THE PRIVATE AND SOCIAL COSTS OF PATENT TROLLS

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Abstract: In the past, non-practicing entities (NPEs) — firms that license patents without producing goods — have facilitated technology markets and increased rents for small inventors. Is this also true for today's NPEs? Or are they "patent trolls" who opportunistically litigate over software patents with unpredictable boundaries? Using stock market event studies around patent lawsuit filings, we find that NPE lawsuits are associated with half a trillion dollars of lost wealth to defendants from 1990 through 2010, mostly from technology companies. Moreover, very little of this loss represents a transfer to small inventors. Instead, it implies reduced innovation incentives.

Keywords: patent, litigation, litigation cost, non-practicing entities, software patents

JEL Classifications: O31, O34, K41

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Executive Summary

Firms that license patents without producing goods—“ non-practicing entities” (NPEs)—have historically facilitated technology markets and increased the profits that small inventors earn from their inventions.

But a self-described new crop of NPEs has emerged that asserts patents and litigates them on an unprecedented scale, involving thousands of defendants every year in hundreds of lawsuits. Do these litigating NPEs improve markets for technology and increase incentives for small inventors? Or are they “patent trolls” who exploit weaknesses in the patent system?

This paper makes several findings about this litigation. First, by observing what happens to a defendant’s stock price around the filing of a patent lawsuit, we are able to assess the effect of the lawsuit on the firm’s wealth, after taking into account general market trends and random factors affecting the individual stock. We find that NPE lawsuits are associated with half a trillion dollars of lost wealth to defendants from 1990 through 2010. During the last four years the lost wealth has averaged over $80 billion per year. These defendants are mostly technology companies who invest heavily in R&D. To the extent that this litigation represents an unavoidable business cost to technology developers, it reduces the profits that these firms make on their technology investments. That is, these lawsuits substantially reduce their incentives to innovate.

Second, by exploring publicly listed NPEs, we find that very little of this loss of wealth represents a transfer to inventors. This suggests that the loss of incentives to the defendant firms is not matched by an increase in incentives to other inventors.

Third, the characteristics of this litigation are distinctive: it is focused on software and related technologies, it targets firms that have already developed technology, and most of these lawsuits involve multiple large companies as defendants. These characteristics suggest that this litigation exploits weaknesses in the patent system. In our book *Patent Failure*, we argue that patents on software and business methods are litigated much more frequently because they have “fuzzy boundaries.” The scope of these patents is not clear, they are often written in vague language, and technology companies cannot easily find them and understand what they claim. It appears that much of the NPE litigation takes advantages of these weaknesses.

We conclude that the loss of billions of dollars of wealth associated with these lawsuits harms society. While the lawsuits increase incentives to acquire vague, over-reaching patents, they decrease incentives for real innovation overall.

1 Introduction

In 2010, operating companies in the US found themselves in lawsuits initiated by non-practicing entities (NPEs) more than 2,600 times, over five times more often than in 2004 (Patent Freedom 2011). Is this a good thing or a bad thing?

NPEs are firms that do not produce goods, rather they acquire patents in order to license them to others.[1] In principle, NPEs can perform the socially valuable function of facilitating markets for technology. Some inventors lack the resources and expertise needed to successfully license their technologies or, if necessary, to enforce their patents. NPEs provide a way for these inventors to earn rents that they might not otherwise realize, thus providing them with greater incentives to innovate. For example, economic historians find evidence of a robust market for technology during the nineteenth century that allowed individual inventors to earn returns on their inventions in the era before the rise of the large R&D laboratories (Lamoreaux and Sokoloff 1999).[2] Optimists argue that the current crop of NPEs perform a similar function and should not be discouraged (Hosie 2008, McDonough 2006, Shrestha 2010, Myhrvold 2010, Morgan 2008).

On the other hand, the recent surge in NPE-related litigation may be more insidious. Critics, including many technology firms, compare these NPEs to the mythical trolls who hide under bridges built by other people, unexpectedly popping up to demand payment of tolls (see, for example, Temple 2011). The critics call these NPEs "patent trolls," claiming that they buy up vaguely worded patents that can be construed to cover established technologies and use them opportunistically to extract licensing fees from the real innovators. Indeed, there has been a general and dramatic rise in patent litigation that some analysts attribute to rapid growth in the number of patents with unclear or unpredictable boundaries (Bessen and Meurer 2008, FTC

1A wide variety of non-practicing firms engage in patent markets including patent brokers, consultants, auctioneers, and more (see Yanagisawa and Guellec 2009 for an overview). Our focus is on non-practicing firms that assert and litigate patents.

2 See also Magliocca (2007) about less socially beneficial activities of nineteenth century NPEs.

2011). To the extent that the recent NPEs opportunistically assert "fuzzy patents" against real technology firms, they can decrease the incentives for these firms to innovate. Innovators deciding to invest in new technology have to consider the risk of inadvertent infringement as a cost of doing business. This risk reduces the rents they can expect to earn on their investment and hence decreases their willingness to invest..

Using empirical evidence, this paper investigates the effect of the current crop of NPE litigation on innovation incentives and on social welfare. We begin by estimating the private losses to publicly listed companies who are defendants in NPE patent litigation by measuring the reaction of the defendant firm's share price during the days following the filing of the lawsuit.[3] Using a database of patent lawsuits collected by Patent Freedom (2011), we perform 4,114 of these event studies from 1990 through 2010. In theory, investors respond to the news of a lawsuit filing by reducing their expectations of future earnings for the defendant firm. This reduction should reflect all the costs the firm faces from the suit, including lost business, fees paid to settle the case, etc., depending on how investors expect the suit to be resolved. Investors also consider the loss or delay of profits from future opportunities. The total change in expected profits is reflected by a drop in the share price.

