fees include patent prosecution and associated maintenance fee costs, but do not include significant litigation costs, such as "any individual litigation expense that exceeds 5% of total." *Id.*; see also Gary Rhoades, *Housing the Measurement of University Innovations' Social Value: Organizational Site, Professional Perspective, Institutional Outlook*, in 19 ADVANCES IN THE STUDY OF ENTREPRENEURSHIP, INNOVATION & ECONOMIC GROWTH 237, 244 (2009) ("[T]he AUTM survey provides data on legal fees, but since 1999, these figures have only included the costs of patent prosecution, and have not included major litigation fees of universities, or the costs of university or externally hired attorneys who deal with technology transfer issues."). Legal fees may include costs associated with drafting "an initial letter to a potential infringer written by counsel." *AUTM Licensing Survey Definitions*, *supra* note 118.

119 This dataset is publicly available from the National Center for Education Statistics. *See* Integrated Postsecondary Education Data System, *Use the Data*, NAT'L CTR. FOR EDUC. STATISTICS, https://nces.ed.gov/ipeds/use-the-data (last visited September 24, 2020). The IPEDS dataset is vast, and not all of it is germane to our study. As such, we merged this dataset with our existing data to

particular, institutions were identified as a public or private university and categorized as "Research 1," "Research 2," or neither under the Carnegie Classification of Institutions of Higher Education in any given year. Research 1 institutions are believed to engage in the highest level of research activity,[120] with Research 2 institutions engaging in slightly less research, and other universities engaging in still less.[121]

Finally, we merged this information with a novel dataset housed at the Stanford Law School, entitled the "Stanford Non-Practicing Entity (NPE) Litigation Database."[122] The Stanford NPE Litigation dataset was created by examining all patent lawsuits in which a non-practicing entity (including universities) was involved since 2000.[123] We merged the NPE Database with our existing datasets to create our principal dependent variables: litigation and frequency of litigation. We also altered the Stanford NPE dataset by contributing a few new variables of our own, indicating the role of each university in litigation.[124]

The final product of the merged datasets provides a rich set of institutional characteristics, which we used in our regression models as covariates. While the final merged dataset contains a wealth of information about universities that were involved in patent litigation in the year range, several institutions from the AUTM dataset were dropped from observation because they were not involved in litigation during the time studied. In the final dataset, we retained 1,738 school-year observations for analysis,

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import information from variables on university expenditures and endowment returns as well as indicators for whether the university was a public or private university and whether the university is classified as a research university by the Carnegie Classification of Institutions of Higher Education.

[120] Noll v. Bd. of Regents of Univ. of Wisconsin Sys., No. 20-CV-293-BBC, 2021 WL 5177422, at *2 n.1 (W.D. Wis. Nov. 8, 2021), *aff'd*, No. 21-3176, 2022 WL 2113081 (7th Cir. June 13, 2022).

[121] Albert Kauffman, *Effective Litigation Strategies to Improve State Education and Social Service Systems*, 45 J.L. & EDUC. 453, 502 (2016).

[122] This dataset is publicly available for registered users to search and download. *See* NPE Litigation Database, *Welcome to the Stanford NPE Litigation Database*, STANFORD L. SCHOOL, https://npe.law.stanford.edu (last visited September 24, 2020).

[123] *See, e.g.*, Miller et al., *supra* note 77, at 243 (noting that the "project objectives are: (1) to review every patent infringement lawsuit, including declaratory judgments, filed in U.S. district court since 2000 and categorize the party (or parties) asserting the patent(s) in each case (hereinafter called "patent asserters") as a practicing entity or as one of 11 types of NPEs (see Table 1); and (2) to conduct a preliminary analysis of the data to determine whether litigation trends differ by patent asserter type and whether there is variation in the characteristics of litigation across pa- tent asserter type.").

[124] These indicators track whether the university involved in the litigation was: the initiating party (i.e., the named plaintiff); a joined party (i.e., its licensee was a named plaintiff); the primary defendant; a co-defendant; a counter-defendant (i.e., the university was a named defendant in a counter motion by the case's principal defendant). In our final dataset, the representation of school-year observations that indicated that a university was a primary defendant (n=9) or co-defendants (n=19) was not meaningful to our ultimate research questions about the extent to which a university engaged in infringement litigation—whether on its own accord or through its licensee. Thus, we only employed these indicators for initiating parties (n=234), joined parties (n=19), and counter-defendants (n=142) in our naive analysis for testing the effect sizes of our estimates. We do not report these results.

Where regressions were performed on a university/year basis, the university was coded with the above variables for the first litigation it filed in the relevant year. For example, if a university was an initiating party in the first case in a year and a joined party in the next two cases in that year, the university was treated as being an initiating party for that year's data.

representing the 89 different universities that were involved in patent litigation between 2000–21.[125] While this sample size is by no means an indication of all of the universities involved in the technology transfer sector during this 21-year period,[126] the analytical sample used in this study can be viewed as representing a complete picture of the population of academic institutions that have been involved in patent litigation in that time.

