The Financial Patent Litigation Puzzle

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This paper examines the litigation of patents relating to financial products and services. I show that these awards are being litigated at a rate 27 times greater than that of patents as a whole. The awards being litigated are disproportionately those awarded to individuals and to smaller, private entities, as well as awards whose features may proxy for higher quality.

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Introduction

In recent years, patents on financial methods have proven to be intensely controversial. The nature of these patents, the legal foundations for the grants, and the distribution of awardees have been extensively discussed in the literature (e.g., Hall [2003]; Lerner [2002]; Merges [2003]).

A vitally important aspect of these awards, however, has been essentially unexplored: the extent to which they have been litigated. In this paper, I examine the litigation of all financial patents awarded between January 1976 and August 2003 through the end of 2005. The key result is a puzzle: financial patents are being litigated at a rate 27 times greater than that of patents as a whole. Even relative to the most extensively litigated major category of patents (drugs and health), the rate is more than an order of magnitude higher. The rates are also far greater than that in the early years of an emerging industry where the extent and breadth of patent protection was initially ambiguous, biotechnology.

The bulk of this paper seeks to understand this puzzle in greater depth. I show that:

- The finance patents being litigated are disproportionately those awarded to individuals. Inasmuch as those awarded to corporations are being adjudicated, it is overwhelmingly those awarded to smaller, private entities.
- The defendants in these cases, on the other hand, are dominated by large financial institutions and exchanges.

- Litigated patents appear to be more important than other financial patents: they have more claims, and disproportionately cite and are cited by other patents. In part, however, the greater number of citations seems due to a "publicity effect": litigation leads patents to be more frequently cited.

In the final section, I discuss the implications of these results. The results are partially consistent with at least two potential explanations. One possibility is that early patents in this field are of high value, and as a result are especially likely to be litigated. Individuals may play a more prominent role in terms of litigation than other fields because the nature of the industry structure and the low capital requirements needed to create financial innovations. Alternatively, the presence of entrepreneurs who obtain and then aggressively litigate patents of dubious validity (e.g., U.S. Federal Trade Commission [2003]) may explain the intensity of litigation and the dominant role played by individuals.

The importance of this topic stems from the economic role played by financial innovation. The impact of financial innovation is widely accepted: the economic importance of new products and services in the financial arena have been highlighted by, among others, Miller [1986] and Merton [1992], and empirically documented by Tufano [1989]. Yet the empirics of financial innovation have attracted remarkably little academic attention (Frame and White [2004]). Because patents fundamentally change the way in which innovations can be used (for instance, they make the type of rapid diffusion documented by Tufano [1989] less feasible), they are critical in understanding

innovation. Moreover, since patent litigation typically entails several millions of dollars of expenditures (AIPLA [2005]), the 246 lawsuits in this sample represent a significant expenditure of resources in their own light.

The plan of this paper is as follows. Section 1 briefly reviews the changes in patent law and practice in relation to business method patents. Section 2 describes the construction of the data-set. Section 3 presents the analysis. The final section concludes the paper.

1. Business Method Patents[1]

There has long been ambiguity about the patentability of business methods in the United States. At least since a 1908 court decision that established the "business methods exception," many judges and lawyers have presumed that business methods were not patentable subject matter. While the U.S. Patent and Trademark Office (PTO) has issued patents on financial and other business methods for several decades, many observers questioned their validity. Consequently, awardees were reluctant to incur the time and expense to litigate their awards.

Attitudes toward business method patents changed with the July 1998 appellate decision in *State Street Bank and Trust v. Signature Financial Group*. This case had originated with a software program used to determine the value of mutual funds, on which Signature had obtained a patent in 1993. State Street Bank sued to have the patent

[1]This section is based on Lerner [2002] and Jaffe and Lerner [2004].

invalidated on the grounds that it covered a business method and was hence not patentable. While State Street's argument prevailed in the district court, the Court of Appeals for the Federal Circuit, the centralized appellate court for patent cases, reversed the finding. In its decision, the court explicitly rejected the notion of a "business method exception." The Supreme Court declined to hear State Street's appeal of the appellate decision in January 1999. In the numerous articles in the trade press that followed the two decisions, the case was interpreted as unambiguously establishing the patentability of business methods.

The decision appears to have lead to a substantial increase in the filing and granting of business method patents, including financial patents. One of the major concerns expressed about the expansion of awards in this area has been about their quality. Merges [2000] asserted that "the increased volume of patent applications stemming from this newly patentable subject matter has pushed the patent system into crisis." These concerns are at least partially supported by Lerner [2002], who shows that while academic research is highly relevant to many financial patents, these works are far less often cited than in patents in other academically related areas, such as biotechnology.

2. Constructing the Data-Set

This section describes how I constructed the data-set used in this analysis.

Patent awards. I identify awards using the online database of the U.S. Patent and Trademark Office, which summarizes all patents awarded since January 1976. Following

the procedure in Lerner [2006], I identify all patents assigned to relevant US Patent Classification subclasses. Patents are classified at the time they issue to one or more classifications. There are over one hundred thousand such classes. The PTO takes such classifications very seriously, because they ensure that examiners will be able to identify the relevant earlier awards when they engage in subsequent patent searches. As in the earlier analysis, I employ all patents with a primary assignment to subclasses 705/4, 705/35 through 705/45, and 902/1 through 902/41. Because I wanted to be able to assess the quality of issued patents (which relies on being able to identify how frequently the awards are cited in subsequent documents), I only included patents in the sample if they were awarded through August 2003. In total, there are 2944 awards in the sample.

