Market Reaction to Patent Litigation Verdicts and Patent Appeal Results

Lorna Zhang
Advisor: Professor Yeon-Koo Che
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Abstract

This paper examines the capabilities of markets in predicting the probability that an intellectual property (IP) litigation verdict will be later overturned upon appeal. Unlike prior research, which have primarily focused on patent litigation cases where a settlement was reached between the two parties, this study examines litigation cases that went to trial. I find evidence of divergence between the ability of the stock returns of claimant and defendant firms in predicting the probability of reversal. In particular, defendant firm market movement is significantly related to the probability of reversal, whereas claimant firm market movement is almost completely insignificant. I also find evidence that the probability of reversal significantly increases when the claimant wins the initial trial. This is likely due to the way the court system is designed to incentive firms to patent their innovations. Additionally, my results suggest that publicly traded firms of difference sizes approach the litigation process differently. I also find that when both the claimant and defendant firms are publicly traded, the probability that the verdict will be overturned increases.

1 Introduction

Patents are one of the most significant legal instruments that protect intellectual property (IP) rights. A patent gives the inventor the exclusive rights to the patented idea for a limited period of time, typically 20 years from the date the patent was filed. A patentable invention must be new, useful and nonobvious to a person skilled in the field of application at the time. Novel ideas that result in new, useful products have an obvious economic value. But, these ideas are also pure public goods, which can make them problematic for a market system to handle and results in a market failure where too few innovations are made[1]. Patents help to alleviate this problem by creating a legal means of conferring excludability upon novel innovations.

Recently, we have seen a steady rise in patent litigation year after year. The number of patent litigations has risen from 2,281 in 2000 to 5,484 in 2012, an increase of about 140%[1]. It is well documented that litigations are costly affairs [20, 15, 18, 19, 6, 7, 22]. For example, a recent study related to patent litigation found that Research in Motion, the maker of Blackberry phones, incurred over $22 million in costs defending itself against a patent infringement lawsuit [20]. An earlier study by Lerner [18], which looked at the effect of litigation on firm value, found an average decrease in firm value of -2% upon the initial litigation announcement for 26 biotechnology suits, representing a median shareholder value loss of $20 million. Mark Lemley, a Stanford Law professor, estimated in an interview with National Public Radio (NPR) that Apple has already spent $700 million in legal fees on the ongoing Apple vs. Samsung litigation [22]. Additionally, numerous studies ([6, 19, 10]) have shown that two of the main reasons firms choose not to apply for a patent is that the expected cost of defending the patent in court and the likelihood that the patent's validity will be called into question when a firm tries to assert said patent in court are prohibitively high.

Given the high cost, for litigation to serve its purpose of protecting valuable innovation, the court rulings must be accurate. However, the fact that 116 of the 560 cases that went to trial in my sample set had verdicts that

[1]Statistic obtained from the Lex Machina intellectual property (IP) litigation database.

were later reversed or vacated upon appeal, a rate of about 20.7% [2], suggests that this might not be the case. Of course we cannot expect rulings to be 100% accurate, and some would argue that 80% is acceptable. One way to test if there is room for improvement is to examine whether markets are capable of indicating which cases are more likely to be overturned upon appeal. If markets are efficient in aggregating information, as is often argued [9], we would expect them to be able to accurately evaluate the outcome of court verdicts, predicting when they are likely to be reversed or confirmed upon appeal.

A large number of studies on the economic impact of litigations ([21, 3, 20, 2]) have utilized a market-based approach to quantify the significance of these litigations. Bhagat and Romano [4] provide an extensive summary of event study methodologies and how they are applied to assess the issues of litigation and corporate law. While there has been extensive research to evaluate what information can be extracted from market reactions to events in the legal arena, relatively little research has dealt specifically with market reactions to different events in patent litigations. There have only been two papers [21, 20] that have examined and analyzed the market response at the announcement and settlement of a patent litigation within different industries, but there have been no prior studies examining the scenario where the case goes to trial.

Past studies have shown that markets view the commencement of patent litigation as an economically significant event; however, the large majority of these cases (about 65.5%[3]) are settled without going to trial or appearing before a judge. Of the 12.9% of cases where there was a winner, only 13.7% of these had gone to trial[4]. The rest were resolved either through a default judgment, summary judgment or consent judgment. Nevertheless, despite

[2]Statistic calculated using data provided by the Lex Machina IP litigation database; this rate is likely to be even higher as firms involved in cases where judgements were rendered in late 2011 or 2012 have likely not yet had enough time to file an appeal, or, if an appeal has been filed, the US Court of Appeals has likely not had the time to deliver a final ruling.

[3]Statistic calculated using data provided by the Lex Machina IP litigation database.

[4]Statistic calculated using data provided by the Lex Machina IP litigation database.

the relative paucity of cases that were litigated to their conclusion, these cases are usually more interesting because both parties must have felt strongly about their position and ability to win the litigation if they would rather take the case to trial than settle [12].

Given the wealth of information embodied in market responses to events, we would suspect that market reaction might be an indicator as to whether a verdict will be overturned upon appeal, if one of the companies involved is a publicly traded company. There is ample evidence to suggest that we can assume that markets have already incorporated expectations about the outcome of the litigation into stock prices well before a verdict is announced. However, regardless of market expectations, there is still a degree of uncertainty surrounding the outcome, which will also be reflected in stock prices. The premise of an event study is based on the assumption that financial markets are informationally efficient, and that we can therefore expect stock prices to reflect investors' expectations of the results of the litigation well before an official verdict is announced [9]. By extension then, if any new information is revealed in the commencement (or termination) of litigation, markets will revise their expectations to reflect their new expectations about cash flow and risk, thereby revaluing the firm accordingly.

Any changes in the stock prices of the companies involved in the litigation immediately after the verdict is publicized will consist of two components: an "uncertainty removal" component and a "surprise" component. The uncertainty removal portion arises from the fact that after the verdict is made public, the uncertainty surrounding the outcome of the litigation is removed. When uncertainty decreases, stock prices will shift to reflect that. The surprise component of the stock price change measures whether or not the verdict was in line with investor expectations. Raghu et al [21] finds that, at least for the defendant, the market reaction at the time of a settlement/termination of the IP litigation largely reflects discrepancies between the expectations of the investors and the actual outcome. If we assume that markets are capable of accurately assessing the optimal scope and value of a patent, then any deviations from market expectations would suggest a problematic ruling. The presence of a surprise component could indicate that there is something troubling about the ruling and that it might be more likely to be overturned in the appeals process.

Studying the predictive power of this market response will allow us to determine both whether or not market reaction is a potential indicator of the success of a future appeal and to what extent markets accurately assess the optimal scope and value of a patent, if at all. To date, there have been no event studies done on whether market reaction to a verdict announcement or any other characteristics of the case have any predictive powers with regards to the probability of a successful appeal. Additionally, I am working with a new set of cases, as previous studies that have utilized the event study methodology to measure how markets percieve the impact of patent litigation only examined cases where a settlement was reached. I am examining cases that went to trial and were litigated to their conclusion.

