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

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

The same week that Marc Andreessen published his well-known essay, "Why Software is Eating the World," Google took steps to buy handset-maker Motorola Mobility, a deal ultimately valued at $12.5B.[3] Andreesen cited this development and others, as well as the rise of software companies Amazon, Netflix, Shutterfly and the demise of bricks and mortar companies Borders, Blockbuster, and Kodak, for the proposition that software had or would be disrupting industries across the economy, requiring leading companies to adapt to new, digitally-driven business models, or die. Since then, the transformation of the car riding industry by "sharing economy" software companies Uber and Lyft, of the hotel industry by AirBnB and others,[4] of the financial services industry by virtual and crypto currency companies and of "countless examples," lend support to his point.[5]

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 200 years,[6] the US patent, for defending against new legal threats. Because while Google acquired Motorola's physical assets through the deal, its main objective was to acquire Motorola's intangible assets, its patents.[7] As Google CEO Larry Page blogged, adding Motorola's patents to Google's own

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[2] Marc Andreessen, *Why Software Is Eating The World*, The Wall Street Journal: Essay (AUGUST 20, 2011), available at http://online.wsj.com/article/SB10001424053111903480904576512250915629460.html.

[3] *Id*., Evelyn M. Rusli and Clair Cain Miller, *Google to Buy Motorola Mobility for $12.5 Billion*, Dealbook: New York Times, (August 15, 2011), available at http://dealbook.nytimes.com/2011/08/15/google-to-buy-motorola-mobility/?_r=0.

[4] David McNierney, *Here's What's Eating Software*, CA Technologies: Rewrite, (March 24, 2016), available at http://rewrite.ca.com/us/articles/digital-transformation/here_s-what_s-eating-software.html.

[5] *Id*.

[6] 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, at 259–64 (1998).

[7] *See*, e.g. description of the deal in Walter Isaacson, THE INNOVATORS: HOW A GROUP OF HACKERS, GENIUSES, AND GEEKS CREATED THE DIGITAL REVOLUTION, at__ (2014).

portfolio would protect Google's Android operating system from potential attacks by competitors like Microsoft, Apple and others.[8]

Just as software innovation is on the rise, so is software patenting.[9] Identifying software patents is notoriously difficult, but applying the World Intellectual Property Organization's industry definitions, the share of US patents that can be classified as Electrical Engineering – a class that includes digital communications, computer technology, and communications, among others[10]– 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 had risen to nearly 50%. The remaining industries segments, including instruments, chemicals (a category that includes pharmaceutical drugs) and mechanical engineering divided, roughly evenly, most of the remainder.

The question is whether software is eating the world because of software patents, despite them, or something else. Patents can help young companies overcome the advantages of incumbents, including by helping them access capital;[11] and, much software innovation happens in young firms. But the rise in high-tech patenting has directed intense academic and policy attention to how to improve the fit between software patents and software innovation, in particular, with respect to the challenge of maintaining patent quality, when much software innovation is incremental and fast-paced,[12] and with respect to the growth in software patent

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[8] Larry Page, *Supercharging Android: Google To Acquire Motorola Mobility.* Official Google Blog, (August 15, 2011), available at https://googleblog.blogspot.com/2011/08/supercharging-android-google-to-acquire.html.

[9] *See*, James Bessen and Robert M. Hunt, *An Empirical Look At Software Patents,* J. OF ECON & MAN. STRAT., (March 1, 2007), Vol. 16, No. 1, 157-89, available at http://www.researchoninnovation.org/swpat.pdf. (Documenting an increase of software patents to 15% of the total by 2004). Brian Kahin, Software Patents: Separating Rhetoric from Facts, SCIENCE PROGRESS (May 15, 2013), FIG. 3 (available at http://scienceprogress.org/2013/05/software-patents-separating-rhetoric-from-facts/) (showing an approximately 2.6 fold increase in software grants from 2005 (26,000) to 2012 (68,000) and the granting of 75 percent more software patents in 2012 than in 2009).

[10] 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)*, Karslruhe: Fraunhofer ISI. (Jun. 2008), available at 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,* National Bureau of Economic Research, (October 1, 2001) (available at http://www.nber.org/papers/w8498.pdf), and is preferred for this reason.

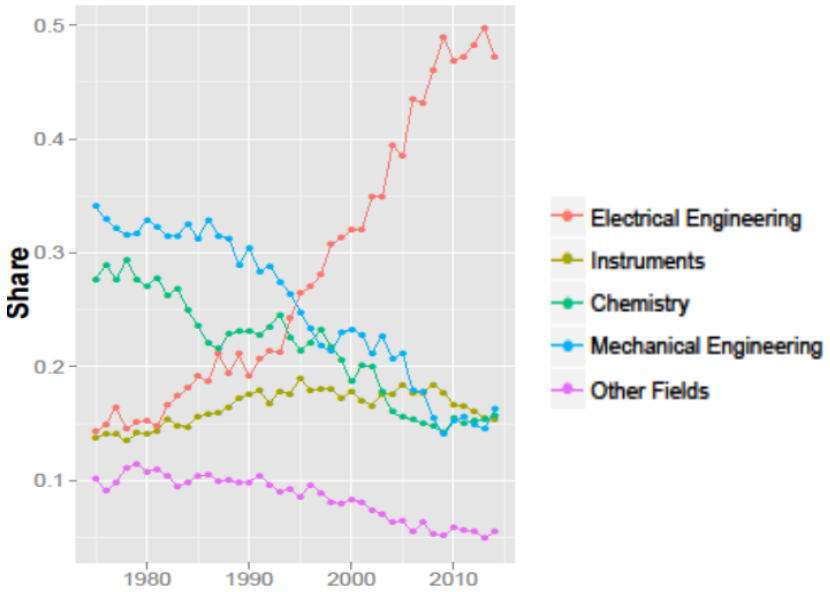
[11] As discussed infra at Part ____.

[12] The challenges of evaluating the patentability of software inventions have long been well-known. *See*, e.g. Report to the Senate Judiciary Committee, *President's Commission on the Patent System, To Promote the Progress of Useful Arts*, S. DOC. NO. 90-5, at 21 (1st Sess. 1967). ("The Patent Office now cannot examine applications for programs because of the lack of a classification technique and the requisite search files. Even if these were available, reliable searches would not be feasible or economic because of the tremendous volume of prior art being generated. Without this search, the patenting of programs would be tantamount to mere registration..."). In addition, because U.S. patent examiners rely heavily on U.S. patents to determine whether an application meets the standards of patentability, that much of software innovation occurs outside of the patent system in turn, makes it more difficult to assess patentability.

litigation, including by patent assertion entities.[13] In a 2011 report to Congress, the GAO found that lawsuits involving software-related patents accounted for 89 percent of the increase in

FIG __: The Rise of Silicon and Decline of Carbon and Steel[14]

Shares of US Patents by Industry 1970-2015



defendants from 2007-2011 and that between 2007 and 2011, two-thirds of defendants were sued over software-related patents.[15] In 2015, USPTO Director Michelle Lee launched an "Enhanced Patent Quality Initiative" to ensure that issued patents were "correct and clear," making the program a centerpiece of her tenure.[16] Law academics have written dozens of studies addressing the topic of patent litigation by patent assertion entities alone.[17]

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[13] *See*, e.g. Executive Office of the President, *Patent Assertion and U.S. Innovation,* (2013), available at https://www.whitehouse.gov/sites/default/files/docs/p atent_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.

[14] Reproduced from Colleen V. Chien, *Opening the Patent System* __ SO. CAL. LAW REV.___ (2016), Fig. 2 (forthcoming).

[15] General Accounting Office, *INTELLECTUAL PROPERTY: Assessing Factors That Affect Patent Infringement Litigation Could Help Improve Patent Quality,* GAO-13-465, (Aug 22, 2013), available at http://www.gao.gov/products/GAO-13-465.

[16] Michelle K. Lee, Director's Forum Blog, United States Patent and Trademark Office (USPTO), *Enhanced Patent Quality Initiative Moving Forward*, (November 6, 2015), available at http://www.uspto.gov/blog/director/entry/enhanced_patent_quality_initiative_moving.

[17] *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), available at http://cpip.gmu.edu/wpcontent/uploads/2015/03/Economists-Law-Profs-Letter-re-Patent-Reform.pdf; http://patentlyo.com/patent/2015/03/rewards-effective-reform.html; and, the studies cited by the Council of Economic Advisors March 2016 Issue Brief, *THE PATENT LITIGATION LANDSCAPE: RECENT RESEARCH AND DEVELOPMENTS,* available at https://www.whitehouse.gov/sites/default/files/page/files/201603_patent_litigation_issue_brief_cea.pdf.

