Competing on Standards? Entrepreneurship, Intellectual Property and the Platform Paradox

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Abstract: *This paper studies the intellectual property strategy of firms that participate in the formal standards process. Specifically, we examine litigation rates in a sample of patents disclosed to thirteen voluntary Standard Setting Organizations (SSOs). We find that SSO patents have a very high litigation rate, and that patents assigned to small private firms are litigated more often. We also estimate a series of difference-in-differences models and find that small firm litigation-rates increase following disclosure to an SSO while large-firm litigation rates remain unchanged or decline. We interpret this result as evidence of a "platform paradox"— while open standards promote entry by small specialized technology developers, these firms often pursue an aggressive IP strategy that may undermine the standard's openness.*

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1. Introduction

Personal computers, the Internet and cellular telephony are three prominent examples of a technology *platform* – a system of independently supplied yet inter-operable components governed by a common set of technical standards. Many of the most successful information technology and communications platforms are based on *open standards*, meaning that any firm can access key components and interface technologies at little or no cost. These specifications are typically developed by voluntary Standard Setting Organizations (SSOs), which offer their members a quid pro quo: in return for the opportunity to promote their proprietary technology, and perhaps have it endorsed as an industry standard, firms agree to disclose relevant intellectual property (IP) and license it broadly (Chiao, Lerner and Tirole 2005).

While large "platform leaders" (Gawer and Henderson 2007) often play a central role in the creation of new standards, so too do entrepreneurs and small specialized technology developers. But SSO intellectual property rules can place these small firms in a difficult position; while they are often anxious to have a standard — especially if it will complement (or rely on) their proprietary technology — small firms typically lack the manufacturing, marketing and distribution capabilities that enable large firms to "cooperate on standards and compete on implementation" (IBM 2007). In fact, many small firms view the standards process as an attempt to secure cheap access to their proprietary technology. But when small firms assert their intellectual property rights aggressively, their larger rivals tend to view it as an effort to manipulate the standards process, and often respond by accumulating a large pool of "defensive" patents (Hall and Ziedonis 2001). We label this phenomenon the platform paradox — open standards create favorable conditions for innovation by technology entrepreneurs while simultaneously providing incentives for opportunistic behavior that undermines the openness of a platform.

This paper provides empirical evidence on the intellectual property strategy of SSO participants and finds evidence of a platform paradox – i.e., that large firms have a greater incentive to pursue a liberal IP licensing policy following the creation of standard. Our data were collected by reviewing 2,558 intellectual property disclosures made at thirteen influential SSOs and compiling a list of 2,049 U.S. patents contained in these disclosures. Since we cannot observe actual licenses, our strategy is to examine patent litigation, which indicates that a patent owner has tried to assert its IP and that initial negotiations were unsuccessful.

We find that SSO patents have a very high litigation rate (roughly six times that of a random sample from the same vintage and technology class), and that small private firms are more likely to litigate than larger ones. We interpret these results as selection effects: firms disclose their most important patents, and the marginal patent is less important at large firms simply because they have a larger portfolio.

Our evidence for the platform paradox is based on *changes* in the litigation rate following disclosure. Specifically, we estimate difference-in-differences models that use firm or patent-level fixed effects to control for differences in disclosure strategy, and find that litigation rates increase for small-firm patents relative to large-firm patents after a standard is created. We also show that patent citations follow the opposite pattern – patents assigned to small firms receive relatively fewer cites after disclosure – which suggests that the litigation effects are driven by changes in the incentive to litigate, rather than a shock to the relative demand for small versus large-firm IP (i.e. the amount of infringement).

Finally, we ask whether the increase in small-firm litigation rates is driven by "patent trolls" – firms that use the patent system to hold-up investments in a new standard and extract quasi-rents from potential implementers (Shapiro 2001; Jaffe and Lerner 2004). The evidence for trolls is mixed. We find that among VC backed firms, litigation rates are substantially higher among firms that do not IPO – suggesting that litigation is often a "last ditch" strategy for entrepreneurs. However, many of the entrepreneurs in our data are acquired by large systems vendors, suggesting they had value beyond a team of lawyers and some dubious IP. We tentatively conclude the divergence of litigation rates following an IP disclosure reflects *both* firms' differential ability to "compete on implementation" and use of the hold-up strategy.

The remainder of the paper proceeds as follows: Section 2 describes the standard setting process – particularly the importance of IP disclosure and "reasonable and non-discriminatory" (RAND) licensing rules – and develops a simple model of patent litigation. Section 3 describes the construction of our data set and presents a number of summary statistics. Section 4 discusses our empirical methods. Section 5 present our main results, including the difference-in-differences regressions, which show a significant divergence in the litigation rate for large and small firm patents after disclosure. We also present several robustness checks and supplemental analysis that help to interpret these results. Section 6 discusses the implications of our findings and offers several conclusions.

2. Formal Standards and Intellectual Property Strategy

Standards are an important part of the competitive landscape in information technology markets. This section describes several ways that formal standards are used, explains why firms are willing to contribute IP to "open" standards, and develops a simple model of patent litigation to motivate our empirical work.

2.1 The Role of Compatibility Standards

At a basic level, standards exist to promote product inter-operability. Consumers expect any DVD player to plug into a wide variety of television sets and play DVDs released by different studios. Matutes and Regibeau (1988) were among the first to analyze the positive externalities associated with this type of "mix and match" compatibility, which is central to the basic idea of a platform.

Standards can also help firms or consumers make a coordinated transition between platform generations. In theory, markets with strong network effects may converge on inferior technology or take "too long" to make a Pareto-improving switch (Arthur, 1989; Farrell and Saloner 1985). In practice, SSOs work to solve these problems by seeking the best available technology, and issuing a formal endorsement that serves as a signal to customers – providing a focal point that may lead to bandwagons in the adoption process. For example, affixing the "Wi-Fi" label to the IEEE's 802.11g standard helped reassure end-users that new products would be compatible with the installed base of 802.11b equipment. Rysman and Greenstein (2007) describe how the ITU helped break a standards deadlock that slowed the adoption of 56K modems.

Yet another use of standards is to lower the cost of innovation by specifying a set of boundaries or "modules" that reduce opportunities for differentiation in some dimensions of product design but promote experimentation in others (Baldwin and Clark 2000). For example, widespread adoption of the Internet's core transport protocols (TCP/IP) helped foster a great deal of experimentation at the underlying physical or delivery layer.[1] Similarly, when IBM opened up the personal computer architecture, there was a great deal of entry and experimentation in the design of both PCs and peripheral devices (Bresnahan and Greenstein 1999).

[1] Some of the physical-layer protocols developed include ATM, DSL, ADSL, Cable modems (DOCNET), and a host of different wireless technologies.

Finally, standards may be used in an anti-competitive manner to either create or reinforce a position of market power. One such anti-competitive strategy is to delay or withhold important technical information from competitors. Mackie-Mason and Netz (2007) suggest that this strategy was used by members of the consortium that developed the USB 2.0 standard. Firms can also create market power by inserting patents into an industry standard. The most vivid example of this strategy comes from the Rambus case (Farrell et al 2004; Graham 2004).

Rambus was founded in 1990 by two Stanford engineering professors who patented several technologies that improved communication between micro-processors and computer memory. While developing these technologies, Rambus participated in an SSO called JEDEC that was working towards an open standard to address the same problem. Evidence suggests that Rambus used information gained through JEDEC participation to ensure that its IP would cover the open standard, but withdrew from the SSO when the group was on the verge of completing its work (possibly to avoid any disclosure obligations). Rambus then sought to license its IP to firms adopting the JEDEC standard. This led to a wave of public and private anti-trust litigation that focused on Rambus' obligation to disclose its patent applications to JEDEC and subsequently license them on "reasonable" terms. Eventually, a unanimous ruling by the U.S. Federal Trade Commission found that Rambus violated JEDEC's membership rules, and placed royalty caps on both existing IP and any patents derived from applications filed while Rambus was a member of the SSO.

2.2 Standards and Intellectual Property

While Rambus' "submarine" strategy and the resulting litigation has attracted a great deal of attention, it is important to note that JEDEC and most other SSO's do not prohibit IP in standards or the licensing of essential patents. Rather, these groups encourage *ex ante* disclosure of relevant IP, so members can evaluate the trade-off between technical quality and implementation cost. Most SSOs also seek a promise to license on "reasonable and non-discriminatory" (or RAND) terms, which promotes widespread adoption of the final specification.[2]

In practice, the meaning of RAND and its European equivalent FRAND ("Fair" reasonable and non-discriminatory) is unclear. Lemley (2002) presents evidence from a survey of SSO IP policies and suggests that RAND represents a commitment to refrain from exclusive licensing or the use of injunctions during

[2] For a detailed discussion of how these IP rules fit into the broader process of standards creation see, for example, Cargill (1997), Lemley (2002), or Farrell and Simcoe (2007).

patent litigation. However, the determination of a “reasonable” royalty rates is the subject of ongoing litigation.[3] While a simple solution to the problems created by a vague RAND standard might be to allow for *ex ante* negotiation of royalty rates (i.e., before choosing standard), most SSOs prohibit any prospective discussion of licensing during the formal standards process – generally citing fears of antitrust litigation or of alienating particular members.[4] The practical result is that most SSO participants have considerable flexibility to pursue an aggressive licensing strategy, even if they have made a RAND commitment.

Why do firms participate in a formal standards process that limits how they can use their IP (even if the limitations imposed by RAND are weak)? There are two broad answers to this question: firms may benefit when *their own* technology becomes the industry standard, or they may benefit when *some* technology emerges as the industry standard. That is, firms may “compete on standards” or “compete on implementation.”

The obvious reason firms compete on standards (within SSOs) is to push for an endorsement of their own technology. Owning patents in a standard can be extremely lucrative, even under RAND licensing restrictions, such as they are. One example of this strategy is Qualcomm, whose portfolio of CDMA cellular telephony patents generates several billion dollars of licensing revenue annually. In the “defensive” version of this strategy, firms may participate in an SSO to prevent an IP-rich company from controlling the standard, or contribute their own IP to ensure access to a less costly cross-licensing arrangement.[5]

Firms may also “compete on standards” even if they do not expect to make money on licensing. In some cases, they are literally willing give away their IP (via a royalty-free license or non-assertion covenant) to have their own technology endorsed as a standard. These firms typically hope to benefit from product development lead times, backwards compatibility, or the existence of proprietary complements. For example, Henderson (2003) describes how Ember

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[3] Broadcom vs. Qualcomm (cite). Initial rulings suggest that the circuit court is willing to adjudicate claims of attempted monopolization through “unreasonable” licensing, and that tests of reasonableness might be based on the Georgia Pacific doctrine (cites).

