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Patent Litigation, Competitive Dynamics, and Stock Market Volatility

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Received: 8 April 2020; Accepted: 7 May 2020; Published: 14 May 2020

Abstract: Recently, the number of patents of enterprises has been increasing year by year, obviously improving the degree of attention paid to the added value of patents by said enterprises, but also creating patent infringement lawsuits. First, through analysis of the position of competitors, it can be seen that the disclosure of patent infringement litigation information influences the abnormal returns of shareholder wealth. Second, through projecting to competitive dynamics, it could be determined whether expected or actual action are consistent or inconsistent, and whether the stock returns and volatilities are obviously changed. This work utilized event study and GJR-GARCH to discuss the information value of short-term abnormal returns and the long-term effect of stock returns and volatilities of patent infringement lawsuits, respectively. The empirical results of this article highlight the significantly negative short-term abnormal returns of plaintiffs when market commonality between the enterprises was higher. In addition, the cumulative abnormal returns of shareholders were reduced when the resource similarity was higher. Finally, in terms of the corresponding plaintiff enterprises, if the expected theory and the actual strategy were inconsistent, then the return and the risk decreased significantly; however, when the strategy was consistent, the return and the risk increased significantly.

Keywords: patent infringement lawsuits; market commonality; resource similarity

1. Introduction

With ever-increasing firm sizes, fierce competition among supply chains in industry, and constant technical innovation and development, companies sometimes need to invest heavily in research and development (R&D) in order to find new technologies or to improve existing resources, so as to meet customer needs and maintain competitiveness in the market. However, to protect research achievements, enterprises typically patent their creative products. Most scientific and technological patents are ones of physics (G) and electrical science (H). Figure 1 shows the total number or respective numbers of physics (G) and electrical science (H) patents according to international patent classification indices. The International Patent Classification (IPC) definition is based on a structured definition format, the most important part of which is to provide a more detailed definition of the classification location range. The text of the definition description can be used to replace the related vocabulary and phrases in the classification position class name of the patent document. In order to protect R&D achievements, Taiwanese technology manufacturers tend to apply for patents to protect their innovative products. The patent name of the valid data or product is retrieved first, and most of the patents in Taiwan in the sample search technology category belong to the physical (G) and electrical (H) categories. In recent years, the total number of physical (G) and electrical (H) patents of the international patent classification indicators, or individual cases, has been rapidly expanding with

the application of consumer electronic products, and at the same time, there is a trend of rapid climb. The more that companies apply for patents to defend their innovations, the more attention they pay to the added value of patents.

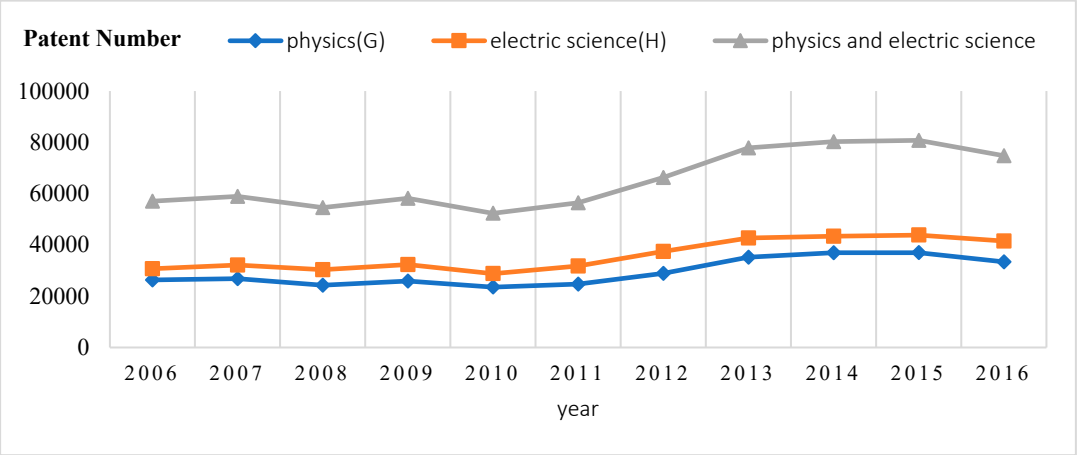

Figure 1. The total number or respective numbers of physics (G) and electrical science (H) patents according to international patent classification indices.