My results suggest that the impact of market reaction on the probability of reversal differs significantly between claimant and defendant firms. Specifically, markets do seem to have some predictive power in determining the likelihood that an initial verdict will be overturned upon appeal when the event study firm is the defendant. A simple OLS regression indicates that a 1 unit increase in the deviation of actual market reaction from the expected market value results in a 7.35% increase in the probability that the verdict will be reversed upon appeal. The p-value on the coefficient in front of this variable is around 11%. While this value is not highly significant, neither is it trivial. The positive coefficient suggests that the larger the deviation of the actual stock return from the expected return, the more likely it is that the verdict will later be reversed, thus reaffirming the theory.

It is also possible that this reaction is a bit dampened because markets might be anticipating an appeal, and have therefore already factored some of that anticipation into the reaction. This is very plausible given the fact that over 80% of the cases in my initial sample were later appealed. However, this is only the case when the event study is done on defendant firms. When I split my sample up into claimant and defendant firms and ran separate regressions for the two samples, the coefficient on the market reaction variable when the event study firm is the claimant is completely insignificant, with a

p-value of around 70%. This indicates that only market reaction for defendant firms has any relation with the probability of reversal. This is likely due to the fact that defendant firms have a much larger downside than claimant firms [3, 12]. A defendant firm may experience significant financial distress if it is ruled to have infringed upon the claimant's patents. A decrease in their wealth and competitiveness is inevitable if the ruling is not later overturned. On the other hand, if the claimant loses, they do not have to cease production of their product nor do they have to pay any royalties to the defendant firm. Thus, the claimant's downside is essentially capped at the status quo. As a result, it is unsurprising that market reactions are much larger for defendant firms. Similarly, the effect of industry characteristics on the probability of reversal is very significant for defendant firms (p-value around 1%), while extremely insignificant for claimant firms (p-value around 94%). These results suggest that publicly traded claimant and defendant firms have markedly different characteristics and very different reaction magnitudes to an unexpected initial verdict. Additionally, I found that when the claimant wins the trial, the verdict is significantly more likely to be overturned upon appeal. This result is very strong (p-value < 0.01 for most regressions) and consistent across regressions with different specifications. Similarly, when both the claimant and defendant are publicly traded, the probability that the ruling will be reversed is significantly higher.

While market reaction seems to have some success in indicating which verdicts are more likely to be overturned upon appeal, it appears to have no explanatory or predictive power in terms of forecasting the proportion of verdicts reversed per case. In fact, the p-value for the joint test that all the coefficients are 0 ranges between 79.8% and 87.5%, indicating that none of the variables in the regression are significant. However, measuring the degree of reversal by using the proportion of verdicts overturned upon appeal per case is slightly flawed. Cases that only asserted a single patent will naturally have a 100% reversal proportion, but cases where multiple patents were asserted will have a larger range of possible values. Another consequence of using this measurement is that a case where 1 out of 1 patents asserted were overturned would have the same calculated degree of reversal as a case where 8 out of 8 patents were reversed; however, I would consider the latter to have a larger degree of reversal but proportions do not reflect this.

Thus, I also use an alternative variable to measure the degree of reversal. I decided to examine whether market reaction, along with my other control variables, might be a better indicator of the number of verdicts overturned per case. I find that this is indeed the case, and that the variables I have chosen to use have a much stronger relationship with the number of patents overturned rather than with the proportion of patents overturned. The p-value for the joint null hypothesis test that all the coefficients are simultaneously 0 ranges from 3% to 9%, suggesting that it is highly probable that at least one of the variables is significant. Additionally, I find market capitalization to be significant at the 15% significance level.

Finally, I also regress the probability that an appeal is filed on the magnitude of the market reaction and other control variables. When using an OLS regression, the coefficient of the magnitude of the market reaction to has a p-value of 14.4%. The regression indicates that a 1 unit increase in the standardized difference between the actual and expected market returns results in an 2.6% increase in the probability that an appeal will be filed. Once again, as with my regressions on the probability of reversal, I find that when the claimant wins, there is a significantly higher probability that the case will be appealed (p-value < 0.01).

The rest of the paper is organized as follows. Section 2, provides background information for the study. Section 3 is a literature review followed by a research hypothesis in section 4. Section 5 details the event study methodology used for this analysis followed by a description of the data in section 6. Section 7 gives an analysis of the results. Lastly, I conclude and present considerations and suggestions for further research in section 8.

2 Background

Patent litigations are complicated proceedings with a significant amount of variation between cases. Figure 1 displays a timeline of events that can occur during the course of litigation; at any point in this process, the litigation can be terminated if the parties reach a settlement agreement. Additionally, the judge can dismiss the case in a summary judgment if it is determined that either side does not have enough evidence to argue the infringement case further, and both parties can file a motion for a summary judgment anytime before the commencement of the trial.

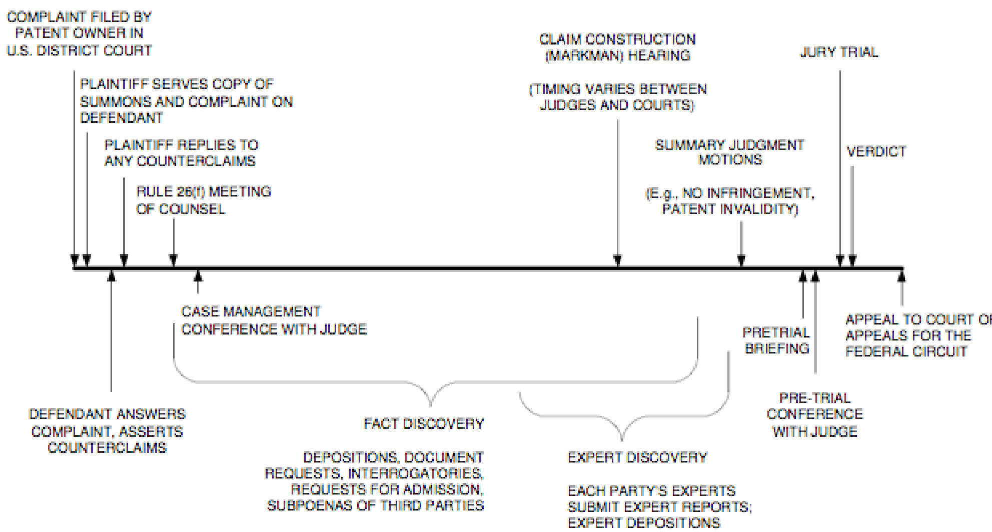

Figure 1: Patent Litigation Timeline.[5]

While summary judgment rulings can also be appealed, I chose to only study cases that actually went to trial given that these cases would be expected to be the most heavily contested. Additionally, there is evidence to suggest that information is revealed during the fact discovery period and the trial that helps the market form expectations regarding the final verdict. If markets adjust their expectations as new information comes to light during the litigation, then we would expect to see the market capitalizations of the claimant and defendant firms moving opposite to each other as information that strengthens the claimant's case will necessarily weaken the defendant's. Figure 2 displays the movement in the market capitalization of two firms

[5]Timeline taken from `http://iposgoode.ca/TheUSPatentLitigationProcess-IPOsgoodeDecember2010.pdf`

involved in a patent litigation and reference lines have been placed at key points in the litigation process. It is clear from this graph that the movement in market capitalizations of the two firms almost exactly mirrors one another in the period between the commencment of the litigation and the delivery of the jury verdict. This suggests that markets are constantly adjusting their expectations throughout the litigation process and will have formed reasonable expectations of the outcome of the litigation before the actual verdict is announced. These market cap adjustments imply that markets find patent litigations to be economically significant events, which is consistent with past studies on patent litigation [20, 21, 11, 16].