The problem with these efforts is that an exclusive focus on the "endpoints" in the life of a software patent overlooks the role of patents, not at the flashpoints of patent acquisition and litigation, but as part of the routine and everyday functions of facilitating financing, transactions, freedom to operate, and the transfer of technology. The gap in empirical work on the ways in which patents do (or do not) support software innovation is understandable in light of the lack of public information about these practices. There is no requirement to publicly record patent licenses, for example, much less to disclose price data about such transactions.[18] Even when licenses are disclosed in the course of litigation, which are public proceedings, their terms are often kept secret behind protective orders and under seal.[19] As a result, the legal academy has devoted relatively less empirical attention, with a few notable exceptions,[20] to the considerable "middle layer" in the life of software patents in particular their licensing, sale, and related transactions.[21] But the gap in the literature is also problematic, insofar as it produces at best incomplete and at worst a distorted understanding of the relationship between patents and software innovation.

This paper attempts to address this gap, by exploring software innovation from the perspective of software licenses and patent sales. The data sources for this paper include significant patent licenses that have been recorded with the SEC as part of the duty of public companies to report "material" events, as well as sales of software patents recorded with the US Patent and Trademark Office (USPTO). While patent litigation involves an estimated 1-2% of all patents,[22] software patents are transferred at a much higher rate – at around 1.5% per year, which translates into 21% over a 13.5-year period.[23] Material licenses involving software – wih and without patents –

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[18] *See*, e.g. Carlos C. Serrano, *The Dynamics of the Transfer and Renewal of Patents*. THE RAND J. ECON., Vol 41, No. 4, pp. 686-708, at 690, (2010) available at http://www.econ.upf.edu/~cserrano/papers/serrano_rand2010.pdf, (describing the lack of a requirement to publicly record patent licenses, and providing a summary of the anecdotal data that is available).

[19] *See*, discussion in Part ___ *infra*.

[20] 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") available at 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), available at 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 __.

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

[22] Lerner et. al., document the 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. Lerner et. al., *Financial Patent Quality: Finance Patents After State Street*, Harvard Business School, (November 2015), available at http://www.hbs.edu/faculty/Publication%20Files/16-068_702dabb8-70c5-4917-a257-75dc8b0c4f6b.pdf.

[23] As described in further detail in part ___, in a forthcoming study of transfers recorded between 2012 and March 2016, Chien and Khaskari document that about 6.3% of patents were transferred at least once during the 4.25 year

were reported by an estimated 13% of the studied "pure software" companies. Based on the analysis, this paper finds:

- Software is part of an estimated 42% of material technology agreements registered at the SEC since 2000 (2,645 out of 6019), and is core to about 24% of these agreements (1,451 out of 2,645).
- Significant technology licenses involving software are being entered into across industries, including: biotechnology, healthcare, and traditional manufacturing sectors in addition to "digital" sectors like computers, internet, and semiconductors;[24] about 23% of "pure software" public companies with less than $10M in revenue have reported at least one material technology agreement since 2000.
- Patents (and to a lesser degree other forms of intellectual property) support the licensing of software, but they play a mixed role, transferring legal liability in the majority of cases but also transferring technology in a substantial minority of them. Within our small sample, patents were more likely (approximately 60%) to be held by the smaller party to the transaction.[25]
- In a given year, about 1.5% of software patents (or 21%, over a 13.5-year life) are transferred in a stand-alone sale, 73% of the time from a larger to a smaller entity (in terms of patent numbers), resulting in a redistribution upward of capital but redistribution downward of patents.
- Patent sales appear to be supporting both the transfer of legal liability and technology.

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 the results. Part IV concludes.

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period or approximately 1.5% per year, which would translate into an approximately 21% chance of transfer over the lifetime of a patent that stayed in force through the third maintenance fee (13.5 years). *Cf* Serrano, *The Dynamics Of The Transfer And Renewal Of Patents*, *supra* note ___. (reporting a hazard rate for patent transfer in general, based on patents from 1983-2002, of 13.5%)

[24] In addition to supporting Marc Andreesen's statement above, this finding is supportive of other studies on the cross-industry impact of software innovation as discussed infra in Part__.

[25] As elaborated further in Part ___, *infra*, we calculated this figure in two ways, first by assuming that in a case where revenue could not be found for either the filing company or the counterparty, that the filing company was larger than the counterparty (N=119, 62% patentholder was smaller), and second by excluding such cases from analysis (N=80, 58% patentholder was smaller) [file: Patent120 Analysis GDoc].

Part I: Theory and Evidence Regarding the Licensing and Sale of Patents, in Particular Software Patents

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...."[26] 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.[27] Ex ante, the inventor is 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.[28] Society gets greater innovation though it also pays more in reduced competition.

Transactional justifications for the patent system adjust this story in a few ways. Ex ante, transactional freedom strengthens the basic incentive as the ability of patentees to sell their technology to those who can more efficiently develop and commercialize technology "prospects"[29] raises the likelihood of a favorable return on investment. Patents increase the odds of transactions happening by increasing the confidence of patentholders that their inventions won't be copied based on negotiation disclosures, thereby overcoming the challenge of selling information known as the "Arrow information paradox."[30] Ex post, patents can

[26] U.S. CONST. Art. 1, § 8 cl. 8.

[27] Described, e.g. in Michael J. Burnstein, Patent Markets: A Framework For Evaluation. ARIZONA ST. L.J. Vol 47, pp. 9 (April 6, 2015, Forthcoming). Across surveys, deterring copying is consistently reported as the top reason that inventors patent. *See*, e.g. Graham et. al., 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, Feb. 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, Mar. 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 et. al., Motivations to Patent: Empirical Evidence From an International Survey 2, 8, Tbl. 2, available at *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).

[28] See Mark Lemley, Ex Ante v. Ex Post Justifications for Intellectual Property

[29] *See*, e.g., Ted. Sichelman, *Commercializing Patents*, 62 STAN. L. REV. 341, 373-76 (2010) available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1395558; Michael Abramowicz, *The Danger of Underdeveloped Patent Prospects*, 92 CORNELL L. REV. 1065, 1068-70 (2007) available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2282633.

[30] 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) available at http://scholarship.law.berkeley.edu/.

promote freedom to operate[31] and access to capital and talent,[32] by signaling a small or young firms' innovative potential to investors[33] or banks (through the securitization process)[34] or directly, through sales or licensing.

But just as patent transfers exploit comparative advantages in commercialization, they can also exploit comparative advantages in enforcement.[35] While both forms of transfer can promote innovation, transactions that are motivated by the extraction of rents through patent assertion retard innovation.[36] As Justice Kennedy has noted, there is a distinction between the use of patents "as a basis for producing and selling goods" and as a "bargaining tool to charge exorbitant fees."[37] Many commentators and policymakers have noted that the patent market supports both uses, 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 – acknowledging that it may be difficult to develop a consensus regarding whether or not a license falls into this category[38]– can decrease social welfare.[39]

To what extent do these theories of the patent system 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.[40]

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[31] 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), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1703557.

[32] *See*, e.g., Robert P. Merges, *A Transactional View of Property Rights*, 20 BERKELEY TECH. L.J. 1477 (2005), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=707202&rec=1&srcabs=1323408&alg=1&pos=1.

[33] Carolin Haussler et. al., *To Be Financed or Not…-The Role of Patents for Venture Capital-Financing, ZEW-Centre for European Economic Research*, Discussion Paper No. 09-003 (2012).

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

[35] Alberto Galasso et. al.,*Trading and Enforcing Patent Rights*. THE RAND J. OF ECON, Vol. 44, No. 2, pp. 275-312, (June 1, 2013).

[36] *Id*.

[37] *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388, 396 (2006).

[38] *See* Colleen V. Chien, *Holding Up and Holding Out*, Michigan Telecommunications & Technology Law Review 21:1 (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.")

