

**DO UNIVERSITY PATENTS PAY OFF?
EVIDENCE FROM A SURVEY OF UNIVERSITY INVENTORS IN
COMPUTER SCIENCE AND ELECTRICAL ENGINEERING**

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ABSTRACT

Studies of the costs and benefits of university patent ownership have, to date, focused on life sciences technology. Increasingly, however, many of the most lucrative university-owned patents relate to computing and telecommunications, not genes or pharmaceuticals. In 2007, a University of California spin-off named Eolas settled a patent suit with Microsoft for \$100 million. In 2010, Cornell University won a \$184 million jury verdict against Hewlett-Packard in a case that later settled on confidential terms. And most recently, in 2014, Carnegie Mellon University received a \$1.5 billion judgment—one of the largest patent damages awards in history—in an ongoing suit against Marvell Semiconductors.

As universities shift their focus in the patent arena, so too must those studying tech transfer. Commentators generally agree that the costs and benefits of the patent system vary greatly across industries and many place the high-tech and bio-tech industries at opposite ends of that spectrum. Accordingly, universities would be well advised to reassess the costs and benefits of their own tech transfer programs as they allocate more resources to high-tech patenting.

This Article examines the pros and cons of university patenting in high-tech fields by reporting the findings of a survey of professors at major U.S. universities who teach and research in the areas of computer science and electrical engineering. Among other findings, survey responses suggest that:

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- *Patenting high-tech inventions made on university campuses may not be a profitable undertaking, even at those universities best-positioned to profit from tech transfer. Based on the patenting and licensing activities of survey respondents, I estimate that university patent programs collectively earn a negative rate of return—an overall loss of more than three percent—on funds invested in high-tech patenting.*
- *The prospect of obtaining patent rights to the fruits of their research does not appear to motivate university researchers in high-tech fields to conduct more or better research. Eighty-five percent of professors report that patent rights are not among the top four factors motivating their research activities. Moreover, fifty-seven percent of professors report that they do not know how, or if at all, their university shares licensing revenue with inventors.*
- *University patent programs may, instead, actually reduce the quantity and quality of university research in high-tech fields by harming professors' ability to obtain research funding, to collaborate with faculty from other institutions, and to disseminate their work to colleagues.*
- *University patent programs seem to be, at best, a modest benefit to professors seeking to commercialize high-tech academic research. Entrepreneurial professors report that these programs hinder their ability to work as consultants with companies that show interest in their research, and fewer than half of university spin-off founders report that the ability to patent their research affirmatively helped their commercialization efforts.*

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INTRODUCTION

In the three decades since the Bayh-Dole Act first allowed universities to freely patent most academic research,¹ inventions in the life

¹ The Bayh-Dole Act, Pub. L. No. 96-517, 94 Stat. 3015 (1980) (codified as amended at 35 U.S.C. §§ 200-211 (2006)), allowed universities to automatically take ownership of patentable inventions discovered in the course of federally-funded academic research. Overall, about two-thirds of university research funding comes from the federal government. See University Research: The Role of Federal Funding, ASS'N OF AM. UNIVS. (Jan. 2011), <http://www.aau.edu/WorkArea/DownloadAsset.aspx?id=11588> (“[T]he federal government supports about 60% of the research performed at universities. In 2009, that amounted to the federal government supporting about \$33 billion of universities’ total annual R&D spending of \$55 billion.”). Prior to the Act’s passage, U.S. universities received just dozens of patents annually; today they receive several thousand. See Peter Lee, *Patents and the University*, 63 DUKE L.J. 1, 35 (2013) (“In 1965, the U.S. Patent and Trademark Office (USPTO) granted 96 patents to 28 U.S. universities or related institutions. In 1992, a little over a decade after the Act, the USPTO granted almost 1,500 patents to over 150 U.S. universities or related institutions. By 2002, academic institutions were receiving more than 3,000 patents per year.” (footnotes omitted)). But see David C. Mowery & Arvids A. Ziedonis, *Academic Patent Quality and Quantity Before and After the Bayh–Dole Act in the United States*, 31 RES. POL’Y 399 (2002) (concluding from a study of patents owned by the University of California system, Stanford, and Columbia that

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sciences have dominated headlines and bottom-lines in the world of university technology transfer. Recombinant DNA,² stem cells,³ genes,⁴

this growth in patenting was primarily due to the concurrent “rise of biomedical research and inventive activity,” not the Bayh-Dole Act).

² Stanford University and the University of California system, which jointly licensed the technology through Stanford’s Office of Technology Licensing, earned approximately \$255 million in royalties for recombinant DNA, or “gene splicing,” technology before their patent rights expired in 1997. See LOUIS G. TORNATZKY ET AL., *INNOVATION U: NEW UNIVERSITY ROLES IN A KNOWLEDGE ECONOMY* 161-62 (2002).

³ The University of Wisconsin—through its patent-holding counterpart, the Wisconsin Alumni Research Foundation (WARF)—has licensed patents covering fundamental stem cell technology for more than a decade. See Christopher D. Hazuka, *Supporting the Work of Lesser Geniuses: An Argument for Removing Obstructions to Human Embryonic Stem Cell Research*, 57 U. MIAMI L. REV. 157 (2002); see also Terri Somers, *Foundation’s Stem Cell Patents Impede Research, Scientists Say*, SAN DIEGO UNION-TRIBUNE, July 30, 2006, <http://legacy.utsandiego.com/news/science/20060730-9999-1n30stems.html> (“Under the patents, a researcher in the United States who uses embryonic stem cells in any way must pay a licensing fee to WARF . . . as high as \$250,000 . . . [and] annual maintenance fees of about \$40,000.”); Kathleen Gallagher, *Geron to Begin Clinical Trials for Stem Cell Therapy*, MILWAUKEE-WISCONSIN JOURNAL SENTINEL, Jan. 23, 2009 (reporting that “WARF has 30 commercial embryonic stem cell licensees, and many more in discussion” (internal quotation marks omitted)). Many believe that WARF’s licensing efforts have impeded, rather than spurred, stem cell research in the United States. See, e.g., Sandy Kleffman, *Stem Cell Research’s Newest Foe: Patents*, CONTRA COSTA TIMES, July 19, 2006, at F4 (“[WARF’s] patents are impeding our research . . . [and] making scientists go overseas to do this sort of research.” (quoting Jeanne Loring, Director, Stem Cell Research Center, Burnham Institute for Medical Research)). WARF’s patent rights were challenged at the Patent and Trademark Office with some success by Consumer Watchdog and the Public Patent Foundation (PubPat). See Susan Decker, *Gene Patent Case Fuels U.S. Court Test of Stem Cell Right*, BLOOMBERG, Jan. 5, 2014, <http://www.bloomberg.com/news/2014-01-06/gene-patent-case-fuels-u-s-court-test-of-stem-cell-right.html>.

⁴ Though many universities own gene patents, none has garnered more publicity than the University of Utah, which received patent rights to two genes linked to hereditary breast cancer and transferred those rights to a spin-off named Myriad Genetics. See generally E. Richard Gold & Julia Carbone, *Myriad Genetics: In the Eye of the Policy Storm*, 12 GENETICS IN MED. S39 (Supp. 2010). As WARF did with its rights to stem cell lines, Myriad sought licensing fees from researchers and medical providers in a manner that many deemed ethically questionable. See Mildred K. Cho et al., Special Article, *Effects of Patents and Licenses on the Provision of Clinical Genetic Testing Services*, 5 J. MOLECULAR DIAGNOSTICS 3, 6 (2003) (finding that 9 of 122 surveyed U.S. laboratories stopped conducting genetic tests for the BRCA genes due to fear of infringement litigation with Myriad); see also Gold & Carbone, *supra*, at S44 (collecting similar studies). Myriad’s patent rights were largely invalidated by the Supreme Court in 2013 in a case brought by public interest groups, including the ACLU and PubPat. *Ass’n for Molecular Pathology v. Myriad Genetics, Inc.*, 133 S. Ct. 2107 (2013).

and popular pharmaceuticals like Lyrica⁵ and Emtriva⁶ have driven university licensing revenue and, consequently, have been the primary focus of scholars studying invention on college campuses.⁷

However, things are changing in the world of university patenting. In recent years, tech transfer tectonics have shifted strongly in the direction of computing and telecommunications. Increasingly, universities are pursuing patents on high-tech⁸ inventions⁹ and, moreover, enforcing those

⁵ In 2007, Northwestern University sold a portion of its right to Lyrica, a pharmaceutical used to treat nerve pain, for \$700 million. See Irene Abrams et al., *How Are U.S. Technology Transfer Offices Tasked and Motivated—Is It All About the Money?*, 17 RES. MGMT. REV. 1, 3 (2009).

⁶ In 2005, Emory University sold the rights to Emtriva, a pharmaceutical used to treat HIV, to Gilead Pharmaceuticals for \$525 million. *Id.*

⁷ See, e.g., Robin Feldman & W. Nicholson Price, *Patent Trolling—Why Bio & Pharmaceuticals Are at Risk* (U.C. Hastings Research Paper Series, Paper No. 93, 2014), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2395987 (searching the patent portfolios of five major universities for patents covering biotech inventions that could be widely asserted); David E. Winickoff, *Private Assets, Public Mission: The Politics of Technology Transfer and the New American University*, 54 JURIMETRICS J. 1, 1 (2013) (“Technology transfer has become a site through which law, life sciences, and the idea of the ‘entrepreneurial university’ are coevolving.”); Arti Kaur Rai, *Regulating Scientific Research: Intellectual Property Rights and the Norms of Science*, 94 NW. U. L. REV. 77, 77 (1999) (“Among legal scholars, a debate is currently raging about the proper scope of intellectual property rights in non-commercial—or ‘basic’—scientific research. The debate focuses on basic research in molecular biology, the foundational science of the large and dynamic biotechnology industry.”); Rebecca S. Eisenberg, *Proprietary Rights and the Norms of Science in Biotechnology Research*, 97 YALE L.J. 177 (1987) (analyzing intellectual property rights in basic research through the lens of norms among biotech researchers).

⁸ In this Article, I use “high-tech” generally to refer to all technology pertaining to computers, electronics, and telecommunications. Cf. Brian J. Love, *An Empirical Study of Patent Litigation Timing: Could a Patent Term Reduction Decimate Trolls without Harming Innovators?*, 161 U. PA. L. REV. 1309, 1329 (2013) (“I label ‘high tech’ all patents covering computer, electronics, and/or telecommunications technology, including all software patents.”).

⁹ See Arti K. Rai et al., *University Software Ownership and Litigation: A First Examination*, 87 N.C. L. REV. 1519, 1534-35 (2009) (finding in an empirical study of university patents that “university software patenting increased more than ten-fold over the 1982-2002 period” and also that the share of all university patents covering software rose from 9% in 1982 to 13% in 2002). Today, high-tech patents constitute a third or more of some universities’ portfolios. For example, patents covering “software and computing” inventions have comprised about 30% of the University of Illinois’s patent portfolio since 2006. University of Illinois at Urbana-Champaign, Office of Technology Management Annual Report Fiscal Year 2006, at 4 (2006), available at <http://otm.illinois.edu/sites/all/files/files/2006-otm-annual-report.pdf>. Likewise, at Carnegie Mellon, faculty from the electrical engineering and computer science departments file over 40% of all invention disclosures. Carnegie Mellon University, Center for

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rights widely and aggressively.¹⁰ Though virtually unheard of when Eolas, a University of California spin-off, sued Microsoft in 1999, high-tech patent suits initiated by universities and their partners have become commonplace in the fifteen years since.¹¹ Following in Eolas's footsteps, Cornell University sued Hewlett-Packard in 2001.¹² The University of Wisconsin sued Creative Technology in 2002, Sony and Toshiba in 2003, and six more high-tech companies over the next five years.¹³ The University of Texas accused fifty-five high-tech companies of infringement in three cases filed in 2005.¹⁴ A Yale University spin-off named Mirror Worlds sued Apple in 2008, winning a \$625 million jury verdict that was later overturned.¹⁵ The

Technology Transfer and Enterprise Creation, From Research to Real Life, at 5 (2007) available at <http://www.cmu.edu/cttec/documents/cttec-annual-report-06-07.pdf> (showing that in 2007 computer science faculty filed about 33%, and electrical engineering faculty about 13.5%, of all invention disclosures).

¹⁰ See Jacob H. Rooksby, *Sue U.*, ACADEME, Sept.-Oct. 2012, <http://www.aaup.org/article/sue-u#UvAP2vldW6I> (identifying "more than sixty universities' participation in more than 280 patent-infringement lawsuits since 1973 (the first year for which moderately reliable records exist), with substantial growth since the year 2000"). For greater detail on university administrators' thoughts on filing patent suits, see Jacob H. Rooksby, *When Tigers Bare Teeth: A Qualitative Study of University Patent Enforcement*, 46 AKRON L. REV. 171 (2013).

¹¹ See, e.g., Joe Mullin, *The Web's Longest Nightmare Ends: Eolas' Patents Are Dead on Appeal*, ARS TECHNICA, July 22, 2013, <http://arstechnica.com/tech-policy/2013/07/the-webs-longest-nightmare-ends-eolas-patents-are-dead-on-appeal/> (reporting that Eolas' suit against Microsoft settled for more than \$100 million and netted the University of California approximately \$30 million). Eolas went on to sue two dozen more companies in 2009 after settling with Microsoft. *Id.*

¹² See, e.g., Susan Kelley, *Hewlett-Packard, Cornell Reach Settlement in Patent Case*, CORNELL CHRON., June 9, 2010, <http://www.news.cornell.edu/stories/2010/06/hewlett-packard-cornell-reach-settlement-patent-case> (reporting that the case resulted in a jury award of \$184 million that was subsequently reduced by the judge post-trial to \$71.3 million, before the case settled on confidential terms).

¹³ WARF v. Intel Corp., 656 F. Supp. 2d 898 (W.D. Wis. 2009); WARF v. Adv. Micro Dev., Inc., No. 3:06-cv-00726 (W.D. Wis. filed Dec. 12, 2006); WARF v. Cypress Semiconductor Corp., No. 3:05-cv-00336 (W.D. Wis. filed June 7, 2005); WARF v. Int'l Bus. Mach. Corp., No. 3:04-cv-00867 (W.D. Wis. filed Nov. 17, 2004); WARF v. Infineon Tech. AG, No. 3:04-cv-00394 (W.D. Wis. filed June 21, 2004); WARF v. Sony Corp., No. 3:03-cv-00595 (W.D. Wis. filed Oct. 20, 2003); WARF v. Creative Tech. Ltd., No. 3:02-cv-00570 (W.D. Wis. filed Oct. 15, 2002).

¹⁴ Bd. Regents, Univ. of Tex. Sys. v. Mitsubishi Elec., No. 1:05-cv-00333 (W.D. Tex. filed May 6, 2005); Bd. Regents, Univ. of Tex. Sys. v. Alcatel, No. 1:05-cv-00198 (W.D. Tex. filed Mar. 22, 2005); Bd. Regents, Univ. of Tex. Sys. v. BenQ Am. Corp., No. 1:05-cv-00181 (W.D. Tex. filed Mar. 11, 2005).

¹⁵ See Susan Decker, *Apple Win in Mirror Worlds Case Left Intact by High Court*, BLOOMBERG, June 24, 2013, <http://www.bloomberg.com/news/2013-06-24/apple-win-in->

University of Washington sued thirty high-tech companies between 2010 and 2012, including Garmin, Logitech, Sandisk, and Sharp.¹⁶ And, in what may prove to be a watershed moment for university patent enforcement, Carnegie Mellon University won a \$1.17 billion verdict against Marvell Semiconductor in 2012, a verdict that was enhanced by thirty-one percent before Marvell appealed the case in 2014.¹⁷

Inspired by the (at least temporary) successes of patentees like Mirror Worlds and Carnegie Mellon,¹⁸ universities filed more high-tech patent suits in 2013 than any year to date.¹⁹ Boston University alone filed

mirror-worlds-case-left-intact-by-high-court.html (reporting that the case resulted in an approximately \$625 million jury verdict that was overturned after the trial).

¹⁶ See, e.g., Wash. Research Found. v. Apple, Inc., No. 2:12-cv-02092 (W.D. Wash. filed Nov. 30, 2012); Wash. Research Found. v. Samsung Elec. Co., No. 2:11-cv-02079 (W.D. Wash. filed Dec. 12, 2011); Wash. Research Found. v. Sharp Corp., No. 2:11-cv-02080 (W.D. Wash. filed Dec. 12, 2011); Wash. Research Found. v. Sony Ericsson Mobile Comm. AB, No. 2:11-cv-00651 (W.D. Wash. filed Apr. 15, 2011); Wash. Research Found. v. Silicon Labs., Inc., No. 2:10-cv-01050 (W.D. Wash. filed June 24, 2010). Washington also sued several more high-tech companies in 2006. See, e.g., Wash. Research Found. v. Matsushita Elec. Indus. Co., No. 2:06-cv-01813 (W.D. Wash. filed Dec. 21, 2006). To be clear, this list includes just a fraction of the high-tech patent suits filed by universities during the last decade. Other notable examples include the University of Illinois's 2011 suit, Micron. Bd. Trustees, Univ. Ill. v. Micron Tech., Inc., No. 2:11-cv-02288 (C.D. Ill. filed Dec. 5, 2011), which is discussed *infra*.

