Do Patent Trolls Exist? Examining the Economic Impact of Non-Practicing Entities and Patent Infringement Litigation on Innovation

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DO PATENT TROLLS EXIST?

EXAMINING THE ECONOMIC IMPACT OF NON-PRACTICING ENTITIES AND PATENT INFRINGEMENT LITIGATION ON INNOVATION

by

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Submitted in partial fulfillment

of graduation requirements for the degree of

Bachelor of Arts

Boston College

International Studies Program

May 2012

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Abstract

Non-practicing entities (NPEs) – firms that do not produce goods or services but license to and sue other companies with portfolios of patents – have drastically increased patent infringement litigation since 2006. Over the same period, the USPTO has granted an increasing amount of patents, indicating that American innovation has strengthened by one measure. This paper finds fault with equating patents granted to innovation and develops a new metric of innovation – the ratio of a firm's intangible to total assets. Through empirical analysis this study concludes that lawsuits initiated by NPEs between 2006 and 2011 do not affect the rate of American innovation. However, this study also finds that NPEs inflict at least a $567 million *innovation cost* to the top twenty-five most litigated against firms in the United States. This cost represents money that could be allocated towards research and development or investment, but it is not a dead-weight loss – it is the cost associated with firms' growth measured in inflation-adjusted total assets. Ultimately, this study highlights the need for continued research into the impact of NPEs on the American economy but provides empirical evidence that the *patent troll* classification is unwarranted.

TABLE OF CONTENTS:

ACKNOWLEDGEMENTS i
TABLE OF CONTENTS ii

I. INTRODUCTION. 1
II. BACKGROUND 4
1. PATENTS STIMULATE INNOVATION 4
2. SYSTEMIC INEFFICIENCIES 4
i. Tragedy of the Anticommons 4
ii. Patent Thicket 5
3. A BRIEF HISTORY OF PATENT TROLLS SINCE 200 6
4. HISTORY OF PATENT INFRINGEMENT LITIGATION 10
5. TRENDS IN INFRINGEMENT INDUSTRIES 11
6. PORTFOLIO OF PATENTS 14
7. FILING LOCATION OF PATENT INFRINGEMENT CASES 19
8. NPES ATTRACT VALUABLE HUMAN CAPITAL 21
9. YAHOO! V. FACEBOOK, A RECENT CASE 22
10. USPTO AND NEW LEGISLATION 24
11. HOW AIA AFFECTS NPES 26
III. LITERATURE REVIEW. 27
1. EMPIRICAL FINDINGS 27
i. A Market for Patents is Not New 28
ii. Descriptive Empirical Results 28
a. Who do NPEs Sue? 30
b. Timing in Term Length of Patent Litigation 30
iii. Empirical Study: Shrestha (2010) 31
iv. Empirical Study: Bessen (2011) 35
a. NPE Litigation Effect on Stock Prices 35
b. Limitations 36
c. Dead Weight Loss? 37
v. An Additional Recent Study 38
2. CONCLUSION 39
IV. METHODOLOGY. 40
1. PATENTS AS A METRICS FOR INNOVATION 40
2. OTHER METRICS 42
3. INTANGIBLE ASSETS 42
4. RATIOS 43
5. OTHER DATA 43
V. DATA. 44
1. PATENT GRANTS PER COMPANY 44
i. Definition 44
ii. Limitations 45
2. NPE LAWSUITS PER COMPANY 47

i. Definition 47
ii. Limitations 48
3. RATIO PER COMPANY 48
i. Definition 48
ii. Descriptive Statistics 49
iii. Limitations 51
4. SUMMARY STATISTICS 52
VI. ANALYSIS. 54
1. INTRODUCTION 54
2. ANALYSIS 1 55
i. Regression Results 55
ii. Estimates of Model 58
iii. Limitations 60
3. ANALYSIS 2 61
i. Regression Results 62
ii. Limitations 63
VII. CONCLUSION 64

APPENDIX 67
WORKS CITED. 73

I. Introduction

The number of utility patents granted by the United States Patent & Trademark Office in 2011 was an all-time high. The USPTO granted 224,505 utility patents out of 503,582 applications, indicating that innovation has increased, at least by one metric (USPTO 2012a). At the same time, however, 2011 marked an all-time high for times in which a company was a defendant in patent litigation with a non-practicing entity (PatentFreedom 2012c). Firms labeled non-practicing entities (also sometimes referred to as patent assertion entities, but hereafter referred to as NPEs) do not produce goods or services. Instead, they profit by maintaining a portfolio of patents as their main asset. Unlike other firms that also have large numbers of patents, NPEs are distinguished because they mainly license patents to and initiate litigation against other firms that infringe upon their patents.

NPEs are often successful because they are not vulnerable to counter patent-assertion litigation by the firms they sue. They buy patents and occasionally invent and apply for grants themselves, then earn revenue by licensing their patent to practicing entities (firms that *do* produce goods and services). The latter firm uses the information contained in the patent to create a product or service to serve as their revenue stream. This system only works, however, if NPEs can extract an appropriate licensing fee for their patent. In many cases, firms infringe upon existing patents knowingly and unknowingly, and NPEs sue for patent infringement. These patent litigation suits can cost both the plaintiff and defendant millions of dollars over the course of multiple years, causing many firms to settle even if they stand a good chance of winning the lawsuit.

Specifically, NPEs can employ strategic actions in the course of litigation, such as injunctive relief measures against product-producing companies, which allow NPEs to gain an upper hand in bargaining and encourages many firms to settle rather than risking a higher settlement payout.

Thus, the debate is fierce over the role of NPEs. Some advocate their beneficial role to society and innovators while most critics decry their perceived damaging economic impact.

Nathan Myhrvold, CEO of Intellectual Ventures, an NPE, and former CTO of Microsoft might be the best-known supporter of their activity. He asserts that the primary role of NPEs is to extract compensation for inventors who get shorted when a larger firm infringes upon their invention without paying licensing fees (see Roberts 2011). Since litigation can cost millions, NPEs are a form of leverage for these small inventors who otherwise would not be able to bring an infringing firm to court. Furthermore, NPEs create more demand and a larger market for patents, which subsequently raises their value, and promotes innovation through the higher expected profit of inventing. Specialized investment banks, private equity firms, brokers, and patent auction operators all enter and profit from the increase in NPE activity (Lohr 2009).

Others have labeled NPEs as *patent trolls*, a derogatory term referencing NPEs alleged lack of real innovation in the form of products or services and discouragement of growth. Due to vague wording and other imperfections in U.S. patent law, NPEs can extract economic rents from larger firms by suing for infringement of patents that may not hold up in court (Bessen 2011 and Shrestha 2011, 3). Google spent $12.5 billion to

acquire Motorola Mobility and its portfolio of 17,000 patents in an attempt to engage in defensive patenting, so that no other leading high-tech firm could sue them. This strategy, however, does not affect the function of NPEs who can sue large tech firms without any fear of being sued against in return, since they do not sell products themselves. Therefore, with one or two important patents, a company can amass huge revenues by licensing to and/or litigating against major corporations.

This paper analyzes NPE litigation to determine the economic cost to this activity on innovation in the United States, and determines that the patent-troll designation *cannot* be justified to any degree. I focus on the estimated economic costs on innovation associated with such litigation to the top twenty-five litigated-against firms in the United States. The paper begins with a background of NPEs, focusing on activity since 2006, and the economic environment in which they conduct business. This section is followed by a review of the current literature on NPEs, focusing on prior empirically based studies. Next, I describe the data accumulated for this study, and note their limitations before proceeding through the subsequent empirical analysis.

Ultimately, I conclude that NPE activity will cost the 25 most litigated against firms in the United States $567 million in 2012. I further project a $3 billion loss to the U.S. economy if my model's assumptions hold beyond the sample data set. Although this money could have been allocated towards increasing innovation and developing new technologies, I cannot determine if NPEs significantly affect the U.S. economy positively or negatively through a new metric of innovation developed in this study.

II. Background

1. Patents Stimulate Innovation

Ultimately, sovereign states grant patents to foster innovation. According to the USPTO, "a patent is an intellectual property right granted by the Government of the United States of America to an inventor 'to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States' for a limited time in exchange for public disclosure of the invention when the patent is granted" (2012c). Patent grants reward investment in research and development and encourage the diffusion of knowledge to the general public by giving the innovator an exclusive right to benefit from the investment. Most economists note that the patent system helps alleviate some of the burden of a "tragedy of the commons problem" that would otherwise exist for the patented idea had it remained a public good (see Jakobs 2011; Cornish and Llewelyn 2007, 37). Instead of resulting in the decline of a public-access resource, or in this case stagnation in innovation, fencing off innovation through the granting of IP rights helps "promote dynamic competition between innovators that would otherwise merely imitate" (Jakobs 2011, 4).

2. Systemic Inefficiencies

i. *Tragedy of the Anticommons*

More significantly, however, Moritz Jakobs (2011, 4-6) presents what he believes to be "systemic inefficiencies" in the patent system that have led to an increase in NPE patent-assertion litigation. First, the number of patents incorporated in a single product has increased to the point where a "tragedy of the anticommons" problem exists. Michael

Heller (1998, 656) writes that this problem can cause a scarce resource to be under utilized due to the fragmentation of rights and numerous owners holding rights of exclusion against one another. This problem can be seen in the advent of high-tech products such as smart phones, which can incorporate hundreds of patents. Manufacturing and service oriented firms typically engage in mutual blocking methods by creating patent pools, cross-licensing, or developing an extensive patent portfolio. The first two methods encourage collaboration and mutual assistance between competing companies. The latter technique, however, is a defensive tactic companies employ to try to deter other companies from suing for patent infringement out of the threat of counter suits. A company with an arsenal of patents would discourage others from suing it for patent infringement, because the former company could likely find a patent within its portfolio that could classify as a legitimate patent infringement case for one of its competitors' products as well. NPEs are successful because they target this "systemic inefficiency" like any good arbitrager who finds flaws in asset valuations, and they are not vulnerable to counter-assertion and do not need to cross-license or patent pool for their own products.

ii. *Patent Thicket*

The second inefficiency Jakobs identifies is that it has become increasingly difficult to determine which patents a product incorporates as well as which are actually necessary. The economist Carl Shapiro (2001) believes the current patent system facilitates a *patent thicket*, which he describes as an "overlapping set of patent rights requiring that those seeking to commercialize new technology obtain licenses from

multiple patentees." Because it is increasingly hard to determine what patents a company needs to have permission to use, companies are subsequently more at risk of inadvertently infringing upon a patent. Furthermore, Shapiro presents the risk of hold-up problems in combination with the patent thicket. Since firms are increasingly in danger that their "new products will inadvertently infringe on patents issued after these products were designed" (119), NPEs have leverage when filing infringement suits and can initiate them when most profitable to do so. He concludes that the transaction costs associated with innovation built upon numerous patents, overlapping IP rights within the thicket, and hold up problems will only rise.

Writing in 2001, he was prescient in asserting, "a would-be entrepreneur or innovator may face a barrage of infringement actions that it must overcome to bring its product or service to market" (Shapiro, 144). He fails to account for the significance of the patent thicket for NPEs, however, which operate under a business model that favors their success. NPEs can utilize the holdup problem to their advantage by selectively pursuing patent-assertion litigation because of their information asymmetry. In addition through injunctive relief measures, they can place significant economic pressure on both knowing and accidental infringers to encourage a swift trial settlement (Jakobs 2011).

3. A Brief History of Patent Trolls since 2006

"Intellectual Ventures is building an active market for invention that brings together expertise and capital, and links buyers with sellers. We see great opportunities for inventors, companies, investors, partners, and world economies to benefit from a global market for invention.

Our goal is to develop a more efficient and dynamic invention economy, establishing an invention capital system. We build, buy, and collaborate to create inventions. We supply those inventions to innovative companies through a variety of licensing and partnering

programs. We believe an active market for invention and ideas will energize technological progress, potentially changing the world for the better."

- Intellectual Ventures®, the largest alleged NPE (Intellectual Ventures 2012).

"If you're a startup, and you hope to defend your position through patents, forget about it. By the time they're granted, you won't be able to enforce them. They're only useful to patent trolls and large companies with deep pockets who can afford to do something about them."

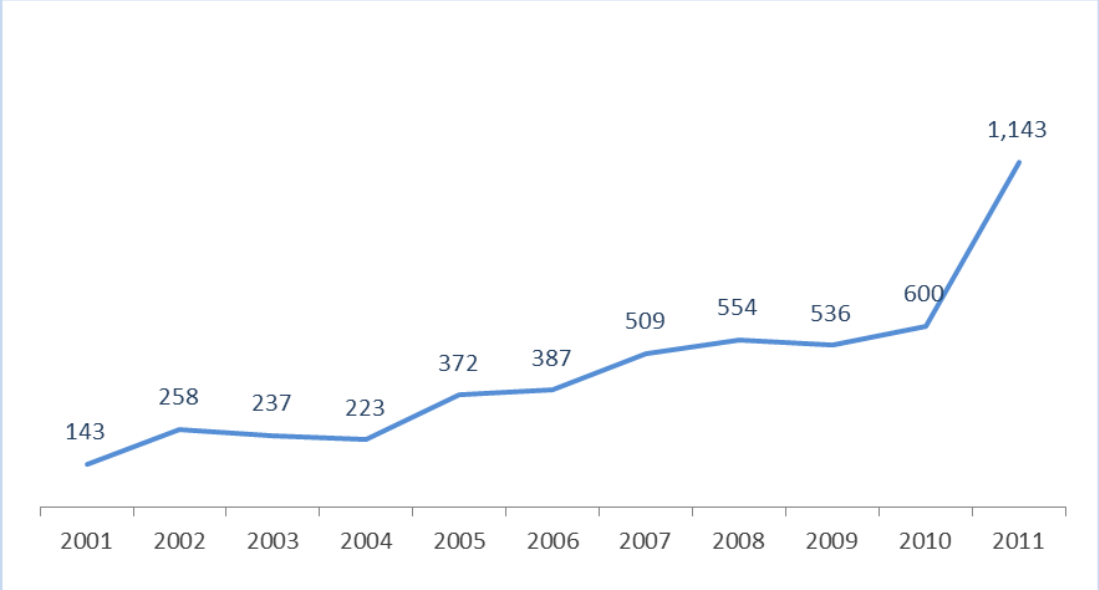
- David Sacks, CEO Yammer, Silicon Valley Start-Up (Rosoff 2012)

This paper focuses on NPE patent-infringement litigation cases between 2006 and 2011. Perhaps the best-known NPE lawsuit, coincidently, was settled in 2006 for $612.5 million between NTP and Research in Motion, Inc., producer of Blackberries. NTP filed litigation against RIM for infringing upon several of its patents concerning a wireless email system after previously refusing to license their patent technology, which ultimately led to a five-year lawsuit. The lawsuit concluded in 2006 with a huge settlement victory for NTP that gave RIM the ability to license NTP's patents, highlighting the ability for American companies to hold patents for inventions they never plan to produce themselves. Interestingly, several of NTP's patents were declared invalid by the USPTO after the court proceedings and settlement concluded. This result emphasizes the fact that many software and tech patents are vaguely worded and often do not hold up in court, but nonetheless can be used as leverage by NPEs in securing large payouts from practicing firms (Heinzl and Sharma 2006, and Longino 2006). The NTP v. RIM case sparked a fierce debate over the economic impact of NPEs and served as a catalyst for other firms to emulate the business model of NTP and enter the fray of patent-assertion and infringement litigation. NPE activity has increased dramatically over the past five years since the NTP v. RIM case.

