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The Market for Software Innovation Through the Lens of Patent Licenses and Sales

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THE MARKET FOR SOFTWARE INNOVATION THROUGH THE LENS OF PATENT LICENSES AND SALES*

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ABSTRACT

Software innovation is transforming the US economy. Yet our understanding of how patents and patent transactions support this innovation is limited, in part because of a lack of public information about patent licenses and sales. Claims about the patent marketplace, for example, extolling the virtues of intermediaries like non-practicing entities, or questioning the social utility of ex post patent licenses, tend not to be grounded in empirical evidence. This article brings much-needed data to the policy debate by analyzing transactional data from several proprietary databases of patent licenses and transfers, and reporting several novel findings. First I find that, despite recent legal developments that have reduced the enforceability of software patents, the market for software patents is remarkably robust and actually grew, not declined, from 2012 to 2015. I speculate that the strength of this demand is driven by the defensive, not only offensive, value of software patents, the importance of software business models, and bargain shopping in the acquisition of patents. Second, I explore the extent to which software patent transfers support the transfer of technology as opposed to supporting just the transfer of liability, or freedom from suit, with mixed results. I find that the majority of material software licenses reported by public companies to the SEC from 2000-2015 (N=245), which are non-representative of licenses in general, to support true technology transfer. However, I also find evidence that in recent years, large numbers of software patents apparently been sold to avoid litigation or provide general operating freedom, rather than to access specific technologies. Software patents transferred between public companies between 2012 and 2015 were two to three times more likely to go from an older company to a younger company, and from a higher revenue to a lower revenue public company. This finding lends some support to the perception that software patents are a tax on innovation that younger, lower revenue companies must pay to older firms with higher revenue.

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I. INTRODUCTION

"Software is eating the world" -- Marc Andreesen[2]

The same week that Marc Andreessen published his well-known 2011 essay, "Why Software is Eating the World," Google moved to buy handset-maker Motorola Mobility for $12.5 billion.[3] Andreesen cited this development and others, including the rise of software companies like Amazon, Netflix, and Shutterfly and the demise of bricks-and-mortar companies like Borders, Blockbuster, and Kodak, for the proposition that software had or would be disrupting industries across the economy, requiring companies to adapt to new, digitally-driven business models, or die. Since then, the transformations of the car riding industry by "sharing economy" software companies such as Uber and Lyft, demonstrate what researchers have found: that traditional sectors of the economy, including automobiles, aerospace and defense, medical devices, and pharmaceuticals are increasingly turning to software to differentiate products, enhance product performance, and increase user utility. .[4] But just as Google's acquisition underscored the dominance of new, digital companies, it also demonstrated the importance of an instrument that has existed for over two hundred years,[5] the United States (U.S.) patent. Because while Google acquired Motorola's physical assets through the deal, its main objective was to acquire Motorola's intangible assets, its patents.[6] As Google CEO Larry Page wrote in a blog post, Motorola's patents were key to protecting Google's Android operating system from potential attacks by competitors like Microsoft, Apple, and others.[7]

2 Marc Andreessen, *Why Software is Eating the World*, THE WALL STREET JOURNAL (Aug. 20, 2011), http://online.wsj.com/article/SB10001424053111903480904576512250915629460.html.

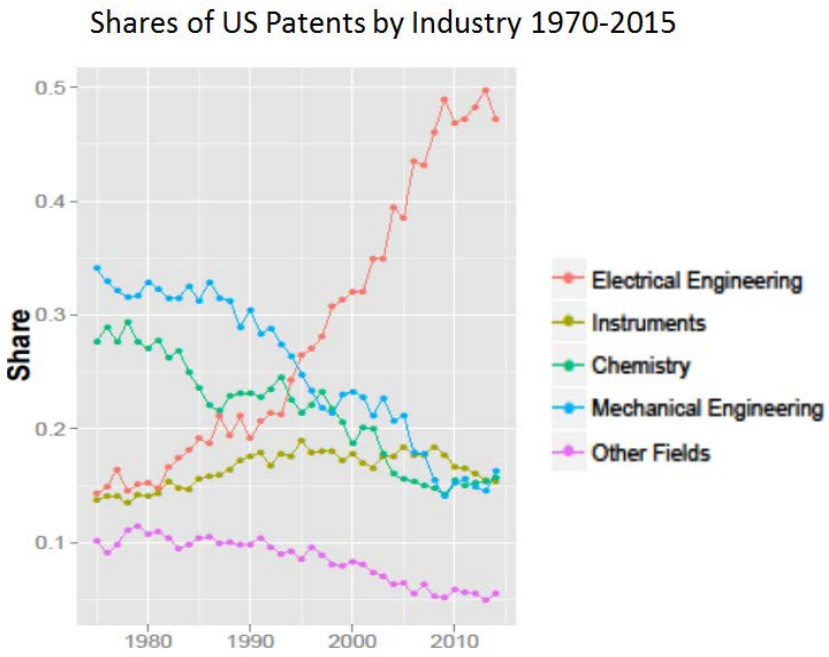
3 *Id.*; Evelyn M. Rusli & Clair Cain Miller, *Google to Buy Motorola Mobility for $12.5 Billion*, THE NEW YORK TIMES: DEALBOOK (Aug. 15, 2011), http://dealbook.nytimes.com/2011/08/15/google-to-buy-motorola-mobility/?_r=0.

4 Lee Branstetter, Matej Drev, and Namho Kwon, *Get With the Program: Software-Driven Innovation in Traditional Manufacturing*, NBER Working Paper No. w21752. Available at SSRN: https://ssrn.com/abstract=2699996 5 The first era of U.S. patenting was from 1790 to 1793, and resulted in few issuances. Described in EDWARD C. WALTERSCHEID, TO PROMOTE THE PROGRESS OF USEFUL ARTS: AMERICAN PATENT LAW AND ADMINISTRATION, 1798–1836 259–64 (1998).

5 The first era of U.S. patenting was from 1790 to 1793, and resulted in few issuances. Described in EDWARD C. WALTERSCHEID, TO PROMOTE THE PROGRESS OF USEFUL ARTS: AMERICAN PATENT LAW AND ADMINISTRATION, 1798–1836 259–64 (1998).

6 *See, e.g.*, description of the deal in WALTER ISAACSON, THE INNOVATORS: HOW A GROUP OF HACKERS, GENIUSES, AND GEEKS CREATED THE DIGITAL REVOLUTION __ (2014).

7 Larry Page, *Supercharging Android: Google To Acquire Motorola Mobility*, OFFICIAL GOOGLE BLOG (Aug. 15, 2011), https://googleblog.blogspot.com/2011/08/supercharging-android-google-to-acquire.html.



Source: Colleen V. Chien, Opening the Patent System: Diffusionary Levers in Patent Law, 89 SO. CAL. L. REV. 4 (2016) data from PATSTAT, taxonomy from WIPO.[8]

Just as software innovation is on the rise, so is software patenting, at least in the US. Identifying software patents is notoriously difficult, but applying the World Intellectual Property Organization's industry definitions, the share of U.S. patents that can be classified under "Electrical Engineering" – a class that includes digital communications, computer technology, and communications, among others[9]– has grown markedly. In 1975, about 15% of all new US patents were electrical engineering, with no one industry grouping capturing a majority of patents. In 2015, the electrical engineering share rose to nearly 50%. (FIG __) The remaining industry segments – including instruments, chemicals (a category that includes pharmaceutical drugs) and mechanical engineering – divided, roughly evenly, most of the remainder. (FIG __)

The question is whether software is eating the world because of software patents, despite them, or something else. Patents encourage investment and risk-taking in innovation by granting exclusive rights in exchange for novel, nonobvious inventions. But they can also interfere with downstream innovation by preventing others, including those who invent independently, from practicing their own inventions. Young companies experience these tradeoffs most acutely: when a startup gets a patent,

[8] Accord, https://www.uspto.gov/sites/default/files/documents/USPTO_economic_WP_2015-01_v2.pdf, Figure 11 (showing that annual patent grants in the "Computers & Communications and Electrical & Electronics NBER categories vastly outnumber patents in all other categories beginning in the early 2000s.")

9 For a description of the scheme, including a complete list of subclasses within "Electrical Engineering," and their rationale, *see* Ulrich Schmoch, *Concept of a Technology Classification for Country Comparisons: Final Report to the World Intellectual Property Office (WIPO)*, FRAUNHOFER ISI. (June 2008), http://www.wipo.int/export/sites/www/ipstats/en/statistics/patents/pdf/wipo_ipc_technology.pdf. This approach was developed later than the industry categorization developed by Hall, Jaffe, and Trajtenberg as described in: Bronwyn H. Hall et al., *The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools,* NAT'L BUREAU OF ECON. RES. (Oct. 1, 2001), http://www.nber.org/papers/w8498.pdf, and is preferred for this reason.

its likelihood of funding rises,[10] as most small firms don't patent.[11] But if the company becomes the target of litigation, the event is highly disruptive, and can cause the firm to pivot away from products lines[12] or reduce research and development ("R&D") expenditures.[13]

To be sure, whether these dynamics are at the periphery of software innovation, or – at the heart of it – is unclear. According to one view, the value proposition associated with software-based innovation is so compelling that such innovation will happen regardless of the initial distribution of rights under patent law, which can be altered by contract.[14] In the digital world, monopolies are driven not by the right to exclude conferred by patents, but by network effects, scale,[15] and winner-take-all economics.[16] But patents are hard to ignore when Google spends more money on them than on R&D, as it did in the year of the Motorola purchase.[17] So did Apple that year, when it contributed to the purchase of patents from defunct telecommunications equipment provider Nortel for $4.5 billion.[18] These sales were huge and anomalous, but also raise concerns about the vulnerability of those with fewer resources to buy protection or patents, which includes just about every other company.

The controversy over software patents also extends to software patent transactions. Patent transactions can enhance the patent system's incentive-inducing role by supporting specialization and extending the reach of the patent system to those who invent regardless of their position in the marketplace, helping to overcome the advantages of incumbents.[19] A startup company's ability to license or sell, rather than develop their technology reduces its market risks and enhances innovation through its transfer of technology. Patents can support the diffusion of software innovation between firms by providing transferable, tradeable assets.

But the growth in software patent litigation, including by non-practicing entities ("NPEs"), patent assertion entities[20] or "trolls," has also been supported by the patent marketplace. In a 2011 report to

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10 *See, e.g.*, Joan Farre-Mensa et al., *The Bright Side of Patents* (USPTO Economic Working Paper No. 2015-5, 2016), http://ssrn.com/abstract=2704028.

11 http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2637602

12 *See, e.g.*, Colleen Chien, *Startups and Patent Trolls*, SANTA CLARA LAW DIGITAL COMMONS (Sept. 13, 2012), http://digitalcommons.law.scu.edu/cgi/viewcontent.cgi?article=1554&context=facpubs; *see also* Colleen Chien, *Startups and Patent Assertion*, SANTA CLARA LAW DIGITAL COMMONS (Sept. 2013), http://digitalcommons.law.scu.edu/facpubs/856/.

13 *See, e.g.*, Catherine E. Tucker, *Patent Trolls and Technology Diffusion* (TILEC Discussion Paper No. 2012-030, 2013), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2136955, Scott Morton, Fiona and Carl Shapiro. 2014. "Strategic Patent Acquisitions," Antitrust Law Journal 79 (2): 463- 499 (finding the enhanced monetization of patents by patent assertion entities (PAEs) to be harmful to innovation); Smeets, Roger. 2014. "Does Patent Litigation Reduce Corporate R&D? An Analysis of US Public Firms" Rutgers University working paper [can we email Smeets for the final copy?] [Also I'd like us to add parentheticals for Tucker and Smeets]

14 Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. 1293 (1996).

15 As discussed in PETER THIEL, ZERO TO ONE [add pincite] (2014).

16 *See, e.g.*, Om Malik, *In Silicon Valley Now, It's Almost Always Winner Takes All*, THE NEW YORKER (Dec. 30, 2015), www.newyorker.com/tech/elements/in-silicon-valley-now-its-almost-always-winner-takes-all.

17 Based on public filings and data, in 2012, Google spent $12.5 billion to buy Motorola Mobility and its patents, and $5.2 billion on R&D. In 2011, Apple spent $2.4 billion on R&D but contributed more, at least $2.6 billion (estimated), to a single transaction to buy patents from Nortel. *See* Colleen V. Chien, *Reforming Software Patents*, 50 HOUS. L. REV. 325, 329 nn.11 & 12 (2012).

18 *Id.*

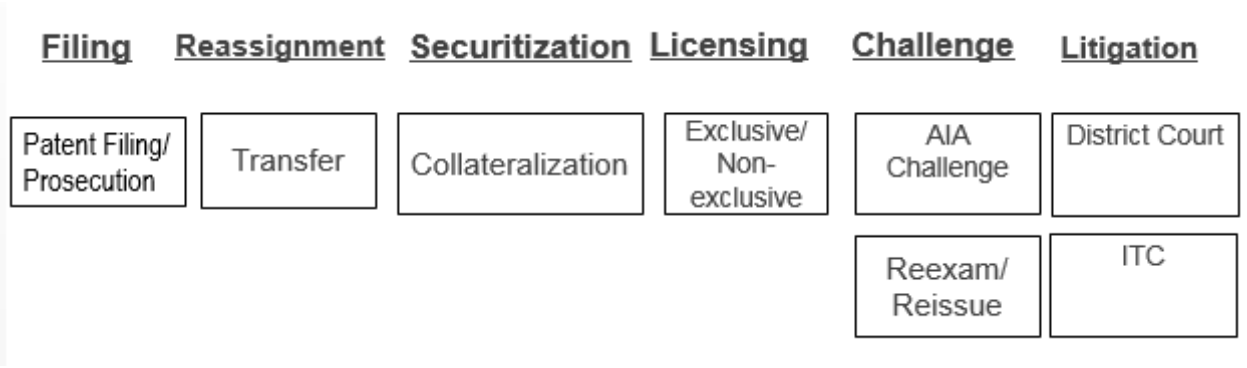
19 As discussed *infra* at Part ____.

20 *See, e.g.*, Executive Office of the President, *Patent Assertion and U.S. Innovation* (2013), https://www.whitehouse.gov/sites/default/files/docs/patent_report.pdf, and slate of USPTO-led Executive Actions on High-Tech Patents, including "Clarity in Patent Claims," and "Crowdsourcing of Prior Art," directed at software patents, available at http://www.uspto.gov/patent/initiatives/uspto-led-executive-actions-high-tech-patent-issues.

Congress, the General Accounting Office ("GAO") found that lawsuits involving software-related patents accounted for 89% of the increase in defendants from 2007-2011 and that between 2007 and 2011, two-thirds of defendants were sued over software-related patents.[21] The majority of the patents held by NPEs have been bought in the marketplace from operating companies, studies have found.[22] These transfers support not only the transfer of technology but also the transfer of the legal right to sue, from operating companies that are limited in their ability to sue, due to reputational and counter-assertion risks, to those without such limits.

Law academics have written dozens of studies on the topic of patent litigation by patent assertion entities alone,[23] much of it involving software inventions.[24] Relatively less empirical attention, with a few notable exceptions,[25] has been devoted to the considerable "middle layer" of events between the prosecution and litigation of a patent, in particular, a patent's licensing, sale, and related transactions.[26] (FIG. __)

FIG___: Events in a Patent's Lifecycle



Adapted from Colleen V. Chien, *Predicting Patent Litigation,* 90 TEX L. REV. 283, 300 (2011)

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21 General Accounting Office, *Intellectual Property: Assessing Factors that Affect Patent Infringement Litigation Could Help Improve Patent Quality,* GAO-13-465 (Aug. 22, 2013), http://www.gao.gov/products/GAO-13-465.

22 Michael Risch, *Patent Troll Myths*, 42 SETON HALL L. REV. 457, 485-88 (2012) (finding, based on studying 347 patents, that 243 were initially assigned to a company, and "more than 75% of these companies were corporations while the remainder were LLCs and limited partnerships").

23 *See* the studies cited by two letters sent to members of Congress in 2015: Letter from Forty Economists and Law Professors to House and Senate Judiciary Committees (Mar. 10, 2015), http://cpip.gmu.edu/wp-content/uploads/2015/03/Economists-Law-Profs-Letter-re-Patent-Reform.pdf; Letter from Fifty-One Intellectual Property Scholars to the Members of Congress (Mar. 3, 2015), http://patentlyo.com/patent/2015/03/rewards-effective-reform.html; and, the studies cited by *The Patent Litigation Landscape: Recent Research and Developments*, THE COUNCIL OF ECON. ADVISORS ISSUE BRIEF, Mar. 2016, https://www.whitehouse.gov/sites/default/files/page/files/201603_patent_litigation_issue_brief_cea.pdf.