We employ three principal methods to analyze this dataset, basing our method of analysis on the dependent variable operationalization. In our first analysis, we use a logistic regression specification to predict the likelihood that a university would be involved in litigation as an initiating party or a counter-defendant—the latter of which is usually the case when the university is already the initiating party. We chose our method of analysis (logistic regression) because the model bounds the likelihood of litigation involvement between 0 and 1.[127] With a binary dependent variable, this method is preferable to an Ordinary Least Squares regression approach, because the latter does not bind the outcome between 0 and 1 but rather models the outcome continuously. Likewise, the resulting coefficients are interpretable by their deviation from a mean of 1, meaning that each one-hundredth of a deviation above one equals a one percentage point positive increase in the likelihood of the depend variable equaling one, while each one-hundredth of a deviation below one equals a one percentage point negative decrease.[128]

In our next two analyses, the dependent variable is measured by the frequency with which a university has been involved in litigation as an initiating party, joined party, or counter-defendant.[129] That is, our dependent variable is a measure of how involved a given university in a given year is in terms of litigating its patent portfolio. The first of these specifications employs an Ordinary Least Squares regression with all meaningful covariates. This method is warranted where the outcome is continuous, as ours is here[130]—a measure of litigation frequency. And it is more parsimonious than our second analysis. In our second analysis, we use an Instrumental Variable Estimation—or Two-Stage Least Squares analysis—to remove the endogeneity of one of our independent variables:[131] the natural log of net legal expenditures, which we

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125 In total, 8 of these universities were not research universities, while the other 81 were classified as research universities, and 53 entries were identified as public universities and 28 were identified as private universities.

126 The data covered cases filed from January 2000 to August 2021, so the coverage was actually just shy of 22 years.

127 *See* Tammy W. Cowart et al., *Two Methodologies for Predicting Patent Litigation Outcomes: Logistic Regression Versus Classification Trees*, 51 AM. BUS. L.J. 843, 847 (2014).

128 W. Michael Schuster et al., *An Empirical Study of Gender and Race in Trademark Prosecution*, 94 S. CAL. L. REV. 1407, 1451 (2021).

129 In fact, looking at annualized data from 2000–17, all but nine times in a year a university was a counter-defendant, they were also an initiating party in that year (n=133). The counter-defendants that were not initiating parties were joined parties (n=9).

130 Richard L. Wiener et al., *Unwrapping Assumptions: Applying Social Analytic Jurisprudence to Consumer Bankruptcy Education Requirements and Policy*, 79 AM. BANKR. L.J. 453, 466 n.56 (2005).

131 Jon P. Nelson, *Cigarette Advertising Regulation: A Meta-Analysis*, 26 INT'L REV. L. & ECON. 195, 211 (2006).

hypothesized might be related to research expenditures. By instrumenting the latter on the former, we were able to remove the endogeneity posed by regressing both variables independently. That is, by performing this analysis, we could remove the bias that legal expenditures have on our dependent variables—likelihood and frequency of litigation—expressed through our key independent variable: namely, research expenditures. Our findings suggest a curious relationship and result, which we explore in the results section of this article.

C. ASSUMPTIONS

To facilitate combination of the multiple datasets used herein, several assumptions were necessary. An initial concern was the varying levels of specificity in the datasets. For instance, the litigation dataset included plaintiff data that could refer to multiple specific universities. When the "Board of Trustees of the University of Arkansas" brings a lawsuit, the case could have arisen from one of the many public universities in the state.[132] However, the IPEDS data is more specific, identifying particular institutions, such as the "University of Arkansas Main Campus" or the "University of Arkansas at Little Rock."[133] In such cases, the plaintiff was assumed to be the primary academic unit within the larger organization (e.g., the University of Arkansas Fayetteville (Main Campus) was identified for "Board of Trustees of the University of Arkansas").[134]

Likewise, where the AUTM or IPEDS data appeared to contain multiple entries for a single institution, the code for the primary unit was employed. For instance, IPEDS data for "Johns Hopkins University" was used instead of that for "Johns Hopkins Hospital-School of Radiologic Techn." We have no reason to believe that the above assumptions introduce any consistent bias or error into our data. Moreover, this form of attribution is consistent with other studies that have used such data.

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[132] Four-year public universities in the state include: University of Arkansas (Fayetteville), University of Arkansas at Little Rock, University of Arkansas for Medical Sciences, University of Arkansas at Monticello, University of Arkansas at Pine Bluff, University of Arkansas at Fort Smith, and University of Arkansas Grantham. University of Arkansas System, *Campus Units*, https://www.uasys.edu/campuses-units/.

[133] The AUTM was similarly specific, including institutions such as "University of Arkansas Fayetteville" and "University of Arkansas for Medical Sciences."

[134] Similar assumptions were made for the University of Massachusetts (defaulted to U. Massachusetts, Amherst), the Research Foundation for the State University of New York (SUNY Buffalo), University of Tennessee Research Foundation (U. Tennessee, Knoxville), Regents of the University of Minnesota (U. Minnesota, Twin Cities), etc.

This rule was deviated from where there were multiple plaintiffs of varying degrees of specificity. In such an instance, the lawsuit was treated as arising from the most specific unit for which data was available. For example, where both the "University of Texas System" and "MD Anderson Cancer Center" (a distinct academic unit within the Texas System) were named plaintiffs, the lawsuit was treated as arising from MD Anderson, not the primary academic institution within the Texas System (i.e., the main campus in Austin, TX).

D. RESULTS

Across all of our analyses, we use a similar set of independent variables and covariates. Our independent variables of interest are natural logs of total research expenditures and legal fees expended by a university in a given year.[135] We specify the legal fees in two ways. First, we take the natural logs of combined legal fees and reimbursed legal fees. And second, we take the natural log of the difference of these two variables by subtracting the latter from the former. We then include a covariate indicator for whether the university is a public entity.

