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The effects of patent litigation on university licensing efforts

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Abstract

One effect of increased patenting by universities over the past 20 years has been a rise in lawsuits to enforce university patent rights. In this paper we ask what effect patent litigation has on university efforts to license technology. Using secondary data on licensing and interviews with technology licensing office (TLO) directors for research universities, we find both qualitative and quantitative evidence that patent litigation has an adverse effect on university licensing activity. Our interviews suggest that this adverse effect occurs because litigation disrupts overall TLO activity, and reduces the time and resources available for marketing technologies and establishing licenses.

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1. Introduction

One of the changes that have accompanied the growth of patenting and licensing at American universities since the passage of the Bayh-Dole Act almost 25 years ago is the increased use of lawsuits by universities to enforce their intellectual property rights. For example, the University of California sued biotechnology firm Genentech, alleging intellectual property theft by a

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former post-doctoral researcher and violation of the university's human growth hormone patent, and negotiated a \$200 million settlement. Similarly, the University of Minnesota settled its dispute over patents covering Glaxo Wellcome's AIDS drug Ziagen with a multi-year \$300 million licensing deal, while the University of Rochester recently lost a billion-dollar lawsuit, and all subsequent appeals, to enforce its cox-2 inhibitor patent against pharmaceutical companies Pfizer and Merck.

Aggregate statistics illustrate the increasing use of patent litigation by universities. University patent litigation is growing more rapidly than overall U.S. patent litigation, more than tripling in the period 1985–2000, as compared with a “mere” doubling for the latter (Merz and Pace, 1994; Somaya, 2004).² However, despite increased patent litigation by universities, there has been no research that examines the role of this activity in the university technology licensing process.

An examination of this topic is valuable for two main reasons. First, this investigation would allow us to understand an important part of universities' strategic behavior, and its impact on the national innovation system. Universities are significant contributors to private sector innovation (Adams, 1990; Jaffe, 1986). As a result, their decisions about the creation and dissemination of technology influence innovative activity in the economy (Nelson, 1993). Therefore, understanding university patent litigation is important to our knowledge about university licensing and technology commercialization, and their role in the national innovation system.

Second, our study allows us to evaluate whether the incentives provided by the Bayh-Dole Act have unintended consequences, given the different goals of universities and policy makers. The primary purpose of the Bayh-Dole Act, which gave universities the property rights to federally funded inventions, was to encourage private sector commercialization of academic inventions, not to provide universities with an additional mechanism to generate revenues. However, many university administrators report that revenue generation is a major goal of their technology transfer operations (Thursby et al., 2001). University patent litigation is an important manifestation of the divergent goals of policy makers and university administrators because universities can generate revenue through litigation at the expense of reduced private sector commercialization of academic inventions. Therefore, quantifying the effect of patent litigation on technology transfer activities is important for public policy. Federal policy toward university intellectual property needs to consider whether university patent litigation reduces technology licensing activity and, thus, technology transfer to the private sector.

Our study employs two sources of empirical data. First, we conduct interviews with the directors of technology licensing offices at 13 Carnegie I research universities to understand what effect patent litigation has on technology licensing office operations. Second, we analyze quantitative data from an annual survey of university TLOs, which we combine with a dataset of university patent litigation. Using panel data techniques, we examine the impact of university patent litigation on licensing activity for 116 leading U.S. research universities from 1991 through 2000.

Our interviews and statistical analyses show consistent patterns. Patent litigation imposes important costs on university licensing activity and significantly reduces the number of new licenses executed. Our interviews suggest that this is because litigation disrupts TLO activ-

² It is important to note that university patenting also grew faster than overall patenting during this period.

ity and reduces the time and resources available to market technologies and form licensing agreements.

2. Patent litigation and university licensing

2.1. Intellectual property rights and licensing

A significant motivation for the Bayh-Dole Act of 1980, which awarded property rights for federally funded university inventions to the universities, was the perception that many university inventions were going unlicensed because potential licensees were unwilling to make complementary investments in the commercialization of new technologies if they could not be assured of some exclusivity in the marketplace (Eisenberg, 1996; Mowery and Sampat, 2001). It was felt that companies were wary of investing in the development of university technologies because, without barriers to imitation, later entrants could simply expropriate these investments.

According to some theories of innovation, patent protection can be used to prevent the expropriation of complementary investments made for the development of inventions and thus mitigate an important market failure in the commercialization of new technologies (Kitch, 1977; Mazzoleni and Nelson, 1998). Kitch also argued that patent owners have strong incentives to maximize the commercial use of their inventions because they benefit most when the inventions are more fully exploited. By giving universities property rights on inventions from federal grants, which they could then transfer to their licensees, the Bayh-Dole Act encourages technology commercialization by giving both the universities and their licensees incentives to invest in the development of those inventions (Jensen and Thursby, 2001).

However, the Bayh-Dole approach of transferring intellectual property rights to universities may also provide university technology licensing offices (TLOs) with a higher incentive to pursue rents from patent enforcement relative to the other activities required to commercialize university technology. In many universities, maximizing licensing revenues has become a major goal (Thursby et al., 2001), which can lead to patent enforcement even when it does not foster technology transfer.

To license university inventions, TLOs must overcome informational inefficiencies in finding buyers for new inventions through active marketing and search activities. Further, to sign licensing contracts, they must engage in time- and resource-intensive negotiations over incentive alignment issues and potential contractual hazards, as well as valuation of the technology.

Patent litigation takes time and attention of licensing officers away from these marketing, search, and negotiation activities. Because legal enforcement of patent claims provides an alternative mechanism for obtaining financial returns from university intellectual property, TLOs may choose to litigate patents at the expense of licensing activity, thereby reducing the amount of technology licensing that would have occurred in the absence of patent litigation.³

³ Aggressive patent enforcement may also send a poor signal about the university's desirability as a licensing partner, thus diminishing interest in the university's technologies and thereby reducing licensing activity. While our quantitative analyses cannot differentiate between the disruption effects that we propose above and these negative reputation effects, our interviews strongly suggest that the disruption effect is the primary reason for the decreased licensing activity associated with patent litigation.