Litigation. I employ the Derwent LIT/ALERT patent litigation database to determine if, and how often, each patent in the sample has been litigated. This database is built using reports to the PTO from the district courts where the patent litigation is initiated. While these reports are required to be filed, as Lanjouw and Schankerman document [2001, 2003], in a considerable number of instances (about 35% in recent years and more earlier), no such report is made. (To address this deficiency, I adjust the computed patent litigation rates, as discussed in detail in Section 3.B.) The data on litigation were downloaded in May 2006. There appears, however, to be substantial reporting lags: no suits from 2006 and only one after August 2005 were found.[2] From the database, I gather information on the key dates, parties, and location of the case, as well

[2]I assume in the calculations below that the database contains all records involving patent litigation filed through the end of 2005. Thus, the estimates of the amount of litigation—and the disparities from other areas of patent litigation—are slightly understated.

as the patents that were involved.[3] Because the lists of litigating parties provided by Derwent were incomplete (it only assigned one patent to each lawsuit prior to 1990, even if there were multiple ones at issue), I obtained the docket filings for the earlier cases and augmented their records. I count the number of lawsuits involving each patent, regarding each case as one suit even if there are multiple defendants named.

Characteristics of patentees. I also characterize the features of the parties to whom the patents were assigned in the year of the award. First, I classify the awardees into publicly traded corporations, privately held firms, individuals, and others (e.g., government and university entities). I define publicly traded entities as those for which financial and related information for the year prior to the award is available from Compustat, WorldScope, or filings with the U.S. Securities and Exchange Commission. I classify as private firms all other cases where there is a non-governmental, non-academic assignee other than the inventor.[4] For private entities, I employ a variety of sources, including the *Moody's* manuals, the *Corporate Technology Directory*, national directories of firms (particularly of Japan), and directories of various segments of the financial services industry. In these cases, I simply seek to obtain information on the revenues and employment of the firm, as well as the nation in which its headquarters is based. If I am unable to identify the relevant information in the year of award, I use information from

[3]Because the considerable majority of patent cases ultimately settle, and these settlements are highly diverse and rarely disclosed to the public, it is impossible to characterize the outcomes of these cases in a systematic manner.

[4]Because it is difficult to determine whether non-U.S. foreign firms are publicly traded, some public firms may be misclassified as private. Given that the corporate financial patentees are dominated by U.S. and large Japanese firms, this problem should be limited.

the year beforehand or, if this is not available, the year after the award. In many cases, however, I am unable to locate the sales and revenue information: many of the assignees are small patent holding companies that keep extremely low profiles. I am, however, able to characterize the location of all assignees: if information on firm location is not available from the above databases, I employ the location of the assignee as identified in the patent award. If there is no assignee, I use the location of the inventor.

Features of the patents. Over the past two decades, a variety of quantitative measures of patents have become widely adopted (Hall, Jaffe, and Trajtenberg [2002]; Lanjouw, Pakes and Putnam [1998]). These methods rely on the citations either to or by the patent award to characterize the awards (forward and backward citations respectively), as well as the count of the claims in the awards. Patents with more forward citations and claims are frequently interpreted as being more important, while those with more backward citations are seen as more carefully describing the "prior art" of already-issued patents. The interpretation of self-citations is ambiguous: in part, it may indicate firms that are more valuable to the patentees, but earlier work suggests that large firms disproportionately cite themselves.

I compiled the number of forward and backward citations through July 2006 in order to have as full depiction of the patents as possible. I also identified those forward and backward citations that are self-citations. Finally, I computed two alternative measures of patent quality, generality and originality (see Hall, Jaffe, and Trajtenberg [2002]).

3. An Analysis of Litigation

A. Summary Statistics

Before turning to the central puzzle posed by the paper, Table 1 provides an overview of the firms and patents included in the sample. Several patterns stand out in Panel A:

- While the award date of the patents in the sample ranges from 1976 to 2003, they are concentrated in the second half, with the mean award in late 1994. This reflects the acceleration of financial patenting activity in recent years.
- These patents are heavily cited relative to the typical U.S. award. Jaffe and Trajtenberg [2002, p. 439] find that the typical twelve-year-old patent had received just fewer than seven citations, or one-quarter the level seen here.[5]
- Financial patenting activity is dominated by U.S. firms, which account for 74% of the awards. In recent years, approximately one-half of all patent awards have gone to non-U.S. entities. This disparity is particularly dramatic among individuals and private firms. The foreign assignees are dominated by Japanese firms to a much greater extent than in other technical fields, which reflects the fact that Japan is one of the few nations outside the U.S. that unambiguously allows business method patents.
- As noted in Lerner [2002], the representation of government and university assignees (about 0.4%) is considerably less than in patents as a whole, and

[5]The predicted number of citations is slightly lower if one computes a weighted average based on the actual ages of the awards in the financial patents sample.

certainly much less than in other academically-linked fields such as biotechnology and advanced materials.

