

THE EFFECTS OF PATENT LITIGATION ON UNIVERSITY LICENSING EFFORTS

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Abstract

One of the effects of increased patenting by universities over the past 20 years has been a rise in the use of lawsuits by universities to enforce their patent rights. In this paper, we ask: “*What effects does patent litigation have on university efforts to license technology?*” We conduct interviews with directors of technology licensing offices (TLOs) at 13 Carnegie I research universities and empirically analyze licensing data for 116 Carnegie I research universities from 1991 through 2000. We find quantitative evidence that patent litigation has an adverse effect on overall university licensing activity. Our interviews with TLO directors suggest that this adverse effect occurs because litigation takes time and attention of licensing officers away from marketing technologies and establishing licenses. Given the adverse effects of litigation on licensing, we investigate why universities litigate. Our qualitative evidence suggests that universities litigate when they believe that they can overcome the perceived risks and financial and organizational demands of litigation. Specifically, they litigate when university TLOs are less reliant on industry funding and can take a more aggressive posture towards private firms; when they have a stronger financial base of royalty income; when they have more licensing and litigation experience; and when they license less exclusively. Our quantitative evidence is consistent with these qualitative observations.

I. 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. The University of California, for example, sued biotechnology firm Genentech alleging intellectual property theft by a 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. Of course, universities do not always succeed with these lawsuits, making them costly and uncertain activities. For example, the University of Rochester recently lost a major lawsuit to enforce its cox-2 inhibitor patent against pharmaceutical companies Pfizer and Merck, after exhausting all its opportunities for appeal.

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). However, despite its increasing use by universities, there has been no research that examines the role of patent litigation in the university technology licensing process.

An examination of this topic would be 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 are appropriate 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, Jensen and Thursby, 2001). University patent litigation is an important manifestation of the divergent goals of policy makers and university administrators toward technology licensing because universities can generate revenue through litigation at the expense of reduced private sector commercialization of academic inventions. Therefore, quantifying its effect on technology transfer activities is important for public policy. Federal policy toward university intellectual property needs to consider whether patent litigation resulting from the allocation of property rights over federally funded inventions to universities reduces technology-licensing activity, and thus, technology transfer to the private sector. If so, the government may be providing universities with “too strong” property rights to federally-funded inventions.

This paper 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 why they litigate to enforce their patents, and what effect this 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, and the determinants of patent litigation activity, from 1991 through 2000 for 116 leading U.S. research universities.

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 activity, and reduces the time and resources available to market technologies and form licensing agreements. We also found that universities spend more time litigating patents when they can overcome the perceived risks and the financial and organizational demands of litigation. Therefore, higher levels of university patent litigation are correlated with prior royalties from technology commercialization, less reliance on industry research funding, higher levels of non-exclusive licensing, and larger, more experienced licensing offices.

II. Determinants of University Licensing and Patent Litigation

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; Mazzoleni and Nelson, 1998; 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.

The prospect theory of patents (Kitsch, 1977) provided intellectual support for this policy by arguing that patents could protect investments in the development of inventions. Thus, patents would mitigate concerns about ex-post expropriation and help to address an important market failure. Kitch also argued that property rights holders have strong incentives to promote commercialization of their inventions, because they benefit 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 their 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 provide university technology licensing offices (TLOs) with too much of an 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, Jensen and Thursby, 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, they must engage in patent negotiations over incentive-alignment issues and potential contractual hazards, as well as valuation of the technology to sign licensing contracts.

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 to technology licensing 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.¹

Motivations for University Patent Litigation

The conventional explanations for litigation in law and economics are centered on understanding why the bargaining surplus, created by forgone litigation costs, does not motivate the parties to settle. Three explanations are typically cited – information asymmetry between the parties, different expectations by the parties about the likely outcome of litigation (even with common information), and stake asymmetries wherein one party gains more from winning than the other party loses (for reviews see Cooter and Rubinfeld, 1989; Daughety, 2000; Spier, 2005).

Briefly, each party’s expected gains from litigation can be viewed as follows:

$$\text{Plaintiff: } P_w T_w - C$$

$$\text{Defendant: } -p_w t_w - c$$

where P_w and p_w are the plaintiff’s and defendant’s estimates of a plaintiff win, respectively, and T_w and $-t_w$ are the expected transfers for the plaintiff and defendant, respectively, in the event of a plaintiff win. C and c are the plaintiff’s and defendant’s respective expected costs of litigation.

Thus, the net surplus for the two parties by avoiding litigation is $(C + c) - (P_w T_w - p_w t_w)$, which forms the bargaining core over which they can negotiate. Asymmetric information and differential

¹ Aggressive patent enforcement may also send a poor signal about the university’s desirability as a licensing partner, and thus diminish interest in the university’s technologies, thereby reducing licensing activity. While our quantitative analyses cannot differentiate between the disruption effect for which we argue and the reputation effects, our interviews suggest that the disruption effect is the primary reason for the decreased licensing activity associated with patent litigation. Therefore, we propose the disruption effect as the mechanism through which litigation reduces licensing activity..

expectation explanations essentially imply that $P_w > p_w$, while asymmetric stakes imply that $T_w > t_w$. In each case, the bargaining surplus is diminished, which in turn leads to litigation. With information asymmetries, the parties have the opportunity to strategically disclose information so that at least some of the costs of litigation are avoided, while earning the most bargaining rents (Spier, 1992). With patents, the preponderance of the literature – both theoretical and empirical – suggests that stake asymmetries are an important motivation for litigation. Meurer (1989) and Lanjouw and Lerner (1998) link asymmetric stakes to the higher rents obtained from monopolization that results from a patentee win. Waldfoegel (1995, 1998) finds empirical evidence that intellectual property suits are different from other litigation in their (high) level of asymmetric stakes, and links these stakes to reputations. Somaya (2003) argues that asymmetric stakes in patent disputes arise from non-contractible strategic interests, and finds corroborative evidence in settlement decisions.