Additionally, information on several measures of a university's technology transfer activity was added. These attributes include licenses issued that generate over $1 million in revenue for the university in a given year; the cumulative number of active licenses issued by the university; the total number of patents issued to the university in a given year; the number of new patents a university applied for in a given year (i.e., first applications in patent families); and the *total* number of patents the university applied for in a given year (including all continuations, divisionals, etc.).[136] We report all of these covariates in the tables that follow.

Our information from the Stanford NPE Dataset was coded for the year that any relevant lawsuit was filed. However, our current interest is the university's choice to engage in litigation as it is influenced by other patent and research-related events. Accordingly, we want to ensure that the independent variables occurred prior to the possibility of the dependent variable taking place. As such, we use current year values of independent variables and covariates in all of our specifications below, but we use one future year values for our dependent variables. Doing so drops some of our observations from analysis. For example, likelihood of litigation in the year 2022 cannot be predicted because there is no data for that year in the dataset;[137] however, we are confident that this specification presents a more realistic model of litigation engagement than using current-year values of independent variables and covariates.

In our first model, we use a logistic regression to predict the likelihood of a university's engagement in litigation. Thus, the dependent variable here is whether an infringement lawsuit was filed—regardless of whether it was one of many cases that were brought. In this logistic regression, we employ fixed effects by year and university to isolate the differences that exist not only between years but also between institutions engaged in patenting and patent litigation. The results are interpretable as looking within a given year at a given university.

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[135] The net of overall litigation fees expended by a university is a variable that we created independently from the AUTM dataset. The two variables used to create this variable were the overall litigation fees expended by a university and the amount of legal fees reimbursed to a university in a given year. The latter was subtracted from the former, and the natural log of the resulting difference was calculated to create this variable. For the other two variables, we calculated the natural log of the amount of federal research receipts and independent research grants.

[136] *See* Appendix A for full definitions of relevant variables.

[137] We use covariate information from 2020 to predict the information for 2021, which extends through August of 2021.

We find that the number of new patents applied for (i.e., an application that is not a continuation of a prior filing) in the current year and the total number of patents applied for (including continuations) by a university in a current year predict its likelihood of litigation in the immediate future year at statistically significant levels. We observe that as the total number of patents a university has applied for at the USPTO increases, the likelihood of that university engaging in litigation in the next year decreases by 0.4 percent. By contrast, we find that for every new patent a university applies for in a given year, the likelihood of that university engaging in litigation in the following year increases by 0.5 percent. This may suggest a somewhat contradictory finding. However, we take this to mean two things: (1) universities with the largest patent filing totals (especially those that file many applications in single families) are marginally depressing the likelihood of litigation because the addition of one more filing to a cumulative filing total (e.g., adding on more application to a patent family) does not drive litigation; yet, (2) the addition of one more new patent filing (covering a new technology and starting a new patent family) suggests an increase in the likelihood of patent litigation. As such, we have reasonable confidence in the latter finding: that filing applications covering new technologies (i.e., starting new patent families) are positively related to litigation likelihood, where cumulative totals of filings may not be.

Two additional variables in this model draw our consideration—and both are related to the research funds that a university expends. For every one percent increase in the research funds that a university expended in a given year, the likelihood of that university engaging in litigation increases by more than 3.78 percent. This rate of increase is notable, as one might expect the rate of patent litigation to increase in lockstep with research expenditures. However, we see a litigation rate that increases faster than the growth rate of research expenditures as funds spent on research get larger. Likewise, for every one percent increase in licensing revenue that a university received in a given year, its likelihood of litigation in the next year increases by more than 1.25 percent. We note that the statistical significance of the last of these observed effects did not rise to conventional levels, but it is close enough to conventional levels of statistical significance (p=0.094) that it merits our attention.

These results indicate the meaningfulness of technology transfer activity, as measured by how aggressively universities seek and are issued patents for their inventions, on the likelihood that a university will seek to enforce its patents via infringement litigation. This result stands to reason. But more troublingly, we see evidence that research funding receipts may also be predictive of litigation likelihood, suggesting that the more public and private support a university has for its research, the more likely it is to contribute to patent thickets that are reinforced via litigation, and maybe even patent hold-up. Thus, we further investigate this relationship in our next two analyses.

Table 1: Logistic Regression Predicting Likelihood of Litigation in the Following Year (Odds Ratios)			
	Model		
	Odds Ratios	*Std. Err.*	*p*
Constant	4.20e-15	5.57e-14	**
Public University	2.175	2.801	
Licenses Generating $1 Million +	1.055	0.081	
Cumulative Active Licenses	1.001	0.001	
Gross Licensing Income (Log)	1.253	0.169	*
New US Patents Applied For	1.005	0.002	***
Total US Patents Applied For	0.996	0.002	**
US Patents Issued	1.003	0.005	
Total Research Expenditures (Log)	3.788	2.418	**
Legal Fees (Log)	0.886	0.314	
Reimbursed Legal Fees (Log)	1.268	0.248	
Model Statistics (Obs: 1,229)	*p* >X2:0.000***	R^2: 0.2421	
*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$.			

NOTE: The above table looks within year and within university, employing fixed effects for both.

In our next analysis, we used an Ordinary Least Squares regression to estimate the effect of the values of the aforementioned independent variables and covariates on the frequency with which a university engages in litigation in the next observation-

year. Unlike the prior analysis (shown in Table 1), the dependent variable here is how many cases were brought in a given year—such that it could be any integer 0 or greater. Once again, we used fixed effects for year and university, which means that our results are interpretable as looking within a university in a given year. Notably, none of the covariates achieve statistical significance in this model–except for one. A ten percent increase in research expenditures in the prior year increases the frequency of litigation by 0.0570 cases. This may not seem like much, but given that the explanatory power and effect size was wanting for all other covariates, it points to a trend that we wished to further investigate in our final analysis: the role of research expenditures in driving patent litigation.