3. Data and variables

3.1. *The qualitative data*

We conducted interviews with 13 directors of technology licensing offices at Carnegie I research universities to gain a thick description of the effects of patent litigation on technology licensing activity. We initially sent interview requests to 16 randomly selected directors of technology licensing offices. Of these, 13 agreed to participate in the study. The interviews were structured and followed a written interview protocol. They lasted between 30 and 45 min. All interviews were tape recorded and transcribed. We worked from the interview transcripts to conduct the qualitative analysis.

3.2. *The quantitative data*

We use data from the Association of University Technology Managers (AUTM), which conducts an annual survey of U.S. and Canadian universities and hospitals about their technology transfer activities.⁴ To minimize potential confounds, we restrict our analysis to U.S. universities. Because AUTM has gathered data on licensing activity since 1991, we explore the relationship between litigation and licensing over the period 1991–2000. The AUTM surveys are based on activity that occurred during university academic years, which run from July through June; for example, the academic year 1998 runs from 1 July 1998 through 30 June 1999. We therefore conform all our data and analyses to academic years.

Because we employ panel data techniques in our analyses, our sample is restricted to the 116 U.S. universities for which data from at least 2 years is available. Of these institutions, 56 have participated in all 10 years of the survey, and 74 have participated for at least 8. Virtually all the significant U.S. research universities, accounting for over \$25 billion of sponsored research in 2000, participate in the AUTM survey. The universities in our sample account for 85 percent of all patents issued to universities in the United States.

Our study defines a university as an institution of higher education that operates under a single set of policy rules. Therefore, we combine data from multiple campuses of the same university into a single university entity unless the university operated the different campuses with different technology licensing policies. Because we are unsure about the right aggregation strategy to use for the various campuses of the University of Texas, we exclude it from our analyses.⁵

Although most of our variables were obtained directly from the AUTM survey, our measures of litigation and university patenting were obtained from secondary sources. We relied on two main sources for patent litigation data: the U.S. Patent and Trademark Office (USPTO) Litalert database,

⁴ AUTM licensing survey (various editions: FY1994–2000), Association of University Technology Managers, Northbrook, IL, © 1996–2002. The FY1994 edition contains data going back to 1991.

⁵ The University of Texas System has nine academic campuses and six medical centers, many of which have their own separate technology transfer offices. However, patent litigation efforts appear to be led by the UT System Office of General Counsel (OGC) at the system-wide level. Unfortunately, our data does not allow us to assign litigated UT patents to specific campuses or medical centers, and it is also unclear whether litigation by the OGC would have a location-specific or system-wide effect. Furthermore, data for all of the university's campuses and medical centers are not available consistently over multiple years in the AUTM data, thus vitiating attempts to aggregate variables at the university system-wide level.

and Federal Judicial Center (FJC) database of U.S. Federal Civil Litigation.⁶ The two sources overlap substantially in their coverage and have been discussed in detail elsewhere (Lanjouw and Schankerman, 2001; Somaya, 2003).

For the purposes of this study there are two main differences between the data sources. First, the FJC database contains all suits in which patent law is the primary cause of action, whereas the USPTO database contains only a subset (about 56 percent) of that population. Second, the USPTO database has more comprehensive data about the parties involved in a suit, whereas the FJC database reports only the first plaintiff and first defendant. We compensate for the lack of complete party-related information in the non-overlapping subset of FJC cases through searches for news articles in Lexis-Nexis. Since we have an estimate of the incompleteness of the USPTO data, we are confident that we have accounted for virtually all the university litigation not reported in it.

We developed a list of likely university patent litigation by searching for common university-related strings such as “Univ”, “College”, “Regent”, and “Trustee” among the litigating parties in the FJC and USPTO datasets. In addition, different name variations for each university were also searched (e.g. “Purdue”, “AZ State”, “Arizona”). The results of our Lexis-Nexis searches for news articles about university patent litigation informed our choice of search strings, which were interactively refined and improved. Because we erred on the side of inclusion with the search strings, this process produced a probable list of over 12,000 suits. The false positives were removed by manual examination of the suits. Further, by using the USPTO dataset, we were also able to identify a number of suits relating to patents that were assigned to universities, which did not include the university as one of the litigating parties.

From the process described above, we identified 315 patent suits involving AUTM universities that were active in any academic year from 1987 to 2000. We define “active” suits as those suits whose dockets were open for any fraction of a given year. Thus, a suit is active in its filing and ending years, as well as all intermediate years between them. Among these 315 suits, universities were litigants in 235 suits, while 80 were licensee-only suits. Thirty-two suits did not involve commercial firms as a counter party (to the university), which we call “non-company” suits, and exclude from our analysis.⁷ This left 203 suits in which universities directly engaged in patent litigation with companies.

In Fig. 1, it is evident that while litigation by universities has been increasing overall, licensees are taking on an increasing role in the enforcement of university patents. Table 1, which compares patent litigation with patent issuances for the 74 universities for which we have at least 8 years of AUTM data, indicates that the ratio of university patent litigation to patent issuance is about 12–13 suits per 1000 patents issued. This ratio is similar to the litigation propensity for all U.S. patents (about 14 per 1000) (Lanjouw and Schankerman, 2001), which is surprising because university patents are widely believed to be more valuable (see for example, Henderson et al., 1998, who find that university patents are more heavily cited than commercial patents) and would therefore be expected to experience more litigation.

⁶ Federal Judicial Center. Federal Court Cases Integrated Database (various versions, 1970–2000), Ann Arbor, MI: Inter-university Consortium for Political and Social Research (distributor).

⁷ Non-company suits primarily involve individuals, except in five cases where they involve other universities or non-profits. Typically, these suits are about ownership over the patent and are of a qualitatively different character than the suits involving companies. Moreover, these suits are unlikely to impinge on the working of the university technology licensing office since they are not directly related to technology licensing activity and are typically prosecuted by the university General Counsel.