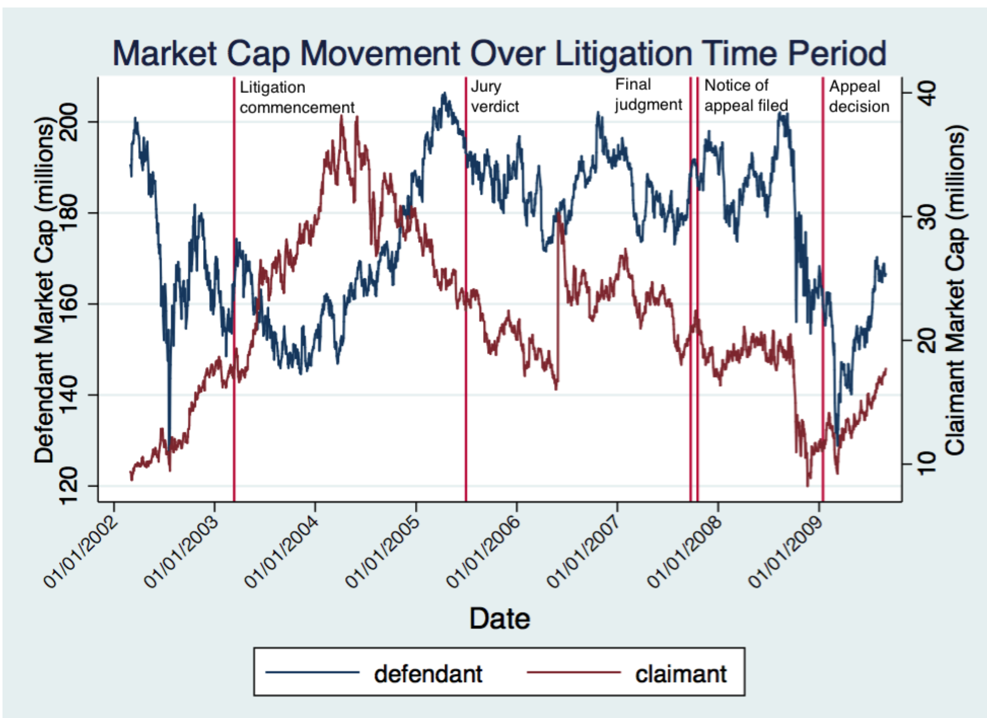

Figure 2: Movement in market capitalization of the claimant and defendant firms during litigation. Graph created using stock price and shares outstanding data provded by the Center for Research in Security Prices

3 Literature Review

A rich set of literature exists that documents the economic significance of patents, and by extension, patent litigation [16, 11, 21, 20]. The economic efficacy of acquiring a patent has been widely discussed. The issue of whether patents provide firms optimal returns to R&D investments has been questioned by academics and businessmen alike. Evidence indicates that firms outside the field of pharmaceuticals rely more heavily on other mechanisms to generate returns to R&D investment [19, 6]. Additionally, reasons for patenting differ significantly between industries. In particular, many papers [10, 6, 19, 14] have used the distinction between complex and simple technologies to explain the differing goals of patenting across industries. Simple technology is generally defined as technology that can be understood by a single individual, whereas complex technologies cannot be understood by a single individual [10]. In the patent system, this difference translates into a difference in the number of patents used by a commercialized product or process [6]. Simple technologies generally utilize a small, discrete number of patents per product, while complex technologies often require hundreds of patents to produce even one product. Thus, complex technology industries are more likely to patent not to protect returns to R&D but rather to strengthen negotiating positions. One possible explanation as to why patents are not more effective in inducing R&D investment is the potentially prohibitive cost of patent enforcement [17]. While the true cost of patent enforcement is unknown, event studies can provide a rough measure as to how the markets assess the price of litigation.

Recently, there have been a couple of studies investigating market reaction to patent litigations. Raghu et al. [21] examined market response at both the announcement of a litigation suit and at the settlement or termination of the lawsuit in order to gauge the economic impact of intellectual property litigation on the plaintiff and defendant of information technology (IT) firms. They found that news of an IP lawsuit was viewed unfavorably for the defendant, as the best possible result for the defendant would be to not lose. However, even in this best-case scenario, significant direct and indirect costs are still incurred by the firm and seem to be large enough for the overall reaction of the market to be negative. On the other hand, they found that the response for the plaintiff both at the announcement and termination of the litigation was significantly positive. The fact that there were significant movements in the stock prices of the firms involved in the litigation at these announcement dates suggests that IP litigations are economically significant events. Following Raghu et al, Narayanamoorthy & Zhou (2010) [20] focused specifically on analyzing market responses to the news of a settlement in IP litigation cases and how different characteristics of the case and the companies involved affect the market reaction. The results of their study suggest that markets form expectations about the lawsuit prior to termination of the case and react accordingly to new information as it becomes available. If this is the case, then markets should also form expectations about the verdict of the litigation should it proceed to trial, and react accordingly when said verdict is announced. This is not a novel idea. A 1998 paper by Bhagat, Bizjack and Coles [2] examined market reactions around filings and settlement announcement of corporate lawsuits. The rationale provided for not including data on verdicts was that "there were so few verdict (or dismissal) announcements and the market is likely to have information about the case that could suggest the verdict in advance of it."

This assumption is predicated on the belief that financial markets are at least semi-strong-form informationally efficient [4, 21], meaning that markets incorporate all publicly available information. If this is the case, then we can expect the stock prices to have already incorporated investors' expectations for the outcome of the litigation well before an official verdict is announced [9]. Event studies, which examine the movement of stock prices due to specific events, is the most common methodology used to evaluate the significance of market reactions to said events. This methodology was originally developed to test the efficient market hypothesis: that markets immediately incorporate newly released information into stock prices and that therefore investors cannot earn abnormal profits by trading on publicly available information. These event studies suggest that markets are indeed semi-strong-form informationally efficient, and subsequently, that this methodology can be used to assess the significance of the event under study [4].

4 Research Hypothesis

It is evident that intellectual property rights disputes greatly affect the present value of expected cash flows of the firms involved, thus resulting in changes in the valuation(s) of said firm(s). Figure 2 illustrates a rudimentary demonstration of this fact. Moreover, given that markets continuously adjust their expectations as new information is revealed throughout the course of litigation implies that markets will have formed expectations about the result of the litigation before a verdict is reached [9]. If the final verdict is in line with market expectations, then we would expect to see a relatively small deviation from the expected stock return for both firms. On the other hand, if the final verdict is not in line with expectations, then the deviations should be much larger. These predictions are summarized in the table below.