- While the bulk of patents are not litigated, a few awards are extensively so, with one patent being involved in fifteen lawsuits. (This is an award to an individual inventor, Lawrence B. Lockwood, which is being litigated through the patent holding company Pangea Intellectual Properties. The patent—number 6,289,319—covers an automated "financial transaction processing system," and is cast in sufficiently broad terms that it probably covers all e-commerce transactions, as well as those employing automated teller machines. Pangea has been targeting small firms in its litigation, in a successful effort to obtain settlements of hundreds of thousands of dollars each from firms that are reluctant to bear the cost of litigation.[6])

The second panel indicates a few characteristics of the lawsuits themselves. Most involve a single financial patent, but several encompass multiple awards. More interestingly, the role of third parties here is much greater than elsewhere. Only 46% of the disputes involve an assignee or an inventor as a plaintiff or a defendant. In other cases, the litigation is being conducted by third parties (who have typically purchased or licensed the patent) instead. This share of third parties is much greater than seen elsewhere. For instance, Lanjouw and Schankerman [2001, Table 1] find that in 68.5% of the cases, the assignee is either a plaintiff or defendant. (They do not examine cases

[6]See, for instance, the discussion in http://www.infoworld.com/articles/hn/xml/02/05/15/020515hnpangea.html (accessed October 10, 2006).

where the inventor but not the assignee was a litigator, which would increase the share at least modestly.)

This point is further underscored by Table 2. This presents the five most frequently represented firms in several categories, which prove to be dramatically different:

- The first column reports the most frequently represented financial innovators, as reported in Lerner [2006]. This compilation is based on stories in the *Wall Street Journal* on financial innovation between 1990 and 2002.[7] This list is dominated by financial institutions and includes a major publisher.
- The second column presents the most frequent financial patentees between January 1976 and August 2003. While Citigroup appears here as well (and other financial institutions appear further down on the list), it is dominated by information technology companies. These firms—which routinely file for protection of hardware and software inventions—rapidly began filing for patents on innovations that were developed in the course of projects for financial service firms after the *State Street* decision (or even before).

[7]Mergers and acquisitions introduced complications to the tabulations. Citicorp appears in the first column because it was an active innovator until its acquisition by the Travelers Group in 1998. Subsequent innovations by this institution were attributed to Citigroup, its corporate parent in 2003 (which is credited with innovations developed by the new combined entity and the old Travelers Group). (Lerner [2006] provides a more detailed description of the procedure used.)

- The most frequent plaintiffs[8] in financial patent litigation between 1976 and 2005 are reported in column 3. This list, in contrast to the others, is dominated by patent holding companies that have no lines of business other than licensing and litigating patent awards.
- The most frequent defendants in financial patent litigation between 1976 and 2005 are reported in the fourth column of Table 2. In contrast to the plaintiffs, the compilation of the most frequently represented defendants is dominated by major investment banks, trading exchanges, and other established financial institutions.

B. The Puzzle

I then examined the propensity for these patents to be litigated. The basic distribution of patent awards over time is presented in Table 3. The first two columns make clear that the number of financial patents granted has increased in recent years and that the rate of litigation (which is expressed as suits per thousand awards) peaked among the patents awarded between 1990 and 1994.

The data in column 2, however, have two limitations. First, not all cases are reported to the PTO. Lanjouw and Schankerman address this issue by comparing the number of cases reported to the PTO with the number of case filings identified as patent

[8]In some cases, entities file for "declaratory relief," or for a ruling that a patent they are being threatened with infringing is invalid. These cases appear relatively rare in the sample. Prior to making this and the subsequent tabulation in the fourth column of Table 2, I eliminate cases where the defendant is an assignee or an inventor of a patent in contention, but the plaintiff is not. I also eliminate from the list of defendants parties that appear twice or more as plaintiffs, as these cases are also likely to be suits for declaratory relief. In the third and fourth columns, when two firms are involved in the same number of suits, I rank them based on the number of patents over which they have litigated.

related by the Federal Judicial Center. This administrative office compiles a comprehensive database of all litigation. It does not, however, indicate which patents were involved in individual cases, so cannot be used as the basis for the analysis here. From this information, they are able to compute an adjustment factor (reported in Appendix I of their 2003 paper), which scales up the number of reported cases to reflect non-reporting.

The second limitation has to do with the fact that all patents are not litigated immediately after issue. Rather, a considerable number of cases are initiated involving patents that are a few years old (the probability of litigation drops considerably for older patents). Because many of the patents in the sample are quite young (having been awarded as recently as mid-2003), this truncation bias may be significant. Based on the actual distribution of litigation over time of patents awarded between 1982 and 1986, Lanjouw and Schankerman [2003, Appendix I] report adjustment factors: i.e., factors that allow one to compute the total expected amount of litigation over a patent's lifetime based on the extent of such activity in the initial years after award.[9]

[9]There are two subtle differences between my procedure and Lanjouw and Schankerman's. First, the earlier authors assumed that there was only one patent per lawsuit due to the limitations in the early Derwent data noted above, while I researched the cases to determine missing patents. Because there are on average 1.3 patents per case in my sample, my reported litigation rate will be slightly higher. Second, approximately twenty percent of the entries in the Derwent database are duplicate records, referring to different actions in the same suit. I deleted these entries (which apparently was not done by Lanjouw and Schankerman). Thus, collectively these two adjustments should have a very modest effect on the comparisons.