¹⁷ See Jonathan Stempel, *Marvell Patent Verdict Grows to \$1.54 Billion*, REUTERS, Apr. 1, 2014, <http://www.reuters.com/article/2014/04/01/marvell-carnegiemellon-lawsuit-idUSL4N0MT37L20140401> (noting that “the award is 31 percent more than the \$1.17 billion previously awarded by a jury”).

¹⁸ Historically, large damages awards in patent cases have, more often than not, been reversed or reduced after trial or on appeal. See *2012 Patent Litigation Study*, PRICEWATERHOUSECOOPERS, available at <http://patentlyo.com/media/docs/2013/03/2012-patent-litigation-study.pdf> (finding that, of the ten largest patent verdicts between 1995 and 2011, “most . . . have since been vacated, remanded, or reduced, while some remain in the appellate process”). A group of fifteen law professors, including the author, filed an amicus brief in support of Marvell's appeal arguing that the jury verdict improperly awarded damages for extraterritorial conduct that, by law, cannot constitute U.S. patent infringement. Brief *Amici Curiae* of Fifteen Professors of Intellectual Property Law in Carnegie Mellon Univ. v. Marvell Tech. Grp., Ltd., No. 14-1492 (Fed. Cir.), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2479090.

¹⁹ Universities filed ninety-five total patent suits in 2013, up from sixty in 2012, forty-two in 2011, and twenty-four in 2010. See LEX MACHINA, <http://www.lexmachina.com> (searching for all patent suits involving a party with “university,” “college,” or “research foundation” in its name, and removing false positives). Boston University was responsible for thirty-nine of those ninety-five. *Id.* This tally excludes cases filed by parties that exclusively licensed or purchased university patents and, thus, understates the total number of suits enforcing university-originated patents.

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thirty-nine suits against more than twice as many companies.²⁰ In fact, universities have proven so litigious in the high-tech sector in recent months that they have increasingly been hit with the “patent troll” moniker,²¹ a designation that they have long been spared.²²

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,²³ and patent assertion on the whole has never been more popular.²⁴ Moreover, university groups have recently voiced strong

²⁰ *Id.*

²¹ See, e.g., Daniel Engber, *In Pursuit of Knowledge and Profit: How Universities Aid and Abet Patent Trolls*, SLATE, May, 8, 2014, http://www.slate.com/articles/technology/history_of_innovation/2014/05/patent_trolls_universities_sometimes_look_a_lot_like_trolls.html; John Koetsier, *Congratulations, Boston University, You're Now a Patent Troll*, VENTUREBEAT (July 3, 2013, 12:17pm EDT), <http://venturebeat.com/2013/07/03/congratulations-boston-university-youre-now-a-patent-troll/>; Timothy B. Lee, *Patent Trolls Have a Surprising Ally: Universities*, WASH. POST: THE SWITCH (Nov. 30, 2013, 11:05am EDT), <http://www.washingtonpost.com/blogs/the-switch/wp/2013/11/30/patent-trolls-have-a-surprising-ally-universities/> (“When it’s pointed out that this definition of a patent troll also applies to some universities, patent reformers are usually quick to clarify that they don’t regard universities as patent trolls. But the reality is that some universities do, in fact, behave like patent trolls.”).

²² See Mark A. Lemley, *Are Universities Patent Trolls?*, 18 FORDHAM INTELL. PROP. MEDIA & ENT. L.J. 611, 612 (2008) (“Universities are non-practicing entities. They share some characteristics with trolls, at least if the term is broadly defined, but they are not trolls.”); Chief Judge Randall R. Rader, Remarks at the Eastern District of Texas Judicial Conference on the State of Patent Litigation (Sep. 27, 2011) (“[T]he NPE designation sweeps in some unintended ‘culprits’ like universities . . .”). For a discussion of university administrators’ fears of being labeled “trolls,” see Rooksby, *When Tigers Bare Teeth*, *supra* note 10, at 191-94.

²³ See, e.g., *More US Colleges Face Stagnating Enrollment and Tuition Revenue*, According to Moody’s Survey, MOODY’S INVESTOR SERV. 1 (Jan. 10, 2013), <http://www.marquette.edu/budget/documents/MoreUSCollegesFaceStagnatingEnrollmentandTuitionRevenueAccordingtoMoodySurvey11013.pdf> (finding in a survey of U.S. universities that nearly 50% are facing declining enrollment and about 40% expect tuition revenue to decline or grow by less than 2% in 2013).

²⁴ The percentage of patent suits filed by patentees that, like universities, do not sell tech products—often referred to as non-practicing entities (NPEs)—has been on the rise since at least 2000. See Sara Jeruss et al., *The America Invents Act 500: Effects of Patent Monetization Entities on US Litigation*, 11 DUKE L. & TECH. REV. 357, 365 (2012) (finding, in a study of 100 patent suits filed each year from 2007 to 2011, that the percentage attributable to NPEs was roughly 22% in 2007, 27% in 2008, 33% in 2009, 30% in 2010, and 40% in 2011); Robin Feldman et al., *The AIA 500 Expanded: The Effects of Patent Monetization Entities*, 17 UCLA J.L. & TECH. 1, 7 (2013) (expanding Jeruss et al.’s study to find that NPEs filed roughly 59% of patent suits in 2012); Colleen V. Chien, *Of Trolls, Davids, Goliaths, and Kings: Narratives and Evidence in the Litigation of High-Tech Patents*, 87 N.C. L. REV. 1571, 1604 (2009) (finding, in a study of 2,300 high-tech

opposition to “troll fighting” patent reform bills presently pending in Congress, a likely signal that universities anticipate enforcing high-tech patents more often in the future.²⁵

As universities shift their focus in the patent arena, so too must those studying tech transfer. Commentators generally agree that the costs and benefits of the patent system vary greatly across industries,²⁶ and many place high-tech and bio-tech at opposite ends of that spectrum.²⁷ Drastic differences between these two industries in terms of patent density,²⁸ non-

patent suits filed between 2000 and 2008, that NPEs filed 10% of all suits initiated between 2000-2001, 16% between 2002-2003, 16% between 2004-2005, and 20% between 2006-2008).

²⁵ See Lee, *supra* note 21 (noting that several university groups have publicly expressed opposition to a patent reform bill “target[ing] patent trolls” that passed in the House in 2013).

²⁶ See Robert P. Merges & Richard R. Nelson, *On the Complex Economics of Patent Scope*, 90 COLUM. L. REV. 839, 880 (1990) (modeling the impact of patents in industries with a variety of characteristics, including “discrete,” “cumulative,” “chemical,” and “science-based” industries); Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1615-30 (2003) (matching industries with five economic theories of patent protection: prospect theory, competitive innovation, cumulative innovation, anticommons theory, and patent thickets).

²⁷ See DAVID C. MOWERY ET AL., *IVORY TOWER AND INDUSTRIAL INNOVATION: UNIVERSITY-INDUSTRY TECHNOLOGY TRANSFER BEFORE AND AFTER THE BAYH-DOLE ACT 177-78* (2004) (finding “significant interindustry differences in the importance of patents as vehicles for knowledge transfer . . . between universities and industry” and “that university patenting and licensing were more important for the biomedical inventions than for the one electronics invention we studied”); Rai et al., *supra* note 9, at 1550 (“As the data on the varying importance of patents as incentives in different industries suggests, . . . the optimal mode of university-industry technology transfer is likely to vary by industry and invention [and] the theory espoused in the legislative history of Bayh-Dole . . . does not apply neatly in the software context, where development costs are often low relative to other types of inventions.”); see also Richard Posner, *Do Patent and Copyright Law Restrict Competition and Creativity Excessively?*, BECKER-POSNER Blog (Sept. 30, 2012, 10:30pm), <http://www.becker-posner-blog.com/2012/09/do-patent-and-copyright-law-restrict-competition-and-creativity-excessively-posner.html> (“The pharmaceutical and software industries are the extremes so far as the social benefits and costs of patent protection are concerned”); Clarisa Long, *The PTO and the Market for Influence in Patent Law*, 157 U. PA. L. REV. 1965, 1992-93 (2009) (“[T]he pharmaceutical industry and the software industry . . . have generally proven to be . . . balanced on opposite sides of many key issues in patent law and policy.”).

²⁸ Compare Lisa Larrimore Ouellette, *How Many Patents Does It Take To Make a Drug? Follow-On Pharmaceutical Patents and University Licensing*, 17 MICH. TELECOMM. & TECH. L. REV. 299, 316-17 (2010) (reporting that pharmaceuticals are typically protected by just two to four patents per drug), with Brian J. Love, *Apple Bites Back: But Will the Company Come to Regret its Huge Court Victory?*, L.A. TIMES, Aug. 30, 2012, at A15 (“The average smartphone may arguably infringe as many as 250,000 patents, not to mention myriad copyrights and other design-related intellectual property.”).

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patent incentives for invention,²⁹ the overall speed of innovation,³⁰ and the prevalence of innocent infringement,³¹ all suggest that patent rights impose different costs of different magnitudes and generate different benefits of different magnitudes in each field. Accordingly, they also suggest that universities would be well advised to reassess the costs and benefits of their own tech transfer programs as they allocate more resources to high-tech patenting.

This Article aims to assist in this reassessment by presenting the results of a survey of university researchers in high-tech fields. Part I of the Article details the survey itself, including the target population, sample, and survey logistics. Part II presents survey data on the direct fiscal costs and benefits of university patenting in high-tech fields and uses this data to estimate the rate of return universities earn from their high-tech patent programs. Part III expands this initial analysis by presenting additional survey data on the broader indirect costs and benefits university patenting may have for society as a whole. Parts II & III conclude that patenting high-tech university research may fail a cost-benefit analysis. Specifically, survey responses suggest that:

- Patenting high-tech inventions made on university campuses may not be a profitable undertaking, even at those universities best-positioned to profit from tech transfer. Based on the patenting and licensing activities of survey respondents, I estimate that university patent programs collectively earn a negative rate of return—an overall loss of

²⁹ See, e.g., Stuart J.H. Graham et al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Survey*, 24 BERKELEY TECH. L.J. 1255, 1262, 1290 (2009) (finding in a survey of start-up companies that (i) first mover advantage, not patent protection, was the most “important” means to “capture competitive advantage” in the software industry, and (ii) that the majority of start-up companies in the software industry hold no patents at all). Consider also that the software industry flourished in the late 1980s and early 1990s despite the fact that software was not clearly patentable until later in the decade. See, e.g., Burk & Lemley, *supra* note 26, at 1618-19.

³⁰ In the computer industry, products become twice as powerful roughly every two years. This observation, which has held true for decades, is known as “Moore’s law.” See Gordon E. Moore, *Progress in Digital Integrated Electronics*, Int’l Electron Devices Meeting, IEEE (1975), reprinted in SCS: IEEE SOLID-STATE CIRCUITS SOC’Y NEWS, Sept. 2006, at 36, 37 (predicting that computing power will double approximately every two years).

³¹ See Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421, 1445 (2009) (finding that, overall, allegations of copying are made in about 11% of patent suits—the majority of which involve pharmaceutical or chemical patents—while copying is alleged in just 3% of high-tech cases).

more than three percent—on funds invested in high-tech patenting.

- The prospect of obtaining patent rights to the fruits of their research does not appear to motivate university researchers in high-tech fields to conduct more or better research. Eighty-five percent of professors report that patent rights are not among the top four factors motivating their research activities. Moreover, fifty-seven percent of professors report that they do not know how, or if at all, their university shares licensing revenue with inventors.
- University patent programs may, instead, actually reduce the quantity and quality of university research in high-tech fields by harming professors' ability to obtain research funding, to collaborate with faculty from other institutions, and to disseminate their work to colleagues.
- University patent programs seem to be, at best, a modest benefit to professors seeking to commercialize high-tech academic research. Entrepreneurial professors report that these programs hinder their ability to work as consultants with companies that show interest in their research, and fewer than half of university spin-off founders report that the ability to patent their research affirmatively helped their commercialization efforts.

Finally, given the above findings, Part IV takes a closer look at survey responses—particularly narrative comments—that shed light on why universities and professors choose to patent research, even when doing so appears to not always be in their own best interest.

I. SURVEY METHODOLOGY, POPULATION, AND SAMPLE

To study the costs and benefits of patenting academic research related to computing and telecommunications, I surveyed electrical and computer engineering (ECE) and computer science (CS) professors at top U.S. research universities to collect data on their experiences with university patenting and licensing programs. In this Part, I describe my survey population and the sample of professors who responded.

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A. Target Population

For this survey, I chose a target population of all 2,387 tenured and tenure-track faculty members³² affiliated with the nation's top twenty ECE and CS departments, shown below in Table 1, as ranked by U.S. News and World Report in 2013.

Generally speaking, this population covers the most fertile ground in the United States for patentable university research related to computers and telecommunications. On average, these universities attract the best faculty members, who in turn benefit from the strongest graduate students, the best facilities, and the most lucrative research packages.³³ Accordingly, they presumably enjoy the circumstances best-suited to produce large-quantity and high-quality university invention.³⁴ Statistics bear this out. Reports of aggregate university licensing revenue routinely place these universities among the top in the nation.³⁵ They also have among the nation's most experienced³⁶ tech transfer offices and are among the universities that produce the most patents³⁷ and academic papers³⁸ in high-tech fields.

³² I identified faculty members by visiting each department's website. This tally excludes "research" faculty, grad students, and post-docs, but does include tenured and tenure-track "affiliated" faculty from other departments, as well as emeritus professors who appeared to have an office and conduct research.

³³ The methodology U.S. News uses to rank these programs includes an assessment of, *inter alia*, student selectivity, faculty resources, and research activity. See Sam Flanigan & Robert Morse, *Methodology: Best Engineering Schools Rankings*, U.S. NEWS & WORLD REP., Mar. 11, 2013, <http://www.usnews.com/education/best-graduate-schools/articles/2013/03/11/methodology-best-engineering-schools-rankings>.

³⁴ Dante Di Gregorio & Scott Shane, *Why Do Some Universities Generate More Start-ups than Others?*, 32 RES. POL'Y 209, 222 (2003) (finding that commercialization activities are correlated with a university's "intellectual eminence" and hypothesizing that this is because (i) "researchers from more prestigious universities are better researchers and thus are more likely to create firms to capture the rents to their rare and valuable intellectual property" and (ii) "investors use signals, such as institutional reputation or prestige, to help assess the commercial potential of university technologies").

³⁵ As shown below in Table 1, these 17 universities and the University of California system, which reports aggregate statistics, account for 5 of the top 10, and 11 of the top 35, universities ranked by average annual licensing revenue earned between 1991 and 2012. See ASSOC. UNIV. TECH. MANAGERS, STATISTICS ACCESS FOR TECH TRANSFER (last accessed Apr. 21, 2014), <http://www.autm.net/source/STAT/index.cfm?section=STAT>. They also account for 11 of the top 24 universities ranked by the average number of licenses executed per year between 1991 and 2012, and 15 of the top 22 universities ranked by the average number of spin-offs created each year between 1991 and 2012. *Id.*

³⁶ These 17 universities and the University of California system, which reports aggregate statistics, account for 12 of the 35 oldest tech transfer programs in the nation. See *id.* The youngest of these 18 tech transfer programs (Georgia Tech's) was established in 1990. *Id.* Prior studies have found a correlation between tech transfer office age and profitability.

As a result, this population essentially represents a best-case scenario for the observation of the fiscal and social benefits of university high-tech patenting. If university tech transfer programs fail to successfully carry out their mission at these schools, they very likely also fail to do so at lower-ranked schools.³⁹

See Ashley Stevens, *Do Most Universities Lose Money on Their Technology Transfer Activities?*, Presentation at Assoc. Univ. Tech. Managers Annual Meeting, at 35 (2005), http://sites.kauffman.org/pdf/tt/Stevens_Ashley.pdf (showing that tech transfer offices established prior to 1990 are more likely than newer offices to turn a profit today).

³⁷ As ranked by Rai et al., *supra* note 9, at 1536, tbl. 1, these universities account for 9 of the top 10 “software” patent producing universities.

³⁸ As ranked by Microsoft Academic Search, these twenty universities account for 18 of the top 20 most cited computer science faculties in the U.S. and 15 of the top 20 most cited electrical engineering faculties in the nation. Microsoft Academic Search, Top Organizations in Computer Science (last accessed Feb. 1, 2014)

<http://academic.research.microsoft.com/RankList?entitytype=7&topdomainid=2&subdomainid=0&last=0&continentid=2&orderby=1>; Microsoft Academic Search, Top Organizations in Electrical Engineering (last accessed Feb. 1, 2014)

<http://academic.research.microsoft.com/RankList?entitytype=7&topdomainid=8&subdomainid=6&last=0&orderby=1&continentid=2>. Prior studies have noted a correlation between professors’ publication record and rate of patent disclosures. See Jerry G. Thursby et al., *Patterns of Research and Licensing Activity of Science and Engineering Faculty*, in SCIENCE AND THE UNIVERSITY, at *14 (Paula E. Stephan & Ronald G. Ehrenberg eds., 2007),

https://www.ilr.cornell.edu/cheri/conferences/upload/2003may/chericonf2003_07.pdf (finding in a survey of engineering and science faculty at 6 major research universities between 1983 and 1999 that “[a]s publications increase, the likelihood of [invention] disclosure increases”); see also Darren E. Zinner et al., *Participation of Academic Scientists in Relationships with Industry*, 28 HEALTH AFFAIRS 1814, 1818 (2009), available at <http://content.healthaffairs.org/content/28/6/1814.full.pdf+html> (“[F]aculty with industry relationships published significantly more and published at greater rate in the last three years than respondents without such connections.”).