Of course, other events also affect the share price on any given day, including events that affect the market generally and idiosyncratic events that affect the firm being studied. We use standard methods to control for the effect of the market and we average over a large number of lawsuits to filter out random idiosyncratic price changes. This allows us to estimate the average percentage change in the defendant's stock price for each lawsuit filing and the change in market capitalization of outstanding common stock. Aggregating the change in market capitalization over two decades, we find that the aggregate loss of wealth to these firms exceeds half a trillion dollars. Over the last four years, the loss of wealth exceeds $83 billion per year.

3 In this paper, we use the term "defendant" to refer to the firm against which the NPE is asserting a patent. In some cases, this firm will technically be the plaintiff in a legal action seeking a declaratory judgment.

This private loss might seem surprisingly large, but it does not necessarily mean that this litigation harms society. The effect on society depends on two considerations. First, there is a static effect on net social welfare. To the extent that litigation involves socially wasteful activity, such as a diversion of firm resources from production to litigation support, it reduces social welfare. Such activity implies a "deadweight" loss. On the other hand, to the extent that the losses just represent transfers of wealth from one party to another — perhaps from large defendants to independent inventors — then the static effect on social welfare could be neutral.

Second, there is a dynamic effect: this litigation could increase or decrease innovation incentives overall, thus affecting future social welfare. The large private losses seem to imply a disincentive for the defendants, who are largely technology firms after all. But perhaps transfers to the patent holders constitute a positive incentive to them that more than compensates for the disincentives imposed on the defendant firms. Then the dynamic effect could be to increase innovation incentives overall.

Some general evidence leans against such an optimistic evaluation. The literature on litigation commonly finds that the loss of wealth experienced by defendants is, in fact, largely a deadweight social loss; little of it flows to the plaintiffs (Bhagat and Romano 2002). Moreover, the large magnitude of lost wealth in these patent cases seems hard to reconcile with a story of transfers to independent inventors — in recent years the losses comprise a significant fraction of total US R&D spending. If these losses were offset by massive transfers to independent inventors, we think we would have heard or read reports documenting this bonanza and a corresponding surge in research activities by small inventors. There is little evidence that NPE litigation has produced massive transfers to independent – or any other sort of – inventor.

Nevertheless it is helpful to look specifically at evidence of the wealth actually transferred to NPEs and to inventors as a result of NPE litigation. Using the financial statements of publicly listed NPE firms, we obtain upper bound estimates on these transfers. We find that

relatively little of the wealth lost by defendant firms shows up as a transfer to NPEs and relatively little of the funds flowing to NPEs is transferred to outside inventors.

These findings allow us to draw some conclusions about the effect of the recent surge in NPE litigation on markets for technology, how the current crop of NPEs are different from those in the past, and how this affects innovation incentives.

1.1 Literature Review

Various sorts of NPEs have long played an important role in technology markets (see Arora et al. 2004). For example, Arora (1997) documents the pivotal role that specialized engineering firms play in the refining and petrochemical industries by licensing their technology. Several commentators have argued that today's NPEs play a similar role in facilitating markets (McDonough 2006, Hosie 2008, Morgan 2008, Myhrvold 2010). It is crucial to note, however, that the firms studied by Arora provided valuable technological information as well as patent and trade secret licenses to licensees. It appears that the current crop of NPEs usually offers naked patent licenses after the technology in question has already been developed (FTC 2011). Little empirical evidence has been advanced to show whether today's NPEs are providing enhanced incentives to small inventors or whether NPE litigation is inhibiting innovation.

What evidence we have supports the view that today's NPE are different from the specialized engineering firms operating in chemical industries. Consider the following distinctive aspects of current NPE litigation:

1. The scale of litigation. While Ball and Kesan (2008) show that NPEs accounted for only about 5% of patent litigation in 2000-2002, Chien finds (2009) that NPEs account for 17% of high tech patent lawsuits. Patent Freedom (2011) finds that NPEs account for 16% of all patent lawsuits in 2009. This amounts to hundreds of lawsuits per year.

2. Many of these lawsuits involve multiple defendants (Chien 2009), making the effective impact greater. The lawsuits involve thousands of defendants per year.
3. Much of this litigation concerns software patents, including business process patents. Chien finds that 90% of the high tech lawsuits involve software or finance patents. Allison et al. (2010) study patents litigated multiple times and find that software patents account for 94% of the lawsuits.
4. These lawsuits tend to happen long after the initial patent application. Allison et al. (2009) find that the patents in these lawsuits are much more likely to have multiple continuing applications, allowing for claims to be modified long after the initial application. Risch (2012) finds that the mean NPE lawsuit occurs 8 years after the patent was issued.[4] The long delays suggest that in many cases these patents are not asserted until other firms actually develop the technology.