University patent litigation, however, does not fit easily with an asymmetric stakes rationale. Since universities do not commercialize their own innovations, they are clearly not seeking market power. Moreover, from our interviews, it also appears that universities do not seek to develop a reputation for litigation and tough negotiation. Since university budgets are typically tight, there is a perception that they can neither set aside the “war chest” needed for patent litigation, nor afford the associated risks. Chief among these perceived risks are the possibility of simply losing millions of dollars in litigation costs, and the potential damage that litigation may cause to relationships with important donors and industry sources of research funds.

Therefore, it is appropriate to view university patent litigation decisions as being driven more by the private expected value of litigation ($P_w T_w - C$), than the diminution of the joint

bargaining surplus. While conventional factors leading to bargaining breakdowns may also come into play, our interviews suggest that university litigation behavior is driven largely by the perceived private incentives to enforce patents. Thus, when university TLOs are larger or more experienced, the risk perception of patent litigation is reduced, leading to more litigation. Similarly, TLOs that have built up royalties from prior licensing are better able to fund litigation, and convince university leaders about the need for it. Furthermore, when levels of industry research funding are low, universities have less to lose from damaged relationships with industry, again leading to higher levels of patent litigation.

III. Data and Variables

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 process by which universities decide whether to litigate against patent infringement, and the effects of that 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 minutes. All interviews were tape recorded and transcribed. We worked from the interview transcripts to conduct the qualitative analysis.

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.² To minimize potential confounds, we restrict our analysis to U.S. universities only. 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 – e.g., the academic year 1998 runs from July 1, 1998 through June 30, 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 two years is available. Of these institutions, 56 have participated in all ten years of the survey, and 74 have participated for at least eight. 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 produce almost all of the academically-generated intellectual property 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 according to 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.

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)

² AUTM Licensing Survey (Various editions: FY1994-2000), Association of University Technology Managers, Northbrook, IL, © 1996-2002. The FY 1994 edition contains data going back to 1991.

Litalert database, and Federal Judicial Center (FJC) database of U. S. Federal Civil Litigation.³ These 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 them. First, the USPTO database contains only a subset of the suits (about 56%) reported in the FJC database, which contains the entire population of litigation. Second, the USPTO database contains more comprehensive data about the parties involved in a suit, whereas the FJC database only reports 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 about university patent litigation in Lexis-Nexis. Since we have an estimate of the incompleteness of the USPTO data, we are confident that we have accounted for almost 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”, “Colleg”, “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 searches on Lexis-Nexis 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 (when issued) to universities, but did not include the university as one of the litigating parties.

³ Federal Judicial Center. Federal Court Cases Integrated Database (various versions, 1970-2000), Ann Arbor, MI: Inter-university Consortium for Political and Social Research (distributor).

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, a university was a litigant in 235 suits, while 80 were licensee-only suits. Further, 32 suits did not involve commercial firms as a counter party (to the university), which we call “non-company” suits, and exclude from our analysis.⁴ This left 203 suits in which universities directly engaged in patent litigation with companies.

In Figure 1, it is evident that while litigation by universities has been increasing, 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 thousand) (Lanjouw and Schankerman, 2001), which is surprising because university patents are widely believed to be more valuable (see for example, Henderson, Jaffe and Trajtenberg (1998), who find that university patents are more heavily cited than commercial patents – and would therefore be expected to experience more litigation).

[INSERT FIGURE 1 AND TABLE 1 ABOUT HERE]

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

⁴ Non-company suits primarily involve individuals, except in 5 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.

many suits. These multiple suits can arise from suits 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. 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.⁵

Our variable, *Licensee-only litigation* measures the number of litigation-years of suits filed by licensees alone. *University-led litigation* measures the number of litigation-years of suits led by universities. 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.⁶ *End of lawsuit (prior)* measures the number of lawsuits that ended in the year before the year of observation. *Prior litigation* measures the number (stock) of patent litigations in which the University was involved prior to a given year.

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 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 using active litigation instead of litigation-years.

⁶ 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.

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, Fogarty and Banks, 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 U.S. patent litigation (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 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. *Gross royalties* is the total dollar value of royalties obtained by the university in a given year.

We measured the *Exclusive licensing share* as the fraction of the university's licenses that were exclusive over all years for which this data was available. Since the AUTM surveys collected exclusive licensing information for only four effective years of our data (1996-2000), we were unable to compute usable stocks of exclusive licenses, and rely instead on an average measure that accounts for the overall propensity of a university to engage in exclusive licensing. There is substantial variation in this measure between universities. Similarly, the *Small firm*

licensing share is also computed as the fraction of the university's licenses made to small and start-up firms for the four years (1996-2000) that AUTM collected the data.

We also use a dummy variable for universities that have a *medical school*, and a variable that measures the age of the university technology office in the year 2000 (*office age*).