[39] *See* e.g. Colleen V. Chien, *Reforming Software Patents*, 50 Hous. L. Rev. 325, ___(2012) (describing nuisance fee-driven patent litigation and settlement), FED. TRADE COMM'N, THE EVOLVING IP MARKETPLACE: ALIGNING PATENT NOTICE AND REMEDIES WITH COMPETITION (Mar. 2011), available at https://www.ftc.gov/sites/default/files/documents/reports/evolving-ip-marketplace-aligning-patent-notice-and-remedies-competition-report-federal-trade/110307patentreport.pdf, Burstein, note __ and Robert P. Merges, *The Trouble with Trolls: Innovation, Rent-Seeking, and Patent Law Reform*, 24 BERKELEY TECH. L.J. 1583, 1588 (2009), available at http://scholarship.law.berkeley.edu/ (describing "inefficient socially wasteful patent transactions" carried out by patent "trolls")

[40] For a summary of the pros and cons of patents for software startups, based on about 60 interviews with software developers, venture capitalists, angel investors, banks that lend to software startups, large software and

Software innovations tend to be incremental, conceptual, and algorithmic; patents are supposed to be reserved for only non-obvious,[41] non-abstract, non-mathematical inventions.[42] As property rights, patents function best when they articulate clear boundaries for the range of excluded behavior. But software patent boundaries are notoriously "fuzzy,"[43] given their functional nature, reliance on non-specific language[44] that captures the function rather than the form of the underlying code, and the use of "patentese"[45] - the special, technical legal language of patents.[46] Software cycles tend to be short, while patent cycles are long. It currently takes, on average, 17 months for the US Patent and Trademark Office (USPTO) to begin examining a patent application, and about another 10 months for it to complete examination.[47] Under the normal default, the patent application will publish at 18 months,[48] and a patent can stay in force for up to 20 years from the date of filing. It takes about a year,[49] and often hundreds of thousands, if not millions of dollars, to resolve a patent case.[50] But in fields like smartphone mobile applications, the market environment is changing quickly.[51] Many apps fail within weeks if not months, making it hard to know ex ante whether or not the app is worth protecting. Imitation cycles are also fast, with the most successful applications imitated within months;[52] 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

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hardware firms, and others, *see* Ronald Mann, *Do Patents Facilitate Financing in the Software Industry?* 83 TEX. L REV. 961 (2005), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1507543.

[41] 35 U.S.C. §103 (Restricting patentability to non-obvious subject matter).

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

[43] James Bessen and Michael J. Meurer, PATENT FAILURE: HOW JUDGES, BUREACRATS, AND LAWYERS PUT INNOVATORS AT RISK (Princeton University Press, 2008).

[44] https://www.flickr.com/photos/opensourceway/6554315093/sizes/l

[45] Sean B. Seymore, *The Teaching Function of Patents*, 85 NOTRE DAME L. REV. 621, 627 (2010), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1352044.

[46] To take one recent example, does the term "distributed learning control module" cover any software or hardware that carries out a set of basic of 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, LLC*, 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

[47] USPTO Dashboard http://www.uspto.gov/dashboards/patents/main.dashxml (Last visited November 15, 2015).

[48] 35 U.S.C. § 122.

[49] Mark Lemley, *Where To File Your Patent Case*, AIPLA QUAR. J. Vol 38, No. 4 (2010), available at http://law.stanford.edu/wp-content/uploads/sites/default/files/publication/260028/doc/slspublic/ssrn-id1597919.pdf.

[50] *Aipla Report Of The Economic Survey*, Law Practice Management Committee, I-153–54 (2015), available at http://files.ctctcdn.com/e79ee274201/b6ced6c3-d1ee-4ee7-9873-352dbe08d8fd.pdf.

[51] Christian Helmers, et. al., *Innovation Without Patents? Evidence from the Smartphone App Markets,* 2013 draft available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2529669; 2014 draft on file with the author.

[52] *Id*. Fig 2-5.

patent. According to a recent study by Christian Helmers and his colleagues, only a tiny share – around 0.04% - of smartphone applications are protected by app-relevant patents.[53] There are obviously counterexamples to the app-environment – 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.[54] But the sense that "software is different,"[55] has led prominent leaders in the industry to reject the premise that software patents are necessary to incent software innovation.[56] As the Berkeley Patent Survey found, two-thirds of software entrepreneurs do not have or seek patents.[57]

Putting aside the incentive to invent story, software patents nevertheless may be supporting (or deterring) innovation through the transactional pathways alluded to above. Studies to address this issue have tended to focused on the motives, benefits and costs of patent acquisition and the challenges associated with patent litigation against small firms. While they confirm that for small and startup firms, the successful pursuit of patents can support the creation of jobs and sales growth,[58] as well as be driven by signaling and financing motives,[59] they also show that patenting takes resources away from engineering tasks,[60] and that patent litigation demands are a distraction and strain on the innovative enterprise, sometimes taking a significant operational toll on small companies.[61]

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[53] *Id*. Table 4.

[54] *Id*. Table 5.

[55] *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."

[56] *See*, e.g. Fred Wilson, *Enough is Enough*, Business Insider (June 1, 2011), available at http://www.businessinsider.com/enough-is-enough-2011-6 ("I believe that software patents should not exist").

[57] Graham, *supra* note ___ at Table 1. But among venture backed software startups, the share of patenting was much higher, 2/3rd (*Id*.).

[58] *See*, e.g. Joan Farre-Mensa, et. al., *The Bright Side of Patents,* USPTO Economic Working Paper No. 2015-5, (January 26, 2016), available http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2704028; David H. Hsu and Rosemarie H. Ziedonis, *Patents as Quality Signals for Entrepreneurial Ventures*, (2008). Academy of Management Best Paper Proceedings (finding a positive effect on startup company value and patents).

[59] Stuart J.H. Graham, et. al., *High Technology Entrepreneurs and the Patent System: Results of the 2008 Berkeley Patent Surve*y, 24 BERKELEY TECH. L. J., 1255, 1327 (2009), Table __.

[60] Ronald Mann, *Do patents facilitate financing in the software industry?* 83 TEX L. REV. 961, (2005).

[61] *See*, e.g. Colleen V. Chien, *Startups and Patent Trolls*, STANFORD TECH. L. REV. (first posted in 2012), available at https://papers.ssrn.com/sol3/Papers.cfm?abstract_id=2146251; Colleen V. Chien *Patent Assertion and Startup Innovation,* Open Technology Institute White Paper, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2321340; and, James Bessen [add year, etc.] https://hbr.org/2014/07/the-evidence-is-in-patent-trolls-do-hurt-innovation/ [add parenthetical] *see* also [add expanded cite] http://engine.is/wp-content/uploads/VCsforPatentReformLtr2015-1.pdf.

Despite their value, these studies 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, take place after technology has been transferred or copied, or not.[62] 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 exclusively on litigation or acquisition, in turn, tend to focus in isolation on the innovation-deterring and innovation-enhancing roles of patents. The present study is different, because it directly observes the actual transactions – licenses and sales – in the marketplace for patented software innovations.[63] These transactions have the ability to support the transfer of technology, embodied for example in know-how and trade secrets that supplement the patent document, as well as transfer of liability. In this paper I distinguish between technology transfers and "liability transfers," a value-neutral term I use to refer to licenses whose patent provisions do not include the transfer of technology but the transfer or formalization of liability between the parties through indemnity and settlement clauses. While liability transfers could be welfare-enhancing, insofar as they support the exclusion that animates the incentive to invent story as well as reallocate patents to entities that are more efficient at resolving disputes,[64] 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.[65] In the following paragraphs, I review existing work as a backdrop to the present study.

Lamoreaux and Sokoloff have performed the most significant early work on markets for technology in the 19th century using the patent record.[66] Made known by weekly descriptions published in the publication *The Scientific American* starting in 1845 and the patent lawyers and agents who acted as intermediaries, 19th century patents frequently changed hands.[67] They estimate that approximately 12% to 28% of patents were assigned more than once, including through corporate acquisition.[68] But while these sales, as well as other information, provide evidence that patents supported technology transfer, Usselman has also shown that 19th

[62] Christopher A. Cotropia and Mark A. Lemley, *Copying in Patent Law*, 87 N. C. L. REV. 1421, (2009) available at http://law.stanford.edu/wp-content/uploads/sites/default/files/publication/258951/doc/slspublic/Lemley%20Copying.pdf.

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

[64] For example, defensive patent aggregators like RPX who may buy up a patent in order to remove the threat from its member companies.

[65] Some might argue that even such transfers may have positive welfare effects, insofar as liability transfers reduce the need for litigation, and a patent, even if wrongfully issued, induces socially valuable racing, however.

[66] Naomi R. Lamoreaux and Kenneth L. Sokoloff, *Inventors, Firms, Inventors, Firms, and the Market for Technology in the Late Nineteenth and Early Twentieth Centuries*, NBER Historical Working Paper No. 98 (1997), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=225061.

[67] *Id*. at ___

[68] *Id*. at Table 1.

century patents were also used for liability transfers, in the railroad industry. The widespread phenomenon of "avaricious patent agents" buying up patents and then using them to sue the entire industry,[69] led then-Senator Christiancy to complain 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."[70]

Though these transactions predated the rise of digital technology, Serrano's study of patent reassignments from 1983 to 2000 specifically considered the prevalence of patent transfers among different industries. He found that drugs in the computer and communications as well as the drug and medical industries had the highest rates of transfer, and that the rate of transfers in the US has been about 13.5 percent between 1983 and 2002.[71] Because this study was based solely on the patent record, Serrano could not tell whether or not transferred patents were being sold to support the transfer of liability or the transfer of technology. However, a pair of studies, including one by Serrano and his colleagues, looked specifically at the relationship between transfer and litigation. He found that, on average, the transfer of patents reduced litigation risk,[72] but that patents traded to small entities that fit into the buyer's portfolio were associated with higher litigation.[73] Studies that consider from whom non-practicing entities get their patents and which identify large firms in particular as important sources[74] – are consistent with this finding.