PatentFreedom, a business that provides information on NPE activity and individual patents to international companies to combat the growing risk of patent infringement, has published statistics about NPE lawsuits over time:

Figure 1: Operating Company Parties in NPE Lawsuits Over Time (PatentFreedom 2012c)

Figure 2: Unique Patent Lawsuits By NPEs Over Time (PatentFreedom 2012c)

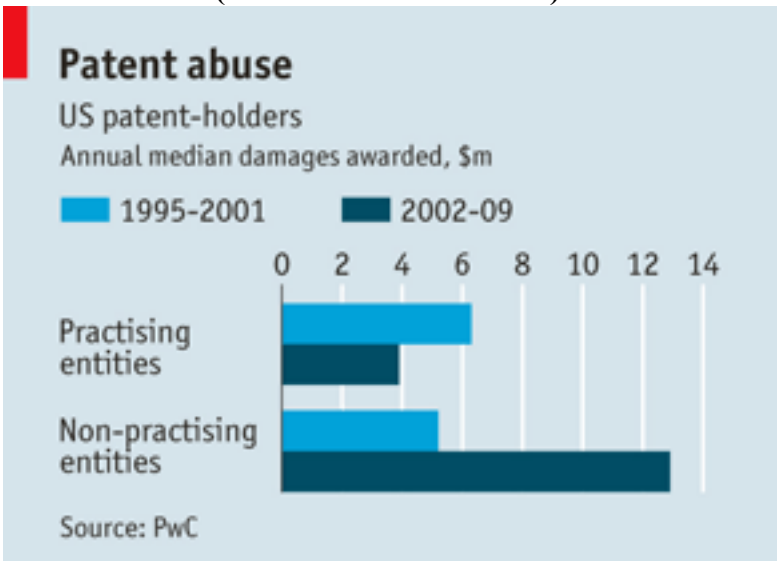


Significantly, both the number of occasions in which an operating company was the defendant in a patent litigation case with a NPE, and the number of unique patent lawsuits involving NPEs have increased over time. As Figure 1 shows, the annual number of defendant companies targeted by NPE lawsuits has risen over 400% since 2006, and NPE lawsuits in the last 5 years account for 80% of the total NPE litigation in the last 10 years. Figure 2 shows that NPEs often target multiple companies with the same patent lawsuit: each observation represents a unique NPE lawsuit, whereas Figure 1 counts the same patent infringement case against multiple different defendants as multiple observations.[1]

The number of NPEs and patent infringement lawsuits they initiate seem to be rising at least in part because the industry is growing in profitability. Since 1995, practicing entities (firms that *do* produce goods and services) have found it less profitable to initiate patent infringement lawsuits themselves. The median damages awarded to NPEs in patent infringement cases, however, has more than doubled over the fifteen-year period from 1995-2009 as can be seen in Figure 3 below.

[1] The sharp jump in 2011 in Figure 2 can partly be explained by changes in joinder provisions that came into effect last year with the passage of the Leahy-Smith America Invents Act (PatentFreedom 2012c). For more on the joinder provisions in the AIA, see sections 10 and 11 below.

Figure 3: Annual Median Damages Awarded in Patent Litigation (Inventive Warfare 2012)



Furthermore, patent infringement litigation by NPEs may be rising due to methods by which the USPTO approves a patent grant. According to a recent NPR report, 30% of patents are granted for inventions that already exist (Blumberg and Sydell 2011). If that statistic is anywhere near correct, then up to 30% of new products or inventions could be liable to infringement litigation because of inefficiencies in the patent granting system.

4. History of Patent Infringement Litigation

Despite the proliferation of NPE patent-litigation activity in the past decade, specifically since 2006, the desire to extract worth from one's patent holdings through licensing or the threat of a lawsuit is not a new phenomenon. The USPTO granted George Selden a patent for putting a gasoline engine on a chassis to make a car in 1895, although questions arose whether it was truly non-obvious and if his "innovation" was actually contributing anything to the development of early automobiles. Nonetheless, he

proceeded to wield his patent as a threat against carmakers in order to collect hundreds of thousands of dollars in royalties until 1911 when Henry Ford refused to pay royalties to Selden and invalidated the patent in court (Raustiala and Sprigman 2011).

Somewhat similarly, an independent inventor by the name of Robert Kearns developed an intermittent windshield wiper system: Ford, GM, and Chrysler employed the system in their designs but refused to offer Kearns compensation. Kearns ultimately settled with Ford for $10 million and received close to $30 million from Chrysler. He spent over fifteen years of his life fighting legal battles in court, and his case may highlight the demand for NPEs, who can spend resources and time litigating patents so that inventors can be left in peace to continue innovating (Schudel 2005). Although critics questioned the validity of both Selden and Kearns' patents, both inventors were legally justified to pursue patent-infringement litigation in court because the USPTO granted the patents. These two cases preceded an era in which independent companies are founded on the basis of a non-practicing business model that solely engages in patent-infringement litigation, but nonetheless show that inventors have had a desire to license technology and sue for infringement since at least the nineteenth century.

5. Trends in Infringement Industries

NPEs have been extracting settlement awards in a variety of industries since at least the early 1990s. Companies such as Microsoft were "at first…caught off-guard by aggressive patent litigation," contends a recent Popular Mechanics report, and Microsoft paid $120 million to Stac Electronics for infringing on a data-compression patent in 1994. In 1994, a NPE called E-Data procured a patent, first granted in 1985, that it interpreted

to cover any online sales. E-Data successfully settled with many of the over one hundred companies that it sued until the patent expired in 2002 (Goodier 2011).

Many of the largest and most notable cases in the past five years have dealt with smart phone technology. One noteworthy case in the past year that does not concern the smart phone industry is the NPE Smartphone Technologies' suit against Amazon for violating four patents in its new Kindle Fire tablet product. Overall, while the rapid escalation of NPE patent-infringement lawsuits has garnered newfound attention from media sources in recent years, NPEs and patent-infringement litigation are neither new nor confined to one niche industry. The phenomenon is widespread across a variety of disparate industries, although as PatentFreedom's data on NPE litigation by industry in Table 1 below shows, the electronics, software and telecommunications industries are certainly amongst the most affected:

Table 1: NPE Patent Litigation Statistics by Industry 2001-2011 (Patent Freedom 2012a)[2]

Industry	Operating Companies in NPE Patent Litigation	Unique Operating Companies in NPE Patent Litigation	NPEs in Patent Litigation	NPE Patent Litigations	NPE-Litigated Patents
Electronics	2773	527	298	1377	1290
Retail	2724	895	268	1050	798
Media/Telecom	2289	663	244	1128	850
Computer Software/Services	2125	882	278	1130	1084
Computer Hardware	1951	306	287	1052	1165
Financial Services	1519	571	161	602	460
Automotive & Transport	1442	506	127	560	404
Consumer Products	908	495	161	474	374
Semiconductor	781	146	116	388	451
Industrial Manufacturing	609	396	176	408	486
Healthcare & Pharma	553	389	72	244	184
Energy/Utilities	503	281	130	353	285
Other (Hotels, Services, Agriculture)	1438	766	243	811	797

Furthermore, Table 2 below shows that the percentage of litigation by NPEs targeting high-tech sectors has been slowly decreasing since 2004:

Table 2: Operating Company Parties in NPE Lawsuits by Sector (PatentFreedom 2012a)

	2004-2005	2006-2007	2008-2009	2010-2011
Hi-Tech Sectors	63%	52%	56%	48%
Other Sectors	37%	48%	44%	52%

[2] Column 1 shows the number of operating company counter-parties that are defendants of patent litigation by NPEs. Column 2 shows the unique number of operating companies that have been the target of a NPE lawsuit since 2001. Column 1 counts an operating company twice if it is the defendant in two separate cases, while column 2 would only count the company once. Column 3 shows the number of NPEs initiating lawsuits against operating companies in that industry, and NPEs can file lawsuits against companies across industries.

6. Portfolios of Patents

Without taking a side on the debate over the recent surge in NPE patent litigation activity, it is clear to all observers that technology and other product-producing firms that rely heavily on patents are reacting to the potential threat of litigation by stockpiling vast patent portfolios. In December 2010 Apple, Microsoft and two other companies collaborated to buy 880 patents and applications owned by Novell, a struggling software firm, for $450 million. In 2011, a consortium including Apple, Microsoft and RIM bought 6,000 patents from the bankrupt Canadian telecom-equipment maker Nortel, for $4.5 billion – more than five times the opening bid and the largest patent auction in history, according to Blumberg and Sydell (2011). The senior vice president of Google had previously stated his desire to bid for Nortel's patents to defend against the increasing threat of patent litigation:

> "The tech world has recently seen an explosion in patent litigation, often involving low-quality software patents, which threatens to stifle innovation. Some of these lawsuits have been filed by people or companies that have never actually created anything; others are motivated by a desire to block competing products or profit from the success of a rival's new technology…But as things stand today, one of a company's best defenses against this kind of litigation is (ironically) to have a formidable patent portfolio, as this helps maintain your freedom to develop new products and services. Google is a relatively young company, and although we have a growing number of patents, many of our competitors have larger portfolios given their longer histories. So after a lot of thought, we've decided to bid for Nortel's patent portfolio in the company's bankruptcy auction."
>
> Google Senior VP Kent Walker, 4/4/11 (Walker 2011)

In response to having been outbid for Nortel's patents, Google proceeded to buy 1,000 patents from IBM then paid $12.5 billion to buy Motorola Mobility in 2011. The purchase of Motorola Mobility, maker of mobile devices and undoubtedly holder of wireless and 4G patents, came with 17,000 issued patents and another 7,500 pending (Inventive Warfare 2011). HP, IBM, and RIM, amongst eighteen others, banded together

to form Allied Security Trust – a consortium that identifies valuable high tech patents on the open market. Upon paying an initiation fee of $150,000 and annual $200,000 fee, member firms receive information on patents, and can either bid on the patents directly, or fund AST's acquisition of a patent with the privilege to license it at no additional cost (AST 2012). Most recently, Microsoft bought a portfolio of 800 patents and the right to license an additional 300 patents from AOL for $1.1 billion in April 2012 as Michael De La Merced of the New York Times notes (2012). Soon after, Microsoft sold and licensed some of the patents it bought from AOL to Facebook for $550 million in cash, in a move widely regarded as a reaction to Google's activity (Wingfield 2012). Tables 3 and 4 below highlight some of the patent portfolios of NPEs, the most litigated against firms, and other notable technology companies.

Table 3: Largest NPE Patent Portfolios (PatentFreedom 2012b) [3]

Largest NPE Patent Holdings	No. of Patents in Portfolio
Intellectual Ventures	12,500+
Round Rock Research LLC	3,428
Interdigital	2,576
Wisconsin Alumni Research Foundation	2,139
Tessera Technologies Inc	1,267
IPG Healthcare 501 Limited	1,157
Mosaid Technologies Inc	1,151
CSIRO	1,106
Rambus	998
Acacia Technologies	833
Walker Digital LLC	817
Wi-Lan	595
Jerome H Lemelson	465
Scenera Research LLC	409

[3] Intellectual Ventures patent portfolio is estimated by The Economist to be as large as 27,000 in 2009, so its total would be significantly higher than PatentFreedom's early 2012 estimate above (see Trolls Demanding Tolls 2009).

Table 4: Practicing Entities' Patent Portfolios (USPTO 2012d) [4]

Ranking by Company in Terms of Most NPE Lawsuits	Notable Firms	No. of Patents in Portfolio
1	HP	23,931
2	Apple	4,666
4	Sony	36,577
5	Microsoft	19,858
6	Dell	2,492
7	Samsung	47,964
7	Motorola	21,047
9	LG	17,062
10	Verizon	1,119
14	Google	1,136
22	IBM	68,871
22	Yahoo	1,034
-	Facebook	21
-	Zynga	3
-	Groupon	3
-	LinkedIn	1

To be sure, these highly profitable product-producing firms are seeking to increase their patent portfolios in response to more than just the threat of NPE lawsuits. Large firms mainly want to ensure they obtain market share, as a Gizmodo report notes, and therefore future revenue streams (Barrett 2011). To accomplish this, companies sue each other for patent infringement when cross-licensing talks are not preferable or fall through. Nokia recently settled a suit it filed against Apple in 2011, for instance, and

[4] Table 4 shows some of the top 25 most litigated against firms in the United States used in this study as well as some other notable firms. The numbers before each firm correspond to the ranking of the company in terms of having to defend against the most lawsuits by NPEs. Tables 11-16 in the appendix present the full list of companies.

This table shows the number of patents granted by the USPTO, however it does not incorporate how many patents the company bought. For example, Apple bought 12-17,000 patents from Motorola in 2011 and would definitely have more than 4,666 patents if the estimate accounted for patents bought. The data was calculated by looking at the company's assignee-name only and does not account for any subsidiaries of a company that might have patents listed under a different name. In addition, AT&T is the third most litigated against company in this study but is not listed above because USPTO did not have accurate data for the company. Table 4 is useful, however, because it gives a comparison between NPEs and PEs and shows how some notable new tech firms do not have much in-house defensive patent protection.

Apple challenged HTC in a patent suit. This prompted HTC to buy an unprofitable software firm, S3, for $300 million because S3 had recently won a suit against Apple for patent infringement, and its acquired patents could potentially help counter the Apple lawsuit (see Android Alert 2011). Perhaps executives at these firms hope that stockpiling patents, as a defense tactic, will lead to a legal détente where the strongest or most established companies will prevail at the expense of innovative startups. Regardless of the motives behind the patent arms race, the environment of the patent world in the past five years has contributed to the increase in NPE activity.

Although I focus solely on NPE versus PE patent infringement cases, it is important to understand the environment in which NPEs operate. Besides NPE lawsuits, PEs are also initiating more lawsuits against each other. Figures 4 and 5 show that the number of patent lawsuits Apple and Microsoft have been involved in as both defendants and plaintiffs has risen over time. Not all of the increase in patent infringement lawsuits by these two companies can be explained by the increase in litigation by NPEs, so infringement lawsuits between PEs must also have risen over time.