IV. EVIDENCE ON THE EFFECT OF LITIGATION

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.

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 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. Nonetheless, universities admitted that they do sometimes initiate patent lawsuits for various reasons that we explore in a later section.

[INSERT TABLE 2 ABOUT HERE]

The Disruptive Effect of University-Led Lawsuits

The TLO directors were unanimous that university patent litigation caused a significant dislocation in the operation of the technology licensing office. This adverse effect stems from many sources. At the most basic level, litigation takes up a significant amount of time and resources, which 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. Meetings have to be held and the litigation strategy analyzed.

One interviewee estimated that a typical licensing officer who is involved with an infringement lawsuit will spend approximately 20 percent of his or her time on litigation related work. That highlights an important aspect of the cost of patent litigation – it disproportionately impacts the time available to 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. Some TLO directors described litigation as a continuous distraction, which interferes with the functioning of the licensing office. 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 get called in for advice and help, which can then spread to other personnel, therefore disrupting the operations of the office as a whole.

[INSERT TABLE 3 ABOUT HERE]

Differential Effects on Licensing, Royalties, 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 and to collect royalties on existing licenses, as summarized in Table 4. This is because these activities require the direct involvement of licensing officers, and are the most discretionary. Since licensing officers need to be directly involved in university patent litigation, lawsuits reduce the time and attention that licensing officers can devote to marketing new inventions, concluding technology licenses, and following up on royalties from prior licensing contracts.

[INSERT TABLE 4 ABOUT HERE]

University technology licensing offices report that they do not have enough personnel to effectively market all of their invention disclosures (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 with prospective licensees directly to see if 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 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 that 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 frontlines 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, which make it hard for licensing offices to cut back on this activity.

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, royalties received, patents filed, and disclosures received as a function of patent litigation-years⁷ 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 sample drawn from a population. Further, Hausman's test for random effects indicates that the unit-specific error terms are correlated with the regressors.⁸

Table 5 provides descriptive statistics. Table 6 reports the fixed effects regressions that estimate the effect of patent litigation. We examine five models, each of which estimates the effect of litigation and various control variables on a dependent variable in the following year. Our use of lagged predictor variables is supported by our interviews and because we wish to rule out reverse causality. Each of our models incorporate a number of control variables, including

⁷ We obtain qualitatively the same results when we measure the number of active lawsuits in place of the number of days of litigation.

⁸ We largely stay within the regression framework – because our dependent variables are generally much larger than zero even though they are often count variables, our judgment is that count models will not add much to the analysis. However, we did estimate negative binomial count models and obtained similar results.

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.

[INSERT TABLES 5 AND 6 ABOUT HERE]

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 5 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, two 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 the litigation years.

Based on the average length of litigation in our sample of university patent suits (18.5 months), the magnitude of this catch-up (5.23 licenses) is smaller than the negative effect of university-led litigation 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 two 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 five years (1996-2000). Here too, we observe a negative effect of university litigation. In fact, the decrease in exclusive licenses accounts for all of the decrease in the overall level of new licenses. One litigation-year of patent litigation in the previous year

decreases exclusive licenses executed by 11.7 licenses, a decrease of about 83% 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 because they typically involved smaller firms, which take more time to manage. Because exclusive licensing takes a great deal of licensing officer time, patent litigation has a large negative impact on exclusive licensing.

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 reject the hypothesis that the licensing office “catches up” with its backlog of exclusive licensing two 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.

Model 5 examines the effect of litigation on the royalties generated by universities, net of one-time gains from the sale of equity. Controlling for the same factors as in Model 1, we observe a significant decrease in the level of royalties earned following litigation. Each litigation-year of patent litigation decreases royalties by \$ 6.19 million, which is well over 100% of the mean level of royalties (\$4.25 million). This significant decrease in royalties is consistent with of the qualitative evidence provided by TLO directors who explain that generating royalties

requires the active engagement of licensing officers, which is impaired by patent litigation. Model 5 also shows that universities do not “catch-up” the lost royalties in the two years following litigation.

However, both the magnitude and “catch-up” effects for royalties need to be interpreted with caution. Damages awarded in litigation are often included in the royalties reported by universities, and tend to be paid out over several years. As a result, the average level of royalties in non-litigation years may be “artificially” inflated by damage awards, resulting in a higher estimate of the decrease in royalties due to litigation, and an inability to measure post-litigation catch up with end-of-litigation dummy variables.

V. Evidence on Determinants of Litigation

Given the negative effects of patent litigation on university licensing activity, we also investigate why universities engage in patent litigation. Our motivation for this stems not from a concern that patent litigation is inefficient for universities (indeed, the potential for very large damage awards suggests otherwise), but from a desire to understand why universities engage in this strategic behavior. Our interviews with the directors of technology licensing offices suggest four primary drivers. First, royalties earned from prior licensing activity gives the TLO the financial independence and internal credibility required to overcome university risk perceptions about patent litigation. Second, more experienced technology licensing offices are better able to plan for and manage the disruption of patent litigation, and therefore more likely to litigate. Third, universities are less likely to litigate when they are more dependent on industry funding because litigation has the potential to damage relationships with industry. Fourth, universities

that license more exclusively litigate less often, leaving their licensees to enforce the patents instead.