Column 3 presents the adjusted amount of litigation. Once these corrections are made, there is no clear time trend in the amount of litigation: the upward adjustments are greatest for the oldest patents (due to the severe non-reporting biases in early years) and the most recent ones (because of their greater truncation). Comparing the litigation rates to the similarly adjusted data of Lanjouw and Schankerman [2001, Table 1], the overall rate of litigation is some *twenty-seven times greater* than in their overall sample of awards.

The rate of patent litigation is far greater than that in other fields. In the technology group with the greatest litigation rate in the Lanjouw-Schankerman sample, "drugs and health," has a litigation rate that is less than 7% that seen in financial patents. Nor do other emerging technologies—where uncertainty is presumably greater—appear to have rates approaching financial patents. For instance, Lerner [1995] examines the litigation of the first 2048 biotechnology awards. He finds that the rate of litigation was less than one-fifth the rate seen here.

Table 4 considers the litigation rate for patents with different classes of owners. Here again, there are dramatic differences between the litigation of these patents and that of patents more generally. There are substantial differences along three dimensions:

- Lanjouw and Schankerman [2001, page 145] found that corporate owners were far more likely to become involved in a patent suit than individual owners. Here, precisely the opposite result holds: patents assigned to individuals are five times more likely to be litigated than those held by public corporations, and 50% more

likely to be so than those held by private firms (which include both smaller operating firms and patent holding companies).

- Overall (Lanjouw and Schankerman [2001, Table 1]), patents by individuals and institutions in the United States are 4.7 times more likely to be litigated than foreign-owned ones. Among financial patents, the ratio of the probabilities is almost twice as large (8.9 times).
- No clear patterns appear overall in the litigation rate of firms of different sizes (Lanjouw and Schankerman [2004, Table 3]).[10] Here, by way of contrast, a dramatic effect appears. Among patents awarded to firms with fewer than 200 employees at the time, there is more than one lawsuit per patent. Among the patents awarded to the largest firms (those with over 200,000 employees), there is no litigation at all in this sample. When firms are segmented by revenues, a similarly dramatic pattern appears.

Thus, the characteristics of the patentee—particularly, type and size—appear to drive the decision to litigate financial patents to a considerably greater extent than in other fields. The prevalence in litigation of small firms and individual inventors is quite striking.

I compare the characteristics of the patents themselves in Table 5. Following Lanjouw and Schankerman [2001], I examine domestic and foreign patentees separately, as their citation practices may differ. I contrast patents that are and are not litigated. Like litigated patents overall, litigated financial patents have more forward citations and

[10]It is important to note that these authors use the size of the firms' patent portfolios to proxy for firm size. While these measures may be correlated, the relationship is unlikely to be exact.

claims. The difference in the number of forward citations, however, is much smaller and no longer statistically significant at the five-percent confidence level when I compute citations per claim. Thus, while litigated financial awards may be more expansive in their claims, they are not disproportionately cited once the number of claims are controlled for (unlike litigated patents more generally). Among awards generally, patents with more backwards citations are less likely to be litigated. Among financial patents, the opposite pattern holds: litigated patents actually cite more prior art.

In the tabulations above, I have assumed that forward citations proxy for importance, which drives litigation. There might be another relationship between citations and innovation, however: patents that are litigated might be more frequently cited, not because they are more important, but rather because the publicity generated by the lawsuit calls attention to the award. This might lead to false inferences.

Following the procedure of Lanjouw and Schankerman [2001, Table 4], I test for the presence of a publicity effect. In particular, for all litigated patents, I look at the mean number of citations obtained in the years after the patent was applied for. In the first column, I look at the citations per year for patents that had not yet been (but eventually will be) litigated, separating the awards by the time since the patent has issued. I then compute in subsequent columns the number of citations that all patents received in the year after the filing of the lawsuit, the second year after such a suit, and so forth.

The results in Table 6 show that at least part of the difference in citations between litigated and non-litigated patents is driven by the "publicity effect." In the three years after the dispute, the litigated patents garner 5.2 more forward citations relative to the baseline before the inception of litigation. (By the fourth year, the citation rate has returned to the baseline.) For the mean patent in the sample, which is twelve years old, this translates into a little under one-half of a citation per year. This accounts for roughly 23% of the difference in annual forward citation rates for litigated and non-litigated financial patents (4.0 and 2.1).

I then turn in Table 7 to a regression analysis to explain the prevalence of litigation. The unit of observation is each patent award in the sample. I employ two dependent variables in the reported regressions. The first (following the analyses in Table 5 of Lanjouw and Schankerman [2001]) is an indicator denoting as one instances where the patent was litigated before the end of 2005, and zero otherwise. This is in the first column, which features a probit analysis. The second (in the remaining columns) is the count of lawsuits in which the patent was involved. In these cases, I estimate Poisson and negative binomial specifications. (I do not adjust the dependent variable here for truncation or reporting biases, instead employing dummy variables for each patent award year.)

In the first three regressions (which include a probit analysis as noted above, as well as a Poisson and more robust negative binomial regression when using the count of lawsuits), I employ a set of control variables modeled after those used by Lanjouw and

Schankerman [2001].[11] These include the number of claims, the logarithm of one plus the number of forward and backward citations per claim, dummy variables denoting cases where there were no forward or backward citations, and the share of citations that are self-citations (which, as discussed above, may be informative about the importance of the patent to the firm or just citation practices).[12]

Each of these regressions paints a consistent story. Patents with more claims and with more forward and backward citations are more likely to be litigated. The controls for self-citations are consistently insignificant.