³⁹ Prior research demonstrates that a small number of top universities dominate tech transfer statistics. See, e.g., Lita Nelsen, *Ten Things Heads of Institutions Should Know About Setting Up a Technology Transfer Office*, in INTELLECTUAL PROPERTY MANAGEMENT IN HEALTH AND AGRICULTURAL INNOVATION 540 (A. Krattiger et al., eds. 2007) (“[T]en universities in the U.S. (6.3% of the total) account for almost 60% of the total royalty income . . .”); Walter D. Valdivia, *University Start-Ups: Critical for Improving Technology Transfer*, BROOKINGS INST. 6 (Nov. 2013) (“In 2012, a year very much in line with the ten-year trends in this sector, the top 5% of earners (8 universities) took 50% of the total licensing income of the university system; and the top 10% (16 universities) took nearly three-quarters of the system’s income.”).

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Table 1: Target Population

University	US News Rankings:			AUTM: ⁴⁰	Faculty Size
	ECE	CS	Average	License Rev.	
M.I.T.	1	1	1	9	155 (ECE & CS)
Stanford	1	1	1	7	67 (ECE), 54 (CS)
U.C. Berkeley	3	1	2	2 ⁴¹	105 (ECE & CS)
Univ. of Illinois	3	5	4	33	100(ECE), 61(CS)
Carnegie Mellon	7	1	4	34	93 (ECE), 111 (CS)
Cornell	7	5	6	41	49 (ECE), 58 (CS)
Georgia Tech	5	10	7.5	63	140 (ECE), 36 (CS)
Cal. Tech.	5	11	8	20	22 (ECE), 25 (CS)
Princeton	11	8	9.5	16	34 (ECE), 39 (CS)
Univ. Texas	11	8	9.5	51	80 (ECE), 44 (CS)
Univ. Michigan	7	13	10	25	77 (ECE & CS)
Univ. Wisconsin	14	11	12.5	5	62 (ECE), 48 (CS)
U.C.L.A.	13	14	13.5	2	59 (ECE), 98 (CS)
U.C. San Diego	14	14	14	2	75 (ECE), 55 (CS)
Univ. Maryland	14	14	14	68	76 (ECE), 57 (CS)
Purdue	10	20	15	55	106 (ECE), 57 (CS)
Univ. Washington	26	7	16.5	10	43 (ECE), 54 (CS)
Univ. So. Cal.	14	20	17	61	85 (ECE), 34 (CS)
Columbia	19	17	18	4	33 (ECE), 42 (CS)
Rice	19	20	19.5	140	25 (ECE), 25 (CS)

B. Survey Respondents

I conducted the survey by sending email invitations⁴² with links to an online survey instrument⁴³ that remained active between May 28 and

⁴⁰ Average annual licensing revenue reported to the AUTM between 1991 and 2012. ASSOC. UNIV. TECH. MANAGERS, *supra* note 35.

⁴¹ The AUTM reports only aggregate data for the UC system as a whole. *Id.* The Berkeley, Los Angeles, and San Diego campuses collectively account for 53.1% of all UC system patents active as of 2013. University of California, Ideas, Inventions, Impact: Technology Commercialization Report 22 (2013), *available at* http://www.ucop.edu/innovation-alliances-services/_files/ott/genresources/documents/IASRptFY13.pdf.

⁴² I constructed an email database using professors' contact information as provided on their respective departments' websites. *See, e.g.*, Faculty & Advisors, MIT EECS (last accessed Feb. 1, 2014), <http://www.eecs.mit.edu/people/faculty-advisors>.

⁴³ I created the instrument using Google Docs and hosted it via Google Drive using my Santa Clara University Google Apps account. A copy of the survey is reproduced in Appendix A, with the exception of two series of (mostly attitudinal) questions that I have tentatively reserved for use in future research and do not discuss *infra*.

June 19, 2013.⁴⁴ During this period, I collected a sample of 269 responses, for an overall response rate of 11.3%.⁴⁵

Respondents in this sample are highly representative of the target population with respect to publicly-observable characteristics. To measure representativeness, I collected demographic information from a random selection of 100 professors from my target population for comparison with survey respondents.⁴⁶ As shown below in Table 2, respondents are highly representative of the target population with respect to duration of work experience, gender, and rate and quantity of patenting and entrepreneurial activities.

Table 2: Target Population vs. Respondent Sample

	Population	Respondents
Departmental affiliation:		
ECE	48.3% ⁴⁸	48.3%
CS	37.6%	37.9%
Both/Other ⁴⁷	14.1%	13.8%
Mean years' experience:		

⁴⁴ I invited professors in the target population to participate in the survey by email on May 28, 2013. I invited professors who had not yet responded a second time on June 10, 2013. I received my final survey response on June 18, and closed data collection on June 19, 2013. To encourage participation, I stated in both emails that “the first 300 respondents to complete the survey will each receive a \$5 Amazon.com e-gift card. Additionally, ALL respondents who complete the survey by Wednesday June 19 will be entered in a raffle that will award another \$500 total in Amazon.com e-gift cards.”

⁴⁵ This response rate is typical for an online survey. See Survey Monkey, Survey Sample Size (last accessed Feb. 1, 2014), <https://www.surveymonkey.com/mp/sample-size/> (“For online surveys in which there is no prior relationship with recipients, a response rate of between 20-30% is considered to be highly successful. A response rate of 10-15% is a more conservative and a safer guess if you haven’t surveyed your population before.”). Some respondents chose not to answer every question and, thus, some of the results reported below are drawn from a smaller sample. I have noted this *infra*, where applicable.

⁴⁶ I collected this information from professors’ publicly available biographies, CVs, and social network accounts.

⁴⁷ At several universities, both areas are combined into a single department. See, e.g., Electrical Engineering & Computer Science, MIT EECS (last accessed Feb. 1, 2014), <http://www.eecs.mit.edu/>. Also, a small number of professors hold joint appointments with one or both of their respective university’s EE and CS departments *and* another department, such as aerospace engineering, biomedical engineering, communications, industrial engineering, information science, materials science, mathematics, music, physics, or psychology.

⁴⁸ These departmental affiliations were calculated using the entire 2,387 professor population, not the 100 professor random sample.

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As a professor	20.1 years ⁴⁹	20.7 years ⁵⁰
As non-prof academic researcher ⁵¹	6.1 years	6.1 years
In industry ⁵²	3.1 years	3.1 years
Percent named as inventor on at least 1 univ. patent ⁵³	51.5%	54.3%
Mean no. of univ. patents per named inventor ⁵⁴	7.2	7.0

⁴⁹ For 10 professors in the random target population sample, I was unable to locate complete work experience data. Thus, these averages were calculated from 90, rather than 100, observations.

⁵⁰ For survey questions requesting data on years of work experience, my instructions stated that respondents could round to the nearest multiple of five. *See* App. A, *infra* (“For this question and the two that follow, feel free to round to the nearest 5-year increment (i.e., 5, 10, 15, 20) if you cannot recall the number with greater precision.”). Nonetheless, the vast majority of respondents provided data rounded to the nearest year.

⁵¹ This figure includes years spent as a graduate student and any additional time spent in a post-doc program, visiting assistant professorship, or other temporary university-affiliated research position. *See* App. A, *infra* (“Include, if applicable, years spent in a Masters, PhD, or post-doc program working on potentially patentable research”).

⁵² In addition to long-term post-graduation work in industry, this figure includes summer internships and periods of time working as an industry consultant while employed as a professor, the latter discounted by 80% to reflect that university policies generally limit consulting to one day per week. *Cf.* ASS’N OF AM. MED. COLLEGES, GUIDELINES FOR DEALING WITH FACULTY CONFLICTS OF COMMITMENT AND CONFLICTS OF INTEREST IN RESEARCH (Jan. 29, 1998), *available at* <http://ethics.iit.edu/ecodes/node/3185> (reporting that “most institutions afford their faculty one day per work week for scholarly pursuits that relate to and advance professional growth and public service”); David M. Rabban, *Does Academic Freedom Limit Faculty Autonomy?*, 66 TEX. L. REV. 1405, 1420 (1988) (“[U]niversities frequently allow professors the discretion to spend a certain portion of each week, typically no more than one day, on off-campus activities or on nonuniversity work on campus.”).

⁵³ The percentage of professors in the respective samples with at least one issued U.S. patent covering research they conducted in their capacity as a university employee. For the random target population sample, I collected this data by searching for each professor’s name in the U.S. Patent and Trademark Office’s online database. U.S. PAT. AND TRADEMARK OFF., USPTO PATENT FULL-TEXT AND IMAGE DATABASE, <http://patft.uspto.gov/netahtml/PTO/search-adv.htm> (last updated Apr. 22, 2014). Survey respondents answered the following two questions:

(1) “Has your university research ever been the subject of a patent application listing you as an inventor or coinventor? Do not include, for example, patent applications filed by you or an outside company based on research you performed as a consultant or on research you performed in industry before entering academia”; and

(2) “How many of those applications have to date issued as patents?” App. A, *infra*.

⁵⁴ Among professors named as an inventor or co-inventor on at least one issued university-owned U.S. patent, the average number of university patents issued in each professor’s name. For collection details, see *id.*

Percent who founded a startup ⁵⁵	20.6%	21.9%
Gender	90.9% male, 9.1% female	89.4% male, 10.6% female

II. THE COSTS AND BENEFITS OF UNIVERSITY HIGH-TECH PATENTS

Survey respondents provided a variety of data on their patent-related activities and experiences. This Part reports their responses, broken down into two broad categories. First, I report survey data on the direct financial costs and revenues to universities—i.e., the profitability—of patenting high-tech university research. Second, I report survey data on the indirect societal costs and benefits of the same activity. Both sets of data suggest that the costs of high-tech university patent ownership may exceed the benefits.⁵⁶

A. *Direct Costs and Revenues to Universities*

Table 3 below presents data on survey respondents' patent filing and licensing activities. Approximately two-thirds of respondents reported that they have been named as an inventor or co-inventor on a U.S. patent application resulting from their university research, with a median of four applications per respondent. Of those who had filed an application covering their university research, more than four-fifths reported that at least one of their applications had resulted in an issued U.S. patent, with the median patentee-respondent reporting that his or her research had resulted in three issued patents.⁵⁷ Of respondents whose research had been patented, about

⁵⁵ The percentage of professors who are either expressly identified as a company's "founder" or otherwise held a senior position, such as Chief Technology Officer or Chief Scientist, at an early-stage university spin-off.

⁵⁶ Other studies of the direct costs and revenues of university tech transfer offices have reached the same conclusion. Valdivia, *supra* note 39, at 9 (estimating that 130 of 155 surveyed universities did not break even in 2012); Memorandum from Bob Litan & Lesa Mitchell, The Kaufman Found., to Esther Lee, Dep't Com., 2 (Aug. 17, 2009) (copy on file with author) ("[T]he majority of university [technology licensing offices] actually lose money – that is, generate less licensing revenue for the university than the cost of their operations."); Stevens, *supra* note 36, at 31 (finding in a survey of university tech transfer offices that only about 50-65% made a profit each year between 1992 and 2004).

⁵⁷ Overall, respondents reported a total of 1517 applications resulting in 1024 issued patents. This ratio of applications to issued patents comports with prior estimates of the aggregate grant rate nationwide. See Mark A. Lemley & Bhaven Sampat, *Is the Patent Office a Rubber Stamp?*, 58 EMORY L.J. 181, 193 (2008) (finding that, taking continuation applications into account, the PTO grants patents to more than 70% of applicants).

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two-thirds reported licensing at least one of their patents, with the median licensor-respondent reporting that licenses to his or her patents have, to date, earned his or her university a total of \$30,000 in royalties.⁵⁸

Table 3: Respondents' Patent-Related Activities

Patent Applications	
Percent of respondents who filed a university patent application ⁵⁹	65.7% (176 of 268)
No. university patent apps per filer	
Mean	8.7
Median	4
Issued Patents	
Percent with an issued university patent	54.5% (146 of 268)
No. issued university patents per patentee	
Mean	7.0
Median	3
Licenses and Royalties	
Percent with a licensed university patent	35.4% (95 of 268)
No. licensed university patents per licensor ⁶⁰	

However, as discussed *infra* in note 74, I was only able to account for about 85% of reported applications using application data collected from publicly available databases, which suggests that respondents who provided an approximate number of applications may have disproportionately rounded up. See App. A, *infra* (inviting respondents “to round to the nearest increment of 5 (i.e., 5, 10, 15, 20) if [they] cannot recall the number [of patent applications they have filed] with greater precision”).

⁵⁸ There is at least one good reason to believe that even this number is an overestimate. Anecdotal evidence suggests that some professors may have included some royalties earned from copyright, rather than patent, licenses in their total dollar figure. Two professors noted that, in addition to patent rights, they had separately licensed copyrights to software they created as part of their research activities. One stated that he had excluded copyright license fees from the amount he reported, but was unsure whether this was the correct choice. Another stated that he had in fact included copyright license fees in his reported figure. Thus, it is possible that other professors were similarly confused and, as a result, inflated their royalty totals.

⁵⁹ Specifically, the survey asked: “Has your university research ever been the subject of a patent application listing you as an inventor or co-inventor?” App. A, *infra*. Cf. Thursby et al., *supra* note 38, at *8 (finding in a study of all “science and engineering” faculty at six major research universities between 1983 and 1997 that roughly 65% had never pursued a patent on their research).

Mean	4.1
Median	2
Royalties earned	
Per licensor ⁶¹	
Mean	\$606,771
Median	\$30,000
Std. Dev.	\$2,603,403
Per licensed patent	
Mean ⁶²	\$140,132
Median ⁶³	\$9,259
Std. Dev.	\$622,639

As shown below in Figures 1 and 2, aggregate licensing revenue is heavily dependent on a small number of licenses that are extreme outliers. More than seventy percent of the reported royalty total was generated by less than three percent of licensors,⁶⁴ and the top nine percent of licensors were responsible for over eighty-five percent of all reported licensing revenue. By contrast, almost twenty-five percent of all licensor-respondents⁶⁵ reported that their licenses have, at least to date, failed to earn any royalties. Another nine percent of licensors each reported earning \$5,000 or less for their universities.

⁶⁰ Of the 95 respondents who indicated that at least one of their university patents had been licensed, only 92 provided data on the number of patents they had licensed.

⁶¹ Of the 95 respondents who indicated that at least one of their university patents had been licensed, only 75 provided data on the size of the royalties paid for those licenses.

⁶² One respondent provided data on total royalties earned, but did not specify how many of his or her patents had been licensed. This figure is the per patent mean excluding this respondent's partial data. Replacing that respondent's missing number of licensed patents with the mean (4) would yield a per patent mean royalty of \$138,743. Replacing the missing data with the median (2) would yield a mean royalty of \$139,594. Neither would change the median per patent royalty.

⁶³ Because each respondent reported his or her royalty figures in the aggregate, rather than per individual patent, I cannot calculate a precise per patent median. This figure is, instead, the median of licensors' individual per patent means.

⁶⁴ Accounting for 2% of patentees, 1.7% of applicants, and 1.1% of respondents.

⁶⁵ 24 percent of licensors, accounting for 16.4% of patentees, 13.6% of applicants, and 9% of respondents.