These findings suggest that today's NPEs are distinct in some ways, however, that does not really tell us much about their effect on innovation. Shrestha (2010) compares the characteristics of patents in NPE lawsuits to a sample of other patents (see also Allison et al. 2009, Risch 2012, Fischer and Henkel 2011). Finding, for example, that NPE patents receive more citations than other patents, Shrestha concludes that many NPEs hold "high value" patents and are therefore good for innovation.[5] Unfortunately, this conclusion does not logically follow. While it is true that higher value patents tend to receive more citations, this is a rather weak correlation and many factors other than value can influence citations received (Bessen 2008). This correlation does not imply that NPE litigated patents are more valuable just because they have more citations.[6] Moreover, even if these patents are valuable, it is important to remember that the ultimate question is whether or not enforcement of these patents provides a net incentive

4 And this underestimates the lag because it only considers lawsuits filed by 2010.

5 Shrestha also looks at non-self citations and indices of originality and generality.

6 In effect, Shrestha is arguing: A) Valuable patents receive higher citations, and, B) NPE litigated patents receive higher citations, therefore, C) NPE litigated patents are valuable patents. This is a classic logical fallacy.

for innovation.[7] This paper looks at the actual transfer of wealth to inventors from NPE patent litigation.

Shrestha also looks at win rates for those lawsuits that do proceed to a final judgment, finding that NPEs have similar win rates to other patent plaintiffs. Based on this, Shrestha concludes that these lawsuits are not "frivolous." However, this finding is based on a very small sample and the lawsuits that proceed to final judgment are not necessarily representative of all of the lawsuits filed. Moreover, Allison et al. (2010) look at win rates for a larger sample of the most-litigated patents and find that plaintiff win rates are much lower than for other patent litigation. But even so, this does not directly measure how harmful the litigation is to innovation or to social welfare. Using extensive event studies, this paper measures the private losses that result from NPE litigation and relates this to possible social losses.

The event study methodology has been used before to study litigation, beginning with Cutler and Summers (1988) in the context of litigation over a merger. Several papers have performed event studies of patent litigation, both the event of the initial filing and the terminating event (settlement, judgment or verdict), including small sample studies by Bhagat, et al. (1994), Lerner (1995), Bhagat et al. (1998), Lunney (2004), Haslem (2005), and a large sample study by Bessen and Meurer (2007). None of these studies looked specifically at NPE litigation.

2 Data and Methods

2.1 Data Sources

The data for this research comes from two primary sources. The first source is an extensive database of NPE lawsuits generously provided by Patent Freedom, an organization devoted to researching and providing information on NPE behavior and activities. Patent

7 Broad patents that can be credibly asserted against valuable technologies might have enormous private value and at the same time negative social value when they are not disclosed until after the technology was independently developed, and especially when they face a significant risk of invalidity. Such patents might attract a large number of citations, and might also retard innovation.

Freedom defines a non-practicing entities as companies that "do not practice their inventions in products or service, or otherwise derive a substantial portion of their revenues from the sale of products and services in the marketplace. Instead, NPEs seek to derive the majority of their income from the enforcement of patent rights."

The second data source is the Center for Research in Security Prices (CRSP) US Stock Database, a comprehensive collection of security information. Using these sources, a sample comprised of all instances in which a known NPE sued a publicly traded firm between 1990 and October 2010 was constructed. This was done by first matching defendant names with a previously constructed list of public domestic firms and subsidiaries using a software program, and then manually reviewing the resulting list and updating matches that had been either missed by or incorrectly assigned by the software. To assess the validity and coverage of the matches, a random sample of 100 parties was manually checked using corporate websites and CRSP's Company Code Lookup tool. For this sample, while 11% of parties that were either public companies or their subsidiaries were left unmatched, there were no false positives.

This process yielded a sample of 1,630 lawsuits filed by a NPE against one or more publicly listed defendants. Because many of these lawsuits were filed against multiple defendants, the total number of events in the sample was substantially higher than the number of suits, at 4,114 (for the sample using a 5 day window to measure the returns).

Finally, we linked the data in our sample to Compustat and to data from Derwent Litalert to obtain information on firm characteristics and patents involved in the lawsuits. We also used financial information on publicly listed NPEs from Compustat.

2.2 Estimating Cumulative Abnormal Returns

To estimate the impact of a lawsuit filing on the value of a firm, we use event study methodology (see Mackinlay 1997 for a review). In particular, we use the dummy variable

method described by Michael Salinger (1992).[8] This assumes that stock returns follow a market model,

(1) $$r_t = \alpha + \beta r_t^m + \epsilon_t$$

where r_t is the return on a particular stock at time t, r_t^m is the compounded return on a market portfolio, and ϵ_t is a stochastic error. If an event, such as a lawsuit filing, occurs on day T, then there may be an "abnormal return" to the particular stock on that day. This can be captured using a dummy variable,

(2) $$r_t = \alpha + \beta r_t^m + \delta I_t + \epsilon_t$$

where I_t equals 1 if $t=T$ and 0 otherwise. Equation (2) can be estimated using OLS for a single event. In practice, this equation is estimated over the event period and also over a sufficiently long pre-event window. In this paper we use a 200 trading-day pre-event window. The coefficient estimate of δ obtained by this procedure is then an estimate of the abnormal return on this particular stock. For different stocks, the precision of the estimates of δ will vary depending on how well equation (2) fits the data. The estimated coefficient variance from the regression provides a measure of the precision of the estimate of the abnormal return.

We want to obtain a representative estimate of the abnormal returns from lawsuit filings for multiple stocks, under the assumption that these represent independent events and that they share the same underlying "true" mean. Previous papers estimating abnormal returns from patent lawsuits have simply reported unweighted means for the group of firms. Although the unweighted mean is an unbiased estimator, it is not efficient. Since we are concerned with obtaining the best estimate to use in policy calculations (and not just testing the sign of the mean), we use a weighted mean to estimate the "average abnormal return," where the weight for

8 Salinger shows that this model is mathematically equivalent to the OLS market model described in Brown and Warner (1985) and widely used.

each observation is proportional to the inverse of the variance of the estimate of δ for that firm.[9]

When we test our means against the null hypothesis that the true mean is zero, we report both the significance of *t*-tests using the weighted mean and also the significance of the *Z* statistic (see Dodd and Warner 1983), a widely used parametric test of significance that incorporates the variation in precision across events.[10] In any case, the significance test results are closely similar as are those of some non-parametric tests.