[4] This is changing. Some SSOs, such as the IEEE, now allow for *ex ante* disclosure of royalty caps as part of the IP disclosure process. Some of the SSOs' antitrust concerns were also addressed by the Standards Development Organization Advancement Act of 2004 (H.R. 1086), and recent statement from various antitrust agencies: see e.g. Majoras (2005) or the discussion in the FTC's unanimous Rambus opinion (FTC 2006, page 36).

[5] For more on cross-licensing, see Grindley and Teece (1997) or Hall and Ziedonis (2001).

hoped create an advantage for its proprietary wireless networking systems by influencing the development of the IEEE 802.15.4 standards process and playing a prominent role in the ZigBee alliance.

While "competing on standards" clearly creates an incentive to participate in formal standards development, some firms join SSOs even if they do not have a specific technology to promote. These firms naturally place more emphasis on the emergence of a high-quality standard than on where it comes from, or who wins or loses. Often, they are large customers, systems vendors or "platform leaders" with a strong position in complementary markets. For example, Thomson (1954) describes the role of the major auto manufacturers in the standardization of a wide variety of parts and sub-assemblies. Similarly, Intel participates in a broad array of standards activities that could lead to new applications for its micro-processors (Conway 2007). And IBM's increasingly co-operative patent licensing strategy reflects a broad move into computing services. Many firms refer to this strategy as "competing on implementation."

We expect the distinction between "competing on standards" and "competing on implementation" to produce variation in firms' IP strategies – both in the cross-section, and over time. The primary source of cross-sectional variation will be driven by size – especially as it relates to the investments in complementary assets (e.g. manufacturing, marketing or distribution capabilities) or a firm's presence in complementary markets. Longitudinal variation will be driven by the standards process itself. In particular, while firms that "compete on standards" must create the perception that they will not be aggressive licensors (e.g. by hiding their IP, making a RAND promise or refraining from litigation) until a standard has diffused widely, this constraint disappears once a standard is in place. However, firms that "compete on implementation" are unlikely to pursue aggressive licensing and litigation even after a standard is in place, since it reduces the supply of complementary product, and is likely to diminish their credibility in future standard-setting efforts.[6]

A natural place to look for evidence of these broad differences in intellectual property strategy would be data on patent licensing. Unfortunately, it is very difficult to collect licensing data, as most firms hold these agreements in strict confidentiality (often because of legal restrictions). The next best alternative is to

[6] Gawer and Henderson (2007) offer an insightful discussion of Intel's methods of committing not to compete "too hard" in complementary product markets – a problem that is analogous to the licensing decision considered here.

examine data on litigation, which we do below. The remainder of this section develops a simple model of the litigation process to motivate our empirical tests.

2.3 Patent Litigation

This paper looks for evidence of a platform paradox by examining data on patent litigation. Specifically, we collect a sample of patents disclosed in the formal standards process and count the number of lawsuits for each patent in each year after the patent is granted. Each lawsuit reveals two pieces of information: (1) the patent-holder has tried to assert their IP, and (2) bargaining between the patent-holder and potential infringer has broken down. On the first point, a lawsuit signals an attempt to enforce a patent whether it is an infringement suit initiated by the patent-holder or a declaratory judgment (validity challenge) initiated by the potential infringer – i.e., it does not matter whether the patent-holder is the plaintiff or defendant.[7] The second point leads to a question that has received a great deal of scholarly attention: what stopped the parties from bargaining to a more efficient outcome? The legal literature contains three broad explanations – divergent expectations, incomplete information and asymmetric stakes – that can be illustrated using a simple model.

Consider a bargaining game played between a patent-holder i and potential infringer j, where litigation is the players' only outside option. If the patent-holder goes to court and wins, the infringer will be forced to pay damages of $\$D$ (with no payment in the event of a loss). The total cost of litigation is $\$C$, of which c_i are borne by the plaintiff (patent holder) and c_j by the defendant (infringer). Finally, assume the plaintiff and defendant place the probability of winning a trial at b_i and b_j respectively. If all costs, benefits and beliefs are observable, the two parties will go to court if and only if

$$D(b_i + b_j - 1) > C \tag{1}$$

The logic is straightforward – unless the total expected value of going to trial, $Db_i - D(1-b_j)$, exceeds the total cost, there is always some side-payment less than

[7] In practice, the roles of plaintiff and defendant are decided by "who pulls the trigger" since infringement suits typically lead to counter-claims of invalidity, and vice versa. Until the *Medimmune* case in 2007, the law was clear that a non-patentee could not initiate an invalidity suit unless they faced "an explicit threat or other action by the patentee, which creates a reasonable apprehension on the part of the declaratory plaintiff that it will face an infringement suit." Sierra Applied Scis., Inc. v. Advanced Energy Indus., Inc., 363 F.3d 1361, 1373 (Fed. Cir. 2004) (quoting BP Chems. Ltd. v. Union Carbide Corp., 4 F.3d 975, 978 (Fed. Cir. 1993)). Overturned by MedImmune, Inc. v. Genentech, Inc.,127 S. Ct. 764 (2007).

C that will make both players better off. Equation (1) also illustrates the simplest version of the "divergent expectations" hypothesis: litigation only occurs when $b_i + b_j > 1$. This clearly implies that one or more players is over-estimates their true chance of winning.[8] While incomplete information models generally place more structure on the bargaining game (e.g. Nalebuff 1987; Spier 1992), the underlying idea is simple: the players may reveal private information about *D* or *C* as part of the litigation process (e.g. during discovery).

The literature on patent litigation (e.g. Lanjouw and Lerner 1998; Somaya 2002; Hall and Ziedonis 2007) does not place much weight on either divergent expectations or incomplete information models (for an exception, see Galasso (2007)). This reflects the fact that parties in patent litigation are relatively sophisticated (compared to other kinds of suits) as are the courts that hear most patent cases. Moreover, much of the relevant information is already in the public domain. The alternative explanation – asymmetric stakes – is based on the idea that litigation is not necessarily a zero-sum game.

Suppose the plaintiff in our model actually places the value of winning a jury trial at αD. In this setting, α might be greater or less than one. For example, winning might allow a plaintiff to extract greater concessions in third-party license negotiations. Going to trial might also help a patent-holder establish a reputation for "tough" bargaining or, in a world of "probabilistic patents" (Lemley and Shapiro 2006), obtain a validity ruling that would increase the value of their IP. On the other hand, going to trial may produce negative externalities for large systems vendors who are more inclined to "compete on implementation." For example, litigation may induce wasteful efforts to invent around a patent, or reduce innovation and entry in complementary markets. Practitioners frequently cite the threat of a counter-suit leading to injunctions that would prevent the original plaintiff from operating in downstream markets.

Whatever the cause, if litigation creates positive externalities (α>1) for a plaintiff, the negotiation surplus shrinks and the likelihood of settlement becomes smaller.[9] In particular, our simple model predicts litigation whenever

[8] The recent literature on bargaining (e.g. Yildiz 2004) takes a more sophisticated view of the issue. In particular, it is not the players' beliefs about the probability of winning next period, but rather their expectations about how quickly others will update their priors about litigation outcomes that drive bargaining delays.

[9] Farell and Shapiro (2007) point out countervailing externalities that may encourage a defendant to settle. In particular, fighting to invalidate the plaintiff's IP is akin to providing a public good and we naturally expect some free-riding.

$$D(\alpha b_i + b_j - 1) > C \quad (2)$$

How, then, do standards influence the propensity to litigate? Suppose the indicator variable s_{it} equals 1 if firm i's patent is essential to implement an industry standard in period t. We assume that standardization can influence both the level of "asymmetric stakes" $\alpha(i,s)$ and the demand for a patented technology $N(i,s)$ – which we interpret as the number of unique implementations. To further simplify matters, we fix b_i, assume that $D \approx C$ and let b_j be a random variable with cumulative distribution $F()$ on [0,1]. Thus, the probability that a given implementation leads to litigation is $P(i,s)=1-F[C/D + 1 - b_i\alpha(i,s)]$. Moreover, when N is large and P small, total litigation for firm i's patent can be approximated by a Poisson distribution with mean:

$$E[Suits \mid i, s_{it}] = P(i,s)N(i,s) \quad (3)$$

Equation (3) provides the basis for our empirical tests, which attempt to measure the impact of disclosure on litigation, and perhaps more importantly, whether this effect is larger for specialized entrepreneurs who "compete on standards" than for large systems vendors that can "compete on implementation." The central empirical challenge will be to control for potential correlations between P, N and i created by endogeneity in the disclosure process. Our basic strategy is to estimate difference-in-difference models that contain firm or patent fixed effects and the time-series variation associated with new standards creation. The next two sections describe our data and empirical methods in greater detail.

3. Data

Our data were collected from publicly available SSO IP disclosure archives, the NBER US patent database (Hall, Jaffe and Trajtenberg 2001), the Derwent LIT/ALERT patent litigation database, the U.S. Federal Judicial Center, CompuStat and Venture Economics. This section discusses our main data sources and presents a series of firm and patent-level summary statistics.

3.1 Standard Setting Organizations and IP Disclosures

We began by identifying fourteen SSOs (listed in Table 1) with publicly accessible IP disclosure archives.[10] The scale and scope of these institutions varies substantially, with two large umbrella organizations, the American National Standards Institute (ANSI) and the International Organization for Standards

[10] Table A.1 in the Appendix contains a short description of the fourteen SSOs in our study.

(ISO), at one end of the spectrum and several small consortia, such as the DSL Forum, ATM Forum and Multi-Service Switching Forum (MSSF) at the other.