Table 2: OLS Regression Predicting Frequency of Litigation in the Following Year (Number of Cases)			
	Model		
	Coefficient	*Std. Err.*	*p*
Constant	-9.833	6.076	*
Public University	-0.491	0.740	
Licenses Generating $1 Million +	-0.031	0.039	
Cumulative Active Licenses	0.000	0.000	
Gross Licensing Income (Log)	0.017	0.064	
New US Patents Applied For	0.001	0.001	
Total US Patents Applied For	-0.002	0.001	
US Patents Issued	0.004	0.003	
Total Research Expenditures (Log)	0.570	0.301	**
Legal Fees (Log)	-0.054	0.145	
Reimbursed Legal Fees (Log)	0.018	0.081	
Model Statistics (Obs: 1,282)	$p > F$:0.000***	R^2: 0.1698	
*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$. [PY] Prior Year Values.			

NOTE: The above table looks within year and within university, employing fixed effects for both.

Because the effect of research expenditures on litigation propensity and frequency was statistically significant in our first two models, we sought to further investigate this relationship, which we hypothesized might be endogenous.

Specifically, given university budgeting processes, research expenditures should only affect litigation frequencies through fiscal outlays earmarked for legal expenditures. And it stands to reason that legal expenditures would impact the frequency of the rate at which universities pursue involvement in litigation. But a curious finding would be that these net legal expenditures are moderated by the effect of research expenditures. Further, it would imply that research expenditures *drive* legal expenditures. Our preliminary descriptive and relational statistical results support inquiry into this topic, as annual research expenditures and legal expenses correlated at a rate exceeding 0.85 within our dataset. We thus are curious as to whether increases in research expenditures drive increases in litigation rates above and beyond that which would be predicted by simple increases in legal fees that increase along with research funds.

Before further delving into this relationship, we must be clear what the data represents. An obvious potential mechanism between research outlays and litigation is that: (1) increases in research expenditures increases legal outlays, and (2) increased available funds for legal issues will drive the willingness to bring lawsuits. However, one aspect of our data may potentially complicate this direct causal relationship between research funds and litigation. Notably, the legal expenses reported by AUTM exclude significant *litigation* expenses. Rather, that data only includes outlays for patent prosecution and *preliminary* litigation (e.g., sending cease and desist letters) costs.[138] Thus, any increases in legal fees in proportion to growth in research funds does not necessarily mean that more fees are available for litigation. We do, however, still hypothesize that net funds available for litigation may move in concert with the legal fees reported by AUTM, which include preliminary litigation costs. That is, the litigation variable reported by AUTM is a good proxy for total legal expenditures, which likely has an impact on litigation propensity. Thus, it is still worth investigating if research outlays drive litigation above and beyond any associated growth in legal fees. As such, and to further test the relationship between research expenditures, legal expenditures, and litigation, we employed an instrumental variable estimation analysis in our final model, also known as a two-stage least squares regression.

Our first stage regression model and endogeneity tests proved that the natural log of net legal expenditures was indeed endogenous. We found that the logged current year measure of research expenditures was a strong instrument for logged current year net legal expenditures. In other words, the bias from net legal expenditures on patent litigation likelihood and frequency was moderated by research expenditures. Thus, we instrumented logged research expenditures on logged net legal expenditures in our second stage least squares regression analysis.

Our results indicate that, net of research expenditures, legal expenditures are a statistically significant predictor of litigation frequency. Specifically, we find that a ten percent increase in net legal expenditures in a given year results in a 0.347 case increase in the frequency of patent litigation. Although this effect may appear modest, it is not. In most years in our sample, the vast majority of universities in our sample are not involved in any patent litigation. The fact that just a ten percent increase in overall net

[138] *See supra* note 118 and Appendix A.

legal expenditures represents a roughly thirty-five percent increase in patent litigation frequency, starting from zero, underscores the effect that this independent variable has on our dependent variable. And it underscores the clear relationship that research expenditures have on legal expenditures, pointing to the fact that the former drives the latter.

Yet, some of the effects observed in our first analysis that were erased in our second analysis return in this instrumentation. Public universities have a statistically significant and a negative relationship with litigation frequency. Licenses with revenues exceeding $1 million have a positive and statistically significant relationship with litigation frequency. But licensing revenue has no statistically significant effect on frequency of patent litigation. Likewise, the number of patents issued to a university has a modest effect on its patent litigation frequency in the next year, even though this effect size is just outside of conventional levels of statistical significance. However, the number of new applications (i.e., new patent families) and the total number patents applied for (i.e., all patent applications) by a university have a flat, or marginally negative, and statistically insignificant effect on patent litigation frequency. In both cases, the effect of these variables on the dependent variable falls outside of conventional levels of statistical significance, but here, the effect has drawn down, like most of the other covariates in the model, toward a default position of zero. Finally, we did not include fixed effects by year and university in this model as we did with the previous model but instead included a dichotomous variable indicating whether the litigation occurred before or after the passage of the AIA.