Finally, (2) describes the abnormal return for a single day. It is straightforward to design dummy variables to estimate a "cumulative abnormal return" (CAR) over an event window consisting of multiple consecutive days. In the following, for instance, if the suit is filed on date $t=T$, then we may use a window from day T-1 to T+4.

3 Empirical Findings

3.1 Summary statistics

Some characteristics of defendant firms in our sample are reported in Table 1. These are, on average, large firms. Almost two thirds of the firms are technology firms, including software and communications firms, and these firms, on average, spend a lot on R&D and have very substantial intangible assets. A significant number of financial, retail and wholesale firms are also represented. And these firms are typically subject to multiple NPE lawsuits.

Table 2 shows that most of the NPE disputes involve multiple defendants, either in the same suits or from multiple suits filed by the NPE on the same day.[11] The number of publicly listed defendants mostly range between two and nine defendants (median of 5). Only 17% of the defendants were the sole defendant listed. This contrasts sharply with other patent litigation

9 In any case, we find that for our entire sample, the weighted mean is quite close to the unweighted mean and also to the median.

10 The *Z* statistic is a joint test of the individual firm *t*-tests. We use a robust version described in Kramer (2001).

11 The numbers are also high if we restrict the defendants to the same suit filings.

where 85% of defendants are solo (Bessen and Meurer 2007).

Another difference is the distribution of these patents across technology classes. Looking at the main patent listed in Derwent, about 62% of the patents are software patents, using the technology class categorization used in Bessen (2011). Using the NBER categorization (Hall et al. 2001), 75% of the patents are in computer and communications technology. Thus this sample shows the same concentration of NPE litigation in software and related technologies as in earlier studies. Both this technological concentration and the prevalence of multiple defendants are important for interpreting the nature of the current crop of NPEs.

3.2 Estimates of cumulative abnormal returns

Table 3 reports basic estimates of cumulative abnormal returns (CARs) for the sample of NPE defendants. Columns 1 and 2 report the weighted mean (with standard error) and median values. The first row shows the results using a five day event window that starts one day before the lawsuit filing and continues through the fourth day after. The mean loss is 0.32% and the median loss is 0.52%.

The second row reports results for a comparable analysis using a 25 day window. Previous research indicates that the news of a lawsuit sometimes leaks out slowly, especially for small firms (Bessen and Meurer 2007).[12] The results shown in the second row suggest that this does not appear to be the case for the defendants of NPE lawsuits, which are, as noted, mainly large firms. The CARs in this row are only slightly larger than those in the five day window. This also suggests that the initial loss of wealth was not an overreaction by investors that was subsequently corrected, at least not within 25 days. Because the longer window has larger standard errors as a result of the measurement technique, we use the sample with the five day event window for most of the remaining analysis.

12 One might expect that the news of a lawsuit would be important to arbitragers and so they would find out the information without a public announcement. However, for stocks with little float and wide bid-ask gaps, arbitrage might not be sufficiently profitable to invest in obtaining the information quickly.

These CARs are substantially smaller than those found in the study of all patent lawsuits involving publicly listed firms from 1984 to 1999 by Bessen and Meurer (2007). The third row shows the CARs for defendant firms from that study and the fourth row shows the CARs from solo defendant firms in that study. We parse out the results in the fourth row to provide the most relevant comparison to the NPE lawsuits in this study. Most NPE lawsuits in our current study have multiple defendants (83%). Most of the lawsuits in our earlier studied involved a single defendant (85%); we suspect that almost all of those lawsuits do not involve an NPE plaintiff. The mean CAR for all single-defendant lawsuits is nearly twice as large as the mean CAR reported for the five day window in the NPE sample. This difference is also statistically significant.[13]

The NPE CARs are also much smaller than those reported in the previous literature on patent litigation event studies. For example, Bhagat et al. (1998) study 33 defendants of patent lawsuits announced in the Wall Street Journal. They find a mean CAR of -1.50%, nearly five times larger than the estimate here. Studying 26 biotech firms, Lerner (1995) found a 2.0% reduction in the wealth of the defendants and plaintiffs combined.

3.3 Why do NPE lawsuits cause smaller percentage losses?

One clear reason that the NPE lawsuits have lower CARs than in previous studies is that the sample of defendants in the NPE lawsuits is very different from the samples in the earlier studies. Some of those studies found much larger losses but used highly select small samples of lawsuits that had been announced in the Wall Street Journal or Dow Jones News Service. Bessen and Meurer (2007) show that patent lawsuits announced in the Wall Street Journal tended to involve companies with greater capital per employee and higher stock market betas. These factors might be directly related to larger percentage losses on the announcement of a lawsuit.

13 Using one-tailed t-tests, allowing unequal variances between the sub-groups and calculating the degrees of freedom using Satterthwaite's approximation (1946), P = .070.

The large sample of lawsuits involving publicly listed firms in Bessen and Meurer (2007) were not necessarily announced, but these, too, show larger percentage losses than in the current sample of NPE lawsuits, although not so much larger. The NPE sample differs from that sample in two important ways: NPE lawsuits tend to involve larger defendants and multiple defendants.