In Table 8, I explore the magnitude of the coefficients. I analyze the first, third, fourth and fifth regressions reported in Table 7. In the first column, I report the predicted dependent variable at the means of the continuous variables and with the binary variables coded as zero. In the subsequent rows, I change one independent variable at a time, e.g., increasing the number of claims by one standard deviation or shifting the binary variable denoting a U.S. assignee from zero to one. In each case, I show the change in predicted dependent variable as the independent variable is shifted.

[11]The sample size is smaller in the first regression. Some observations are dropped from the probit regression because a zero or one outcome is perfectly predicted.

[12]In cases where there are no citations, I code the share of self-citations as zero. I omit a number of independent variables used by Lanjouw and Schankerman as less appropriate to a single industry sample, such as a measure of the similarity of each patent to the patents citing the award. Because so many of the awards are litigated by third parties, I do not run separate equations estimating the prevalence of litigation initiated by patentees and alleged infringers.

These provide an illustration of the magnitude of the effects delineated above. For instance, regarding the finding that patents with more claims are more frequently litigated, a one standard deviation increase in the third regression increases the predicted number of suits per thousand patents from 24 to 64. Those with more forward citations also experience an increase—a one standard deviation boost in the third regression raises the litigation rate per thousand to 49. Patents with more backwards citations, which again may suggest more important (or better documented) awards, similarly experience an increase in the litigation rate (to 40 per thousand).

Regression 4 adds a variety of characteristics of the patentee to the specification. (Once again, each patent is a separate observation, so some patentees are represented multiple times in the regression). Consistent with the cross-tabulations in Table 4, patents awarded to public corporations are far less likely to be litigated: the predicted litigation rate falls by two-thirds. Those patents awarded to U.S. residents are more likely to be so. (The patterns concerning individuals are statistically insignificant.) When I add the logarithm of employment (in thousands) and sales (in millions of 2003 dollars) in the year of the award to the specification in regressions 5 and 6, larger firms are associated with less litigation as before. (In each case, I add one to the count of employees or sales before taking the logarithm.) For instance, a one standard deviation increase in employment in the fifth regression reduces the expected amount of litigation by 70%.

C. Robustness Checks

I undertake a variety of robustness checks to examine whether the results are sensitive to the specification used. Most of these changes appear to have little impact.

The first concern is whether the results are sensitive to my assumption that the appropriate time control was the date of award. It is reasonable to control for award date, as older patents may be more frequently litigated simply because they had more time to generate conflicts and the propensity to litigate will vary over time (patents can typically not be litigated until they are awarded). But it may be that there are systematic patterns in the patents applied for over time. To address this concern, I repeat in unreported regressions the specifications reported in Table 7, now also employing dummy variables for the application year. The key results are little changed.

Another possibility is that the specification is problematic because it fails to account for the large number of zero observations in the sample. One way to address this problem is to estimate a zero-inflated negative binomial specification, in which a first stage estimates the probability that the patent is litigated at all, and the second focuses on the number of suits filed conditional on there being litigation. I report the second stage in column 7 of Table 7, again using a second-stage specification akin to that in column 3. (The first stage, which includes controls for the year of the award, the employment and sales of the firm, and the status of the assignee, is not reported.) The basic results go through as before. In unreported regressions, I repeated the other analyses using zero-inflated equations, and found that the key results were qualitatively unchanged.

Another concern is that lawsuits may vary in intensity. In some cases, suits may be dropped or settled soon after being filed; in others, litigation may progress for years. (Of course, a suit that is quickly settled for a large amount may also be very disruptive to a defendant.) In order to measure the intensity of litigation, I total the number of docket filings in each case, using the records of the PACER system.[13]

I then estimate Tobit regressions, employing the cumulative number of docket entries in the lawsuits associated with each patent as the dependent variable. Table 9 reports the regressions corresponding to the negative binomial analyses in columns 3 through 6 of Table 7. The primary results that appeared in the earlier regressions continue to go through as before.

I also undertook a variety of other robustness checks in unreported analyses. Among the changes were:

- Using the adjusted counts of lawsuits, as in Tables 3 and 4, rather than the actual counts as the dependent variable in the regressions. (In the reported regression, by using dummies for the year of the award, I addressed the differing vintages of the awards.) In ordinary least squares regressions, the results were similar in both the magnitude of marginal effects and statistical significance.

[13]In approximately five percent of the cases, I am unable to obtain the index of the docket file, either through PACER or an examination of the physical docket. In these instances, I assume that the case had zero docket entries. I also repeat the analysis, assuming that these missing cases have the mean number of docket entries, and find that the results are essentially unchanged.

- Repeating the analysis using alternative measures of patent importance, such as originality and generality (Hall, Jaffe, and Trajtenberg [2002]) in lieu of the citation counts. These alternative measures proved to have limited explanatory power.
- Employing the additional financial data available on public firms. The basic patterns continued to hold when these controls were added.
- Adding fixed effects for the firms awarded the patents. In regressions akin to that reported in column 3 of Table 7, the results were little changed: patents with more forward citations and claims were significantly more likely to be litigated. When measures of firm characteristics were added, however, these coefficients' significance dropped sharply from the reported regressions, which reflected the fact that the features of the firms only changed slowly (if at all).
- Dividing the patentees by those above and below the median employment (and in a separate analysis, sales). Among both large and small patentees, the basic patterns held: patents with more claims and citations are more frequently litigated. The relationship between firm size and probability of litigation, however, is only statistically significant among the smaller firms.