Qualitative Evidence

As Table 7 summarizes, universities are more likely to litigate if they have generated significant royalties from past licensing. Even if a particular patent appears promising and could generate high levels of royalties if enforced, universities often do not litigate. Universities are typically budget constrained, and are reluctant to take money from their general funds to pursue highly uncertain patent litigation. Moreover, universities are significantly averse to the risks of patent litigation, both in the domain of public opinion and in the potential financial impact of legal costs. Some licensing offices have the discretion to use their own royalty funds to enforce patents, thus allowing licensing offices that have built up prior reserves to litigate. Moreover, many of our interviewees argued that prior success with patent licensing, as measured by licensing revenues, builds up the credibility and organizational influence of the technology licensing office within the university. In turn, this credibility enables the licensing office to obtain the backing, both financial and otherwise, of the university administration for pursuing patent litigation.

[INSERT TABLE 7 ABOUT HERE]

As Table 8 summarizes, universities with more experienced technology licensing offices are more likely to litigate to protect their patent rights. More experienced licensing offices can negotiate the organizational reluctance to pursue patent litigation more effectively, and are politically more capable of obtaining backing from the university administration. In addition, prior experience of the TLO also makes the university more comfortable managing the adverse

publicity from litigation. Furthermore, experience increases the licensing office's ability to evaluate the university's legal case in an objective and impartial manner, leading to greater confidence in its ability to pursue patent litigation, and manage any disruption caused.

[INSERT TABLE 8 ABOUT HERE]

As Table 9 summarizes, universities are more likely to litigate if they receive a greater proportion of research funding from the government, rather than from industry. Most technology licensing offices consider the overall costs and benefits to the university when they decide to pursue litigation, and usually solicit input from the university administration in making this decision. This means that the offices "factor in" the impact of litigation on grants and research contracts from industry. Few universities want to follow the example set by the University of Illinois in litigating intellectual property relating to the Mosaic web browser, only to lose future funding from Netscape founder, and Illinois alumnus, Mark Andressen (Reid, 1997). Therefore, many technology licensing office directors indicate that certain companies are "off limits" in patent litigation because they are strong supporters of the university and its research.⁹

[INSERT TABLE 9 ABOUT HERE]

As Table 10 summarizes, universities that license more of their patents exclusively are less likely to litigate. The TLO directors explained that when patents are exclusively licensed, they usually prefer to delegate responsibility for enforcing patent rights to their licensees. Non-exclusive licensees on the other hand have no legal *locus standi* in patent enforcement, which means that universities are virtually forced to enforce non-exclusively licensed patents themselves or abandon their claims on the technology. As a result, university-led litigation is

⁹ The interviewees also suggested that that universities that receive more of their funding from industry litigate their patents less frequently because also more likely to know how to resolve disputes with industry privately, and so do not let conflicts escalate to litigation.

less common when university patents are licensed exclusively and more common when universities engage in non-exclusive licensing.

[INSERT TABLE 10 ABOUT HERE]

Quantitative Evidence

In our sample of 116 universities over the 1991-2000 time period, we estimate the impact of share of industry funding, prior year royalties, age of the TLO, prior litigation experience, and exclusive licensing share on the level of university patent litigation, measured in litigation-years. For our main regression, we use random effects models because some of our hypotheses relate to variables that have no within-university variation, which would lead to misidentification if a fixed effects model were used. A random effects model also enables us to use information about inter-university differences in the other independent variables and obtain efficient estimates of their impact on the propensity to litigate. We complement these estimates with estimates from a fixed effects model that excludes some variables. To account for the large number of left-censored observations, we use Tobit models in each case. We also control for the university's stock of patents in the previous year and its distribution across the five technological classes described earlier ("mechanical" is the omitted category). We also control for the size of the university TLO, whether the university had a medical school, for the proportion of licenses to small and start-up firms, and include a full set of year dummy variables.

Model 1 in Table 11 presents estimates from the random effects Tobit regressions. Consistent with our interviews, we find more experienced technology licensing offices are more likely to engage in litigation, as suggested by the TLO directors that we interviewed. While the main effect of licensing office age is positive, the effect eventually attenuates, as suggested by

the negative sign of the coefficient for age-squared. However, at the mean age of University TLOs (about 16 years in 2000), each year of experience increases litigation by net amount of 22 days, equivalent to about 40 percent of the mean level of litigation. The inverted U-shaped relationship of age to likelihood of litigation reaches its maximum for licensing offices that are 35 years old, or established prior to 1965. Because only 5 universities in our sample had technology licensing offices prior to 1965, this suggests that the amount of university litigation likely reaches a plateau with age.

[INSERT TABLE 11 ABOUT HERE]

Also consistent with our argument that more sophisticated offices engage in more patent litigation is the effect of prior litigation experience on the likelihood of litigation in a given year. Each prior patent lawsuit increases litigation by about 126 litigation days, equivalent to about 2.3 times the mean level of litigation.

Our interviewees also indicated that licensing offices with higher royalty incomes would have both the organizational credibility and the access to funds required to pursue patent litigation. Consistent with that argument, we find that each million dollars of additional gross royalties in the prior year (the average gross royalty is \$4.3 million) increases litigation by about 5.7 days, equivalent to about 10.4 percent of the mean level of litigation.

Our interviewees explained that licensing offices which receive more industry funding should engage in less litigation. Our quantitative results provide strong evidence that a higher proportion of industry funding, indicating closer ties to industry, significantly reduces the likelihood of university patent litigation. Each additional percentage of industry funding (the mean is 10%) reduces litigation in the following year by about 16 days, equivalent to about 30 percent of the mean level of litigation.