Collectively, the fourteen SSOs in our sample have developed a number of commercially significant standards. Prominent examples include Ethernet (IEEE), the 802.11 or Wi-Fi protocols for wireless networking (IEEE), core Internet protocols such as TCP/IP (IETF), cellular telephony protocols such as CDMA and TDMA (ATIS and ETSI) and various modem protocols (ITU and DSL Forum). While several of the larger SSOs (e.g. ISO and ANSI) develop safety and quality standards, nearly all of the patent disclosures are related to compatibility standards used for information and communications technology.[11]

For each SSO, we collected all disclosures made through July 2006. A disclosure is typically a letter or e-mail message indicating that a firm may own relevant IP and is willing to license on RAND terms. Each disclosure contains a firm name and date. In some cases, disclosures list specific intellectual property. However, there are a substantial number of "blanket" disclosures that do not mentioning any specific patent or application numbers. While most disclosures indicate a particular standard or technical committee this information is difficult to use because we have no map from the technical nomenclature (e.g. ANSI-X-09-567) onto the common name for a given standard. In Appendix A, we reproduce two of the letters from our sample to provide a sense of the heterogeneity in disclosure practices.

Table 1 contains a number of summary statistics for our sample of IP disclosures. The first two columns show that we reviewed 2,558 disclosure letters, of which 969 were blanket disclosures listing no IP. There is substantial variation across SSOs in the amount of IP listed per disclosure: the average disclosure at ETSI listed 42 separate patents and patents applications (many from international jurisdictions), while the average TIA disclosure listed 0.2 pieces of IP.[12] Our review of the disclosure letters identified 2,049 U.S. patents and 224 application numbers that we matched to a U.S. patent via the USPTO's web site. Figure 1 shows the increase in annual disclosure over time.

[11] Table A.2 in the Appendix shows that ninety-nine percent of U.S. patents in our data have a primary (3-digit) technology classification of Computing, Communications, Electrical or Electronic technology.

[12] The evidence in Table 1 suggests that disclosure norms at ETSI are quite different from the rest of the sample – firms seem to have "dumped" their patent portfolios into the 3G standards process – and we exclude these disclosures from the analysis below. Results with ETSI in the sample are qualitatively similar.

We pause here to offer two caveats about the disclosure data. First, we do not observe whether a given standardization effort was successful or whether a piece of IP was indeed essential to the final specification. Thus, our sample of disclosed patents is likely to contain a number of "false positives" (i.e. disclosures where the standard failed or the SSO chose an alternative technology), though we expect these patents to bias any estimates of the disclosure effect downwards. Second, disclosure is clearly not exogenous. We expect disclosed patents to be among the most important in a firm's IP portfolio, and disclosures to be concentrated in an SSOs most important and commercially relevant standards efforts. Thus, when we compare SSO patents to various "control" samples below, the controls are meant to provide a measure of the average patent, rather than a true counter-factual.

3.2 SSO Patents

In much of what follows, we focus on patents and patent litigation. Our litigation data come from the Derwent LIT/Alert database (based on data supplied to the Patent Office by the US courts), whose strengths and weaknesses are discussed in Lanjouw and Schankerman (2003).[13] We matched all of the U.S. patents listed in one or more disclosure letters to the Derwent litigation data as well as an augmented version of the NBER U.S. patent database. Table 2 presents a number of summary statistics for this sample of SSO patents along with several different matched control samples.

The first two columns in Table 2 compare the full sample of SSO patents (excluding ETSI) to a set of patents chosen to have the same grant year, three-digit technology classification, and assignee country as each SSO patent.[14] The first seven rows in this table examine data on litigation. We find that SSO patents have a substantially higher litigation rate than an average patent (9.4 versus 1.8 percent), and that this difference is larger for older patents (e.g. the difference is 14.2 versus 2.0 percent for patents granted before 1994). Conditional on litigation, both the SSO and control patents are involved in an average of two separate lawsuits, but the SSO patents are roughly 2.5 years older when first litigated. Finally, we find that slightly more than one-third of the SSO patents are involved in litigation *before* they are disclosed to an SSO. This last fact is quite interesting:

[13] They note that these data suffer from systematic underreporting through the mid-1990s, and we have no reason to believe that this issue had been resolved during the period in which our data was recorded (through 2006). However, they find no evidence of any systematic reporting bias based on either geography or technology.

[14] Our assignee countries are really continents – i.e. either the US or the rest of the world.

since lawsuits often draw a tremendous amount of attention, it suggests that many disclosures are less about revealing the existence of IP than about signalling the strength of a firm's patent portfolio.

The next set of rows in Table 2 examine a variety of patent quality measures. Not surprisingly, we find that the SSO patents score substantially higher than an average patent along almost all of these quality dimensions. The last set of rows in Table 2 compares the SSO and control patents in terms of assignee characteristics. (We characterize a firm as a "systems vendor" if it is public and has more than 500 employees, and the VC Match variable indicates that the assignee is listed as a recipient of venture capital funding in the Venture Economics database.) The summary statistics show that SSO and control patent assignees are broadly similar, though the former are more likely to have received VC funding.

The third and fourth columns in Table 2 compare SSO patents to a set of matched controls selected to have the same grant year, broad technology category (subcat), and the *same assignee* as each SSO patent. While the first panel contained the full sample of SSO patents, this one contains a smaller subset since we could not obtain matched controls for unassigned SSO patents and a substantial number of patents assigned to smaller firms (note the increase in patents assigned to systems vendors). Once again, we find that the SSO patents are substantially more likely to be litigated – especially as they get older – and generally appear to be higher quality based on forward citations, claims and the "generality" index of Henderson, Jaffe and Trajtenberg (1991), which indicates that they cite a more diverse array of prior art.[15] Overall, these results highlight the fact that SSO patents are likely to be selected from a firm's overall patent portfolio based on perceived importance.

In the rightmost columns of Table 2, we compare the SSO patents to a set of matched controls that have the same grant-year, technology category, assignee-country and *cumulative citation* count.[16] Our goal was to see whether forward citations (one the most widely used measures of patent significance) would

[15] It is interesting to note that controlling for the assignee through matching eliminates any difference in the propensity of SSO and control patents to cite non-patent prior art.

[16] Since it was difficult to draw an exact match once cumulative citations become large, we simply drew the control patent that matched on all other characteristics and had the next highest citation count (after the focal SSO patent). We had to drop 9 patents from the SSO sample in the matching process because they were the most highly cited patent in a particular grant-year technology-class cell, so that no comparable control patent could be identified.

capture a substantial amount of the variation in litigation rates. In fact, they do not. While the litigation rates in this control sample are slightly higher, they do not approach those of the SSO patents – in spite of the fact that the controls score slightly higher on the citation-based quality measures by construction.

Once again, these results highlight the idea that the disclosure process is revealing an important set of patents and that unobserved patent characteristics are an important determinant of the litigation decision. For that reason, the remainder of our analysis will focus on the sample of SSO patents.

3.3 Entrepreneurs and Systems Vendors

A major challenge in any research that relies on patent data is identifying individual firms. We rely on the assignee codes contained in the NBER patent data.[17] Unfortunately, many patents are assigned to subsidiaries or related entities, and ownership can change over time. As a result, we undertook an extensive effort to identify the parent firm for every assignee in our data, using a variety of corporate directories and extensive Internet research.

We identified 190 unique parent firms in the sample of SSO patents. Collectively, these firms account for 92 percent of the patents disclosed to SSOs. Of the remainder, 5 percent were unassigned, and 1 percent each were assigned to a university, non-profit research institute or government agency. We obtained CUSIP numbers for 126 of the firms in our data set who were publicly traded on a US or foreign exchange at some point in time. For these firms, we gathered data on Sales, Assets, Employees and R&D expenditures from Compustat.[18] We also used firm names to match 58 of the companies in our sample to the Venture Economics database and created a variable indicating the "investment outcome" (e.g. bankruptcy, merger or IPO).

Since our empirical tests focus on differences between large and small firms, we constructed a measure of vertical specialization that plays a central role in our analysis. Specifically, we define any private company or public firm with fewer than 500 employees (averaged over all available years) as an "entrepreneur" or small-firm. We refer to the remaining public firms as systems vendors. This results in a set of 118 large systems vendors and 72 smaller entrepreneurs.

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[17] These data have been updated and can be found on Bronwyn Hall's web site. We also used the Compustat name matching programs created by Bronwyn Hall and Megan MacGarvie as the starting point for our own name matching algorithms.

[18] Wherever possible, these data are for the application year of a given patent, though we settled for the closest available year in several cases.

Table 3 lists the top-ten entrepreneurs and systems vendors in our data based on a count of disclosed patents. All of the systems vendors are household names, and seven of the ten have more than 50,000 employees. None of the entrepreneurs are a household name[19] and if public, they have fewer than 500 employees by construction. Several of the entrepreneurs are clearly fit the category of vertically specialized firms described above. For example, Interdigital earns all of its revenue from licensing, and Verisity Design is a "fabless" semiconductor company.

The bottom half of Table 3 provides a list of the most common plaintiffs and defendants in our data set.[20] One of the interesting things about this list is that it has relatively little overlap with the list of firms disclosing the most patents. The litigants also appear to be a very heterogeneous set of companies that includes large corporations (Philips, Qualcomm, Dell, Microsoft) and vertically specialized technology developers (Interdigital, Agere, Compression Labs). Finally, with the exception of Elonex IP Holdings, the litigation does not appear to be highly concentrated within a small set of firms.[21]

Table 4 presents a number of summary statistics at both the firm and patent-level suggesting that the entrepreneurs in our data set are indeed smaller and more vertically specialized. The first two rows in the top panel of Table 4 show that firms classified as entrepreneurs disclose patents to fewer SSOs and have a substantially smaller patent portfolio. The next two rows show that these small firm patent portfolios are also more concentrated using a Herfindahl index based on 3 digit patent classes over a 10 year period. The next three rows in the top panel show that the "systems vendors" are older and larger than the public firms in our set of entrepreneurs (for whom we can observe data on employment). Finally, we find that a slightly higher percentage of the small firms received VC funding, though a substantial number of the systems vendors do appear in the venture economics data.