Figure 4: Total Patent Litigation Cases Involving Apple, Inc. Between 2001-2012 (Lex Machina 2012)[5]

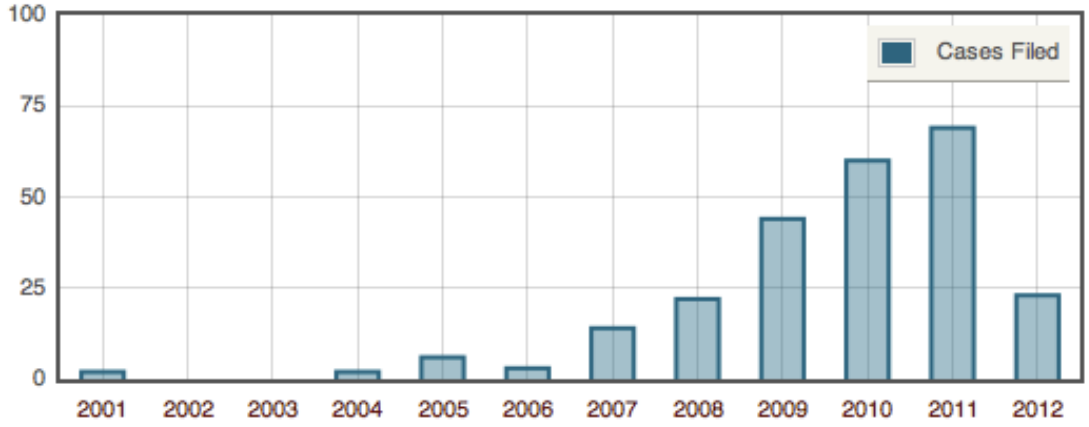
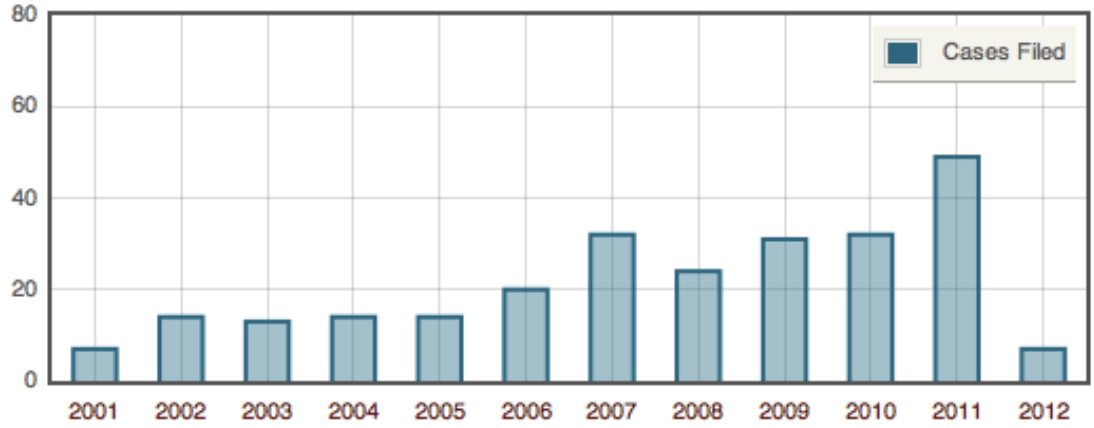


Figure 5: Total Patent Litigation Cases Involving Microsoft, Inc. Between 2001-2012 (Lex Machina 2012)



As Table 12 in the appendix shows, Apple has been the defendant of 134 lawsuits initiated by NPEs between 2006-2011, but has had 246 cases since 2001. Apple has been the plaintiff in 26 patent cases, and close to 200 of its patent cases have occurred between 2006-2011. Similarly, Microsoft has been the defendant in 100 NPE lawsuit cases between 2006-2011, but has had 266 patent cases since 2001. It has been the defendant in

[5] Lex Machina Inc. hosts the publicly available data from the Stanford Intellectual Property Litigation Clearinghouse, which is free to "academicians, public interest researchers, judges, policymakers and the media" after signing terms of use. Figures 4 and 5 utilize data accessed on April 22, 2012 (Lex Machina 2012).

34 of those cases. Clearly, the number of lawsuits initiated by both PEs and NPEs has risen over the time period of this study, but I look at the impact of NPEs filing litigation against PEs only.

7. Filing Location of Patent Infringement Cases

There appears to be a phenomenon in the location where NPE lawsuits are being filed and litigated. Notably, the U.S. Eastern District of Texas is a haven for patent infringement litigation. The district has seen 2,604 patent cases since 2000. The number of cases seen by the district is larger than the number of cases heard by six of the eleven U.S. District Court Circuits across the nation, although the district is only one of nine districts in the circuit. The Eastern District of Texas has accounted for 61% of the patent litigation filed in the Fifth Circuit since 2000 (Lex Machina 2012).

According to the aforementioned NPR report from July 2011, firms hold empty offices in the district to serve as address drops in order to file infringement there (Blumberg and Sydell 2011). According to a report from *The Economist*, the Eastern Texas district is "famously plaintiff-friendly" (Inventive Warfare 2011) and an MIT report in 2006 found that patent plaintiffs in the district had an 88% win rate in comparison with a 66% win rate nationwide (Williams 2006). The heavy emphasis on IP litigation, however, seems to be a product more of convenience and circumstance rather than ease of judges. Previously, for instance, the district saw many personal injury cases until a reform of Texas tort law in 2003 ended that practice, creating a path for IP litigation to take over.

In addition, Williams (2006) notes, "the general rule in patent law is that

defendants can't file a motion to dismiss until a "Markman hearing," a post-dotcom procedure during which a plaintiff finally reveals to a judge the exact nature of the infringed claim." In The Eastern District of Texas where local rules dictate a "brisk pre-trial process," NPE attorneys have 30-60 days before the Markman hearing to prepare an excellent prosecution for the jury (Williams 2006). Furthermore, the London *Guardian* reports that a jury usually tries the patent suits in the district. Since the technicalities of patent suits are complex and hard to tease out when explaining them to a jury, the uncertainty leads to juries favoring plaintiffs (Kollewe 2011). While many patent infringement suits are settled outside of the court, the first instance of a jury finding the defendant not-guilty in a patent infringement case in the Eastern District of Texas since 2007 was Bedrock Computer Technologies, LLC v. Yahoo! in May 2011 (Analysis Group 2012). Most important, however, is that cases tried in the district proceed through trial more quickly than in other districts. McKool Smith, a leading IP litigator based in Texas with an office in Marshall, Texas, claims:

> "Since the 1960s, the federal court in East Texas has been known for quickly resolving high-stakes commercial disputes. It often takes 18 months or less for a complex commercial dispute to go to trial in East Texas – approximately half the time of many other federal districts." – McKool Smith, law firm (McKool Smith 2012).

I have found no evidence that these cases are being appealed higher up in the Court system and that the NPEs are merely pursuing a strategy in Eastern Texas to gain an injunction in the short term. It appears that the aforementioned district is most advantageous for NPEs initiating patent infringement lawsuits.

8. NPEs Attract Valuable Human Capital

Another facet in the escalation of NPE activity is that NPEs are attracting some of the most elite patent lawyers in the country from their law firms. Instead of defending some of the largest U.S. firms in patent cases, attorneys are leaving their firms to set up their own practices to represent NPEs in lawsuits against their previous clients. A Wall Street Journal article profiles two of these individuals, John Desmarais and Matt Powers, who each left multi-million dollar partnerships at two of the most prominent IP law firms to take advantage of the growing NPE opportunity. Mr. Desmarais founded his own law firm as well as the NPE Round Rock Research LLC, which, according to PatentFreedom, is the NPE with the second largest patent portfolio in the country. Micron Technology Inc., a semiconductor maker, sold its patent portfolio to Mr. Desmarais to generate immediate revenue and avoid having to initiate litigation itself to obtain value from its patents. Mr. Desmarais set up his NPE and law practice with venture capital funding for the sole purpose of licensing and litigating the patents he acquired from Micron. Interestingly, both attorneys and legal experts say Mr. Desmarais and Mr. Power's moves are the product of a "rapidly changing patent landscape," the article reads, and NPEs will continue to attract top-flight attorneys if the industry remains profitable (Jones 2012). An empirical study could be conducted to determine the social economic impact caused by the loss of human capital to NPEs, but it is likely insignificant if lawyers are leaving one law firm to establish another, and beyond the scope of this paper.

9. Yahoo! v. Facebook, A Recent Case

One of the most recent cases of potential NPE activity concerns Yahoo's patent-infringement suit against Facebook. In mid March of 2012, Yahoo filed suit against Facebook for allegedly infringing upon 10 of its patents. Part of the official statement from Yahoo on the matter follows:

> "Yahoo! has invested substantial resources in research and development through the years, which has resulted in numerous patented inventions of technology that other companies have licensed. These technologies are the foundation of our business that engages over 700 million monthly unique visitors and represent the spirit of innovation upon which Yahoo! is built. Unfortunately, the matter with Facebook remains unresolved and we are compelled to seek redress in federal court. We are confident that we will prevail."

And more specifically concerning the alleged patent infringement:

> "Yahoo! recognized that website users are attracted to free services. But website operators need a way to generate revenue even when offering services for free. Yahoo!'s Advertising Patents claim effective methods of advertising, or generating advertisements that relate to users individually and monitoring advertising clicks for potential click fraud"
>
> "Prior to adopting Yahoo!'s patented social networking technology in 2008, Facebook was considered one of the worst performing Internet sites for advertising. Facebook's use of that social networking model has reportedly dramatically driven up Facebook's advertising click through rates." (Kash, Smith, and Verhoeven 2012)

Yahoo's decision to sue Facebook for patent infringement after its announced IPO is not a completely new business tactic employed by Yahoo, as Jay Yarow from Business Insider notes, because the case yields similarities to Yahoo's previous suit against Google (Yarow 2012a). It is concerning to members of the tech world, such as notable venture capitalist Fred Wilson and Mark Cuban, however, because the case appears to lack merit because the same infringement claims noted above could be applied to most ad supporting websites (Savitz 2012 and Yarow 2012b). Yahoo is an aging company that is

no longer considered at the cutting edge of tech firms, like Apple, Google, or Facebook, and could perhaps be pursuing a shift to the tactics of NPEs by asserting its patents against firms that do not have the ability to countersue. If Yahoo were to present the same patent-infringement lawsuit against Google or Microsoft, for instance, the latter firms would most likely be able to countersue after finding several of their own patents that Yahoo is potentially infringing upon.

The case is unusual because it could represent a shift in the business models of IP heavy, but aging, tech firms who see enormous profits to be made by targeting firms without strong patent portfolios of their own. Facebook has only 21 granted patents despite its significant growth, for instance, while Yahoo has 1041 patents, although Yahoo is most likely not currently generating services or products with many of them (USPTO 2012d). By suing Facebook for violation of 10 of its patents, Yahoo is perhaps hoping that one or two might prove worthwhile and hold up in court or that Facebook chooses to settle and avoid hefty lawyer fees and distractions in advance of its forthcoming IPO (Dragani 2012). Lance Lieberman, a New York patent lawyer specializing in software, believes that Yahoo could soon morph into a NPE with its broad portfolio of patents. In an interview with VentureBeat, he says, "With a new CEO facing pressure from Wall Street and activist investors breathing down his neck, intellectual property is a way to drum up revenue quickly," and therefore a victory against Facebook could give them incentive to monetize as many of their patents as possible (Popper 2012).

Regardless of the validity of Yahoo's claims, the case highlights a potential paradigm shift in what is considered "patent trolling" behavior. Currently, practicing

entities cross-license patents to each other and often refrain from lawsuits because each has a patent arsenal to employ in the courtroom, while NPEs pursue the bulk of patent-litigation against practicing entities. This dynamic, however, could begin to incorporate faltering or aging firms with patent portfolios but few new ideas or products that need to raise revenue quickly. Furthermore, as Yammer CEO David Sacks notes in his response to the Yahoo patent suit, patent trolls are moving towards litigating against less established firms as well as start-ups still undergoing rounds of funding since it is extremely cheap to file patent infringement paperwork (Rosoff 2012). How this will affect future regulation of patent litigation and patent laws is yet to be seen.

10. USPTO and New Legislation

Although this paper does not focus on legislation regarding patents or the newly signed *Leahy-Smith America Invents Act* (AIA), it is important to briefly discuss the environment within which NPEs operate, which might explain their increased relevance in patent litigation in the past decade. As of September 2011, there were 670,000 patent applications awaiting first action by the USPTO, although this backlog has decreased from 765,000 in January 2009 (USPTO 2012f). In an effort to lower this backlog as well as improve the patent system, the AIA was passed by a bipartisan majority in Congress and signed into law by President Barack Obama on September 16, 2011.

Most notably, the patent granting system changed from a first-to-invent format to first-to-file, meaning that an inventor is awarded a patent grant if he or she is the first to file for the invention application rather than the first person to prove he or she invented it (Goodier 2012). This change will align the United States with much of the rest of the

world and hopefully increase cooperation and efficiency in patent examinations worldwide. More importantly, however, lawmakers hope the new system with help decrease legal arguments over who invented a certain technology or idea first. The bill initiates new procedures to allow alleged infringers to challenge a patent's validity through the USPTO rather than in court, and additional parties now have a greater ability to demonstrate "previous art" through the USPTO, which would suggest the patent is not new and therefore should not be granted (Many Patents, Still Pending 2011).

Although the bill has barely had a chance to affect the way patents are granted, interested parties and commentators have hotly debated how the bill will affect American innovation and the economy. Some entrepreneurs, an Economist report reveals, "argue that it forces companies to file for patents before their inventions are fully developed" (Inventive Warfare 2011). Significantly, the new bill did not guarantee the USPTO more funding, so the backlog will likely persist into the future (Many Patents, Still Pending 2011). In an opinion piece for Forbes, Silicon-based venture-capitalist Gary Lauder admonishes the bill's allowance for a third form of post-grant review, claiming that "post-grant review…is used by deep-pocketed companies to prevent other's patents from issuing" (Lauder 2011). He goes on to assert that lobbyists were likely successful in getting the bill passed because it would help their clients and organizations. He claims the first-to-file system will most directly benefit pharmaceutical and large companies who have small conception-to-development times for their inventions, while the system risks hurting small inventors who often need to publicize their ideas to obtain funding before they can even consider filing a patent.