24 *See, e.g.*, Colleen V. Chien & Edward Reines, *Why Technology Customers Are Being Sued En Masse for Patent Infringement and What Can Be Done*, 49 WAKE FOREST L. REV. 235 (describing the assertion of patents against large numbers of end-user defendants based on digital innovations).

25 Two are 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 (2009) (hereafter referred to as the "Berkeley Patent Survey"), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1429049, which probed patent licensing and financing in depth by surveying entrepreneurs; and, Colleen V. Chien, *Predicting Patent Litigation,* 90 TEX. L. REV. 283 (2011), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1911579&, an empirical study of securitization, reassignment, and other characteristics of patents "acquired" after issuance, as well as those developed before issuance and their influence on a patent's propensity to be litigated. Both are discussed in greater detail in Part __.

26 There are a greater number of economics studies on these topics, as recounted in greater detail in Part ___.

The gap in the literature is understandable in light of the lack of public information about the marketplace for patents. There is no requirement to publicly record patent licenses, for example, much less to disclose the prices of such transactions.[27] Even when licenses are disclosed during the course of litigation, which are public proceedings, their terms are often kept secret behind protective orders.[28]

But the gap is also highly problematic insofar as it produces at best an incomplete and at worst a distorted understanding of the relationship between patents and software innovation. Claims about the patent marketplace for example, extolling its virtues[29] or questioning its social utility,[30] for example, tend not to be grounded in empirical evidence. Patent litigation involves an estimated 1-2% of all patents, yet occupies a much larger share of policy and academic attention, creating at least two additional risks. First, neglect of commercially important but non-litigated patents may be leading to missed opportunities to observe and improve innovation and patent policy. Second, policy-making intended to address the 1-2% of litigated patents may have unintended and potentially negative consequences for the patent system's important functions of facilitating financing, transactions, and the freedom to operate.

This paper is part of a larger project to address the substantial void in our understanding of the market for patents and patented innovations,[31] which, for the reasons elaborated in Part ___ , have long been considered "the dark continent." It leverages two datasets to address the questions that to date have been largely unanswerable in any systematic way about the role of the patent marketplace in promoting or hindering innovation. The first database, of "patent transfers" includes the universe of standalone software and related patent reassignments[32] recorded at the USPTO from 2012 through 2015, as provided by Innography. The second database comprises "material technology licenses" recorded with the Securities and Exchange Commission (SEC) from 2000 to 2015. While each dataset has its strengths and limitations, discussed in depth in Part ___ it should be noted that the material technology license database by its own terms has a much narrower range that does not include licenses between private companies, or agreements signed by public companies that do not reach the threshold of "materiality" that triggers disclosure.[33] For at least this reason, our findings with respect to licenses should be understood as reflective of a cross-section of material licenses, rather than representative of licensing in general.

The analyses I describe here support several findings about the market for software innovation and its role in encouraging innovations. First, while most of the academic and policy attention devoted to software patents has focused on their litigation, I find, consistent with other studies, that the chance of a software patent being traded or licensed is much greater than the chances of it being litigated.[34]

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27 *See*, *e.g.*, Carlos C. Serrano, *The Dynamics of the Transfer and Renewal of Patents*, 41 RAND J. ECON. 686, 690 (2010) (describing the lack of a requirement to publicly record patent licenses, and providing a summary of the anecdotal data that is available).

28 *See*, discussion in Part ___ *infra*.

29 Robin Feldman & Mark A. Lemley, *Do Patent Licensing Demands Mean Innovation?,* 101 IOWA L. REV. 137 (2015).

30 Michael J. Burstein, *Patent Markets: A Framework For Evaluation*, 47 ARIZ. ST. L.J. 407 (2015).

31 Currently filled by the resources described in Section ____ .

32 That is, assignments subsequent to the initial assignment.

33 See description of the materiality requirement in Part ___, infra.

34 *See* Serrano, *The Dynamics Of The Transfer And Renewal Of Patents*, *supra* note ___ (finding that about 13.5% of patents are transferred at least once over their lifetime), and http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2696147 (reporting an annual patent "churn" rate of 4.5% per year). Though each of these and this study uses a different methodology to track reassignments, making direct comparisons difficult, they consistently report a greater transfer than litigation hazard).

While patent litigation involves an estimated 1-2% of all patents,[35] software patents are being sold in standalone transactions in at a much higher rate – around 1.5% per *year* from 2012-2015. In addition, the decline in the enforceability over the past few years of software patents has not led to a corresponding slowdown in patent sales. To the contrary, the number and share of software patent transfers increased, not decreased, between 2012 and 2015 I find. I speculate that this rise is due to bargain shopping (as prices per patent have declined), the robustness of defensive patenting strategies, and the underlying significance and importance of software innovation.

Second, I used the data to probe the extent to which the market for software patents primarily supports the transfer of technology or the transfer of rights, with mixed results. Recent studies suggest that patent licenses rarely are accompanied by technology transfer when initiated by the patentholder.[36] But my analysis of material software technology licenses reported to the SEC finds that in most cases, when patents were licensed, so were know-how, trade secrets or code. This suggest that, among this subset of licenses at least, agreements supported the transfer of technology, rather than just naked patent rights.

When looking at recorded transfers of software patents from 2012-2015, however, it appears that patents are being transferred to support the transfer of technology as well as to head off or avoid disputes, or to bolster a firm's freedom to operate. Among companies for whom age information could be found, we found software patents overwhelmingly more likely to be sold from older to younger companies, and from companies with more revenue to companies with less revenue. I speculate the reasons for these trends, which I believe deserve further consideration and analysis.

The paper proceeds as follows: Part I describes the theory and available evidence about the licensing and sale of patents, in particular software patents, and the role of patent transactions in supporting software innovation. Part II describes the methods, data sources, and approaches this paper used to advance current understanding. Part III discusses my findings and their implications. Part IV concludes.

II. PART I: THEORY AND EVIDENCE REGARDING THE LICENSING AND SALE OF PATENTS, IN PARTICULAR SOFTWARE PATENTS

A. TRANSFERRING RIGHTS AND TRANSFERRING TECHNOLOGY IN THE PATENT MARKETPLACE

The purpose of the patent system, as enshrined in the Constitution, is to "…promote the progress of [] useful arts, by securing for limited times to [] Inventors the exclusive right to their [] discoveries...."[37] According to the "incentive to invent" story, an inventor comes up with a product, obtains a patent over it, and uses the patent to deter others from copying.[38] Ex ante, the inventor is

[35]35 Lerner et al. document the litigation hazard rate for a selected group of patents at about 1.29% with financial services patents almost twice as likely to be litigated. However, this study likely understates the total because of the age of the patents studied. Josh Lerner et al., *Financial Patent Quality: Finance Patents After* State Street,(Harvard Business School, Working Paper 16-068, 2015), http://www.hbs.edu/faculty/Publication%20Files/16-068_702dabb8-70c5-4917-a257-75dc8b0c4f6b.pdf.

36 Feldman & Lemley, *supra* note ___.

37 U.S. CONST. art. I, § 8, cl. 8.

38 Described, *e.g.*, in Michael J. Burstein, *Patent Markets: A Framework For Evaluation*, 47 ARIZ. ST. L.J. 507, 516 (2015). Across surveys, deterring copying is consistently reported as the top reason that inventors patent. *See*, *e.g.*, Graham et al.,

encouraged to take greater risks and engage in more R&D because of the protection the patent provides; and ex post, make greater investments in commercialization and dissemination.[39]

Transactional justifications for the patent system adjust this story in a few ways. Ex ante, transactional freedom strengthens the basic incentive to invent as the ability of patentees to sell their technology to those who can more efficiently develop and commercialize technology "prospects"[40] raises the likelihood of a favorable return on investment. Ex post, patents make transactions more likely in several ways. First, they create defined property rights that are, unlike unregistered rights such as trade secrets, observable. The boundaries of patent rights are also more readily ascertainable than trade secrets, defining the duration of the right and the scope of the claims so that the parties don't have to.[41] Patents increase the confidence of patentholders in that their inventions won't be copied based on negotiation disclosures, thereby overcoming the challenge of selling information known as the "Arrow information paradox."[42] Patents can also promote freedom to operate[43] and access to capital and talent[44] by signaling a small or young firm's innovative potential to investors[45] or banks (through the securitization process)[46] or directly, through sales or licensing.

But just as patent transfers exploit comparative advantages in commercialization, they can also exploit comparative advantages in enforcement.[47] While both forms of transfer can promote

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supra note___. Wesley M. Cohen et al., *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (Or Not)* figures 7–8, (Nat'l Bureau of Econ. Res., Working Paper No. 7552, 2000) (showing that 96% of the 1,478 R&D managers surveyed by Cohen and his colleagues indicated that preventing copying motivated the acquisition of their last product innovation patent); Sadao Nagaoka & John P. Walsh, *Commercialization and Other Uses of Patents in Japan and the U.S.: Major Findings from the RIETI-Georgia Tech Inventor Survey* at fig. 13 (Ga. Tech Sch. of Pub. Policy, Working Paper No. 47, 2009) (describing the results of a survey of inventors of "triadic patents"—patents whose applications were filed in both the Japanese Patent Office and the European Patent Office and granted in the United States Patent Office and finding that 82% of the 7,933 American inventors selected enhancing exclusive exploitation, followed by blocking, as the top answer to the question of what motivated their patenting); Gaetan de Rassenfosse & Dominique Guellec, *Motivations to Patent: Empirical Evidence From an International Survey*, 2, 8, Tbl. 2, *http://www.epip.eu/conferences/epip04/files/DERASSENFOSSE_Gaetan_2.pdf* (reporting that, "to prevent imitations by competitors" was the top motivator for getting patents among 604 respondents to a survey sent to randomly selected applicants of European Patent Office (EPO) patents).

39 *See* Mark Lemley, *Ex Ante Versus Ex Post Justifications for Intellectual Property*, 71 U. CHI. L. REV. 129 (2004).

40 *See*, *e.g.*, Ted Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 373-76 (2010); Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065, 1068-70 (2007).

41 On the transactional advantages of patents over trade secrets, which are available even in the absence of compelling evidence of their impact on incentives to invent, and which don't risk destruction upon disclosure, *see* WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF INTELLECTUAL PROPERTY LAW (2003).

42 As Robert Merges describes, "To sell, one must disclose the information, but once the information is disclosed, the recipient has it and need not buy it. On the other hand, if one does not disclose anything the buyer has no idea what is for sale." Robert Merges, *Intellectual Property Rights and Bargaining Breakdown: The Case of Blocking Patents*, 62 TENN. L. REV. 75 (1994).

43 For a description of the pursuit of freedom to operate and other defensive motives and their contribution to patenting trends, *see*, *e.g.*, Colleen V. Chien, *From Arms Race to Marketplace: The Complex Patent Ecosystem and Its Implications for the Patent System*, 62 HASTINGS L.J. 297, 326, 328 (2010).

44 *See*, *e.g.*, Robert P. Merges, *A Transactional View of Property Rights*, 20 BERKELEY TECH. L.J. 1477 (2005).

45 Carolin Haeussler et al., *To Be Financed or Not… - The Role of Patents for Venture Capital Financing (*ZEW - Centre for Eur. Econ. Res., Discussion Paper No. 09-003, 2012).

46 Aleksander Nikolic, *Securitization of Patents and Its Continued Viability in Light of the Current Economic Conditions,* 19 ALB. L.J. SCI. & TECH. 393 (2009), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2644638.

47 Alberto Galasso et al.,*Trading and Enforcing Patent Rights,* 44 RAND J. ECON 275, 302 (2013). ("("Our estimates suggest that patents with low values of P (defined as an estimate of probability of not having changed ownership) are more likely to be involved in transactions driven by product market gains, and patents with high P are more likely to be involved in transactions driven by enforcement gains.")

innovation, how, and whether they do, on balance, varies. As Justice Kennedy has noted, there is a difference between the use of patents "as a basis for producing and selling goods" and as a "bargaining tool to charge exorbitant fees."[48] Many commentators and policymakers have made similar distinctions, generally agreeing that while patent transfers that support technology transfer increase social welfare, licenses driven primarily by avoiding the cost of litigation or switching costs, rather than the value of the technology,[49] on balance, decrease social welfare.[50]

B. SOFTWARE PATENTS AND THE PATENT MARKETPLACE

To what extent do theories of the patent system described above explain the present relationship between software patents and software innovation? In many respects, the fit between the primary, "incentive to invent" story of the patent system and software innovation is poor.[51] Software innovations tend to be incremental, conceptual, and algorithmic; patents are supposed to be reserved for only non-obvious,[52] non-abstract, and non-mathematical inventions.[53] As property rights, patents function best when they articulate clear boundaries for the range of excluded behavior. However, software patent boundaries are notoriously "fuzzy,"[54] given their functional nature, reliance on non-specific language[55] that captures the function rather than the form of the underlying code, and the use of "patentese"[56] – the special, technical, legal language of patents.[57] Software cycles tend to be short, while patent cycles are long. It currently takes, on average, 17 months for the U.S. Patent and

48 eBay Inc. v. MercExchange, L.L.C., 547 U.S. 388, 396 (2006) (Kennedy, J., concurring).

49 Acknowledging that it may be difficult to develop a consensus regarding whether or not a license falls into this category, *see* Colleen V. Chien, *Holding Up and Holding Out*, 21 MICH. TELECOMM. & TECH. L. REV. 1 (2014) (describing how even nuisance settlements can also function as last resorts for patentees confronted by infringers who refuse to provide license fees or "hold-out").

50 *See, e.g.*, Colleen V. Chien, *Reforming Software Patents*, 50 HOUS. L. REV. 325, ___(2012) (describing nuisance fee-driven patent litigation and settlement); *The Evolving IP Marketplace: Aligning Patent Notice and Remedies with Competition*, FED. TRADE COMM'N (Mar. 2011), https://www.ftc.gov/sites/default/files/documents/reports/evolving-ip-marketplace-aligning-patent-notice-and-remedies-competition-report-federal-trade/110307patentreport.pdf; Burstein, *supra* note __; and Robert P. Merges, *The Trouble with Trolls: Innovation, Rent-Seeking, and Patent Law Reform*, 24 BERKELEY TECH. L.J. 1583, 1588 (2009) (describing "inefficient, socially wasteful patent transactions" carried out by patent "trolls").

51 For a summary of the pros and cons of patents for software startups, based on about sixty interviews with software developers, venture capitalists, angel investors, banks that lend to software startups, large software and hardware firms, and others, *see* Ronald Mann, *Do Patents Facilitate Financing in the Software Industry?,* 83 TEX. L REV. 961 (2005).

52 35 U.S.C. § 103 (Restricting patentability to non-obvious subject matter).

53 Bilski v. Kappos, 561 U.S. 593 (2010) ("abstract ideas", "mathematical formula", "algorithms" are not patentable).

54 JAMES BESSEN & MICHAEL J. MEURER, PATENT FAILURE: HOW JUDGES, BUREACRATS, AND LAWYERS PUT INNOVATORS AT RISK (2008).

55 https://www.flickr.com/photos/opensourceway/6554315093/sizes/l. https://www.flickr.com/photos/opensourceway/6554315093/sizes/l. https://www.flickr.com/photos/opensourceway/6554315093/sizes/l. To take one recent example, does the term "distributed learning control module" cover any software or hardware that carries out a set of basic functions, specifically, the functions of "receiving communications transmitted between the presenter and the audience member computer systems and for relaying the communications to an intended receiving computer system and for coordinating the operation of the streaming data module"? US Patent 6, 155, 840. Until recently, even the courts haven't been sure. *See, e.g.*, *Williamson v. Citrix Online, L.L.C.*, 792 F.3d 1339 (Fed. Cir. 2015). The use of vague terms in software patents like "module," has prompted one parody patent drawing that consists of a combination of "thing-a-ma-jig"s, "stuff, "whatzit"s, "doo-hickie"s and "you know." https://www.flickr.com/photos/opensourceway/6554315093/sizes/l.

56 Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621, 627627627633 (2010).

57 *Id.* at 633-634.