The bottom half of Table 4 presents patent-level summary statistics. The litigation rate of patent assigned to entrepreneurs is significantly higher than for

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[19] The possible exception is Digital Theater Systems (DTS) whose name you may recognize from movie trailers or the introductory bits of a DVD.
[20] These names were obtained by linking our sample of litigated patents to the Federal Judicial Center data.
[21] Elonex is a British PC manufacturing and computer services firm that filed 13 lawsuits using a single patent originally assigned to a firm called Cordata. Elonex acquired the patents when Cordata was shut down in 1995.

patents assigned to systems vendors – particularly for patents granted before 1998. While the two sets of patents receive a similar number of forward citations, those assigned to entrepreneurs have later grant years, and so are cited slightly more often on an annual basis. One item that stands out in the second panel is the greater use of continuation actions in the entrepreneur sample. This is potentially a method for "hiding" a patent inside the PTO. Finally, we note that the systems vendors disclose substantially more IP per firm.

4. Methods

An ideal approach to measuring the impact of the formal standards process would be to identify a set of substitute technologies, randomly assign one to be the industry standard, and observe how the firms who own essential IP respond. Given a large number of these random assignments, we could compare the response of large and small IP-holders to see whether there is any evidence of a divergence in their IP strategy. In practice, a key objective of most SSOs is to identify and promote the best available technology.[22] This leads directly to our first empirical challenge: if SSOs choose the best available technology, is related IP litigated because it reads on the standard, or because of its inherent quality?

To be more specific, suppose we observe a vector of covariates X_{ijt} for patents j, owned by firms i, in period t. We assume that the disclosure date is a proxy for standardization, so $s_{ijt} = 0$ before disclosure and 1 thereafter, and specify the probability of litigation as $P(ij,s)=exp\{\beta_1 X_{ijt} + \theta s_{ijt}\}$ and the demand for the intellectual property as $N(ij,s) =exp\{\beta_2 X_{ijt} + \eta s_{ijt}\}$. Then equation (3) leads to the following regression:

$$Log(E[Suits \mid X_{ijt}, s_{ijt}]) = X_{ijt}(\beta_1+\beta_2) + s_{ijt}(\theta+\eta) \qquad (4)$$

This specification highlights the two main issues we confront below. First, in a simple cross-sectional regression, it is highly likely that s_{ijt} is correlated with firm- or patent-level unobservables that enter the litigation decision (consider the summary statistics in Table 3, particularly for the citation-matched control sample). And second, the data do not separately identify standards' impact on litigation incentives θ and their demand effects η.

[22] In fact, many SSOs seem to foster an engineering culture that explicitly downplays the idea that there may be trade-offs between technical quality and the costs of implementation (e.g. because of patents) – creating a situation that can frustrate lawyers and economists.

We address the first of these issues by restricting attention to SSO patents and comparing *changes* in the litigation rate. In particular, we include firm or patent fixed effects in equation (4). In these regressions, our measure of the standards effect $(\theta+\eta)$ is identified by changes in the within-firm (patent) litigation rate following standardization. If the timing of formal standards creation is exogenous, we can interpret these estimates as the causal impact of standardization on the litigation rate of standards-related IP (i.e. the treatment on the treated). However, the creation of new standards is almost certainly correlated with time-varying unobservable shocks in the importance of different technologies. Thus, our interest will center on how the "standards effect" varies across firms, which leads to the second challenge – separating the incentive and demand effects.

Our informal "platform paradox" hypothesis focuses on variation in the incentive to litigate standards-related IP. However, our data can only identify a "standards effect" $(\theta+\eta)$ that captures a joint shift in incentive and demand for the underlying IP. We address this issue by examining differences in the standards effect for large and small firms. Specifically, we interact an indicator variable k_i that equals one for small firms with the time-varying indicator for standardization s_{ijt}. We allow small firm litigation rates to respond to changes in both incentives α and demand shocks δ, leading to the following specification:

$$Suits_{ijt} = \lambda_t + \gamma_j + X_{ijt}(\beta_1+\beta_2) + s_{ijt}(\theta+\eta + k_i(\alpha + \delta)) + \varepsilon_{ijt} \quad (5)$$

Clearly, we have not eliminated the identification problem. While the patent fixed effects γ_j should pick up time-invariant factors that drive difference in large and small-firm litigation rates (e.g. systematic differences in patent quality driven by disclosure strategies), we can still only identify $(\alpha + \delta)$. Without more data, it is not possible to dis-entangle the incentive and demand effects. Thus, our final step is to bring in additional data. In particular, we use patent citations as a proxy for demand. When we substitute citations for litigation in Equation (5), our estimates of $(\alpha+\delta)$ are consistently zero or negative. Thus, we argue that $\delta \leq 0$ in the litigation model and our estimates provide a lower bound on the true size of the incentives-based platform paradox.

5. Results

This section begins with results based on (4) and (5) that demonstrate our main finding: there is a substantial difference in the response of large and small firm litigation rates following standardization. We then show that citations display the opposite pattern, in support of our lower bound arguments. We conclude by examining the relationship between litigation and performance for VC backed firms and by taking a closer look at the litigation process. These extensions reinforce our view that the phenomenon we identify is not simply driven by the presence of a large number of "trolls" in the sample of small firms.

5.1 Pooled Cross Sectional Models of Patent Litigation

Table 5 presents our first set of results, which are based on a pooled cross-sectional regression. The unit of observation is the patent-year, and our dependent variable is a count of new lawsuits filed on a patent in that year.[23] We use a Poisson quasi-maximum likelihood specification (i.e. Poisson regression with robust standard errors) which is less restrictive than other count models. All of the explanatory variables are dummies or enter in logs, so the coefficients have an elasticity interpretation. Finally, we include a set of bi-annual year dummies for all years later than 1995 to capture any changes in broader economic environment (e.g. specific legal rulings) that influence the propensity to engage in patent litigation.

The first column in Table 5 focuses on 153 patents assigned to small private firms. In this sub-sample, there is a substantial positive correlation between disclosure and a patent's litigation rate. In fact, the coefficient on *Disclosure* implies that litigation per patent-year more than doubles in the post-disclosure period. We also include a dummy for *Past Litigation* that equals one in all years after the first lawsuit for any litigated patent. Here also, we find a large positive correlation with the litigation rate. One interpretation of the large amount of repeat litigation is that it caused by state-dependence induced by the litigation process. In particular, a patent that has been ruled valid in court and perhaps subjected to re-examination is considerably more valuable than an untested property right. However, the *Past Litigation* coefficient may also capture unobserved heterogeneity in patent significance.

In the sample of small firm patents, we also find that the litigation rate declines with patent age and is strongly correlated with a patent's cumulative citations through the prior year. Patents with more claims or a continuation history are also more likely to be litigated. Finally, we find some differences between SSOs in the probability of litigation. Relative to ANSI (the excluded SSO) we find that small-firm patent disclosed at IEEE or the various smaller consortia are more

[23] While patent litigation almost always involves a series of claims and counter-claims by two or more litigants, these are typically aggregated into a single case by the court. In our data the modal number of lawsuits for litigated patents is one.

likely to be litigated, while those disclosed at the IETF are less likely to be involved in a lawsuit.

The second column in Table 5 focuses on the other half of the sample – the 640 patents assigned to large public firms. In contrast to the small firms, we find no significant correlation between disclosure and litigation rates for these patents. We do continue to observe a large and statistically significant repeat litigation effect. (Dropping the *Past Litigation* variable does not lead to a meaningful change in the *Disclosure* coefficient.) For the large firms, we also fail to find a correlation between patent *Age* and the litigation rate. Surprisingly, we find no correlation between cumulative citations and the litigation rate for large firm patents. We do, however, observe a large positive correlation between litigation and the number of patent claims, as well as a weaker correlation with the use of the PTO's continuation procedure. Finally, we find little evidence of variation in the litigation rate across SSOs for this sub-sample.

The third column in Table 5 combines the large and small-firm sub-samples in a single regression. We continue to see a large and statistically significant difference between large and small firms in pre- versus post-disclosure litigation rates. In this specification, we also include a dummy for patents assigned to the small private firms in our first sub-sample. The coefficient on this *Small Firm Dummy* is relatively large – suggesting a 60 percent increase in the baseline litigation rate – but not statistically significant. The other notable finding for the full sample results in column 3 is the statistically significant coefficient on the interaction between *Age* and the *Small Firm Dummy*, which continues to suggest that large firms have a greater propensity to litigate their older patents than do small firms.

In the last column of Table 5, we focus on the sub-sample of 462 patents where we could obtain detailed information on firm size and financials (in the year when the patent was granted) using Compustat. These patents are concentrated among the large firms by construction, since they are all publicly listed, and only a handful of the public firms in our data are classified as small (i.e. average less than 500 employees).[24]

The results in column 4 reinforce the idea that large firms are less likely to litigate (at least in the cross-section). In particular, the coefficient on *log Employees* is

[24] Since any partition into "large" and "small" firms (Entrepreneurs and Systems Vendors) will inevitably contain Type I and Type II errors, this sample will also produce a less contaminated set of "large firm" estimates.

highly significant. Perhaps more importantly, we find that asset intensive firms – as measured by the log of *Assets per Employee* – are substantially less likely to litigate, with an elasticity of roughly -1.6. On the other hand, firms that do a significant amount of patenting seem to be slightly more litigious. Interestingly, we find some evidence of heterogeneity across SSOs in this sub-sample. Relative to ANSI (the omitted SSO dummy) patents disclosed at IEEE and particularly ITU are significantly less likely to appear in a lawsuit. Comparing the large negative coefficient on IEEE to the positive and significant IEEE coefficient in Column 1 suggests that patents disclosed to IEEE may be driving much of our large/small difference.

5.2 Fixed Effects Models of Patent Litigation

Table 6 presents our main set of estimates, which are based on difference-indifferences models of the change in patent litigation rates following disclosure. Once again, our main prediction is that the impact of disclosure on the litigation rate will be positive and larger for the small (vertically specialized) entrepreneurs than for the large systems vendors.

The specification we use in Table 6 is very similar to the pooled cross-sectional regressions in Table 5, with the addition of firm or patent fixed effects. Once again, the unit of observation is the patent-year, the dependent variable is a count of new lawsuits, the coefficients have an elasticity interpretation and we include a set of bi-annual year dummies in each regression. We estimate Poisson quasi-maximum likelihood specification models with conditional fixed effects (Wooldridge 1999). Unlike OLS fixed effects models, the Poisson with conditional fixed-effects will discard any units (i.e. firms or patents) where there is no litigation observed.[25] Thus, the sample size in Table 6 is considerably smaller.