Although larger defendants tend to have smaller CARs (Bessen and Meurer 2007), size related differences cannot directly explain much of the difference in the CARs between the samples. The difference in the CARs between small and large firms is simply not large enough to account for the difference in the NPE sample and these small firms only make up 14% of the NPE sample in any case.[14]

Nevertheless, the large size of the defendants in the NPE lawsuits and the fact that so many of these lawsuits involve multiple defendants changes the economics of litigation in an important way: in these circumstances, litigation might still be credible for plaintiffs who have a low probability of winning. A lawsuit only poses a credible threat if the plaintiff's expected gains from winning exceed the costs of prosecution. The expected gains are the ex ante probability of winning times the conditional benefits of winning. Normally, a lawsuit with a low probability of winning does not pose a credible threat. However, when a patent has a chance of being interpreted broadly so that it reads on the business of multiple large companies, the payoff to winning might be so large that the threat of a lawsuit is credible even if the probability of winning is low.

This provides another possible explanation for lower percentage losses found in NPE lawsuits: the plaintiffs in a substantial portion of NPE lawsuits might have low probabilities of winning at court, hence these lawsuits will cause smaller losses to defendants, all else equal. Because many of these suits might involve aggressive interpretations of patent scope, allowing the claims to read on many defendants, they might have lower probabilities of winning, but still

14 In an unreported result from the 2008 study, the mean CAR for solo defendants that had more than 500 employees was -.56% (.18%), just slightly smaller than the return listed in the fourth row of Table 3.

provide credible threats because of the multiple defendants. This explanation is supported by Allison et al. (2011) who find that NPE suits with multiple defendants are more likely to settle and when they do go to trial, the plaintiffs are much more likely to lose (but see Shrestha 2010). This explanation is thus plausible, however, our evidence for it is not conclusive.

3.4 Loss of wealth

Nevertheless, just because the percentage loss of defendant firms is smaller in NPE lawsuits, this does not imply that the loss of wealth is small. Using the CAR estimates, we can calculate the loss of wealth that occurs upon a lawsuit filing. Columns 4 and 5 of Table 3 show the mean and median loss of wealth calculated by multiplying the mean CAR by each firm's capitalization.[15] The mean wealth lost per lawsuit is $122 million in 2010 dollars and the median loss is $20.4 million. These figures are substantially higher than the previous estimates for patent lawsuits of all types found by Bessen and Meurer (2007), shown in row 3. These estimates are, of course, much larger than the direct costs of legal fees. They also include the costs of lost business, management distraction and diversion of productive resources that might result from the lawsuit, possible payments needed to settle the suit, and the reduction in expectations of profits from future opportunities that are forestalled or foreclosed because of the suit.

Investors' expectation of future profits are notoriously volatile. To the extent that one might want to gauge the effect of the lawsuits on current profits while excluding expectations about future profits, it is possible to make some crude adjustments to the above figures. One method is to divide the estimated loss of wealth by the ratio of the market capitalization of the

15 We could, alternatively, calculate the average by summing the estimated loss from each suit, however, that procedure would provide a less efficient estimate. This alternative estimator is $\frac{1}{N}\sum_{i=1}^{N}(r+e_i)\,x_i$ where N is the number of firms, r is the true CAR, e is the error in measuring the ith firm's CAR, and x is the ith firm's market capitalization. The estimator we use is $\frac{1}{N}\left(r+\frac{\sum_{i=1}^{N}e_i}{N}\right)\sum_{i=1}^{N}x_i$. It is straightforward to show that both are unbiased but that the latter has smaller variance assuming that e and x are uncorrelated.

firm's common stock divided by the value of the firm's capital assets.[16] This reduces the mean wealth lost to $112 million in 2010 dollars. Alternatively, the loss can be divided by the ratio of the total market value of the firm to the value of the firm's capital assets, reducing the mean loss to $64 million in 2010 dollars. These figures are also quite substantial and, although investors' expectations of future profits might occasionally be "exuberant," our basic estimate nevertheless captures the actual loss of wealth related to the lawsuit.

Thus although the NPE CARs are lower than the CARs for other lawsuits, the mean loss per lawsuit is larger because the market capitalization of the NPE defendants is that much larger. This, combined with the tendency of NPE lawsuits to involve multiple defendants means that these suits have an outsized impact on firm wealth. Aggregating over the sample (column 6), shows that NPE lawsuits from 1990 through October 2010 are responsible for over half a trillion dollars in lost wealth (in 2010 dollars). From 2007 through October 2010, the losses average over $83 billion per year in 2010 dollars, over a quarter of US industrial R&D spending per annum. Moreover, because this total is only for publicly listed firms, it likely understates the true loss of wealth resulting from NPE lawsuits.

Whatever the theoretical and historical role of NPEs might be in facilitating markets for technology, it is clear that the current crop of NPE litigation is responsible for an unprecedented loss of wealth. The next section looks at whether this private loss of wealth to the defendants is also a loss to society or not.