11. How AIA Affects NPEs

Despite the plethora of arguments in favor or against AIA, it is important to note how NPEs will be affected. In an article for Popular Mechanics, Professor James Bessen from Boston University argues that NPEs usually buy previously granted patents to use in litigation, so changing the granting system from first-to-invent to first-to-file will not affect the operating business model of NPEs. Further, since it costs only about $1000 to renew a patent, NPEs are enabled to stockpile patents they will only ever use in litigation. He notes that the new AIA law only raises the cost of patent renewal by 15%, which may only make NPEs more efficient in what patents they target (Goodier 2011). The AIA, however, does attempt to prohibit multiple defendants from being sued, or threatened, by the same plaintiff as part of the same lawsuit. 35 U.S.C. § 299(b) of the AIA reads:

> ALLEGATIONS INSUFFICIENT FOR JOINDER.—For purposes of this subsection, accused infringers may not be joined in one action as defendants or counterclaim defendants, or have their actions consolidated for trial, based solely on allegations that they each have infringed the patent or patents in suit.
> (LEAHY–SMITH AMERICA INVENTS ACT)

This provision appears to be a direct attempt to counter the swiftly increasing litigation by NPEs, which, as Figure 2 shows, commonly sue multiple defendants for alleged infringement of the same patent(s).

In fact, the prevalence of NPE litigation has become so rampant in the past several years, that the AIA devotes a section to their activity, where NPEs are formally acknowledged. A study of the consequences of litigation by NPEs will be conducted by 2012 under Section 34 of the Act to determine if any laws or regulations should be

considered in the future to curb, or otherwise regulate, the activity of these firms. In particular, the study will focus on:

> (1) The annual volume of litigation described in subsection (a) over the 20-year period ending on the date of the enactment of this Act.
> (2) The volume of cases comprising such litigation that are found to be without merit after judicial review.
> (3) The impacts of such litigation on the time required to resolve patent claims.
> (4) The estimated costs, including the estimated cost of defense, associated with such litigation for patent holders, patent licensors, patent licensees, and inventors, and for users of alternate or competing innovations.
> (5) The economic impact of such litigation on the economy of the United States, including the impact on inventors, job creation, employers, employees, and consumers.
> (Leahy-Smith America Invents Act)

This paper gives insight into both the estimated costs of NPE litigation and the economic impact of such litigation on the economy of the United States through the activity's effect on innovation and the response of the top twenty-five most litigated against firms.

III. Literature Review

This section provides insight into previous completed studies that try to determine the effect of NPEs on innovation. It also provides significant knowledge on the practices, strategies and claims for and against NPEs. Ultimately, it demonstrates that there is no conclusive study conducted on the effects of patent litigation by NPEs on innovation.

1. Empirical Findings

Most of the research concerning the economic impact of NPEs on innovation is qualitative and theoretical based. Even the two in-depth empirical studies I present below devote much of their papers to theoretical arguments for and against NPEs. Since most NPEs are private companies and settlements are usually not disclosed to the general

public, it is hard to tease out the impact of NPEs on innovation and social costs. Many studies on the topic present more descriptive statistics and findings about NPE activity rather than attempts to determine if their presence is helping or hurting the economy. Below I discuss studies that have quantitatively analyzed NPEs and their litigious practices, concluding with two in-depth studies that are the most empirical I have found on the topic, but ultimately lack decisive and conclusive evidence.

i. A Market for Patents is Not New

Lamoreaux and Sokoloff (1999) find that an increase in the trade of patent rights in the early nineteenth century led to more specialization and efficiency between inventors. Scholars have found parallels between this study and the role NPEs play in allowing inventors to focus their "attention and resources on the pursuit of inventive activity," while they conduct the expensive and time-consuming litigation process (see for example Shrestha 2010, 128).

ii. Descriptive Empirical Results

These studies conduct quantitative analysis on NPE litigation but are more descriptive than analytical, and much of the information here corroborates summary information presented in the background.

Colleen Chien notes that NPEs amount to 17% of high-tech patent lawsuits (Chien 2009, cited in Bessen 2011). PatentFreedom shows that in 2004-2005, 63% of patent enforcement by NPEs was centered in the high-tech sectors, but that percentage has decreased to only 48% in 2010-2011 (see Table 2). Both Chien (2009) and PatentFreedom (2012c) find that many of these lawsuits involve multiple defendants,

which increases their economic impact. Bessen (2011) finds that only 17% of defendants of NPE litigation between 1990 and 2010 were the lone defendant listed on the lawsuit, which is a distinguishable from other patent litigation that has single defendants 85% of the time (Bessen and Meurer 2007). Allison, Lemley & Walker (2010) focuses on patents litigated multiple times, as Bessen (2011) points out, and observes that software patents total 94% of these lawsuits.

Allison et. al (2009) looks at the most litigated patents between 2000 and 2007, through access to Stanford's Intellectual Property Clearing House, and finds "powerful evidence" that the most litigated patents have clear and different characteristics than once-litigated patents. These characteristics are the same that researchers have generally used to identify most-valuable patents, notably: "more claims, more prior art citations, more forward citations, a higher likelihood of assignment between issue and litigation, and larger numbers of continuation applications." Therefore, they draw the conclusion that the most litigated patents represent the most valuable patents. Significantly, the study finds that the most litigated patents are "disproportionately owned by nonpracticing entities." Allison et al. (2009) finds that NPEs file only 16% of once litigated patents, but over 80% of the most litigated patents, while owning more than 50% of the most litigated patents. The study's authors admit, however, that perhaps these patents are optimized for litigation by being "better protected against…validity challenges based on uncited prior art" because they have been cited more extensively. In addition, the study concludes by declaring we should not focus on determining if NPEs should be labeled trolls or not, but rather make sure that patent laws allow all patentees the ability to receive just

compensation without invoking holdup or other predatory measures.

a. Who do NPEs Sue?

Ball and Kesan (2009) study the potential disadvantage facing small parties seeking to defend their intellectual property rights as well as the fear that some of these small inventors and licensing firms may be "using the courts as a mechanism to extract economic rents from large companies." They find that most small plaintiffs are suing other small parties, although 20% of litigation is directed towards companies with over $500 million in annual sales. Furthermore, they find some evidence that small parties are only enforcing their most "valuable" patents when suing large firms, again where valuable is calculated by looking at claims and citations. The study concludes by stating there is "little evidence that 'trolls' are posing a serious problem," because the number of patent licensing firms was small and they were almost equally as likely to sue small, medium, and large firms. They do acknowledge, however, that there was some evidence of licensing firms being less likely to pursue a judgment or a trial when suing a large firm. This evidence, although modest, is an important result to analyze in the present since patent litigation pursued by NPEs has increased nearly eightfold since 2002, the year in which data was collected for the study.

b. Timing in Term Length of Patent Litigation

Brian Love (2011) conducted an empirical study of patent litigation timing in the hopes of determining whether a patent term reduction would help innovators by decreasing the amount of NPEs filing patent assertion claims at the end of their terms. He distinguishes between patents filed by NPEs and those filed by product-producing

companies and finds that, "all claims asserting the average product-company patent are resolved before the average NPE patent is asserted for the first time." Although NPEs enforce just 20% of the patents he studies, he finds that they are responsible for more than two-thirds of all patent litigation and over 80% of patent claims litigated in the final three years of the 20-year patent term. His research suggests that the length of the patent term advantages NPEs, who do "little more with their aging patent rights than impose steep legal costs on those selling successful products," and therefore concludes that NPEs can be draining the resources of firms using patents to produce products that incorporate their technology.

This paper strives to calculate one metric of the way the most litigated-against firms are reacting to the increasing threat of NPE litigation.

iii. Empirical Study: Shrestha (2010)

Sannu K. Shrestha (2010) attempts to test some of the arguments made in support and against NPEs to determine whether they positively or negatively impact innovation. Specifically, Shrestha focuses on the critique of NPEs that claims they "use weak and vague patents to extract excessive licensing fees or to engage in frivolous infringement litigation against product manufacturers" against the claim that, on the other hand, "these firms enhance innovation and competition by providing capital to independent inventors and creating an efficient market for trade in technological information." Ultimately, the study concludes that NPE patents have significantly higher value, and thus importance, than other litigated patents, even when compared against a patent's technological class. Furthermore, Shrestha finds that the success rate of NPE patent infringement litigation is

very similar to that success rate of other litigants. Therefore the study concludes that NPEs provide a valuable service and should not be dismissed as trolls and regulated against by lawmakers until further studies can prove they cause harm to innovation or social welfare.

Shrestha first attempts to disprove the claim that NPEs use weak patents to engage in frivolous litigation. The study acknowledges existing literature that supports the claim that higher valued patents have more citations, and then concludes that patents held by NPEs are more valuable than the average patent in litigation because they have more citations (see, for example Hall, Jaffe & Trajtenberg 2000). Bessen (2011) argues with this conclusion, for although valuable patents receive higher citations and NPE litigated patents have higher citations, one can not claim that NPE litigated patents are therefore valuable patents. It is a classic correlation versus causation mistake. Furthermore, Bessen writes that, "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 for innovation." Shrestha acknowledges, "one cannot definitively say whether NPEs benefit or harm innovation based on the analysis of this Note" (2011, 150).

Next, Shrestha attempts to disprove the claim that NPEs partake in more frivolous litigation than other patent-assertion entities. Because plaintiffs need roughly $2 to $3 million to conduct an infringement suit, Shrestha argues that it would be irrational to sue a defendant if there was a low probability of a positive outcome. Therefore, since NPE lawsuits have a similar win rate to other patent plaintiffs, the lawsuits cannot be labeled

disparagingly as “frivolous.” Bessen (2011) again finds fault with this interpretation, for the Shrestha study was based on a very small subset of NPE lawsuits and is biased because it only looks at the alleged value of patents involved in litigation, as opposed to the patents a NPE owns but does not litigate with. Further studies, such as Risch (2011) find that NPE patents brought to judgment have significantly higher rates of invalidation. Bessen cites that Risch concludes “54% had no valid claims while an additional 44% had some invalid claims” (Bessen 2011, 8). In addition, Allison et al. (2010) takes a larger sample of litigated patents and finds that plaintiff win rates of NPEs are much lower than for other patent litigation. Bessen even suggests that this debate is essentially worthless when trying to measure how harmful the litigation is to both innovation and social welfare.

Shrestha (2011) also tackles two other widely made assertions by opponents of NPEs that claim NPEs are detrimental to innovation. The study finds evidence to reject the argument that NPEs drive up the cost of products by extracting high licensing fees from manufacturers with the same strategy of examining the value of patents to clarify whether the licensing revenues earned by NPEs are “exploitative, or simply reflective of the value of their patents.” This conclusion has the same faults as listed above for determining the value of patents based off of citations alone, and the study itself recognizes that even though NPEs own “valuable” patents, one cannot rule out the possibility that they consistently engage in opportunistic and exploitative strategies without empirical evidence and analysis.

The study also attempts to contend with the issue that NPEs potentially exacerbate

the patent thickets problem, whereby fragmented rights over a product or technology can "raise prices, lower demand, and cause a net welfare reduction." Here Shrestha notes an FTC study that implies the thickets problem derives from the immense number of patents granted by the USPTO every year, which do not all represent non-trivial and novel technologies (see FTC 2003, cited in Shrestha). Therefore, the study concludes the underlying problem is "caused by the issuance of patents on trivial variations of the same invention, and not the NPE business model."

Lastly, Shrestha contends with issues that supporters of NPEs highlight about their contribution to the economy, though it remains a more qualitative approach with only some quantitative evidence in support of NPEs. Essentially, the study supports the claim that NPEs provide capital and bargaining power to independent investors and small businesses, at least somewhat, and therefore help differentiate valuable from trivial patents. This service would help alleviate another information asymmetry problem that might have driven successful innovators with valuable patents out of the market had they not been recognized by the due diligence performed by NPEs. Again the study relies solely on the claim that patents are more valuable because of their high citations, and focuses more on theoretical arguments than hard empirical data.

In sum, the Shrestha study is important because it helps change the general perception that NPEs are solely detrimental to innovation, by giving qualitative and theoretical argument both for and against the NPE business model. The empirical data, however, are imperfect as Shrestha and Bessen both note, but the study effectively calls attention to the need for more research into the effect of NPEs on innovation and social

welfare before legislative and judicial actions propose decisions that will alter the state of innovation in the United States.

iv. Empirical Study: Bessen (2011)

a. NPE Litigation Effect on Stock Prices

I have discovered no study that has attempted to quantitatively analyze the effect of NPEs on innovation and social welfare more than Bessen (2011). His study uses proprietary data on patent assertion litigation announcements and stock market event studies to determine whether litigating NPEs "improve markets for technology and increase incentives for small inventors" or "exploit weaknesses in the patent system." The study observes changes to a defendant firm's stock price after the filing of a patent lawsuit by a NPE, and then determines the defendant's subsequent loss in wealth after investors alter their valuations of the stock, accounting for market trends and random noise in stock price movement. Ultimately, the study affirms that NPE litigation has resulted in half a trillion dollars of lost wealth to defendants between 1990 and 2010, with over $80 billion of that in each of the last four years alone. Further, the study attempts to see if there was a transfer of wealth from defendants to NPEs by looking at the financial statements of publicly listed NPEs. The study determines that the total revenues of the NPEs would only amount to 9% of the wealth defendants lost. Lastly, the study asserts that NPEs take advantage of "fuzzy boundaries" in patents on software and business methods because they are often vaguely written and product-producing companies cannot easily find them or understand what they legally cover.

To estimate the impact of NPE litigation on the value, or wealth, of a firm

determined by its stock price, Bessen uses an event study methodology that assumes stock returns follow a market model. The study attempts to capture any "abnormal return" to a particular stock after the filing of a lawsuit. Bessen obtains significant results for the mean cumulative abnormal returns in both five and twenty-five day event windows after the lawsuit filing of -0.32% and -.037% respectively. These negative cumulative abnormal returns represent an aggregate loss of over $500 billion due to NPE lawsuits, which Bessen expresses concern might reflect investors temporarily over-reacting to the perceived loss of value of the lawsuit filing.

b. Limitations

He states that a persistent over-reaction would be driven to a more accurate level by arbitrageurs, but it is hard to believe that investors would notice and be willing to take advantage of a less than 0.3% stock drop on a consistent basis. First of all, stocks that move 1% a day in either direction draw only minimal attention in the short-run. With transaction costs, gains might be negative in real terms for arbitrageurs to take advantage of the perceived benefit if they can only post a 0.3% gain maximum. Furthermore, Bessen does not show comprehensively how he is accounting for market trends and random noise associated with stock movements, which form the basis of his evidence and argument. It is unclear how he parses out solely movements from litigation, from other daily developments such as earnings and dividend reports, product releases, customer reviews, institutional investment backings, and mergers to name a few.