The first two columns in Table 6 present estimates from Firm fixed-effects models for the small and large-firm sub-samples respectively. We do not include SSO dummies in these regressions as the majority of firms in our data disclose to a single SSO. The last two rows of the Table show that 19 of the 72 small firms in our data set litigate at least one patent, compared to 23 of the 118 large firms – leaving us with a sample of 59 small firm patents and 202 large firm patents.

The coefficient estimates in the first two columns of Table 6 are broadly similar to those in the pooled cross-sectional regressions. We continue to find a large

[25] We obtain similar results using OLS fixed effects models that keep all of these units.

statistically significant correlation between *Disclosure* and litigation in the small firm sample, and we now find a sizable negative coefficient for the large firms, though we cannot reject the hypothesis of no disclosure effect for that sub-sample. For the small firm sub-sample we continue to find positive and statistically significant coefficients on the *log Citations* and *log Claims* variables, though there is no within-firm correlation between the use of continuations and the litigation rate. Overall, these results remain consistent with our "platform paradox" hypothesis.

Even with firm fixed-effects, we might be concerned that litigated patents are quite different from unlitigated, and that this heterogeneity is correlated with the timing of disclosure. So, the final three columns in Table 6 present estimates of patent-level diff-in-diff models. That is, we identify the "disclosure effect" using within patent changes in the litigation rate. Because the fixed-effects Poisson model discards any un-litigated patents, we are left with a relatively small sample of SSO patents: 26 assigned to a small firm and 71 assigned to a large firm, for a total of 885 patent-year observations.

The last three columns in Table 6 continue to show a strong within-patent correlation between disclosure and litigation for small firms and moderately negative but statistically insignificant effect at large firms. The interaction between *Disclosure* and a *Small Firm* dummy in the final column shows that this difference is statistically significant at the 5 percent level. We interpret this result as strong evidence that the formal standards process has a differential impact on large and small firms.

However, the simple model developed in Section 2 and 4 suggests that these estimates capture some combination of demand and incentive effects. That is, if standardization has a larger impact on the demand for small-firm IP (where "demand" encompasses both the number of infringers the scope of infringement), then our estimates – which measure $(\alpha+\delta)$ – will be biased upwards. In the next sub-section, we use patent-citations as a proxy for the demand-effect and argue that $\delta \leq 0$, so our estimates actually provide a lower bound on the true "platform paradox" α.

5.3 Disclosure, Litigation and Patent Citations

Citations are an admittedly imperfect proxy for the amount of infringement. However, there is a large literature that uses patent citations as a measure of a patent's economic or technological significance. And forward citations are arguably the best available information that we can use to examine how the perceived importance of patent changes around the disclosure date.

We estimate a series of citation models very similar to those used in Rysman and Simcoe (2007). They are based on a Poisson specification with individual patent (conditional) fixed effects. We focus on a 10 year window that includes the four years prior to disclosure along with five post-disclosure years, and include a complete set age-relative-to-disclosure dummies (excluding the dummy for the year prior to disclosure). We also include a set of non-linear *Age* (since grant) variables to capture well-documented non-linearities in the citation age-profile. In this specification, changes in the counterfactual citation rate are estimated using undisclosed SSO patents with the same age.

We are primarily interested in measuring the difference between large and small-firm citation rates following disclosure. We do this in two ways: first by including a simple interaction between the *Small Firm* and *Disclosure* dummy variables, and second, by including a separate set of age-relative-to-disclosure effects for the small firm patents.

The first column in Table 7 presents coefficient for the small-firm disclosure interaction along with a full set of age-relative-to-disclosure effects. The interaction suggest that the citation rate of small-firm patents increases 30 percent less that the citation rate of large-firm patents following disclosure, though this estimate is not significantly different from zero at conventional levels. The age coefficients are very similar to those reported in Rysman and Simcoe (2007), there is a 15 to 20 percent increase in the citation rate in the year before disclosure, followed by a upward trend that adds another 20 percent over the next three to five years. In the second column of Table 7 we repeat this exercise for the smaller sample of 70 litigated patents and find similar results – the age effect increase somewhat while the small-firm disclosure interaction is effectively zero.

Columns 3 and 4 in Table 7 repeat the exercise of columns 1 and 2, adding a *Litigation Dummy* variable and its interaction with the *Small Firm* indicator. Interestingly, there is a substantial increase in the citation rate of small-firm patents (relative to large firm patents) following litigation. However, the results continue to suggest that the "demand shock" from disclosure is greater for the large-firm IP. This suggests that our previous estimates are actually a *lower bound* on the actual size of the platform paradox.

Figure 2 makes this point in different way. In particular, we estimated the model of Table 7 including a complete set of interactions between the *Small Firm* dummy and the *Age* (relative to disclosure) coefficients. This allows for a very flexible "citation response" to disclosure in both the small and large-firm sub-samples. Figure 2 graphs the estimated coefficients. We see that citation trends in the two samples are parallel until the year prior to disclosure, when there is a sharp increase in the large-firm citation rate (in fact the lines cross, since the omitted age variable is -1 in both samples) and then a very gradual further separation.

5.4 Hold-up?

Our results raise the question why small firms litigate more than large ones following disclosure? In particular, a number of observers have raised concerns that an increasing number of firms use the patent system to hold others' investments in technology development and commercialization hostage. Firms that pursue this rent-seeking strategy are often labeled "trolls" (e.g. Lerner 2006; Reitzig, Henkel and Heath 2007).[26] We take a neutral stance on this question: emphasizing that while hold-up is a real threat, small firms may also lack the complementary assets needed to "compete on implementation" and be inclined to (legitimately) rely on IP.

However, it is well known that standards promote specific investments that lead to hold-up opportunities for the opportunistic patent holder. Law suits, and the threat of injunctions (court orders that prevent a firm from employing the patented technology), are powerful tools against electronics firms with many different technologies embedded in products and for whom product life-cycles are relatively short. In this sub-section, we consider whether our results reflect a greater propensity of small firms to use the "patent hold up" strategy. We consider the evidence on three key components of the hold-up story: secrecy, quality and intentions.

For hold-up to profitable, a target company (infringer) must make substantial sunk or technology-specific investments. It is the patent holder's ability to prevent a company from realizing the return on these investments (i.e. "holding them up") that makes the strategy profitable. Of course, few firms would make

[26] Part of the difficulty with the "trolls" hypothesis is the lack of a consensus definition (e.g. Lemley 2007) Under some of the more expansive definitions, it would be difficult to exclude any of the small companies in our sample.

the investments if they recognized the threat of hold-up. Thus, secrecy plays an important role.

The evidence on secrecy is mixed. On the one hand, we observe a substantial number of "blanket" disclosures that may be an effort to hide relevant IP until after standards have been implemented. On the other hand, even though it is possible to identify the *specific* IP in our sample from the disclosure documents, we continue to see a substantial amount of litigation after the standard setting process. Another way to preserve the secrecy of a patent is to use the PTO's continuation procedures, and Table 2 shows that our SSO patents are continued more than an average patent. Table 4 shows that continuations are even more common for small-firm patents. However, since continuations are also a way to preserve an early priority date, this high frequency may simply be the result of a selection process – all firms are looking to disclose their best IP, part of which is having an early priority date.

A second dimension of the hold-up story concerns patent quality. In particular, many observers suggest that firms obtain dubious patents with early priority dates and use them to hold standards-related investments hostage. This does not seem consistent with our evidence on the quality of disclosed patents. These patents are well above average values on a host of quality dimensions – particularly references to non-patent prior art. While there may be a number of fringe players that use low-quality patents as part of a concerted hold-up strategy, there is little evidence that they are appearing in our sample of disclosures.

The third key dimension of the hold-up story is intentions: are firms patenting as part of a conscious rent-seeking strategy? While these intentions are not measurable, we can look at the relationship between firm performance and litigation strategy in the sample of VC backed companies. Our idea is that while firms may not start out with the hold-up strategy in mind, it may become more attractive if alternative plans fare badly. In Table 8 we examine how the probability of litigation for disclosed patents varies with the current state of the investment outcome in the Venture Economics data. There are five potential investment outcomes: Merger, Acquisition, Defuct, Active Investment, and IPO. Of these, IPO is the only result that is clearly positive. Mergers and acquisitions may or may not correspond to strategic acquisitions on favorable terms, and there is reason to believe that a reasonable portion of active investments in these data are "living dead."

Our main result in Table 8 is based on differences in the litigation rate between firms that had an IPO and all other outcomes. At the patent level, an IPO is associated with a 22 percentage point decline in litigation. At the firm level, there is 34 percentage point drop in litigation propensity. Both of these differences are highly significant based on a univariate t-test. This suggests that either litigation is a last ditch strategy for unsuccessful entrepreneurs, or that the market for their intellectual property is dominated by firms looking to exploit the standard process to create a hold-up scenario.

However, a closer look at the actual lawsuits casts some doubt on the hypothesis that much of the observed litigation is carried out by trolls. In particular the lawsuits filed by non-IPO firms were divided relatively evenly among those filed by the actual assignee, cases filed by systems vendors (Cisco, Motorola, Broadcom and TI) that had acquired the assignee and its entire patent portfolio, and cases filed by smaller firms that had purchased specific patents from an original assignee. While the last set of companies are clearly consistent with the troll hypothesis, the first two are closer to the picture of vertically specialized operating companies we describe above. We conclude that the evidence on hold-up is mixed. In particular, our finding that litigation rates diverge may be driven by multiple factors, including "last ditch" litigation among poorly performing small companies and very high-quality IP among those that are targets of an acquisition.

5.5 The Litigation Process

The last stop in our exploration of SSO patent litigation is to compare trial outcomes for these patents to those in a matched control sample using data from the Federal Judicial Center (FJC). The 151 SSO-patent suits identified in the Derwent data were matched to suits recorded in the FJC data, the latter of which include rich information on the procedural progress and outcomes of the litigation. Because the FJC data are collected upon case termination, while the Derwent data are reported at case filing, we were only able to match 102 cases. We formed our control sample by selecting a random sample (without replacement) of 102 other (non-SSO) patent cases matched on being filed in the same court within 10 days of each SSO patent-suit filing.