Trademark Office ("USPTO") to begin examining a patent application, and about another 10 months for it to complete examination.[58] Under the normal default, the patent application will publish at 18 months,[59] and a patent can stay in force for up to 20 years from the date of filing. But in fields like smartphone mobile applications (or "apps"), the market environment is changing quickly.[60] Many apps fail within weeks if not months, making it hard to know ex ante whether or not the software is worth protecting.[61] Imitation cycles are also short, with the most successful applications imitated within months;[62] meaning that the whole cycle from conception of a feature for the mobile app, to its copying by another can happen even before the patent application matures into a patent.

According to a recent study by Christian Helmers and his colleagues, only a tiny share –around 0.04% – of smartphone applications available in the Apple iOS store are protected by app-relevant patents.[63] There are obviously counterexamples to the app industry – software areas that are heavily patented, and rely on much longer product cycles. Even in the app environment, patented apps command higher prices, and are more likely to be rated extensively.[64] But the sense that software is different[65] has led prominent leaders in the industry to reject the premise that software patents are necessary to incent software innovation.[66] As the Berkeley Patent Survey found, two-thirds of software entrepreneurs do not have or seek patents.[67]

But the same Survey found that among venture backed software startups, the majority had patents.[68] One of the reasons that venture capitalists like patents is because they can distinguish firms with unique, proprietary technologies, and provide salvageable assets should the firm fail. Within firms, the successful pursuit of patents can support the creation of jobs and sales growth.[69] But filing for patents takes resources away from engineering tasks,[70] and patent litigation demands are a

58 USPTO Dashboard, http://www.uspto.gov/dashboards/patents/main.dashxml (last visited Nov. 15, 2015).
59 35 U.S.C. § 122.
60 Christian Helmers, Sebastian G. J. Brandes Kraaijenzank, Yongdong Liu, *Innovation without Patents? Evidence from the Smartphone App Markets,* 2014 draft available at https://www.dropbox.com/s/mb4yqhfulq2whzl/Helmers%20on%20apps.pdf?dl=0 ; 2014 draft on file with the author. [I INSERTED A DROPBOX LINK AS I DON'T THINK THE 2014 VERSION IS POSTED – YOU MAY WANT TO DL FOR YOUR RECORDS]
61 Assuming that it contains protectable inventions.
62 *Id.* at Fig 2-5.
63 *Id.* at Table 4. Across all app stores in the study, it's 4.5%.
64 *Id.* at Table 5.
65 *See*, *e.g.*, Github conversation between Marc Andreesen and Peter Thiel, https://gist.github.com/jm3/2669267 ("There are some areas in tech—drugs and mechanical equipment, for instance—where parents are fundamental. In these areas there are long established historical norms for who gets to do what. But in software, things change extremely quickly. The big companies used to have huge war chests full of patents and use them to squash little guys. Now they're fighting each other. The ultimate terminal state of big companies seems to be a state in which they build nothing. Instead, they just add 10,000 patents to their portfolio every year and try to extract money through licensing. It'd be nice if none of this were the case. But it's not startups' fault that the patent system is broken. So if you have a startup, you just have to fight through it. Find the best middle ground strategy.").
66 *See*, *e.g.*, Fred Wilson, *Enough is Enough*, BUSINESS INSIDER (June 1, 2011), http://www.businessinsider.com/enough-is-enough-2011-6 ("I believe that software patents should not exist").
67 Graham et al., *supra* note ___ at Table 1.
68 *Id.*
69 *See*, *e.g.*, Joan Farre-Mensa et al., *The Bright Side of Patents* (USPTO Economic Working Paper No. 2015-5, 2016), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2704028; David H. Hsu & Rosemarie H. Ziedonis, *Patents as Quality Signals for Entrepreneurial Ventures* (Apr. 2007) (on file with author) (finding that patents have a positive effect on startup company value).
70 Ronald Mann, *Do Patents Facilitate Financing in the Software Industry?*, 83 TEX L. REV. 961, 982-84 (2005).

distraction and strain on the innovative enterprise, sometimes taking a significant operational toll on small companies.[71]

While valuable, studies about filing for, obtaining, and litigating patents are at the periphery of the patent market. Patent licenses signed as the result of patent litigation are a highly selected part of the patent market, and because they are formed ex post, they also tend to take place after technology has been transferred or copied, or independently invented.[72] Funding events that follow the issuance of patents do not represent market transactions of the patent, and the extent to which patent-holding causes funding events, rather than being a characteristic of fundable, well-run startups, is hard to tease apart. Studies that focus on the strategic acquisition of patents in order to litigate them,[73] in turn, do not address sale of patents for commercialization and other objectives.

The present study is different, because it directly observes actual transactions – licenses and sales – in the marketplace for patented software innovations.[74]By studying recorded sales in general, and reported, material licenses in particular, these transactions span a variety of reasons that patents are licensed and sold, enabling their direct comparison.

1. Transfers of Rights vs. Transfers of Technology

In this paper I distinguish between patent transactions that affect technology transfers and patent transactions that affect rights, or liability transfers. A patent-centric view glosses over this distinction, finding that all patent transactions happen in the shadow of litigation, and are driven by consideration of how a court might view the settlement in subsequent litigation.[75] But while some licenses are motivated by the desire to avoid suit, others are motivated by the desire to gain technology. Rather than happening in the shadow of litigation, agreements to transfer the technology happen in the shadow of the market, and competition, for example in the race to be first to market. Rather than being driven by the cost of litigation, the price of licenses to transfer technology is driven by the value of the technology and the extent to which the technology can accelerate development of a product or yield a return for the business. While those forced to take patent licenses in order to avoid being sued are in some sense reluctant licensees, those who seek out licensing partners in order to access their technology represent willing licensees.

The distinction has not only descriptive but also normative significance. Those who extol the virtue of patent markets credit to them the benefits of the technology transfer, including gains associated with specialization in innovation. But not every patent license achieves these gains. Some transfers of rights are in effect just preemptive legal settlements that eliminate the risk of potentially rent-seeking lawsuits. While such transfers could be welfare-enhancing, insofar as they

71 *See*, *e.g.*, Colleen V. Chien, *Startups and Patent Trolls*, 17 STAN. TECH. L. REV. 461 (2014); Colleen V. Chien, *Patent Assertion and Startup Innovation,* OPEN TECHNOLOGY INSTITUTE (Sept. 5, 2013), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2321340; and, James Bessen, *The Evidence is In: Patent Trolls Do Hurt Innovation*, HARV. BUS. REV. (Nov. 2014), https://hbr.org/2014/07/the-evidence-is-in-patent-trolls-do-hurt-innovation/ [add parenthetical]; *see also* Letter from Startup Investors to Congress (Mar. 17, 2015), http://engine.is/wp-content/uploads/VCsforPatentReformLtr2015-1.pdf.

72 Christopher A. Cotropia & Mark A. Lemley, *Copying in Patent Law*, 87 N.C. L. REV. 1421, 1465 (2009).

73 See, e.g. http://faculty.haas.berkeley.edu/shapiro/pae.pdf

74 The licenses admittedly through a highly selected vantage point, as described further in Part __.

75 Jonathan S. Masur, *The Use and Misuse of Patent Licenses*, 110 Nw. U. L. Rev. 115 (2015).

support the exclusion that animates the incentive to invent story,[76] they can also be welfare-reducing when they involve the enforcement of a wrongly-issued patent, or encourage enforcement and settlements based on the cost of litigation and switching costs, rather than the value of the technology.[77] In the following paragraphs, I review existing work as a backdrop to the present study.

2. *Studies of the Patent Marketplace: Transferring Technology and Transferring Rents*

Lamoreaux and Sokoloff have performed the most significant early work on markets for technology in the 19th century using the patent record.[78] Made known by weekly descriptions published in *The Scientific American* starting in 1845 and the patent lawyers and agents who acted as intermediaries, 19th century patents frequently changed hands.[79] Lamoreaux and Sokoloff estimate that approximately 12% to 28% of patents were assigned more than once, including through corporate acquisition.[80] These sales, as well as other information, provide evidence that patents supported the buying and selling of technology more broadly, not just the buying and selling of the patents themselves. But other studies have documented the use of 19th century patents for the purpose of transferring the rights to sue others as well, in the context of farming and railroad patents.[81] In the case of farming patents, trivial improvements formed the basis of patents that were used to demand royalties from unsuspecting farmers, many of whom bought the allegedly infringing technology.[82] As historian Earl Hayter writes, farmers were "threatened and harassed by royalty collectors on such articles as sliding gates, barbed wire, clover hullers, harvesters, seeders, plows, drivewells, and others too numerous to mention."[83] Royalty agents worked on behalf of the inventors and at times deluged farmers with multiple collectors over the same device, making them wary about adopting technologies.[84] During a parallel period in the railroad industry, around the 1880s, the rapid development of the railroad agency led "avaricious patent agents" to buy up patents and then use them to sue the entire industry.[85] Then-Senator Christiancy complained to Congress about "patent-sharks [who] . . . procure an assignment of . . . [a] useless patent, and at once proceed to levy blackmail . . . upon any man who has ever manufactured or sold, or even used, the later and valuable invention."[86]

Though these transactions predated the rise of digital technology, Serrano's study of patent reassignments from 1980 to 2001 specifically considered the prevalence of patent transfers among different industries. He found that patents in the computer and communications as well as the

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76 For example, defensive patent aggregators likmarcoe RPX who may buy a patent in order to remove the threat from its member companies.

77 Some might argue that even such transfers as these? that? may have positive welfare effects, insofar as liability transfers reduce the need for litigation, and a patent, even if wrongfully issued, induce socially valuable racing.

78 Naomi R. Lamoreaux & Kenneth L. Sokoloff, *Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries* (Nat'l Bureau of Econ. Research, Historical Working Paper No. h0098, 1997).

79 *Id.* at 22-24.

80 *Id.* at Table 1.6.

81 For an overview of these chapters in the history of the agrarian and railroad industries, *see* Colleen V. Chien, *Reforming Software Patents*, 50 HOUS. L. REV. 325 (2012) (discussing the parallels between the historical and modern patent controversies); Christopher Beauchamp, *The First Patent Litigation Explosion*, 125 YALE L.J. 848 (2016).

82 *See* Earl W. Hayter, *The Patent System and Agrarian Discontent, 1875-1888,* 34 MISS. VALLEY HIST. REV. 59, 61 (1947).

83 *Id.* at 65.

84 *Id.*

85 STEVEN W. USSELMAN, REGULATING RAILROAD INNOVATION: BUSINESS, TECHNOLOGY, AND POLITICS IN AMERICA, 1840-1920, 115-17 (2004) (describing the activities of patent dealers Chittenden and Sayles who bought up patents and sued a whole industry based on them in particular).

86 8 CONG. REC. 307-08 (1879) (statement of Sen. Christiancy).

drug and medical industries had the highest likelihood of being transferred during their lifetime, about 13.5 percent.[87] In late 2015, the USPTO's Chief Economist Office released the "USPTO Patent Assignment Dataset," a database covering approximately 6 million assignments and other transactions recorded from 1970 to 2014.[88] According to these records, recent patents[89] are more likely to be transferred than patents from earlier decades, the growth led in particular by the transfer of patents in the computers and communications sectors.[90] Graham and his co-authors find, based on analyzing this data, a yearly churn rate of 4.5% in 2014, as compared to Serrano's lifetime transfer rate of 13.5%. However, differences in the methodology between Graham et al. and Serrano probably explain the discrepancy between these numbers.

Because these studies were based solely on patent records, neither probed the motives for or conditions of patent transfers. However, a pair of studies have looked specifically at the relationship between transfer and litigation. While both studies find, on average, that the transfer of patents reduces litigation risk,[91] Galasso and his coauthors also find that patents traded to smaller entities were associated with a greater chance of litigation.[92] Sales from larger companies to smaller NPEs[93] fit this trend.

In contrast with data about patent sales, which are routinely publicly recorded, public data about patent licenses are harder to come by.[94] There are no requirements to record, and licensing data, even when it involves publicly funded patents,[95] is regarded as highly sensitive.[96] Surveys estimate that about 10 percent of patents are licensed,[97] but that the extent of licensing depends on the entity

87 Serrano, *supra* note ___, at ___.

88 http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2696147,

89 Patent issued since 2000-2005

90 http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2696147, 18.

91 Chien, *Predicting Patent Litigation supra* note ___ ; Alberto Galasso, Mark Schankerman, and Carolos Serrano, *Trading and Enforcing Patent Rights*, 44 RAND J. ECON. 275 (2013).

92 Galasso et al., *supra* note __, at 34.

93 Michael Risch, *Patent Troll Myths*, 42 SETON HALL L. REV. 457, 485-88 (2012) (finding, based on studying 347 patents, that 243 were initially assigned to a company, and "more than 75% of these companies were corporations while the remainder were LLCs and limited partnerships").

94 *See* Iain M. Cockburn, *Is the Market for Technology Working? Obstacles to Licensing Inventions, and Ways to Reduce Them* 6-7, Conference on Economics of Technology Policy, Monte Verità (2007), https://faculty.fuqua.duke.edu/~charlesw/s591/Bocconi-Duke/Bocconi/S2_2008_02_11_MFT/Cockburn_-_Is_the_Market_for_Technology_Working.pdf (describing these difficulties).

95 Arti K. Rai & Bhaven N. Sampat, *Accountability in Patenting of Federally Funded Research*, 30 NATURE BIOTECH. 953 (Oct. 2012).

96 As a result, studies generally rely on proprietary databases. *See*, *e.g.*, Bharat N. Anand & Tarun Khanna, *The Structure of Licensing Contracts*, 48 J. INDUS. ECON. 103, 115 (2000), and Joshua S. Gans et al., *The Impact of Uncertain Intellectual Property Rights on the Market for Ideas: Evidence from Patent Grant Delays*, 54 MGMT. SCI. 982 (2008), http://www.nber.org/papers/w13234.pdf (analyzing a sample of 200 licenses announced between 1990 and 1999 in the Security Data Corporation database) (analyzing 1612 patents from the Strategic Alliance database of Securities Data Company).

97 Harhoff, *supra* note ___ at __ (summarizing surveys by Motohashi (2008), Nagaoka and Kwon (2006), and Gambardella et al., (2007)).

size.[98] The empirical studies of licensing that do exist, generally conducted by economists, focus on the prices[99] and strategies behind licensing.[100]

3. Naked Patent Licenses v. Licenses for Know-How

One proxy for whether patent licensing supports technology transfers or liability transfers is the extent to which licenses provide only patent rights as opposed to patent rights with know-how. Patent licenses that include knowledge, know-how, personnel, or joint venture relationships are more likely to represent direct transfers of technology, whereas the transfer of "naked" patent rights is more likely to represent a change to the balance of liability between the parties. Which type of patent license is more prevalent? The answer varies considerably based on context. Varner's study of 1,458 patent licenses, including patent assignments, included as exhibits in filings to the SEC found that 56% of patent agreements included know-how, while 33% were "bare patent" transfers and 11% were patent assignments,[101] consistent with earlier and smaller samples.[102] These proportions were roughly consistent across the industries he considered, including "high-tech."[103] But when Feldman and Lemley surveyed those who had received licensing demands, they found the opposite: that in the overwhelming majority of cases, the subsequent license was *not* accompanied by the transfer of knowledge, know-how, personnel, joint venture relationships, or other indicia of technology transfer.[104] Like Varner's study, the Berkeley Patent Survey presents a mixed view, based on surveying over 1,300 startups in mid-2000. Among venture-backed software startups, 12% licensed in technology.[105] About 70% of them did so to gain knowledge, technology, or know-how while approximately a quarter of firms did so only to avoid a dispute, and *not* to gain technology.[106] A quarter of software startups, and 67% of venture-backed startups overall had patents.[107]

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98 Paola Giuri et al., *Everything You Always Wanted To Know About Inventors (But Never Asked): Evidence From the Patval-EU Survey*, MUNICH SCH. MGMT., UNIV. MUNICH (2006), https://epub.ub.uni-muenchen.de/1261/1/LMU_WP_2006_11.pdf [need parenthetical].

99 *See, e.g.*, GREGORY J. BATTERSBY & CHARLES GRIMES, LICENSING ROYALTY RATES (2015 ed. 2014); Deepak Hedge, *Essays on Institutions and Innovation* (2010) (unpublished Ph.D. dissertation, University of California, Berkeley), http://escholarship.org/uc/item/0sp3n4sk; Jonathan E. Kemmerer & Jiaging Lu, *Profitability and Royalty Rates Across Industries: Some Preliminary Evidence*, KPMG GLOBAL VALUATION INSTITUTE (Nov. 19, 2012), https://www. kpmg .com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/gvi-profitability-v6.pdf.