Finally, our interviewees explained that licensing offices which engage in more exclusive licensing should engage in less litigation. Consistent with this qualitative finding, our quantitative analyses show a significant effect of exclusive licensing on the level of university litigation – each additional percentage of licenses that are exclusive decreases litigation by about 3.3 days, which corresponds to about a 6 percent decrease in litigation at the mean level.

To complement our random effects estimates, we also report fixed effects Tobit estimates in Model 2. While we cannot test all of our hypotheses within the fixed effects framework, we find results that are largely consistent with the random effects estimates discussed above. Industry funding share has a significant negative effect on litigation, while gross royalties and prior litigation have significant positive effects. These results help to rule out the possibility that these results are artifacts of unobserved heterogeneity among universities in our sample. Unfortunately, we cannot test for the effect of exclusive licensing share and licensing office age, as these variables are invariant within each university.

VI. 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 licensing inventions exclusively, in which the licensees are typically new and small firms. We also provide both qualitative and quantitative evidence that universities are more likely to engage in patent lawsuits if they have more experience with licensing, greater royalties, fewer exclusive licenses, and rely less on industry funding.

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, one interpretation of the large positive effect of licensee-only litigation on university licensing in our quantitative analysis is that licensee litigation has a positive reputation or publicity effect by showing that a university's intellectual property rights are valuable and being enforced.¹⁰ Nevertheless, the consistency of our quantitative and qualitative results, and the rejection of the reputation explanation in our qualitative evidence, suggest 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. 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 out. 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 organizational disruption.

¹⁰ This result does not 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.

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 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 some goals of universities in patent enforcement are at odds with the goals of the federal policy that gave them these enforcement rights. 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 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 lies primarily among exclusive license agreements, which tend to be signed with new and small firms. Therefore, the incentive given by the Act for universities to

use the legal system to enforce patent rights might reduce licensing primarily to those entities to which the Act was designed to increase licensing.

Furthermore, assigning universities the rights to federally-funded inventions may provide incentives for universities to adopt strategies to maximize royalties rather than technology licensing. However, the policy goal of the Bayh-Dole Act was to encourage university technology transfer, not to maximize university licensing revenues. The incentives provided by property rights to universities under the Bayh-Dole Act may be too strong, leading to socially excessive levels of patent litigation by universities and less than the optimal amount of licensing. Our results suggest that policy makers need to consider these unintended adverse effects on technology licensing of the assignment of intellectual property rights to federally funded inventions to universities, and of the use of lawsuits as a mechanism to enforce those property rights.

Patenting and patent litigation by universities are growing at a faster pace than patenting and litigation by private firms. Our research shows that universities are currently being constrained in pursuing patent enforcement primarily by their perceptions about litigation risks. As universities get 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 to the adverse effects of university patent litigation is likely to become increasingly important.

Finally, our results provide the first direct quantification of the non-pecuniary organizational costs of patent litigation. While other research has argued that patent litigation takes an organization's time and attention away from other important activity (Somaya, 2003; Walsh, Arora and Cohen, 2003), these organizational dislocation costs have not previously been

quantified. The clearly defined scope of activities pursued by university licensing offices and the availability of quantitative data on these activities has enabled us to estimate these dislocation costs for university TLOs. While these costs are significant, we also find that they are mitigated because licensing offices catch up with some of their workload when litigation ends.

VII. References

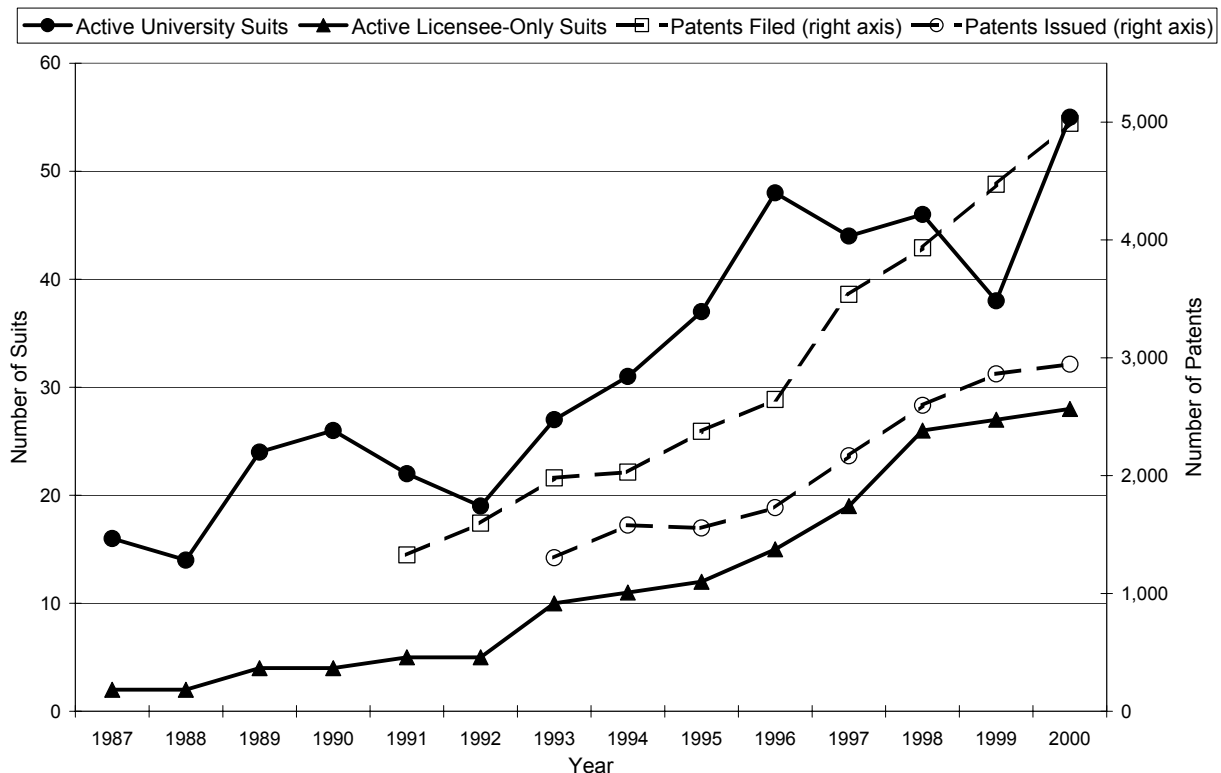
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FIGURE 1. LITIGATION TO ENFORCE UNIVERSITY ASSIGNED PATENTS OVER TIME