Table 10 shows a series of univariate tests for differences in litigation outcomes across these two samples. Note that the outcome shares are not intended to sum to unity (for instance, the "reached trial" share is a subset of the "final verdict" share of cases). We find that the litigation process looks broadly similar for SSO and non-SSO patents. While the length of the process is 61 days (14 percent) shorter for SSO patent trials, this difference is not statistically significant. Otherwise, the share of cases that are terminated during discovery (the initial phase of the suit in which parties are permitted to collect information, including documentary and depositional) is 4.9% greater for the non-SSO patent suits, but this difference is not statistically significant. Each sample has the same likelihood of reaching trial (4.9%), and while the SSO patent suits are 4% less likely to result in a final verdict (whether after trial or on motion), the difference is not statistically significant from zero. Given these statistics, it is worth noting that the American Intellectual Property Law Association reports that patent litigation on suits of between $1-25 million in value cost litigants on average a total of $2.5 million through discovery, and $5 million through trial (2007). These costs have been rising substantially since 2001 when the figures were $1.6 million and $3 million, respectively.

Despite these roughly similar patterns, we find two statistically significant differences. First, we find is that SSO patent lawsuits are 13 percent more likely to end with a settlement order. A settlement order (an order requested and agreed upon by both parties) is not the only evidence of a settlement. In fact, Lanjouw and Schankerman (2003) make the assumption that all suits that do not reach trial (in our samples, 95.1%) are "settlements." To be sure, if the filing of a suit signals a controversy, and one or the other party terminates the suit prior to trial and final verdict, their assumption is reasonable. What the *settlement order* does bring to parties is a court-sanctioned recognition of the parties' rights and responsibilities, dictated in the settlement order. Of course, parties could create legal rights and responsibilities by signing contracts in consideration of the parties dismissing the action (without a settlement order), but our data show that these SSO participants are significantly more likely to opt for the court-ordered settlement than their non-SSO counterparts. This preference may signal a desire among SSO litigants for an added institutional support to the settlement agreements, although without further study that hypotheses must remain speculative.

While very few of these cases actually reach the trial stage, the second statistically significant difference we find is a large disparity in plaintiff win rates. In particular, plaintiffs win 54 percent of the SSO-patent cases compared to 24 percent in the control sample (+ 30%). We also find that the SSO cases are 18 percent less likely to end in a defendant victory, and 12 percent less likely to end in a shared victory.[27] However, as we discussed above, it is difficult to interpret these findings, since the patent holder might be either plaintiff or defendant in these cases (i.e. they are all essentially infringement cases).

Finally, we report the whether the original assignee appears as plaintiff, defendants or neither in our sample of SSO-patent lawsuits. We were able to definitively identify whether the assignee was the plaintiff or the defendant in 86% of the cases (N=171). Of these, the patent assignee was a named plaintiff in 138 cases (80.7%). Lanjouw and Schankerman (2004) reported identifying about two-thirds of their patent assignees as either plaintiff or defendant, and found that 84% of those cases were initiated by patentee (as plaintiff). Not surprisingly, the distribution is quite different for the large and small firms. In particular, the small firms are more likely to be neither plaintiff nor defendant.

6. Conclusions

This paper examines the role of intellectual property (IP) in the formal standards process and looks for evidence that "entrepreneurs" (i.e. small vertically specialized technology developers) pursue a more aggressive IP strategy than systems vendors. Our empirical strategy uses the formal standards process in several ways. First, SSOs provide a window onto open systems development. Since firms are typically required to disclose relevant IP in the standard setting process, we can identify a set of patents that will inform us about the specific question of standard-related IP strategy. Second, we exploit disclosure timing as a "shock" to the value of a particular patent and examine how entrepreneurs and systems vendors respond differently to this event.

We find that patents assigned to small entrepreneurial firms are more likely to be litigated than those assigned to large public companies. We also find a statistically significant difference in litigation timing, with small firms' more likely to litigate after patents are disclosed to an SSO.

While these results shed some new light on important questions related to IP strategy the development of open platforms, we acknowledge that it is very difficult to draw clear welfare implications from our findings. We certainly do not mean to suggest that the "platform paradox" implies a need to reform the current patent system. While there may good reasons for patent reform, our

[27] A shared victory may occur, for instance, when a defendant is found to be infringing some of the patent claims, but the plaintiff's patent is found to have other claims that are invalid.

results suggest that patents are truly important to entrepreneurs and that IP plays an important role in supporting the division of innovative labor.

If anything, we suspect that the current RAND standard adopted by many SSOs needs to be re-examined. The lack of a clear standard for "reasonableness" seems likely to send an increasing number of litigants into the system as open platforms continue to proliferate. In fact, some SSOs (including IEEE and ANSI) have been exploring the idea of allowing firms to state an *ex ante* royalty cap as part of their IP disclosure. This strikes us as a reasonable policy. However, it is important to recognize that SSOs have to balance any change in their IP policy against the possibility that the marginal participant will "opt out" rather than give away any IP. If that marginal participant goes on to become a "submarine" patent holder, the welfare effect of a move to *ex ante* royalty cap disclosure could well be negative.

Finally, our results raise interesting questions about the dynamics of open platform development that await further research. In particular, what strategies can systems vendors or "platforms leaders" adopt to encourage entry by entrepreneurs who provide critical complements while preserving the benefits of platform openness?

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Table 1: Disclosure Summary Statistics by SSO

This table provides disclosure-level summary statistics by SSO. A "blanket" disclosure contains no patent or application numbers that would identify a specific piece of intellectual property. A "large firm" is publicly traded or has more than 500 employees.

SSO	Total Discs	Blanket Discs	Total IPR	US Patents	US App's	Min Disc Year	Mean Disc Year	Mean Disc Age*	Large Firms*
ANSI	278	177	278	127	15	1971	1996	3.08	0.87
ATIS	58	38	51	20	2	1986	1996	2.68	0.82
ATM Forum	25	1	90	45	1	1995	1998	4.22	0.92
ETSI	324	0	13,684	1,164	160	1990	2002	3.77	0.93
IEEE	390	239	966	278	12	1983	2000	3.35	0.89
IETF	353	188	351	101	6	1995	2003	3.26	0.95
ITU	643	0	1,175	200	18	1983	1999	4.12	0.89
TIA	126	117	23	19	0	1989	1998	3.16	0.99
DSL Forum	8	0	32	3	1	2000	2004	0.75	0.86
ISO	24	8	44	16	1	1980	1995	3.59	0.73
ISO/IEC JTC1	217	194	61	13	7	1992	1998	4.05	0.96
MSSF	13	7	15	3	0	1999	2002	0.33	1.00
OMA	44	0	185	53	1	1999	2004	3.63	0.72
VESA	55	0	62	7	0	1995	2001	1.14	0.88
Pooled Sample	2,558	969	17,017	2,049	224	1971	2000	3.66	0.91

* These statistics are based on disclosed US patents rather than disclosures.

Table 2 : Summary Statistics for SSO Patents and Matched Controls

This table compares SSO patents to three sets of matched controls drawn from the same grant year and technology class. Firm Matches also have the same assignee and Cite Matches the same cumulative forward citation count.*

	SSO Patents	*Random Match*	*P-value*	*SSO Patents*	*Firm Match*	*P-value*	*SSO Patents*	*Cites Match*	*P-value*
Litigation Rate (percent)	9.38	1.69	0.00	7.16	1.26	0.00	9.15	1.91	0.00
Lit Rate (Granted <1994)	14.24	1.99	0.00	11.66	1.79	0.00	13.85	2.70	0.00
Lit Rate (1994-1998)	7.11	1.55	0.00	5.11	1.02	0.00	6.99	1.55	0.00
Lit Rate (Granted >1998)	4.46	0.96	0.01	4.53	0.41	0.00	4.46	0.96	0.01
Lawsuits (count)**	1.97	2.06	0.87	1.76	1.67	0.79	1.95	1.94	0.98
Litigation Age**	6.20	3.75	0.02	6.10	5.44	0.65	6.12	5.11	0.41
Pre-disc suit (percent)**	33.71			29.41			33.72		
Forward Cites 63-06	33.88	16.84	0.00	30.86	17.05	0.00	31.64	32.32	0.70
Backward Cites	10.75	10.36	0.56	9.89	10.08	0.77	10.79	11.48	0.32
Non-patent Cites	9.07	4.69	0.00	8.54	8.33	0.89	8.97	7.39	0.22
Claims	22.24	17.89	0.00	22.02	17.67	0.00	22.12	20.31	0.05
Continuation actions	0.43	0.31	0.00	0.40	0.28	0.00	0.43	0.30	0.00
Generality	0.51	0.44	0.00	0.50	0.45	0.02	0.50	0.50	0.60
US Firm	62.17	61.54	0.78	66.29	66.99	0.78	62.45	60.85	0.48
US Other	2.42	2.53	0.88	1.83	1.83	1.00	2.13	3.30	0.12
Non-US Firm	26.87	27.82	0.64	30.20	29.63	0.82	27.02	28.09	0.61
Non-US Other	2.53	1.58	0.15	1.69	1.54	0.83	2.55	1.49	0.10
Unassigned	6.01	6.53	0.64				5.85	6.28	0.70
Systems vendor	79.45	78.93	0.78	91.85	91.85	1.00	79.57	72.87	0.00
VC Match	23.65	10.71	0.00	16.99	16.15	0.67	23.73	12.94	0.00
Patents	949	949		712	712		940	940	

*See text for additional description of the matching process. **Statistics in these cells are conditional on litigation.

Table 3: Common Firms

This table provides the names of the top ten Large and Small in our data set (ranked by the number of disclosed patents). It also lists the most frequent plaintiffs and defendants out of 206 total lawsuits.