Scenario	Expectation	Effect on Claimant	Effect on Defendant
Claimant wins	Claimant wins	+ (slightly)	
Claimant wins	Defendant wins	+	−
Defendant wins	Claimant wins	−	+
Defendant wins	Defendant wins		+ (slightly)

Regardless of expectations, the announcement of a verdict will reduce the uncertainty surrounding the firms involved in the litigation. This will have an unambigously positive effect on all firms involved in the case because when uncertainty decreases, the risk surrounding the projected future cash flows of the firm also decreases. Thus, when the firm that the market expects to win wins, we would expect there to be a positive effect on that firm's stock return. However, the effect on the other firm is ambiguous. On the one hand, uncertainty has been reduced, but at the same time the firm has lost the litigation suit. Investors' expectations are not identical. Specifically, we would expect those who invest in the defendant firm to be more optimistic about the defendant's position than those investing in the claimant, and vice versa (it should be noted that expectations of shareholders of either firm are not necessarily the same as the market expectations as a whole). Thus, the shareholders of the losing firms are likely to experience a negative shock even if the result is in line with market expectations. However, the magnitude of this surprise component is likely to be much smaller than if the entire market were surprised by this ruling. The overall effect on the market value of the firm will depend on the relative sizes of the two components. That there is still some sort of negative shock is unsurprising for two reasons. First, when an infringement suit is litigated to its conclusion, this is usually a signal that both sides feel strongly about their position given that they chose to go to trial rather than settling [12]. Thus, it is unlikely that a clear winner will be evident at the conclusion of a trial. Secondly, there is always variation around expectations and those who invest in either the claimant or defendant are likely to be more optimistic about that firm's chances of winning the litigation than the market as a whole. Therefore, regardless of whether the verdict was in line with the general market expectations, there is likely to be at least some sort of shock, though the magnitude of this shock is likely to be fairly small. On the other hand, if the verdict is contrary to market expectations, there is likely to be a large surprise component to the stock movement, the sign of which will depend on which firm was expected to win.

5 Event Study Methodology

The methodology for evaluating whether market response to a verdict announcement can be used to assess the probability of an initial verdict being overturned in the appeals process is divided into two parts. The first part is an event study. The second part is a regression utilizing the results from the event study. As mentioned above, event studies are commonly used to assess the significance of specific events. There are four parts to every event study [4]:

1. Defining the event day(s).
2. Measuring the stock's return during the event period.
3. Estimating the expected return of the stock during this period.
4. Computing the abnormal return (actual return minus expected return).

The announcement or event date was defined as the first date where the result(s) of the litigation were accessible by the public. This does not necessarily coincide with the final judgment date, where the results are made official. Sometimes a jury will deliver a verdict a couple of months before a final judgment is issued by the judge. In those cases, the date of the jury verdict is used as the event date as it is the first date that the markets will receive the news. Additionally, a window of two days, which includes the day of the verdict announcement and the day after, was used to account for the fact that we do not know what time the ruling was released to the public. If it were after the markets had closed for the day, then the reaction would not be seen until the next day. In order to ensure that the abnormal return we calculate embodies the market reaction to the verdict, we use a two-day event window.

The expected return, measured in step 3, is the return that would have accrued to shareholders in the absence of the event. There are several models to measure expected return. The most widely used model, and the one used in this study, is the market model which states that,

$$R_{it} = \alpha_i + \beta_i * R_{mt} + e_{it}$$

where,

R_{it}	The expected return on the stock of firm i at time t.
α_i,β_i	Firm specific parameters measuring how the security varied with the market portfolio

R_{mt} The market return for period t.

The firm-specific parameters, α_i and β_i; were calculated using 200 daily returns in the period leading up the announcement. This period of 200 returns must be free of firm-specific shocks that might cause its returns to deviate from its baseline level as these will resulted in biased estimated parameters[6]. However, it is not necessary that the market as a whole be free of shocks. So long as the shock is not specific to the firm that the event study is being conducted on, then we can expect that the market returns will also reflect the effect of these events.

I used the estimated α_i and β_i along with the return on the market portfolio to calculate an expected return on the event study firm's stock. The abnormal return was calculated by subtracting the actual return from the expected return. As I used a two-day event window, for each event study, the abnormal returns for day 0 and day 1 were summed to give a cumulative abnormal return (CAR). The standardized CARs were calculated using the formula $\frac{CAR_{it}}{s_{it}}$, where s_{it} is the standard deviation of the regression residuals [21].

6 Data

This study examines both the claimants (i.e. the firm(s) seeking damages for infringement) and the defendants (the firm(s) that have allegedly infringed) of a patent infringement litigation. In court documents, the first firm to file a lawsuit is labeled the "claimant" regardless of who owns the patent.

However, sometimes a firm that has potentially infringed upon another firm's patent(s) will preemptively file a lawsuit claiming that the patent(s) they have potentially infringed upon are invalid. The patent holder will then file a counterclaim arguing that not only are their patents not invalid, but that the other firm has also infringed upon the patents. In these cases, the

[6] This can be anything from the commencement of a litigation to a change in upper level management of the firm

firm that has allegedly infringed on another firm's patent will be labeled the "claimant" and the patent holder the "defendant" in court documents. For consistency, I define the person or firm that owns the patent in question as the "claimant" and the person or firm that has allegedly infringed on the patent the "defendant", regardless of who filed first. As we are interested in observing the market reactions to the announcement of a verdict, in order to be useable, at least one firm involved in the litigation must be a publicly traded company. I have excluded subsidiaries of publicly traded companies from this study as there is no data readily available that points to the importance of the subsidiary to the parent firm.

The data collection process was two-fold: first, litigation data was obtained and the characteristics of the case ascertained. Once a useable sample was assembled by paring down the dataset to cases where an appeal was filed with at least one publicly traded firm, an event study analysis was done for each publicly traded company, for a total of 142 event studies. Litigation data was provided by Lex Machina, formerly the Stanford IP Litigation Clearinghouse. Since there was no consolidated list of appealed cases, I had to create my own dataset by using information from the Lex Machina database. I looked only at cases that went to trial from 2000 to 2012, a total of 562 cases and determined whether each case had been appealed or not and documented the outcome of the appeal by manually going through the docket events of the case.

A large majority (81%) of cases that went to trial were appealed; this is unsurprising given that only cases where both firms felt strongly about their positions would go to trial [12]. The true value is actually probably even higher, as firms involved in cases resolved in 2012 likely have not had the time file an appeal.

I have also chosen to only include cases where an appeal was filed for two reasons. First, as litigation is a costly affair, only the wealthiest firms are able to afford to exhaustively litigate a case; thus, it is highly likely that when a firm chooses not to appeal, it is not based on the strength of their position, but rather due to financial considerations. Secondly, as mentioned earlier, cases that were concluded in 2012 will likely not have had the chance to file an appeal yet. Were these cases to have been included, it would bias the sample. Originally, I had also intended to include subsidiaries of publicly traded companies in my sample. When I realized that I could not easily obtain information regarding the relative importance of the subsidiary to the parent company[7], I decided to drop the event studies involving subsidiaries. The table below illustrates the categories and the number of cases that fell into each category:

Condition	Count
Total Cases	562
Only appealed cases	457
Includes at least 1 publicly traded company or subsidiary of a publicly traded company	178
Only publicly traded companies (excludes subsidiaries)	124
Total number of event studies (cases where both the claimant and defendant are publicly traded will have 2 event studies)	142

Of the 142 event studies, 64 were reversed upon appeal. Oftentimes, an appeal will not result in a simple decision to "affirm" or "reverse", rather an appeal will be "reversed-in-part"," affirmed-in-part", and/or "remanded". In these cases, I have chosen to denote any case where any portion was reversed or vacated upon appeal as "reversed," because a reversal of any part of the original verdict indicates that there was something problematic about the inital ruling that I expect the market to have captured.