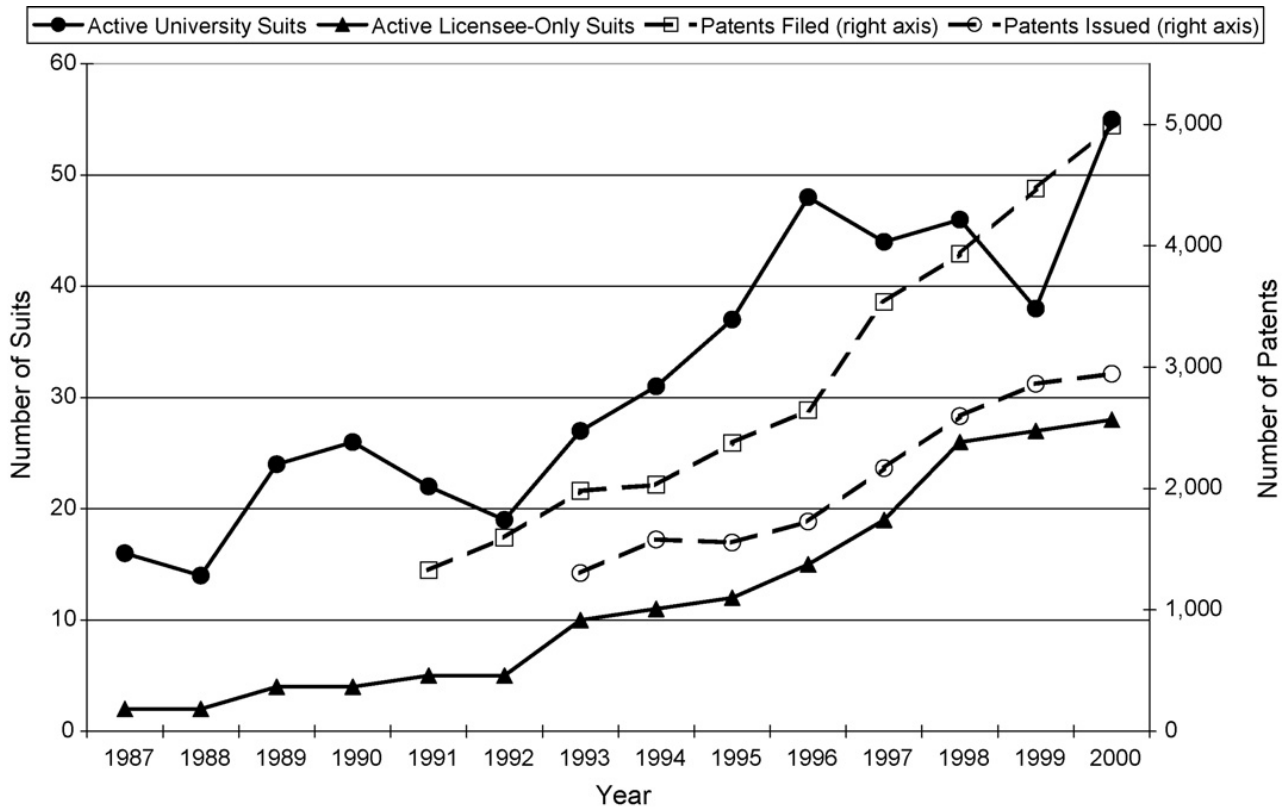


Fig. 1. Litigation to enforce university assigned patents over time. There is a slight downward bias in the patenting graph due to non-reporting of patenting data by some (smaller) universities in some (random) years. Counts of patents filed are based on (subsequently) issued patents, which produces a downward truncation bias in later years.

Table 1
Key features of patent litigation (recurrent universities)

Time period	Suits filed	Licensee-only suits (percent)	Non-company suits (percent)	Patents filed	Patents issued	Litigation propensity (suits per 1000 issued patents)
1993–1996 (S.E.)	65	26.2 (0.055)	12.3 (0.041)	12,588	4996	13.01
1997–2000 (S.E.)	107	41.1 (0.048)	7.5 (0.025)	22,086	8824	12.13

We measure the effect of patent litigation on universities by adding up the number of days that a university is involved in separate patent suits in each year. Sometimes, patent litigation in the same dispute (i.e. between the same parties and over the same patent) can span many suits. These multiple suits can arise from actions filed in different district courts or from the re-opening of closed dockets (typically after an appeal). In these cases, we combine all of these suits into a “litigation unit” that starts from the first date of the first suit filed to the last date of the last suit to end (there are no intervening gaps in our data). We sum up the number of days a university engages in distinct litigations in any given year and transform this variable into litigation-years (dividing by 365) for ease of coefficient interpretation. The litigation-year variable can be greater than “one”. If a university experiences two patent litigations that each last the entire year, for example, this will be measured as two litigation-years for that university.⁸

⁸ All our analyses are conducted using data at the litigation unit level, but we have also replicated them at the suit level (using suit-years instead of litigation-years) and by using the number of active litigations instead of litigation-years.

Our variable, *University-led litigation*, measures the number of litigation-years of suits led by universities (licensees may be co-plaintiffs). *Licensee-only litigation* measures the number of litigation-years of suits filed by licensees alone. Our use of litigation-years accounts for the actual amount of time (and proxies for resources) spent in patent litigation instead of simply counting suits that are filed or active in a given year. We also code two indicator variables for the end of a lawsuit. *End of lawsuit (current)* measures the number of patent lawsuits that ended in the year of observation.⁹ *End of lawsuit (prior)* measures the number of lawsuits that ended in the year before the year of observation.

Using data from the U.S. Patent and Trademark Office on patents issued to each university in our sample, we employ both the aggregate level and the technology distributions of 5-year patent stocks as control variables. The latter is calculated as the percentage of patents belonging to each of five commonly used technology groups, based on their U.S. patent class (Jaffe et al., 1998): *Electrical and Computer*, *Drugs and Medical*, *Chemical*, *Mechanical*, and *Other*. We use the fraction of mechanical patents as the omitted variable because mechanical patents have approximately the same propensity of litigation as the average patent in the U.S. (Somaya, 2004). Because we set the percentages equal to zero for those universities with no patents during the observed year, we also include a dummy variable *Zero patents* (=1 if the university had no patents during the year).