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Figure 1

Total Licensing Revenue, by Licensor Percentile

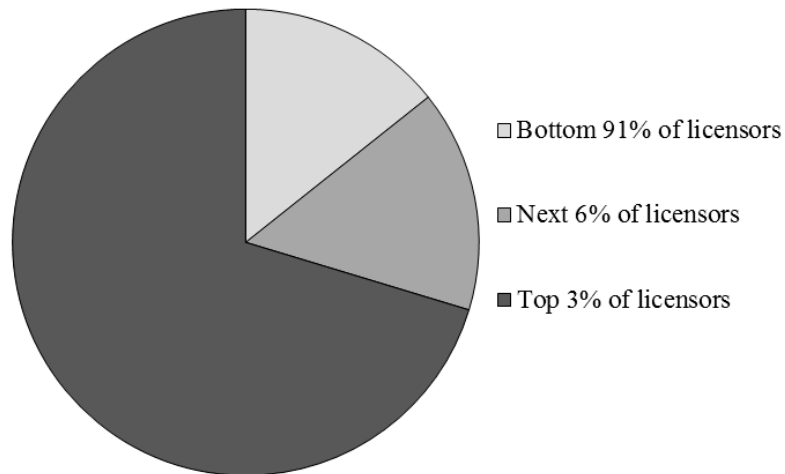
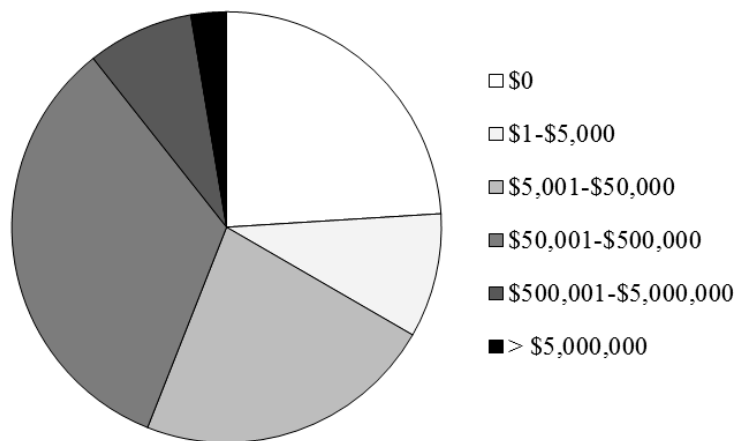


Figure 2

Licensors, by Reported Revenue



Licensing successes are so rare, in fact, that high-tech patenting may be a net loss for these twenty universities.⁶⁶ To estimate the cost of prosecuting respondents' applications and maintaining respondents' patents, I collected cost-related data from a sample of respondents' patent

⁶⁶ In the aggregate. To be sure, some individual universities—i.e., those that were a party to one or more of the outlier licenses—may turn a profit. See Valdivia, *supra* note 39, at 9 (estimating that roughly 16% of university tech transfer programs made a profit in 2012).

applications and issued patents. As shown below in Table 4, I found that universities prosecuted respondents' applications through an average of 3.8 total responses per original application, corresponding to roughly 1.67 final dispositions per application with 2.28 responses per disposition.⁶⁷ A little over seven percent of respondents' applications included an appeal to the Board of Patent Appeals and Interferences, and over forty percent were preceded by a provisional application.⁶⁸ I also observed that universities frequently hired top-dollar legal talent to prosecute respondents'

⁶⁷ I collected prosecution-related data from the U.S. PTO's Public Patent Application Information Retrieval (PAIR) database for a sample of 165 of respondents' published, original applications. U.S. PAT. AND TRADEMARK OFF., PAT. APPLICATION RETRIEVAL INFO., <http://portal.uspto.gov/pair/PublicPair> (last visited Apr. 23, 2014). The average number of responses per original application among respondents is very similar to the overall average among all U.S. patent applicants, though respondents had slightly fewer responses per disposition and slightly more final dispositions per application. *Cf.* University of California, *supra* note 41, at 20 (showing that between 2009 and 2013 the UC system filed 4031 original applications and 3720 continuations, a ratio of almost 1:1). Overall, U.S. patent applicants prosecute their applications through an average of about 3.75 responses, corresponding roughly to an average of 1.5 "final dispositions" of 2.5 office actions each. *See* John R. Allison & Mark A. Lemley, *Who's Patenting What? An Empirical Exploration of Patent Prosecution*, 53 VAND. L. REV. 2099, 2125 (2000) (finding that between 1996 and 1998 patents were prosecuted, on average, through 1.5 final dispositions); Thierry Lo, Presentation to the Amer. Intell. Prop. L. Ass'n, USPTO Statistics Update (Patents, PPH, & Reexaminations) 17 (Apr. 19, 2012), <http://www.aspa.org.sg/Thierry%20Lo%20Presentation%20on%20USPTO%20Patent%20Stats.pdf> (showing that, according to PTO data, the number of office actions per disposal has varied between 2.91 and 2.42 in recent years). As defined by the PTO, a "final disposition" can be any of the following: an "(1) allowance, (2) final rejection, (3) the declaration of an interference, or (4) abandonment." Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, *Did You Know?*, FULL DISCLOSURE 10 (Nov. 2011), http://www.finnegan.com/files/upload/Newsletters/Full_Disclosure/2011/November/FullDisclosure_Nov11_Print.pdf. Despite their designation as "final," many applications continue to be prosecuted after a "final" rejection as continuation applications, as "RCE" applications, and/or through appeals to the Patent Trial and Appeal Board. *See, e.g.*, ROBERT PATRICK MERGES & JOHN FITZGERALD DUFFY, PATENT LAW AND POLICY: CASES AND MATERIALS 52 (6th ed. 2013) (providing an overview of prosecution options following a "final rejection").

⁶⁸ Respondents are above average on both counts. Overall, U.S. patent applicants file an appeal during the prosecution of about 1.5 to 4.5% of applications, Ron Prevost, U.S. Dep't Com., Off. Inspector Gen., USPTO's Other Backlog: Past Problems and Risks Ahead for the Board of Patent Appeals and Interferences 1 (Aug. 10, 2012), <http://www.oig.doc.gov/OIGPublications/OIG-12-032-A.pdf> ("Around 1–3 percent of the applications that examiners decide [presumably including continuation applications] each year are appealed by the applicant."), and file about one provisional for every three original applications, Dennis Crouch, *NonProvisional and Provisional Patent Applications FY 2002-2008*, PATENTLY-O (June 3, 2008), <http://patentlyo.com/media/images/2008/06/Patent.Law083.jpg>.

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applications, with more than forty percent handled by law firms ranked among the 250 largest in the United States.⁶⁹ In addition to prosecution expenses, universities paid maintenance fees to keep respondents' issued patents alive at above-average rates, electing to make the first maintenance fee payment for ninety-four percent of their patents, the second for eighty percent of their patents, and the third for sixty-nine percent of their patents.⁷⁰

On the other hand, roughly nine percent of respondents' applications were co-assigned to their respective universities *and* another entity, one which may have helped to defray the costs of prosecution and maintenance. 7.4% of respondents' applications were co-owned at the time of their publication by a for-profit corporation, very likely a research partner that funded the research leading to the respondent's invention, and 1.5% were co-owned by another non-profit research institution, very likely the employer of a respondent's co-inventor.⁷¹ Moreover, respondents' patents

⁶⁹ As ranked by the National Law Journal. *2013 NLJ 350*, NAT'L L.J., <http://www.nationallawjournal.com/id=1202603325795> (June 10, 2013). Roughly 90% of these firms—i.e., 36% of all firms prosecuting respondents' applications—are also among the 100 most profitable law firms as ranked by *The American Lawyer*. *2013 Am Law 100*, AM. LAW., <http://www.americanlawyer.com/id=1202489912232/The-2013-Am-Law-100> (Apr. 25, 2013). Firms prosecuting multiple of respondents' patent applications include, *inter alia*, Baker Botts, L.L.P.; Fish & Richardson, P.C.; K&L Gates, L.L.P.; McDermott, Will & Emery, L.L.P.; and Wilson Sonsini Goodrich & Rosati, P.C.

⁷⁰ I collected this data from a sample of 315 issued university-owned patents that list a respondent as an inventor or co-inventor and for which at least one maintenance fee payment had come due. On average over the last 20 years, U.S. patent owners have paid the first maintenance fee roughly 80 to 90% of the time, the second roughly 60 to 70% of the time, and the third roughly 40 to 50% of the time. Dennis Crouch, *Patent Maintenance Fees*, PATENTLY-O (Sept. 26, 2012), <http://patentlyo.com/patent/2012/09/patent-maintenance-fees.html>.

⁷¹ I collected co-assignment information from Google Patents for a sample of 715 published, original applications listing a respondent as an inventor or co-inventor. The rate of co-ownership among respondents' applications appears to be slightly above average for university patents as a whole. See Mark Funk, *Patenting Partnerships by US Universities*, J. BUS. ADMIN. ONLINE (Fall 2012), https://www.atu.edu/jbao/Patenting_Partnerships_by_US_Universities.pdf (finding that, between 1976 and 2006, 10.8% of university patents were co-owned with another entity and also that, of the 2506 partnerships that produced these co-owned patents, 1481 (or 6.4%) were university-corporate partnerships and 357 (or 1.5%) were partnerships between universities and other non-profit research institutions); see also Robert Kneller et al., *Industry-University Collaborations in Canada, Japan, the UK and USA – With Emphasis on Publication Freedom and Managing the Intellectual Property Lock-Up Problem*, PLOS ONE, Mar. 2014, e90302, at 1, 12, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3954545/#pone.0090302.s045> (estimating based on a sample of patents owned by 90 tech companies that “[t]he percentage of US

and non-abandoned applications have an average of 7.2 years of post-survey protection remaining and, thus, will likely continue to earn royalties in the future.⁷²

Table 4: Data on Respondents' Patent Prosecution Intensity and Maintenance Fee Payment Rates

Frequency of Prosecution Events	
Responses per final disposition	2.28
RCEs per final disposition	0.21
Child applications per original application	0.67
Appeals per original application	0.072
Provisional applications per original application	0.43
Size of Prosecuting Firm	
One of largest 250 firms in the U.S.	41.4%
Other firms with 60 or more attorneys	17.2%
16-59 attorneys	24.2%
4-15 attorneys	8.2%
1-3 attorneys	8.9%
Application Co-ownership	
Co-owned with for-profit corp.	7.4%
Co-owned with non-profit univ./institute	1.5%

university patents that are co-owned by companies is less than five"). *But cf.* University of California, Technology Transfer Annual Report 21 (2012), available at [http://ucop.edu/innovation-alliances-](http://ucop.edu/innovation-alliances-services/_files/ott/genresources/documents/IASRptFY12.pdf)

services/_files/ott/genresources/documents/IASRptFY12.pdf (reporting that, in 2012, 16.6% of inventions disclosed to the UC system TTO "included non-UC inventors").

⁷² I collected this data from a sample of 515 published, original applications listing a respondent as an inventor or co-inventor. Accordingly, on average, respondents' patents reached the half-way point of their 20-year term of protection in 2012. Assuming (i) a constant rate of inflation and (ii) that respondents' patents brought in licensing revenue in a roughly symmetrical distribution centered on the mid-point of their term of protection—e.g., because, as I assume *infra*, licensing revenue was constant over these patents' terms or, more likely, because relatively few patents brought in licensing revenue both before being issued and in the last few years before expiration—a sum of all reported licensing revenue produces a tally that is, in effect, a time-adjusted total in 2012 dollars. Provided this assumption is accurate, I can estimate an overall inflation-adjusted rate of return for respondents' patent activities by directly comparing, without the need for further adjustment, total reported licensing revenue with an estimate of respondents' patent prosecution and maintenance costs expressed in 2012 dollars.

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Years of Term Remaining per Patent	
Average	7.2
Median	7
Maintenance Fee Payments	
First payment made	94%
Second payment made	80%
Third payment made	69%
Mean number of international patent applications per U.S. patent application	0.4

Despite the possibility of future royalties, even a conservative extrapolation of patent costs from the figures reported in Table 4 suggests that universities spend more obtaining and maintaining high-tech patents than they earn back in overall royalties. The patent activity reported by survey respondents would result in a *negative* rate of return of over three percent, even making the following favorable assumptions:

- that patents and applications reported in this survey will continue to bring in royalties at current levels until expiration, despite the fact that high-tech inventions depreciate rapidly and despite the likely existence of at least some one-time lump-sum royalties,⁷³

⁷³ My estimate assumes that respondents' patents will be as lucrative in their remaining years as they have been on an annual basis to date. Under this assumption, respondents' patents will earn future royalties equal to 36.2% of their current tally. This assumption, however, likely overstates the total revenue universities will earn. It is likely that at least some reported licenses were made in exchange for one-time lump sum royalty payments. See Jerry G. Thursby et al., *Objectives, Characteristics and Outcomes of University Licensing: A Survey of Major U.S. Universities*, 26 J. TECH. TRANSFER 59, at *10 (2001), available at <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.200.3716&rep=rep1&type=pdf> (finding in a survey of TTOs that 69% reported having "negotiated a license agreement in which the only form of payment was an up-front fee"). These licenses will not generate any additional revenue in the future. In addition, even patents licensed on an ongoing basis are likely to bring in less money over time. Many licenses with running royalties are frontloaded by required up-front payments, *id.* (finding that 92% of TTOs "often" or "almost always" include an upfront payment even in a license with a running royalty), and, as a practical matter, the useful lifetime of a high-tech invention is relatively short and, thus, is unlikely to be of equal value throughout its term. See Love, *supra* note 8, at 1342 ("Product lifecycles in the high-tech industry are notoriously short. Computing power, after all, doubles roughly every two years. Thus, high-tech patents are the most likely to be grossly out of date—technologically speaking—when asserted nearly two decades after their filing dates." (footnote omitted)).

- that all reported patent applications I was unable to account for using public records (and making a reasonable estimate of the number of abandoned applications filed before November 29, 2000) are erroneous overestimates that should be excluded from my estimate of prosecution costs, despite the fact that some are likely to be unpublished applications filed post-2000 and others are likely to be applications published with errors in their inventors' or assignees' names,⁷⁴
- that all reported licensing revenue is attributable solely to respondents' U.S. patent rights, despite the fact that respondents filed about one international application for every 2.5 U.S. applications reported in this survey,⁷⁵
- that all reported licensing revenue was earned without filing a lawsuit and, thus, without incurring litigation expenses,
- that these twenty universities paid median legal fees (the nationwide median charged within each prosecuting law firm's

⁷⁴ Using Google Patents, I was able to locate published, original patent applications invented or co-invented by respondents accounting for about 73% of the total number that respondents reported. Combining the number of published patents filed by respondents prior to November 29, 2000 with the fact that roughly 30% of original applications filed prior to that date were abandoned without at least one child application issuing as a published patent, I can account for another 12% of the total number of original applications reported by known respondents. See 35 U.S.C. § 122(b) (2006) (requiring the publication of most patent applications filed on or after November 29, 2000 “promptly after the expiration of a period of 18 months from the earliest filing date for which a benefit is sought under this title”); Lemley & Sampat, *supra* note 57, at 193 (finding that only about 30% of original patent applications fail to result in at least one issued patent). In an abundance of caution, I excluded the remaining 15% of reported applications from my cost estimate. At least some of these are likely legitimate applications filed post-2000 that were abandoned before publication. See 35 U.S.C. § 122(b)(2)(B)(i) (2006) (making an exception to the publication requirement “[i]f an applicant makes a request upon filing, certifying that the invention disclosed in the application has not and will not be the subject of an application filed in another country”); Dennis Crouch, *Unpublished US Applications*, PATENTLY-O (Dec. 7, 2013), <http://patentlyo.com/patent/2013/12/unpublished-us-applications.html> (finding that roughly 7% of patents in recent years issued from applications that were filed solely in the U.S. by applicants who requested secrecy until issuance). Additional legitimate applications were likely erroneously excluded from my searches due to idiosyncratic database errors. For example, there are 7 published patent applications in the Google Patents database purportedly assigned to the “Perdue,” rather than Purdue, Research Foundation and another 2 assigned to “William Marsh University,” rather than “William Marsh Rice University.”

⁷⁵ See *supra*, tbl. 4.

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respective size cohort) for the prosecution of patent applications covering moderately complex technology, despite the fact that over thirty-five percent of their applications were prosecuted by firms among the 100 most profitable in the U.S.,⁷⁶

⁷⁶ For all but the largest firms, my cost estimate assumes that universities paid legal fees to each prosecuting firm equal to the nationwide median charge reported by similarly-sized firms in the AIPLA 2013 Report of the Economic Survey for prosecution activities involving “relatively complex, electrical computer” applications. AM. INTELLECTUAL PROP. LAW ASS’N, REPORT OF THE ECONOMIC SURVEY 2013, at I-114-18 (2013). However, the largest firm size category for which the AIPLA reports fee data is “60 or more” attorneys. *Id.* (breaking down fee data for firms sized “1-3 Attorneys,” “4-15 Attorneys,” “16-59 Attorneys,” and “60 or more Attorneys”). As discussed *supra* in note 69, about 40% of firms that prosecuted respondents’ patents have between 200 and 2400 attorneys each. Accordingly, because they are such extreme outliers among AIPLA respondents, my estimate assumes that universities paid fees to firms ranked among the 250 largest in the U.S. at the 75th percentile, rather than median, reported by firms in the “60 or more” attorneys category. See Am. Bar Assoc., Lawyer Demographics, http://www.americanbar.org/content/dam/aba/administrative/market_research/lawyer_demographics_2013.authcheckdam.pdf (finding in a 2005 survey of ABA members that only 1 percent of law firms employ 100 or more attorneys). This departure is still likely to be a gross underestimate of fees paid to these firms. As discussed *supra* in note 69, 90% of the large firms in my sample are also among the 100 most profitable firms in the U.S., which places them roughly among the top one-fifth of one percent of U.S. law firms. See *id.* (additionally showing that in 2005 there were roughly 475 law firms falling within the 1 percent of firms that employ more than 100 attorneys); The 2013 Am Law 100, *supra* note 69 (showing that all ranked firms employed well over 200 attorneys each). In addition, the fees reported to the AIPLA for firms in the “60 or more” attorneys category included large outliers, as evidenced by the fact that for most prosecution events the 75th percentile fee in this category is actually *smaller* than the average fee. REPORT OF THE ECONOMIC SURVEY 2013, *supra*, at I-114-18. Finally, as discussed *supra* in note 72, because the 2013 AIPLA survey actually reports fees that firms charged in 2012, I can roughly calculate a rate of return for respondents’ patenting activities by directly comparing—without the need for further time-value adjustments—total reported licensing revenue with an estimate of total patent prosecution and maintenance costs extrapolated from this fee data. Because median prosecution-related attorney’s fees have actually been roughly steady over the last decade—and for many tasks have actually *decreased* modestly among large firms, rather than risen annually due to inflation—this time-value assumption likely underestimates the legal fees respondents’ universities paid as measured in 2012 dollars. Compare REPORT OF THE ECONOMIC SURVEY 2013, *supra*, at I-114-18 (reporting an overall median cost of \$10,000 for filing an original high-tech patent application of moderate complexity) with INTELLECTUAL PROP. LAW ASS’N, REPORT OF THE ECONOMIC SURVEY 2005, at I-95-100 (2005) (same).