We interpret these findings to mean that the effect of research expenditures observed in the previous OLS regression model is indeed a significant driver of litigation frequency, suggesting that universities may indeed use funds earmarked for research and innovation purposes on patent litigation. This behavioral pattern is economically rational, in the sense that universities may be responding to an incentive to protect their intellectual property rights at best, or at worst to rent-seek. But this behavior is ultimately the result of strategic firm decisions regarding resource allocation decisions that inure to a university's private benefit—not the benefit of the public.

Table 3: IVE Regression Predicting Frequency of Litigation			
	Model		
	Coefficient	*Std. Err.*	*p*
Constant	-2.675	1.569	*
Net Legal Expenditures (Log)	3.470	0.176	**
Public University	-0.226	0.098	**
Licenses Generating $1 Million +	0.067	0.028	**
Cumulative Active Licenses	0.000	0.000	
Gross Licensing Income (Log)	-0.108	0.066	
New US Patents Applied For	0.000	0.000	
Total US Patents Applied For	-0.001	0.000	
US Patents Issued	0.004	0.002	*
Post AIA	0.081	0.097	
Model Statistics (Obs: 1,304)	$p > X^2$:0.000	R^2: 0.0581	***
*** $p \leq 0.01$, ** $p \leq 0.05$, * $p \leq 0.1$. First Stage Tests: Eigenvalue statistic = 160.72 ($p > F = 0.000$***).			

NOTE: The instrumented variable in the first stage regression equation was logged research expenditures, on the log of net legal expenditures, with the following covariates: licenses generating $1M+, cumulative active licenses, the log of gross licensing income, new patents applied for, total patents applied for, patents issued, and a dichotomous variable representing whether the litigation appeared after the passage of the AIA.

E. IMPLICATIONS

The above findings raise several discrete questions that warrant further consideration and future research. The below section begins by addressing potential concerns about public funds being used to bring patent infringement lawsuits. Specifically, it addresses the propriety of diverting potential research expenditures toward legal costs and any resultant downstream inefficiencies. The section concludes by situating our findings within the stated goals of the Bayh-Dole Act. Future research questions are presented.

1. Potential Misallocation of Public Funds

Our findings that universities receiving more federal funds are increasingly likely to bring patent infringement lawsuits raise concerns about the efficient use of taxpayer dollars. Research grants are intended to benefit the public through generating and disseminating new knowledge. While our research does not address to what extent these goals are being served by the current situation, we must wonder about potential public harm arising from university filed lawsuits, and how this litigation is funded.

Patent infringement lawsuits filed by institutions receiving public research funds raise three discrete concerns warranting future research. First, lawsuits divert money from the university and its research-centric goals towards litigation costs. This raises questions about the propriety of such an allocation.[139] Indeed, even those directly involved in these lawsuits seem to question whether they further the university's research mandate. In a survey conducted by Professor Rooksby, more than half (54.6 percent) of chief research officers at 23 different universities disagreed with the idea that patent litigation furthered "their universities' research missions."[140]

Of course, the case can be made that university-filed patent litigation protects research investments by maximizing licensing income, not to mention potential revenues from settlements or damages awards if the litigation is successful.[141] The resultant funds can then be recycled into the research pipeline. Whether this occurs in practice is, however, a question warranting further investigation.[142] Recognizing that universities are disproportionately successful in patent litigation when compared to other NPEs,[143] the question of whether these lawsuits are income positive or negative remains. Furthermore, future research must analyze whether these lawsuits increase

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[139] *See generally* Grazia Sveva Ascione, Laura Ciucci, Claudio Detotto & Valerio Sterzi, *Universities Involvement in Patent Litigation: An Analysis of the Characteristics of US Litigated Patents*, 127 SCIENTOMETRICS 6855, 6858 (2022) (discussing different perceptions of university research and patent litigation).

[140] Rooksby, *supra* note 87, at 341, 351.

[141] The same study by Rooksby found that over 90% of chief research officers agreed with the proposition that "If we are willing to invest in research and incur costs to obtain patents, we must be willing to sue infringers of our patents." *Id.* at 351.

[142] Bayh-Dole requires that patent income from Bayh-Dole owned patents be "utilized for the support of scientific research or education." 35 U.S.C. § 202. But this is an empty obligation. By definition, Bayh-Dole patents are at least initially owned by universities. As charitable organizations, universities can only use any income they receive in support of their charitable mission of education.

[143] Ansell, Arad, Branch, Lee, Pasha & Robinson, *supra* note 75, at 10.

licensing income outside of litigation. Indeed, this topic is animated by a 2013 Brookings Institute report which found that over 80 percent of universities don't bring in enough from their patent licensing to cover associated costs of their technology transfer office and patent prosecution.[144] Relatedly, future work should investigate whether such licensing and litigation income is cycled back into research endeavors.

A second issue associated with university patent litigation is to what extent it harms downstream consumers. A case could be made that public funds are misallocated when used to bring infringement cases that harm consumers. As an example, if universities assert low quality (e.g., questionably valid) patents or bring lawsuits with a small chance of success, many defendants will rationally settle instead of paying the costs associated with invalidating the patent or establishing non-infringement.[145] In such a case, these defendants will ultimately increase prices to consumers to cover licensing costs.[146] This in turn, presents consumer harm.

Some commenters allege that universities are involved in such lawsuits. In 2021, the Electronic Frontier Foundation asserted that a multi-university group focused on licensing technology patents would behave largely consistent with the above modus operandi and, ultimately, would "lead to worse, more expensive products."[147] Similarly, others argue that universities commonly transfer patents to trolls, who engage in antisocial licensing activities.[148] This would be an example of horizontal coordination on the part of universities that leads to market harms. On this front, future research is warranted into the pre-trial settlement rate and likelihood of patent invalidation during university litigation (or litigation of former university patents). Such information is needed to determine the effects of university patents and litigation on downstream consumers.