Stock market data was obtained from the Center for Research in Security Prices (CRSP). CRSP is part of the Booth School of Business at the University of Chicago and maintains a database of historical stock market

[7]I could have used these cases and simply added a dummy variable for whether the firm was a subsidiary or not, but I felt that this added information would not be sufficient. For example, if one subsidiary only accounts for 1% of total revenue of the parent company and another subsidiary accounted for 50% of total revenue, obviously the second subsidiary is much more important to the parent company and the results of the trial will be much more important for the second company. However, a dummy variable would not capture this difference.

prices. For each company, daily returns of the company's stock were obtained for 200 days prior to the verdict announcement. If within these 200 days there is another event, such as the commencement of the litigation, that could also result in an abnormal return, then I use daily returns starting from 2 days after the first event until the day before the verdict is issued to estimate the firm specific parameters of the event study. Additionally, the market capitalization of the company was calculated by averaging the market capitalizations for these 200 days as well.

7 Analysis

7.1 Reversal

The general probit regression model is as follows:

$$P(REV = 1) = \phi(\beta_0 + \beta_1|STDCAR| + \beta_2 BOTH\_PUB + \beta_3 CLAIM + \\ \beta_4 CAR\_CLAIM + \beta_5 CWIN + \beta_6 MKTCAP + \beta_7 COMPLEX)$$

where,

REV a binary variable indicating whether the initial verdict was reversed upon appeal

|STDCAR| the absolute value of the standardized cumulative abnormal returns

CLAIM a dummy variable indicating whether the firm used for the event study was a claimant (claim = 1) or defendant (claim = 0)

CAR_CLAIM an interaction variable between the absolute value of the standardized cumulative abnormal returns and

BOTH_PUB a dummy variable which indicates whether both companies were publicly traded (both_pub = 1) or not (both_pub = 0)

CWIN a dummy variable which indicates whether the claimant (cwin = 1) or defendant (cwin= 0) won the initial trial

MKTCAP the market capitalization of the event study firm, in millions

COMPLEX a dummy variable indicating whether the firm is in a complex technology industry (complex = 1) or not (complex = 0)

$\phi()$ the cumulative standard normal distribution function

As mentioned earlier, my dependent variable is a binary variable indicating whether or not any portion of the initial ruling was overturned or vacated upon appeal. The independent variables include the magnitude of the standardized cumulative abnormal stock returns (CAR), whether both the claimant and defendant firms were publicly traded, whether the firm is a claimant or defendant, an interaction variable between whether the firm is a claimant or defendant and the magnitude of the standardized CAR, whether the claimant or defendant won the initial trial, the market capitalization of the firm, and whether the industry of the firm is characterized as complex or not.

The dummy variable indicating whether or not the event study firm is the claimant or defendant (CLAIM) is used because studies have shown that the returns to winning an infringement case are asymmetric [3, 12]. Specifically, these studies show that wealth leakages occur such that defendant firms lose more wealth than claimant firms gain when the claimant firm files a patent infringement suit. This is in part due to the costs of the increased probability of financial distress that the defendant experience. By this logic, we might also expect the magnitude of the standardized CARs to depend on whether the firm was a claimant or defendant. This is also the reason I include an interaction variable between the magnitude of the standardized CARs and CLAIM as it is likely that the magnitude, and thus by extension the significance, of the standardized CARs differ between the claimant and defendant for the same case. In particular, I would expect the reaction of defendant firms to be much more extreme and perhaps a better measure of the probability of reversal upon appeal.

Table 1 displays three different results of the regression estimations using a probit regression. However, these results can only be interpreted at a specific point; thus, I also run an ordinary least squares (OLS) regression to obtain a general idea of the relative impact of each variable on the probability of reversal. Table 2 gives the results of this regression. In both tables, regression 3 uses all the variables.

All three regressions for both the probit and OLS models indicate that the coefficient on the dummy variable for whether or not both the claimant and defendant are publicly traded (BOTH_PUB) to be significant at the $p < 0.01$ level. The OLS regression estimates that there is about a 26% increase in the probability of reversal when both companies are publicly traded compared to when only one of them is[8]. This resuls corroborates previous studies which have shown that the impact of patent litigation depends on who the opposing firm is. Additionally, past papers have shown that the measurable costs of prosecuting or defending a patent infringement litigation to its conclusion requires far more resources than all but the largest firms possess [5]. It unsurprising that, when both firms are publicly traded, the probability of the verdict being overturneed is higher because it is more likely that both firms will have the resource to fully dedicate themselves to the appeals process. As discussed earlier, litigations are extremely expensive, and the longer they drag on, the more expensive they become. Thus, it is possible that a case might be terminated early for financial reasons, regardless of the strength of a firm's position. The event study firm's market capitalization is also used as a control variable, but market capitalization only tells us about the resources of the event study firm; it gives no indication of the financial situation and resources available to the opposing firm while the dummy variable BOTH_PUB does. I cannot use market capitalization as a more accurate proxy of the financial resources of the opposing firm because firms

[8]I do not have any results for when neither company is publicly traded as in order to run my regression and calculate an abnormal return, at least one company had to be publicly traded

that are not publicly traded do not have market capitalizations; thus, in essence, a dummy variable on whether or not both firms are publicly traded captures the exact same information but with much less variability.

Additionally, I find that the control variable indicating who won the initial trial (CWIN) to be significant at the $p < 0.001$ level. Specifically, I find that when the patent holder or claimant wins the trial, there is a much higher probability that the verdict will be overturned upon appeal. In table 2, I find that there is about a 36% higher probability that the case will be later overturned when the patent holder wins the initial trial than when the non-patent holding firm, or defendant, wins.

This is not surprising when we consider that, for two reasons, the burden of proof is much higher for defendants than for plaintiffs. Firstly, over the past couple of decades, there has been a trend in policy to stregthen patent protection; as a result, patent rates, claimant success rates in infringement suits, and the number of infringement suits filed have all increased [13, 6, 15]. This is done in order to increase firm's incentives to patent their innovations and thereby share their knowledge with the rest of the world. If a firm knows that there is a high probability that the court will rule either invalidity or noninfringement when it tries to defend its patent in court, then there would be no incentive for the firm to patent their innovation. Thus, necessarily, the patent litigation system is be set up so that the probability that an invalid or non-infringed patent will be declared valid and infringed upon is higher than the reverse situation.

Secondly, when a firm is sued for infringement, it will often argue that the patent in question is invalid or unenforceable. However, any patent that has been issued has already been screened by the US Patent Office and as a result of this, proving invalidity is difficult. These two facts mean that when the non-patent holding firm does win, due to the high burden of proff required to achieve such an outcome, the verdict is less likely to be overturned.

The coefficient on the variable |STDCAR| varies between 0.161 and 0.169 when the event study firm is the defendant (about 59% of my sample size). When using the third regression and holding all variables constant at their mean value and setting CLAIM = 0, an increase in the magnitude of the standardized abnormal returns by 1 unit results in an increase in the probability of reversal from 39.74% to 46.02%. The p-value on this coefficient is 13.8%. While the result is not extremely significant, neither is it trivial. It could be that this response is dampened due to the fact that the large majority of verdicts (>80%) are appealed; thus, it is likely that markets assume that the litigation will be ongoing and, to some extent, are anticipating a reversal. As a result, the market reaction will be subdued and might not reflect that true amount of shock. The OLS regression indicates that increasing the standardized CARs by 1 unit results in an increase of 5.21% in the probability of reversal when using the specifications of the third regression.