The remaining variables in our analyses are taken from the AUTM survey. *New licenses* is a count of the number of licenses (and options) executed by the university in the year of investigation. *New exclusive licenses* is a count of the number of new exclusive licenses (and options) executed by the university, which the AUTM surveys only collected for five effective years of our data (1996–2000). *New patents filed* is a count of the new patent applications filed by the university in a given year. *New invention disclosures* is a count of the number of new inventions disclosed by inventors to the university. *Research funding* is the dollar value of the universities' research and development expenditures from all sources, and *Industry funding share* is the fraction of these funds that are obtained from industry sources. *TLO staff FTEs* is the number of full time equivalents (FTEs) employed in the university licensing office in a given year, an estimate of the size of the office.

4. The effects of patent litigation

4.1. The qualitative evidence

We summarize the evidence we obtained from interviews with directors of technology licensing offices at 13 universities in the sections below. Illustrative quotes from our interviewees that support our summary findings are included in tabular form. Overall, our interviews indicate that patent litigation is a relatively rare event for many universities and therefore involves a departure from mainstream activities of the licensing office.

4.1.1. Different types of lawsuits

Our interviews sought to understand the differences in the effect of licensee and university-led lawsuits on the operations of a technology transfer office. TLO directors indicated a preference

⁹ In some instances, more than one patent litigation ends in the same year. The end-litigation variable is therefore not a 0/1 dummy variable.

Table 2
The effect of licensee vs. university-led lawsuits

University	Examples of the respondents' descriptions of the effect of licensee-led lawsuits
D	"If we're just a co-plaintiff, then there isn't an awful lot that necessitates extraordinary effort on the part of our office."
G	"It doesn't take much time away from the licensing office when the licensee handles it."
K	"If there is a licensee and someone infringes then our licensee is going to be handling that and the university doesn't get as involved. . ."

Key: Representative examples from the qualitative interviews conducted with 13 directors of technology licensing offices at Carnegie I research universities.

on the part of universities for not filing patent lawsuits themselves and, if possible, for licensees to conduct the litigation instead. This preference stems largely from their perception that licensee lawsuits have little (negative) impact on the operations of the technology licensing office, as summarized by the comments in Table 2. Nevertheless, TLO directors admitted that universities also do initiate patent lawsuits.

4.1.2. *The disruptive effect of university-led lawsuits*

The TLO directors were unanimous that university-led patent litigation caused a significant dislocation in the operation of the technology licensing office. This adverse effect stems from many sources (Table 3). At the most basic level, litigation takes up a significant amount of time and resources that could be spent on other licensing office activities. Licensing officers must typically collect and organize records so that they may be made available during the discovery phase of litigation. They must coordinate between the inventor, university administration, and legal counsel (both in house and external). They must provide depositions and answer interrogatories. This highlights an important aspect of the cost of patent litigation: it draws upon the time and attention of licensing officers, who are a key resource in university technology licensing offices. It becomes difficult for these same personnel to maintain other TLO activities at pre-lawsuit levels while they are dealing with a lawsuit.

In addition, patent litigation can also have a broader impact on the effectiveness of the entire technology licensing office. Some TLO directors described litigation as a continuous distraction, which interferes with the functioning of the licensing office. For example, many meetings have to be held and the litigation strategy analyzed. Other directors explained that lawsuits are stressful, and the resulting strain can affect office morale. Moreover, the efforts and time involved cannot be isolated to specific licensing officers. Their superiors tend to be called in for advice and help, which can then spread to other personnel, therefore disrupting the operations of the office as a whole.

4.1.3. *Differential effects on licensing, patent filings, and disclosures*

While our interviewees indicated that university-led lawsuits are disruptive in general, this cost was not evenly distributed across all licensing office activities. Patent lawsuits have most of their adverse effects on efforts to market new licenses, as summarized in Table 4. The activities entailed in marketing licenses require the direct involvement of licensing officers and are the most discretionary. When licensing officers are involved in university patent litigation, this reduces the time and attention that they can devote to marketing new inventions and concluding technology licenses.

Table 3
How university-led lawsuits impact licensing office activity

University	Examples of the respondents' descriptions of the effect of university-led lawsuits
H	"There is an effect of litigation on the office. Litigation takes years. It is not over in two or three. I mean there's a lawsuit at [University X] that has been going on for more than 10 years. It's a continual drain on resources. It is multiple millions of dollars. You need someone involved in your office. You have a lot of long meetings. This is all extra, in addition to your normal workload."
D	"Litigation takes up time that you could be devoting to other things. . . If we are bringing suit ourselves, then there is a fair amount of time and energy involved. . . If there is a suit going on the particular licensing professional responsible for the patent and probably me will have a certain amount of time consumed with dealing with the suit. And whatever we're engaged in is going to have to be reduced to some degree."
E	"The effect of litigation adds up—an hour or two here and there. . . If you have a full year. . . there's a ripple effect. . . And his or her boss, the director, might have to spend a quarter of that same percentage."
K	"The expense of litigating can be a multiplier of two or three on top of what it already costs to operate the technology transfer office. . . A huge amount of time is invested in assisting with the analysis of the litigation and then participating in the litigation, all of the pre-meetings and settlement meetings. . . Tech transfer is there as a representative of the academic administration and we have to dig up all of the files and make them available for copying and arrange all sorts of meetings and that kind of stuff."
F	"Our technology transfer office needs to be intimately involved in terms of. . . carrying through the whole process. . . The TLO licensing officer tends to be the one that effectively acts as a coordinator, making sure the inventor is involved. The TLO officer essentially acts as the focal point for coordination of these efforts. In our lawsuit against [a major pharmaceutical firm], over a period of a year, that basically consumed my time. I didn't do anything else for a year and a half."
A	"In discovery, you've got to prove a lot of things. You've got to get the research notebooks. You've got to have the faculty available to do things. You might have to get depositions. So when you're pretty well strapped trying to manage a couple of hundred disclosures a year with four people and now the university may be trying to do a hundred with two people, if anything is a distraction, it interferes."
M	"It's not a pleasant thing. It definitely has an effect on morale and productivity and our relationship with inventors. . . If you have discovery, you have to get all the documentation and the correspondence together and that is a huge amount of work. . . You're going to have to pull a lot of information out of the files and generate a lot of information to show. The people who you are suing are going to defend themselves and you are going to get an action back and you are going to have to produce a whole lot of documentation. Plus people might have to be deposed or appear before a judge. . . And if they're not going to be deposed you have to prepare for that anyway. . . So this is a lot of time and effort."
I	"Lawsuits are very stressful. They are disruptive and counterproductive for the most part. The negative connotations that go along with it are demoralizing. It consumes what seems like lots of time."
J	"Patent litigation consumes an enormous amount of everyone's time and it can become very stressful for everyone involved. . . It diverts them from their normal duties to help manage the litigation. Your secretaries are going to be searching for records. Your data managers are going to be searching databases for information and documents and email. . . It becomes a time sink and a strain on the whole staff because of the amount of documents that you have to produce, the resources you have to use to respond to document production issues of depositions and being responsive to interrogatories. All this diverts you away from the ordinary business so it is a huge investment."
L	"Filing lawsuits are a tremendous distraction. It takes a good bit of time to make the discovery and then there is the trial. I cannot imagine an office being involved in more than one active dispute at a time."