This means that many more enterprises have protected their creative achievements through patents and have paid more attention to the added value brought by said patents. Lu et al. [1] studied different patent categories in Taiwan and demonstrated that the number of patents applied for by enterprises shows a trend of gradual growth, and that the number fluctuates with time.

Enterprises sometimes seek cooperation through market overlapping or industrial similarity, so as to reduce the cost of the same research and to raise the technical level. To prevent new research achievements from being imitated, they plan to patent their achievements. Nevertheless, similar products and technologies often cause infringement among enterprises; therefore, enterprises file infringement lawsuits to protect their interests. The following cases are cited to explain the strategies that enterprises adopt to file a patent lawsuit.

1. Patent infringement lawsuits filed against the same enterprise: Acer filed several patent infringement lawsuits against HP in less than one year. On 7 March 2007, Acer filed patent infringement lawsuits on processor-chip and DVD-editing technology; later, on 19 April, Acer filed lawsuits pertaining to resolution and information transmission.
2. Patent lawsuits filed against several enterprises within a short time: Phison filed several patent infringement lawsuits pertaining to SD cards, solid state drives, and USB flash disks against RITEK and PNY Technologies, Asia Pacific Limited.
3. The plaintiff and the defendant of a patent lawsuit sue each other within a short time: Within six months, Macronix and Spansion filed patent lawsuits against each other. On 15 August 2013, Macronix filed a patent lawsuit against Spansion for NOR flash; afterward, Spansion filed a patent lawsuit against Macronix for flash memory.
4. Several enterprises file patent infringement lawsuits against the same enterprise within a short time: In 2012, HTC was sued by Eastman Kodak for infringement involving the electronic products and parts of patented image technologies and by Pragmatus AV for patented technologies of tablets, cell phones, and related products.

Whether an enterprise is the plaintiff or the defendant in a patent infringement lawsuit, the lawsuit itself has great effects on brand image, consumers' purchase intention, and shareholder wealth of the enterprises [2–4]. In recent years, patent lawsuits have been regarded as the final adaptive approach of enterprises and exude a high cost, are-time consuming, and are complicated [5–7]. According to the

findings of relevant studies [8–11], a lawsuit is not a game theory for the market. For the defendant and the plaintiff, they discuss the impact of the litigation declaration date or the result announcement date on shareholders. The research results show that not much shock is experienced by the plaintiff company when the declaration is made; on the contrary, the litigation is for the defendant company. However, the stock return drops significantly, indicating that the disclosure of the litigation information has a significant impact on the value of the defendant company, which indirectly shows that information disclosure also has the opportunity to obtain benefits. According to the studies in Raghu et al. and Nam et al. [5,12], a patent lawsuit has positive effects on the abnormal returns of the plaintiff, but negative effects on that of the defendant. However, previous studies divided patents into the categories of invention, new design, and new pattern, according to patent law. In contrast, this work classified the samples according to the International Patent Classification (IPC). When enterprises face a patent infringement lawsuit, they seldom analyze the dynamic competitive orientation of the market and have no idea whether to cooperate or compete with rivals and whether to maximize or minimize shareholders' interests according to their market commonality or existing resources. Hence, this research explores the effects of patent infringement lawsuits on shareholder wealth with the consideration of resource similarity and market commonality.

For enterprises, a patent is something used to protect their research achievements; therefore, they attach great importance to patent infringement lawsuits. Nonetheless, previous studies do not share the same conclusions concerning the effects of a lawsuit on the shareholder wealth of the plaintiff or the defendant. Therefore, this study takes a further step to discuss under what orientation are the markets or resources of samples the rivals, indirect rivals, or potential competitors? What effects does a patent infringement lawsuit have on shareholder wealth? First, this paper observes the market response to patent lawsuits with the suing day and the publication day as the event day. Second, this article uses market commonality [13–15] to discuss the overlapping of competitors in a common market, and applies revealed patent advantage (RPA) to define the intensity of patent technology [16] to measure resource similarity. With the average of two variables, market commonality and resource similarity, as the boundary, four quadrants take shape to form a competitor analysis architecture [15]. With said competitor architecture, this research explores the extent of market commonality or the similarity of resources in the market, to find out whether enterprises are mutually direct, indirect, or potential competitors in a dynamic competition, to enable decision-makers to conduct response strategies in advance. Moreover, the orientation of the competitor analysis architecture is projected to a dynamic coopetition model (i.e., Bengtsson et al.), to observe the consistency between theories and practical strategies (i.e., sue/not sue) and to analyze the variance of returns and risks in the case of consistency or inconsistency. Thus, the research purpose of this work is to compare the short-term and long-term responses of the plaintiff and the defendant on the stock market. Moreover, this work discusses the effects of patent lawsuits on the share prices of the plaintiff and the defendant among the samples and the abnormal returns that patent lawsuits contribute to the shareholder wealth of the quadrants—consisting of market commonality and resource similarity, with the publication day and the suing day as the event day. Finally, this paper employs an event study and the GJR-GARCH model, to discuss the samples defined by the quadrants of resource similarity and market commonality and to analyze the relationship between the returns and risks of the plaintiff after a comparison between theories and practical strategies.