What's more, while the Bayh-Dole Act gives universities the ability to patent inventions funded by government grants, it does not require them to do so. Universities could also choose to place those inventions in the public domain for everyone to use. The premise of the Bayh-Dole Act is that patented inventions are more likely to be commercialized and thereby benefit the public. But the premise could easily be wrong. After all, why would a private business decline to use a valuable invention in the public domain? A cynic might suspect the real purpose of the Bayh-

144 Valdivia, *supra* note 39.
145 Katya Assaf, *Of Patents and Cobras: Exposing the Problem of Asymmetry*, 35 CARDOZO ARTS & ENT. L.J. 1, 25 (2016).
146 Mark A. Lemley & Carl Shapiro, *Patent Holdup and Royalty Stacking*, 85 TEX. L. REV. 1991, 1993 (2007).
147 Joe Mullin, *15 Universities Have Formed A Company That Looks A Lot Like A Patent Troll*, ELECTRONICS FRONTIER FOUNDATION, https://www.eff.org/deeplinks/2021/06/15-universities-have-formed-company-looks-lot-patent-troll; *see also* John Koetsier, *Congratulations, Boston University, You're Now a Patent Troll*, VENTUREBEAT (July 3, 2013, 12:17 PM), http://venturebeat.com/2013/07/03/congratulations-boston-university-youre-now-a-patent-troll [https://perma.cc/4B2K-4AWH] (asserting that Boston University behaves like a patent troll).
148 Ayres & Ouellette, *supra* note 40, at 274 ("Universities have been criticized for selling their patents to patent assertion entities.").

Dole Act was to use the patent system to indirectly subsidize universities. If so, we should ask whether that is efficient, effective, and appropriate.

Lastly, even if it is assumed that litigation costs are an efficient use of public or research funds—and they surely are not an economically efficient use of these funds, in the classical sense, because they do not grow the size of the proverbial pie—the public perception thereof can have consequences. Should the public believe that universities receiving research grants are "improperly" allocating funds to litigation, general support for research and university funding may diminish. Such a phenomenon might occur through several mechanisms, including beliefs (correct or not) that "universities shouldn't litigate patents" or "universities are acting as patent trolls." Beliefs of this nature may eventually harm support for public funding of university research and consequently diminish the funding itself. Activity of this sort would necessarily harm the scope of university research.

2. The Future of the Bayh-Dole Act

Recalling that the Bayh-Dole Act was passed in response to perceptions that university-generated technologies were being under commercialized,[149] it is worth evaluating whether the law is addressing this issue. As a starting point, we recognize a position set forth by Professors Ayres and Ouellette, questioning how non-exclusive licensing of university patents—and related lawsuits—to firms that have *already adopted* the technology furthers this goal of Bayh-Dole.[150] Our findings support a concern that public funding of university research taken in conjunction with patent-allocation through Bayh-Dole is bringing about more lawsuits against parties who have already adopted university-created inventions. Those lawsuits, in turn, incentivize defendants (actual or would-be) to adopt non-infringing alternatives. Thus, in a perverse twist of events, in some instances, the Bayh-Dole act may actually discourage use of university-generated technology.

Of course, this is not to say that Bayh-Dole has, *in the aggregate*, had the net effect of discouraging use of university inventions. While our research is consistent with that conclusion, it does not prove Bayh-Dole is net inefficient. However, this query warrants future research into how common it is that university assertion of patents actually discourages use of the relevant technology.

To be fair, while the primary focus of Bayh-Dole's legislative history is private commercialization of university technologies,[151] other potential prosocial benefits may

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[149] Christopher S. Hayter, *A Social Responsibility View of the "Patent-Centric Linear Model" of University Technology Transfer*, 54 DUQ. L. REV. 7, 11 (2016); 35 U.S.C. § 200 (The first listed "policy and objective" of the Bayh-Dole Act was to "promote the utilization of inventions arising from federally supported research or development."); Network Signatures, Inc. v. Citibank, N.A., No. SACV08-0718DOC(RNBX), 2008 WL 5216032, at *3 (C.D. Cal. Dec. 4, 2008) ("The primary purpose of the Bayh -Dole Act is to ensure that government-funded inventions are commercialized, and thus allow the public to benefit from those inventions.") (citing 35 U.S.C. § 200).

[150] Ayres & Ouellette, *supra* note 40, at 275.

[151] *Id.* at 287 (discussing the legislative history).

arise from the statute's allocation of patents to the university. For example, patenting of university inventions may further dissemination of relevant information and could increase university income through licensing.[152] However, to the extent that these were not the primary goal of Bayh-Dole, it is questionable to what extent such considerations are relevant to future analyses of whether the statute is fulfilling its goal and whether future policy changes are merited.

IV. CONCLUSION

The current state of university patents—especially with respect to the perverse incentives inherent in the patent regime that privilege university-generated research and patenting—is a mess. As we explain in this article, a substantial body of scholarship questions the effectiveness, efficiency, and wisdom of university patents in general and the Bayh-Dole Act in particular.[153] It is unclear why patent ownership would cause universities to generate more valuable innovation, and there is limited evidence that this goal was actually fulfilled.[154] Thus, it is difficult to justify subsidizing university research both directly through grants and indirectly through patents, and the justifications provided work far better in theory than in practice.