However, when the event study firm is the claimant, the effective coefficient on the variable |STDCAR| is -0.057. The OLS regression in table 2 estimates that an increase of 1 unit in the standardized CAR will result in a change of -1.35% in the probability of reversal. While the fact that this number is negative seems to indicate that an increase in the magnitude of the CAR would actually result in a decrease in the probability of reversal, the proximity of this coefficient to zero would suggest that when the firm is a claimant, the magnitude of the standardized CARs is virtually insignificant in predicting the probability that the ruling will be overturned upon appeal.

It is interesting that the defendant firm's magnitude of the standardized CAR is so much more effective in predicting the probability that a verdict will be reversed than the claimant's; however, this is not completely unexpected. As mentioned earlier, studies have shown that the defendant has much more at stake in a patent infringement case than the claimant because there is a much larger downside for the defendant [3, 12]. The worst case scenario for the claimant is that their patent is declared invalid and they lose royalties, but they would not have to stop producing their product. Additionally, it is also unclear whether the claimant will be able to take full advantage of the reduced competition should they win. Since there are usually more than two firms competing in single market, it is highly likely that other firms might come in and take advantage of the reduced competition as well.

On the other hand, if the defendant loses, the firm could experience significant financial distress due to the damages and royalties they would be ordered to pay to the claimant firms. Even if the defendant could afford these costs, they would probably have to cease producing and marketing the offending product, which could significantly damage their long term profit prospects and cause them to lose market share if they are not able to reach a licensing agreement with the plaintiff. Thus, given that the defendants have much more at stake than the claimants, the stocks of defendant firms are likely to react more strongly, both positively and negatively, to a surprising verdict and would thereby be a better indicator than the reaction of the claimant firms.

To explore this possibility, I split my sample based on whether the event study firm was the claimant or defendant, and ran both probit and OLS regressions on each sample set. The results are displayed in table 3. The p-value on the coefficient of |STDCAR| for the claimant sample is 66.6% for the probit regresion and 70% for the OLS regression, indicating that the magnitude of the standardized CARs is completely insignificant in predicting the probablity that the initial verdict will be overturned upon appeal when the event study firm is the claimant. However, for the defendant, the p-values are 10.2% and 11%, respectively. As mentioned above, it is possible that this result is dampened by the market's anticipation that an appeal will be filed and that the true market movement is in reality much larger. These results suggest that it is only in the case of defendant firm event studies that market reaction is capable of providing us with a useable prediction of the probability that the initial ruling will be overturned upon appeal.

Additionally, it also appears that the effect of whether or not the firm's industry is a complex technology industry on the probability of reversal differs greatly between claimant and defendant firms. Specifically, the dummy variable COMPLEX is very significant in predicting the probability of reversal for defendant firms with p-values of 0.8% and 1.1% for the probit and OLS regressions, respectively. The OLS regression indicates that when a firm is part of an industry with complex technology, there is a 29.3% increase in the probability of reversal when the firm is the defendant. However, when the firm is a claimant, the coefficient on this variable is completely insignificant (p-value around 94%). One possible explanation for this discrepancy could be due to the type of companies or individuals likely to sue large, publicly traded firms. Aside from the 22 out of 83 firms where both the claimant and defendant were publicly traded, it is possible that that claimant is a much smaller firm that is looking to capitalize on a larger firm infringing on one of their patents or a non-practicing entity (NPE). NPEs are patent owners who use their patents solely for the purpose of suing infringers. It is much easier for these plaintiffs to make a case when the defendant firm is in a complex technology industry where the boundaries of a patented invention are less clearly defined and where a single product can consist of hundreds, if not thousands, of different patented parts and processes. At the same time, due to such complexities, it is also less difficult to make a compelling case for non-infringement. These cases are thus much less clear cut. All these factors combined make it much more likely that the initial verdict will be reversed upon appeal.

7.2 Degree of Reversal

I was also interested in measuring whether market reaction was a useful measure of predicting the degree of reversal, given that a verdict is overturned. I used a generalized linear model in order to deal with the fact that the degree of reversal is a proportion between 0 and 1. As mentioned earlier, oftentimes, multiple patents are asserted in a single litigation; however, reversal is not an all or nothing game. Many times, cases will be reversed-in-part and affirmed-in-part. In table 4, the degree of infringement reversal is defined as the proportion of the number of patent infringement rulings overturned. For example, if 5 patents were asserted and the ruling on 3 of them were reversed, then the degree of reveral would be 3/5.

Table 4 displays the results of this regression. As is immediately obvious, none of the variables included appear to have any impact on predicting the degree of reversal. In fact, the *p*-value for the joint null hypothesis test that the coefficients on all the variables are simultaneously 0 ranges from 80% to 87%, suggesting that it is highly probable that all the coefficients are 0. However, using the proportion of the patent rulings reversed is a slightly flawed measure as cases which only asserted 1 patent will naturally have a 100% reversal proportion, while cases where multiple patents were asserted will have a larger range of possible values. Thus, the range of possible proportions varies from case to case. Another consequence of using this measurement is that a case where 1 out of 1 patents asserted were overturned would have the same proportion of overturned verdicts as a case where 8 out of 8 patents were reversed; however, I would consider the latter to have a have a larger degree of reversal even though proportions do not reflect this.

In order to compensate for this, I also ran a linear OLS regression on the number of patent rulings overturned per case and market reaction to the initial verdict announcement. These results are much more significant. The p-value for the joint hypothesis test that all the coefficients are 0 ranges from around 1.6% to 10%; the results at least suggest that the variables have some relation to the number of patent infringement verdicts overturned per case despite being completely irrelevant when the proportion of verdicts overturned is used as the dependent variable. The coefficient on |STDCAR| ranges from 0.174 to 0.2, with p-values ranging from 13% to 20%. It seems to indicate that an increase in |STDCAR| by 1 unit will result in an increase in the number of patent rulings overturned by 0.174 to 0.2. It is not unusual that this number is well below 1, because 39 out of the 59 event studies only had 1 patent ruling reversed.

Additionally, the coefficient on the market capitalization of the firm is negative and significant at the 10% significance level. This suggests that more patent infringement rulings are overturned when the market cap is smaller. This could be due to the fact that smaller firms have less resources available to them and are more likely to assert multiple patents in a single litigation case in order to cut costs. As it is impossible to overturn more patent infringment rulings than the number of patents asserted, the the two numbers are necessarily positively correlated with each other. Finally, I also find that when both firms are publicly traded, 0.5 more rulings are likely to be overturned. While this number is obviously not realistic, as you cannot overturn half a ruling, it does suggest that when both firms are publicly traded, the degree of overturning is likely to be higher. This value is significant at the 15% significance level.

7.3 Probability of Appeal

Lastly, I decided to examine the relationship between the litigation case characteristics and the probability that the ruling will be appealed. I used both probit and OLS regressions to examine this relationship. My results suggest that the value of the coefficients in predicting the probability of appeal do not vary significantly between claimant and defendant firms. The probit regression suggests that, when all values are held constant at their means, an increase in the magnitude of the standardized CAR by 1 unit results in a change in the probability of appeal from 77.34% to 84.13%; the p-value on the coefficient is 17.6%. This value, while not very significant, is not trivial and it does seem to show that there might be a relationship between the probability that an appeal is filed and the magnitude of the standardized CAR. However, given that the large majority of verdicts are appealed at some point, this potential relationship may not be very meaningful in a real world sense. Once again, as with the reversal regressions, I find that the coefficient for the dummy variable on who won the initial trial indicates that when the claimant wins, an appeal is about 17% more likely to occur, according to the OLS regression. This value is significant at the 1% significance level for both the probit and OLS regressions. The reasoning for this is the same as with the reversal regressions analyzed above.