2. Literature Review

For enterprises, the filing of a lawsuit and the result of judgment are of great significance, while for investors, they are of tremendous investment value. There are many uncertainties in a lawsuit. Lerner [17] argued that the diversity and size of a patent have such a significant effect on the corporate value of enterprises that enterprises need to delay their operations or reevaluate their value. The result of a lawsuit is also reflected in a firm's stock price through media reports, but sometimes there is an

overreaction, and sometimes a slow reaction. This gives investors an opportunity to obtain returns through the resultant price gap [18–21].

There are some studies in the literature on the impacts of the lawsuit declaration day or the result announcement day on the shareholders and stock price of the defendant and the plaintiff, respectively. According to the findings of these studies, the announcement does not have much effect on the plaintiff; conversely, a lawsuit causes the stock price of the defendant to significantly decline. These findings show that the disclosure of lawsuit information has remarkable impacts on corporate value. Indirectly, they reveal that the release of information also offers chances for investors to earn profits: The party that wins the lawsuit obtains positive returns, while the party that loses the lawsuit has negative returns [9–11]. In industrial competitions, enterprises often increase their value through persistent innovation, but this requires a high research cost. Small enterprises are strong in innovation, but they are too small in size and are underdeveloped in technology, without adequate funds. Consequently, they are likely to be forcibly acquired by big companies that share similar resources with them. For this reason, size is also a key factor in industrial competitions and patent lawsuits.

Chen et al. [14] found that, in industrial competitions, big companies are quick to make a response, but slow to act if they are sued; conversely, small companies are slow to make a response, but quick to act, and most of them adopt a guerilla strategy. Additionally, Bhagat et al. [8] noticed that company size also influences a lawsuit: The influence of big companies is little and transparent, while the stock price of small companies significantly declines due to lawsuits. As the counterattack of big companies may cause financial crises for small companies, investors show a stronger response in the market.

The reason why enterprises try their best to safeguard patents is that patents can help them dominate the market and can create value for them and their shareholders. The protection of the achievements of creative research can also be taken as chips of negotiation in a win–win strategy; hence, a patent lawsuit is regarded as a useful tool for companies [22–25].

Earlier academic papers focused much attention on analyzing the external environment in the industry, such as employing the static Five Forces Analysis. Recently, another competitive advantage study supported by the IT perspective found that IT infrastructure flexibility is a strategic foundation and provides the ability to stop management. Therefore, when senior management personnel support IS business expertise, it directly improves the company's competitive advantage and operating performance, and then quickly forms a key factor that affects the survival and success of the company [26]. Chen [15] proposed the dynamic structure of industrial competitor analysis, which comprises the market commonality developed from the concept of multimarket contact [27] and the resource similarity developed from the resource-based theory [28]. In addition, there is much cooperation among industries. Bengtsson et al. [18] established the dynamic coopetition model and, at the same time, explored competition and cooperation among enterprises.

2.1. Dynamic Competition

Enterprises often compete with each other in different markets; hence, when there is multimarket access among enterprises, they sometimes seek common interests and rely on each other to turn market competition into having low performance [27] and to weaken the extent of mutual competition. However, the resource-based theory emphasizes that the resources of enterprises are unique, rare, and heterogeneous, and can create much value. Therefore, each enterprise makes use of strategic resources to create different, irreplaceable, and constant competition strategies, to gain a vantage point in the competitive market [25,28]. As a result, Chen [15] combined external (e.g., multimarket contact) and internal (e.g., resource-based theory) factors to construct a dynamic competitor analysis architecture to analyze the market orientation of competitors. Chang et al. and Chen [25,29] mentioned that enterprises drive action through awareness, motivation, and capability, and they also argued that a key factor of industrial competition is dynamic competition—manufacturers evaluate the relative competitiveness in the market through market analysis, integrate the resources of enterprises, reduce product costs, and create extra benefits through attack and defense processes.