Key: Representative examples from the qualitative interviews conducted with 13 directors of technology licensing offices at Carnegie I research universities.

Table 4

The effect of university-led lawsuits on licensing, disclosures and patent filing

University	Examples of the respondents' descriptions of the effect of patent litigation on licensing, disclosures and patenting
I	"Licensing activities would be most affected. . . Marketing leads to licensing so those are the two things that tend to suffer the most when they get busy or distracted." "For the most part, our faculty are not really aware of legal issues and would continue to disclose new technologies."
D	"You're spending your time dealing with all the brouhaha on the litigation, you're going to have less time to be marketing and negotiating licenses." "Getting disclosures just happens. While yes, there's a certain amount of outreach, getting disclosures happens. That's initiated by the inventors. It really isn't initiated by the office." "Even during litigation, filing patents happens because you've got inventors who want their patent filed. So there's pressure on the office to complete that process."
A	"While you are litigating, you're not doing two license agreements because you're fighting this one. It can take a lot of your time."
B	"There's an effect on the productivity of the office when you're involved in a lawsuit because this person can't. . . market as many licenses." "We're usually quiet about lawsuits so I don't think inventors know [re. impact on disclosures]."
K	"Litigation is such a distraction that it gets in the way of pursuing new business opportunities."
J	"The people that are handling the area of technology that is being litigated are going to have their time drawn away from what they otherwise would be doing in the marketing area. . . Also to the extent that licensing officers are responding to the demands of litigation, that's going to slow down our approach to turning around agreements and getting them done." "There is less of an impact on disclosures and processing them." "I don't think there is an impact on patent filings because most of our filings are done by outside attorneys."
F	"If there is a major litigation that tends to take a knock out of marketing new stuff or doing new license agreements. As a practical matter, disclosures keep coming in, patent activity still happens. A lot of these things are time sensitive and time driven. So if your time is limited, you've got to make sure that you're taking care of the time sensitive stuff. And some of the longer term or self-initiated things like marketing are probably the ones that fall by the wayside."
E	"You might have an effect on the one inventor who brings an infringer to us and thinks we should have gone after the infringer and we didn't. But overall, there would be no effect [on disclosures]." "In many offices, you have dedicated administrative personnel who help to process the new patent filings, so there isn't that much of an effect of litigation on patent filings."

Key: Representative examples from the qualitative interviews conducted with 13 directors of technology licensing offices at Carnegie I research universities.

University technology licensing offices report that they do not have enough personnel to market all of their invention disclosures effectively (Thursby et al., 2001). In fact, the typical university licenses only about half of its patented inventions (Shane, 2004). Moreover, the licensing of university inventions is time consuming because the technologies are typically very early stage and the modal number of interested licensees is low (Shane, 2004). The limited development of technologies means that licensing offices must interact extensively with prospective licensees to see whether they would be interested in licensing the invention (Shane, 2004; Hsu and Bernstein, 1997; Thursby et al., 2001). If licensing officers are preoccupied with patent litigation, they are less able to engage in these activities.

However, the TLO directors indicated that litigation tends not to affect the disclosure of inventions or the filing of new patent applications. Licensing officers spend very little time obtaining invention disclosures (Owen-Smith and Powell, 2001), which are usually filed voluntarily by the

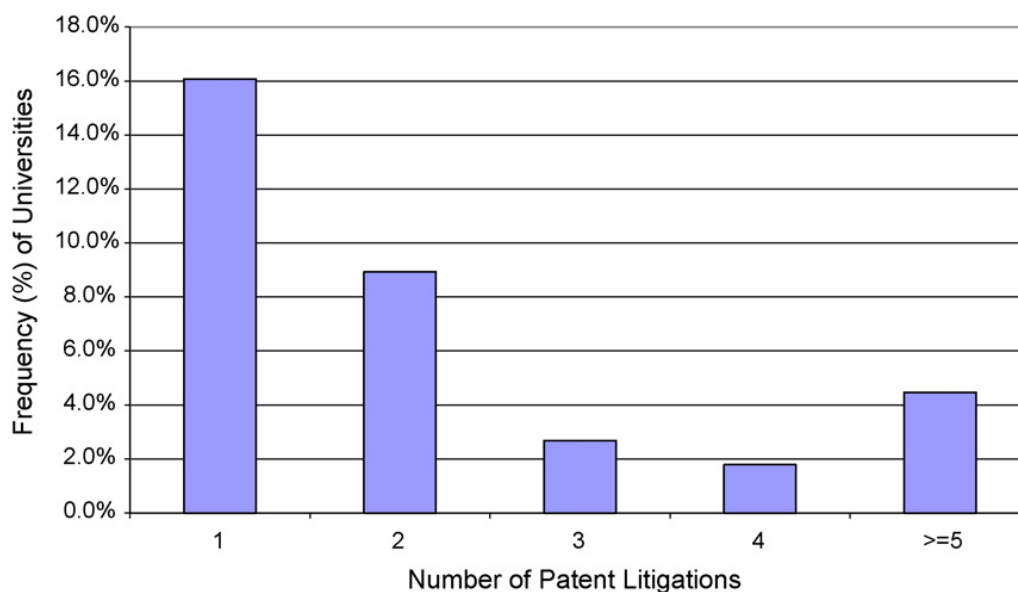


Fig. 2. Frequency distribution of university-led patent litigation.

inventors. Thus, the distraction of licensing officers with litigation has little effect on the inflow of invention disclosures. Moreover, licensing offices rarely advertise patent litigation within the university, and most TLO directors whom we interviewed do not believe that inventors are even aware of university patent litigation.