100 *See, e.g.*, Goretti Cabaleiro Cervino, *Firm Strategies Behind the Establishment of Licensing Agreements* (2014) (unpublished Ph.D. dissertation, University of Madrid), http://e-archivo.uc3m.es/bitstream/handle/10016/18988/goretti_cabaleiro_tesis.pdf?sequence=1.

101 Thomas R. Varner, *An Economic Perspective on Patent Licensing Structure and Provisions*, 46 BUS. ECON. 229, 232 (2011).

102 Victor Braun, *Licenses as Critical Sources of Innovation*, 43 LES NOUVELLES 225, 226 (2008) ("Contractor (1985) found that in the early 1980s 75 percent of U.S. license agreements contained know-how transfers. Vickery (1988) in a Les survey of 119 international licensing transactions detected 67 percent. In the Chemical Industry, all but the simplest licenses involve a mixture of patents and know-how.").

103 Varner, note __ at Table 1. The "high-tech" category included: Computer Software, Computer Hardware, Electronic Components, Instrumentation, and Telecommunication firms.

104 Robin Feldman & Mark A. Lemley, *Do Patent Licensing Demands Mean Innovation?*, 101 IOWA L. REV. 137, Fig. 5-28 (Feb. 15, 2015).

105 Graham et al., *supra* note __ at 1318.

106 *Id.* at ___.

107 *Id.* at ___.

4. Exclusivity Provisions

Another view of the ways in which patents support the market for technology can be achieved by looking at the extent to which the terms of the license mirror the terms of the patent. An exclusive license lets the licensee, with the right to exclude conferred by the patent, to "step into the shoes" of the patentholder with the exclusive right to commercialize the invention. A cross-license, on the other hand, represents the exchange of permissions to practice the technology – one that promotes freedom to operate but, on balance, does not necessarily lead to more technology being transferred than otherwise would have in the absence of patents on both sides. Non-exclusive licenses can certainly transfer technologies in a way that questions the need for a patent to incent ex post commercialization, though it does not necessarily undermine ex ante incentives to invent.[108]

A number of studies have looked at the level of exclusivity present in patent licenses, again with mixed results. Anand and Khanna's study of licensing deals involving at least one US participant between 1990 and 1993 reported that more than 30 percent of the 1612 deals involved exclusive licenses.[109] However, there were strong industry differences. Only 15% of "electronic" company licenses were exclusive, while over 50% of "chemical" company licenses were.[110] But electronic industry licenses (20%) were twice as likely to be cross-licenses as chemical licenses (10%).[111] A number of studies have also found a relatively higher level of exclusive licenses among university and biotechnology patents. In their review of 1,715 patents developed at the University of California and the Department of Energy National Laboratories between 1977 and 2009, Drivas and his colleagues found that the overwhelming majority were exclusively licensed.[112] In a parallel study of university patents covering DNA published in 2006, Pressman found that exclusivity provisions varied by licensee size. The smaller the company, the more likely the license was exclusive.[113]

In sum, while existing studies of patent sales and licenses provide a glimpse of the role of patent transactions, sometimes big, sometimes small, in innovation, they raise just as many questions as they answer in the context of the central issue of whether software is "eating the world" despite, because of, hindered or helped by software patents. Serrano and his colleagues have demonstrated that patent sales have been happening to a considerable degree, reducing litigation risk except when sales to larger entities are made. However, his study, which ends in 2000 transactions, predates many of the major developments in the software patent law as well as the software marketplace.[114] It also doesn't focus on software patents. The same is true of all of the existing studies of patent license terms. The Khanna and Anand study, which comes closest, studies licenses that are over two decades old. Given the importance of software innovation, it is worth building upon what is known by focusing specifically on software patents, software companies, and software sales and licenses. The rest of this study uses several sources to attempt to do this, with a focus on two main questions:

How robust is the paid market for software innovation, when measured through the lens of software patent sales and software licenses?

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108 I thank John Duffy for pointing out this distinction to me.
109 Anand & Khanna, *supra* note ___ at 109.
110 *Id.* at Table III(i).
111 *Id.*
112 Kyriakos Drivas et al., *Academic Patent Licenses: Roadblocks or Signposts for Nonlicensee Cumulative Innovation?*, SOC. SCI. RES. NETWORK 9 (Aug. 29, 2014).
113 Lori Pressman et al., *The Licensing of DNA Patents by US Academic Institutions: An Empirical Survey*, 24 NATURE BIOTECH. 31 (2006).
114 As described, *e.g.,* in the FTC's Report, *supra* note ___.

To what extent are the licensing and sale of software patents facilitating the transfer of technology as opposed to legal liability, based on looking at the ways in which patents are being redistributed?

The next section outlines the methods, sources, and assumptions used, and the following section, outlines my main findings.

III. PART II: DATA SOURCES AND METHODOLOGY

To explore the market for software innovation and the role of patents in supporting this market, I drew upon several novel sources of data. Despite the recent growth in empirical patent scholarship, law academics have generally paid less attention to markets for technology for several reasons. First, data on patent transactions has been actually or practically inaccessible or in an un-useable form, including for the reasons described below. In addition, patent scholars have generally paid less attention to the use of patents for commercialization, signaling, and financing purposes, which these data sources reflect, and more attention to the pursuit and litigation of patents, consistent with the Constitutional idea of promoting the progress of science and the useful arts, by rewarding innovators for their innovative ideas, in order to "fuel the fire of genius,"[115] and give them the opportunity to exclude others from the marketplace.[116]

Recent developments have both highlighted the importance of considering the "middle layer" of patent transactions, and chipped away at obstacles to studying it. The high profile purchases of patents by Apple and Google described earlier drew attention to the importance of patents and the freedom to operate. At the same time, the Obama Administration's commitment to "open data" and decision to treat government-generated data as public assets has led to the opening of hundreds of thousands of government datasets[117] These datasets drive government accountability and transparency, spawn new businesses, and support existing ones.[118] Thus, though one of the two enumerated duties of the USPTO is to "be responsible for disseminating to the public information with respect to patents and trademarks,"[119] only in the last 10 years, in concert with the creation of the Office of Chief Economist, has the agency engaged in the release of large quantities of patent data in digital form, detailing not only the details of patent prosecution, but ownership and other events that occur over a patent's lifetime.[120] These developments have been a boon to the more than 135 patent data companies[121] that exploit the application of machine learning and artificial intelligence techniques to code, clean, and ultimately, transform raw open government data on the application, maintenance, licensing, securitization, and sale of patents, as leveraged in this analysis into useable insights. As highlighted earlier, the importance of the market for patents and technology, the range of non-exclusionary uses of patents, and our understanding of these developments has grown in recent years. Thus, in addition

115 *Lecture on Discoveries and Innovation*, ABRAHAM LINCOLN ONLINE (2016), http://www.abrahamlincolnonline.org/lincoln/speeches/discoveries.htm.

116 *See* discussion of U.S. CONST. art. 1, § 8, cl. 8 above.

117 *See, e.g.*, Data.gov. These datasets pertain to everything from disaster relief, to information about Medicare and Medicaid services, to sexual assaults on campuses. *See id.* and *Case Studies of US Open Data,* and *Open Data Community Events,* listed at https://project-open-data.cio.gov/.

118 Project Open Data, https://project-open-data.cio.gov/.

119 35 U.S.C. § 2(a)(2) (2012).

120 Before these releases, the USPTO would provide certain data upon request but charge fees in the thousands to get it. In 2010, the USPTO, in partnership with Google, released a large amount of transactional data about patents and TM, including grants, assignments, and maintenance fees, publicly available for free. Described in Colleen V. Chien, *Predicting Patent Litigation*, 90 TEX. L. REV. 283, 300 n.110 (2011), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1911579&.

121 Referred to in Colleen V. Chien & Brian J. Love, *Comment to the USPTO on Quality Case Studies*, 1 (Feb. 2016), http://www.uspto.gov/sites/default/files/documents/casestudies_f_chien%26love_12feb2016.pdf.

to the development of the "supply" of patent data, the "demand" for this data, as companies seek technology and financing partners, has also grown.

A. IDENTIFYING "SOFTWARE" AGREEMENTS AND PATENTS

In order to explore the importance of software licenses and the role of patents in supporting software innovation, I had to identify "software" companies, "software" licenses, and "software" patents, well-known to be challenging tasks. Previous researchers have developed several approaches for identifying software patents: keyword searching (i.e. for "computer program" or "software")[122] and, patent classification[123] filtering (i.e. for classes G06F "Electrical Digital Data Processing" or G06F "Recognition Of Data; Presentation Of Data; Record Carriers; Handling Record Carriers").[124] To find "pure" software *companies,* Graham et al., has selected companies falling within several SIC codes.[125] In this work, I relied on all three approaches - keyword searching (and keyword coding) to identify software agreements, Standard Industrial Classification ("SIC") codes to identify pure software companies, and patent class codes to identify software patents. Given the broad distribution of software innovation,[126] it is likely that the classification-based identification techniques we used underestimate the scope of software patents and companies in which software innovation is occurring. I therefore proceed with caution, using these measures as a basis for performing and reporting *relative* trends and prevalence, rather than considering them to represent comprehensive measures of software innovation.

B. DATA SOURCES

To understand the market for software innovation through the lens of software licenses and software patent sales, I relied primarily on two proprietary databases: the ktMine database of material technology licenses reported to the SEC, and the Innography database of patent transfers. Though populated with open government data, each database is proprietary, introducing several limitations to this study. First, their use precludes the release of the underlying data I analyzed and complicates replication efforts. Second, the databases themselves contain known coverage gaps, for example, of unrecorded transactions and transactions involving patent applications that were abandoned prior to publication. However, even more problematically, they may include unknown gaps or otherwise be incomplete, biasing the data in unknown ways. Third, reliance on the coding of others subjects the analysis to the risk that the coding contains errors or may be incorrectly interpreted. I took several measures to minimize the impact of these defects. First, I describe in the paper what we know about the databases and along the way, carried out confirmatory checks using our independent coding. I also, to the degree permitted under license agreement, provide information about the search approaches I used. In addition to using raw open government data, I relied upon additional codings supplied by the providers, as described in greater detail below. To avoid interpretational errors with respect to these codings, I conferred closely with each provider regarding their data sources and

122 James Bessen & Robert Hunt, *An Empirical Look at Software Patents*, 16 J. ECON. & MGMT. STRATEGY 157 (2007).
123 Based on the CPC and IPC schemes.
124 Stuart Graham & David Mowery, *Intellectual Property Protection in the U.S. Software Industry, in* PATENTS IN THE KNOWLEDGE-BASED ECONOMY (Wesley M. Cohen & Stephen A. Merrill eds., 2003).
125 SIC Codes 7371, 7372,7373, 7379,. *See* 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, 1269 (2009).
126 See Branstetter, supra note ___.

methodology and carried out independent confirmatory codings in a number of cases to ensure that my understanding was correct.

1. Patent Sales Data

Although there is no obligation to publicly record ownership or transfers of patent rights, doing so provides legal rights against those who might attempt to later purchase the patent.[127] However, the task of identifying what patents have been sold, to whom, and under what terms, has been complicated by the large variety of recordable "conveyances" of patent rights, including securitizations, licenses, intra-company transfers of patents, and merger and acquisition-based transfers.[128] As a result, the task of separating "true transfers" of a patent from other types of conveyances presents a significant obstacle to doing research on the patent market. About 10% of conveyances recorded at the USPTO represent true inter-company transfers.[129]

In related work, Esmail Khaksari and I co-authored a study at Innography relying upon searches involving "true transfers"[130] of software patents[131] that had been recorded at the USPTO between 2012 and 2015. We drew upon Innography's "PMT" database, which is comprised of conveyance data that has been cleansed and processed so that only true, inter-company transfers outside of the context of the merger or acquisition are left.[132] We found 30,898 reassignments of software patents from January 1, 2012 to December 31, 2015, some involving the same patent, together representing the transfer of 25,210 unique patents. To determine the rate at which patents were being transferred, we had to estimate the universe of possibly transferable patents. We included any patent in force during the period of transfer in this denominator (N= 433,430).[133]

2. "Significant" Software Technology Licenses

Although license data is generally not available,[134] publicly traded companies are required by SEC regulations to report in their filings, "material definitive agreements not made in the ordinary course

127 Alicia Griffin Mills, *Perfecting Security Interests in IP: Avoiding the Traps*, 125 BANKING L.J. 746 (2008).

128 Form PTO-1595, the "Recordation Form Cover Sheet" enables recordation of 8 different types of conveyances, including "Other." *See* http://www.uspto.gov/forms/pto1595.pdf. Discussed in Colleen V. Chien, *Predicting Patent Litigation* at footnote ___.

129 http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2696147, Figure 7; Accord *Patent Market Tracker: Fall 2015 Key Trends*, INNOGRAPHY, INC. (2016), https://www.innography.com/public/upload/files/general-files/Innography-Patent-Market-Tracker.pdf (accessed on October 15, 2015). (estimating the share of conveyances that are interfirm assignments to be 15%)

130 *See* Colleen V. Chien & Esmaeil Khaksari, *The Patent Marketplace 2012-2015*, forthcoming, from which all original research on transfers reported in this article is drawn, for more details about the PMT tool and how it is constructed.

131 As defined by Graham & Mowery's CPC-based classification. Described supra at note ____.

132 Because of the way that transfers are evaluated, the PMT excludes patent transfers that follow acquisitions of companies where the child is merged into the parent entity. However, transfers that support spin-outs or transfers to entities that are distinct from the original patentholders are still included.

133 To determine which assets were in force, we used actual and projected expirations dates of the patent which are estimated by Innography by taking into account patent type, priority date, patent term adjustments, abandonments, and maintenance activities, but which do not include terminal disclaimers. *See* http://education.innography.com/overview-patent.

134 The lack of public data about technology licenses is a well-known impediment to research in this area. While technology and the permissions to use it are routinely exchanged in return for money or other consideration, there is no requirement that licensing transactions be publicly recorded. Even when one party might be willing to disclose what they paid or what they were paid, or other terms of the agreement, non-disclosure agreements typically prevent the divulgence of license details, even selectively. *See*, *e.g.*, discussion in Anne Kelley, *Practicing in the Patent Marketplace,* 78 U. CHI. L. REV.

of business."[135] While I refer collectively in this article to these publicly filed agreements as the "SEC Database," in fact, there is no central repository of such agreements or easy way of identification in the SEC record, due to the lack of designation of such licenses and the non-standard ways in which agreements are formed and referred to by parties.[136] Although this study was able to leverage the aggregation, cleaning, and coding of these licenses by the proprietary vendor kTMine, SEC license data has several structural limitations that are worth discussing upfront. First, in contrast to public records about patent sales, which trigger protections against subsequent purchases of a patent by any transactor, only a small subset of agreements triggers SEC reporting requirements – agreements that are material to a public company, which, in turn, comprise only a small subset of all companies. As such SEC licenses are surely not representative of agreements in general,[137] but rather agreements that survive two significant filters: they are relevant to a publicly traded company, and substantial enough to be considered material. As a result, these agreements are not representative of commercial technology licenses in general but are biased towards larger, rather than smaller agreements, and reporting by smaller, rather than larger firms, as observed in our own data as reported at FIG ___.

I used ktMine's licensing database, which includes over 100,000 material agreements, collected from public sources, primarily the SEC Database, and performed my analysis using ktMine's "Royalty Rate Analyzer" tool, which contains about 16,000 IP license agreements with royalty terms, a subset of the total.[138] I relied upon ktMine's coding of basic facts about each agreement including the licensor, licensee, effective date of the license, industry of the agreement, agreement type,[139] and keywords, indicating the subject matter of the license.[140]

In order to focus on agreements that affect the diffusion of technology between firms, I excluded certain types of agreements such as asset purchases (typically, associated with M&A activity), marketing, distribution, and services agreements. The "technology agreements"[141] I found comprised about 20-25% of all agreements, and I focused my analysis on the subset of licenses with an effective date of 2000 through 2015 (N=6,109). I chose these effective dates in order to capture recent trends in licensing. However, due to lags between the execution and recordation of licenses, the dataset has relatively fewer licenses from recent years compared with older years.

115, 117 (2011), and Jorge L. Contreras et al., *Study Proposal- Commercial Patent Licensing Data* (University of Utah College of Law, Research Paper No. 164, 2016), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2755706.

135 SEC Form 8-K, Current Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934, Item 1.01, http://www.sec.gov/about/forms/form8-k.pdf.