The firm Apple, for instance, saw its stock rise steadily from $90 to $210 over the course of 2009 (Google Finance 2012). The firm was also the defendant to twenty-seven

new lawsuits initiated by NPEs that year, according to PatentFreedom, and undoubtedly numerous other patent lawsuits by non-NPEs as well as other types of lawsuits (as Figure 4 shows). It is unreasonable to assume an average, albeit rational, investor can value the ultimate impact a patent-infringement lawsuit will have on a company that had $42 billion in revenues for the 2009 fiscal year, especially when investors do not have intimate knowledge of the patent nor the patentee (Google Finance 2012).

c. Dead Weight Loss?

Bessen's secondary conclusion that the loss of wealth generated by the NPE lawsuits did not result in an equivalent transfer of wealth to individuals or NPEs appears more significant and factual. The study finds that at max only 9% of the total loss to defendants could be captured in the revenues of NPEs. Even if the total wealth loss is grossly overstated, it seems quite apparent that there is a dead-weight loss, and therefore social cost, to the activity of NPEs. Bessen does note that "these social losses might be offset if NPE litigation acts like an investment in a reputation for toughness that deters future piracy," or if "transfers to independent investors increase innovation incentives," but no empirical evidence can validate this counter claim. He does express that his findings should be considered cautiously, but also makes an important distinction between firms that buy and license technologies from NPEs who assert and litigate patents. He acknowledges that patent agents, patent licensing companies and markets for technology are an important part innovation in the United States. He wants to distinguish these practices, however, from NPEs, which focus on litigating software technologies, targeting companies that have already developed a technology, suing large companies

concurrently, and cannot be the defendant of countersuits. The Bessen study provides helpful empirical data to the growing literature on the economic ramifications of the proliferation of NPEs in the past five years, but more research is needed to turn the debate from theoretical and hypothetical studies towards concrete evidence in support or against the NPE business model.

v. An Additional Recent Study

Since this study has concluded, I have discovered an additional study by MIT economist Catherine Tucker that attempts to quantitatively examine the effect of NPE lawsuits on innovation. As Ray Fisman (2012) notes, Tucker found that the NPE, Acacia Research Corporation acquired a patent from an inventor for sharing medical images via communication networks. Acacia then sued several companies that used "picture archival and communications systems, or PACS, which store medical images from ultrasounds, CT-scans, and other diagnostic tests," (Fisman 2012) which Acacia believed the companies were infringing upon. Since each defendant company produced medical-image-storage software and text-storage systems, and the patent only covered the former, Tucker (2011) believed the "latter could be used as a benchmark to assess the impact of the Acacia suit on the PACS market." Tucker concludes by finding "evidence that relative to similar products, made by the same firm, but not covered by the patent, imaging software sales declined by one-third. This was not due to a suppression in demand by hospitals but instead is linked to a lack of incremental product innovation during the period of litigation." Her study uses new and interesting methods to show how NPE lawsuits affect innovation in an atypical way, although it is limited by only looking

at one side. Fisman, who summarizes her article, accurately notes that "licensing patents by NPEs creates markets that encourage innovation by inventors" (Fisman 2012) and Tucker's study does not take into account how much the original patent inventor benefited from the sale of the patent to Acacia. However, her study is a unique and much needed empirical analysis of NPE lawsuits on innovation, and should encourage continued research in the future.

2. Conclusion

A lot of the recent attention given to patent infringement suits filed by NPEs by both the mainstream media and Internet articles label NPEs as patent trolls. This labeling has often transformed academic debate into one-sided polemic against NPEs. The above studies begin to address the social and economic costs and benefits of NPEs. It is apparent, however, by the existence of concern for NPEs in the recent *America Invents Act*, that serious academic empirical studies must continue to be conducted to arrive at conclusive findings in the future. Empirical analysis needs to take over the debate on NPEs, but NPEs will continue to be labeled as trolls until a conclusive report can prove the troll designation is inherently unwarranted. This paper contributes to that growing debate by furthering the discussion of the impact of NPEs on innovation, and finds the *patent troll* label is unjustifiable.

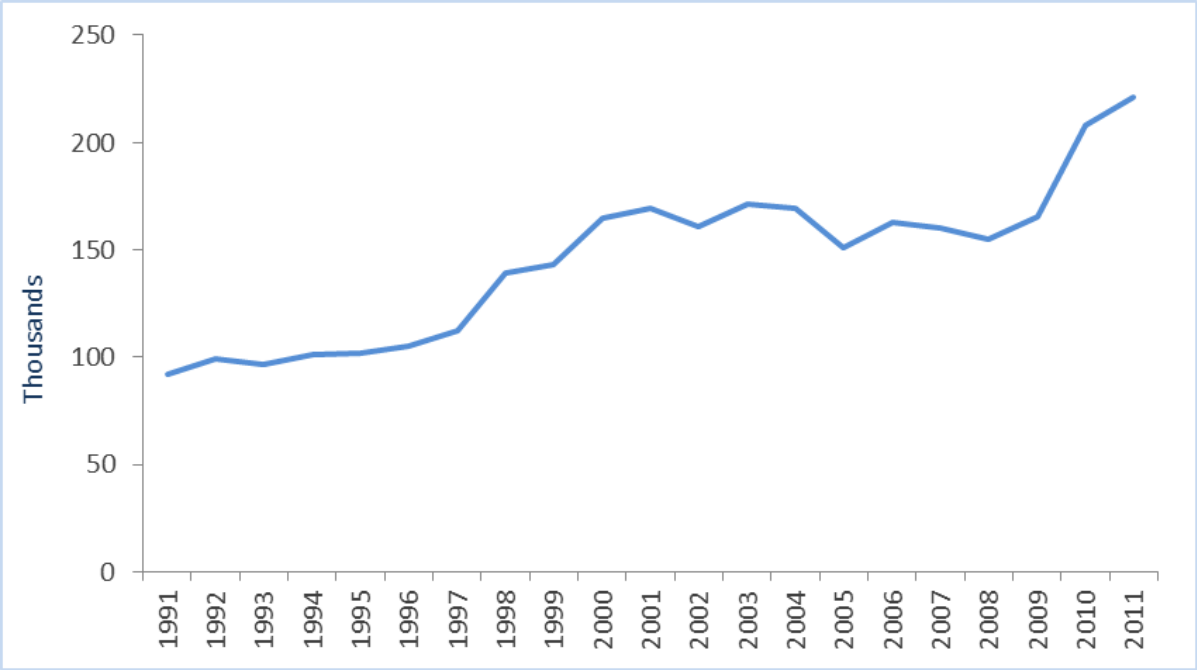
IV. Methodology

1. Patents as a Metric for Innovation

The aim of this paper is to determine an effect, if any, NPEs have on innovation, since innovation fuels economic growth and is directly related to maintaining our high standard of living. Normally, the benchmark measure for innovation is the number of patents granted by the U.S. Patent and Trademark Office. It is the most obvious and widely cited metric of determining the level and change of innovation.

Patents are divided into three classifications: utility, design, and plant patents. Overall the number of patents applied for has risen from 90,982 to 535,188 between 1963 and 2011. The number of patents granted has risen from 48,971 to 247,713 over the same time period. Utility patents, which are the subject of patent assertion litigation by NPEs because they are "issued for the invention of a new and useful process, machine, manufacture, or composition of matter, or a new and useful improvement thereof…" and have also steadily risen annually in both number of applications and grants (USPTO 2012b). In 1963, 85,869 utility patent applications were filed, while 45,679 were ultimately granted and 224,505 of 503,582 applications were granted in 2011. Clearly, utility patents represent the bulk of patents granted by the USPTO. If the United States is receiving more utility patent grants on an annual basis, specifically if the percentage of patents granted to the United States increases annually, it can be said that we are experiencing growth in innovation.

Figure 6: U.S. Utility Patents Granted Over Time Since 1991
(Patent Freedom 2012c)



The number of patents applied for and granted, however, has risen fairly consistently since 1963, so it is challenging to tease out the effect NPE litigation has had on this metric of innovation. The number of American utility patents granted has increased by 29% from 2006 to 2011, although the years 2007-2009 had less grants than 2006. At the same time, NPE litigation has increased over 400% in the same time period, so it would be difficult to tease out the effect an increase in patent litigation has had on patents granted. There is also a significant backlog of patent applications at the USPTO, so annual totals of patent grants could represent inventions that are now several years old. Additionally, companies and individual investors are even incentivized to develop new patents, for "any patent the PTO grants enjoys a legal presumption of validity," as professors Kal Raustiala and Chris Sprigman note (2011). Companies have incentive to rush a grant for trivial, unfinished or non-unique patents that could nevertheless be

leveraged to discourage competition or extract settlement fees through patent assertion litigation, even if they knew the patent would likely be invalidated in trial.

Thus the simple metric of patents granted does not account for what effect NPEs actions have had on the desire or necessity to develop patents (Raustiala and Sprigman 2011). NPEs have definitely affected the way inventors and companies file patents, so the number of patents granted is not a conclusive metric for innovation. The question turns to finding a metric that can incorporate the growing importance of patents and lead to a more practical method of quantifying innovation, and I propose an alternative metric.

2. Other Metrics

Other metrics for innovation could be product releases, accounting profits, percentage of revenue from new products, number of new markets entered, and percentage of revenue allocated to R&D to name a few. All have benefits and limitations, but other than merely looking at profits, which is directly correlated with many things other than innovation, most of this data is not readily available.

3. Intangible Assets

Patents are one form of *intangible asset*, which is a non-monetary asset that has a more discretionary value. Patents fall under the category of legal intangible assets, also known as intellectual property, and thus firms value the worth of their patent portfolio on their balance sheet. I use intangible assets as a metric demonstrating how a firm measures its patents, and therefore growth in innovation. Using the example of Bessen (2011) that looked at every case of litigation filed by a NPE between 1990-2010, I focus my study on 2006-2011 because of the availability of the data and increasing relevance of NPEs in the

past five years. Rather than looking at every individual case, this study concentrates on the top twenty-five operating companies most litigated against by NPEs. PatentFreedom classifies companies they deem NPEs and also provide data on the number of suits and ranking of the operating companies most litigated against by NPEs between the years of 2006-2011. This study focuses on how these twenty-five international firms that have faced a majority of the lawsuits from patent infringement litigators have valued their intangible assets.

4. Ratio

Instead of looking at just intangible assets, however, I use the ratio of intangible assets to total assets so that I can compare across companies (as well as across currencies) to determine the relative importance of intangible assets as companies face different rates of growth. This data is available on annual 10-k forms filed through the SEC, and I collect the data set myself.

5. Other Data

In addition, this study incorporates data from numerous other sources. As mentioned above, the USPTO provides annual statistics of patent applications, patent grants and type of patent. The office also provides annual patent grants by organization. Therefore, I am able to obtain the number of patent grants each of the twenty-five most litigated against firms received for each year of the study. PatentFreedom provides data on the lawsuits each company faced by NPEs annually as well as data on total number of NPE lawsuits on an annual basis. Stanford's Intellectual Property Litigation Clearinghouse, Lex Machina, provides additional statistics on patent litigation cases over

the past decade. To finalize the data, some descriptive statistics are used – for example, whether or not a firm is headquartered in the United States.

This study empirically analyzes the data gathered to present statistics, charts and trends of NPE litigation and firm's responses between 2006 and 2011. Much of the data are qualitatively analyzed first, and the study explicitly states limitations and reasons for caution in analyzing the data. Next, the study conducts regression analysis on the data gathered in the attempt to conclusively determine the impact of NPE litigation on the economy through innovation.

V. Data

For this study's empirical analysis, three main data sets are used: patent grants received by each company per year; NPE lawsuits in which a company was a defendant; and ratio of each company's intangible assets to total assets listed on their balance sheet. For each of the three main data sets, observations are recorded annually between the years 2006-2011 and for each of the top twenty-five most litigated against firms.

1. Patent Grants per Company

i. Definition

Table 11 in the appendix lists the number of utility patent grants each defendant company received from the USPTO during the calendar years 2006 to 2011. Table 5 below lists the average patent grants to the twenty-five firms over the same period, as well as averages for U.S. firms in comparison with foreign firms. There are 144 observations in this sample.

Table 5: Patent Grants Received by each Company Per Year since 2006 (USPTO)

Average Patent Grants	2006	2007	2008	2009	2010	2011	Total
All	19,177	17,596	21,333	26,154	33,423	34,097	151,780
U.S.	9,392	8,234	9,943	12,041	15,099	14,767	69,476
Foreign	9,785	9,362	11,390	14,113	18,324	19,330	82,304

ii. Limitations

The USPTO reports statistics on patenting by organizations but only lists companies, government agencies and other organizations that are granted more than 40 patents in the calendar year (USPTO 2012e). Therefore, not every observation (company, year) has a corresponding number of patent grants received that year. Verizon, for example, received 108 and 159 total patents in 2010 and 2011 respectively but less than 40 the four previous years. However, once Verizon's subsidiaries such as Verizon Services and Verizon Wireless are accounted for, the number of patents granted increases to 80 in 2006. Time Warner has only had 24 patents granted by the USPTO since 2006, so it is an outlier in the data set. In addition, Deutsche Telekom has only 3 American patent grants, but clearly has chosen not to file for patent applications in the United States and chosen to only concentrate on IP protection in Germany and Europe. Other foreign-headquartered firms, such as Panasonic, have increased their amount of patent grants immensely, suggesting that the company already possessed the IP property in Japan but only recently began to protect the same invention in the United States through the USPTO granting system. Panasonic received only 41 patents in 2006 but was one of the largest recipients of patents in 2011 with 2,467 grants. For these reasons, I manually counted the number of patents listed to each company and its subsidiaries through the

USPTO database. Rather than estimating number of patents granted to Deutsche Telekom, I have chosen to leave those observations blank so as not to further compromise the data.

International Business Machines Corporation (IBM) received a larger amount of patent grants than any other firm or organization in every year since 2006. Google, on the other hand, had less than 40 grants in both 2006 and 2007 but increased to 426 in 2011. However, this amounts to only 7% of the amount of patents IBM was awarded in 2011. Clearly, Google's relatively weak patent portfolio contributed to its decision to spend billions of dollars to increase their patent portfolio in 2011.

Lastly, some companies have more than one subsidiary listed as receiving patent grants. The Korean-based firm Samsung, for example, is listed as Samsung Electronics, Samsung Electro-Mechanics, Samsung SDI, Samsung Mobile Display, and Samsung LED. Some of these subsidiaries of Samsung, and other companies, had substantial patent grants, while others barely made the list of having more than 40 patent grants. Therefore, some subsidiaries might not have appeared on the USPTO list and my calculations will undervalue the intellectual property of certain companies. The data set for patents granted to a company used in the regression analysis, however, incorporates the patent grants received by subsidiaries, because it is a more accurate number than the main company listing. It is a more dynamic measure than just using patents granted to the main company listing, since it accounts for organizational and structural changes within a company. For a more detailed account of the way in which this data was obtained see the Note corresponding to Table 11 in the appendix.