4. Conclusions

This paper examines the litigation of financial patents. The analysis uncovers a central puzzle: financial patents are being litigated two dozen times more frequently than patents as a whole. The awards being litigated are disproportionately those awarded to

individuals and to smaller, private entities. Patents with more claims and more citations are also more frequently litigated.

As suggested in the introduction, the interpretation of these results is ambiguous. Two plausible explanations are as follows:

- Theoretical models of suit and settlement (reviewed in Cooter and Rubinfeld [1989]) suggest that more valuable and more uncertain patents should be litigated more frequently. Given the importance of financial innovation, and the extent of uncertainty about these awards, the high level of litigation may thus not be surprising. The finding that financial patents with more claims and citations are more frequently litigated appears consistent with this argument. The frequency of litigation of individuals' and small firms' patents may reflect the prevalence of syndication and other cooperative relationships among larger firms (documented, for instance, in Hayes, Spence, and Marks [1983]), which may lead them to be reluctant to initiate litigation against each other.
- The wave of litigation has been driven by individual entrepreneurs, who exploit the weaknesses of the patent office to get problematic patents that they can use to litigate. In many cases, their targets, facing the prospect of an injunction that will require them to shut down key operations, will choose to settle rather than fight back. If a corporation with manufacturing and service operations were to aggressively pursue rivals, it might face counter-charges of patent infringement that would disrupt its own operations. Because these entrepreneurs have no

activities other than litigation, they are much less vulnerable to such threats (for a theoretical discussion, see Farrell and Shapiro [2007]).

The ultimate resolution of this puzzle is left to future scholarship by financial economists and legal scholars. Among other topics, there is a need for detailed assessments of the originality of these patents and the way in which they have been interpreted in the courts. In light of the complexity of such analyses, researchers are likely to need to focus on a sub-set of these awards. But given the importance of financial innovation and the potential of patent litigation to fundamentally alter this process, the rewards are likely to be substantial.

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Table 1: Characteristics of Patents and Lawsuits

The sample consists of 2942 financial patents awarded between January 1976 and August 2003. The table presents the key features of the patents and the 246 lawsuits involving these patents through the end of 2005.

Panel A: Patent Awards	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Award year	1994.7	7.3	1976	2003
Application year	1992.1	7.1	1969	2002
Claims made	20.9	20.9	1	375
Citations made	13.3	17.6	0	243
Citations made per claim	1.2	3.1	0	121.5
Citations received through July 2006	24.0	33.2	0	407
Citations received through July 2006 per claim	2.3	6.0	0	129
Self-citations made	0.6	2.1	0	60
Self-citations received through July 2006	0.4	1.0	0	15
Generality	0.44	0.25	0.07	1
Originality	0.53	0.27	0.06	1
Sales of assignee in award year (billions of 2003$s)	24.9	37.8	0	467
Employment of assignee in award year (000s)	86.0	113.3	0.005	891
Assignee is a U.S.-based individual	16.0%			
Assignee is a non-U.S.-based individual	2.3%			
Assignee is a U.S.-based public corporation	32.5%			
Assignee is a non-U.S.-based public corporation	16.2%			
Assignee is a U.S.-based private firm	24.9%			
Assignee is a non-U.S.-based private firm	7.7%			
Nationality of assignee (if non-U.S.):				
Japanese	57.6%			
British	8.5%			
French	6.5%			
German	6.3%			
Lawsuits involving patent through end of 2005	0.08	0.59	0	15

Panel B: Lawsuits	*Mean*	*Std. Dev.*	*Min.*	*Max.*
Number of financial patents in suit	1.32	1	1	7
Patents awarded to plaintiff?	5.90%			
Patents assigned to plaintiff?	32.60%			
Patents awarded to defendant?	1.10%			
Patents assigned to defendant?	6.40%			

Table 2: Most Frequently Represented Firms

The table summarizes the firms most frequently represented in the tabulations of financial innovators between 1990 and 2002, financial patentees between 1976 and 2003, and litigators of financial patents between 1975 and 2005. The tabulations of plaintiffs and defendants exclude cases where an alleged infringer sues for declaratory relief; the compilation of defendants, actions against frequent patent plaintiffs..

Innovators	*Patentees*	*Plaintiffs*	*Defendants*
Merrill Lynch	Hitachi	Pangea Intellectual Properties, LLC	American Express
Citigroup	International Business Machines	Divine Technology Ventures	Citigroup
American Express	NCR	Source, Inc.	Chicago Board of Trade
Citicorp	Citigroup	Meridian Enterprises Corp.	New York Mercantile Exchange
McGraw-Hill	Fujitsu	Travelers Express Co.	JP Morgan Chase

Note:
The source of the first column is Lerner [2006].

Table 3: Distribution of Adjusted and Unadjusted Lawsuits, by Year

The sample consists of 2942 financial patents awarded between January 1976 and August 2003. The table presents for each time period the number of financial patents awarded and the adjusted and unadjusted rate of lawsuits involving these patents. See text for discussion of the adjustment process.