- that these universities paid PTO fees at micro-entity levels, despite the fact that this fee discount did not exist prior to March 19, 2013,⁷⁷
- that 100 percent of licensees reimbursed universities for 100 percent of the cost of prosecuting and maintaining licensed patents, none of which was reported by respondents as licensing revenue,⁷⁸ despite the fact that a prior survey of tech-transfer offices found that about ten percent of TTOs at major research universities require reimbursement only “sometimes” or “rarely,”⁷⁹
- that 100 percent of corporate co-owners paid for 100 percent of the cost of prosecuting co-owned applications and maintaining co-owned patents, none of which was reported by respondents as licensing revenue,
- that non-profit co-owners paid for one-half of the cost of prosecuting co-owned applications and maintaining co-owned

⁷⁷ My analysis assumes that universities pay patent office fees at the current rate for micro-entities. See U.S. Patent & Trademark Off., Fee Schedule, *available at* <http://www.uspto.gov/web/offices/ac/qs/ope/fee010114.htm> (showing that “micro entities” pay fees at a 75 percent discount); 37 C.F.R. § 1.29(d) (providing that an “institution of higher education” qualifies as a “micro entity”). For the vast majority of applications at issue in this study, this is a gross underestimate because micro-entity status did not exist prior to March 19, 2013. U.S. Patent & Trademark Off., *AIA Changes: Micro Entity New Fees*, INVENTORSEYE, Feb. 2013, <http://www.uspto.gov/inventors/independent/eye/201302/Advice.jsp>. Nonetheless, because this analysis is most useful in predicting the current profitability of university high-tech patenting, using the current level of fees provides the best metric.

⁷⁸ Many universities—including at least five of those selected for this survey—*do* count reimbursed fees as licensing income, which (as a practical matter) they are. University of California, *supra* note 71, at 21 (“Obtaining a licensee’s commitment to reimburse these costs is a high priority objective of license negotiations, and reimbursement, therefore, are considered part of total licensing income.”); University of Maryland, Office of Technology Commercialization, <http://www.otc.umd.edu/about/statistics/revenue> (last accessed May 16, 2014) (counting both “royalty income” and “patent reimbursement income” as “revenue”); Rice University, Office of Research Annual Report (2011), *available at* <http://research.rice.edu/FY11AnnualReport/> (counting both “royalties” and “patent reimbursement” as “revenue”).

⁷⁹ Thursby et al., *supra* note 73, at *24, tbl. 4 (finding in a survey of tech-transfer staff at 62 major research universities that 67.7% reported “almost always” including a patent cost reimbursement clause in their license agreements, 21% reported doing so “often,” 8.1% reported doing so “sometimes,” and 3.2% reported doing so “rarely”)

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patents, none of which was reported by respondents as licensing revenue,

- that the tech transfer offices at these twenty universities incur a slightly lower than typical rate of overhead expense in addition to the cost of PTO and attorneys' fees,⁸⁰ and finally
- that total licensing revenue is the best measurement of the direct monetary benefit universities receive from their patents, despite the fact that universities are required by law to share a percentage of royalties with faculty inventors.⁸¹

A detailed explanation of this calculation is included *infra* in Appendix B.

⁸⁰ My estimate assumes that the tech transfer offices at these universities incur additional overhead costs equal to their expenditures on PTO and attorneys' fees, an assumption that would make them about 10 percent more efficient than the average tech transfer office at a U.S. university. See Irene Abrams et al., *supra* note 5, at 1 (finding, in a survey of 165 tech transfer offices, that office budgets were 45 percent legal fees and 55 percent overhead). Among tech transfer offices at surveyed universities, some appear to be slightly more efficient, and others less efficient, than average. For example, the Cornell Center for Technology, Enterprise, and Commercialization's overhead expenses were at least 78% as large as its legal expenses (not including cost reimbursements) between 2008 and 2012. Cornell University, Center for Technology, Enterprise and Commercialization, 2012 Annual Report 17 (2012), available at <http://www.cctec.cornell.edu/about/2012-AnnualReport.pdf> (showing a five-year total of \$27.6 million in "legal" expenses, excluding litigation costs and reimbursements, and \$21.4 million in "office operations" expenses, excluding certain other "extraordinary" expenses). The Purdue Research Foundation's operating expenses, on the other hand, appear to be well in excess of its expenditures on legal fees each year between 2009 and 2013. Purdue Research Foundation, About Purdue Research Foundation, <http://prf.org/prf-about> (last accessed May 16, 2014) (linking to the Foundation's Annual Reports for 2009 through 2013, each of which include line item costs for "patent and royalties," "salaries and other benefits," and "supplies," among others).

⁸¹ Universities are legally required to share royalties with faculty inventors. See 35 U.S.C. § 202(c)(7)(B) (requiring "the contractor to share royalties with the inventor"). University policies generally provide a one-third share (net of prosecution costs) to inventors. See Valdivia, *supra* note 39, at 9 ("[U]niversities generally split licensing revenue in three parts: a third for the faculty-inventors, a third for their department or lab, and a third as discretionary funds for the university."). As a result, rather than total income, some prior studies have used licensing income *net of inventors' share* when estimating TTO profitability. See Abrams et al., *supra* note 5 at 13 (measuring TTO profitability using "net income after distributions to inventors and for research").

Table 5: Universities' Estimated Rate of Return on High-Tech Patents

Method for handling unreported data ⁸²	Est. rate of return
Overall	
Median substitution	(3.5%)
Mean substitution	8.9% ⁸³
Net of disbursements to inventors⁸⁴	
Median substitution	(30.6%)
Mean substitution	(22.3%)

With faculty members at these highly-ranked schools reporting losses even under the favorable assumptions outlined above, it seems likely that high-tech patenting is unprofitable for all but a few U.S. universities and, moreover, is substantially less profitable than university patenting in the life sciences, which generates a profit for at least some significant fraction of institutions.⁸⁵

B. Indirect Costs and Benefits to Society

However, university patents' direct fiscal impact on university budgets does not tell us whether the practice is a net cost or benefit for society. High-tech patenting on university campuses could be a boon to the public, while at the same time a financial drain on higher education. Patents

⁸² Twenty respondents reported that one or more of their patents had been licensed, but did not report licensing revenue. One respondent reported licensing revenue, but did not report the number of patents licensed.

⁸³ As discussed *supra*, the mean is highly skewed by a small number of extreme outliers. Nonetheless, even when replacing missing data with this highly misleading mean, I estimate an overall rate of return earned over the 20-year life of a patent that barely outperforms the *annual* inflation-adjusted rate of return for a stock market index fund. See, e.g., Matt Krantz, *Effect of Inflation Not Included in 10% Stock Return Rule*, USA TODAY, May 7, 2012 (reporting that the average annual inflation-adjusted rate of return for the U.S. stock market is roughly 6%).

⁸⁴ These rates assume an average disbursement to inventors equal to one-third of royalties earned net of PTO and legal fees. See Valdivia, *supra* note 39, at 9.

⁸⁵ See *supra* note 56 (collecting cites on the overall profitability of university tech transfer); see also Harun Bulut & GianCarlo Moschini, *U.S. Universities' Net Returns from Patenting and Licensing: A Quantile Regression Analysis* (Ctr. for Agric. & Rural Dev., Iowa State Univ., Working Paper 06-WP-432 Sept. 2006), available at <http://www.card.iastate.edu/publications/synopsis.aspx?id=1024> (finding that universities without medical schools are unlikely to profit from tech transfer).

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exist to encourage research and facilitate its commercialization,⁸⁶ and universities likely pursue patents, at least in part, with these larger societal goals in mind.⁸⁷ Data collected in this survey, however, also casts doubt on the indirect societal value of high-tech university patents. Among respondents, university patenting appears to discourage, rather than encourage, academic research and has, at best, a mildly positive impact on commercialization.

1. Do University High-Tech Patents Encourage Academic Research?

One way university patent ownership might benefit society is by motivating professors to conduct more or better research. In other words, even if patents appear to be a net drain on university budgets, universities might rationally pursue patents to motivate their faculty to produce additional research in furtherance of their mission to bring knowledge to the world. Unfortunately, respondents reported almost uniformly that the prospect of obtaining patent rights does not spur their research activities.

i. Factors motivating research activities

As shown below in Figures 3 and 4, only about ten percent of respondents report that the prospect of obtaining patent rights encourages them to produce more or better research.⁸⁸ To the contrary, more than half

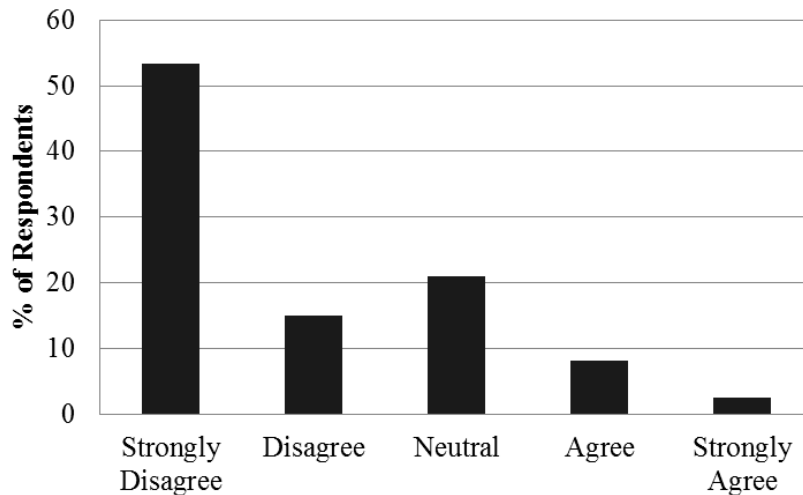
⁸⁶ See, e.g., Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 736-38 (2012) (explaining that “the orthodox utilitarian theory of patent law” is that “[w]e grant patents . . . to encourage inventions we wouldn’t otherwise get” and that “[t]he dominant alternative theory of patent law focuses not on incentives to invent, but on the development and commercialization of an invention once it has been made”).

⁸⁷ See Abrams et al., *supra* note 5, at 17 (finding that only 11.5% of surveyed university tech transfer offices ranked “revenue maximization” as their top priority and noting that “‘Economic Development’ . . . anecdotally is reported to be a significant driving force at publicly owned institutions”); Stevens, *supra* note 36, at 39 (“Of course, revenue generation serves as an incentive. But first and foremost, technology transfer must serve our core mission: sharing ideas and innovations in the service of society’s well-being.” (quoting Mary Sue Coleman, President, University of Michigan)).

⁸⁸ The total number of responses recorded in Figures 3 and 4 is 247. Prior researchers have reached the same conclusions about faculty motivation. See MICHELE BOLDRIN & DAVID K. LEVINE, *AGAINST INTELLECTUAL MONOPOLY* 241 (2008), available at <http://www.micheleboldrin.com/research/aim.html> (“[W]e are not aware of anybody claiming, let alone documenting, that after the Bayh-Dole Act took effect, the quality of biomedical research in U.S. universities and federal sponsored laboratories visibly increased. It just remained roughly where it was, meaning that patentability made no difference as far as general incentives are concerned.”); Hazuka, *supra* note 3, at 196

of respondents strongly disagree that this is true. Moreover, as shown below in Table 6, respondents overwhelmingly ranked the prospect of obtaining patent rights outside the top four factors motivating their research efforts.⁸⁹

Figure 3
Agree or Disagree: The ability to patent my university research encourages me to do MORE research than I would otherwise



(“[A]cademic scientists, who have driven the revolutionary advances in biomedical science, are not generally motivated by the possibility of obtaining patents. Instead, they seek publication and the esteem of their peers. Indeed, much biotechnology upstream, basic research would take place in the absence of the patent system.”); Rai, *supra* note 7, at 89–90 (observing that norms in the scientific research community “promote a public domain of freely available scientific information” and eschew “claiming property rights in invention . . . as immoral”).

⁸⁹ A total of 248 respondents answered the question shown in Table 6. It is, of course, possible that respondents’ rankings of these factors reflect some degree of self-serving bias. See Donelson R. Forsyth, *Self-Serving Bias*, in INTERNATIONAL ENCYCLOPEDIA OF THE SOCIAL SCIENCES 429 (2d ed. 2008) (“Self-serving biases are particularly evident when individuals formulate attributions about the causes of personal actions When explaining positive actions and experiences, their attributions emphasize the causal impact of internal, dispositional causes, but when identifying the causes of negative events, they stress external, situational factors.”).

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Figure 4

Agree or Disagree: The ability to patent my university research encourages me to do HIGHER QUALITY research than I would otherwise

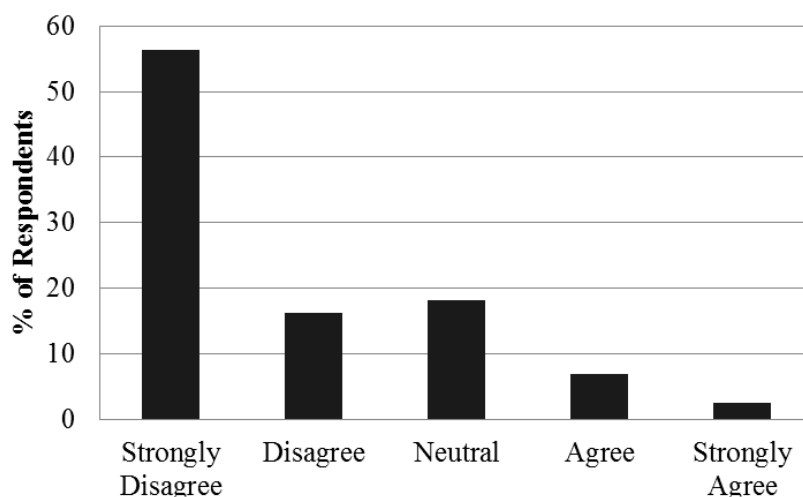


Table 6: Factors Motivating Respondents' Research

Motivating Factors	Rank				
	1	2	3	4	Not among top 4
Enjoyment / curiosity / desire to advance knowledge	75.8%	13.3%	7.2%	1.6%	2.0%
Publication and/or presentations	10.9	35.1	31.0	12.5	10.5
Informal status / recognition among my peers	9.7	37.5	29.8	12.9	10.1
Tenure / promotions / raises	6.4	13.3	14.5	29.8	35.9
Formal awards / recognition ⁹⁰	4.0	4.8	12.5	21.4	57.3
Other	7.3	4.0	1.6	3.2	83.9
Patent rights / licensing	0.0	2.0	4.8	8.0	85.1
Other IP rights, like trade secrecy and/or copyrights	0.4	1.2	3.2	4.0	91.1

⁹⁰ As shown on the survey instrument, this choice read in full: "Formal awards / recognition, such as Best Paper/IEEE/ACM awards, NAE membership, IEEE Fellow, Turing, Nobel, etc." App. A, *infra*.

ii. Awareness of royalty sharing

Respondents' disinterest in patent rights is also revealed by a widespread lack of knowledge among professors about their universities' royalty sharing policies. In the overall sample, 13.7% of respondents reported that they did not know whether their home institutions have a policy of sharing royalties with faculty inventors.⁹¹ Another one percent incorrectly reported that their universities do *not* share royalties with faculty.⁹² Even among faculty who reported that their universities do share royalties, fifty percent reported that they do not know what percentage of royalties faculty inventors are entitled to.⁹³ Altogether, 57.3% of respondents do not know at least one of these two facts.

Though these figures improve among respondents who are more familiar with the patent system, the improvement is surprisingly small. Among patent-holding respondents, 6.3% reported not knowing whether their universities share royalties,⁹⁴ and 1.1% reported incorrectly that their universities do not.⁹⁵ Among patentee-respondents who reported that their universities do share royalties, 42.9% reported that they do not know how royalties are divided between faculty inventors and their universities.⁹⁶

Among respondents who had licensed at least one patent, 2.1% reported not knowing whether their universities share royalties,⁹⁷ and 1.1% reported incorrectly that their universities do not.⁹⁸ Among licensor-respondents who reported that their universities do share royalties, 31.5% reported that they did not know how royalties are divided between inventors and their universities.⁹⁹ Finally, and perhaps most surprisingly of all, among startup founders 7.5% reported not knowing whether their universities share royalties,¹⁰⁰ and 2.5% reported incorrectly that their universities do not.¹⁰¹ Among founder-respondents who reported that their

⁹¹ 34 of 248 overall respondents who answered this question.

⁹² 2 of 248 overall respondents who answered this question. As discussed *supra* in note 81, universities are required by law to share royalties with faculty inventors, and most provide inventors a one-third share net of PTO and legal fees.

⁹³ 106 of 212 overall respondents who answered this question.

⁹⁴ 11 of 174 patentee-respondents who answered this question.

⁹⁵ 2 of 174 patentee-respondents who answered this question.

⁹⁶ 69 of 161 patentee-respondents who answered this question.

⁹⁷ 2 of 95 licensor-respondents who answered this question.

⁹⁸ 1 of 95 licensor-respondents who answered this question.

⁹⁹ 29 of 92 licensor-respondents who answered this question.

¹⁰⁰ 3 of 40 founder-respondents who answered this question.

¹⁰¹ 1 of 40 founder-respondents who answered this question.