2. NPE Lawsuits per Company

i. Definition

Table 12 in the appendix lists the number of instances in which a company was the defendant of a patent infringement lawsuit by a NPE. I have used PatentFreedom's data, which necessitates that I also use their classification of NPEs. PatentFreedom defines a NPE as "any entity that derives substantial revenue from the licensing or enforcement of patents and for which we have been unable to obtain verifiable evidence that the entity sells products or services that would make it vulnerable to patent counter-assertion" (PatentFreedom 2011). HP and Apple are by far the most litigated against firms and there has definitely been an increase in litigation over the course of the past six years. Figure 7 below summarizes the data from Table 12 in the appendix and shows that for the firms in this study NPE lawsuits have increased by over 500% from 2006 to 2011. There are 140 observations in this sample.

Figure 7: NPE Lawsuits to Top 25 Most Litigated Against Firms 2006-2011 (PatentFreedom 2012d)

ii. Limitations

There are imperfections in these measurements that arise with any raw data. First and foremost, the data collection began in the fall of 2011 when the available data from PatentFreedom was dated January 2011. After January 2012, updated data became available that gave data on 2011 as well as new estimates for previous years in the study. As of January 2011, PatentFreedom had only classified 380 unique NPEs, whereas in 2012 PatentFreedom has classified over 560 distinct NPEs. Therefore, this study uses the list of the top twenty-five most litigated against firms from the 2011 data set. PatentFreedom has classified more NPE lawsuits during the time period between 2006-2010 that it had not done yet for 2011's data, so many of the observations have been revised upwards. For instance, PatentFreedom found HP to be the defendant in 17 lawsuits in 2010 in its 2011 study, but has now revised that number to 32 lawsuits in its 2012 study. The new data are only for the five-year period of 2007-2011, however, so the data in Table 12 uses 2006 observations from PatentFreedom's 2011 study, while 2007-2011 incorporate the 2012 study's observations. The year 2006 is likely a little undervalued and does not incorporate lawsuits by NPEs that PatentFreedom discovered after the 2011 study. For a more detailed account of the way in which these data were obtained see the Note corresponding to Table 12 in the appendix.

3. Ratio per Company

i. Definition

Table 13 in the appendix presents the ratio of intangible assets to total assets of each of the top twenty-five most litigated against firms in the United States on an annual

basis from 2006 to 2011. The ratios are calculated by examining each company's annual SEC 10-k filings, and by looking at the annual reports of internationally based firms that are not required to submit reports through the SEC. There are 147 observations in this sample.

ii. Descriptive Statistics

Nineteen of twenty-five companies had a greater ratio of intangible assets to total assets in the final recorded year compared to the first recorded year between the period of 2006-2011. After calculating the annual ratio for each company for each year in the study, an annual average of all the countries was taken. This average can be seen below in Table 6, as well as the annual averages for American and Foreign companies.

Table 6: Annual Average of Ratios Across Companies

Annual Average Across Companies	2006	2007	2008	2009	2010	2011
Ratio	2.44%	2.91%	3.64%	3.64%	3.80%	4.25%
U.S. Companies	3.35%	3.69%	4.66%	4.15%	4.25%	4.12%
Foreign Companies	1.76%	2.57%	3.20%	3.74%	4.01%	5.24%

Table 7 shows the annual averages across companies for total assets and intangible assets. These figures are in 2011 U.S. Dollars ($).

Table 7: Annual Average of Total Assets and Intangibles Across Companies (2011 USD)[6]

Annual Average Across Companies	2006	2007	2008	2009	2010	2011
Total Assets	72,257,285,839	76,438,720,176	75,850,772,968	76,140,260,045	79,804,445,991	85,386,573,537
Patents/Intangibles	1,918,546,749	2,158,223,306	2,402,833,395	2,343,591,610	2,589,815,225	2,901,166,909

As these two Tables show, the average ratio of intangible to total assets for the firms in the study increased between 2006 and 2011. This increase was not due solely to

[6] 2011 USD figures were calculated using the core PPI as an inflation index (BLS 2012).

an increase in intangible assets as both intangible and total assets rose. It is clear, however, that intangibles rose by a greater percentage than total assets. Figures 8 and 9 below present visual depictions of the findings, and it is clear that from 2008 to 2009 there was a slight drop off in the average ratio across firms, due to a drop in total assets. It is apparent from Figure 9 that both American and foreign headquartered firms have experienced growth in the ratio of their intangible/total assets, but that American firms have valued intangibles as a greater percentage of total assets more consistently. The ratio for American firms has been much more volatile, however, whereas the ratio for foreign companies has risen steadily and was larger than for U.S. companies in 2011. The next section presents results from empirical analysis of the data denoted in this section.

Figure 8: Annual Ratio of Intangible to Total Assets of Defendant Firms

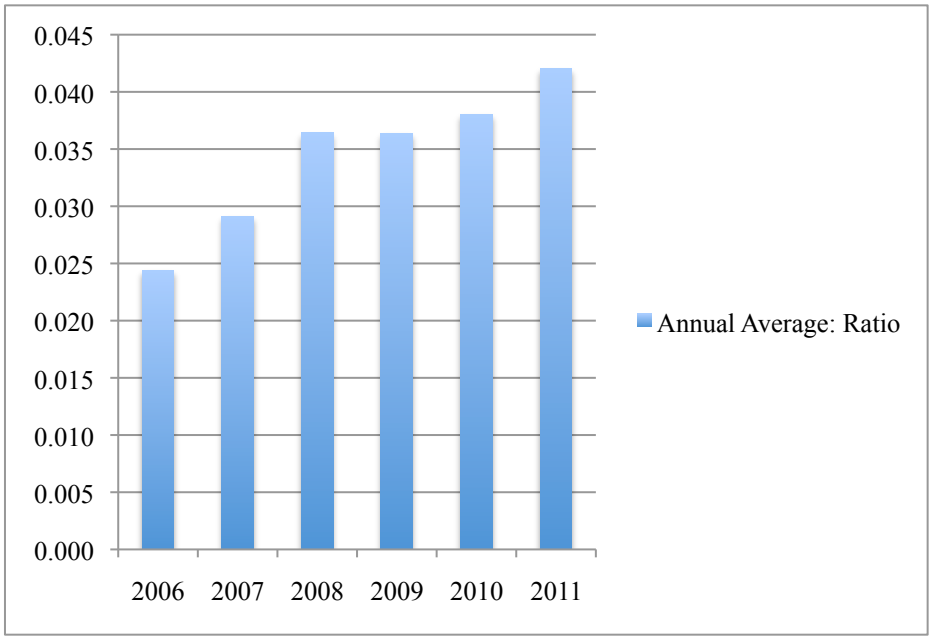
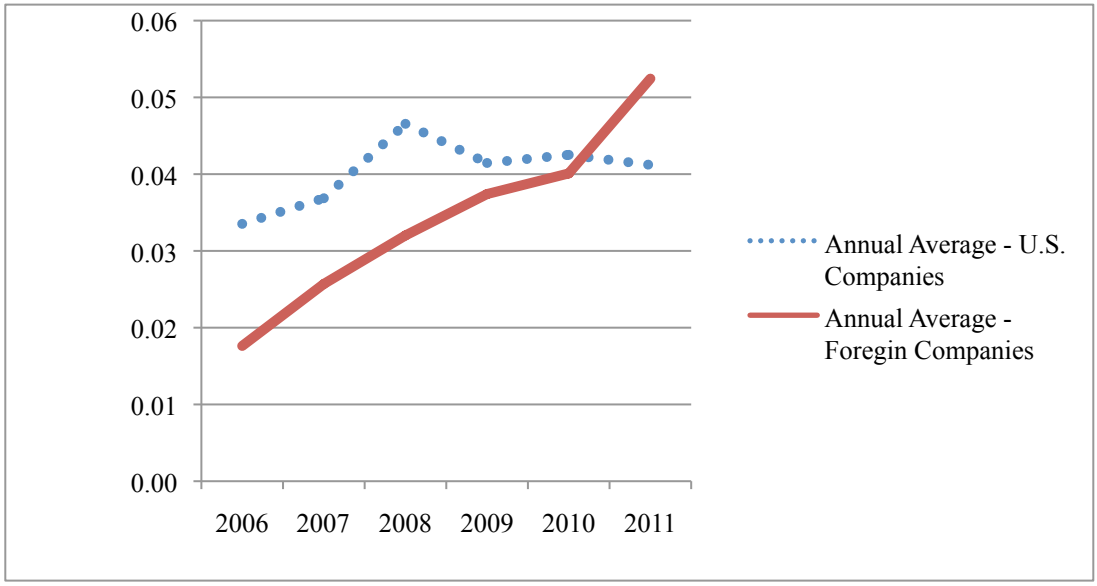


Figure 9: Annual Ratio for American and Foreign Firms



iii. Limitations

Some obvious problems with this methodology exist that I would like to draw attention to before proceeding to results. First, intangible assets take into account other items such as trade secrets, customer lists, copyrights, contracts, licensing fees (which may or may not have been based on patents held by the company), and goodwill. Each company lists intangible assets differently and incorporates different calculations based upon its financial reporting techniques, but goodwill was removed from nearly all twenty-five companies. Furthermore, financial numbers for each company vary depending on the source, so the SEC 10-k filings were used, except when noted, for American countries, while annual reports were downloaded from foreign company websites. Companies have different fiscal years, so 2011 data were not available for Acer by the time of this study, and some earlier data are missing for two firms as well. In addition, some firms have had discrepancies during the time period, such as Motorola's transition into Motorola

Solutions and Motorola Mobility. Lastly, patents have become arguably more valuable to firms because of their value in cross licensing and litigation, so companies might have just upgraded the valuation accounting methods for their own patent portfolio, and therefore an increase in the ratio would not represent an increase in innovation. Finally, some firms derive revenue from licensing patents and technologies to other firms, which may be reflected in cash or accounts receivable on the balance sheet, and therefore undermine the importance of intangible assets. Despite these potential and actual limitations, however, the ratio of intangible assets to total assets for the 25 companies with the most NPE-generated lawsuits, provides another metric for determining how important intangible assets, and by extension, innovation is becoming for these firms. For a detailed account of how the ratios were observed for each firm please see the footnote below. For a more detailed account of the way in which this data was obtained see the Note corresponding to Table 13 in the appendix.

4. Summary Statistics

The summary statistics for the data I use in my regressions can be seen in Table 8. I use Ordinary Least Squares (OLS) multivariable panel regressions to empirically examine the ways in which NPEs affect innovation.

Table 8: Summary Statistics of Regression Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Ratio of a Defendant Company's Intangible to Total Assets	146	3.46%	3.25%	0.00%	14.07%
Lawsuits Faced by a Defendant Company	140	13.89	8.54	0	42
Annual Utility Patent Grant Applications	150	464726	25517	425967	503582
Annual Utility Patent Grants	150	183382	28053	157282	224505
Annual Lawsuits by NPEs	150	2643	1185	1012	4508
Annual Lawsuits to Unique Defendants	150	622	243	387	1143
U.S. Firm?	150	0.56	0.5	0	1
Annual Patents Granted to a Defendant Company	144	1054	1324	0	6148
Log of Ratio of a Defendant Company's Intangible to Total Assets	146	-4.01	1.69	-13.91	-1.96
Log of Annual Patents Granted to a Defendant Company	144	5.85	1.91	0.69	8.72
Log of Lawsuits Faced by a Defendant Company	139	2.43	0.68	0.69	3.74
Total Assets of Defendant Company (in billions)	148	77.69	67.17	2.20	303.18
Intangible Assets of Defendant Company (in billions)	146	2.39	2.53	0.00	12.13
Log of Total Assets of Defendant Company	148	3.91	1.08	0.79	5.71

The above summary statistics show some interesting results. First, the ratio of a defendant company's intangible to total assets varies widely across firms and time. The standard deviation is nearly as large as the mean of 3.46%. The average defendant company between 2006-2011 faced almost 14 lawsuits initiated by NPEs each year, with two companies (Apple and Samsung) facing 42 in 2011. The companies in this study averaged 1054 patent grants each year of the study, although this number varied considerably between 0 and 6148. Lastly, although the defendant companies in this study are the top twenty-five most litigated against firms, HTC in 2006 was the smallest company in terms of total assets with $2.20 billion while AT&T had $303.18 billion in assets in 2007.

VI. Analysis

1. Introduction

This analysis proceeds in two parts. First, I analyze the impact of NPEs by examining how independent variables affect the amount of NPE lawsuits in a given year. Mainly, I am interested in seeing the relationship between patents granted by the USPTO and the subsequent rise in NPE activity. As determined before in this study, the number of patents granted is often judged as the ultimate measure of innovation. If patent grants increase year-by-year, the argument goes, we are becoming a more innovative country. However, as this study also shows, this logic is fallible. Patent grants are not a definite metric of innovation. There is a backlog of over 680,000 patents waiting to be reviewed by the USPTO – more than three times the amount of patents granted in 2011 alone – so the number of patents granted in a certain year cannot measure "innovation" in that same year. In addition, the patent thicket is a growing problem as software and business methods patents are granted that overlap and merely obfuscate the patent system. The number of patents granted annually, therefore, is a flawed measure of innovation – but the first part of this analysis uses that measure to determine if an increase in patents is correlated with an increase in NPE activity. Essentially, my question is how does the number of patents granted to the most litigated against companies affect the number of NPE lawsuits it must defendant against? I then quantify the total cost that firms have to spend in response to NPE lawsuits.

The second part of this analysis employs my new metric for innovation, the ratio of a firm's intangible to total assets, to see if variables gathered on NPE activity in this

study have led to a significant increase in the ratio

Analysis 1:

Table 9: OLS Regressions 1-3 of *Log* of Lawsuits Faced By a Defendant Company

Dependent Variable: ln(Lawsuits faced by a defendant company)			
Regression	(1)	(2)	**(3)**
ln(Patents granted to defendant company)	0.0335	0.0172	0.0213
	(0.0220)	(0.0221)	(0.0225)
Total assets of defendant company (in 2011 $ billions)		0.0018***	0.0016***
		(0.0005)	(0.0006)
U.S. domestic firm?			0.0780
			(0.0797)
Year fixed effects?	Y	Y	Y
Constant	1.2170***	1.1753***	1.1218***
	(0.1485)	(0.1476)	(0.1574)
Summary Statistics:			
# of observations	133	131	131
R^2	0.6159	0.6409	0.6437
* p < 0.10, ** p < 0.05, *** p < 0.01			
Note: standard errors in parentheses			

i. Regression Results

Regressions 1, 2, and 3 are OLS panel regressions that account for one, two, and three independent variables respectively. These regressions all include time fixed effects (by year). The regressions incorporate time fixed effects to account for unobserved effects that vary across time and impact the number of NPE lawsuits in a given year. I employ yearly dummy, or binary, variables to account for the time fixed effects. The omitted year is 2006. I did not include results from the same regressions without time fixed effects in Table 9 above because the R^2 values were much lower (less than 0.1.)