Similarly, patent filing is also unaffected by lawsuits because licensing officers, who are on the front lines of patent litigation, are not deeply involved in patent filing. In many institutions, patent filing is outsourced to patent attorneys or delegated to dedicated personnel, whose work is not significantly affected by litigation. In addition, patent applications have deadlines and are actively pursued by the inventors, making it hard for licensing offices to cut back on this activity.

4.2. *The quantitative evidence*

We also examined the impact of university litigation on TLO activity through the use of fixed effects regressions. The estimated models predict the number of licenses issued, patents filed, and disclosures received as a function of patent litigation-years for an unbalanced panel of 116 universities from 1991 to 2000. We use fixed effects models because we are concerned about the inconsistency of estimates due to omitted variables and have virtually the entire universe of significant research universities rather than a random sample drawn from a population. Further, Hausman's test for random effects indicates that the unit-specific error terms are correlated with the regressors.¹⁰

Table 5 provides descriptive statistics. Fig. 2 shows the distribution of the university-led patent litigation variable. As the figure shows, two thirds of the universities in the sample experienced no university-led patent litigation during the observation period.

¹⁰ We largely stay within the OLS framework. Even though our dependent variables are count variables, they are generally much larger than zero. Our judgment is that count models will not add much to the analysis while requiring additional distributional assumptions. Nevertheless, we did estimate negative binomial and Poisson models and obtained similar results. Specifically, the relevant coefficients had the same signs and remained significant in the count models. Because count-models produce coefficients that are essentially elasticities, their magnitudes are not comparable to our reported results.

Table 5
Descriptive statistics

Variables	Mean overall	S.D.			Minimum overall	Maximum overall	Observed overall
		Overall	Between university	Within university			
New licenses	23.6	44.4	38.7	29.1	0.0	994.0	990
Licenses to startups and small firms	20.1	55.3	45.7	34.0	0.0	974.0	491
Exclusive licensing	14.1	18.4	15.4	9.2	0	248	496
New patents filed	28.9	39.8	31.7	21.9	0.0	432.0	980
Invention disclosures	75.4	92.2	81.8	37.8	0.0	999.0	995
University-led litigation-year	0.11	0.42	0.28	0.31	0.00	4.30	1610
Licensee-only litigation-year	0.06	0.31	0.20	0.23	0.00	5.12	1610
End of lawsuit	0.05	0.28	0.11	0.26	0.00	5.00	1610
Research funding	170.5	200.9	187.1	49.6	4.3	2084.6	998
Industry funding share	0.11	0.09	0.07	0.06	0.00	1.00	979
TLO staff FTEs	8.5	13.9	12.5	4.3	0.0	167.8	981
Electrical and Computer	0.21	0.19	0.14	0.13	0.00	1.00	1610
Drugs and Medical	0.35	0.24	0.21	0.13	0.00	1.00	1610
Chemical	0.24	0.19	0.14	0.12	0.00	1.00	1610
Other	0.04	0.07	0.05	0.06	0.00	1.00	1610
Mechanical (omitted)	0.08	0.10	0.07	0.08	0.00	1.00	1610

Table 6 reports the fixed effects regressions that estimate the effect of patent litigation. We examine four models, each of which estimates the effect of litigation and various control variables on a dependent variable in the following year. We use lagged predictor variables to rule out reverse causality, and because their use is supported by our interviews. Each of our models incorporate a number of control variables, including the university's number of invention disclosures, share of industry funding for research, the size of the technology licensing office (in full time equivalent staff), the proportion of inventions in different technology areas, and dummy variables for the year under investigation.

Consistent with the qualitative evidence from the interviews, Model 1 shows that each litigation-year spent in patent enforcement in the prior year reduces the number of new licenses issued in the subsequent year by about five licenses, a decrease of 18 percent at the mean level of licensing. Moreover, we find that the end of a lawsuit has no statistically significant effect on the number of licenses issued in the subsequent year. The end of a lawsuit in the year prior to the lagged variables (in effect, 2 years before the year under investigation) has a statistically significant positive effect on the number of new licenses issued. This suggests that there may be some "catch-up" by the licensing office on its workload from prior litigation-years.

Catching up would occur if university technology transfer offices made up for the reduced licensing activity during the period of litigation by undertaking higher levels of licensing in the post-litigation period. Catching up would be possible if university technology transfer offices have slack in their operations, allowing them to increase their level of licensing in periods when they have large amounts of unlicensed patents and if patents are still licensable more than 2 years after their initial disclosure. Existing research (e.g. Shane, 2004) suggests that both of these assumptions are plausible.