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universities do share royalties, 47.2% reported that they do not know how royalties are divided between inventors and their universities.¹⁰²

Though these findings may appear to call into question respondents' ability to report accurate licensing data, a sensitivity analysis confirms that the royalty figures reported *supra* in Part II.A are robust despite many licensors' ignorance of their universities' revenue sharing policies. As also discussed *supra*, total licensing revenue is largely attributable to a small number of licensors, all of whom reported knowing what share of licensing revenue they receive.¹⁰³ After all, they have a strong financial incentive to know this information. The majority of licensors who reported not knowing how royalties are shared at their universities also reported that their licenses had not generated any royalties to date or, likely in an abundance of caution, chose not to answer the revenue question. These licensors' ignorance of revenue-sharing policies has no impact on the overall revenue statistics introduced above. The remaining licensors who were hazy on revenue apportionment reported earning relatively small royalty amounts that even if trebled (under the assumption that every one of these respondents mistakenly reported his or her own share only) would raise the estimated rates of return shown in Table 4 by less than four-fifths of one percent.

iii. Government funding

Yet another reason to question whether patent rights motivate professors is the prevalence of government funding to support academic research. Intellectual property, after all, exists first and foremost to encourage *ex ante* investment in research that would not otherwise occur absent *ex post* rights to the fruits of that research.¹⁰⁴ If research is funded *ex ante* from a third-party non-profit source, there is good reason to believe that the research will occur irrespective of patent rights, and thus the economic basis for issuing those rights is correspondingly weak.¹⁰⁵

¹⁰² 17 of 36 founder-respondents who answered this question.

¹⁰³ All of the top 18 highest-grossing licensors (collectively responsible for 94% of all reported revenue) indicated that they knew the details of their universities' royalty sharing policies.

¹⁰⁴ See, e.g., Lemley, *supra* note 22, at 736 (“[I]f scientists can develop a new invention in the course of their regular work, the law doesn’t need to encourage that work with exclusivity We grant patents, on this theory, to encourage inventions we wouldn’t otherwise get.”).

¹⁰⁵ Accordingly, government subsidies for research are often viewed as substitutes for patent rights. See, e.g., Daniel J. Hemel & Lisa Larrimore Ouellette, *Beyond the Patents-Prizes Debate*, 92 TEX. L. REV. 303, 307 (2013) (listing “the four main policy tools for promoting R&D: patents, prizes, government grants, and R&D tax incentives”).

Consistent with prior studies of publicly-funded research in the life sciences,¹⁰⁶ survey respondents report that ex ante funding from the government for high-tech research is plentiful on university campuses. Sixty-eight percent of professors' university patent applications covered publicly-funded research.¹⁰⁷ Eighty-three percent of respondents who had filed an application had filed at least one covering the fruits of government funded research.¹⁰⁸

In addition to practical concerns about incentives to invent, patenting the fruits of publicly-funded research also raised ethical concerns for some professors. In narrative responses, several questioned the propriety of a system that, in effect, publicizes the cost of research and privatizes the benefits. As one respondent put it: "My research is funded by government agencies. The public has already paid for it. They should not have to pay again." Several others provided similar comments.¹⁰⁹

¹⁰⁶ See MERRILL GOOZNER, *THE \$800 MILLION PILL: THE TRUTH BEHIND THE COST OF NEW DRUGS* 8 (2005) ("Taxpayer-financed medical research, whether in NIH labs or through government grants to academic and nonprofit medical centers, reached \$27 billion in 2003, almost equal to industry spending Over the years, NIH funded research played not only the key role in virtually all of the basic scientific breakthroughs that underpin modern medicine but also a central role in the application of those findings to the search for many new therapies."); Gold & Carbone, *supra* note 4, at S48 (noting that the National Institutes of Health "has funded part of virtually every major U.S. biomedical research project at some stage"); Anna Schissel et al., *Survey Confirms Fears About Licensing of Genetic Tests*, 402 NATURE 118, 118 (1999) (finding that 67% of genetic patents issued in the United States covered research funded by the U.S. government); Ouellette, *supra* 28, at 323 (reporting that patent rights to over 9% of pharmaceuticals approved by the FDA between 1988 and 2005 are owned in whole or in part by universities or other public institutions).

¹⁰⁷ 1031 of 1517 total applications. This percentage of patents matches almost perfectly the percentage of overall high-tech university research funded by the government. See RONDA BRITT, NAT'L SCI. FOUND., *ACADEMIC RESEARCH AND DEVELOPMENT EXPENDITURES: FISCAL YEAR 2004*, at 15-16 (2006), available at <http://www.nsf.gov/statistics/nsf06323/pdf/nsf06323.pdf> (showing that between 1997 and 2004, the federal government funded 67% of all university R&D expenditures in computer science and electrical engineering).

¹⁰⁸ 30 of 176 total respondents who have at least one issued patent.

¹⁰⁹ One respondent wrote: "I believe that publicly funded research should belong in the public domain and should therefore not be patentable by universities, professors, or students." A second: "The Bayh-Dole Act has been a disaster for American universities . . . [because] it encourages publicly financed research to be privately held and exploited for profit." And, a third: "It's not clear to me why any institution or individual can own results of publicly funded research."

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2. *Do University High-Tech Patents Hinder Academic Research?*

In fact, rather than encouraging academic research, many survey respondents reported that university patenting programs actually impede their research. As shown below in Figures 5-7, among respondents who expressed a clear opinion one way or the other, the majority indicated that university patent rights actually harm their ability to bring in research funding from private sources, to collaborate with professors at other institutions, and to share their discoveries with the rest of the research community.

Moreover, dissatisfaction with patents' impact on academic research increased, rather than decreased, with respondents' experience with university tech transfer. Among respondents who had founded a startup, presumably those who had "benefited" the most from university patent rights, thirty-four percent indicated that patents harmed their ability to obtain research funding, thirty-four percent indicated that patents hindered their ability to collaborate with other researchers, and twenty-nine percent indicated that patents harmed their ability to disseminate their ideas, compared to just twenty-two, four, and twelve percent, respectively, who indicated that patents helped in each category.

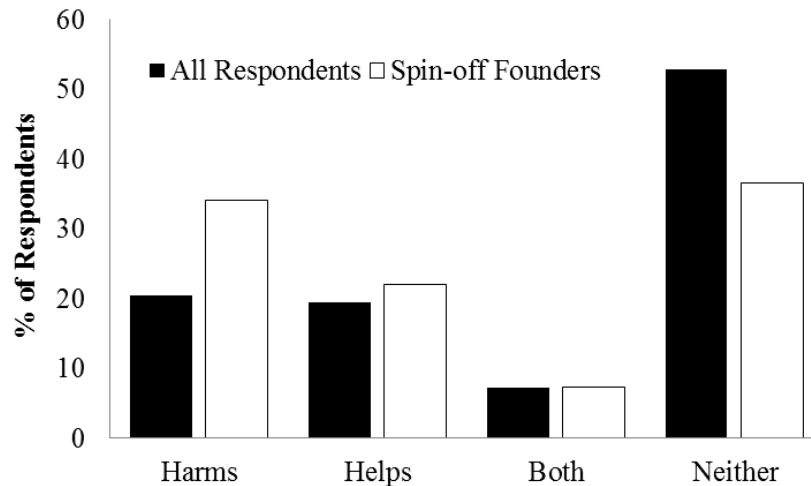
i. Research Funding from Private Sources

Among those who provided narrative commentary related to research funding, respondents most often noted the potential for university patent rights to strain relationships between professors and companies that fund academic research. Several faculty members reported that, increasingly, they cannot negotiate research agreements with industry partners without involving their tech transfer offices, a requirement that adds complexity and delay to the process of acquiring funds.¹¹⁰ Also, as

¹¹⁰ See Rice University, *supra* note 78, at 7 ("Since its inception, OTT has taken on an increasingly larger role in the completion of industry-sponsored research agreements. Over this time, the negotiation of intellectual property clauses has become increasingly difficult and complex."); Scott Jaschik, *Fast Track or End Run?*, INSIDE HIGHER ED, May 28, 2013, <http://www.insidehighered.com/news/2013/05/28/ucla-tells-professors-not-apply-major-new-pharmaceutical-grant> (explaining how GlaxoSmithKline's attempts to directly fund faculty research projects, rather than approaching faculty indirectly through the UCLA TTO, led "the University of California at Los Angeles [to take] the unusual step of telling professors not to apply to a major new grant competition from [the] pharmaceutical company"); Steve Lohr, *IBM and Universities Plan Collaboration*, N.Y. TIMES, Dec. 14, 2006, at C11 ("Universities have made life increasingly difficult to do research with them

one professor noted, aggressive patent licensing efforts have the potential to backfire: tech companies threatened with patent assertion have been known to retaliate with their own “threat[s] . . . not [to] give any more grants if a lawsuit is filed.” Micron recently made one such threat. When it was sued by the University of Illinois, the company responded with a public statement that “effective immediately, Micron will no longer recruit UIUC students . . . and . . . [will] suspend participation in other joint activities [with the university].”¹¹¹

Figure 5: Effect of University Patenting on Ability to Attract Research Funding¹¹²



because of all the contractual issues around intellectual property” (quoting Stuart Feldman, Vice President for Computer Science, IBM Research)).

¹¹¹ See, e.g., Dennis Crouch, *Although “Without Tact”, Micron’s Retaliatory Decision to Stop Hiring University of Illinois Graduates Is Not Illegal*, PATENTLY-O (Apr. 11, 2013), <http://patentlyo.com/patent/2013/04/although-without-tact-microns-retaliatory-decision-to-stop-hiring-university-of-illinois-graduates-is-not-illegal.html>. For a discussion of university administrators’ take on the possibility that patent assertion will reduce faculty members’ research budgets, see Rooksby, *When Tigers Bare Teeth*, *supra* note 10, at 197-99.

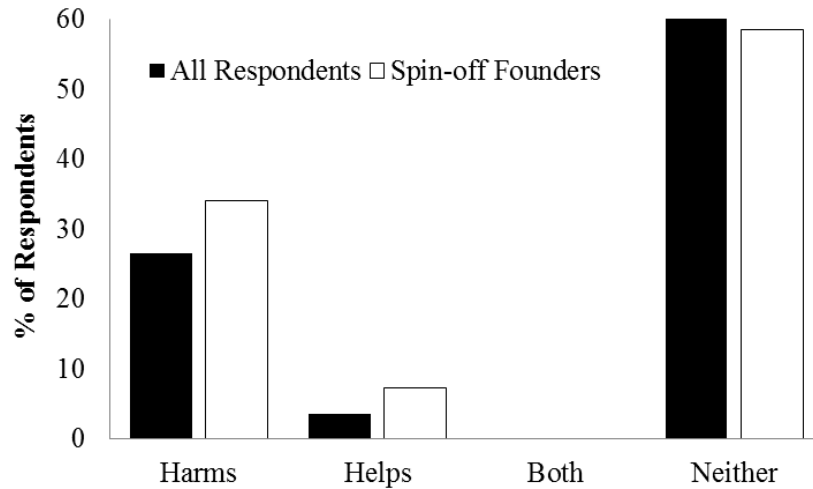
¹¹² On the survey instrument, respondents were presented with a checklist of possible costs and benefits from which to select. The choices pertaining to research funding were, in full: “HARMS faculty members’ ability to bring in RESEARCH FUNDING by, e.g., creating conflicts between the university and companies/entities that might help fund their research” and “HELPS faculty members bring in additional RESEARCH FUNDS by, e.g., attracting companies/entities that help fund their research.” App. A, *infra*.

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ii. Collaboration

Respondents likewise expressed concern that university patent programs make it more difficult for faculty members to collaborate with colleagues at other institutions. In today's academic environment, cross-university collaboration requires coordination between multiple institutions' tech transfer offices. The resulting transactions costs deter, and sometime outright tank, collaboration, which as one respondent explained, is particularly troubling for the future of high-tech research because "[t]he best innovations . . . and products involve thousands of interlocking ideas in EECS" and, accordingly, "no one person can actually claim full credit" for creating them.

Figure 6: Effect of University Patenting on Ability to Collaborate Across Institutions¹¹³



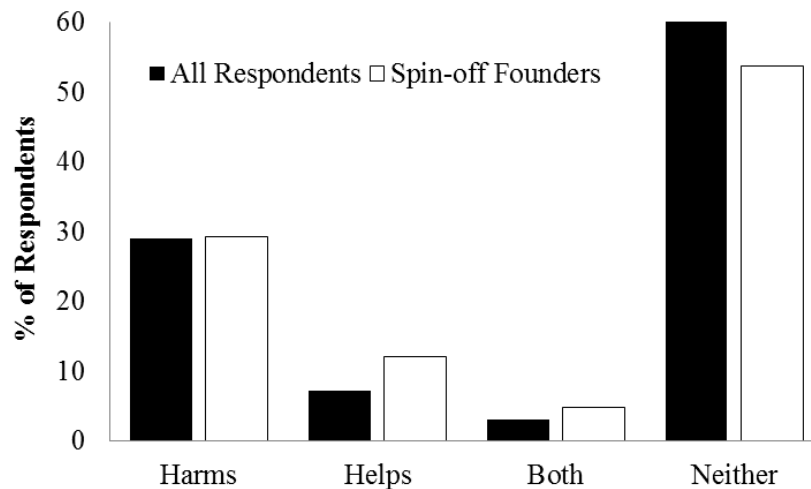
iii. Secrecy

Respondents were also vocal about the impact that patents have on the dissemination of academic research and, consequently, on the research environment at universities. Several wrote that university patents have a negative effect on academic culture. One respondent stated: "Within the

¹¹³ The choices pertaining to collaboration were, in full: "HARMS faculty members' ability to COLLABORATE with others by, e.g., creating conflicts between your university and the university employing a researcher with whom they wish to collaborate" and "HELPS faculty members COLLABORATE with other professors at other universities by, e.g., attracting those professors and/or their home institutions." App. A, *infra*.

university environment, . . . there [historically have been] lots of cultural incentives to share information, record it for posterity, pass it on to students, etc [but] patenting in the university setting adds a lot of cultural pollution to the environment.” Another concurred, adding: “Too much focus on intellectual property in general at universities runs counter to their primary mission of creating and disseminating knowledge. It changes the culture in dangerous ways and can significantly damage both progress and collaboration.”¹¹⁴ In addition to the impact on culture, respondents also expressed concern about increased secrecy’s impact on technological progress. As one put it: “The most valuable commercial contributions of academic research in [computer science] have occurred through . . . open free dissemination of . . . both papers and software”

Figure 7: Effect of University Patenting on Ability to Disseminate Research¹¹⁵



¹¹⁴ Accord David Schwartz, *5 Things Tech Transfer Offices Wish Their Start-ups Knew*, TECH TRANSFER ENEWS Blog (June 5, 2013), <http://techtransfercentral.com/2013/06/05/5-things-tech-transfer-offices-wish-their-start-ups-knew/> (“[D]on’t publish your work in any way unless you know it’s safe from an IP protection standpoint.”); Rai et al., *supra* note 9, at 1547 (noting complaints from computer science faculty at the University of Texas about their ability to share software).

¹¹⁵ The choices pertaining to the dissemination of research were, in full: “HINDERS the dissemination of new research because, e.g., faculty members keep their research secret and/or delay publication until after filing a patent application” and “HELPS disseminate new research because, e.g., researchers read patents to learn about new research they wouldn’t otherwise be exposed to.” App. A, *infra*.

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3. *Consulting and Commercialization Opportunities*

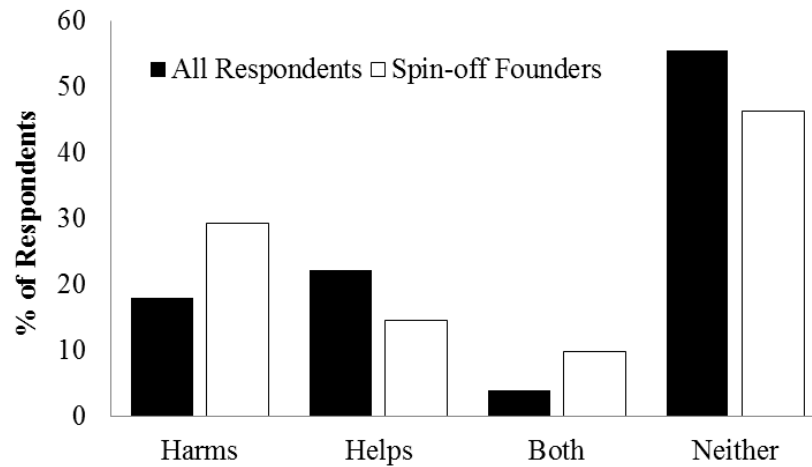
Even if university patenting decreases the overall amount of research—as many survey respondents suggest—university patents could, at least in theory, nonetheless still benefit society by encouraging the commercialization of what university research does take place. This potential benefit was the primary impetus behind the passage of the Bayh-Dole Act¹¹⁶ and is one of the justifications for university patent rights most often cited today.¹¹⁷ Many respondents indicated that patent rights do, in fact, assist faculty members in their commercialization efforts. However, the evidence is mixed.

One way in which faculty members can disseminate their ideas to industry is by working in industry themselves on a part time basis. As shown below in Figure 8, respondents as a whole indicated that the ability to patent their research helps them find work as a consultant, with eighteen percent stating that patenting clearly hinders their consulting activities and twenty-two percent stating that it clearly helps. Interestingly, though, respondents with the most commercialization experience came to the opposite conclusion. Professors who had founded at least one startup stated by a two-to-one margin that patents impede their consulting efforts.