Regression 1 is a log-log regression that only incorporates the effect of the variable for patents granted on NPE lawsuits. Because of the log-log form of this regression, the coefficient on patents granted is the elasticity of NPE lawsuits with

respect to patent grants. The coefficient on log of patents granted is 0.0335 and only has a p-value significant at the 13% level. This implies that if the number of patent grants across companies increases by 100%, the predicted number of lawsuits by NPEs would increase by 3.35%, other things equal. The R-squared value of Regression 1 is 0.6159 so 61.59% of the variation in the dependent variable is explained by the independent variable. Significantly, however, the lower bound of the 95% confidence interval for the independent variable falls below 0, so the regression cannot conclusively say that increasing patent grants will have a positive impact on NPE lawsuits, ceteris paribus.

Regression 2 adds an independent variable for a firm's total assets. The variable measures the firm's growth in assets over time (in billions) and should help explain some of the variation in NPE lawsuits a firm faces, since NPEs likely target profitable firms. The coefficient on patent grants lowers from Regression 1 to .0172 and is not statistically significant at the 10% level. The variable for total assets (in billions), however, is significant at the 1% level with a coefficient of 0.0018. The coefficient of 0.0018 implies that a $1 billion dollar increase in a firm's assets in 2011 inflation adjusted dollars, other things equal, would predict a 0.18% increase in NPE lawsuits. For many of the firms included in this study a $1 billion increase in assets is less than a 1% increase in assets, so the finding is not insignificant. This regression includes time fixed effects and has an R^2 value of 0.6409 so it is slightly higher than the R^2 value for Regression 1.

Regression 3 adds a binary independent variable, which, when equal to 1, denotes that a firm is headquartered in the United States. American firms tend to file patents through the USPTO differently, place different weights on their intangible to total asset

ratios, and are more active in the United States so I want to determine if NPE lawsuits target American and foreign firms differently. Regression 3 is the main regression of this section in the study's analysis. There are 124 observations in the panel data and the R-squared valued is 0.6437, signifying approximately two-thirds of the variation in NPE lawsuits is captured by the independent variables. This is R^2 value barely increased from Regression 2, however. The U.S. domestic firm binary variable has a coefficient of 0.078 but is not significant at the 10% level. Therefore, this study cannot conclusively predict that, other things equal, American firms will have 7.8% more lawsuits than foreign firms especially since the lower bound of the 95% interval still predicts a negative correlation. The headquarters location of a firm is insignificant in determining the amount of NPE lawsuits that company will receive in a given year. I thought that American firms would be sued more often than foreign firms because they are more active and thus NPEs would have an easier time suing American firms for patent infringement. This was not the case, however, and perhaps could result from the fact that American firms also have better patent protection.

Log of patents granted has a coefficient of 0.0213 and is also not significant at the 10% level, which is interesting because it implies that the number of patents granted to a company does not significantly affect the number of lawsuits that company will need to defend against, other things equal. Lastly, the coefficient for total assets is 0.0016 with a p-value of 0.007. Therefore, an increase in a firm's total assets by $1 billion in inflation-adjusted dollars will increase NPE lawsuits by .1603%, ceteris paribus.

ii. Estimates of Model

This last finding appears irrelevant to the effect of NPEs on innovation and the economy, but it is quite interesting when quantified into a more approachable number. The total assets of the 25 firms in this study in 2010 were $1.995 trillion (in 2011 USD). In 2011 total assets increased to $2.135 trillion. Total assets increased by approximately $140 billion for the 25 companies involved in this study. If we assume that total assets will increase by the same amount for these companies between 2011 and 2012 (probably a conservative estimate), then using the model from Regression 6, NPE lawsuits will increase by 22.44% over the same period for these companies, other things equal.

These companies were the defendants of 560 of the 4,508 NPE patent-litigations in 2011 (or 12.4%), so the model approximates that NPE lawsuits will increase by 126 in 2012 for these 25 companies. My sample data set is not a random data set representative of every defendant company of patent litigation in the United States, so my model does not allow me to conjecture about how other firm's increases in total assets or patent grants affects the amount of NPE litigation cases in which they are defendants. However, if we assume that these companies are similar to other companies sued by NPEs for patent infringement, then my study shows that a possible 1,008 (or 8x126) patent litigation suits could arise in 2012 based solely on firm growth (measured by total assets).

According to a 2009 survey by the American Intellectual Property Law Association, total litigation costs average approximately $3 million when the amount in dispute is less than $25 million and roughly double that figure when the dispute is more than that sum. Therefore, applying my model to American firms at large and assuming

that the model would hold for less-litigated against firms, 1,008 additional NPE lawsuits would cost $3.024 billion in 2012 (with an average cost of $3 million per lawsuit). At the very least, however, the model can predict that 126 NPE suits will arise in 2012 because of the 25 firms' growth in assets. Applying an average cost of $4.5 million to the defendant companies, per lawsuit, my model predicts that NPE lawsuits will cost $567 million, if firms experience the same inflation-adjusted growth from 2011 to 2012.

Overall, this model predicts that a similar increase in total assets of $140 billion between 2011 and 2012 for the 25 most litigated against firms would lead to an increase in NPE patent infringement litigation that would cost these companies $567 million to $3.024 billion. This amounts to only 0.4 - 2.17% of the firm's increase in total assets, but represents a net loss of over half-a-billion dollars that could have been allocated more efficiently and put into research and development to develop the technologies of the future. Significantly, this value does not include settlement payments, so it only represents the net loss of lawyer and administrative fees that could have been allocated to better uses. Settlements themselves can be millions, if not billions, of dollars as the RIM v. NTP case showed, but this study is not able to comment on that because of an unavailability of settlement data. Further, some of the settlement payments surely represent a transfer to NPEs as well as the just payments to innovators who have been infringed upon, and are therefore not a deadweight loss to society.

I am going to title the cost my model estimates above as an *innovation cost*. Because firms are successful and patents are granted at an increasing rate, NPEs are taking advantage of an opportunity to sue the most successful firms and limit the

beneficial effects of traditional measures of innovation, namely patents granted and growth (in assets, or wealth) of firms.

iii. Limitations

There are many limitations with this data and model that I must expressly state so that any results are used with caution. First, this model violates an OLS assumption in that it does not represent a random sample of firms and patent lawsuits from across the nation. I took available data and concentrated on the top twenty-five most litigated against firms. Some observations are missing and more comments can be found in footnotes to the data in the appendix. This model obviously fails to account for other fixed and random variables that surely affect the number of patent lawsuits filed by NPEs.

Furthermore, my model is likely biased by endogeneity, and therefore the estimates are likely biased upwards. I attempted to account for the fact that companies that are doing well and growing fast may be more likely than average companies to also be increasing their patents. Both patents granted and total assets are representative of companies that are doing well and growing fast. Better companies increase their assets and patents, but great companies might be a target of NPE lawsuits for reasons unrelated to "trolling." For instance, better and faster growing companies are more active, often have wider portfolios of products, are often in the tech sector where the patent thicket problem is larger, and are probably more likely to get targeted by lawsuits for reasons having nothing to do with their innovation activities.

One could address the problem of endogeneity by instrumenting for ln(patents

granted). However, it is difficult to find a variable that varies over time and across companies that is correlated with having a patent granted for a specific company that was not correlated with fast growth, or anything else correlated with lawsuit potential. My attempt was to use the unemployment rate by state that a company is headquartered in to serve as my instrument for patent grants, because I assumed a low unemployment rate would correspond to a boom business cycle and more money spent on R&D as well as have no correlation whatsoever to NPE lawsuits. Unfortunately, this turned out to be quite noisy, and a weak instrument. Above all, this study has many limitations, but I believe the findings are still extremely interesting and useful to furthering the study of NPEs.

Analysis 2:

This analysis concentrates on the metric this study developed for measuring innovation. This section attempts to determine if a dramatic rise in NPE activity since 2006 has led to a change in innovation, and if that change can be empirically measured.

Table 10: OLS Regressions 4-6 of *Log* of Ratio of Defendant Company's Intangible to Total Assets

Dependent Variable: ln(Ratio of defendant company's intangible to total assets)

Regression	(4)	(5)	**(6)**
ln(Lawsuits faced by defendant company)	-0.0925 (0.3377)	-0.0785 (0.3425)	-0.1106 (0.3423)
Patents granted to defendant company	-0.00036*** (0.0001)	-0.00037*** (0.0001)	-0.00036*** (0.0001)
U.S. domestic firm?		-0.0865 (0.2998)	-0.1053 (0.2993)
Year fixed effects?	Y	Y	Y
Constant	-4.3820*** (0.6054)	-4.3426*** (0.6229)	-4.3966*** (0.6224)
Summary Statistics:			
# of observations	129	129	128
R^2	0.1365	0.1371	0.1434

* p < 0.10, ** p < 0.05, *** p < 0.01
Note: standard errors in parentheses

i. Regression Results

Regression 4 is a multivariable OLS panel regression that accounts for time fixed effects (by year) but does not include the binary variable for location of a firm's headquarters. Regression 5 is a similar regression that accounts for the U.S. domestic firm variable but does not produce drastically different results since the coefficient on the additional binary variable is insignificant. Regression 6 drops some outlier data, and is the main regression of this analysis (see Note 7).[7] Ultimately, the regression's independent variables can only explain 14.34% of the variation in log of the ratio, and the binary variable signifying a U.S. domestic firm has essentially no determinable effect on

[7] Regression 6 drops data from Time Warner for 2006 and 2007 because the observations were outliers.

the dependent variable. Most significantly, however, we *cannot* reject the null hypothesis that NPE lawsuits have an effect on a firm's ratio. The coefficient on log of NPE lawsuits is not significant and the 95% confidence interval ranges from -78.8% to 56.8%. The number of suits filed by a NPE against a defendant firm is the most descriptive variable I have of NPE activity. This regression is not encompassing enough to be able to reject the null hypothesis that NPE patent infringement suits have an effect on the ratio of a firm's intangible to total assets. Therefore, we can conclude from this model that this study cannot determine if NPEs positively or negatively affect innovation.

ii. Limitations

Again this study is prone to a weakness in random selection bias and sample size. Further, innovation here is measured through the metric I created, which is an imperfect measure as stated in the data collection. This regression shows, if anything, that NPEs do not definitely negatively impact innovation. If NPEs are conclusively negative for the economy, in general, and innovation, specifically, then the results would have spoken as much. Instead, the 95% confidence interval showing the percentage effect a 100% increase in suits has on innovation has a lower bound of -78% and an upper bound of 57%. Studies such as Bessen (2011) that categorically claim NPEs have caused a dead-weight loss, while perhaps statistically true, cannot take every impact of NPEs into account. This regression highlights that the debate over NPEs must still be pursued through further empirical studies.

VII. Conclusion

This study has two primary goals. First, introduce readers to the activity of non-practicing entities and highlight the theoretical and empirical debate over their growing relevance. Second, this study aims to contribute to the empirical literature concerning NPEs through multivariable regression analysis, since most of the literature is theoretical or mainly empirically descriptive in nature. To accomplish this, a new panel data set was built from the ground up that incorporated publicly available data on NPEs, as well as manually scrubbed data from SEC 10-k filings. Further, the study develops a new metric for innovation, which was used to attempt to find conclusive evidence of the social and economic impact of NPEs. Clearly, the study is limited by the availability of data on NPEs and by problems associated with small and non-random sample size.

The study's first analysis provides evidence of at least a $567 million *innovation cost,* the money the most litigated against firms must spend to provide legal defense against NPE lawsuits as a result of their success, growth, and patent filing. Second, this study determines that NPE lawsuits against a company cannot predict whether that firm experiences an increase or decrease in innovation. I find that NPEs have no significantly determinable affect on innovation, which is in stark contrast to the majority of existing literature on NPEs. True, other studies do not focus their analysis on innovation, but instead look at other ways in which NPEs are alleged to affect the economy. But since most theoretical studies decry the impact of NPEs on innovation for our economy, I wanted to focus on innovation in this study. This study contributes to the goal of Section 34 of the AIA, in that it helps to estimate the costs associated with NPE litigation as well

as finds that there is no distinguishable effect or economic impact of such litigation on the U.S. economy looking at solely the metric of innovation.

Taken together, it is evident that NPEs do not just affect the economy and innovation in a solitary way. Bessen (2011) claims that NPEs caused a $500 billion dead weight loss to the American economy over the last 20 years, roughly $80 billion of which was lost in each of the past 4 years. The study, however, only looks at how NPEs affect stock prices, if one believes stock price movements can be teased out on such a scale, and not the plethora of ways in which NPEs are changing the way companies act. Bessen (2011) represents an attempt, like mine, to tease out different ways to measure the effect of NPEs, but ultimately the studies in the literature today are neither definitive nor conclusive. As my data show, firms have begun to invest heavily in patents and intangible assets, though to what degree NPEs are responsible for this rise this study cannot determine. This correlation between NPE activity and metrics of innovation, such as patents and the ratio of intangible to total assets, need to be examined before NPEs can be written off as trolls, although they seem to have already acquired that permanent name by the media.

It is easy to shun the concept of NPEs, for they do not produces goods or services and therefore do not contribute to our GDP and measurable economic growth. But how much NPEs are a product of vicious and over zealous litigation as opposed to a business model filling a niche created by poor patent laws remains to be seen. It appears that until there is significant reform in patent laws, and to accomplish reform a majority of government would have to be convinced that NPEs negatively impact the economy and

innovation, NPEs will continue to do what they are best at: sue organizations. Firms are learning and responding to the threat of NPEs by valuing their own patents more, increasing their portfolios, filing more grants, and increasing their knowledge of patent litigation – but when it costs relatively nothing to sue and firms can extract enormous sums from bigger wealthier firms who pragmatically decide to settle, NPEs will persist. IBM has filed more patents than any other institution (business or educational) each year since 2006, but the average American would no longer associate IBM as amongst the most innovative firms in America. They seem to be one of the only companies that grasped the value of patents early (since at least 2006), however, with firms like Google and Apple having to shell out billions of dollars to keep up.

It will most likely take an enormous payment sum from a defendant that loses a trial to a NPE or new regulation by Congress that changes the way NPEs are allowed to operate, but until then NPEs will continue to flourish in their unique space between innovators and practicing-entities. They should not, however, be labeled *patent trolls*, for the designation implies a negative connotation, while in fact this study does not find an impact of NPEs on American innovation. Significantly, NPEs have become an interesting and relevant topic for study and this undergraduate thesis proves the necessity for much more empirical work in the field. Hopefully future analysis takes into account other metrics of innovation, other than the static metric of patents granted, and attempt to isolate the many dynamic ways in which NPEs are impacting the economy.