3.5 Transfers

As discussed in the Introduction, these private losses might or might not correspond to social losses. Litigation incurs static social losses when it involves socially wasteful activity. Aside

16 For the capital assets, we use the inflation-adjusted value of the aggregate sum of accounting assets and R&D. For details on the computation of these quantities, see Bessen (2009). This adjustment implicitly gives the amount of investment that would be needed to restore the firm to its value before the lawsuit. The alternative calculation assumes that the lawsuit does not reduce the market value of the firm aside from the firm's common stock.

from direct legal fees, litigation often involves a diversion of management resources away from productive activity. It may also involve a loss of consumer welfare. For example, preliminary injunctions can shut down production and sales while the litigation pends. Even without a preliminary injunction, customers may stop buying a product. And the threat of final injunction might require the defendant to drastically rework its product or even abandon it. Frequently, products require customers to make complementary investments; they may not be willing to make these investments if a lawsuit poses some risk that the product will be withdrawn from the market. Furthermore, patent owners can threaten customers and suppliers with patent lawsuits because patent infringement extends to every party who makes, uses, or sells a patented technology without permission, and sometimes to those who participate indirectly in the infringement. And the business costs of patent litigation can be large even for those who ultimately win the lawsuits. For example, in the 1990s Cyrix introduced a new class of Intel-compatible microprocessors. Intel sued for patent infringement, but ultimately lost the suit. Nevertheless, while the suit progressed for a year and a half, Cyrix had difficulty selling these microprocessors to computer manufacturers, who were also customers of Intel. Cyrix's private loss was a loss to society as well.

On the other hand, if the private losses arise from transfers of wealth to other parties, they might not incur a static loss of social welfare. When defendants pay legal judgments or licensing royalties to NPEs, the private loss to the defendant is not socially wasteful. To what extent do the half trillion dollars in private losses correspond to such transfers?

To explore transfers to NPEs and, in turn, transfers from NPEs to independent inventors, we assembled a list of NPE firms in our database that are publicly listed. We identified 14 firms (see list in the Appendix). These firms account for 574 litigation events in our data, about 14% of the total. The aggregate losses to the defendants in these lawsuits from 2000 through October 2010 total $87.6 billion in 2010 dollars, about 17% of the total in our database.

How much of this loss represents a transfer to the NPEs? Table 4 shows the cumulative flow of several financial variables over this same time period. Total revenues over these years come to $7.6 billion, about 9% of the total loss to defendants. Revenues necessarily overstate any transfers from the defendants to the NPEs because they also include revenues from firms that are not involved in litigation and from private firms. Nevertheless, it is quite clear that most of the defendants' private loss is not a transfer to NPEs.

Another possible transfer occurs to the defendant's competitors. To the extent that patent litigation causes customers to select a rival product or service, some of the lost business captured in the above calculations represents a transfer to rival firms. Of course, because the NPEs sue multiple parties, it happens frequently that a firm *and* its rivals are sued at the same time, so that no such transfer would occur. This provides us a simple test of the magnitude of potential transfers to rivals: if such transfers are substantial, we should see smaller CARs when a firm and its rival are sued than in cases where rivals are not sued. We identified 1,914 events (47% of the events) where a firm was sued along with another firm in the same SIC 3-digit industry. However, the CARs for these events were slightly higher than in those cases where a rival firm was not also sued.[17] Thus this test is inconsistent with substantial transfers to rivals.

Another transfer occurs to the lawyers, expert witnesses, etc. involved in lawsuits. Estimates of legal costs from Bessen and Meurer (2007) suggest that these transfers cannot be more than a few percent of the loss.

We also conducted event studies of the NPE stocks around the lawsuit filings. The NPE stocks also lost wealth around the lawsuit filings.[18] Although other factors might cause a drop in the plaintiffs' market capitalizations (Bessen and Meurer 2007), this evidence is not consistent with large transfers of wealth to the NPEs.

17 The difference was 0.02% with a standard error of 0.17%.

18 The mean CAR was -5.2% with a standard error of 3.1%, significantly different from zero at P = .064. A loss to plaintiffs is frequently observed in the litigation literature.

In summary, while there are some limited transfers to NPEs and to rivals and lawyers, most of the private losses incurred by defendants in NPE litigation do not appear to be transfers to other parties; presumably, most of the losses correspond to static losses of social welfare.

Of course, NPE litigation might also produce dynamic gains in social welfare if transfers to independent inventors increase innovation incentives. How much of the transfer to NPEs is subsequently transferred to inventors outside of the NPEs? The investment that NPEs make in acquiring patents is included in the accounting category "net cash flow to investing activities." This figure less capital expenditures is shown in Table 4. Although this figure includes other investments in addition to payments to outside inventors, it is small compared to the defendants' losses: $1.7 billion, or about 2% of the defendants' losses. The investments made in patents are also included in the NPE's intangible assets, although these quantities are amortized. The table also reports intangible assets for fiscal 2010. It is less than $600 million, about 1% of the defendants' losses. Note again that both the intangible assets and the net cash flow to investing activities generate revenues from sources other than our defendants, so these figures might overstate transfers to independent inventors. In any case, we can state that less than 2% of the defendants' losses could represent a transfer to independent inventors and quite possibly the true figure is much smaller than 2%.[19]

Some of the NPEs also conduct their own R&D. Indeed, capitalized R&D investments are included in the intangible assets of the firm. The R&D expense flows are also not large, around 2% of the loss.

It is likely that the R&D investments and acquisitions from outside inventors will yield value to the NPE firms beyond 2010. To the extent that this is true, all of these figures overstate the extent to which these investments are tied to the defendant losses occurring through 2010. That is, some portion of these investments is related to defendant losses that will be incurred

19 Risch (2012) also finds evidence that NPE litigation does not help inventors raise funds from venture capitalists either.

after 2010, so only a portion of the investment can be attributed to a transfer of wealth from the pre-2011 defendants.