In contrast with data about patent sales, which are routinely publicly recorded, public data about patent licenses are harder to come by.[75] There are no requirements to record, and licensing data, even when it involves publicly funded patents,[76] is regarded as highly sensitive.[77]

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[69] Steven W. Usselman, REGULATING RAILROAD INNOVATION: BUSINESS, TECHNOLOGY, AND POLITICS IN AMERICA, 1840-1920, at 115-17 (Cambridge University Press, 2004), (describing the activities of patent dealers Chittenden and Sayles who bought up patents and sued a whole industry based on them in particular).

[70] 8 CONG. REC. 307-08 (1879) (Statement of Sen. Isaac Christiancy).

[71] Serrano, *supra* note ___, at ___.

[72] Chien, *Predicting Patent Litigation supra* note ___ , Alberto Galasso et. al., *Trading and Enforcing Patent Rights*, RAND J. of ECON. Vol. 44, No. 2, pp. 275- 312 (2013).

[73] *Id*. Galasso, et. al., at 34.

[74] Michael Risch, *Patent Troll Myths*, 42 SETON HALL. L. REV. 457, 485-88 (2012) available at http://scholarship.shu.edu/cgi/viewcontent.cgi?article=1425&context=shlr.

[75] *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), available at 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).

[76] Arti Rai and Bhaven Sampat, *Accountability in Patenting of Federally Funded Research*. NAT. BIOTECH. Vol. 30, No. 10, 953 (Oct. 2012).

[77] As a result, studies generally rely on proprietary databases. *See*, e.g. Bharat N. Anand, and Tarun Khanna, *The Structure of Licensing Contracts*, 48 J. OF INDUS. ECON. 103, 115 (2000), available at http://www.people.hbs.edu/banand/licensingcontracts.pdf, and Joshua S. Gans, et. al., *The Impact of Uncertain Intellectual Property Rights on the Market for Ideas: Evidence from Patent Grant Delays*, 54 MANAG. SCI. 982 (2008), available at http://www.nber.org/papers/w13234.pdf, (analyzing a sample of 200 licenses announced

Surveys estimate that about 10 percent of patents are licensed,[78] but that the extent of licensing depends on the entity size.[79] The empirical studies of licensing that do exist, generally conducted by economists, focus on the prices[80] and strategies behind licensing.[81]

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,[82] consistent with earlier and smaller samples. [83] These proportions were roughly consistent across the industries he considered, including "high-tech."[84] 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.[85] 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

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between 1990 and 1999 in the Security Data Corporation database). (Analyzing 1612 patents from the Strategic Alliance database of Securities Data Company).

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

[79] Paola Giuri et. al., *Everything You Always Wanted To Know About Inventors (But Never Asked): Evidence From the Patval-EU Survey*, Munich School of Management, University of Munich, (2006), available at https://epub.ub.uni-muenchen.de/1261/1/LMU_WP_2006_11.pdf.

[80] See, e.g. Gregory J. Battersby and Charles Grimes, *Licensing Royalty Rates* (2011), Deepak Hedge, *Essays on Institutions and Innovation*, (Spring 2010) (unpublished Ph.D. dissertation, University of California, Berkeley), available at http://escholarship.org/uc/item/0sp3n4sk. Jonathan E. Kemmerer and Jiaging Lu, *Profitability and Royalty Rates Across Industries: Some Preliminary Evidence*, KPMG Global Valuation Institute (Nov. 19, 2012), available at https://www. kpmg .com/Global/en/IssuesAndInsights/ArticlesPublications/Documents/gvi-profitability-v6.pdf.

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

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

[83] 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").

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

[85] Robin Feldman and Mark A. Lemley, *Do Patent Licensing Demands Mean Innovation?* 101 IOWA L. REV. 137 (Feb 15, 2015), Figure 5-28, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2565292.

technology.[86] 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.[87] A quarter of software startups, and 67% of venture-backed startups overall had patents.

Another way of understanding the influence of patents on markets for technology is by looking at the extent to which the terms of the license mirror the terms of the patent. An exclusive license, in some sense, lets the licensee, armed with the right to exclude conferred by the patent, to "step into the shoes" of the patentholder and assume the responsibility of commercializing 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.[88]

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 the transfer of exclusive licenses.[89] However, there were strong industry differences. Only 15% of "electronic" company licenses were exclusive, while over 50% of "chemical" company licenses were.[90] But electronic industry licenses (20%) were twice as likely to be cross-licenses as chemical licenses (10%).[91] 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.[92] 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.[93]

In sum, while existing studies of patent sales and licenses provide a glimpse of the role of patent transactions in promoting 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,

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[86] Graham et. al., *supra* note __ at 1318.
[87] *Id*.
[88] I thank John Duffy for noting this distinction to me.
[89] Anand and Khanna, *supra* note ___ at 109.
[90] *Id*. at Table III(i).
[91] *Id*.
[92] Kyriakos Drivas, et. al., *Academic Patent Licenses: Roadblocks or Signposts for Nonlicensee Cumulative Innovation*, Social Science Research Network (Aug 29, 2014) at *9, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2489231.
[93] Lori Pressman et. al., *The Licensing of DNA Patents by US Academic Institutions: An Empirical Survey*, 24 NAT. BIOTECH. 31 (2006).

because of, hindered or helped by software patents. Patent sales have been happening to a considerable degree, Serrano and his colleagues have demonstrated, 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.[94] 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 the following questions:

- How prevalent are software transactions, especially by small companies, and how concentrated or diffuse is software innovation?
- Who are small "pure" software companies signing technology agreements with, and on what terms?
- To what extent are patents supporting the licensing of software by facilitating the transfer of technology as opposed to legal liability?
- How often are software patents being transferred and for what purpose? Does the sale of software patents represent the redistribution upwards or downwards of patents and capital?

The next section outlines the methods, sources, and assumptions used, and the following, the answers the analysis yielded.

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 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 reflect, and more attention to the pursuit and litigation of patents, consistent with the idea of "promot[ing] the progress," by rewarding innovators for their innovative ideas, in order to "fuel the fire of genius," by giving them the opportunity to exclude others from the marketplace.[95]

Recent developments have both highlighted the importance of considering the "middle layer" of patent transactions, including the licensing, sale, and securitization of patents, and

[94] As described, e.g. in the FTC's Report, *supra* note ___

[95] *See* discussion of U.S. CONST. Art. 1, § 8 cl. 8. above.

chipped away at these barriers to their study. In 2012, Apple and Google spent more on the acquisition of patents than they did on research and development,[96] drawing attention to the importance of patents and freedom to operate. At the same time, the Obama Administration's commitment to "open data" and decision to treat government-generated data as public asset of public has led to the opening of hundreds of thousands of government datasets,[97] with the ability to drive government accountability and transparency, and spawn new businesses and support existing ones.[98] 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,"[99] 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.[100] These developments have been a boon to the more than 100 patent data companies[101] 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 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 and "software" patents, well-known to be challenging tasks. Previous researchers have developed several approaches

[96] Based on public filings and data, in 2012, Google spent $12.5B to buy Motorola Mobility and its patents, and $5.2B on R&D. In 2011, Apple spent $2.4B on R&D but contributed more, approximately $2.6B, to a single transaction to buy patents from Nortel. See Colleen V. Chien, *Reforming Software Patents*, 50 Hous. L. Rev. 325, 329 (2012) at notes 11 & 12.

[97] *See*, e.g. Data.gov. These datasets pertain to everything from disaster relief, to information about medicare and medicaid services, to sexual assault on campuses. *See Id*. and *Case Studies of US Open Data,* and *Open Data Community Events,* listed at https://project-open-data.cio.gov/.

[98] Project Open Data, https://project-open-data.cio.gov/.

[99] 35 U.S.C.§2(a)(2) (2012).

[100] 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 (2011) at note 110, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1911579&.