¹¹⁶ See Gene Quinn, *Exclusive Interview: Senator Birch Bayh on Bayh-Dole at 30*, IPWATCHDOG (Nov. 7, 2010, 8:27pm), <http://www.ipwatchdog.com/2010/11/07/exclusive-interview-senator-birch-bayh-on-bayh-dole/id=13198/> (explaining that the Bayh-Dole Act was intended to “hook the private enterprise system up with the intellectual enterprise in our universities so we have the entrepreneurial skills of the free enterprise system and the intellectual capacity of our researchers . . . to develop research where it wasn’t already being developed” (quoting Sen. Birch Bayh)); Lee, *supra* note 1, at 31 (“Congress enacted [Bayh-Dole] on the view that exclusive rights were necessary to motivate additional private investment to develop patented inventions into commercial products.”).

¹¹⁷ See, e.g., Valdivia, *supra* note 39, at 5 (“Proponents of Bayh-Dole argue that if the government retained title to public patents, the private sector would not invest in the development and commercialization of those patents.”); Gene Quinn, *Intellectual Dishonesty About Bayh-Dole Consequences*, IPWATCHDOG (May 10, 2013 12:19pm), <http://www.ipwatchdog.com/2013/05/10/intellectual-dishonesty-about-bayh-dole-consequences/id=40200/> (collecting examples of successful commercialization of university research and concluding that these constitute “overwhelming evidence that Bayh-Dole has been extraordinarily successful”).

Figure 8: Effect of University Patenting on Ability to Work as Consultant with Industry¹¹⁸

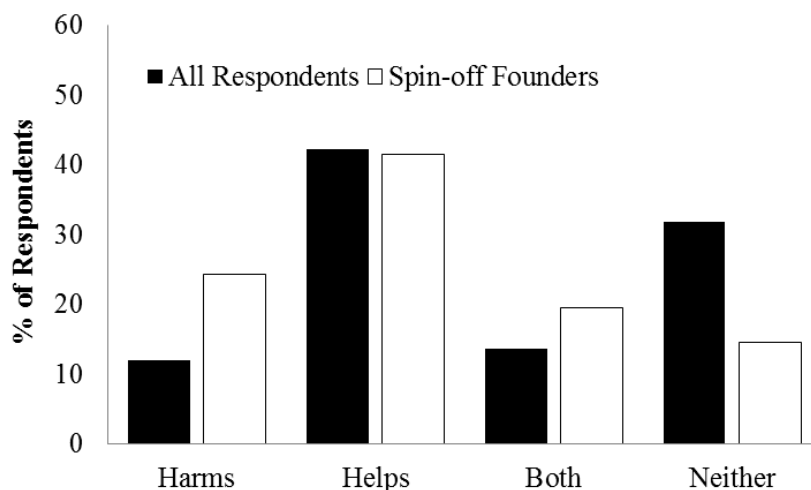


When asked directly about patenting's impact on commercialization, respondents also indicated that patents appear to be a net benefit. As shown below in Figure 9, forty-two percent of respondents reported that patenting helps professors commercialize their research, while twelve percent reported the opposite. Among startup founders, the ratio shrinks considerably, with forty-two percent reporting a positive impact and twenty-four a negative impact. Nonetheless, even among this group, the net effect appears to be positive.

¹¹⁸ The choices pertaining to consulting work were, in full: "HARMS faculty members' ability to work with industry as a CONSULTANT by, e.g., creating conflicts between the university and companies/entities that might hire them as a consultant" and "HELPS faculty members find CONSULTING opportunities by, e.g., attracting companies/entities that might hire them as a consultant." App. A, *infra*.

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Figure 9: Effect of University Patenting on Ability to Commercialize Research¹¹⁹



That said, given that commercialization is the chief reason that universities give for seeking patents, respondents’ enthusiasm for patents’ impact on commercialization is surprisingly modest. Though a significant percentage of professors reported clearly observing this benefit, a majority of respondents reported that university patents had the opposite impact, no impact, or a mixed bag of benefits and costs. Even among startup founders—professors who have accomplished precisely what many universities say they hope to with their tech transfer programs—the majority fails to see a clear positive link between patent rights and commercialization.

Moreover, if narrative responses are any indication of the *magnitude* of the harm or assistance professors received from patents, overall harm to commercialization efforts may well exceed the overall benefit received, despite the results shown in Figure 9. Numerous respondents wrote that patenting their research will, if anything, ensure that their ideas won’t be commercialized. As one respondent put it: “In my field, a patent is a guarantee that the work will not be used.” Another called university high-tech patents “destructive to actual impact,” and yet another wrote that “[i]n

¹¹⁹ The choices pertaining to commercialization were, in full: “HARMS faculty members’ ability to COMMERCIALIZE their research by, e.g., creating conflicts between the university and companies/entities/individuals (including the faculty members themselves) that might commercialize the research” and “HELPS faculty members COMMERCIALIZE their research by, e.g., attracting companies/entities that might help commercialize their research.” App. A, *infra*.

my field, if you patent, you kill your impact[, s]o I don't patent anything” Many others chimed in with similar sentiments, writing for example that “the patent and licensing process at universities for [computer science and engineering] related research [is] a hindrance to research and commercialization,” that universities wrongly equate “patent acquisition with commercialization . . . [because] the latter has substantial benefits, but the former very little,” and that university patent programs “get[] in the way, slow[] down the founding of a company and acquisition of capital and over-value[] the ‘inventions’ [made] at the university” relative to refinements made later by those working to bring an actual product to store shelves.¹²⁰

In fact, some reported that the disconnect between faculty members’ and university administrators’ views on how best to bring technology to market is so great that it can push professors out of academia altogether. As one respondent reported, “[t]he emphasis on money making through patents is driving those with patentable processes outside the university” Another concurred, stating that universities’ tech transfer policies “create[] friction between researchers and administrators” that can “caus[e] a faculty member to leave the university.”

By contrast, very few respondents wrote in favor of university patents, and those who did write, wrote with little enthusiasm, stating for example: “University patents are on the balance better than putting the inventions in the public domain, but it is a fine balance” In addition, several respondents who reported that university patents helped with commercialization efforts also reported that other forms of intellectual property provided as much, if not more, assistance. As one respondent explained: “licenses to copyrighted material . . . [are] a major mode of tech transfer for my work [My university] holds the copyright to my software, as well as the right to patent it, and [the former] is more relevant for me.”¹²¹ Others reported similar experiences, explaining that they “rely

¹²⁰ Other respondents voiced general criticism for software patents, even outside the university setting. One wrote: “Patents in the computing industry hinder progress, rather than promote it, since any meaningful product depends on hundreds of patents. Patent portfolios are a weapon to block competitors Open source and free sharing of ideas are the dominant philosophy.” A second: “I’m personally against patents for software. I think it hurts innovation and distribution of ideas.” A third: “I am strongly against software patents—they are not needed in CS.” And a fourth: “[I]n CS patents harm the field: many are trivial and end up polluting the field. Universities should not pursue patenting at all.”

¹²¹ *Accord* J. Strother Moore et al., Computer Research Association, Best Practices Memo: University-Industry Sponsored Research Agreements (July 2003), <http://archive.cra.org/reports/ip/bestpractices.html> (“[P]atent protection is rarely the best form of IT IP protection. Copyright is usually better”).

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on soft IP such as software [copyright] licensing” more so than on patents and that software “not protected by patent” can nonetheless be successfully “licensed to a start-up that [faculty members] co-founded.” Finally, some respondents wrote that, while they support university patenting in some research areas that occasionally overlap with ECE and CS research, they feel that it is counterproductive for their own research, stating for example that “[p]atents in some fields make sense—chemistry, physics—but not computer science” and that “outside of medicine universities do not need to play that game.”

4. *Net Effect*

The responses described above suggest that the societal impact of university patenting in high-tech fields is mixed. Though it is likely impossible to definitively assess these costs and benefits, the data arguably leaves more reason for concern than optimism.

On the whole, data provided by survey respondents suggests that universities may be losing money on programs that do not motivate professors to conduct more research and, to the contrary, make it at least marginally more difficult for professors to carry out research projects that require industry funding, academic collaboration, or the expeditious dissemination of results. Moreover, though professors do tend to view patent rights as a marginal benefit to commercialization efforts, there is good reason to believe that a great deal of commercialization would occur absent patent rights¹²² and that a significant amount of the remainder is offset by the fact that some research, which might have been commercialized absent university patent programs, never takes place at all due to transactions costs created by those programs.

¹²² See MOWERY, ET. AL, *supra* note 27, at 159, 176 (presenting Axel cotransformation and Gallium Nitride as two examples of patented university inventions for which “development and commercialization would have gone forward without a patent” and thus licensing efforts served only to “levy a tax on the commercialization of an invention that was published in the scientific literature”); Rai et al., *supra* note 9, at 1552-54, 1557 (describing several “case studies in which university software patents appear to have been used in a manner that hindered, rather than promoted, commercialization” and also noting that “a number of unpatented [software] programs [developed at Stanford] have been widely adopted by the industry: both MINOS, a linear and nonlinear optimization program, and Genscan, a gene structure prediction program, have been used (via a copyright license) by dozens of different commercial firms”).

III. WHY DO UNIVERSITIES AND FACULTY MEMBERS PATENT?

If the conclusions drawn from survey data above are accurate—i.e., if universities and faculty members alike generally lose more than they gain from filing patents on high-tech research—they raise an interesting question: why are universities patenting so much research in the first place? This Part discusses survey data that may shed some light on this question.

A. Why Do Universities Patent Research?

According to many respondents, one reason universities continue to patent despite underwhelming results is a “lottery effect” created by rare, but highly-publicized, patent licensing successes. In other words, university administrators may be irrationally basing patent policy on extreme outliers—like Eolas’s success against Microsoft, Mirror Worlds’ near miss with Apple, and Carnegie Mellon’s at least temporary victory against Marvell—that happen far less often than administrators believe.

As two professors explained in narrative responses:

I think most of the patent efforts at my university are motivated by the bizarre fantasies of out-of-touch administrators. These people seem exceptionally unqualified to pick between winning and losing ideas. I suspect that my university spends far more on patent activities than it makes off of its patents.

My institution appears to be overly optimistic in its long-term estimate of the financial benefits attainable from patents. Taken over a decade or more, the patent licensing operation consumes more dollars than it produces . . . Still, the hope for a ‘big score’ seems to motivate administrators to continue the current policy. . . .

According to these professors, 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 and, buoyed by occasional successes that lead to short term profit and acclaim, continue to spend on applications looking for the next big payoff even though their programs remain in the

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red long term.¹²³ Professors reported being hounded by administrative “patent police” who “ask you to patent as much as you can” even though they are “generally ignorant of what should and should not be patented.”¹²⁴ As a result, “[m]uch time is wasted with people/companies arguing over IP rights for things that with high probability will not be worth much.”¹²⁵

B. Why Do Faculty Members Patent Research?

In addition to poor forecasting by administrators, respondents also reported other factors impacting faculty members that fuel patent applications on campus.

For one, consistent with the theory described above, a large percentage of respondents reported that their universities at least informally take professors’ patent activities into consideration when deciding whether to advance professors’ careers. As shown below in Table 7, fifty-one percent of respondents believe that patenting activities are taken into account in tenure decisions, as well as in decisions to promote faculty members to the rank of full professor or to an endowed chair.¹²⁶ Another

¹²³ See 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 TTOs may justify any given year to stay in business on the expected benefit of next year’s having a blockbuster patent to license”); 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.”); Brian J. Love, *Subsidizing ‘Patent Roulette’*, INDIANAPOLIS STAR, March 5, 2012, at A13 (“[E]nticed by rare instances of licensing success, universities across the nation have established offices dedicated to patenting and exploiting faculty research. Each year university officials with wildly optimistic hopes of striking it rich pump more and more funding into faltering licensing programs, while at the same time hiking tuition, saddling graduates with debt, and thinning employee ranks.”).

¹²⁴ Several respondents expressed general concern about the competence of tech transfer office staff. One explained: “Universities typically cannot afford to hire the best people to write patent applications effectively, or even to decide whether or not to file a patent.” A second: “University patents are ineffective, since they are badly managed by the IP office bureaucrats.” And, a third: “One issue that is aggravating in my field (software) is lack of university expertise in patenting. I had to educate the licensing office repeatedly on this point.”

¹²⁵ The distribution of royalties reported above correlates well with this theory. As noted above, 85% of all licensing revenue reported in the study derived from just 9% of licensors, who collectively licensed just 4% of all reported patents and filed just 3% of all reported applications.

¹²⁶ See also Paul R. Sandberg et al., *Changing the Academic Culture: Valuing Patents and Commercialization Toward Tenure and Career Advancement*, Proceedings of the Nat’l Acad. Sci. Early Edition, Apr. 28, 2014, at 5, available at

thirty-eight percent report that they believe patent activities are taken into account by university administrators when determining professors' annual raises. In narrative responses, several respondents additionally reported that university administrators award professors who patent often with the best lab space and extended periods of paid leave.¹²⁷

As a result, relatively junior professors have a strong incentive to file patent applications, regardless of their personal views on whether doing so would otherwise be in their own or society's best interest. In fact, a number of professors reported in narrative responses that they had pursued patents exclusively in the early years of their careers. As one respondent explained, "I did some patents [early in my career], but decided it was interfering with my research and collaborations. So [since then] I have put everything from my group in the public domain. Makes for much easier collaborations, and helps the PhD students focus on intellectually interesting ideas." Another concurred, reporting that though he had patented in the past, "[t]hese days, I never bother with filing patents.

<http://www.pnas.org/content/early/2014/04/25/1404094111.full.pdf+html> (studying tenure policies at 39 universities and concluding that "[i]nclusion of patents and commercialization into tenure and promotion has begun at some universities" with "language varied from strongly endorsing innovation activities to weakly stating that patents can be listed").

¹²⁷ The survey included the following open-ended question: "Does your university (formally or informally) take faculty members' patenting activities into account when allocating other generally applicable benefits/resources (e.g., when considering requests for a reduced teaching load/sabbatical, office/lab space, etc.)? If so, please list them below:" App. A, *infra*. Responses included the two below:

Faculty leave policies are completely suspended in cases where the university suspects that the work may lead to patentable commercial products. I have colleagues who are on leave for five years at a time, despite university policies limiting to one year. The university seems to see itself as an amateur venture capitalist who funds work that they think might 'win big' in the future. The system is very much open to abuse, and has a highly questionable record of success.

[My university] is pretty generous in fostering startup creation by faculty and students, and has a good policy of exclusive licensing to transfer technology to startups, and allows faculty to take leave of absence to pursue the creation of their company. Business and job creation is seen as one of the key missions of the school which also has a specific institute . . . to coach, help and advise faculty and students in creating their own business. Overall, interacting with them has been a positive experience thus far.

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There's nothing in it for me, my students, or anybody else. They're just a waste of time."¹²⁸

Table 7: Administrative Incentives to Patent

Does your university take faculty members' patenting activities into account when deciding whether...	No, not that I am aware of.	Yes - I would say that, at least informally, patents/applications are considered.	Yes - I think there is a formal, written policy.
To award tenure?	48% (85)	44% (79)	7% (13)
To give a promotion?	47% (84)	45% (80)	6% (11)
To give annual raises?	59% (105)	35% (62)	3% (6)

Finally, as shown below in Figure 10, more than a third of respondents reported that patents enhance their universities' and their own reputations.¹²⁹ Accordingly, it seems likely that for many professors and administrators, patents have value—independent of licensing and commercialization potential—as a symbolic metric of research quality and quantity, much like article and citation counts.¹³⁰ Consistent with this theory, many respondents indicated that university patent activities serve as a subtle form of marketing that helps universities attract students and faculty.¹³¹ It is also likely that patents and licenses—even when achieved at

¹²⁸ One respondent explained that he filed patent applications for defensive purposes: “The main reason I have pursued a patent filing was defensive—to keep some patent troll from stopping my research by claiming patent protection for similar ideas.”

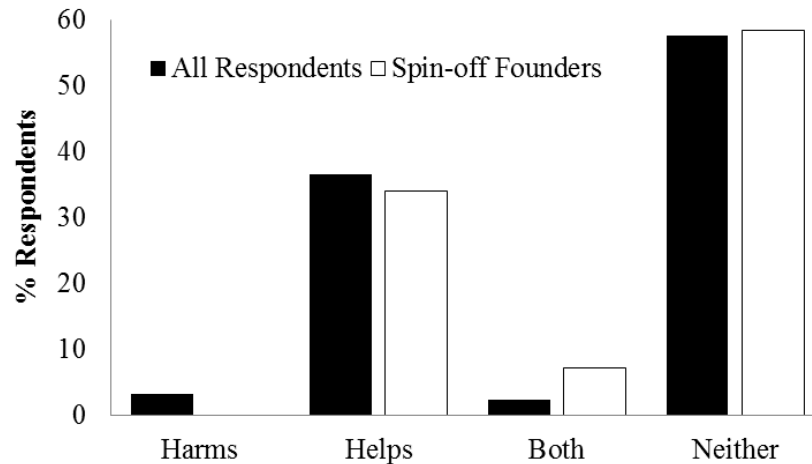
¹²⁹ The choices pertaining to reputation were, in full: “ENHANCES the university’s / faculty members’ reputations by, e.g., linking their names to popular discoveries/inventions (i.e., creating a stronger link to the discovery than would have been possible without a patent)” and “HARMS the university’s / faculty members’ reputations by, e.g., linking their names to unpopular patents and/or unpopular lawsuits/disputes involving university patents.” App. A, *infra*.