136 As Ian Cockburn has described, "license agreements are typically complex, contingent contracts, they are difficult to value or assess, or even count up for statistical purposes. Very few—if any—national statistical agencies collect comprehensive data on technology licensing activity, and the coverage, accuracy and content of databases sold by private vendors is very difficult to assess independently." A cottage industry of companies that harvest, collect, clean, and code this data addresses this gap, including RECAP, RoyaltyStat, Biosciences Advisers, and ktMine.

137 *See*, *e.g.*, Tom Varner, *An Economic Perspective on Patent Licensing Structure and Provisions* (2011) (unpublished manuscript, on file with author), who compared SEC licenses he reviewed to other agreements that he reviewed in the course of expert witness and other work he did, finding the undisclosed agreements "to include a greater percentage of cross-licenses, royalty-free licenses, and fixed fee licenses than observed in the dataset analyzed for this paper."

138 BVR/ktMine, *Royalty Rate Benchmarking Guide 2015/2016 Global Edition*, 5 (2015), http://www.bvresources.com/pdfs/RoyaltyRateGuide_2015_Excerpt.pdf.

139 As described in footnote ___.

140 BVR/ktMine, as described in footnote ___, correspondence with ktMine on file with the author.

141 We included the following agreements types in this category: cross-licenses, joint development, manufacturing/process intangible, other, and software. We excluded asset purchases, distribution, franchise, marketing intangible, and service agreements from our analysis.

Within this group of technology agreements, I focused on "software" technology agreements, as coded by ktMine, yielding 1,431 licenses. I read many of these licenses to confirm that they were, indeed, about software, and, replicating Bessen and Meurer's keyword identification approach,[142] found a roughly equivalent number of agreements (1,451). Within software technology licenses, I distinguished between agreements in which patents were mentioned (N=1,163) and those where copyrights, trade secrets, trademarks, patents, or software source code[143] were coded as "core" by kTMine to the agreement. Based on their methodology, patents were core to 480 of the software technology agreements, which included both technology licenses and asset transfers. I worked with research assistants to code the provisions of software agreements where patent rights were also transferred not in the context of an asset transfer (N=245).

To establish a baseline from which to evaluate the prevalence of licenses, we took several steps. We looked at the prevalence of reporting among "pure software" firms as defined by Graham and his colleagues that were eligible to report licenses over the studied period. These firms fell into three SIC codes: prepackaged software firms such as Microsoft, IBM, and Adobe Systems Inc. (SIC 7372),[144] computer integrated systems design firms like Fujitsu, and Mentor Graphics Corp. (SIC 7373),[145] and companies that provide computer programming services like Sabre Corporation or General Dynamics Information Technology (SIC 7371).[146]

Because companies are routinely listed and delisted from public exchanges, at times within the span of just a few years, taking a single year snapshot does not yield an accurate count of the universe of companies eligible to file material agreements. Therefore, we next used COMPUSTAT to generate an aggregate list of companies within the relevant SIC codes in each of five years (2000, 2004, 2008, 2012, and 2014). Out the five-year period, there were 1,140 unique public "pure software" companies within COMPUSTAT. We further pulled revenue from the year of the agreement so that we could determine the prevalence of reporting among different revenue bands. For companies with reported revenue, this approach had the advantage of being available for multiple years, including the effective year of the relevant transaction, for most but not all companies.[147]

3. Company and Revenue Data

I worked with research assistants to integrate several types of company- and industry-level data into our analysis including revenue, age of founding, and SIC code. To profile public companies in our analysis, we relied primarily on COMPUSTAT and SEC filings. For private firms, we used ReferenceUSA and company websites to determine year of founding. We excluded transactions with individuals from our analysis, as well as transactions involving firms, including all private and many foreign public ones, for which we could not find founding year or revenue data, resulting in a match for about 45% of transactions.

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142 To find agreements that included the term "software" or "computer program," as described in Bessen & Meurer, *Patent Failure*, supra note ___.

143 For each, I worked with kTMine to identify the relevant agreements, based on an exhaustive list of keywords covering each concept.

144 *SIC 7372 Prepackaged Software*, ADVAMEG, INC.: REFERENCE FOR BUSINESS (2016), http://www.referenceforbusiness.com/industries/Service/Prepackaged-Software.html#ixzz49IsPLPkO.

145 *SIC 7373 Computer Integrated Systems Design*, ADVAMEG, INC.: REFERENCE FOR BUSINESS (2016), http://www.referenceforbusiness.com/industries/Service/Computer-Integrated-Systems-Design.html#ixzz49ItBM6j6.

146 *Business List - SIC 7371 - Computer Programming Services*, SICCODE.COM (2016), http://siccode.com/en/codes/sic/7371/computer-programming-services.

147 COMPUSTAT data is not uniformly available for all publicly listed companies. When data from the particular year that the license was reported was not available, we chose the closest year.

IV. PART III: FINDINGS

A. THE MARKET FOR SOFTWARE PATENTS IS ROBUST AND GROWING, DESPITE A DECLINE IN THE ENFORCEABILITY OF CERTAIN SOFTWARE PATENTS.

The first finding of this study pertains to the importance of the marketplace for diffusing software innovation between firms. Studying the market addresses several gaps in our understanding of software innovation. First, although most of the policy attention with respect to software patents has been focused on disputes about their quality, patterns of assertion, and infringement, the sales and licensing of software patents provide more direct insights into the transactional role software patents are playing, on a day to day basis, in stimulating and supporting innovation, or not.

Second, while much has been written about open modes of diffusing software innovation across firms borders, for example through employment laws and policies that do not allow for the enforcement of non-competes[148] or the open source software movement,[149] the paid market for software innovation as reflected in software patent licenses and sales represents a sizeable and important mechanism for technology transfer. Understanding the dynamic between open and proprietary innovation is an important step in ensuring adequate support for both models.

Finally, while there have been a number of significant policy developments in the realm of software patents in the past few years, their impact on software innovation has not been clear. In general, software patents have become harder to enforce in recent years. The America Invents Act of 2011 introduced a host of new procedures to challenge the validity of issued patents.[150] These procedures have not been kind to software patents.[151] The Supreme Court's *Alice* decision in 2014 erected significant limits to patentable subject matter, making it harder to get patents over business methods and the abstract algorithms that are at the heart of software innovation.[152] Almost immediately, defendants began mounting "Alice" challenges to patents they were sued on, invalidating them in many cases.[153] Holding all else equal, these developments would be expected to depress the market for software patents.

148 Described, *e.g.,* in ORLY LOBEL, TALENT WANTS TO BE FREE: WHY WE SHOULD LEARN TO LOVE LEAKS, RAIDS, AND FREE RIDING (2013).

149 For an overview of the open source software movement, *see* Karim R. Lakhani & Eric von Hippel, *How Open Source Software Works: "Free" User-to-User Assistance*, 32 RES. POLICY 923 (2003).

150 These include inter partes review (IPR), the covered business method transitional program (CBM) and post-grant review (PGR). See Joe Matal, *A Guide to the Legislative History of the America Invents Act: Part II of II*, 21 FED. CIR. B. J. 539 (2012) for an overview of the rationale and features of these procedures).

151 Brian J. Love & Shawn Ambwani, *Inter Partes Review: An Early Look at the Numbers*, 81 U. CHI. L. REV. DIALOGUE 93, 105–06 (2014) (finding petitions for inter partes review result in elimination of every challenged claim about twice as often as the same result for requests for inter partes reexamination).

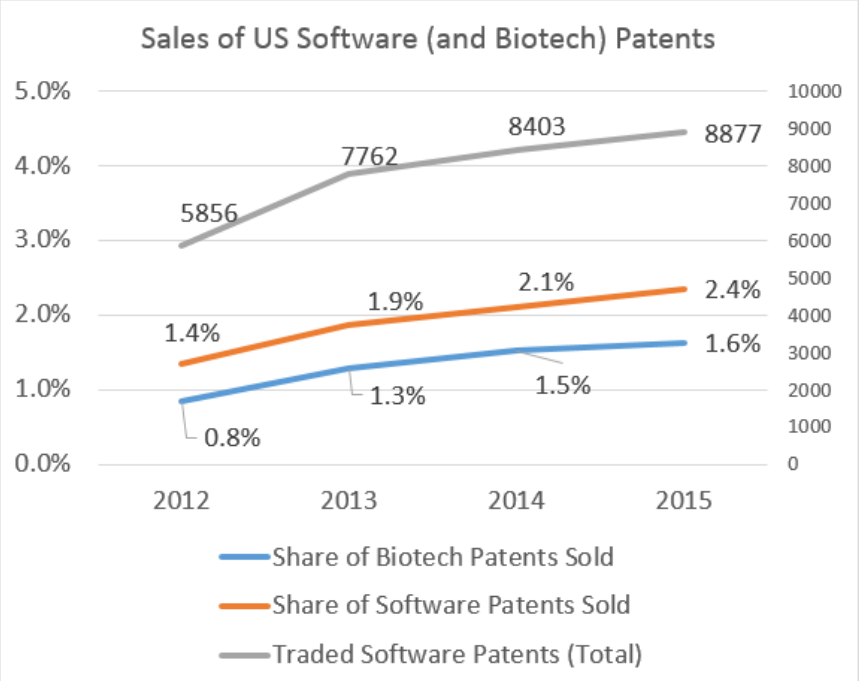
152 *See, e.g.*, Alice Corp. Pty. v. CLS Bank Int'l, 134 S.Ct. 2347 (2014).

153 Jasper L. Tran, *Software Patents: A One-Year Review of Alice v. CLS Bank*, 97 J. PAT. & TRADEMARK OFF. SOC'Y 532, 540–41 (2015) (showing the district courts, PTAB, and the Federal Circuit invalidated 82.9% of patent applications in the year following *Alice*).

1. Patent Sales

Against this backdrop, the data tells a distinct story. The paid market for software innovation is robust: in a single year, the data show, a software patent is as or more likely to be sold (~2%) than it is to be litigated over its entire lifetime.[154] Rather than declining, the absolute number of software patent transfers has actually increased, from around 5.9K patents per year in 2012 to 8.9K patents per year in 2015, a 68% rise. (FIG____)

FIG___ : The Sale of US Software (and Biotech) Patents (2012-2015)[155]



To put these findings in context and explore the possibility that this rate of increase reflects changes in the number of patents or other changes outside the patent system, we considered not only the absolute number of patents being transferred, but the relative rate of software patent transfer, as compared to the total number of in-force patents. We also compared software patent and biotechnology patent transfer rates. [156] These calculations reinforce the robustness of the software patent market — reflecting a rise in the transfer rate from 1.4% in 2012 to 2.4% in 2015, and far outstripping the rate of biotechnology patent transfers, which totaled 0.8% to 1.6%. When we compared the top transactions in both sectors, we saw that the size of the average portfolio of transferred software patents was much larger than that of transferred biotechnology patents.

This finding is significant for at least two reasons — first, it reinforces that software patents are actually much more likely to be transferred than litigated. Scholars and policymakers, in contrast, have concentrated far more on the litigation of software patents than their transfer. The scholarly

154 It is estimated that 1-2% of all patents is ever litigated. See cites supra.

155 Calculated based on unique patents. We did not control for continuations, which may be more common among biotech than software patents.

156 We chose the biotechnology industry as a point of comparison because the biotechnology sector is often held up as an example of a well-functioning innovation market, in which larger firms are well-poised to commercialize and absorb smaller firms or their technology and bring it to market.

community should turn more attention to this set of patent transactions, and the dynamics between sales and litigation. Second, the data show that the market for software patents remains robust, and has even grown, in the face of significant legal developments calling into question the enforceability of software patents. What accounts for this trend? Below I discuss three possible explanations.

a) Bargain Shopping for Software Patents

Although detailed transactional data is hard to come by, one reason for the uptick in patent transactions may be that the price per patent has gone down. According to one estimate,[157] from 2014 to 2015, asking prices were down about ~$90K per patent, from $280K per asset to $190K per asset, even as sales increased.[158] The increased sales volume may reflect opportunistic buying on the part of those who want to decrease the risk of patent assertions and perceive a buying opportunity. In 2016, the patent buying consortia IP3, representing IBM, Apple, Google, Microsoft and a number of the other top targets of patent litigation announced that it would be soliciting offers to sell patents to the consortia.[159] Building on an experiment to buy patents directly from patentholders carried out by Google the previous year[160] and the efforts of defensive aggregating intermediaries,[161] the group is exercising monopsony power to "buy in bulk." This shift in purchasing strategy further reduces the group members' own costs and cuts out the middlemen of patent litigators and patent assertion entities (PAEs). As the enforcement climate grows less favorable to patentholders, the option of monetizing through direct sales rather than assertion may be attractive to both parties, even at lowered prices. In addition, when companies have fixed budgets that they must spend on managing patent risks, including the purchase of patents, and the market cost per patent declines, the volume of patents sold must go up.

b) Defensive, not Offensive Acquisition of Portfolios of Software Patents of Software Patents

Another driver of software patent transactions is the purchase of patents for defensive or strategic, rather than offensive, purposes. Patents create freedom to operate in at least two ways. First, the presence of an arsenal of patents, and closely related technology, deters attacks by competitors because it enables the owner of the arsenal to bring a countersuit if threatened. Second, patents provide trading chits that allow companies to exchange technology through cross-licensing. In both contexts, the quantity of patents held in a portfolio is just as, if not more, important as the quality or enforceability of any individual patent. Thus, while a single patent or group of patents might now appear to be invalid under the *Alice* decision, it is likely that within an entire portfolio, there are still enforceable assets, and the costs of determining the difference on a patent-by-patent basis is often prohibitive. Likewise, in a license negotiation between two parties, even though one patent may be a strong candidate for invalidation under an AIA procedure, challenging an entire patent portfolio, which may number in the

157 Richardson Oliver Law Group, Presentation to the IPBC in Barcelona, June 6, 2016 (presentation on file with the author).
158 *Id.* (reporting a 23% increase in sales of all patents from 2014 to 2015, larger than the increase that we observed among software patents during that period of time).
159 Richard Lloyd, *The Timing is Perfect for IP3's Patent Buyers; For Sellers the Picture is Far Less Rosy*, IAM MEDIA (May 20, 2016), http://www.iam-media.com/Blog/Detail.aspx?g=3cbec828-2e85-4746-b422-772e5f294aa4.
160 *Id.*
161 For example, RPX and Allied Security Trust (AST).

hundreds, is impractical. Thus the decline in enforceability of individual patents has not necessarily translated into a greater freedom to operate, meaning there is still a strong need for additional patent assets. Several of these transactions that appear to be defensively motivated are explored further in Part ___.

c) Software Eats the World

Finally, the value of a patent is a product not only of its legal validity, but the economic value of the technology it covers. A patent that conforms to all the legal requirements of patentability but covers a worthless technology has little value. Similarly, a portfolio of patents over a valuable technology, even if the validity of some of the patents is contestable, can be worth millions. While the legal enforceability of software patents has declined recently, there doesn't appear to be any corresponding decline in software innovation.[162] Growth in the US software sector has outpaced overall economic growth over the past few decades.[163] Google and software company SAS are among the best places to work in America,[164] and the stocks of software and internet companies like Netflix, Electronic Arts, Activision, Amazon lead the stock market.[165] The market for software patents reflects the vibrancy of the software industry to a greater degree than it does the legal enforceability of software patents. In this sense, software innovation could be said to be happening not because of, but in spite of or unrelated to, software patents.

2. Additional Evidence from Licenses

The importance of the market for software-based innovation can be gauged not only through sales of software patents but also through agreements for software innovation. As described earlier, this study considers technology agreements reported to the SEC by public companies that deem the agreements to be "material" events that could impact the company's stock price. As such, it is important to keep in mind the limited nature of this sample, as it excludes many agreements to license software innovation.

Keeping this caveat in mind, the SEC data supports the importance of software in technology transactions among a variety of different industries. According to KTMine's version of the SEC database, about 23% of all technology agreements[166] reported to the SEC between 2000 and 2015 (1,431 out of 6,109) involved the transfer of software.[167] That is to say, nearly a quarter of important technology agreements to public companies were software agreements. To put that number in context,

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162 And in fact, software innovation is increasingly leading even in traditional, manufacturing sectors of the economy, as discussed in Branstetter, supra note ____.

163 Robert J. Shapiro, *The U.S. Software Industry as an Engine for Economic Growth and Employment*, Sonecon 1, 7 (Sept. 2014), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2541673 (finding that, from 1997 to 2012, growth of the software industry outpaced growth in the rest of the economy, capturing an increasing share of national GDP, and contributing 3.2% of GDP in 2012).