[101] Referred to in Colleen V. Chien and Brian Love, National Association of Patent Practitioners, *Comment to the USPTO on Quality Case Studies*, (Feb 2016), p.1, available at http://www.uspto.gov/sites/default/files/documents/casestudies_a_napp_12feb2016.pdf.

for identifying software patents - keyword searching (i.e. for "computer program" or "software")[102] and, patent classification[103] filtering (i.e. for classes G06F "Electrical Digital Data Processing" or G06F "Recognition Of Data; Presentation Of Data; Record Carriers; Handling Record Carriers)."[104] To find "pure" software *companies,* Graham et. al., has selected companies falling within several SIC codes.[105] In this work, we rely on all three approaches - keyword searching (and keyword coding) to identify software agreements, SIC codes to identify software companies and patent class codes to identify software patents. Given the broad distribution of software innovation, 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. We 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 carry out our analysis 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. While previous studies also suffer from these defects, I took several measures to address them. 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 methodology and carried out

[102] James Bessen and Robert Hunt, *An Empirical Look at Software Patents*, J. OF ECON & MAN. STRAT., Vol. 16, No.1, pp. 157-189, (2007).
[103] Based on the CPC and IPC schemes.
[104] Stuart Graham and David Mowery. *Intellectual Property Protection in the U.S. Software Industry* in Cohen, W. and Merrill, S.A.: PATENTS IN THE KNOWLEDGE-BASED ECONOMY (2003).
[105] 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), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1429049.

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

i. "Significant" Technology Licenses

Although license data is generally not available,[106] publicly traded companies are required by Securities and Exchange Commission (SEC) regulations to report in their filings, "material definitive agreements not made in the ordinary course of business."[107] 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 to the agreements.[108] A cottage industry of companies that harvest, collect, clean, and code this data addresses this gap, including RECAP, RoyaltyStat, Biosciences Advisers, and ktMine. We used ktMine's licensing database, which includes over 100,000 material agreements, collected from public sources, primarily the SEC Database. We performed our analysis using ktMine's "Royalty Rate Analyzer" tool, which contains about 16,000 IP license agreements with royalty terms, a subset of the total.[109] 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[110] and keywords, which in the case of IP, indicate the subject matter of the license.[111] The latter two categories were non-exclusive of each other, for example in the case of a license that included the transfer of copyrights and patent rights, and which was both a software and a manufacturing agreement.

I supplemented ktMine's data with information about licenses that we ourselves obtained through Freedom of Information Act (FOIA) requests to the SEC over the course of over a year, to carry out the present analysis of technology agreements. As a result, the analysis includes agreements considered "significant" to at least one publicly filed company. As such it is

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[106] 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. 115, 117 (2011), and Jorge L. Contreras et. al., *Study Proposal-Commercial Patent Licensing Data*, (2016), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2755706.

[107] United States Securities and Exchange Commission, Form 8-K General Instructions, SEC 873, Item 1.01 Entry into a Material Definitive Agreement, p.4, available at http://www.sec.gov/about/forms/form8-k.pdf.

[108] 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."

[109] BVR/ktMine, *Royalty Rate Benchmarking Guide* 2015 Global Edition, p. 5, available at http://www.bvresources.com/pdfs/RoyaltyRateGuide_2015_Excerpt.pdf.

[110] As described in footnote ___.

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

surely not representative of agreements in general,[112] but rather agreements that survive two significant filters: 1) that the agreement is material to a public company, which is only a small subset of all companies, and 2) that it was important enough to the company that the company decide to report it to the SEC.

ii. 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.[113] However, the task of identifying what patents have 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, merger and acquisition-based transfers.[114] 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. According to Innography, less than 15% of conveyances recorded at the USPTO represent true inter-company transfers.[115]

I used searches developed with specialists at Innography to find "true" "software"[116] patent transfers that had been recorded at the USPTO between 2012 and 2015. We drew upon the firm's "PMT" database, which is comprised of conveyance data that has been cleansed and processed so that only inter-company transfers outside of the context of the merger or acquisition of the transferor company by the transferee are left.[117] For patentholder revenue data, we relied on Innography's designation revenue coding which is based on publicly reported revenue data, which Innography then classifies according to standard public company definitions as described in more detail below. Private companies were assigned a revenue value

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[112] *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."

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

[114] 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 ___.

[115] Innography, Patent Market Tracker: Fall 2015 Key Trends, available at http://patentlyo.com/patent/2015/10/patent-market-tracker.html?utm_target/=feedburner&utm_medium=email&utm_campaign=Feed%3A+PatentlyO+%28Dennis+Crouch%27s+Patently-O%29,(accessed on October 15, 2015).

[116] *See* Colleen V. Chien and 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.

[117] 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.

of 0. One limitation with this approach is that it is based on recent revenue figures, rather than representing revenue at the time of the transaction, however, by focusing on transactions recorded only within the last 4 years, we attempted to minimize inaccuracies associated with the time lag.

c. Company and Revenue Data

I worked with research assistants to integrate several types of company- and industry-level data into our analysis including revenue, SIC code, and patent-holdings. For the purposes of profiling companies with material agreements in our analysis, we relied primarily on COMPUSTAT and Edgar annual reports or 10-k filings to determine reporting company revenue and SIC code data. For companies with reported revenue, this data had the advantage of being available for multiple years, including the effective year of the relevant event.[118] However, it had the disadvantage of not including all companies.

To establish a baseline number of "pure software" firms[119] from which to evaluate the agreements, we took several steps. Because companies are routinely listed and delisted from public exchanges, and at times within the span of just a few years, taking a single year snapshot of companies would not give an accurate count of the universe of companies eligible to file material agreements. Instead, we used COMPUSTAT to generate an aggregate list of companies within each of the four SEC codes in each of five years (2000, 2004, 2008, 2012, and 2014). Out of an aggregate list of 2500 companies over the five years, there were 1092 unique public companies that had reported revenue data in COMPUSTAT. We further pulled revenue from the year of the agreement so that we could determine what the prevalence of reporting was among different revenue bands.

For private companies that do not report to the SEC as well as public companies for whom data was not available, we used ReferenceUSA and Bloomberg. If no revenue data could be found in any of these sources, we assumed that the company was within the lowest revenue band. We used this information to determine the relevance of technology agreements to software companies, and particularly small companies, as well as the distribution of technology across agreements.

Part III: Findings (Tentative)

I. Licensing Findings

A. <u>Finding 1: (Important) Software (Licenses) Eat the World</u>

[118] Where not available, we chose the closest year.

[119] Falling within the SIC categories identified by Graham et. al.

I first considered how prevalent reported technology agreements involving software were, especially by small companies. Much software innovation now is done in the open, and as software development becomes ubiquitous across organizations, it is unclear the extent to which technology agreements involving software serve as a differentiator, leading companies to consider them "material." If anything, then, we would expect to see smaller companies reporting agreements. I focused on standalone technology agreements, and excluded other types of agreements such as asset purchases (typically, associated with M&A activity), marketing, distribution, and services agreements. The "technology agreements"[120] we 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 used three different approaches to test the importance of technology licenses to software innovation.

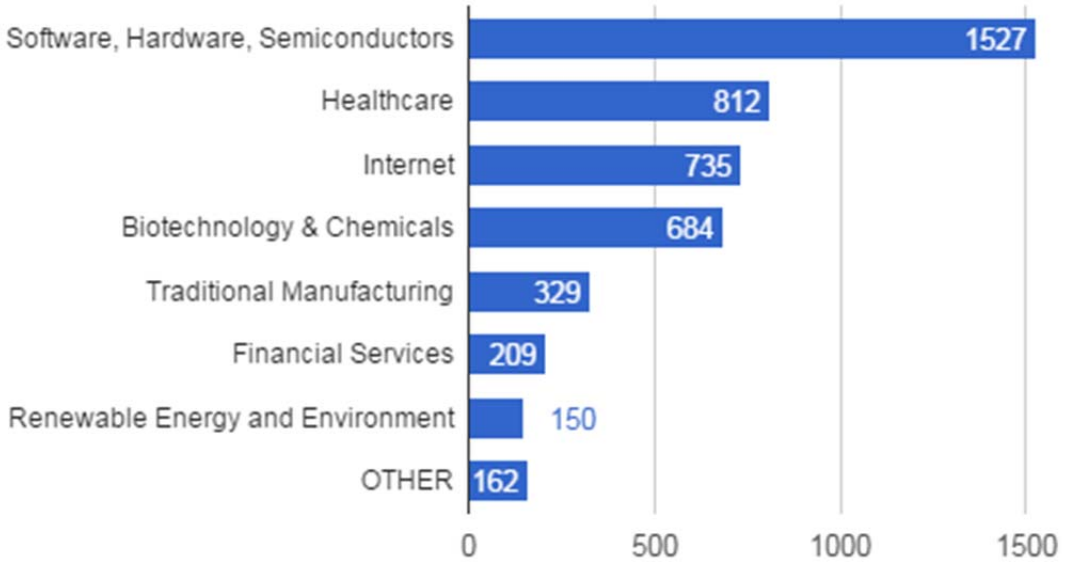
First, within technology agreements, I used Bessen and Meurer's keyword identification approach to find agreements that included the term "software" or "computer program."[121] In order to test the distribution of these agreements across industries, I considered the industries that each technology agreement was associated with, as coded by ktMine.