- 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	% Non-Company Suits	Patents Filed	Patents Issued	Litigation Propensity (Suits per 1000 Issued Patents)
1993-1996	65	26.2%	12.3%	12,588	4,996	13.01
Std. Error		(0.055)	(0.041)			
1997-2000	107	41.1%	7.5%	22,086	8,824	12.13
Std. Error		(0.048)	(0.025)			

TABLE 2: THE EFFECT OF LICENSEE VERSUS 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.

TABLE 3: HOW UNIVERSITY-LED LAWSUITS IMPACT LICENSING OFFICE ACTIVITY

University	Examples of the Respondents' Descriptions of the effect of University-Led Lawsuits
H	<p>“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.”</p>
D	<p>“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.”</p>
E	<p>“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.”</p>
K	<p>“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.”</p>
F	<p>“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 inventors 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.”</p>
A	<p>“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.”</p>

M	<p>“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.”</p>
I	<p>“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.”</p>
J	<p>“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.”</p>
L	<p>“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”</p>

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	<p>“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.”</p> <p>“For the most part, our faculty are not really aware of legal issues and would continue to disclose new technologies.”</p>
D	<p>“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.”</p> <p>“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.”</p> <p>“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.”</p>
A	<p>“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.”</p>
B	<p>“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.”</p> <p>“We’re usually quiet about lawsuits so I don’t think inventors know [re. impact on disclosures].”</p>
K	<p>“Litigation is such a distraction that it gets in the way of pursuing new business opportunities.”</p>
J	<p>“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.”</p> <p>“There is less of an impact on disclosures and processing them.”</p> <p>“I don’t think there is an impact on patent filings because most of our filings are done by outside attorneys.”</p>
F	<p>“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.”</p>

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

TABLE 5: DESCRIPTIVE STATISTICS

Variables:	Mean	Std. Dev.			Min.	Max.	Obs.
	Overall	Overall	Between Univ	Within Univ	Overall	Overall	Overall
New licenses	23.6	44.4	38.7	29.1	0.0	994.0	990
Licenses to startups & 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
Gross royalties	4.3	13.7	9.6	9.1	0.0	267.8	995
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
Patent Stock [5 year]	58.2	108.3	91.3	58.9	0.0	1856.0	1610
Office age	16.0	11.9	11.9	0.0	1.0	75.0	1512
Prior litigation	0.58	1.50	1.36	0.63	0.00	11.00	1610
Exclusive Licensing Share	0.65	0.21	0.21	0.00	0.00	1.00	1090
Small Firm Licensing Share	0.63	0.15	0.15	0.00	0.24	1.00	1090
Medical school	0.59	0.49	0.49	0.00	0.00	1.00	1610

TABLE 6: FIXED EFFECTS REGRESSIONS PREDICTING THE EFFECT OF LITIGATION ON TECHNOLOGY LICENSING OFFICE ACTIVITY

	Model 1	Model 2	Model 3	Model 4
	New Licenses (Mean = 23.6)	New Exclusive Licenses (Mean = 14.1)	New patents Filed (Mean = 28.9)	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 ** (3.448)	6.64 (5.43)
End of (univ.) lawsuit	0.50 (2.02)	5.50 * (2.24)	0.39 (2.24)	-5.84 t (3.42)
End of lawsuit (prior yr)	4.73 * (1.96)	0.69 (1.93)	-1.84 (2.17)	3.59 (3.30)
Invention disclosures	0.08 ** (0.03)	0.06 t (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	2.028 (27.20)	-0.18 (42.63)	-23.70 (34.86)	-28.69 (42.85)
1993	-20775.6 (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 (263509.8)	-261.67 * (118.38)	-2509.25 * (1066.61)
1998	-182.10 (275.40)	6915.26 (31548.4)	-146.75 * (66.30)	-969.42 * (411.56)
1999	-66.21	817.99	-80.02 *	-350.97 *

	(97.35)	(3734.97)	(33.76)	(148.70)
2000	-19.5370	85.34	-33.17 *	-102.90 *
	(27.54)	(400.12)	(13.21)	(42.90)
Constant	9.45	20.8533	5.46	16.34
	(7.56)	(43.2749)	(5.67)	(11.86)
sigma_u	764.9502	1300.544	130.76	1224.40
sigma_e	12.3435	9.2356	14.78	20.56
rho	0.39	0.12	0.62	0.44
R-square within	0.20	0.38	0.22	0.24
R-square between	0.00	0.00	0.01	0.01
R-square 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 ***
N of observations	704	359	700	702
N of universities	112	104	112	112

Key: Standard errors are in parentheses; t $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (Two-tailed tests)

TABLE 6: FIXED EFFECTS REGRESSIONS PREDICTING THE EFFECT OF LITIGATION ON TECHNOLOGY LICENSING OFFICE ACTIVITY (CONTD.)