Finally, I find that when a firm is part of a complex technology industry, the initial verdict is less likely to be appealed; the p-value on this coefficient is around 10%. This is rather suprising given the fact that when the defendant is a publicly traded firm, the probability that the initial verdict will be reversed upon appeal increases when the firm's industry is complex. However, this result could be because my sample only includes publicly traded firms; thus, if a large publicly traded firm wins over a smaller firm with less resources, there is a lower probability than an appeal will be filed. As mentioned earlier, the boundaries of complex patents are much less clearly defined, making infringement cases less obvious than in the case of simple technology industries. When there is a large difference between the financial resources of the plaintiff and defendant, the winner of a litigation on patents with complex technologies may be the firm with more resources to devote to the litigation, as they will be able to hire lawyers and experts who are able to argue their case more persuasively than a less well endowed firm or individual. These firms would also be the ones with the wherewithal to litigate the case to its conclusion; however, if they win on the initial trial, there is no reason for them to file an appeal. Hence, the negative coefficient on the COMPLEX dummy variable may be capturing this phenomenon. Additionally, simple technology industries, such as pharamaceuticals or chemicals, usually require a significant amount of research and development (R&D) before a patentable product is produced. As a result, small firms and individuals are much less likely to hold patents in these types of industries and patent litigation suits are much more likely to be between firms of relatively equal resources, regardless of whether a firm is publicly traded or not. While it is true that the scope and boundaries of a simple technology patent are generally better defined, it is also a fact that only cases where both sides feel strongly about their position will go to trial [12]. This might be another explanation for why cases with firms in simple technology industries are more likely to be appealed than their complex counterparts.

8 Conclusion

Using a market based approach, I have studied the relationship between the characteristics of a patent litigation case and probability of reversal upon appeal. Previous works that have utilized the same approach have only focused on cases where a settlement is reached, and these studies have shown that markets view patent litigations as economically significant events. Based on thess results, I have chosen to look at a previously unexamined set of cases to determine whether market reaction, along with other attributes of the case, are capable of predicting the probability of reversal upon appeal.

My results suggest that the impact of certain case characteristics is not homogeneous across all publicly traded firms. In particular, the importance of market reaction and industry type on the probability of reversal differs significantly between publicly traded claimant and defendant firms. The results show that market reaction is related to the probability that the verdict will be overturned upon appeal when the event study firm is the defendant, but is insignificant when the event study firm is the claimant. This difference confirms results from past studies that have shown there to be asymmetric effects of litigation depending on whether a firm is a plaintiff or a defendant [3, 12].

Additionally, the effect of whether the event study firm is in a complex technology industry also differs significantly between claimant and defendant firms. This difference suggests that there might be a divergence in the way large, publicly traded defendant firms deal with claimant firms of differing sizes, especially within industries with complex technologies. Given that a single product in a complex industry is likely to utilize hundreds, if not thousands, of different patents, when both firms are large and publicly traded, it is very probable that they both produce products that mutually infringe upon the other's patents. Rather than going to trial, it is much more efficient and beneficial for both firms to enter into a cross-liscensing agreement with each other. In fact, surveys have shown that firms in complex industries often patent their innovations for the sole purpose of strengthening their negotiating power when forming these agreements [6, 13, 14, 17, 19]. However, when there is a significant discrepancy in the size and importance of the two firms, it is unlikely that the larger firm will have sufficient incentive to enter into a cross-liscensing agreement with the smaller one. Thus, when the smaller firm is the patent holder, it has no recourse but litigation[9]. The significant difference in the coefficient on whether or not a firm is in a complex technology industry between the claimant and defendant firm samples, may in fact be capturing the divergence between how a large, publicly traded firm deals with other firms of varying sizes. Further work might look into

[9]When the larger firm is the patent holder, there is a higher possibility that it may determine that the costs of litigation outweigh the benefits and thus decide not to litigate the infringed patent.

the magnitude and significance of these differences and whether smaller firms choose to litigate because they have no other option or because they want to take advantage of the potential royalties that would result from winning a patent litigation suit against a large, well-endowed firm.

My research also indicates that when the claimant wins the initial trial, there is a much higher probability that the verdict will be later overturned. Additionally, I looked at whether these same characteristics were related to the degree of verdict reversal. My results show that the impact of market capitalization on the number of patents reversed is negative and significant at the 10% significant level. I argue that this result suggests that that firms with fewer resources are more likely to consolidate multiple related cases into one suit in order to save money; hence, they are more likely to assert mutliple patents in a single suit. The number of patents asserted is positively correlated with the number of patents overturned upon appeal, as it is impossible to overturn more patents than are asserted. Due to this fact, the coefficient on market capitalization may in fact be due to a difference in the way smaller firms approach litgations.

Finally, I examined whether the characteristics that are capable of predicting the probability of reversal upon appeal are also related to the probability that an appeal is filed. I found that the magnitude of the standardized abnormal returns is positively related to the probability of that an appeal is filed. However, the probability of appeal decreases when the publicly traded firm is in a complex technology industry.

These results help to further elucidate the relationship between patent litigations and financial markets. I have shown that markets do exhibit some capabilities in predicting whether an initial verdict will be overturned upon appeal. This suggests that in some cases market forces may be more capable of rendering unbiased rulings than district courts. This is corroborated by the fact that my results also show that courts are consistently handing down too many initial rulings in favor of the patent holder. While this is partly due to the way that the court system has been designed, it is in reality counter productive. If potential patent holders know that there is a significantly higher probability that a ruling in their favor will be overturned upon appeal than a ruling against them, there will still be incentives against patenting. I am not suggesting that the court system should be changed to be systematically biased in favor of patent holders, as this will result in a large increase in frivolous patent litigations suits. Rather, I would argue that the slighter stricter requirements should be placed on claimant firms to prove that the patents in question have been infringed upon so that more accurate rulings will be given more often, thus reducing costs for all parties involved and increasing overall welfare.