Table 6
Fixed effects regressions predicting the effect of litigation on technology licensing office activity

	Model 1 (new licenses, mean = 23.6)	Model 2 (new exclusive licenses, mean = 14.1)	Model 3 (new patents filed, mean = 28.9)	Model 4 (new invention disclosures, mean = 75.4)
University-led litigation	−4.86* (2.14)	−11.71 (2.59)	−3.66 (2.62)	2.65 (3.68)
Licensee-only litigation	12.11*** (2.85)	20.73*** (2.94)	9.84** (3.45)	6.64 (5.43)
End of (university) lawsuit	0.50 (2.02)	5.50* (2.24)	0.39 (2.24)	−5.84+ (3.42)
End of lawsuit (prior year)	4.73* (1.96)	0.69 (1.93)	−1.84 (2.17)	3.59 (3.30)
Invention disclosures	0.08** (0.03)	0.06+ (0.03)	0.09** (0.03)	
Research funding				0.14*** (0.03)
Industry funding share	0.49 (10.98)	6.17 (19.70)	−0.16 (12.75)	19.28 (17.86)
TLO staff FTEs	−0.52*** (0.16)	−0.04 (0.22)	−0.65 (0.18)	0.16 (0.35)
Zero patents	2.69 (14.23)	1.51 (27.64)	−9.40 (18.02)	−32.31 (23.01)
Electrical and computer	−1.50 (15.37)	1.22 (27.97)	13.16 (19.16)	−39.87 (24.83)
Drugs and medical	−4.01 (15.32)	1.42 (27.12)	−10.50 (19.09)	−34.64 (24.82)
Chemical	−0.62 (14.20)	−3.07 (26.80)	−2.92 (17.65)	−41.29 (23.00)
Other	2.03 (27.20)	−0.18 (42.63)	−23.70 (34.86)	−28.69 (42.85)
1993	−20775.60 (31949.75)		−1825.94* (885.15)	−98606.32* (42096.23)
1994	−8124.39 (12485.41)		−1136.16* (546.45)	−39562.04* (16883.83)
1995	−3174.00 (4872.70)		−706.15* (334.28)	−15856.12* 6761.75
1996	−1237.52 (1895.40)		−433.50* (201.57)	−6333.44* (2698.13)
1997	−480.87 (730.87)	57772.78 (263509.80)	−261.67*	−2509.25* (1066.61)
1998	−182.10 (275.40)	6915.26 (31548.40)	−146.75* (66.30)	−969.42* (411.56)
1999	−66.21 (97.35)	817.99 (3734.97)	−80.02* (33.76)	−350.97* (148.70)
2000	−19.54 (27.54)	85.34 (400.12)	−33.17* (13.21)	−102.90* (42.90)
Constant	9.45 (7.56)	20.85 (43.28)	5.46 (5.67)	16.34* (11.86)
σ_u	764.95	1300.54	130.76	1224.40
σ_e	12.34	9.24	14.78	20.56
ρ	0.39	0.12	0.62	0.44
R^2 within	0.20	0.38	0.22	0.24
R^2 between	0.00	0.00	0.01	0.01
R^2 overall	0.01	0.01	0.04	0.01
F	7.44***	8.99***	8.07***	6.24***
F -test that all $u_i = 0$	5.73***	2.19***	2.24***	6.53***
No. of observations	704	359	700	702
No. of universities	112	104	112	112

Key: S.E.s are in parentheses; + $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests).

Based on the average length of litigation in our sample (18.5 months), the magnitude of this catch-up over 2 years after the suit (5.23 licenses) is smaller than the negative effect of litigation itself on new licenses (7.42 licenses). However, given the standard error of the net difference in licenses (4.32), we cannot reject the hypothesis that the licensing office actually catches up with its licensing backlog 2 years after the litigation.

Model 2 examines the effect of litigation on new exclusive licenses executed. This regression uses a much shorter panel than Model 1 because data on exclusive licenses were only collected by AUTM for 5 years (1996–2000). Here too, we observe a negative effect of university litigation. In fact, the decrease in exclusive licenses accounts for almost all of the decrease in the overall level of new licenses.¹¹ One litigation-year of patent litigation in the previous year decreases exclusive licenses executed by 11.7 licenses, a decrease of about 83 percent at the mean level of exclusive licensing.

Our finding of strong effects on exclusive licensing (but none with non-exclusive licensing) is consistent with our interview responses. Several TLO directors explained that exclusive licenses were more time intensive because they tended to entail more complex contractual provisions and typically involved smaller firms, which take more time to manage. Thus, we should expect that patent litigation would have a more severe disruptive influence on exclusive licenses.

Our statistical analysis confirms the qualitative evidence. Even after we control for the catch-up effect (6.19 licenses) after the lawsuit ends, the magnitude of the net decrease in exclusive licenses from an average patent lawsuit is very large (11.67 licenses). Based on the standard error of this net difference in licenses (5.00), we can statistically reject the hypothesis that the licensing office “catches up” with its backlog of exclusive licensing 2 years after litigation.

The third and fourth models examine the effect of litigation on new patent filings and invention disclosures respectively. Consistent with the qualitative evidence from the interviews, we observe no significant relationship between the time spent by universities in patent litigation and the number of patents filed or disclosures in the subsequent year.¹²

Overall, our results suggest that the transfer of patent rights to universities through the Bayh-Dole Act may have carried with it an unanticipated cost. By absorbing valuable licensing officer time and attention, and disrupting TLO operations more generally, university patent litigation appears to be decreasing the overall level of technology transfer to industry.

Table 6 also suggests that licensee-led litigation has the opposite effect from that of university-led litigation, with large and significant positive coefficients in the licensing and exclusive licensing regressions. Therefore, it is possible that licensee-led patent enforcement leads to more licensing, either by enhancing the value of university patents or by generating a positive reputation effect for the university’s enforcement of IP rights at little cost to the university’s licensing effort.

However, our interviews suggest caution in drawing this inference. TLO directors say that there are systematic differences between the patents enforced by the university and those enforced by licensees. First, university-led litigation is more likely for inventions that have not yet been licensed because the university is the only potential litigant for such patents. Second, university-led litigation is more likely for non-exclusively licensed patents than exclusively licensed patents because licensees are more likely to lead litigation when they are the sole licensee to that intellectual property. Because our interviews corroborate the explanation for the impact of university-led litigation, but not licensee-led litigation, we suggest that unobserved heterogeneity about the intellectual property could be the primary explanation for the impact of licensee-led litigation.

¹¹ The magnitudes of the estimates in Table 6 seem to suggest that the impact of litigation on exclusive licenses is larger than the impact on all licensing. However, this is an artifact of the shorter panel used in the exclusive licensing regression. When both regressions are run using the same (smaller) sample, the decrease in exclusive licensing accounts for almost all the decrease in total licensing, but is not larger than it.