Although more than four decades have passed, it remains disappointing that Congress encouraged universities to claim private ownership of ideas, rather than releasing them to the public domain.[155] Since the passage of the Bayh-Dole Act, the practical effect of university patents on innovation policy is clear. The Bayh-Dole Act enabled universities to patent inventions and discoveries produced by academics, rather than releasing them into the public domain.[156] While the Bayh-Dole Act was intended to encourage the commercialization of academic innovation, it may have had the opposite effect. It gave academics an incentive to patent their inventions and discoveries, and it gave universities an incentive to enforce those patents. As a consequence, academics delayed disclosing their research results until they could patent any inventions and discoveries, and universities used those patents to prevent commercialization without a license. Inevitably, research results were often disclosed later or not at all, and became more expensive to commercialize.

In addition, university patents may have reduced the commercialization of innovation, rather than increasing it.[157] Like any other form of intellectual property, patents impose transaction costs.[158] Sometimes, patent transaction costs are worth it, when they encourage more innovation. But universities are charitable organizations and are in the business of funding innovation. They do not need a patent incentive. As charitable organizations dedicated to education and the advancement of

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[152] *Id.* at 282.
[153] Orozco, *supra* note 9; Greenbaum, *supra* note 31; Ayres & Ouellette, *supra* note 40, at 288.
[154] Nussim & Sorek, *supra* note 95, at 31.
[155] *See supra* Part III.
[156] *Id.*
[157] *Id.*
[158] *Id.*

knowledge, universities should make the innovations they produce available to everyone—and perhaps for free. That's their charitable purpose.

At best, the Bayh-Dole Act was a cynical effort to reduce government spending on universities by using the patent system to provide indirect funding. But it is easy to imagine worse intentions, especially given the results. As it stands, universities receive billions of dollars in federal research grants.[159] The Bayh-Dole Act gives them an incentive to patent anything they can and sell those patents to the highest bidder, whether or not the buyer has any interest in commercializing the innovation.[160] The result of the Bayh-Dole Act was predictable, and Congress should have predicted it.[161]

Applying a firm behavior approach to analyzing university activity in the patent space, we have discovered evidence that universities act rationally, if inefficiently. That is, they respond to economic incentives, as any firm would. As expected, universities started patenting innovations produced by their researchers, and began to license or sell those patents to businesses.[162] They also engage in transactions as a firm would. They created technology transfer offices to manage their patent portfolios and policies. Inevitably, those technology transfer offices became institutional fixtures that had to justify their existence by producing revenue or other activities. Most of what they did was require researchers to ensure the patentability of their research and file as many patent applications as possible. Anyone could have seen it would end badly. But the chain of behavior goes deeper than our findings uncover, and it is arguably attributable to the passage of the Bayh-Dole Act.

Today, every research university has a technology transfer office that is a putative source of revenue, when in fact few produce revenue at all.[163] In reality, they are just another part of the academic enterprise, with the unfortunate addition of reducing access to information. Because technology transfer offices are centered around patents, rather than research, they are encouraged to prioritize control, rather than openness and sharing.

It would be depressing if technology transfer offices were wildly profitable, because their profits would reflect nothing more than a double tax on innovation. Every time a university patent generates revenue, that's the sound of the public paying twice. But the reality is even worse. Only a tiny minority of technology transfer offices are profitable, because the many university patents are worthless. Most technology transfer offices are a net cost, and most university patents do nothing but impede future innovation. The majority of university patents are never commercialized. Indeed, many are sold to patent aggregators, which use them to extract rents from actual businesses.

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159 NATIONAL CENTER FOR SCIENCE AND ENGINEERING STATISTICS, *supra* note 53.
160 *See supra* Part III.
161 *Id.*
162 *Id.*
163 *See* Andes, *supra* note 67.

Anyway, the premise of the Bayh-Dole Act was always ridiculous, and its history only makes it look more ridiculous. It never made sense for the government to fund research directly, then fund it again indirectly via patents, and the ostensible justification is embarrassingly weak. Businesses exist to make money. Only in limited circumstances would a business decline to implement an innovation because it did not have a patent.

But it gets worse. Universities act as any rational firm would. They use their research subsidy to patent and use their patents to litigate. Our research shows that the Bayh-Dole Act raised bigger problems than anyone realized. It was supposed to encourage innovation by imposing transaction costs on innovations, which does not seem especially clever. Unsurprisingly, it did not work. Rather than encouraging innovation, the Bayh-Dole Act created some of the densest and most embarrassing patent thickets and gave ammunition to patent trolls.

Fine. Innovators have been dealing with patent trolls for a while now, and they have figured out how to avoid or counter them. But the Bayh-Dole Act and university patents introduce an additional problem.

Our research suggests that the Bayh-Dole Act turns universities into potential rent seekers, and the problem may be getting worse.[164] We observe that when universities invest in research (and thus in patents), they invest even more in patent litigation.[165] In other words, universities are turning themselves into rent seekers. It makes economic sense. They used to outsource these activities (e.g., by assigning patent rights to litigation-happy third parties). Eventually, they realized it was inefficient and brought it in-house.[166]

But this result is not only inefficient from an economic perspective; it is also inconsistent with the charitable purpose of universities.[167] Instead of using government grants to fund research, universities are using government grants to fund litigation.[168] And it couldn't have been more predictable, because universities are merely responding to incentives that would cause any firm to make the same decision. Of course, universities are firms, and we increasingly encourage them to act like firms, so we should not be surprised.