Appendix:

Table 11: Patent Grants Received by each Company Per Year since 2006 (USPTO)[8]

Company	2006	2007	2008	2009	2010	2011	Total
HP	2099	1466	1422	1269	1480	1307	9043
Apple	106	118	185	289	563	676	1937
AT&T	264	273	317	494	563	561	2472
Sony (Japan)	1833	1552	1581	1863	2516	2692	12037
Microsoft	1463	1637	2026	2901	3086	2309	13422
Dell	119	133	159	191	185	226	1013
Samsung (Korea)	2738	2872	4145	4306	5367	5768	25196
Motorola	576	411	350	339	448	343	2467
LG (Korea)	1076	1150	1403	1798	2459	2379	10265
Verizon	80	69	89	88	108	159	593
Panasonic (Japan)	41	45	255	1800	2536	2647	7324
Nokia (Finland)	732	679	608	648	758	628	4053
Time Warner	2	4	5	2	6	5	24
Google	22	35	58	141	275	426	957
Cisco	649	580	704	913	1114	979	4939
HTC (Taiwan)	10	7	4	43	53	71	188
Sprint Nextel	188	187	191	199	295	382	1442
Toshiba (Japan)	1717	1569	1667	1767	2391	2605	11716
Deutsche Telekom (Germany)							0
RIM (Canada)	84	131	205	306	477	663	1866
Acer (Taiwan)	16	16	6	4	15	16	73
IBM	3621	3125	4169	4887	5866	6148	27816
Yahoo	29	28	67	125	290	332	871
Oracle	174	168	201	203	820	914	2480
Fujitsu (Japan)	1538	1341	1516	1578	1752	1861	9586

[8] I conducted a manual search for patent grants for companies that did not make the USPTO's "Patenting by Organizations" list for the calendar years 2006-2011 (they had less than 40 patent grants). This database can be accessed through (USPTO 2012d). Acer, for example, had less than 40 grants each year for a total of 638 listed in USPTO's database. Apparently, the majority of their patents were granted in years prior to 2006, because Acer only had 73 grants in the 6 years of this study. Time Warner's numbers were calculated using this manual search as well as Google in 2006 and 2007. Verizon did not always make the "Patenting by Organizations" list but after manually checking for patents granted to its subsidiaries, it is clear that it received 593 grants since 2006. I manually verified HTC's data as well and found that it received 71, rather than 41, grants in 2011. I manually checked Yahoo's grants in 2006 and 2007 as well as Panasonic's data in 2007. Time Warner is truly an outlier in this data set, and perhaps it is on the list of companies most sued because it does not have as much patent protection as other firms. Foreign companies had many more subsidiaries than American companies. Sony, Samsung, LG, Toshiba, and Fujitsu all had at least four companies affiliated with the main company that also received patent grants.

Again, this data is limited by the existence of subsidiaries and associated organizations to which companies patent grants are listed. However, through manually checking and verifying as many numbers as possible, I believe it is a more accurate data set and the best I could verify manually with the availability of data online. The table clearly shows how companies have been applying for and receiving many more patent grants throughout the years of this study.

Table 12: NPE Lawsuits by Company Per Year since 2006 (PatentFreedom)[9]

Company	2006	2007	2008	2009	2010	2011	Total
HP	8	15	27	27	32	30	139
Apple	3	12	18	27	32	42	134
AT&T	6	18	18	16	21	29	108
Sony (Japan)	5	14	12	23	18	33	105
Microsoft	6	21	16	20	11	26	100
Dell	8	13	8	24	18	34	105
Samsung (Korea)	8	20	12	10	21	42	113
Motorola	4	12	17	12	20	35	100
LG (Korea)	3	14	11	10	22	28	88
Verizon	3	16	13	13	17	26	88
Panasonic (Japan)	4	12	12	20	12	18	78
Nokia (Finland)	4	11	13	14	14	24	80
Time Warner	6						6
Google	3	13	10	16	10	28	80
Cisco	0	18	8	13	14	15	68
HTC (Taiwan)	3	6	15	11	22	29	86
Sprint Nextel	3	13	11	12	8	15	62
Toshiba (Japan)	4	11	8	15	12	20	70
Deutsche Telekom (Germany)	2	13	9	11	9	16	60
RIM (Canada)	2	4	15	11	13	28	73
Acer (Taiwan)	4	10	11	10	6	10	51
IBM	3	12	3	13	10	8	49
Yahoo	2	11	6	12	6	13	50
Oracle	6						6
Fujitsu (Japan)	3	4	7	13	7	11	45

[9] Because of the updated data, Time Warner and Oracle have fallen out of the top thirty firms litigated against from 2007-2011 and therefore this study lacks the most recent data on lawsuits against those companies. Time Warner had 37 lawsuits while Oracle was the defendant in 26 between 2006-2010, but this study does not estimate their new annual totals to not further compromise the data set. Therefore those two companies only have observations for 2006. It is also important to note that firms are not listed in perfect order of decreasing total lawsuits, but rather are listed in the original order of the top twenty-five most litigated against firms from PatentFreedom's 2011 data in order to remain aligned with the rest of the study's data sets. Despite these drawbacks, the data in Table 12 remain the most comprehensive account available of the lawsuits some of the largest multinational companies face by NPEs.

Table 13: Ratio of Each Company's Intangibles to Total Assets per Year since 2006 (SEC)[10]

Company	2006	2007	2008	2009	2010	2011
HP	2.35%	3.12%	3.70%	3.63%	3.05%	5.58%
Apple	0.81%	1.18%	0.79%	0.52%	0.45%	3.04%
AT&T	2.43%	2.14%	2.20%	2.05%	2.03%	1.93%
Sony (Japan)	1.95%	1.99%	2.10%	3.30%	2.94%	3.03%
Microsoft	0.77%	1.39%	2.71%	2.26%	1.34%	0.68%
Dell	3.51%	1.77%	2.83%	2.73%	5.03%	3.87%
Samsung (Korea)	0.00%	0.00%	1.12%	1.12%	2.07%	2.16%
Motorola	0.42%	0.74%	0.84%	0.90%	1.21%	1.36%
LG (Korea)	1.86%	1.76%	1.83%	2.14%	2.36%	3.17%
Verizon	2.72%	2.67%	2.57%	2.98%	2.65%	2.55%
Panasonic (Japan)			1.73%	1.89%	7.24%	6.94%
Nokia (Finland)	1.32%	6.27%	9.89%	7.73%	4.93%	3.88%
Time Warner	8.16%	8.21%	14.07%	13.91%	13.26%	12.86%
Google	1.88%	1.76%	3.14%	1.91%	1.80%	2.17%
Cisco	4.99%	4.76%	3.56%	2.50%	4.04%	2.92%
HTC (Taiwan)		0.19%	0.25%	0.20%	0.49%	8.86%
Sprint Nextel	2.02%	2.86%	6.09%	5.73%	3.89%	3.27%
Toshiba (Japan)	1.84%	5.46%	4.59%	5.04%	4.82%	4.44%
Deutsche Telekom (Germany)	0.78%	0.69%	0.94%	1.18%	0.21%	0.31%
RIM (Canada)	3.72%	4.47%	8.53%	13.16%	12.99%	13.97%
Acer (Taiwan)	0.00%	0.61%	0.28%	0.28%	0.31%	0.10%
IBM	0.08%	0.06%	0.10%	0.11%	0.12%	
Yahoo	3.52%	5.00%	3.55%	2.38%	1.71%	1.72%
Oracle	6.57%	8.57%	9.73%	8.14%	10.42%	7.38%
Fujitsu (Japan)	4.38%	4.26%	3.95%	5.12%	5.74%	5.68%

[10] Table 13 shows the ratio of firms' intangible to total assets per year over the course of the study. Table 14 below shows what exact classification of intangible assets was used to calculate the metric. All data were taken from the SEC annual 10-k reports except where noted below. AT&T earlier data are from AT&T's website, while later years are from the SEC. Sony data are from Stock Analysis On Net, because it included data since 2006, but I verified data from later years and it was aligned with other websites showing Sony's financials. Samsung, LG, and Nokia data are from their respective websites and annual reports. Motorola is formed from summing Motorola Mobility and Motorola Solutions, the former of which has data from 2009. Panasonic's data did not specify intangible values so they were taken from Forbes. Time Warner included AOL and Time Warner Cable until 2009 when they were spun off under different companies, and Time Warner has many subsidiaries so its ratios might be affected. For Cisco I looked at the SEC filings and its website, and Deutsche Telekom, HTC, Acer, and Fujitsu were all taken from their respective websites as well.

Table 14: Notable Differences in Asset Classifications of Defendant Companies (SEC & Annual Reports)[11]

Company	Intangible Asset Classification Used	Ending Month of Fiscal Year
HP	Developed and core technology and patents, gross	Oct
Apple	Acquired Intangible Assets, net	Sep
AT&T	Other Intangible Assets - Net	Dec
Sony (Japan)	Intangibles, Net	Mar
Microsoft	Intangible assets, net	June
Dell	Purchased Intangible Assets, net (06/07 "other")	Jan
Samsung (Korea)	Intangible Assets	Dec
Motorola	Solutions: Patents (gross carrying amount); Mobility: Patents	Dec (Mobility) Mar (Solutions)
LG (Korea)	Intangible Assets	Dec
Verizon	Other intangible assets, net	Dec
Panasonic (Japan)	Intangibles	Mar
Nokia (Finland)	Other Intangible Assets	Dec
Time Warner	Brands, Trademarks, and other Intangibles, net	Dec
Google	Intangible Assets, net	Dec
Cisco	Purchased Intangible Assets, net	July
HTC (Taiwan)	Intangible Assets	Dec
Sprint Nextel	Definite-lived intangible assets, net	Dec
Toshiba (Japan)	Other intangible assets, net	Mar
Deutsche Telekom (Germany)	Intangible Assets	Dec
RIM (Canada)	Intangible Assets, net	Feb
Acer (Taiwan)	Patents	Dec
IBM	Patents/Trademarks, net carrying amount	Dec
Yahoo	Intangible Assets, net	Dec
Oracle	Intangible Assets, net (no software agreements/relationships)	May
Fujitsu (Japan)	Intangible Assets minus Goodwill	Mar

[11] This Table shows the classification of intangible assets I used when calculating the ratio of a defendant firms intangible to total assets. When possible, I used patents or the most accurate data available that would only show a firm's valuation of its patent portfolio, but all companies unfortunately do not describe their intangible assets in explicit detail. Lastly, it shows the ending month of the fiscal year firms use when calculating their financials on their annual reports, although by the time this study was completed only Acer did not have available data to calculate 2011 ratios.

Table 15: Averages of Assets by Company between 2006-2011 Adjusted for Inflation (in 2011 USD)[12]

Company	Average Total Assets 2006-2011 (in 2011 USD)	Average Total Intangibles 2006-2011 (in 2011 USD)
HP	$ 114,304,139,235	$ 4,181,288,000
Apple	54,696,918,712	821,604,102
AT&T	285,216,913,565	6,087,236,545
Sony (Japan)	130,857,552,478	3,393,183,107
Microsoft	83,735,057,481	1,236,576,745
Dell	30,675,858,833	1,037,271,413
Samsung (Korea)	103,650,211,271	1,463,727,303
Motorola	43,132,468,961	330,496,501
LG (Korea)	34,148,491,306	728,115,045
Verizon	220,514,126,835	5,937,835,420
Panasonic (Japan)	83,077,225,294	3,953,683,498
Nokia (Finland)	48,848,686,634	2,981,062,015
Time Warner	94,342,579,965	10,124,792,582
Google	42,684,146,925	898,237,690
Cisco	68,397,611,107	2,515,293,337
HTC (Taiwan)	4,453,750,279	157,302,459
Sprint Nextel	66,881,813,374	2,495,559,418
Toshiba (Japan)	56,518,875,834	2,523,891,110
Deutsche Telekom (Germany)	143,705,265,804	1,014,492,864
RIM (Canada)	6,642,006,847	768,873,173
Acer (Taiwan)	7,926,346,056	242,541,126
IBM	118,347,485,421	111,209,329
Yahoo	14,407,694,160	421,481,378
Oracle	51,085,408,074	4,380,101,913
Fujitsu (Japan)	35,817,683,629	1,738,336,714

[12] This Table shows the average values of assets per company over the course of the 6 years of this study (2006-2011). Values in this table were first converted to U.S. dollars using the annual exchange rates for firms based outside the United States listed in Table 16 below. Values were then adjusted to represent 2011 U.S. dollars after indexing for inflation using the core PPI values located in Table 17. The ratios listed in Table 13 were not influenced by any adjustments of values, but accounting for inflation and exchange rates should improve the regression results in this study.

Table 16: Exchange Rates Used to Calculate Asset Values (IRS 2012)

		Exchange Rate Divided By to Obtain Currency in USD					
Company	**Currency**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
HP	$						
Apple	$						
AT&T	$						
Sony (Japan)	Yen	Data collected for Sony was already in USD					
Microsoft	$						
Dell	$						
Samsung (Korea)	Won	1,008.698	972.681	1,146.949	1,330.240	1,206.268	1,153.728
Motorola	$						
LG (Korea)	Won	1,008.698	972.681	1,146.949	1,330.240	1,206.268	1,153.728
Verizon	$						
Panasonic (Japan)	Yen	Data collected for Panasonic was already in USD					
Nokia (Finland)	Euro	0.829	0.760	0.711	0.748	0.785	0.748
Time Warner	$						
Google	$						
Cisco	$						
HTC (Taiwan)	Taiwan Dollar	33.858	34.198	32.818	34.389	32.814	30.693
Sprint Nextel	$						
Toshiba (Japan)	Yen	122.527	122.527	107.605	97.361	91.342	82.931
Deutsche Telekom (Germany)	Euro	0.829	0.760	0.711	0.748	0.785	0.748
RIM (Canada)	Canadian Dollar	1.180	1.117	1.109	1.187	1.072	1.029
Acer (Taiwan)	Taiwan Dollar	33.858	34.198	32.818	34.389	32.814	30.693
IBM	$						
Yahoo	$						
Oracle	$						
Fujitsu (Japan)	Yen	122.527	122.527	107.605	97.361	91.342	82.931

Table 17: Inflation Rates Used to Value Assets in 2011 USD[13]

Core Producer Price Index

PPI: Finished Goods Less Food Index

Year	**2007**	**2008**	**2009**	**2010**	**2011**
Annual Rate	1.9%	3.4%	2.6%	1.2%	2.4%

[13] I used 2011 data as a base year, then calculated 2010 adjusted values in 2011 dollars by multiplying nominal 2010 data by 1.024. This process was continued until 2006, when nominal values were multiplied by 1.1203.

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