¹² To ensure that our results are not driven by outliers, in unreported regressions, we re-estimate the models presented in Table 6, taking out individual universities one at a time. Our results are qualitatively the same, suggesting that outliers are not driving the results.

5. Conclusions

This paper represents the first empirical investigation of the role that patent litigation plays in the university technology licensing process. We provide both qualitative and quantitative evidence that university patent lawsuits reduce the amount of technology licensed by universities to the private sector. We find that the major adverse effect of patent litigation lies in the diminution of exclusive licensing, in which the licensees are typically new and small firms.

Our findings are subject to a few important limitations. First, while we find support for organizational dislocation as the primary effect of patent litigation in both the interviews and quantitative data, we cannot rule out reputation or publicity effects in our statistical analyses. Indeed, the large positive effect of licensee-only litigation on university licensing (in Table 6) could be interpreted as a positive reputation or publicity effect.¹³ Nonetheless, the consistency of our quantitative and qualitative results and the rejection of the reputation explanation in our qualitative evidence strongly suggests that organizational dislocation is the primary mechanism through which university patent litigation *reduces* licensing activity.

Second, we have no conclusive explanation for why university licensing offices do not offset the demands of patent litigation and avoid the negative effects of litigation on licensing by sufficiently increasing office staff or subcontracting some of their work (including litigation itself). We suggest that they cannot do so because much of this work is very capability-intensive and requires organization-specific knowledge, which cannot be quickly built up or contracted for. Moreover, given the unpredictable nature of patent litigation, the offices are unlikely to be able to plan for such organizational needs in advance, which is necessary in a university budgetary environment. Furthermore, university TLOs may be hesitant to take on the liabilities of long-term employment commitments in response to short-term needs. Finally, increasing staff or subcontracting cannot mitigate the effects of litigation on morale or more general organizational disruption.

Third, some of our variables are not measured as precisely as one may ideally desire. For example, the litigation-year variable is merely a proxy for the actual effort exerted by the TLO in pursuing litigation. Measuring litigation activity alone runs the risks of omitting potential pre-litigation efforts and disruption in the TLO, especially in disputes that are not eventually litigated. In both these cases, an alternate, more accurate measure is not available, and the mis-measurement does not lead to systematic biases in our results. We also cannot discriminate between potential licenses available to universities and are unable to shed further light on the nature of those licenses that do not occur (except that they are likely to be exclusive licenses).

Despite these limitations, our study takes a number of important first steps. Our empirical investigation allows us to understand an important aspect of the new strategic behavior exhibited by universities in the arena of technology transfer. Because universities are important contributors to private sector innovation (Adams, 1990; Jaffe, 1986), the substantial increase in the willingness of universities to engage in patent litigation has implications not only for universities and their operations, but also for the role of universities in the national innovation system. Given the potential gains for universities from large settlements in litigation, it may be privately efficient for them to pursue litigation even at the loss of some licenses. However, this behavior may not

¹³ This result does not necessarily mean that universities should enforce patents through their licensees because the positive effect of licensee litigation might reflect unobserved heterogeneity in the types of patents litigated by universities and their licensees. In particular, licensees may be enforcing patents that they are actively commercializing, whereas universities may be enforcing “inactive” patents in the hope of appropriating royalties from alleged infringers.

be optimal for social welfare, which our study highlights as an important fallout of federal policy towards university patents.

In particular, our findings compel us to question whether the incentives provided by the Bayh-Dole Act have had unintended consequences, given the different goals of universities and policy makers. A wide range of studies indicate that universities have increased their licensing significantly in the wake of the Bayh-Dole Act, suggesting that the Act was useful in encouraging licensing activity. However, the transfer of property rights over federally funded inventions to universities under the Bayh-Dole Act also gives them an incentive to use the legal system to enforce those rights. Our results show that patent litigation spurred by these incentives reduces the overall amount of technology licensed because it hinders the marketing and licensing of technologies by resource-constrained technology licensing offices.

Moreover, the Bayh-Dole Act requires universities to give preference in licensing to new and small firms. Our results indicate that the reduction in licensing that occurs in response to university patent litigation stems primarily from exclusive licenses, which are disproportionately signed with new and small firms. Therefore, the enforcement of patent rights may be reducing licensing primarily to those entities that the Act was designed to help.

A minimalist conclusion that may be drawn from our findings is that patents carry with them the right to sue, and the impact of university patent litigation on TLO tech-transfer is merely an unavoidable consequence of this property right. Taking this view, our study provides a quantification of this phenomenon, which must be weighed against other advantages (and disadvantages) of the Bayh-Dole Act to understand its overall effects on university innovation and technology transfer.

In *Madey v. Duke University*, the Court of Appeals of the Federal Circuit ruled that universities could not claim a research exemption from patent infringement when it furthers “the institution’s legitimate business objectives” (307 F.3d (Fed. Cir. 2002)). While the court construed these business objectives broadly to include the university’s research and teaching goals, it also mentioned that Duke, like other major universities, is “not shy in pursuing an aggressive patent licensing program from which it derives a not insubstantial revenue stream.” In the popular press, this decision has been construed to mean that universities must be willing to be sued if they themselves stake out and enforce private IP rights. Thus, while we do not have evidence for it in our data, a potential long-term consequence of university efforts to enforce patents is that universities may be subjected to increasing litigation by other patent holders as well, which has implications for their primary role as engines of research and education. As a result, over time, we may see universities moving further away from the spirit of Bayh-Dole.

Patenting and patent litigation by universities are growing at a faster pace than patenting and litigation by private firms. As universities become more accustomed to patent litigation and learn to manage litigation risk, it is likely that they will engage in more of this activity. Therefore, developing viable policy solutions for the adverse effects of university patent litigation is likely to become increasingly important. When evaluating policies such as Bayh-Dole, policy makers should consider alternatives on the margin that mitigate the unintended adverse effects of university patent enforcement while substantially preserving the beneficial effects of patents for licensing and technology transfer.

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