Seemingly contrary to the perception that agreements including software were merely a commodity, I find that software is part of an estimated 42% of material technology agreements registered at the SEC. (N=2,564 out of 6,109) In addition, the analysis of industry distribution suggests that significant technology agreements including software are being signed across a wide swath of industries, not just digital industries. (FIG__)

As shown in FIG.__, though the industries with the greatest number of agreements were software, hardware, and semiconductor industries collectively, significant numbers of agreements were signed in industries like healthcare, biotechnology, and chemicals. This finding comports not only with Andreesen's statement that "software eats the world," but with a related recent analysis by Branstetter. That analysis looked at patenting across four industries: autos and auto parts, aerospace and defense, medical devices, and pharmaceuticals. It found that software-driven innovation is increasingly a differentiator even in these "traditional" manufacturing industries, and that firms that have taken a more software-intensive approach to innovation have outperformed their peers.[122]

[120] 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.
[121] Described supra at note __.
[122] Lee Branstetter, Matej Drev and Namho Kwon, *Get With the Program*, NBER Working Paper 21752 (2015)

FIG. __. Material Software Technology Agreements[123] by Industry (2000-2015) (N=2,564)[124]



One limitation of using a word search approach to identifying "software" agreements is that the result included some agreements that had software terms but which were not, at their core, agreements about software. One agreement, for example, was for in-flight entertainment technology and also included a software license.[125] To be able to specifically scrutinize agreements for software, I created a second list of material technology agreements that included "software," "source code," "object code," or "code", as a keyword or subject of the agreement. The number of agreements was still sizeable. (N=1,415). Using this numerator, I find that since 2000, licenses for software represent about 24% of significant technology agreements entered into by small companies.[126] (N=1,415 out of 6,109)

I used a third approach to estimate the importance of material technology agreements to software innovation. I searched for material technology agreements entered into by "pure" software companies, using the SIC-based approach relied upon by Graham and

[123] Technology agreements that include software clauses. See part __ for methodological details."Traditional Manufacturing industries include "Electric Utilities, Industrial Equipment And Machinery, Mining, Transportation Equipment And Parts" [rerun Biotech and Chemicals so that it doesn't include Agrobusiness]

[124] Agreements could be classified in more than one category.

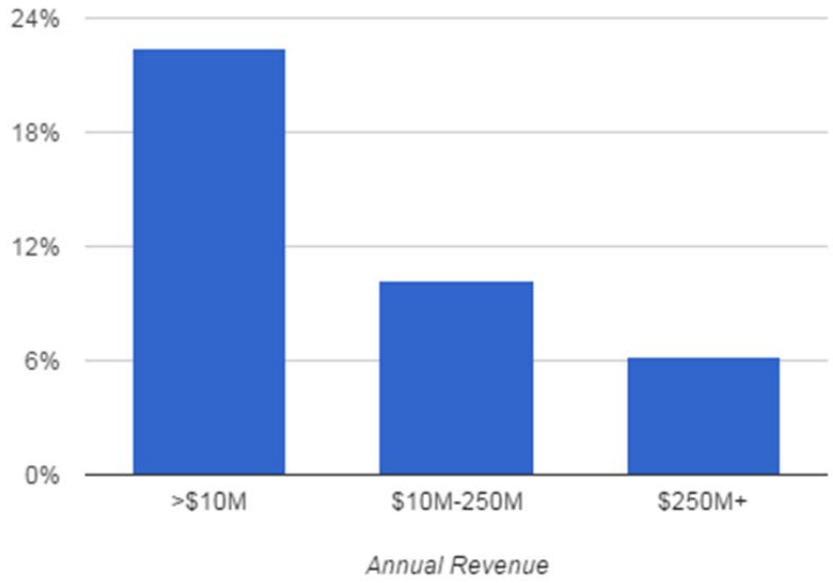
[125] GLOBAL EAGLE ENTERTAINMENT INC., Filing Date: 2/6/2013, Filing Type: 8-K, Filing Exhibit Number: EX-10.12. SIC Code: 6770.

[126] The other types of technology agreements included cross-licenses, joint development, manufacturing/process intangibles and other (add %).

his colleagues in the Berkeley Patent Survey[127] over the period 2000-2015, finding 415 agreements, entered into by 190[128] unique companies, 144 of which had reported revenue.[129]

This number had little meaning by itself, so I worked with research assistants to establish a baseline number of "pure software" firms[130] based on the steps outlined above. Combining data from these two sources, we found that 144 of 1092, or 13% of "pure software," public companies with reported revenue in COMPUSTAT had filed a material technology agreement.[131] The likelihood of reporting a material agreement increased with decreasing revenue, as would be expected. Among companies with less than $10M in annual revenue, the figure was higher, 23%. 75% of software companies with a reported license,[132] made less than $50M.

FIG. ___. Share of Software Companies Reporting Material Technology Agreements (2000-2015 effective dates)



This figure put the other figures in context – though software is a prominent part of technology agreements, material technology agreements are being reported at a rate of less than 1% per year among "pure software" companies. When important technology agreements are actually signed, however, it seems, software is often part of the transaction.

[127] Graham et al. at footnote ___.
[128] Confirm
[129] In COMPUSTAT.
[130] Falling within the SIC categories identified by Graham et al.
[131] With an additional 36 unique companies that did not have revenue reported in COMPUSTAT. Among companies with
[132] 108 of 144

B. *Finding 2: Patents (and to a lesser degree other forms of intellectual property) support the licensing of software, but they play a mixed role.*

I next explored the prevalence of license terms, and what they meant for the relationship between patents (and other forms of intellectual property and software innovation). I focused on the 1,415 material software agreements, and relied upon ktMine's coding of SIC, licensor, licensee, filing company, effective date, and other license characteristics. Among these agreements, I further searched for agreements where patents (or patent) were mentioned (n=1,081), as well as agreements in which "patent or patents" were coded as a core keyword (N=620). I did the same with the terms "copyright or copyrights", "trade secrets, know-how and confidential information."[133] I added public company reporting status and revenue data where available to better understand the transactional dynamic.

In accordance with previous studies, I looked at the exclusivity provisions of the licenses in this dataset. In comparison to "open source" licensing agreements, generally non-exclusive, that pervade software innovation,[134] the licenses in the studied sample 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.[135] 32% of material software agreements were provided on exclusive terms, 5% on non-exclusive terms, and 62% were considered "multi-exclusivity" licenses.[136]

The presence of intellectual property 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 majority of the software contracts I studied fit this pattern, insofar as they contained exclusivity measures that represented a departure from intellectual property's default of exclusive rights.

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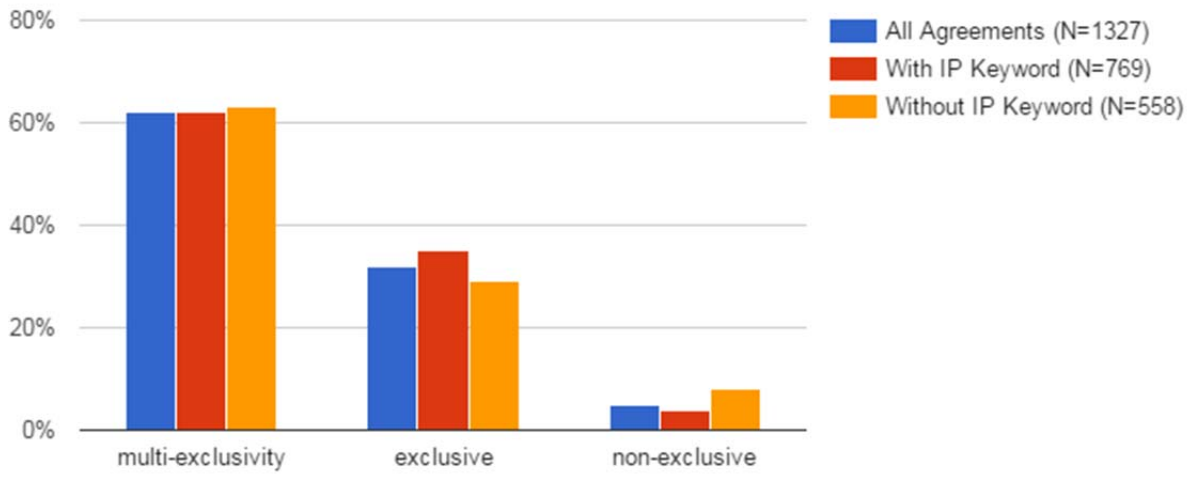
[133] For results see FIG ___.

[134] Open source software dominates the server market (http://news.netcraft.com/archivies/category/web-server-survey) and super computer market (http://www.zdnet.com/article/linux-dominates-supercomputers-as-never-before), and Google Android and Chrome, which have captured a majority of the smartphone operating system and browser market, respectfully, are built on Linux's open source kernel. Chien, *supra* note ___ , at ___.