Patent award year	*Patents*	*Unadjusted lawsuits/ 1000 patents*	*Adjusted lawsuits/ 1000 patents*
1976-1979	110	45.5	285.9
1980-1984	258	19.4	62.4
1985-1989	443	101.6	235.4
1990-1994	294	210.9	411.9
1995-1999	762	86.6	299.2
2000-2003	1075	58.6	337.1
All patents	2942	83.6	293.5

Table 4: Adjusted Lawsuits by Firm Type

The sample consists of 2942 financial patents awarded between January 1976 and August 2003. The table presents for various sub-classes of assignees the adjusted rate of lawsuits involving these patents. See text for discussion of the adjustment process.

Firm type in award year	*Adjusted lawsuits/ 1000 patents*
By Assignee Status	
Publicly Traded Firm	114.5
Privately Held Firm	396.6
Individual	591.7
p-Value, test of no difference	0.000
By Nation of Assignee	
United States	382.8
Japan	29.9
Other	61.0
p-Value, test of no difference	0.000
By Employees in Award Year	
0-200	1153.0
201-1000	313.1
1001-50,000	80.3
50,001-200,000	47.1
>200,000	0.0
p-Value, test of no difference	0.000
By Revenues in Award Year (millions of 2003$s)	
0-10	790.9
10.1-100	681.5
100.1-1000	74.7
1000.1- 10,000	84.5
10,000.1-50,000	45.1
>50,000	0.0
p-Value, test of no difference	0.000

Table 5: Comparison of Means for Litigated and Non-Litigated Patents

The sample consists of 2942 financial patents awarded between January 1976 and August 2003. The table presents for patents assigned to domestic and foreign assignees several characteristics of the patents.

	Domestic		Foreign	
	Litigated	*Not Litigated*	*Litigated*	*Not Litigated*
Claims	31.00	22.73 ***	24.83	14.40 *
Forward citations/year	4.04	2.40 ***	4.07	1.40 ***
Backward citations	19.39	14.78 **	9.83	8.24
Forward cites/year/claim	0.28	0.20 *	0.21	0.16
Backward cites/claim	1.77	1.18 *	0.61	0.96

Note:
*,**, and *** denote significance at the 10%, 5% and 1% significance level

Table 6: "Publicity Effect" on Patent Citation Rates

The sample consists of 2942 financial patents awarded between January 1976 and August 2003.The table reports mean annual forward citations for 6- to 15-year lags after the patent application filing date for the sub-set of awards that were eventually litigated, relative to the litigation date.

Citation Lag (years after patent application filing date)	Annual Citations Among Eventually-Litigated Patents *Not Yet Litigated*	Annual Citations Among Patents Litigated:			
		1-year Previously	*2-years Previously*	*3-years Previously*	*4-years Previously*
6	5.00	2.09	3.09	5.55	3.43
7	4.09	4.64	3.20	3.89	5.82
8	7.50	3.00	7.77	5.25	7.09
9	6.00	5.36	4.40	7.58	2.00
10	7.20	9.20	7.75	4.13	13.75
11	5.33	3.25	10.20	6.22	3.33
12	2.33	11.50	8.50	9.50	4.33
13	6.67	4.67	7.67	3.33	8.33
14	3.00	11.75	7.75	5.67	1.00
15	1.20	16.00	6.00	8.50	0.00
Overall Mean*	4.83	7.15	6.63	5.96	4.91

*Overall mean numbers of annual citations taken over citation lags of 6 through 15 years.

Table 7: Regression Estimates of Number of Lawsuits

The sample consists of 2942 financial patents awarded between January 1976 and August 2003. The dependent variable in the first regression is a dummy variable indicating whether the patent was ever litigated; in the remaining regressions, it is the count of lawsuits involving the patent. The first regression employs a probit specification; the second is a Poisson estimation; and the remainder use negative binomial specifications.

	Dependent variable: Was patent litigated?	*Dependent variable: Number of lawsuits involving firm*					
	Probit	Poisson	Negative Binomial				
Logarithm of number of claims in patent	1.062	1.125	0.976	0.806	0.854	0.621	0.705
	[0.101]***	[0.183]***	[0.184]***	[0.182]***	[0.184]***	[0.198]***	[0.206]***
Log of forward citations per claim	0.668	0.962	0.844	0.704	0.785	0.715	0.824
	[0.118]***	[0.246]***	[0.241]***	[0.237]***	[0.239]***	[0.272]***	[0.289]***
Zero forward citations?	-0.711	-0.177	-0.118	-0.160	-0.138	-0.278	
	[0.731]	[0.912]	[0.891]	[0.885]	[0.889]	[0.889]	
Log of backward citations per claim	0.887	1.047	0.922	0.700	0.709	0.770	0.796
	[0.149]***	[0.295]***	[0.287]***	[0.285]**	[0.287]**	[0.303]**	[0.306]***
Zero backward citations?	-14.189	-14.276	-15.444	-14.675	-16.062	-14.919	
	[863.717]	[1,020.750]	[1,508.425]	[959.875]	[1,936.375]	[1,161.905]	
Share of forward citations that are self-citations	-1.791	-1.420	-0.171	0.076	-0.016	-0.655	-1.278
	[1.616]	[1.413]	[1.004]	[0.947]	[0.963]	[1.257]	[1.219]
Share of backward citations that are self-citations	-0.311	-0.178	0.093	0.162	0.139	0.088	0.085
	[0.404]	[0.416]	[0.286]	[0.281]	[0.278]	[0.510]	[0.426]
Was assignee a public corporation?			-1.092	-0.016	0.094		
			[0.268]***	[0.359]	[0.441]		
Was assignee an individual?			0.428	0.335	0.283		
			[0.282]	[0.284]	[0.280]		
Was assignee based in the United States?			1.309	1.390	1.248		
			[0.387]***	[0.399]***	[0.391]***		
Log of employment in year of award (000s)				-0.573			
				[0.124]***			
Misssing employment data?				-0.186			
				[0.341]			
Log of sales in year of award (millions of 2003 $s)					-0.250		
					[0.073]***		
Missing sales data?					-0.465		
					[0.547]		
Year of award dummy variables	Y	Y	Y	Y	Y	Y	Y
p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	2757	2941	2941	2941	2941	2941	2941