	Model 5	
	Royalties (Mean = \$4.25 Mn.)	
University-led litigation	-6.19	***
	(1.26)	
Licensee-only litigation	12.57	***
	(1.68)	
End of (univ.) lawsuit	3.05	**
	(1.09)	
End of lawsuit (prior yr)	-2.36	*
	(1.06)	
Invention disclosures	0.04	**
	(0.01)	
Research funding		
Industry funding share	0.05	
	(6.22)	
TLO Staff FTEs	-0.26	**
	(0.09)	
Zero patents	-1.48	
	(8.68)	
Electrical and computer	-3.39	
	(9.26)	
Drugs and medical	-3.71	
	(9.23)	
Chemical	-0.45	
	(8.73)	
Other	-10.51	
	(16.75)	
1993	-286.02	
	(684.26)	
1994	-169.72	
	(400.54)	
1995	-100.76	
	(232.70)	
1996	-59.18	
	(133.50)	
1997	-34.88	
	(74.79)	
1998	-20.03	
	(40.07)	
1999	-11.74	
	(19.57)	
2000	-6.20	

	(7.37)	
Constant	5.55	t
	(3.10)	
<hr/>		
sigma_u	21.45	
sigma_e	7.14	
rho	0.59	
R-square within	0.26	
R-square between	0.00	
R-square overall	0.02	
F	9.85	***
F test that all u_i=0	2.74	***
N of observations	708	
N of universities	114	
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Key: Standard errors are in parentheses; t $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (Two-tailed tests)

TABLE 7: THE EFFECT OF ROYALTIES ON PATENT LITIGATION

University	Examples of the Respondents' Descriptions of the Effect of Royalties on Patent Litigation
K	<p>“Universities have typically not considered litigation around tech transfer in whatever budget they hold aside to do these kinds of things. The resources aren’t budgeted for it and most universities work on an annual budget cycle. So when you come along and you have to come up with very significant resources to invest in litigation somebody has to find the money to do it. And if you’ve got the money you can pull it out of central’s share of the royalty distribution and that would make it easier.”</p>
E	<p>“The more successful a licensing office has been the more that you’re going to have support from the administration to have the university stick its neck out in tracking down an infringer. There’s a risk there. There is still some controversy about universities enforcing their IP rights in terms of public relations and the reputation of a university. If it’s been a successful office, you are going to have more support from the administration.”</p>
F	<p>“The office of general counsel is the one that ultimately has the authority to initiate a suit.... Your ability to generate royalties matters from a credibility standpoint.”</p>
G	<p>“If an office is bringing in \$100,000 in royalty income and they go to the president and say we want \$3 million to sue this company, that guy is going to say, ‘prove to me that there’s evidence that it has value’. But if you’re bringing in \$50 million in royalty income, you go to the president and say, ‘I need \$3 million to sue somebody’ then he’s going to say, ‘yeah, I know that technologies do have value.’”</p>
I	<p>“The decision on litigation is made at a very high level. I would say the vice president for research. To get him to agree it would be a good idea to have something in reserve so that there are resources available if they are needed. If a university has to go to generate such a budget item, it is tough to do.”</p>
J	<p>“There are not many offices that have the wherewithal to litigate. So if you’re part of a university, the money that you’re going to get for litigation comes out of the general fund. It’s easier to sell litigation to the administration of the university if you have made money off of patents.”</p>
L	<p>“There is an issue of credibility. If the office is deemed successful then we are going to have more credibility when we recommend to the president that we initiate a legal action.”</p>

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

TABLE 8: THE EFFECT OF TECHNOLOGY LICENSING OFFICE EXPERIENCE ON LITIGATION

University	Examples of the Respondents' Descriptions of the Effect of Technology Office Size and Experience on Patent Litigation
D	“Licensing offices that have been in business longer litigate more because you have to be sophisticated enough to realize that you are going to need expert assistance if you are going to pursue this course. And more experienced offices have more contacts and more context in which to place the whole prospect of litigation.”
K	“Making the decision the first time when your institution has not been through it before there are so many unknowns. It becomes easier to go through that mental thought process when the next opportunity rolls around.”
C	“There are universities that are inexperienced and would be afraid of lawsuits. There are universities that think much like Victorian ladies that getting in the paper is, by definition, a disreputable thing to have happen. I think of that as inexperience..... Also, if they’ve never done it before, it becomes a big hoopla particularly if the chancellor sees visions of \$50 million or \$200 million. The newspapers are calling you up and everything else.”
E	You have some of the third parties out there wanting to blow you off and not get a license. More sophisticated offices are going to be able to track those instances and get people at the tech transfer office to pay attention to it and spend energy on it.”
G	The more sophisticate the office, the more likely they are to identify and take legal action because they have the ability to quantify potential value.”
J	“How long the office has been in operation is important in explaining why offices engage in litigation. It affects how knowledgeable the staff is and the level of advice that they are getting. If your office has been around only for a few years and the staff is relatively inexperienced, I don’t think that they are going to try to get involved in a patent litigation. If you’re an MIT or a Stanford, it may be more likely for you to do it because you understand the process a lot better and you’re more knowledgeable about it.”