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

[136] 1327 of the 1451 software agreements had coded exclusivity provisions, of those 430 were exclusive, 826 were mult-exclusive, and 71 were non-exclusive.

FIG: ___ :Exclusivity Provisions in Material Software Agreements



However, it is also the case that intellectual property was not needed in all cases 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 exclusivity provisions predominated, almost in equal proportion (FIG ___). This seems to suggest that contract law is doing much of the work in terms of allocating rights between parties.

I next turned to the question of the extent to which patents were supporting the licensing of software by facilitating the transfer of technology as opposed to legal liability without technology transfer. My findings here are tentative, based on ongoing reading and coding of the agreements and the clauses that include patents. Based on my initial analysis, however, I found that 1) patents provisions within software agreements primarily function to transfer legal liability (via indemnity clauses or agreements that settle a lawsuit), but that 2) in a substantial minority of cases, patents were an important part of the transfer of the technology, though they were not the only important part.

I began my analysis by identifying the majority (75%) of software licenses that also included patent provisions.[137] This high incidence suggested that patents are playing some role in supporting software agreements. However, the role of patents varied by agreement. Based on a review of a sample of these licenses,[138] approximately 60% of software clauses were indemnity clauses that primarily served to apportion liability for legal claims involving patents (as well as other forms of intellectual property), or were agreements to settle legal claims, rather than being core to the transfer of technology. These agreements could be considered to

[137] 1081 out of 1451 software agreements also included patent provisions within the agreement.
[138] Among the subset of 1081 software licenses in which patents were mentioned, I personally read __ of them to confirm the purpose of the patent provisions.

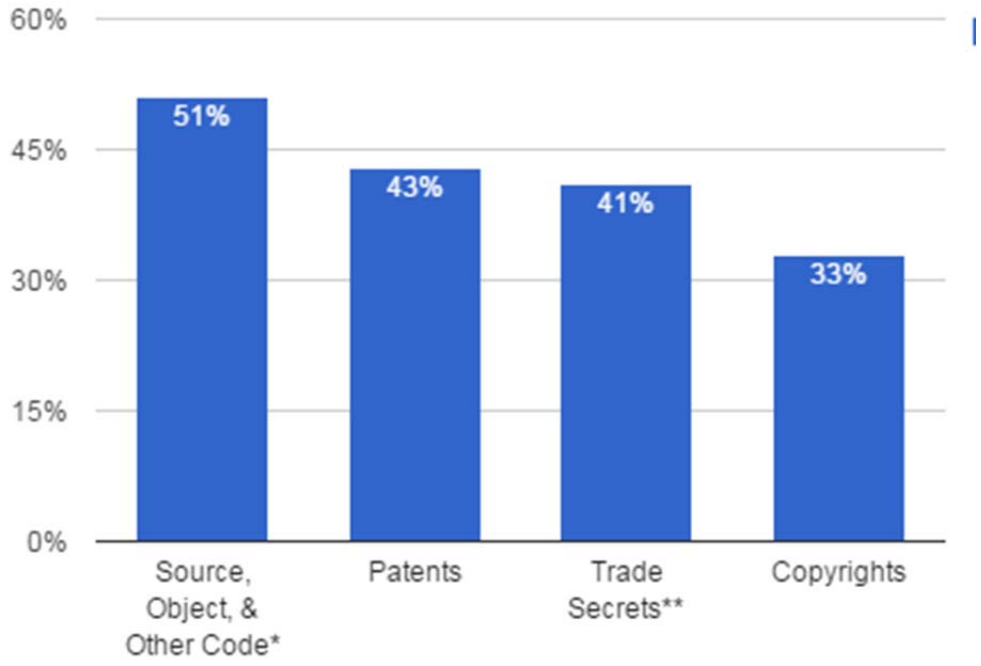
transfer permissions or legal liability, but only indirectly to support the ex ante transfer of technology.

Still, in a substantial minority of software agreements (approximately 30%), in which patents were designated as "key" terms, patents were "core" to the transfer of software technology. In one agreement where patents were core, the license transferred: "the right to use the patents, and the know-how exclusively in connection with the marketing of ultrasonic sensor devices and any related software and hardware utilized for the purposes of detecting firearm discharge, using the Traptec Advanced Helmet Design (AHD)." In another, involving a pending patent, the licensor granted the "right to use the trademarks "SHOTSFIRED" or "SHOTSFIRED INSIDE" (Pending) on or in connection with ultrasonic sensor devices and any related software and hardware utilized for the purposes of detecting the discharge of a firearm."[139] Other agreements contained subject matter that included not only the patent, but also proprietary technology, software, and documentation.[140]

Though such clauses seem to reinforce the story that patents are key to transacting in technology, they are important to keep in context. Even though patents were important to 30% of the studied technology agreements, sui generis computer programming elements, including source code, object code, and algorithms were more likely to be considered "core"; trade secrets and know-how, and to a lesser degree, copyrights were also important parts of these agreements. (FIG.___)

[139] CYBER DEFENSE SYSTEMS INC FILING: **8-K/A** DOCUMENT: **EX-10** FILING DATE: **2/23/2005**
[140] OASYS MOBILE, INC FILING: **10-K** DOCUMENT: **—** FILING DATE: **7/5/2001**

FIG. ___ Key Components of Material Software Agreements (N=1,451)



* includes algorithms, programs, and executables

**includes trade secrets, know-how, and confidential information

Taken at face value, these findings raise questions about two strands of conventional wisdom. First, one frequently cited advantage of patents over trade secrets for the purposes of contracting is that patents are much easier to contract with, due to their relatively more tangible nature and the ease of transfer. In our sample, trade secrets and confidential information were roughly as likely to be an important part of a software license as were patents. If many of the trade secret agreements did not also include patents, that could challenge the conventional wisdom. In addition, another advantage of intellectual property is that it allows the rights holder to exclude others from using the protected innovation. But while the majority of patent software agreements were exclusive (total and multi-exclusive), so were the majority of non-patent software agreements. It's unclear how much patents enabled transactions based on their exclusive nature, though they certainly might have supported it and made it more likely that the transaction took place.

C. *Finding 3: Small "pure" publicly listed software companies have mostly transacted with private companies. When the agreement involved a patent, the patentholder is usually the smaller party.*

Finally, I explored markets for software innovation by considering who small "pure" software companies were signing technology agreements with and the extent to which

transfers of technology and capital flowed in any particular patterns. I analyzed each of the 415 material technology agreements reported by a "pure" software firm, and found that most of the time, licenses were signed with private rather than public counterparties.[141] I looked at the subset of these agreements involving patents, and, further, looked at the size of the licensor as compared to the size of the licensee. Based on the available data, we estimate that 58%-62% of the cases, the rightsholder was the smaller party of the two.[142] Though we caution relying too much on this finding given the small sample size and problems with private company data reporting, it does lend weak support to the idea that intellectual property can level the playing field between parties to a transaction.

II. Findings Regarding Patent Sales[143]

Besides looking at licenses, I and a co-author looked at sales of software patents to support software innovation through the transfer of technology and rents. For patent transfers, we developed a list of patent reassignments recorded at the USPTO from 2012 to March 2016.[144] We found 31,134 transactions involving 30,893 unique patent assets,[145] 24,879 patents and 6,014 applications. We relied on Innography's revenue coding in our reporting, of both assignors and assignees to the transfer

A. Finding 4: Software patents are being sold at a rate of about 6.3% over approximately 4 years, 73% of the time from an entity with more patents to one with less patents. While larger transactions seem to be supporting the transfer of legal liability and technology, the majority of transactions is small (<5 patents).