164 *See, e.g. 100 Best Companies to Work for*, Fortune, http://fortune.com/best-companies/ (listing Google as the #1 top place to work from 2014 to 2016 and SAS Institute among the top ten in that period).

165 https://www.thestreet.com/story/13306053/1/the-10-best-s-p-500-stocks-in-all-of-2015.html

166 As described above, these agreements include joint development, cross-license, manufacturing/intangibles agreements, software agreements and other agreements, and exclude franchise, distribution, service, marketing, and asset purchase agreements.

167 Based on KTMine's designation of the agreement as a "software" agreement.

software companies contributed about 3% to GDP in 2012.[168] That the share of software technology transactions is greater than software's contribution to GDP is unsurprising, but the extent of this difference is dramatic.

a) The Distribution of Software Agreements

How were software agreements distributed, across and within industries? Innovation scholars have long discussed the contrast between "cumulative" innovation areas like software, in which many, even thousands, of incremental innovations may be embodied in a single product, and "discrete" biopharma innovations, which may be covered by just a handful of patents.[169] The differences in these two types of innovation have strained our unitary patent system, which does not permit discrimination based on technology.[170] However, to the extent that cumulative, software-based innovation is widespread across sectors, these distinctions may be blurring.

From 2000 to 2015, this study finds, material software agreements were spread among a variety of different technology areas, with the largest numbers of agreements covering business services, internet, telecommunications, and health care technologies. (See Appendix, XFIG. ___) The broad distribution of software agreements further demonstrates that software innovation is not restricted to certain sectors, but is shaping our economy more generally.[171]

What about the distribution of agreements within industries? The data discussed thus far, about the number of technology agreements, and the share of them that are software agreements, do not measure the likelihood that any individual company is to enter into a material agreement covering software. To measure this, we looked specifically at "pure" software companies and the extent to which they did or did not report material software agreements. We found that a modest share of all public companies,[172] around 9%, had reported one or more software agreements. (FIG. __) The smaller a company was, the more likely it was to have reported an agreement.

FIG___ Share of Pure Software Companies (by Annual Revenue Band) Reporting a Material Technology Agreement to the SEC (2000-2015)

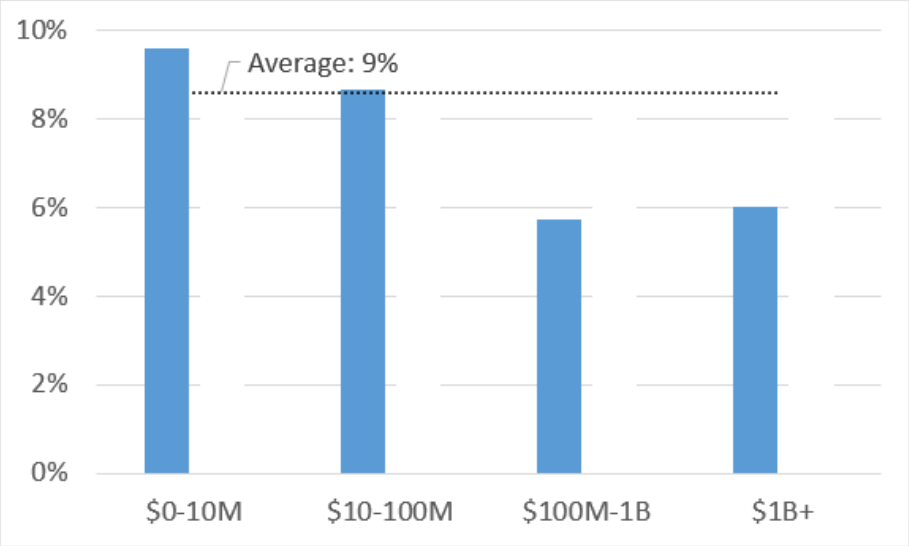
168 Shapiro, *supra* note __ at 17–18 (finding that, from 1997 to 2012, growth of the software industry outpaced growth in the rest of the economy, capturing an increasing share of national GDP, and contributing 3.2% of GDP in 2012).

169 *See, e.g.* Wesley M. Cohen, Richard R. Nelson & John P. Walsh, *Protecting Their Intellectual Assets: Appropriability Conditions and Why U.S. Manufacturing Firms Patent (Or Not)*, (Nat'l Bureau of Econ. Research, Working Paper No. 7552, 2000).

170 TRIPS Article ___ [email me for citation or look for "non-discrimination principle - TRIPS]

171 As discussed in Branstetter, supra note ___, at____.

172 Tracked by COMPUSTAT



While the findings described above provide some basic facts about the likelihood, prevalence, and distribution of paid transfers of software innovation, they do not address the substance of these transfers. When a software patent is transferred from one firm to another, what is sold, exactly? When a company signs an agreement to share software innovation with another, what exactly is it sharing, and on what terms? These questions are important to address as not all transfers of software innovation are created equal, nor do they confer the same social costs and benefits. In the following paragraphs, I consider patterns of patent sales, as well as SEC reported patent licenses, addressing where possible the extent to which the transfer or license represents a transfer of technology or a transfer of liability.

B. SOFTWARE PATENTS ARE MOSTLY BEING TRANSFERRED FROM LARGE TO SMALL, AND OLDER TO YOUNGER COMPANIES, TO SUPPORT TECHNOLOGY AND LIABILITY TRANSFERS

When Google bought Motorola in 2011, it was primarily for its ability to protect the Android ecosystem,[173] but the transaction was unusual — typically when a company buys another, it is in order to buy the business, including the technology and innovation that may be protected by patent. But the wide variety of ways in which patents be used, including for protection (freedom to operate), signaling, trading, or protecting the underlying technology through exclusion[174] gives rise to a wide variety of motivations for patent sale. One way to discern the purpose of sale is to look at its terms and downstream uses. The pattern of a transfer may also reveal the motives of the buyer, in particular with respect to the relative ages of the parties. For example, patents can support the sale of the technology of a young company to an older company better positioned to commercialize the technology, helped

173 https://www.google.com/press/motorola/

174 *See, e.g.* Stephen Yelderman, *Coordination-Focused Patent Policy*, 96 B.U. L. Rev. (forthcoming 2016), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2481025, for an overview of these uses.

by intermediaries.[175] Conversely, patents may be transferred from an older to a younger company when the younger company is infringing the patent and seeks freedom from suit, or a unit of the older company is divested to a younger company.

Although the terms of patent sales are generally not publicized, information about large transactions is often available, and we probe such transactions set in the first step of our inquiry. FIG.___ lists the top ten sales of software patents (by number of patents) recorded from 2012 through 2015. Reviewing public disclosures about each "top transaction," about half appear to have been associated with defensive, or otherwise liability-shifting motivations, while the remainder supported the broader transfer of a technology business. Strikingly, in all of the transactions, assets moved from an older to a younger company. Once we identified this pattern, we probed whether it held among transfers for which information was available. We found that it did, with software patents between two and three times more likely to be transferred from an older to a younger company than vice versa. This finding contrasts sharply with the commercialization story of patents in which a young upstart sells its patents to an established incumbent, as further discussed below. The results were robust across every year studied and both individual patent transfers and transactions. We also found that the skew in favor of "old to young" transfers was much more pronounced among software patent transfers than biotechnology patent transfers. We begin with our analysis of the top ten transfers, as listed in FIG.___.

175 *See e.g.* James F. McDonough III, *The Myth of the Patent Troll: An Alternative View of the Function of Patent Dealers in an Idea Economy*, 56 EMORY L.J. 189, 190 (2006), and cites in Feldman and Lemley, supra note___ note 7.

FIG. ____: Top 10 Software Patent Transfers (2012-215) and Years of Founding of Transferors and Transferees

Transaction	Software Patents Transferred[176]	Year of founding of Transferor	Year of founding of Transferee
IBM to Globalfoundries Inc.	2240	1911	2009
HP Inc. to TCL Corporation	1123	1939	1981
Lenovo Group to Alphabet Inc.	834	1984	1998
Fujitsu and Panasonic to Socionext	820	Fujitsu: 1935; Panasonic: 1918	2015
IBM to Lenovo Group	783	1911	1984
HP to Qualcomm	599	1934	1985
IBM to LinkedIn	516	1911	2002
IBM to Twitter	495	1911	2006
IBM to Facebook	414	1911	2004
Eastman Kodak to Intellectual Ventures Management	310	1888	2000

1. Transferring Liability

One of the most striking things about the list of top ten software patent transfers is that five involve the transfer of patents from IBM to other companies. For years, IBM has been the top recipient of US patents, so its dominance of the top of the seller list isn't necessarily surprising. Three of the five transactions of IBM patents, to the young technology companies of LinkedIn, Twitter, and Facebook appeared to fit the profile of "liability" rather than "technology" transfers. In 2013, IBM reportedly sent a letter to Twitter claiming that it was infringing several of IBM's patents and invited the company to "sort it out or face the consequences."[177] Practicing a well-known tactic,[178] IBM approached Twitter during one of its most vulnerable times, when it was trying to go public.[179] Ultimately, Twittter bought many more patents, perhaps as many as nine hundred, than the handful that it was alleged to be infringing.[180] This suggests that Twitter thought it would be useful to have

[176] It is worth noting that these counts reflect only the transfer of software patents, and the actual transactions may have also encompassed non-software patents.

177 Brid-Aine Parnell, *Twitter Avoids IP Face-off with Big Blue, Will Buy 900 IBM Patents*, THE REGISTER (Feb. 3, 2014), http://www.theregister.co.uk/2014/02/03/twitter_ibm_patents/.

178 As documented, for example, in Robin Feldman & Evan Frondorf, *Patent Demands and Initial Public Offerings*, 19 Stan. Tech. L. Rev. 52, 73–79 (2015) (finding the percentage of companies surveyed with patent claims filed against them jumped from 10% before S-1 filing to 40% shortly before or after the IPO).

179 Brid-Aine Parnell, *Twitter Avoids IP Face-off with Big Blue, Will Buy 900 IBM Patents*, THE REGISTER (Feb. 3, 2014), http://www.theregister.co.uk/2014/02/03/twitter_ibm_patents/.

180 Parnell, *supra* note __.

not only freedom from the patents specifically asserted against it, but also assets that it could use to ward off other threats. According to reports, prospective litigation also led Facebook to acquire at least 400 patents from IBM.[181] (FIG ___). LinkedIn's purchase of IBM patents also appears to have been motivated by a desire to avoid legal liability, which could have been asserted by IBM or a buyer of its patents.[182]

Several others of the top ten purchases appear to have had defensive intents. For example, Intellectual Ventures (IV) purchased a large number of patents from defunct photography company Eastman Kodak. According to public reports, the deal was organized by IV and RPX Corporation on behalf of twelve intellectual property licensees, with each licensee receiving rights with respect to Kodak's digital imaging patent portfolio and related patents.[183] In another apparently defensive move, when Alphabet (Google) sold Motorola's mobile business to Lenovo, it retained the patent assets, which were assigned back to Alphabet when Google was reorganized. (FIG___, Lenovo Group to Alphabet Inc.) [CC to add cite – ask me for it]

As discussed earlier, scholars have previously considered the impact of the patent sales on the propensity of patents to be litigated. While my research on the topic did not find an increase in the likelihood of litigation upon transfer,[184] Serrano and his colleagues found that it depended on the context and that transfers from individual inventors to larger entities reduced the likelihood of litigation, on average, and from larger to certain smaller entities, the likelihood of litigation increased.[185] But while the transactions just described appear to be motivated by the desire to avoid patent enforcement, one transaction in the top ten appears to be effected the liability transfer in another direction, to a party with advantages in enforcement and licensing. In 2014, Qualcomm purchased hundreds of HP patents covering the company's mobile computing technology. [186] Few financial details or intentions with respect to the patents concerning the deal were released,[187] but Qualcomm makes about a third of its revenue from licensing patents.[188] While it cannot be predicted with certainty what exactly Qualcomm will do with its acquired patents, the firm is arguably better equipped than HP to absorb the patents into its existing licensing and monetization efforts.

2. Transferring Technology

While the transfers just described supported liability transfers, in both directions, other top ten transfers supported transfers of entire businesses and technologies. For example, chip manufacturing

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181 Gene Quinn & Steve Brachmann, *Facebook and Twitter: Patent Strategies for Social Media*, IPWATCHDOG (Feb. 14, 2014), http://www.ipwatchdog.com/2014/02/14/facebook-and-twitter-patent-strategies-for-social-media/id=48004/.

182 *See Patent Market Tracker Fall 2015 Key Trends*, INNOGRAPHY (2015), https://www.innography.com/public/upload/files/general-files/Innography-Patent-Market-Tracker.pdf.

183 *Kodak Announces Sale of Patents*, KODAK (Dec. 19, 2012), http://www.kodak.com/ek/US/en/Kodak_Announces_Sale_of_Patents.htm.

184 *See* Colleen V. Chien, *Predicting Patent Litigation*, 90 Tex. L. Rev. 283, 320 (2011).

185 Galasso, et al. *supra* note ____.

186 Jeffrey Burt, *Qualcomm Buys Palm Patents from HP*, EWEEK (Jan. 24, 2014), http://www.eweek.com/mobile/qualcomm-buys-palm-patents-from-hp.html.

187 Jeffrey Burt, *Qualcomm Buys Palm Patents from HP*, EWEEK (Jan. 24, 2014), http://www.eweek.com/mobile/qualcomm-buys-palm-patents-from-hp.html.

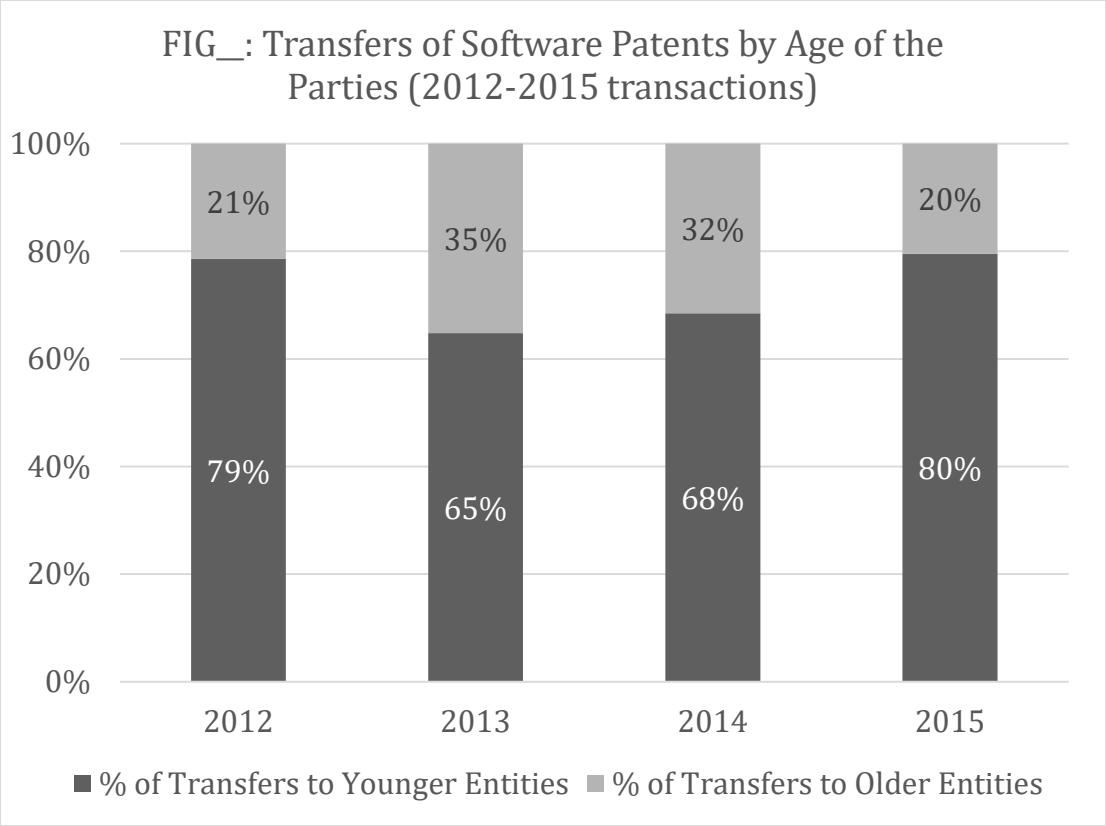
188 *See* Qualcomm Inc., Annual Report 38 (Form 10-K) (Sept. 27, 2015), http://investor.qualcomm.com/secfiling.cfm?filingID=1234452-15-271&CIK=804328 (showing that about $8B out of the firm's $25B in revenue is from licensing).