Although the transfer to inventors are small, it is still positive. Does this mean that NPE litigation nevertheless increases innovation incentives? There are three reasons to conclude that it does not. First and foremost, the losses to technology firms who are defendants in this litigation are two orders of magnitude larger. These losses imply a very large disincentive to innovation for these firms, firms that spend heavily on R&D. Studies show that the more a firm spends on R&D, the more it is likely to be sued (Bessen and Meurer 2005). Moreover, very rarely are the defendants in these lawsuits found to have actually copied the patented technology (Bessen and Meurer 2008, p. 126, Cotropia and Lemley 2009). Instead, they are inadvertent infringers, if infringers at all. This means that they have to anticipate the risk of future lawsuit-related losses as part of their cost of developing new technology and products. This risk is a disincentive to invest in innovation, and our results find that it is a very large disincentive, much larger than any possible incentives provided by transfers to independent inventors via NPEs.

Second, to the extent that independent inventors benefit by licensing or selling their inventions to large firms, this risk of inadvertent infringement reduces *their* innovation incentives as well. Because their prospective licensees have to anticipate the risk of an NPE lawsuit, this risk decreases the amount licensees are willing to pay. Thus the very large losses incurred by defendants tend to reduce the market for technology for independent inventors.

Finally, the incentives provided to patent holders by the current crop of NPEs may be the wrong kind of incentives. The extensive litigation may encourage incentives to obtain patents, especially overly broad and vague patents, rather than incentives to actually innovate.

To summarize, there are a lot of big losers from NPE litigation, while hardly anyone benefits much. The defendant firms and their customers lose while patent holders gain very little by comparison. Even the investors in NPE firms have gained little—these firms barely break

even based on their cumulative net income in Table 4. Apparently, the only real beneficiaries are the lawyers and perhaps the principals of the NPE firms.

4 The New Business Model

These findings should be interpreted cautiously. While there are large losses from NPE litigation, not all NPEs today are opportunistic litigators. Nor does this imply that NPEs have not played a more positive role in the past. It is important to understand what is uniquely different about the NPEs who are behind today's litigation surge.

Indeed, today's NPEs tell us they are different. Proponents tell us they are a new breed of company, a new business model, that is misunderstood (McDonough 2006, Myhrvold 2010). They tell us that NPEs are, in fact, good for society because they are creating "a capital market for invention" by buying patents and selling licenses. This helps "turbocharge technological progress" "by realigning market participant incentives, making patents more liquid, and clearing the patent market."

What, exactly, is new about this business model and what does it mean for innovation? Markets for technology have been around at least since the nineteenth century and studies have documented some of the benefits of these markets (for example, Arora et al. 2004): they allow inventors a way of getting money for their inventions, thus providing them with stronger incentives to invent, and they help spread new technologies to the companies who can commercialize them the best. But most of this literature concerns markets for *technology*, not markets for *patents*. The transactions occurring around NPE litigation do not involve the transfer of technology—the defendants are already using the technology. Instead, these transactions involve just the transfer of patent rights (and money).

Even so, some advocates hold that NPEs are socially beneficial because they reduce the costs of patent transactions (McDonough 2006). To the extent that NPEs facilitate the clearance

of patent rights before firms invest in technology this is a clear benefit. The patent brokers and auctions facilitate transactions, but that is not obviously true for those NPEs who are primarily involved in asserting and litigating patents. Moreover, to the extent that these NPE transactions occur only *after* firms invest in technology, any savings in transaction costs has to be offset by the associated dispute costs. We have shown that the litigation losses amount to over half a trillion dollars, so these dispute costs are substantial. No reasonable estimate of the transaction costs of licensing these patents could approach the magnitude of these litigation losses.

Some proponents of NPEs argue that the threat of patent litigation has been exaggerated. Myhrvold (2006) asserts "there is no 'crisis' or 'explosion' in patent litigation" generally and that NPE litigation is not very significant. Indeed, one study covering the years 2000 – 2002 found that NPE litigation accounted for only five percent of total patent litigation. But litigation rates have risen dramatically since the mid-1990s and NPE litigation rates have grown even faster. More recent studies find that NPE litigation accounts for 16-17% of all patent lawsuits (Chien 2009; see also Patent Freedom 2011).

Although this percentage is not very large (it corresponds to several hundred lawsuits per year), it is a mistake to conclude that NPE litigation is not important. First, because NPE lawsuits involve multiple defendants, their impact is much larger and because of this, the estimates of lost wealth are large. Second, as noted above, NPE lawsuits are concentrated in one technology area, namely, software and software-related patents including business methods. Consequently, this litigation has a disproportionately large effect on firms working with these technologies. A thumbnail calculation suggests that NPEs account for about 41% of patent litigation involving software patents.[20] So NPE litigation is quite significant for this technology.

Thus the new business model for NPEs is not about licensing patents in general; it is

20 From Bessen (2011), about 26% of patent lawsuits involve software patents. If 17% of lawsuits involve NPEs and if 62% of NPE lawsuits involve software patents (Table 2) then .17 x .62 / .26 = 41% of software patent lawsuits are filed by NPEs.

mainly about licensing *software* patents, including patents on business and financial processes. This is significant because we have argued elsewhere that software patent litigation has risen dramatically because of eroding patent notice and that software patents have been an important contributor to this trend (Bessen and Meurer 2008). That is, software patents have "fuzzy boundaries": they have unpredictable claim interpretation and unclear scope, lax enablement and obviousness standards make the validity of many of these patents questionable, and the huge number of software patents granted makes thorough search to clear rights infeasible, especially when the patent applicants hide claims for many years by filing continuations. This gives rise to many situations where technology firms inadvertently infringe. And this means that there is a business opportunity based on acquiring patents that can be arguably read to cover existing technologies and asserting those patents, litigating if necessary in order to obtain a licensing agreement. Models by Reitzig et al. (2007) and Turner (2011) show that the patent troll business model only makes economic sense when there is such inadvertent infringement. And the rise in NPE litigation has closely mirrored the rise in software patent litigation (Bessen 2011). Moreover, fuzzy boundaries can explain why so many NPE lawsuits have multiple defendants: many firms may have reasonably concluded that they did not infringe or the patents were invalid or they may have been unable to find these patents while conducting a clearance search. Later, they encounter an NPE who sues over an aggressively broad interpretation of the patent's scope and validity.