But it is bad innovation policy to encourage universities to pursue patent profits, rather than public welfare. And it is wrong. Universities are charitable organizations because we believe their educational purpose benefits the public. The government subsidizes universities directly by giving them grants, but it also subsidizes them indirectly via charitable tax exemptions and deductions. Universities should earn

164 *See supra* Section II.B.
165 *Id.*
166 *Id.*
167 *See* Strandburg, *supra* note 48, at 108.
168 *See supra* Section III.D.

those indirect subsidies, and should not act inconsistently with their charitable mission. The entire premise of the Bayh-Dole Act was to enable universities to reduce access to the innovations they produce by patenting them. It was always a questionable idea, but it has proven to be even worse in practice than it was in theory. And as discussed throughout this article, there is mounting evidence that we question the efficacy of the Bayh-Dole Act.

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V. APPENDIX A - VARIABLE DEFINITIONS

Variable	Definition and Source
Cumulative Active Licenses	The number of licenses or options (cumulative over all years) that were active (not terminated) as of the end of the relevant year. Source: AUTM Licensing Survey; *see also AUTM Licensing Survey Definitions*, https://autm.net/AUTM/media/Surveys-Tools/Documents/Licensing-Survey-Definitions.pdf (hereinafter "*AUTM Definitions*").
Gross Licensing Income	Gross licensing income received including "license issue fees, payments under options, annual minimums, running royalties, termination payments, the amount of equity received when cashed-in, and software and biological material end-user license fees equal to $1,000 or more." *The Economic Contribution of University/Nonprofit Inventions in the United States: 1996-2015, AUTM & Biotechnology Innovation Organization*, 31, https://autm.net/AUTM/media/About-AUTM/Documents/AUTM_BIO_Economic_Impact_Report_2017.pdf. This does not include "research funding, patent expense reimbursement, a valuation of equity not cashed-in, software and biological material end-user license fees less than $1,000, or trademark licensing royalties from university insignia." *Id.* Source: AUTM Licensing Survey.
Legal Fees	Legal fees spent including "the amount spent by an institution in external legal fees for patents and/or copyrights." *AUTM Definitions*. These fees include patent prosecution and associated maintenance fee costs, but do not include significant litigation costs, such as "any individual litigation expense that exceeds 5% of total." *AUTM Definitions*; *see also* Gary Rhoades, *Housing the Measurement of University Innovations' Social Value: Organizational Site, Professional Perspective, Institutional Outlook*, in 19 ADVANCES IN THE STUDY OF ENTREPRENEURSHIP, INNOVATION & ECONOMIC GROWTH 237, 244 (2009) ("[T]he AUTM survey provides data on legal fees, but since 1999, these figures have only included the costs of patent prosecution, and have not included major litigation fees of universities, or the costs of university or externally hired attorneys who deal with technology transfer issues."). Source: AUTM Licensing Survey.

Licenses Generating $1 Million +	Number of licenses or options that generated over $1,000,000 in income in the relevant year. Source: AUTM Licensing Survey.
Net Legal Expenditures	Legal Fees (defined above) less Reimbursed Legal Fees (defined below).
New US Patents Applied For	Total of all new US patent applications filed in a year that claim new inventions, excluding continuations, divisionals, and reissues. Continuations-in-part are generally excluded. Provisional applications representing new subject matter (i.e., not a refiling of a provisional covering a particular invention) are included. Utility applications claiming priority to a previously counted provisional application are not included. Source: AUTM Licensing Survey; *see also AUTM Definitions*.
Post AIA	This is a dummy variable indicating that the year in question was before (0) or after (1) the America Invents Act ("AIA") went into effect in 2011, with the year 2011 being coded as "0." This is notable here as joinder rules for patent infringement lawsuits became less lenient post-AIA. Tracie L. Bryant, *The America Invents Act: Slaying Trolls, Limiting Joinder*, 25 HARV. J.L. & TECH. 687 (2012); Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (codified in scattered sections of 35 U.S.C.). Post-AIA, multiple cases that might have been filed together pre-AIA might have to be brought as separate lawsuits, thus inflating litigation counts.
Public University	Public Universities are operated by the government. Public universities are contrasted to private universities, which are operated by non-governmental entities. Source: Integrated Postsecondary Education Data System.
Reimbursed Legal Fees	Legal fees that are reimbursed by the institution's licensees. Included in this category are "lump sum [re]payments of costs incurred in prior years" and repayments for costs incurred by the university after a license agreement is entered into. Source: AUTM Licensing Survey; *see also AUTM Definitions*.

Total Research Expenditures	Expenditures paid in a given year to support research, including funds from government, foundations, and other non-profit organizations. Source: AUTM Licensing Survey; *see also AUTM Definitions*.
Total US Patents Applied For	Total number of US patent applications filed during the relevant year, including standard applications, new filings, continuations-in-part, continuations, divisionals, reissues, and plant patents. Patent Cooperation Treaty applications where the US is designated are also included if it is the first non-provisional filing. Source: AUTM Licensing Survey; *see also AUTM Definitions*.
US Patents Issued	The number of patents issued to the organization during the relevant year. Source: AUTM Licensing Survey.
Litigation	This is a dummy variable indicating whether a university initiated patent litigation in the year following the year for which AUTM and IPEDS data was reported. Source: Stanford NPE Database.
Frequency of Litigation	This is a count variable indicating the total number of patent infringement lawsuits initiated by the university in the year following the year for which AUTM and IPEDS data was reported. Source: Stanford NPE Database.