has long been among IBM's many activities, but has caused IBM to lose money in recent years.[189] In 2014, IBM entered into a deal to transfer its facilities to GlobalFoundries, which would continue to operate and produce chips for IBM in exchange for around $1.5 billion in cash.[190] As part of the deal, a large number of patents was transferred to GlobalFoundries. (FIG.___) In another divestiture, IBM sold its personal computer business, including a large number of IBM's patents, to Lenovo group,[191] for $1.75 billion.[192] Other patent transactions in the top 10 appear fit the pattern of being part of a larger business transfer, of HP's Palm unit to TCL,[193] and of the combination of assets of Fujitsu and Panasonic to form Socionext, a chipmaker.[194]

3. Patterns of Patent Transfers – From Old to Young and Rich to Poor

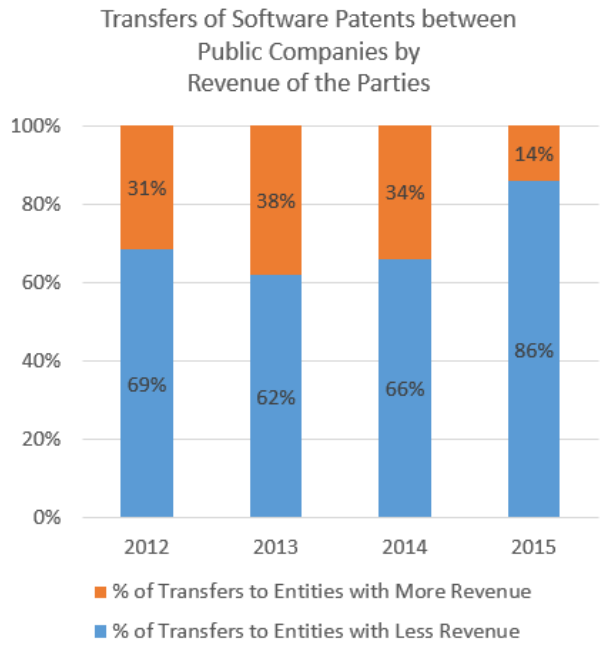
Although each transfer in the top ten had its own motivation, strikingly, each one reflected a similar pattern. In every case, the software patents were being transferred from an older company to younger company. (FIG. ____) More often than not, the transfer also reflected movements from the company with greater revenue to the company with less revenue. Because the top transactions of any set are often unique, and cannot be generalized to the entire set, we investigated whether the transfer patterns observed at the top — from older to younger companies, and from companies with more revenue to companies with less revenue — were observed among transactions in general. Using the methods described previously, we were able to match 45% of the transfers. Because we had to exclude transactions to and from individuals from the analysis, as well as companies that did not have an

189 Joel Hruska, *IBM Sells Chip Business to GlobalFoundries for $1.5 Billion (Updated)*, EXTREMETECH (Oct. 20, 2014), http://www.extremetech.com/computing/192430-ibm-dumps-chip-unit-pays-globalfoundries-1-5-billion-to-take-the-business-off-its-hands.
190 *Id.*
191 *The IBM/Lenovo Deal: Victory for China?,* UNIV. PA.: KNOWLEDGE@WHARTON (Jan. 14, 2005), http://knowledge.wharton.upenn.edu/article/the-ibmlenovo-deal-victory-for-china/.
192 *Id.*
193 Eric M. Zeman, *TCL to Revive Palm with Help from the Tech Community*, PHONE SCOOP (Jan. 6, 2015), http://www.phonescoop.com/articles/article.php?a=15128.
194 *Id.*



*Data represents 45% of recorded software patent transfers

English-language website from which founding year data could be easily determined, the analyzed transactions are likely skewed toward larger, more successful companies. For the revenue data, the match rate was also about 44%, because I excluded all private companies from the analysis due to the lack of reliable sources of private company revenue. The findings are presented in FIGS. ____ and ___.



The results are striking. The patterns of old to young, as well as all higher to lower revenue company software patent transfers were observed, not just among the top sales, but more generally. Across our dataset, sales of software patents were between two and three times more likely to be from an older company to a younger company (73%) than from a younger company to an older company (27%). The difference between the observed distribution and a distribution in which transfers were equally likely to go from a younger to an older entity and from an older to a younger entity was statistically significant, in every single year of our sample.[195] To rule out the possibility that the results were unduly skewed by transactions involving large numbers of patents, we ran statistical tests at the deal level, rather than the individual patent, level. The results were similar.[196] Among transactions between public companies of different revenue levels, the majority of patents also moved from higher revenue to lower revenue companies. Sales were, on average, more than four times more likely to be from a company with more revenue to a company with less revenue (71%) than vice versa (29%). This difference was maintained across the years of the study, and was statistically significant in each year at both the individual patent transfer level and the deal level.[197]

To test how unique these patterns were, and whether they were true of patent transfers in general, rather than mere artifacts of software patent transactions, I replicated the analysis among a subset of

195 I used a standard chi-square test to examine the null hypothesis that, in a given year, software patent transfers were equally likely to go from an older to a younger company as vice versa, yielding p-values of 0 to 1.6197E-81. A p-value of less than .05 is generally interpreted as an indication that the null hypothesis can be rejected (making it statistically significant), while a value greater than 0.10 is viewed as showing that any differences are not statistically significant. See Appendix __ for exact p-values.

196 On average, 60% of deals were from an older to a younger company, and 40% were from a younger to an older company. Running a chitest (using excel's CHITEST function) that compared the observed distribution to an even distribution, the p-values were 0 to 8.17389E-54. See supra for an explanation of the significance of these values, and Appendix __ for exact p-values.

197 See Appendix __ for the p-values.

biotechnology patent transfers.[198] Biotech patents were also more likely to be transferred from older, higher-revenue companies to younger companies with lower revenues. But, the transactions were more evenly split among transfers to older and younger companies, and those with higher and lower revenues. 47% of biotech patent transfers were to older companies, and 53% to younger companies. 45% of biotech transfers were to public companies with more revenue, and 55% to companies with less revenue. Neither of the differences between the observed values and an equal distribution were consistently statistically significant across the tested years;[199] in contrast to the significance of software transfers. This may reflect, in part, the relatively fewer observed biotechnology transfers.[200]

While striking at first blush, the movement of software patents from older, relatively higher revenue companies to younger, lower revenue companies has several explanations. For several decades there has been a "patent arms race" among technology companies, as companies have filed patents early and often, to deter suits by competitors or other operating companies.[201] But as a company matures and evolves, its needs change, including its need for all of the patents in the portfolio. Rather than just retiring the patents, companies can sell them to those who can make better use of them. Younger companies with rapidly increasing revenues, in turn, need patents to protect against potential patent demands: indeed, companies, like Twitter, Facebook, and LinkedIn have found the option to buy patents attractive. These types of transfers benefit both parties, as patentholders are able to recoup some of the costs of R&D and fund additional innovation, and patent-receiving companies can avoid delays and uncertainty at the USPTO and buy, rather than build, their own patent portfolios.

When a patent transfer is part of a larger business transfer the acquired business is rewarded not only for its existing revenue, but for its investment in future products and services. It provides more flexibility for the transferor to develop the technology, either on its own or with commercialization partners. Because they are portable, portfolios of patents can provide scaffolding and support for business transactions, making it easier to transfer technology and the rights to exclude others from practicing them.

But the profile of rent transfers from small to large companies, without any accompanying technology, also supports criticisms that software patents are, effectively, a tax on innovation. Though younger companies get patents, they must pay for them, forcing a transfer of wealth from the relatively younger to the relatively older company. When only patents, not technology, are transferred, the welfare effects can be ambiguous, as the gain to the larger patent holder must be weighed against the cost to the smaller patent implementer, without the exchange of technology. When the patents are transferred and then asserted against independent development and practice of the patent, the "tax" can be widespread, encompassing not only the independent developers, but also the users, of technology.[202]

198 N=1093 biotech patent transfers, for the revenue analysis, and N=995 biotech patent transfers, for the age analysis.
199 See Appendix __.
200 Biotech patent transfers differed in other ways from software patent transfers. Among the top ten, almost all involved less than 100 biotechnology patents, while among top transfers of software patents, most involved more than 500 software patents. This skew in size of top transactions is reflected in a much larger average transaction size, of 7.5 software patents vs. 2.4 biotech patents, per transfer, although, as described below, for both types of patents, the median and mode number of patents per transaction was 1.0.
201 For an overview of the industry and firm-level dynamics that have shaped the marketplace for high-tech patents, see Chien, *From Arms Race to Marketplace, supra* note ___.
202 Described, *e.g.* in Chien and Reines, *supra* note ____ .

If patent sales have been in support of both technology and liability transfers, what about patent licenses? The next section describes the analysis we performed to probe the motivations for licenses, and the results we found.

C. AMONG MATERIAL SOFTWARE LICENSES REPORTED TO THE SEC, PATENTS ARE FACILITATING THE TRANSFER OF TECHNOLOGY

While software patent sales can provide some insight into the extent to which technology and rights are distributed, parties are not required to disclose, much less register, how they intend to use of the transferred patent. A more granular perspective on the substance of the innovation transfers can be gleaned by looking at licenses in which licensor and licensee usually spell out their intentions for the patents. The problem with licenses, however, is that they are largely not available for inspection. In the following analysis, we skirt this obstacle by relying on material technology licenses recorded with the SEC, though it bears repeating that these license are highly selected and nonrepresentative of licenses in general. In the remaining paragraphs, I describe the results of our in-depth review of these agreements for indicia of the software innovation being transferred through them.

Contrary to other studies, we find evidence in this dataset that patents are supporting the transfer of technology, not just freedom from suit. Among licenses where patent are "core," patents generally support the transfer of trade secrets, know-how, or other proprietary information, consistent with theories of how patents resolve the Arrow information paradox. However, non-patent proprietary assets – in particular code and trade secrets – are more commonly transferred than patents. In addition, the presence of intellectual property in the agreement does not necessarily impact the exclusivity profile of the license – that is to say, licenses were just as likely to be exclusive, non-exclusive, or regardless of intellectual property protections. This suggests that in many cases, contract law, rather than patent or other intellectual property, may be doing the heavy lifting.

1. Among Patent Software Licenses reported to the SEC, Patents are Supporting the Transfer of Technology

Though studies described earlier have documented the use of licenses to support the transfer of both technology and liability, current research suggests that in recent years, when licensees are approached to take a license, they walk away from the deal with little more than a way to avoid costly litigation.[203] Recent studies of patent licensing cast patent licenses in a similar light, characterizing them as always conducted in the shadow of litigation, rather than, for example, the shadow of competition.[204] To test the extent to which patent licenses were merely providing a shield from litigation, with little additional benefit, we looked directly at the terms of licenses. We found some evidence consistent with the idea that patent-related clauses within agreements primarily served the

203 Feldman and Lemley, supra note ___ ("finding that very few patent license demands actually lead to new innovation; most demands simply involve payment for the freedom to keep doing what the licensee was already doing.")
204 Jonathan Masur, *The Use and Misuse of Patent Licenses*, 110 NORTHWESTERN UNIV. L. REV. 1115 (2015). William Lee and A. Douglas Melamed, *Breaking the Vicious Cycle of Patent Damages*, 101 CORNELL L. REV. 385 (2016) [pincites and parentheticals needed]

role of confirming or shifting liability. Out of the 1,431 software technology licenses, patents were mentioned 66% of the time (N=1,163). However, on closer inspection, the majority of these mentions were incidental to the actual subject matter of the license, as patents were mentioned not as the subject matter of the grant, but, in the majority of cases, as part of an indemnity or limitation of liability clause (N=683, or 60% of software technology licenses where patents were mentioned).[205] That left only 480 agreements in which patents were considered "core."

We removed licenses that also effected asset transfers, leaving 245 licenses. We studied the terms of these licenses, and, as earlier studies have done, coded the extent to which the agreement was a "naked" patent license, or a license that also included the transfer of trade secrets of all forms (including know-how, proprietary information, and confidential information), computer code, or trademarks. We found that, among registered material agreements to transfer software innovation, the licensing of patents was usually accompanied by the transfer of know-how, code, and other proprietary assets. The vast majority (98%, 240/245) of these patent licenses included trade secrets of some form, or some sort of computer code (generally object code), source code, library, bug fix, and/or executable (95%, 232/245). That is to say, in contrast to some evidence that patent licenses almost never include other forms of technology transfer, we found the opposite – that the patent licenses in our study almost always included trade secrets or source code, and often both. (FIG. ___)

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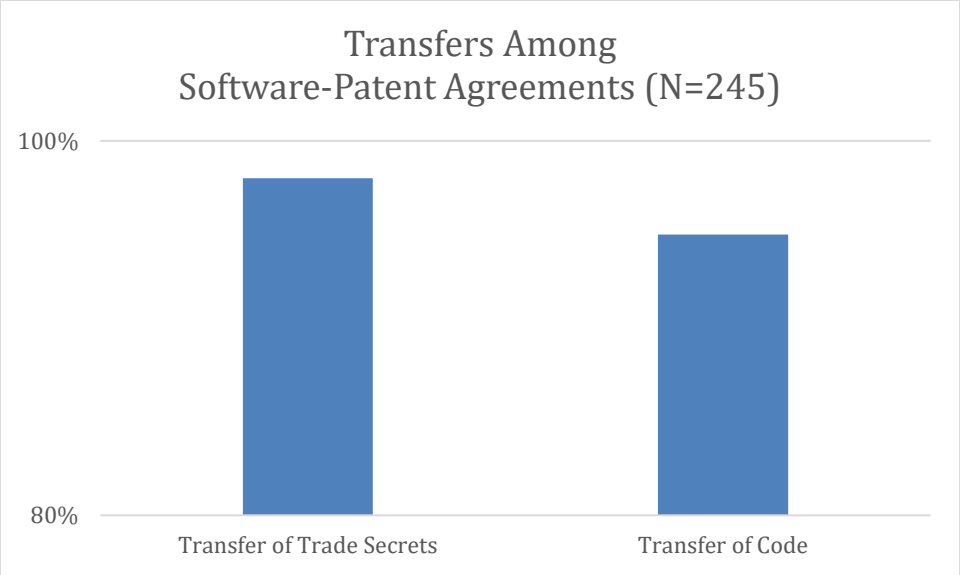
205 See, e.g. the following mentions of patents within agreements: [NOTE TO EDs: this and other footnote paragraphs should be reformatted so they aren't stretching across as such]
"5 INDEMNIFICATION

5.1 Agilent shall defend and indemnify Ansoft and hold it harmless from any and all losses, damages, costs and out-of-pocket expenses, including reasonable attorneys' fees, incurred by Ansoft that result from any claim, lawsuit, proceeding, or other action, whether legal or equitable, by a third party alleging that the unmodified Agilent HFSS Software Products or the Domain Name infringes any copyright, trade secret, patent, or other intellectual property right, anywhere in the world. Counsel provided by Agilent to represent Ansoft shall be mutually acceptable to both parties. Ansoft may participate in any such claim at its own expense."
Exhibit 10.12, AGILENT HFSS TECHNOLOGY LICENSE AND TRANSITION AGREEMENT (effective May 2001), available at https://www.sec.gov/Archives/edgar/data/849433/000095015203007071/j0226301exv10w12.txt

"10.10 No Other Licenses. Nothing in this Agreement will be deemed to grant, by implication, estoppel, or otherwise, a license under any of Parthus's existing or future patents; however, Parthus agrees that it will not assert any of its rights under such patents against Licensee or its Customers based on the manufacture, use, sub-license or distribution of the Licensed Products as permitted by this Agreement. Nothing contained in this Agreement shall be construed as conferring by implication, estoppel or otherwise upon either party hereunder any licenses or other right except the licenses and rights expressly granted hereunder to a party hereto." Exhibit 10.21 PARTHUS TECHNOLOGIES PLC LICENSE AGREEMENT (undated), available at https://www.sec.gov/Archives/edgar/data/1173489/000095016802002982/dex1021.htm



The transfer of technology, as opposed to naked patent rights, was striking. In contrast with *licensor*-initiated licenses, the significant technology agreements we studied largely reflected mutual, rather than one-sided, interest, and the *ex ante*, rather than *ex post,* licensing of technology. This suggests that patents play an integral role with respect to *both* types of transfers.