Thus the rise of this new business model can be explained by the rise of "fuzzy boundaries" for software and other patents. Large numbers of hidden patents or patents with unpredictable boundaries provide an opportunity to extract rents from technology firms. But this is a very different business from the business pursued by those patent brokers, consultants and auctioneers who facilitate markets for technology.

5 Conclusion

Firms that buy and license technologies can improve the market for technology and thus improve the innovation incentives for independent inventors. Patent agents and markets for technology have been an important part of the US innovation system since the nineteenth century.

But the role of the current NPEs who assert and litigate patents is something altogether different: it is focused on software and related technologies, it targets firms that have already developed technology, and it is very much about litigation, especially litigation in the special circumstances where multiple large parties can be sued at once. Whatever the general benefits of technology markets, this does not obscure the fact that this particular manifestation involves large amounts of costly litigation. It is hard to believe that markets can be somehow improved by having thousands of lawsuits that incur hundreds of billions of dollars in losses.

We have shown that defendants have lost over half a trillion dollars in wealth—over $83 billion per year during recent years—and this has not improved incentives to innovate. While the lawsuits might increase incentives to acquire vague, over-reaching patents, they do not increase incentives for real innovation. The defendants in these lawsuits are firms that already invest a lot in innovation. Their losses make it more expensive for them to continue to do so and it also makes them less willing to license new technologies from small inventors. Meanwhile, independent inventors benefit very little from what the large companies lose.

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Tables and Figures

Table 1. Summary Statistics of Defendant Firms
(Millions of $2010)

	Mean	Median
Revenue	$34,487	$13,232
R&D spending	$1,779	$531
Intangible assets	$9,792	$1,269
Employees (1000s)	9.4	3.6
NPE lawsuits per firm (1990-2010)	26.1	12
Industry (2 digit SIC code)		
Electronics (36)	22%	
Machinery & computer equipment (35)	15%	
Retail/wholesale (50-59)	15%	
Software (73)	14%	
Communications (48)	9%	
Financial services (60-67)	8%	

Means of firm characteristics are over 3,821 firm-events.

Table 2. Summary Characteristics of Lawsuits

	Mean	Median
No. of publicly listed defendants	15.3	5
Sole defendant	17%	
In litigation with 10 or more defendants	32%	
Software patent	62%	
Patent Technology Classes (NBER)		
Chemical	1%	
Computers & communications	75%	
Drugs & medical	1%	
Electrical & electronics	12%	
Mechanical	4%	
Other	8%	

Note: The number of defendants in the lawsuits are for all lawsuits filed by the same NPE on the same day. Patent characteristics are for a sub-sample matched to Derwent Litalert and are for the first patent listed in the suit. The categorization of software patents is described in Bessen (2011). We have adapted the NBER technology classes (Hall et al. 2001) to the current technology class system adding classes 398, 715, 717, 725 and 726 to the computers and communications category.

Table 3. Cumulative Abnormal Returns (CARs) of Defendants in NPE Litigation

	Cumulative Abnormal Returns			Loss of common stock value (millions of $2010)			
Sample	Mean	Median	Robust Z statistic	Mean	Median	Aggregate	N
	(1)	(2)	(3)	(4)	(5)	(6)	
5 day event window							
All NPE suits	-0.32% (0.08%)**	-0.52%	-4.01**	$122.0	$20.4	$501,775	4,114
25 day event window							
All NPE suits	-0.37% (0.14%)**	-0.71%	-2.04*	$140.6	$23.6	$579,217	4,119
All patent litigation 1984–99 (Bessen and Meurer 2007)							
All suits	-0.50% (0.16%)**	-0.51%	-3.24**	$75.9	$6.5		2,887
Single defendants	-0.61% (0.18%)**	-0.54%	-2.94**				2,460

Note: Standard errors in parentheses. Single asterisk indicates statistical significance at the 5% level; double asterisk indicates 1% significance. Average cumulative abnormal returns (CARs) are weighted means, with weights proportional to the inverse of the estimated variance of each return. Event window is 5 days (T-1 to T+4) or 25 days (T-1 to T+24). Cumulative abnormal returns are estimated using OLS. The robust *Z* statistic is a joint test of the individual firm *t* statistics (Kramer 2001).

Table 4. Wealth Transfer for Publicly Listed NPEs

	Millions of $2010	As share of Defendants' Losses
Cumulative for 14 NPEs, 2000-2010		
Revenues	$7,639	9%
Net cash flow to investing activities less capital expenditures	$1,697	2%
R&D expense	$2,039	2%
Net income	$258	0%
Combined stock for 14 NPEs, 2010		
Intangible assets	$562	1%
Defendant firms		
Loss of wealth	$87,574	100%

Appendix. Public NPE firms

Acacia Technologies
Asure Software
Burst.com Inc
Decisioning.com Inc
Interdigital
Intertrust Technologies Corp
LecTec Corp
Mosaid Technologies Inc
Network-1 Security Solutions Inc
OPTi Inc
Rambus
Tessera Technologies Inc
VirnetX Inc
Wi-Lan