Top 10 Large Firms	Pat Discs	Employees*	Top 10 Small Firms	Pat Discs	Employees*
Ericsson	276	71,981	Interdigital Technology	170	185
Nokia	181	44,780	Snaptrack	33	
Qualcomm	172	5,949	Int'l Mobile Machines	30	87
Motorola	105	87,656	Tecsec, Inc.	12	
AT&T	77	108,953	Hybrid Networks	11	65
IBM	66	312,643	Verisity Design	10	190
Toshiba	46	147,217	Stac Electronics	9	
Alcatel	45	143,744	Netergy Networks	8	113
Apple Computer	41	10,477	SCS Mobilecom	5	
Philips	41	299,382	Digital Theater Systems	5	

Top Plaintiffs	Lawsuits	Top Defendants	Lawsuits
Elonex IP Holdings	13	Interdigital Technology	5
U.S. Philips	7	Acer Inc	2
RSA Data Security	5	Broadcom Corp	2
Lucent Technologies	5	Ciena Corp	2
Qualcomm Inc.	5	Compal Electronics	2
Interdigital Technology	3	Dallas Semiconductor	2
Compression Labs	3	Dell Computer	2
Agere Systems	3	Ericsson, Gateway, Microsoft, Motorola, Novell	2

*Average over all available years.

Table 4 : Small Entrepreneurs and Large Systems Vendors
This table shows differences between firms classified as small or "entrepreneurs" (private or less than 500 employees) or large "systems vendors."

Firm-Level Summary Stats	*Large Firms*	*Small Firms*	*P-value*
SSO Count	1.69	1.06	0.00
Patent Grants (67-06)	4899.40	39.40	0.00
HHI 1995	0.12	0.34	0.00
HHI 2000	0.13	0.38	0.00
Public Firm	100.00	11.11	0.00
Listing Year	1980.34	1990.89	0.01
log Employees	9.80	5.36	0.00
VC Match	27.12	36.11	0.20
Total Firms	118	72	

Patent-Level Summary Stats	*Large Firms*	*Small Firms*	*P-value*
Litigation Rate (%)	6.67	17.31	0.00
Lit Rate (pre-1994)	10.09	37.93	0.01
Lit Rate (1994-1999)	4.98	12.6	0.02
Lit Rate (post-1998)	4.57	4.23	0.90
Lawsuits*	1.98	2.11	0.82
Litigation Age*	6.11	4.78	0.20
Pre-disclosure Litigation*	32.61	44.44	0.33
Forward Cites 63-06	31.14	33.68	0.46
Backward Cites	10.46	12.80	0.10
Non-patent Cites	8.33	13.54	0.11
Claims	22.07	24.31	0.21
Continuation actions	0.36	0.78	0.00
Generality	0.51	0.49	0.62
Forward Cites / Year	3.07	3.80	0.04
Cites / Claim / Year	0.21	0.24	0.38
Backward Cites / Claim	0.78	0.93	0.28
Non-patent Cites / Claim	0.53	1.42	0.14
Total Patents	690	156	

Table 5: Pooled Cross-Sectional Models of Patent Litigation

This table presents coefficients and robust standard errors (clustered by disclosure ID) from a set of pooled cross-sectional Poisson regressions.

Unit of Observation = Patent Year **DV = Litigation Count (unique suits)**				
Sample	*Small Firms*	*Large Firms*	*All Firms*	*Compustat*
Disclosure	1.447***	-0.0279	0.105	-0.263
	(0.45)	(0.40)	(0.41)	(0.46)
Disclosure * Small Firm			1.276**	
			(0.64)	
Small Firm Dummy			0.605	
			(0.55)	
log(Employees)				-0.255***
				(0.060)
log(Assets/Employee)				-1.647***
				(0.41)
log(R&D/Employee)				0.0115
				(0.32)
log(Patents/R&D)				0.344*
				(0.21)
Past Litigation	1.957***	2.155***	2.085***	0.827
	(0.72)	(0.33)	(0.32)	(0.60)
Age * Small Firm			-0.177***	
			(0.066)	
Age (since grant)	-0.225**	-0.00607	-0.0210	-0.182**
	(0.11)	(0.030)	(0.032)	(0.081)
log(Cites, t-1)	0.525***	0.118	0.303**	0.0740
	(0.17)	(0.16)	(0.12)	(0.15)
log(Claims)	0.289*	0.452**	0.413**	0.354
	(0.16)	(0.22)	(0.17)	(0.28)
Continuation Dummy	0.871**	0.519*	0.720***	1.274***
	(0.38)	(0.27)	(0.22)	(0.46)
US Firm Dummy	1.304**	0.183	0.399	-0.591
	(0.53)	(0.34)	(0.35)	(0.43)
IEEE Dummy	0.905*	-0.0217	0.353	-1.071**
	(0.47)	(0.42)	(0.34)	(0.49)
IETF Dummy	-0.745**	0.0717	-0.0764	-0.438
	(0.35)	(0.66)	(0.57)	(0.74)
ITU Dummy	-0.309	0.679	0.882*	-2.824***
	(0.91)	*(0.48)*	(0.46)	(0.69)
Consortia Dummy	1.518***	0.329	0.915**	-0.248
	(0.48)	(0.50)	(0.42)	(0.45)
Year Effects (Chi2 5 d.f.)	30.63***	20.45***	33.18***	22.25***
Total patents	153	640	793	462
N (Patent-years)	1434	7430	8864	5504

* 10% significance; ** 5% significance; *** 1% significance. (SEs clustered on disclosure).
Omitted SSO is ANSI. Constant term not reported.

Table 6: Fixed Effects Models of Patent Litigation
This table presents coefficients and robust standard errors from a set of Poisson quasi-ML regressions with firm or patent (conditional) fixed effects.

	Unit of Observation = Patent Year				
	DV = Litigation Count (unique suits)				
Sample	*Small Firms*	*Large Firms*	*Small Firms*	*Large Firms*	*All Firms*
Disclosure	**1.342****	**-0.409**	**1.403****	**-0.504**	**-0.421**
	(0.53)	**(0.57)**	**(0.62)**	**(0.62)**	**(0.59)**
Disclosure * Small Firm					**1.991****
					(0.86)
log(Cites, t-1)	0.557**	0.157	0.598	-0.319	-0.050
	(0.22)	(0.24)	(0.47)	(0.45)	(0.35)
log(Claims)	1.002***	0.042			
	(0.29)	(0.22)			
Continuation Dummy	-0.008	0.939***			
	(0.35)	(0.28)			
Age Since grant	-0.245	0.0491	-0.319	0.174	0.088
	(0.15)	(0.037)	(0.24)	(0.16)	(0.14)
Age * Small Firm					-0.186**
					(0.089)
Year Effects Chi2 (5 d.f.)	14.83**	18.75***	13.94**	36.04***	37.94***
Firm Fixed Effects	Y	Y	N	N	N
Patent Fixed Effects	N	N	Y	Y	Y
Patents	59	202	26	45	71
Firms	19	23			
N (Patent Years)	647	2567	317	568	885

*10% significance; ** 5% significance; *** 1% significance. (SE’s clustered on disclosures).

Table 7: Disclosure and Patent Citations

This table presents coefficients and robust standard errors (clustered by disclosure ID) from a fixed-effects Poisson regressions.

Unit of Observation = Patent Year *DV = Forward Citation Count*				
Sample	*All SSO Patents*	*Litigated SSO Patents*	*All SSO Patents*	*Litigated SSO Patents*
Small Firm * Disclosure	**-0.329**	**0.0339**	**-0.449****	**-0.102**
	(0.23)	**(0.30)**	**(0.22)**	**(0.30)**
Litigation Dummy			**0.0416**	**-0.270**
			(0.21)	**(0.22)**
Litigation * Small Firm			**0.723*****	**0.279**
			(0.24)	**(0.24)**
Age (since disc) = -4	-0.231**	-0.485**	-0.227*	-0.554**
	(0.12)	(0.23)	(0.12)	(0.25)
Age (since disc) = -3	-0.232***	-0.330	-0.230***	-0.384*
	(0.082)	(0.21)	(0.083)	(0.23)
Age (since disc) = -2	-0.158***	-0.251*	-0.155***	-0.256*
	(0.054)	(0.13)	(0.054)	(0.14)
Disc Year	0.139*	-0.00952	0.154**	0.0583
	(0.077)	(0.20)	(0.077)	(0.20)
Age (since disc) = +1	0.178*	0.371	0.194*	0.477
	(0.10)	(0.32)	(0.10)	(0.32)
Age (since disc) = +2	0.217	0.352	0.233*	0.472
	(0.14)	(0.32)	(0.13)	(0.32)
Age (since disc) = +3	0.130	0.536	0.146	0.682
	(0.16)	(0.42)	(0.16)	(0.42)
Age (since disc) = +4	0.223	0.439	0.230	0.601
	(0.20)	(0.51)	(0.20)	(0.52)
Age (since disc) = +5	0.295	0.384	0.305	0.598
	(0.24)	(0.54)	(0.24)	(0.54)
Age (since grant) ^{2}	-0.0278***	-0.0232	-0.0287***	-0.0251
	(0.0079)	(0.017)	(0.0079)	(0.017)
Age (since grant) ^{3}	0.00107***	0.000695	0.00112***	0.000782
	(0.00034)	(0.00069)	(0.00034)	(0.00068)
Patent Fixed Effects	Y	Y	Y	Y
Patents	791	70	791	70
N (Patent Years)	6482	605	6482	605

* 10% significance; ** 5% significance; *** 1% significance.

Table 8: Litigation at VC Backed Firms by Investment Outcome

This table shows probability of patent litigation according to company-level "outcomes" for a sample of venture-backed firms in the SSO patent sample. The left panel conducts a T-test for differences in the litigation rate at the patent level. The right panel presents firm-level results, where the dependent variable is a dummy for litigation over any patent disclosed by that firm to an SSO.

	Patent Level		**Firm Level**	
	No Suit	*Suit Filed*	*No Suit*	*Suit Filed*
Acquisition	25	10	9	6
Active				
Investment	16	2	8	2
Defunct	14	4	3	2
Merger	4	1	1	1
Went Public	132	3	26	2
Total	**191**	**20**	**47**	**13**
Litigation Rate				
Other Outcome		22.4%		34.4%
Went Public		2.2%		7.1%
Difference		20.1%		27.2%
T-Statistic		**4.0475**		**2.7602**
P-value		0.0001		0.0081

Table 9: The Litigation Process

This table provides descriptive statistics for outcomes of SSO patent lawsuits and a matched sample of non-SSO patent lawsuits drawn from the same court within 10 days of the SSO lawsuit filing date.