Notes:
Robust standard errors in brackets.
*,**, and *** denote significance at the 10%, 5% and 1% significance level.
The seventh regression is the second stage of a set of equations that controls for probability of no litigation occurring at all.

Table 8: Estimated Litigation Probabilities

The sample consists of 2942 financial patents awarded between January 1976 and August 2003. The dependent variable in the regression in the first row is a dummy variable indicating whether the patent was ever litigated; in the remaining regressions, it is the count of lawsuits involving the patent. The regression in the first row employs a probit specification and the remainder use negative binomial specifications. The first column presents the predicted dependent variable at the means of the continuous variables and with the binary variables coded as zero; the other columns show the change in predicted dependent variable as one variable at a time is shifted.

	At means	+1 Standard Deviation in *Log Claims*	+2 Standard Deviations in *Log Claims*	+1 Standard Deviation in *Log Forward Citations per Claim*	+2 Standard Deviations in *Log Forward Citations per Claim*	+1 Standard Deviation in *Log Backward Citations per Claim*	+2 Standard Deviations in *Log Backward Citations per Claim*
Probability of Litigation (regression #1 in Table 7)	3.22%	8.45%	18.37%	5.57%	9.08%	5.71%	9.49%
Count of Lawsuits (#3)	0.024	0.064	0.170	0.049	0.099	0.040	0.067
Count of Lawsuits (#4)	0.014	0.032	0.076	0.026	0.048	0.022	0.034
Count of Lawsuits (#5)	0.005	0.010	0.021	0.009	0.014	0.007	0.010

	At means	*Patent Holder is a Public Corporation*	*Patent Holder is an Individual*	*Patent Holder is from the United States*	+1 Standard Deviation in *Log Employment*	+2 Standard Deviations in *Log Employment*
Probability of Litigation (regression #1 in Table 7)	3.22%	-	-	-	-	-
Count of Lawsuits (#3)	0.024	-	-	-	-	-
Count of Lawsuits (#4)	0.014	0.005	0.021	0.051	-	-
Count of Lawsuits (#5)	0.005	0.005	0.007	0.020	0.002	0.000

Table 9: Regression Estimates for Litigation Intensity

The sample consists of 2942 financial patents awarded between January 1976 and August 2003. The dependent variable is the count of filings in all lawsuits involving the patent. All regressions employ Tobit specifications.

	Dependent variable: Number of lawsuits involving firm			
	Tobit			
Logarithm of number of claims in patent	253.611	217.638	196.733	200.241
	[37.234]***	[36.742]***	[36.109]***	[36.166]***
Log of forward citations per claim	132.278	116.131	98.600	108.184
	[41.201]***	[40.902]***	[40.800]**	[40.739]***
Zero forward citations?	22.383	6.912	5.720	2.863
	[140.695]	[144.327]	[146.102]	[145.230]
Log of backward citations per claim	284.909	252.231	231.944	228.618
	[52.237]***	[51.074]***	[51.109]***	[50.852]***
Zero backward citations?	-2261.379	-2254.871	-2241.221	-2233.043
	[14490.399]	[9749.142]	[8798.306]	[9032.619]
Share of forward citations that are self-citations	-144.901	-3.578	28.058	17.151
	[225.276]	[132.905]	[130.783]	[130.221]
Share of backward citations that are self-citations	5.834	27.042	40.690	36.589
	[54.521]	[41.425]	[44.194]	[41.247]
Was assignee a public corporation?		246.571	243.371	234.984
		[76.882]***	[78.424]***	[76.193]***
Was assignee an individual?		-29.671	-44.860	-56.751
		[50.894]	[52.851]	[51.193]
Was assignee based in the United States?		-225.985	-35.122	14.706
		[49.876]***	[69.367]	[75.584]
Log of employment in year of award (000s)			-89.986	
			[22.204]***	
Misssing employment data?			-18.262	
			[65.354]	
Log of sales in year of award (millions of 2003 $s)				-41.595
				[12.535]***
Missing sales data?				-30.959
				[93.387]
Year of award dummy variables	Y	Y	Y	Y
p-Value	0.000	0.000	0.000	0.000
Observations	2941	2941	2941	2941

Notes:
Standard errors in brackets.
*,**, and *** denote significance at the 10%, 5% and 1% significance level.