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

TABLE 9: THE EFFECT OF INDUSTRY FUNDING ON PATENT LITIGATION

University	Examples of the Respondents' Descriptions of the Effect of Industry Funding on Patent Litigation
A	"I'm not going to send a scathing letter to Intel or Motorola who are funding research here and blow it on the possibility that they might be infringing....We don't go after someone that is a big researcher, that is some benefactor of the university... because that could come back to bite us."
B	"If we wanted to file a lawsuit, we would check with a lot of folks. We would see if there were any relations with the company from a development standpoint. We would check with sponsored research to make sure there wasn't a relationship with that particular company. Like we always joke in the office, we could never sue [a major computer manufacturer]. It would be politically impossible."
C	"You'll think that the Provost or the President or somebody ought to think about it before we sue one of our favorite friends.... I know of at least one case where a friend of [the university] complained loudly enough that we dropped an appeal after losing the first round."
K	"The unintended consequences analysis needs to come in. We have donors and all sorts of other consequences."
E	"If we have a good relationship with companies through sponsorship of a bunch of research or other things throughout the university, I think we are less likely to get into a dispute with them.... They know us and we know them and we're going to play nicely. We're not going to get into that litigation scenario with them or threaten litigation with them. So to the extent that we know people the less likely we are to have a dispute.... I cannot think of an instance where we have gotten down to sitting on the opposite side of a table with one of our research sponsors because we're accusing them of infringement. Those things usually get worked out if they're a company we have a relationship with....We're not going to get into a dispute with those people who we know anyway because they're going to say, 'yeah' and we're going to say, 'yeah, you know, maybe you should take a license.'"
I	"The university doesn't want to be suing our friends and supports and neighbors and fellow [name of the state] companies. If there is an issue, we would greatly prefer to sit down and discuss it and try to reach a resolution outside the legal system."

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

TABLE 10: THE EFFECT OF EXCLUSIVE LICENSING ON PATENT LITIGATION

University	Examples of the Respondents' Descriptions of the Effect of Exclusive Licensing on Patent Litigation
C	“When we have an exclusive licensee, we usually depend on them to enforce.”
E	“Our licensees who take exclusive licenses have the right to enforce our patents. They’re going to be doing that on their own.”
B	“The reason we filed in the one or two cases it was not exclusively licensed [was that] it was our responsibility to maintain the patents or let those licenses go.”
F	“In the case where we have a licensee that has an exclusive license we certainly have the ability to participate in the lawsuit. But I can’t think of an instance where we have done so. We usually leave that to our exclusive licensee to pursue it.”

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

TABLE 11: REGRESSIONS PREDICTING UNIVERSITY PATENT LITIGATION

	Model 1		Model 2	
	Random effects		Fixed effects	
	Litigation Years (Mean = 0.11)		Litigation Years (Mean = 0.11)	
TLO Staff FTEs	0.01	**	0.01	
	(0.004)		(0.008)	
Industry Funding Share	-4.52	***	-4.77	***
	(0.99)		(1.35)	
Gross Royalties	0.02	**	0.02	*
	(0.005)		(0.008)	
Office Age	0.12	***		
	(0.03)			
Office Age Sq.	-0.002	***		
	(0.001)			
Prior Litigation	0.35	***	0.36	***
	0.04		(.09)	
Exclusive Licensing Share	-0.89	*		
	(0.36)			
Small Firm Licensing Share	-0.22			
	(0.44)			
Patent Stock	-0.004	***	-0.005	***
	(0.001)		(0.001)	
Zero Patents	0.39		2.72	
	(1.00)		(190.48)	
Electrical and Computer	0.39		-2.34	
	(1.07)		(1.87)	
Drugs and Medical	0.55		-0.30	
	(1.01)		(1.95)	
Chemical	1.53		0.70	
	(1.07)		(1.90)	
Other	0.76		-1.88	
	(1.73)		(2.73)	
Disclosures	0.004	**	0.003	
	(0.001)		(0.002)	
Medical School	0.01			
	(0.20)			
1993	-0.52		-0.46	
	(0.25)		(0.35)	
1994	-0.09		0.02	
	(0.22)		(0.30)	
1995	0.06		0.19	
	(0.21)		(0.27)	
1996	0.08		0.17	
	(0.21)		(0.25)	
1997	-0.11		-0.01	

	(0.21)	(0.24)		
1998	-0.22	-0.15		
	(0.21)	(0.23)		
1999	-0.20	-0.22		
	(0.19)	(0.20)		
2000	-0.31	-0.30		
	(0.19)	(0.19)		
Constant	-2.95	0.95		
	(1.15)	(2.39)		
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sigma_u	1.29			
sigma_e	0.72			
rho	0.76			
Log Likelihood	-394.95	-222.15		
Chi2	268.04	***	552.22	***
Pseudo R-square			0.55	
N of observations	805		805	
N of universities	105		105	
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Key: Standard errors are in parentheses; t $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$ (Two-tailed tests)