	SSO Lawsuits	*Non-SSO Lawsuits*	*Difference*	*P-value*
Duration: Filing to termination (days)	449.99	511.52	-61.53	0.34
Outcome Shares (N=102)				
Terminated during discovery	0.314	0.363	-0.049	0.46
Settlement order	0.431	0.294	0.137	0.05
Reached trial	0.049	0.049	0.000	1.00
Final verdict (after trial or motion)	0.127	0.167	-0.040	0.43
Final verdict (N=13 SSO, 17 Non-SSO)				
Plaintiff victory	0.538	0.235	0.303	0.09
Defendant vicory	0.231	0.412	-0.181	0.31
Shared victory	0.231	0.353	-0.122	0.49
Patent Owners (N=91 Large, 73 Small)	***Large Firm***	***Small Firm***		
Assignee is Plaintiff	64	23		
Assignee is Defendant	22	12		
Assignee is Neither	5	38		

Figure 1 : Annual IPR Disclosure at Thirteen Standard Setting Organizations

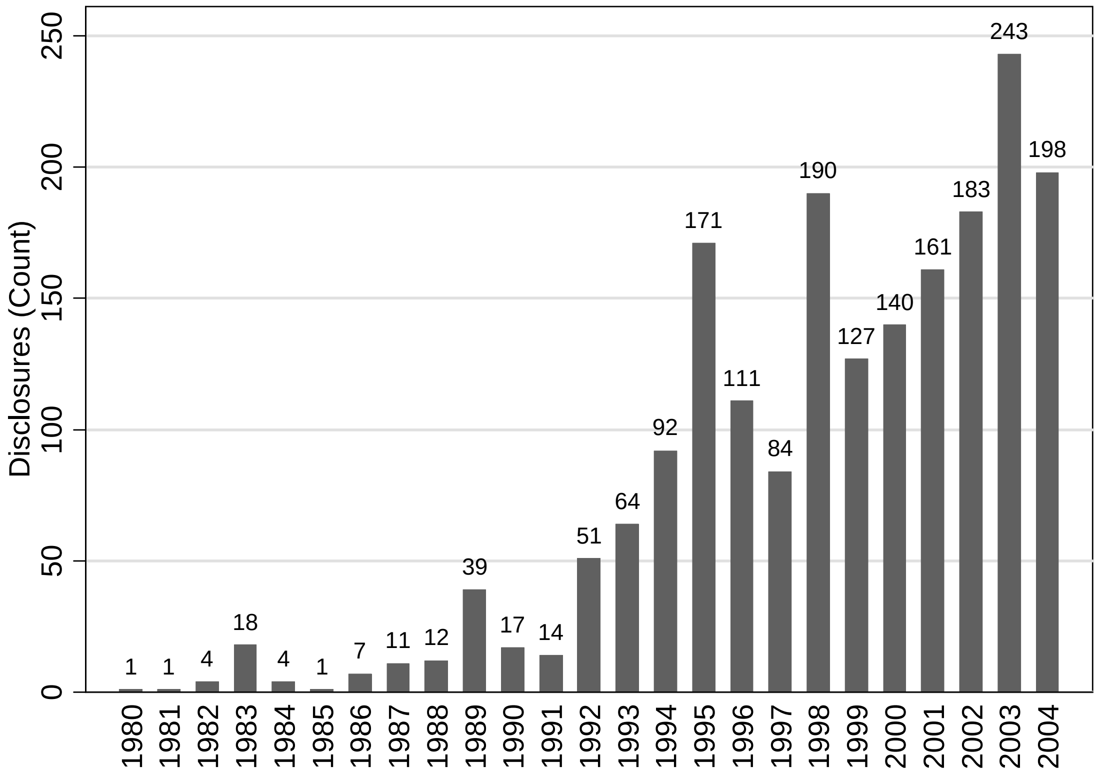
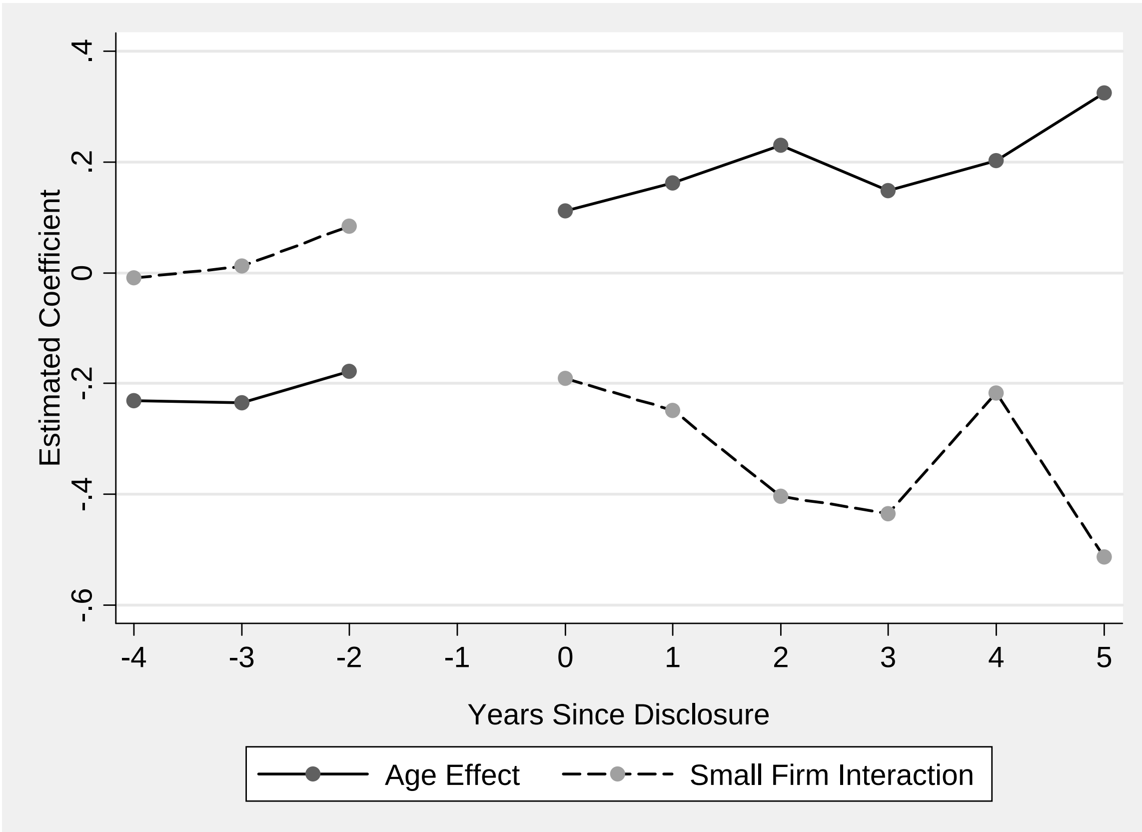


Figure 2 : Large vs. Small-Firm Citation Response to Disclosure



Appendices

Table A.1 : Short SSO Descriptions

Acronym	Description
ANSI	Umbella organization that certifies US Standards Developing Organizations
ATIS	ANSI accredited US SDO that develops telecom standards
ATM Forum	Consortium for Asynchronous Transfer Mode, a switching technology
ETSI	Develops cellular teleohony standard fro Europe. Currently excluded from the analysis
IEEE	ANSI accredited US SDO that develops a host of It standards, notably for networking
IETF	Large independent SSO tha develops core Internet standards
ITU	International SDO, main body for traditional phone network standards.
TIA	ANSI accredited US SDO that develops telecom standards, particularly for wireless
DSL Forum	Consortia for Digital Subscriber Line (high speed modems)
ISO	Umbrella organization for international standards.
ISO/IEC JTC1	Joint ISO/IEC committee for all IT international standards
MSSF	Multiservice Switching Forum. Consortium for "next generation" networking standards.
OMA	Open Mobile Alliance. Consortia to promote mobile application interoperability.
VESA	Video electronics standards organization

Table A.2 : Technology Classification of Disclosed Patents

This table shows the distribution of patents in our sample over a set of broad technology areas, whose definitions are based on the US Patent and Trademark Office's technology classification scheme. These patents primarily cover information and communications technologies.

Technology Category	*All SSOs*	*No ETSI*
Chemical	9	3
Communications	1,500	426
Computers (HW/SW & Other)	563	377
Drugs & Medical	5	4
Electrical & Electronic	121	98
Mechanical & Other	68	34
Total Patents	2,266	942

Figure A.1 : Sample Disclosure Letters

Mark T Starr
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Telephone
215 986 4411

PL 242

UNISYS

VIA FACSIMILE (202) 663-7554
CONFIRMATION BY REGULAR MAIL

December 12, 1995

RECEIVED
DEC 15 1995
ABA ST...

Ms. Cynthia Fuller
ASC X9 Secretariat
American Bankers Association
1120 Connecticut Avenue, N.W.
Washington, DC 20036

Re: United States Patent 4,107,653

Dear Ms. Fuller:

This is to advise you that Unisys Corporation is willing to grant to any requesting party a non-exclusive license under the claims of Unisys U.S. Patent No. 4,107,653, the infringement of which is recommended to properly make, use or sell Magnetic Signal Level Measuring Instruments used for the manufacture and/or calibration of secondary reference documents which are used to carry the signal level reference for the calibration of production signal level measuring equipment as referenced in ANS X9.27 - 1995, when approved and published. Please forward a copy of this letter to ANSI for their use. .

Each grant will be under separate agreement, at a royalty rate of one percent (1%) applied to the net selling price or fair market value of the equipment sold. Also, each requesting party must be willing to grant Unisys Corporation an option to a license of the same scope on similar terms, conditions and charges under the requesting party's patents.

Upon adoption of the ANSI standard, parties who wish a license should contact my office.

Sincerely,

Mark T. Starr

Mark T. Starr

MTS/cdt

Heather Benko

From: smontgomery@tiaonline.org
Sent: Wednesday, January 12, 2005 4:18 PM
To: hbenko@ansi.org
Cc: smontgomery@tiaonline.org
Subject: IPR/Patent Holder Statement

Document Information

Reference Doc. No.	PN-3-3972-UGRV.SF1 (refer to Project Number, Standards Proposal Number or title--one form per document. Note, may fill one statement for a document with multi-parts.)
Publication ID	TIA-733-A [SF1]
Document Title	Software Distribution for TIA-733-A - High Rate Speech Service Option17 for Wideband Spread Spectrum"

General Information

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