¹³⁰ See, e.g., Sandberg et al., *supra* note 126, at 2 (“Successful technology transfer brings recognition to universities and helps communicate, in a tangible way, the impact of university research, which might otherwise seem esoteric.”); NAT’L RESEARCH COUNCIL, MANAGING UNIVERSITY INTELLECTUAL PROPERTY IN THE PUBLIC INTEREST (2010) (recommending the creation of new metrics for university tech transfer beyond traditional measures like the number of issued and licensed patents); see also Clarisa Long, *Patent Signals*, 69 UNIV. CHI. L. REV. 625, 627-28 (2002) (theorizing that even “worthless” patents can be a valuable means for “credibly publicizing information,” such as the quantity of a firm’s “knowledge capital”).

¹³¹ 16.5% of respondents indicated, in response to a survey question, that patent programs help attract and retain faculty. App. A, *infra* (“Which, if any, of the potential BENEFITS of university patent ownership listed below have you witnessed? . . . HELPS attract and/or

a net (direct) loss—assist university administrators, who can cite them to donors and state legislators when seeking additional funding.¹³²

Figure 10: Effect of University Patenting on Reputation



CONCLUSION

Marketing benefits of patenting aside, data collected in this survey paints a less-than-rosy picture of university patent activity in high-tech fields. Surprisingly, given present levels of patent filings and enforcement, patenting high-tech academic research appears to be a net detriment to university budgets and to the overall advance of innovation, even among the

retain better FACULTY”). *But see supra* page 29 (quoting respondents who explained that conflicts over patents can drive away faculty). 11% indicated, in response to the same question, that they “help[] attract better students.” App. A, *infra* (“Which, if any, of the potential BENEFITS of university patent ownership listed below have you witnessed? . . . HELPS attract better STUDENTS). The survey did not include an opposing answer choice regarding whether patent policies drove away faculty or students.

¹³² See, e.g., Caitlin Schneider & Kyle Swanson, *President Coleman Lobbies State Legislators for More Higher Education Funding*, MICH. DAILY, Mar. 3, 2009, available at <http://www.michigandaily.com/content/2009-03-04/u-president-lobbies-state-funds> (“[University of Michigan President] Coleman said the University encourages entrepreneurship in students and faculty, and that these ventures strengthen the school and the state. ‘We want to encourage and reward professors who move inventions and innovations into the market place,’ Coleman said. She cited the NanoBio Corporation . . . founded by James Baker, a professor of internal medicine and biomedical engineering . . . [which] has secured a total of \$80 million in venture capital.”); Thursby & Thursby, *University Licensing*, *supra* note 123, at 631 (noting a “substantial university emphasis on licensing, particularly among public universities where the public expects that their universities encourage growth”).

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nation's most prestigious programs and even making quite favorable assumptions about the costs universities incur when patenting and licensing. According to this survey's respondents, high-tech patenting neither fills university coffers, nor motivates faculty members to produce more or better research. To the contrary, they report that high-tech patenting on college campuses may well reduce the pace and quality of academic R&D. Thus, there is good reason to view present trends in university patent activity—away from pharmaceuticals and toward consumer electronics—as troubling news and, consequently, to encourage universities to think long and hard before further accelerating high-tech patent applications and lawsuit filings.

Even if universities themselves disagree with this assessment, the results of this survey show that there is room for improvement. On the whole, professors know surprisingly little about the potential financial rewards of patenting their research, but experience rather frequently inefficiencies associated with obtaining those rights. If universities want their faculty to patent more often, professors' responses suggest that universities should advertise their royalty sharing programs and, as much as possible, streamline negotiations with industry partners and collaborating researchers. In addition, to control costs and thereby increase the potential that investments in intellectual property will turn a profit, this survey suggests that universities should consider patenting less often—particularly when copyright protection alone is likely to be an effective means of tech transfer—should allow issued patents to expire with greater frequency, and should shop around for more cost-conscious legal representation.

APPENDIX A: FULL TEXT OF SURVEY QUESTIONS

Background Information

Your Academic Affiliation (What university employs you? List more than one if applicable.)

Your Department and/or Research Area (This survey is targeted at faculty in (or affiliated with) CS and/or ECE departments. If you are affiliated with one or both, but call another department home, please select “Other” and list your home department. If you are not affiliated with either, please exit the survey now and accept my sincere apologies for the mix up.)

- Electrical and/or Computer Engineering
- Computer Science
- Both
- Other: _____

How many years’ experience do you have as a tenured and/or tenure-track faculty member? (For this question and the two that follow, feel free to round to the nearest 5-year increment (i.e., 5, 10, 15, 20) if you cannot recall the number with greater precision.)

How many additional years, if any, have you worked in a university research setting? (Include, if applicable, years spent in a Masters, PhD, or post-doc program working on potentially patentable research)

How many years’ experience, if any, do you have working in industry? (Include all years working in a non-academic setting on potentially patentable research)

Your Experience with University Patenting

Has your university research ever been the subject of a patent application listing you as an inventor or co-inventor? (Do not include, for example, patent applications filed by you or an outside company based on research you performed as a consultant or on research you performed in industry before entering academia.)

- Yes

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- No

How many U.S. patent applications (resulting from your university research) have been filed listing you as an inventor or co-inventor? (For this question and the two that follow, feel free to round to the nearest increment of 5 (i.e., 5, 10, 15, 20) if you cannot recall the number with greater precision. If you have international patent applications as well, please list that number separately.)

How many of those applications resulted from research that was directly funded in whole or in part by the federal government or a state government? (If you work at a public university, do not include indirect subsidies like your everyday salary, office space, or office supplies.)

How many of those applications have to date issued as patents?

Your Motivation to File for Patents

Does your university take faculty members' patenting activities into account when deciding whether to award TENURE? (Check all that apply)

- Yes - I think there is a FORMAL, written policy.
- Yes - I would say that, at least INFORMALLY, patents/applications are considered.
- No, not that I am aware of.
- Other: _____

Does your university take faculty members' patenting activities into account when deciding whether to give a PROMOTION (e.g., to a full or endowed professorship)? (Check all that apply)

- Yes - I think there is a FORMAL, written policy.
- Yes - I would say that, at least INFORMALLY, patents/applications are considered.
- No, not that I am aware of.
- Other: _____

Does your university take faculty members' patenting activities into account when deciding whether to give annual RAISES? (Check all that apply)

- Yes - I think there is a FORMAL, written policy.
- Yes - I would say that, at least INFORMALLY, patents/applications are considered.
- No, not that I am aware of.

Other: _____

Does your university (formally or informally) take faculty members' patenting activities into account when allocating other generally applicable benefits/resources (e.g., when considering requests for a reduced teaching load/sabbatical, office/lab space, etc.)? If so, please list them below: (Do NOT consider any mechanism by which the university shares patent licensing revenue with faculty. We'll come back to that later.)

Your Experiences with University Patent Licensing

Have any of your university patents brought in licensing revenue for your university?

- Yes
- No
- One or more of my university patents was licensed, but those license(s) never generated any revenue for the university.
- One or more of my university patents has been licensed, but those license(s) have not YET generated any revenue for the university.

If so, how many of your university patents have been licensed?

Also, if so, about how much total licensing revenue have your university patents earned? (A gross approximation is sufficient.)

According to your university's policies, are you entitled to a share of the revenue your patents earn the university?

- Yes
- No
- Don't know

If yes, do you know (without looking it up) what percent of the revenue you are entitled to receive?

- Yes
- No

If yes, what percent or other arrangement?

Please rank the following factors to indicate how much they motivate you to research: (Each row must contain an answer choice, so please rank your top 4 and then select Column 5 for all factors outside the top 4)

	Most important Factor	Second Most Important Factor	Third Most Important Factor	Fourth Most Important Factor	NOT among the top 4 factors
Patent rights / licensing					
Publication and/or presentations					
Informal status / recognition among my peers					
Tenure / promotions / raises					
Enjoyment / curiosity / desire to advance knowledge					
Formal awards / recognition, such as Best Paper/IEEE/ACM awards, NAE membership, IEEE Fellow, Turing, Nobel, etc.					
Other IP rights, like trade secrecy and/or copyrights					

Other Effects of University Patenting

Which, if any, of the potential COSTS of university patent ownership listed below have you witnessed? (Check all that apply)

- HARMS faculty members' ability to bring in RESEARCH FUNDING by, e.g., creating conflicts between the university and companies/entities that might help fund their research
- HARMS faculty members' ability to COLLABORATE with others by, e.g., creating conflicts between your university and the university employing a researcher with whom they wish to collaborate
- HARMS faculty members' ability to work with industry as a CONSULTANT by, e.g., creating conflicts between the university and companies/entities that might hire them as a consultant
- HARMS faculty members' ability to COMMERCIALIZE their research by, e.g., creating conflicts between the university and companies/entities/ individuals (including the faculty members themselves) that might commercialize the research
- Results in significant LOSS of faculty members' PRODUCTIVITY due to time spent working with patent lawyers (or other university officials)—i.e.,

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loss of substantial chunks of time that faculty members would otherwise devote to additional research

- HARMS the university's / faculty members' reputations by, e.g., linking their names to unpopular patents and/or unpopular lawsuits/disputes involving university patents
- HINDERS the dissemination of new research because, e.g., faculty members keep their research secret and/or delay publication until after filing a patent application
- I have witnessed no such costs and/or such costs do not exist.
- Other: _____

Which, if any, of the potential BENEFITS of university patent ownership listed below have you witnessed? (Check all that apply)

- HELPS attract better STUDENTS
 - HELPS attract and/or retain better FACULTY
 - HELPS faculty members bring in additional RESEARCH FUNDS by, e.g., attracting companies/entities that help fund their research
 - HELPS faculty members COLLABORATE with other professors at other universities by, e.g., attracting those professors and/or their home institutions
 - HELPS faculty members find CONSULTING opportunities by, e.g., attracting companies/entities that might hire them as a consultant
 - HELPS faculty members COMMERCIALIZE their research by, e.g., attracting companies/entities that might help commercialize their research
 - ENHANCES the university's / faculty members' reputations by, e.g., linking their names to popular discoveries/inventions (i.e., creating a stronger link to the discovery than would have been possible without a patent)
 - HELPS disseminate new research because, e.g., researchers read patents to learn about new research they wouldn't otherwise be exposed to
 - I have witnessed no such benefits and/or such benefits do not exist.
- Other: _____

APPENDIX B: DETAILED DESCRIPTION OF COST MODEL

Costs	Revenue
Prosecution costs	Reported licensing revenue
<i>U.S. PTO micro-entity fees:</i>	Total earned to date: ¹⁴⁰
Per original application ¹³³ (no. of applications ¹³⁴)	\$46,007,786
(\$400) (1,264)	Total projected future earnings: ¹⁴¹
Per provisional app. (rate per orig. app.)	\$16,654,819
(\$65) (0.43)	Cost reimbursement by licensees
Per continuation/RCE app. ¹³⁵ (rate per orig. app.)	PTO/legal cost reimbursement for all licensed
(\$400) (0.87)	patents ¹⁴²
Per appeal ¹³⁶ (rate per orig. app.)	\$11,661,781
(\$200) (0.072)	Disbursements to inventors¹⁴³
Per issuance (rate per orig. app. ¹³⁷)	(\$20,887,535)
(\$240) (0.82)	
<i>Attorney's fees</i>	
Est. overall average per original app. ¹³⁸	

¹³³ This figure is the total of three fees due when filing a basic original utility patent application: the filing fee (\$70), search fee (\$150), and examination fee (\$180). *See* U.S. Pat. & Trademark Off., Manual of Patent Examination Procedures § 607 (“The basic filing, search and examination fees are due on filing of the nonprovisional application . . .”); U.S. Pat. & Trademark Off., Fee Schedule, *available at* <http://www.uspto.gov/web/offices/ac/qs/ope/fee010114.htm> (showing fees for “micro entities”). My cost estimate does *not* include any late fees, excess claim fees, or application size fees. *See id.*

¹³⁴ This tally, which represents the number of published original applications I was able to verify using public databases (plus an allocation for abandoned applications filed before November 29, 2000), is only 83% of the 1517 applications reported by respondents, and thus is likely an underestimate. *See supra* note 74.

¹³⁵ *See, e.g.,* George Wheeler, Continuation and RCE Practice, at *4 (2008), <http://www.aipla.org/learningcenter/library/papers/bootcamps/08patentbootcamp/Documents/Wheeler-paper.pdf> (“The fees [due upon filing a continuation application or RCE] are the same as the basic filing, search, and examination fees for a new non-provisional patent application.”).

¹³⁶ My cost estimate assumes that all appeals were terminated without need for oral argument.

¹³⁷ My cost estimate assumes that, in addition to the number of issued patents reported by respondents, 70 percent of respondents’ non-issued original applications filed in 2010 or more recently will eventually result in an issued patent.

¹³⁸ As described *supra* in note 76, I calculated this average legal fee estimate, and all that follow, using the AIPLA’s 2013 Report of the Economic Survey in conjunction with the percentage of firms of various sizes prosecuting respondents’ patents using the following formula: (median fee among firms sized 1-3 attorneys)*(percentage of firms prosecuting respondents’ applications sized 1-3 attorneys) + (median fee among firms sized 4-15 attorneys)*(percentage of firms prosecuting respondents’ applications sized 4-15 attorneys) + (median fee among firms sized 16-59 attorneys)*(percentage of firms prosecuting respondents’ applications sized 16-59 attorneys) + (median fee among firms sized 60 or

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	(\$12, 197)
Est. overall av. per prov. app. (rate per orig. app.)	(\$5,656) (0.43)
Est. overall av. per response (rate per orig. app.)	(\$3,662) (3.8)
Est. overall av. per appeal (rate per orig. app.)	(\$5,283) (0.072)
Est. overall av. per issuance (rate per orig. app.)	(\$750) (0.82)

Maintenance fee costs

U.S. PTO micro-entity fees

1st payment amt. (rate paid per issued patent)	(\$400) (0.94)
2d payment amt. (rate paid per issued patent)	(\$900) (0.80)
3d payment amt. (rate paid per issued patent)	(\$1,850) (0.69)
<i>Est. overall average attorney's fee per payment</i>	(\$380)

Costs paid up front by co-owners

PTO/legal costs paid by corporate co-owners (rate per orig. app.)	\$33,175 (0.074)
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more attorneys)*(percentage of firms prosecuting respondents' applications sized 60-199 attorneys) + (third quartile fee among firms sized 60 or more attorneys)*(percentage of firms prosecuting respondents' applications sized 200 or more attorneys).

¹³⁹ See *supra* note 80. The University of California system reported a very similar, and slightly higher, level of per application overhead expense in 2005 and 2006, the last year for which the UC system provided detailed data on its operating expenses. University of California, UC Technology Transfer Annual Report 6, 12, 17 (2006), *available at* <http://www.ucop.edu/ott/genresources/documents/OTTRptFY06.pdf> (reporting \$31.7 million in “operating expense”—an amount that, itself, “[d]oes not include operating expenses associated with technology transfer program administration at the individual campuses”—in 2005 and 2006, a time period when the system filed approximately 1017 original, non-provisional U.S. patent applications and oversaw approximately 1100 to 1200 active patent licenses). Cornell also reported a similar, and again slightly higher, level of overhead expense per application. See Cornell University, *supra* note 80, at 16-17 (reporting that between 2008 and 2012, the university incurred over \$21.3 million in “office operations” expenses—an amount that, itself, does not include undefined “extraordinary” expenses—and filed 591 original, non-provisional applications).

¹⁴⁰ Including median substitution for missing royalty data. See *supra* note 82. As discussed *supra* in note 58, this figure is likely an overestimate, *inter alia*, because it likely includes at least some amounts paid for copyright, rather than patent, licenses.

¹⁴¹ Assuming constant revenue for an additional 7.2 years. See *supra* note 72.

¹⁴² Assuming that respondents' to-be-issued patents, see *supra* note 137, will be licensed at the same rate as respondents' already-issued patents. This figure is likely an overestimate because, *inter alia*, it very likely double-counts funds that respondents reported as licensing revenue. See *supra* in note 78.

¹⁴³ Factored in as one-third of revenue earned net of PTO/legal costs.

PTO/legal costs paid by non-profit co-owners (rate per orig. app.)	\$16,588 (0.015)	
Est. TTO overhead expenses per orig. app.¹³⁹	\$30,471	
<hr/>		
Est. overall cost total (PTO, legal, and overhead) per orig. app. filed by respondents:	(\$60,943)	Est. overall revenue total per orig. app. filed by respondents:
		\$58,801
		Est. overall revenue total <i>net of disbursements to inventors</i> per orig. app. filed by respondents:
		\$42,276
<hr/>		
Estimated Total Rate of Return:		$[\$58,801 - \$60,943] / \$60,943 = (3.5\%)$
Net of Disbursements to Inventors:		$[\$42,276 - \$60,943] / \$60,943 = (30.6\%)$
<hr/>		