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Table 1: Probit Regression for Reversal Upon Appeal

	Dependent Variable: Verdict Reversal		
	(1)	(2)	(3)
|stdCAR| [a]	0.173^{+}	0.161	0.169^{+}
	(0.109)	(0.113)	(0.114)
claim [b]	0.582^{++}	0.569^{++}	0.581^{++}
	(0.308)	(0.311)	(0.313)
|stdCAR| x claim [c]	-0.220^{+}	-0.219^{+}	-0.226^{+}
	(0.145)	(0.150)	(0.150)
both_pub [d]	0.770**	0.776**	0.776**
	(0.248)	(0.243)	(0.244)
claimant_wins [e]	1.085***	1.116***	1.102***
	(0.277)	(0.288)	(0.289)
mktcap [f]	0.00000101		0.000000778
	(0.00000168)		(0.00000166)
complex [g]		0.382^{+}	0.372^{+}
		(0.240)	(0.241)
Constant	-1.508***	-1.604***	-1.635***
	(0.334)	(0.360)	(0.371)
Observations	142	142	142
p	0.0000372	0.0000412	0.000116
chi2	30.13	29.90	29.53

Standard errors in parentheses

$^{+}$ $p < 0.15$, $^{++}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] The absolute value of the standardized cumulative abnormal return (CAR)

[b] Dummy variable indicating whether the event study firm was the claimant or not

[c] Interaction variable between the standardized CAR and the dummy variable on whether the firm was a claimant or defendant

[d] Dummy variable indicating whether both companies were publicly traded or not

[e] Dummy variable indicating if the claimant or defendant won the initial trial

[f] Market capitalization, in millions

[g] Dummy variable indicating whether the firm was part of a complex or simple industry

Table 2: OLS Regression for Reversal Upon Appeal

	Dependent Variable: Verdict Reversal		
	(1)	(2)	(3)
|stdCAR| [a]	0.0552^{+}	0.0496	0.0521
	(0.0366)	(0.0362)	(0.0366)
claim	0.187^{++}	0.177^{++}	0.180^{++}
	(0.101)	(0.102)	(0.102)
|stdCAR| x claim	-0.0687^{+}	-0.0659^{+}	-0.0678^{+}
	(0.0460)	(0.0450)	(0.0452)
both_pub	0.265**	0.260**	0.261**
	(0.0842)	(0.0830)	(0.0836)
claimant_wins	0.358***	0.363***	0.358***
	(0.0817)	(0.0812)	(0.0822)
mktcap	0.000000353		0.000000276
	(0.000000599)		(0.000000601)
complex		0.119^{+}	0.115^{+}
		(0.0788)	(0.0795)
Constant	0.00458	-0.0146	-0.0244
	(0.0816)	(0.0813)	(0.0840)
Observations	142	142	142
p	3.91e-09	5.58e-10	2.34e-09

Standard errors in parentheses

$^{+}$ $p < 0.15$, $^{++}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] See Table 1 for explanation of independent variables

Table 3: Probit Regression for Reversal Upon Appeal Divided by Claimant and Defendant Firms

	Claimant Firms		Defendant Firms	
	Probit	OLS	Probit	OLS
	(1)	(2)	(3)	(4)
|stdCAR| [a]	-0.0450	-0.0114	0.256^{+}	0.0735^{+}
	(0.104)	(0.0294)	(0.157)	(0.0456)
both_pub	0.834*	0.272*	0.877*	0.277*
	(0.378)	(0.118)	(0.348)	(0.118)
claimant_wins	1.242**	0.424**	0.842*	0.255*
	(0.462)	(0.139)	(0.390)	(0.107)
mktcap	0.00000206	0.000000709	-0.00000110	-0.000000309
	(0.00000286)	(0.000000914)	(0.00000209)	(0.000000748)
complex	-0.0263	-0.00929	0.946**	0.293*
	(0.379)	(0.125)	(0.357)	(0.112)
Constant	-1.100*	0.126	-1.634***	-0.00536
	(0.537)	(0.151)	(0.464)	(0.0994)
Observations	59	59	83	83
p	0.0356	0.00117	0.00314	0.00000290
chi2	11.94		17.85	

Standard errors in parentheses

$^{+}$ $p < 0.15$, $^{++}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] See Table 1 for explanation of independent variables

Table 4: Degree of Infringement Reversal by Proportion

	Share of Patents For Which the Verdict Was Reversed		
	(1)	(2)	(3)
|stdCAR|	-0.0878	-0.0602	-0.0880
	(0.231)	(0.228)	(0.229)
both_pub	0.00000920	0.0539	-0.0268
	(0.608)	(0.639)	(0.635)
|stdCAR| x both [a]	0.194	0.195	0.200
	(0.222)	(0.224)	(0.225)
claim_pub	0.142	0.166	0.121
	(0.655)	(0.665)	(0.671)
|stdCAR| x claim	0.0681	0.0456	0.0679
	(0.183)	(0.178)	(0.183)
claimant_wins	-0.671	-0.726	-0.668
	(0.665)	(0.653)	(0.668)
mktcap	-0.00000230		-0.00000230
	(0.00000276)		(0.00000274)
complex		-0.0863	-0.0856
		(0.426)	(0.426)
Constant	0.789	0.709	0.834
	(0.797)	(0.811)	(0.841)
Observations	64	64	64
p	0.798	0.875	0.871
chi2	3.841	3.111	3.843

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] An interaction variable between |stdCAR| and whether both the claimant was publicly traded or not. See Table 1 for explanation of the other independent variables

Table 5: OLS Regression for Number of Patent Rulings Overturned

	Number of Patent Rulings Overturned Per Case		
	(1)	(2)	(3)
|stdCAR|	0.174	0.200^{+}	0.175
	(0.131)	(0.131)	(0.136)
both_pub	0.449^{+}	0.510^{+}	0.465^{+}
	(0.302)	(0.305)	(0.307)
|stdCAR| x both [a]	-0.126	-0.136	-0.137
	(0.105)	(0.108)	(0.112)
claim	0.0495	0.0923	0.0757
	(0.309)	(0.317)	(0.314)
|stdCAR| x claim	-0.146	-0.168^{+}	-0.145
	(0.101)	(0.101)	(0.106)
claimant_wins	-0.196	-0.259	-0.203
	(0.366)	(0.331)	(0.354)
mktcap	-0.00000236^{++}		-0.00000237^{++}
	(0.00000135)		(0.00000140)
complex		0.172	0.175
		(0.250)	(0.248)
Constant	1.218^{**}	1.031^{*}	1.142^{*}
	(0.446)	(0.410)	(0.443)
Observations	59	59	59
p	0.0163	0.0982	0.0388

Standard errors in parentheses

$^{+}$ $p < 0.15$, $^{++}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] An interaction variable between |stdCAR| and whether both the claimant was publicly traded or not. See Table 1 for explanation of the other independent variables

Table 6: Probit & OLS Regressions On The Probability Of An Appeal Filed

	Dependent Variable: Probability of Appeal			
	Probit Regression		OLS Regression	
	(1)	(2)	(3)	(4)
|stdCAR| [a]	0.223	0.114	0.0430^{++}	0.0263^{+}
	(0.159)	(0.0842)	(0.0221)	(0.0179)
claim	-0.0835		-0.0303	
	(0.325)		(0.0803)	
|stdCAR| x claim	-0.159		-0.0284	
	(0.183)		(0.0338)	
both_pub	-0.242	-0.273	-0.0720	-0.0768
	(0.244)	(0.246)	(0.0634)	(0.0638)
claimant_wins	0.658^{**}	0.631^{**}	0.179^{**}	0.172^{**}
	(0.238)	(0.234)	(0.0659)	(0.0654)
mktcap	0.00000175	0.00000179	0.000000370	0.000000366
	(0.00000196)	(0.00000191)	(0.000000390)	(0.000000383)
complex	-0.383^{++}	-0.374^{+}	-0.100^{++}	-0.101^{++}
	(0.229)	(0.228)	(0.0602)	(0.0598)
Constant	0.576^{*}	0.596^{**}	0.726^{***}	0.724^{***}
	(0.272)	(0.222)	(0.0694)	(0.0635)
Observations	173	173	173	173
p	0.0385	0.0249	0.0430	0.0337
chi2	14.81	12.84		

Standard errors in parentheses

$^{+}$ $p < 0.15$, $^{++}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] See Table 1 for explanation of independent variables