a) Patent Borders

We also tested the theoretical roles of patents by studying actual agreements. Consistent with prospect theory, within agreements, patents provided a way to identify the subject matter of the transfer. In the following example clause from a license, patents are used to designate not only the technology being transferred, but also the technology *not* being transferred:

> (i) TECHNOLOGY – Technology, as used herein, shall mean and refer to the algorithms, software and hardware designs, and methods relating to the field of image processing, specifically to the efficient coding and compression, decoding and decompression of video images, described in Differential Order Video Encoding System, US Patent #5,739,861, issued Apr.14, 1998. Japan Patent #3441736 issued Sept. 2, 2003. Canada Patent #2,252,545, issued July 13, 2004 and Patents Pending in E.U. and Korea, as well as certain related trade secrets, including invention, know-how, trade secret, function, design and any other features related to software that embody or are based upon the patents referred to herein and/or other proprietary intellectual property contained in Source Code. The term "Technology" shall not include, mean or refer to, and nothing contained anywhere in this Agreement shall confer or be deemed to confer upon ICOP any rights in or to, any of the algorithms, software and/or hardware designs, and methods relating to the field of image processing described in US Patents 5,164,819 (Method and System for Coding and Compressing Color Video Signals)

issued November 17, 1992, and US Patent 5,448,296 (Variable Parameter Block Coding and Data Compression System) issued September. 5, 1995.[206]

It's difficult to know, in the abstract, whether or not a given agreement would have been signed without a patent. Besides showing up in an agreement, before the point of the transaction, a patent may have motivated the initial invention and supported the inventions' subsequent disclosure. What about in the example above? One might argue that the deal would have been much harder to reach in the absence of the patents, given the disclosing party's strict delineation of rights. In addition, the patent's terms defined the scope of the agreement, making it easier for the parties to transact. In some of the agreements, the definitional role of patents extended not only to the subject matter of the technology, but also to other terms of the agreement, such as its duration.[207]

However, patents may cut the other way too. The presence of a patent can lead to deals *not* getting done, insofar as it widens the gulf between the patentholder, who may view the technology as that much more valuable because of the patent, and the prospective licensee, who cares only about the technology. When surveyed about why deals don't get done, licensing executives have pointed to the inability to reach agreement on price as the top reason.[208] Transactions involving IP assets are perceived as being more complex and costly to evaluate. [209]

In addition, in some subset of cases, parties who are determined to transact will figure out ways to do so, with or without patents. After all, in the majority of SEC software agreements, patents were not core. The next section provides additional context for understanding the role of patents, and intellectual property in general by comparing other types of transfers, and the impact of the presence of IP on exclusivity provisions.

2. *Non-Patent are More Prevalent than Patent Protections in Transferring Software Innovation, and Exclusivity Does Not Depend on the Presence of IP*

If patent rights were *not* being transferred in the majority of software agreements, what *was* being transferred? We relied on codings by kTMine to probe this question. We found that although patents were core to the transfer in about 34% of software agreements (480/1,419), other forms of intellectual property and proprietary technology were *more* prevalent and likely to be transferred . Trade secrets, proprietary rights, know-how, or related rights were core to 38% of the agreements,[210] while various

206 **SOFTWARE DECODE LICENSE AGREEMENT** between Showlei Associates and ICOP Digital (dated January 7, 2005), available at http://contracts.onecle.com/icop/showlei.lic.2005.01.07.shtml

207 See, e.g. "Section 6.01 - Expiration of Agreement: Unless this Agreement already has been terminated in accordance with the provisions of Section 6.02, this Agreement shall terminate five years from effective date or with the expiration of the last patent, whichever is first, and thereafter is renewable at LICENSEE's request at terms and conditions in force at the time of renewal." DIGITAL AUDIO SYSTEM LICENSE AGREEMENT (Professional Encoders) between Dolby Laboratories and Scopus Network (effective August 2003).

208 Cockburn, supra note ___, at Table 5.

209 Id. at 7.

210 542/1,431 = 38%. A single agreement could effect the transfer of more than one type of right, for example, patent rights and trade secrets. We took a closer look at a few agreements in which trade secrets were transferred in the absence of patent rights. In one case, the agreement specifically referred to "unpatented inventions (LICENSE AND SERVICES

forms of software – executables, source code, programs, bug fixes, libraries, operating systems, algorithms, and other software building blocks – were transferred in 88% of cases.[211] (See Appendix, XFIG.___) Copyright provisions were also pervasive, specifically showing up in about 31% of agreements, a number that potentially understates the importance of copyright, given the automatic nature of copyright. A combination of trade secret, contractual safeguards, copyright, as well as patent measures supported the bulk of the agreements.

In accordance with previous studies, we also looked at the exclusivity provisions of the licenses in this dataset to understand the extent to which intellectual property supported a contract's terms. In comparison to generally non-exclusive, "open source" software licensing agreements, the licenses we studied were at times exclusive, but more frequently, non-exclusive or multi-exclusivity, for example, by being exclusive in one territory or field of use, while non-exclusive in another.[212] Among all agreements, 34% had exclusive terms, 4% had non-exclusive terms, and 62% of the licenses were "multi-exclusivity."[213]

The presence of patents or other forms of intellectual property[214] had ramifications for the amount of exclusivity. One of the arguments made in favor of intellectual property is that it provides a quantum of rights that can then be reduced or otherwise tailored by contract to fit the circumstances. The overwhelming majority of the software contracts (96%) fit this pattern, insofar as they contained some measure of exclusivity. However, it is also the case that intellectual property was not always needed to support this range of exclusivity options. Even when intellectual property was not a key component (N=558), non-exclusive and multi-exclusivity, rather than non-exclusive, provisions predominated, at almost the same rate as they did in intellectual property agreements (FIG ___) . Among these agreements, contract law appears to be doing much of the work in terms of allocating rights between parties.

V. CONCLUSION

Software innovation is transforming the US economy. Yet, the paid market for software innovation is poorly understood, in part because of a lack of public information about the licensing and transfer of innovation between firms. This paper skirts these obstacles by drawing upon several proprietary datasets, exploring the market for software innovation through the lens of patent licenses and sales. I find that despite the intense academic and policy focus on software patent litigation, software patents are much more likely to be transferred than litigated (1.4-2.4% odds of being sold per year vs. 1-2% odds of being litigated per lifetime), and argue that more attention should be paid to the market for innovation. Further, although the Supreme Court and new procedures have made it harder to enforce software patents, I find that the market for software innovation remains remarkably robust, with the number of software patents sold growing over 50% from 2012 to 2015. I attribute this development to the robustness of the demand for patents providing freedom to operate, the strength of software business models, and bargain shopping as the price of individual patents has gone down.

AGREEMENT between Audible, Inc. and Audible.de GmbH (dated August 30,2004)), in another, the agreement mentioned one or more patents were pending but had not been issued.

211 1,261/1,431 = 88%.

212 http://www.ktmine.com/wp-content/uploads/2014/04/044-045-IPM_July_August_2013-Feat.pdf

213 1,308 of the 1431 software agreements had ascertainable exclusivity provisions. Of those 441 were exclusive, 809 were multi-exclusive, and 58 were non-exclusive.

214 Copyright, trade secret, or trademark and related rights.

This paper distinguishes between transfers to support the transfer of technology as opposed to mere transfers of liability (generally through naked patent licenses). Contrary to other studies, I find that the majority of significant software patent agreements registered with the SEC (N=245) support true technology transfer. However, trade secret and code were more important than patent for transferring software innovation between firms. In addition, it appears that large numbers of patents, are being sold to avoid litigation or provide freedom to operate, not to access technology for development. The traditional narrative of patents enabling young companies to get access to the commercialization capabilities of larger, more established firms isn't supported by the data – patents are two to three times more likely to go from an older company to a younger company, and from a higher revenue to lower revenue public company, based on available data. When transactions are not accompanied by the transfer of technology, this finding lends some support to the perception of software patents as a tax on innovation that young companies must pay to older firms.

VI. APPENDIX

XFIG___ : The Distribution of Material Software Agreements Reported to the SEC Across Industries[215] (2000-2015)

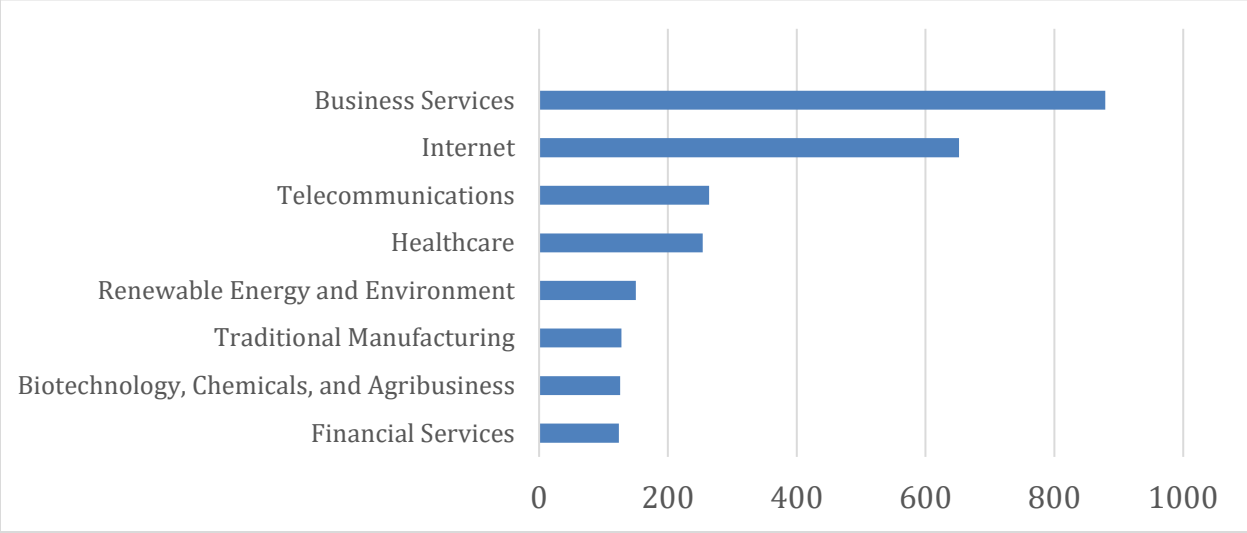
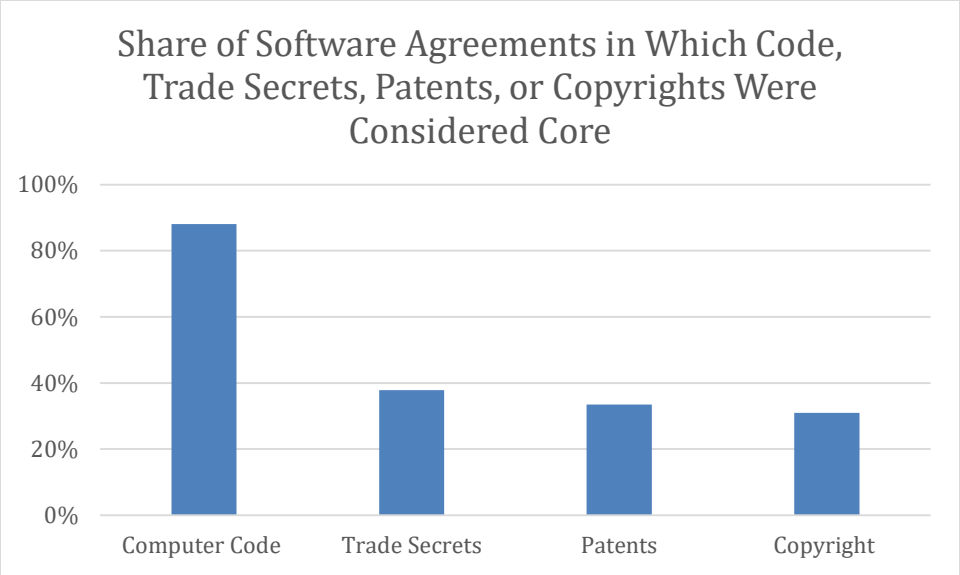


Table X___: Chi-Test Results

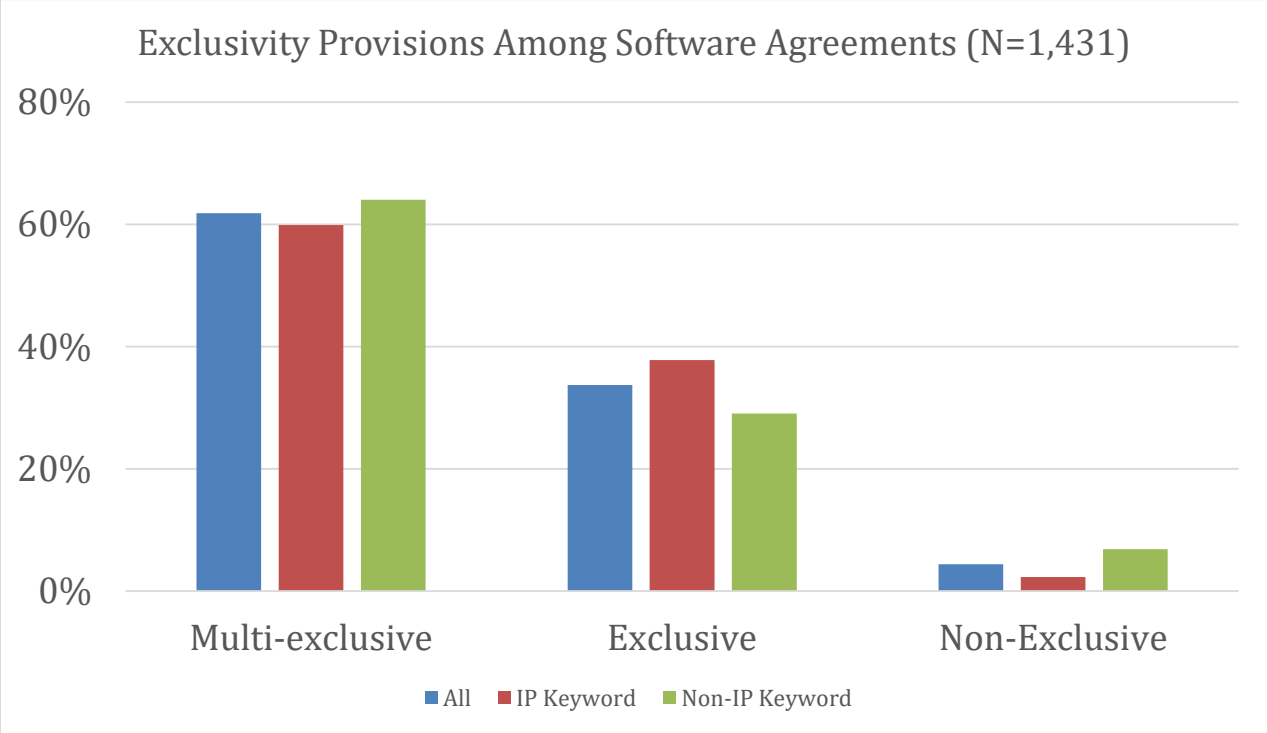
Shares						
Year	***Software Patent Transfers- To Younger Firm***	***Biotech Patent Transfers- to Younger Firm***	***Software Patent Deals- to Younger Firm***	***Biotech Patent Deals - Ages***	***Software Patent Transfers - to Poorer Company***	***Biotech Patent Transfers - to Poorer Company***
2012						
2013						
2014						
2015						
All						
P-Values						
2012	1.7E-162	3.6E-10	0.0E+00	0.0E+002	7.4E-03	7.0E-01
2013	1.6E-81	3.3E-16	8.2E-54	2.9E-08	1.2E-02	8.0E-02
2014	1.4E-116	4.5E-01	3.1E-87	1.8E-09	4.4E-03	4.5E-03
2015	0.0E+00	8.4E-01	0.0E+00	1.0E-25	1.2E-03	1.1E-01
All	0.0E+00	5.6E-03	0.0E+00	1.2E-03	1.2E-08	2.6E-01

215 A single agreement may be assigned to one than one more industry.

XFIG: ____


Share of Software Agreements in Which Code, Trade Secrets, Patents, or Copyrights Were Considered Core
100%
80%
60%
40%
20%
0%
Computer Code
Trade Secrets
Patents
Copyright

XFIG: ____


Exclusivity Provisions Among Software Agreements (N=1,431)
80%
60%
40%
20%
0%
Multi-exclusive
Exclusive
Non-Exclusive
All
IP Keyword
Non-IP Keyword