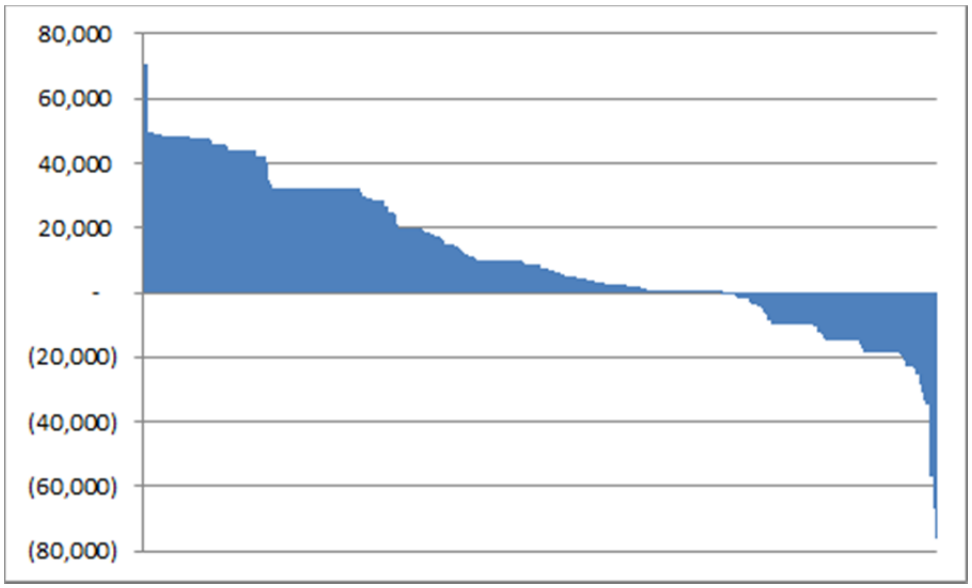
How much are patents being sold? We assumed that recorded transactions involved in-force assets and used that to estimate the universe of unique transferrable software patents at about 388,353.[146] Comparing this figure to the unique number of transferred software patents of 24,879, this indicates that about 6% of all patents were transferred during this approximately four year period, which, assuming a steady rate of transfer, translates to about a 21% chance of transfer for a patent kept in force for 13.5 years. This number is nearly double the average rate

[141] Only 31 out of 415 transactions involved a public counterparty.
[142] N = 80-119. We calculated this figure in two ways, first by assuming that in a case where revenue could not be found for either the filing company or the counterparty, that the filing company, by virtue of its filing, was larger than the counterparty (N=119, 62% patentholder was smaller), and second by excluding cases where revenue could not be found for both parties from analysis (N=80, 58% patentholder was smaller) [file: Patent120 Analysis GDoc]. See discussion, *infra* note___
[143] This section draws from an analysis in a forthcoming work by Colleen V. Chien and Esmaeil Khaksari, *The Market for Technology*
[144] Methodology and results described in greater detail in Id.
[145] Some assets were transferred more than once.
[146] Innography search: (cpc_G06F or cpc_G06K) and 697,022 Patents, limited to patents that were active after 1/1/2012. [PMT Analysis file]

of transfer reported by Serrano of 13.5%,[147] however, differences in the patents, time period studied, and age of patent all contribute to this difference.

We wanted to understand the direction of patent sale – e.g. from large to small entities or patent haves to patent have not. Though revenue data was unavailable for the private entities, we were able to collect patent portfolio size for nearly all of the transferors and transferees. We found that in the majority of transactions (73%), perhaps unsurprisingly, patents were being transferred from a company with a larger portfolio to a company with a smaller portfolio. (FIG.___)

FIG. ___: Differences between Patent Assignor and Patent Assignee Patent Portfolios



(each line on the x-axis represents one transacation)

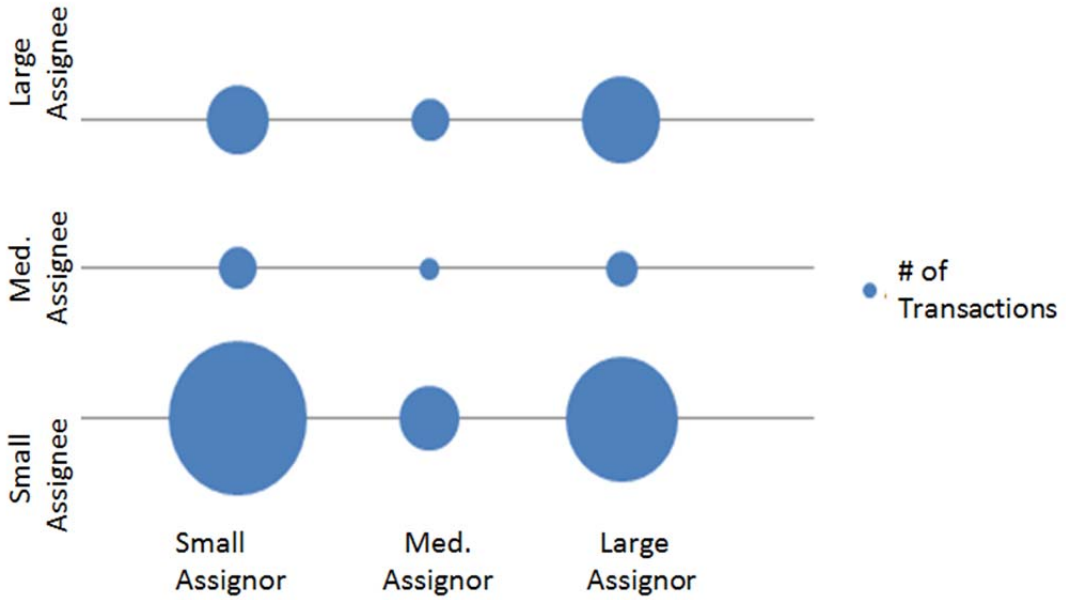
However, on closer inspection, when we reviewed the data at the transaction level, we found that many of sales were between entities with small portfolios. Law firms transferred patents to companies, or a company with a small portfolio transferred to another company with a small portfolio, for example.[148] In fact, among all recorded transactions, the number of patents that was transferred was just 1 patent, belying the idea that individual patents are important than the portfolio.

[147] p. 15. See also Table 2 (reporting transfer rates of 12.9% and 13.8% for computers and communications, and electrical and electronic patents, respectively.) Serrano's 2004 dataset included patents granted after January 1, 1983, whereas our dataset was limited to patents filed in 2000 through March 2016.

[148] See, e.g. the transfers of patents 8453102 and 8468482 from Aka Chan LLP, an Intellectual Property law firm to Grid Simulation Technology, Inc., and transfers of patents 5546532, 5428754, 5519829, and US5539898 from Avesco Group Plc to 3DLABS Ltd.

When patent transfers did involve redistributions of patents from holders of a portfolio of patents of one size to holders of patents of another size, patents tended to be redistributed, understandably, from those with more patents to those with fewer patents. This represents a redistribution downward of patents, from the "patent rich" to the "patent poor." However, assuming money changed hands, it also represents a redistribution upward of capital, from those without patents to those with them.

FIG. ___ The Redistribution of Patents by Revenue of the Parties (Transactions)[149]



"True transfers" recorded from January 2013 through March 2016.
Size based on patentholding. Small = <15 patents; medium = 15-100 patents; large = 101+ .

When we looked at the top 10 assignments, we saw that in many cases, an incumbent firm transferred assets to a "newer" younger firm. To the extent one views patents on a "tax" on innovation, these data suggest that such a tax at times operates in a regressive fashion, as upstarts with fewer patents are paying "tolls" to incumbents with more patents. However, as described earlier, the exchange or licensing of patents can support at least two types of transfer – the transfer of liability and the transfer of technology. When we looked at the top 10 assignments, we saw anecdotal evidence of both types of transfers. Although incumbent firms

[149] Chien and Esmaeil Khaksari, *The Market for Technology (forthcoming),.* Image in file: downward "Redistribution of Patents"

generally transferred assets to "newer" younger firms, they apparently did so for different reasons. "Liability transfers," for example, fell into two categories. In some cases, the transaction appeared to be defensive, not supporting the transfer of technology but the transfer of assets that would provide the buyer with greater freedom to operate (see, e.g. sales of patents from IBM to LinkedIn, Twitter, Facebook and LinkedIn, and Lenovo to Alphabet).

FIG____ : Top Assignments of Software Patents (Based on Transfers recorded between January 2013 and March 2016)

Top Transactions	Number of patents transferred
IBM to Globalfoundries Inc.	2240
HP Inc. to TCL Corporation	1123
Lenovo Group to Alphabet Inc.	834
Fujitsu and Panasonic to Socionext	820
IBM to Lenovo Group	783
HP to Qualcomm	599
IBM to LinkedIn	516
IBM to Twitter	495
IBM to Facebook	414
Eastman Kodak to Intellectual Ventures Management	310

In other cases, the liability transfer seemed to be going the other way, from a company that was either ailing or in the process of restructuring, to an entity focused on licensing patents and the more efficient monetization of assets (see, e.g. purchases of Eastman Kodak patents by Intellectual Ventures and HP patents to Qualcomm). While such "liability transfers" represented most of the sales, several sales also supported the formation of new ventures and were as such supportive of technology transfer. For example, the top transaction, of IBM's patents to Globalfoundries, was part of the spinoff of IBM's microelectronics division to the firm.[150] When Fujitsu and Panasonic transferred its patents to Socionext, it was to support a new joint venture between the firms.[151]

[150] http://globalfoundries.com/newsroom/press-releases/2014/10/20/globalfoundries-to-acquire-ibm's-microelectronics-business
[151] http://www.fujitsu.com/global/about/resources/news/press-releases/2015/0302-02.html

TO BE CONCLUDED