2.2. Dynamic Coopetition

As for the definition of coopetition, Chuang and Tsai [30] regarded an enterprise as a value net that consists of suppliers, customers, competitors, and supporters. Some scholars have defined it as the cooperation among enterprises that has a direct or indirect effect on the competition among enterprises [31–33]. In a narrower sense, coopetition is defined as the competition, as well as the cooperation, between two enterprises in the market [18,23]; in other words, it is the competition and cooperation between two enterprises that are highly similar in resources and common in the market. Bengtsson and Kock [18] believed that there are four dynamic coopetition factors among enterprises: low cooperation and low competition; low cooperation and high competition; high cooperation and low competition; and high cooperation and high competition. Appropriate cooperation and competition will effectively enhance corporate value.

With the change of times and technical advancement, competition and cooperation in industry have become an important part in the internal innovation of enterprises, especially in technology industries. Li et al. and Zhang et al. [34,35] argued that cooperation and competition effectively promote the acquisition of knowledge and expand internal knowledge. Coopetition among enterprises also influences innovation. The inter-industry transfer of knowledge generated by cooperation or competition can strengthen the innovation capability of companies [36–38]. Nevertheless, if two tit-for-tat enterprises form an alliance, then it will cause a negative response of entrepreneurial performance in innovation [39], or otherwise, does not demonstrate the possibility of enhancing the performance of innovation [40]. A patent is often applied to prevent creative achievements from being imitated. Hence, this work takes the quantity of patents as the criterion of innovation and observes the orientation of the sample companies of patent lawsuits in a dynamic market.

Above all, patent litigation is constantly changing all over the world, whether in developed countries or emerging markets; thus, it is necessary to understand the judicial trends in major markets and to pay attention to commercial shocks, the relative strength of patents of both parties, whether there are potential weaknesses, the duration of litigation, etc., although the factors are the focus of research. However, most of the important patent litigation events are concentrated in the United States or the European Union. This is because the scale of the patent litigation investigation process (i.e., discovery) in the United States and Europe is quite large, and most of said events are for well-known global enterprises. Therefore, for reorganization of the current global supply chain, the communication between the huge production system of manufacturing and foundry and the capital market has become the focus of market participants. For this reason, the Taiwanese technology industry, which mainly relies on foundries, used to compete with enterprises in order to win by volume and to increase market share. However, with the fierce patent litigation risks and the drastic changes in industrial structure, the empirical results can provide experience for emerging market or new-type supply chain models in the face of patent risks.

3. Sample and Methodology

3.1. Sample Collection

First, the defendant and plaintiff samples in this article had to meet the following keywords and their synonyms: “Patent”, “lawsuit”, “infringement”, “defendant”, “sue”, and “complain”, which were used to describe the news about patent infringement in the UDN database. The UDN database has a comprehensive archive of news articles, provided by the United Daily News Group in Taiwan. Secondly, this article further used the Taiwan Economic Journal (TEJ) database to retrieve the corresponding stock price information of the defendants and the plaintiffs in this paper. All of the subjects were listed companies, including 59 plaintiff and 54 defendant samples (113 in total), and 45 events were included. The stock price period of the GJR-GARCH model extended from one year before the event day to one year after (i.e., two years in total). The source of the data regarding the quantity of the companies in this work came from the Intellectual Property Office, Ministry of Economic Affairs

(2017). Through the retrieval in the patent list, the quantity of patents of the samples was counted according to the combination of applicant and IPC, and the applicant was the name of the concerned corporation. The patents were then categorized from A to H, according to the IPC. All of the samples of this research were classified as either G (physics) or H (electrical science); hence, the search was based on classification (G01~G12, G21, and H01~H05). P_{aj} indicates the number of patents of the "a" (ordinal number) company in the classification (G01~G12, G21, and H01~H05), Pa refers to the total number of patents of the "a" company, P_{bj} represents the number of patents of the "b" (ordinal number) company of the same lawsuit in the classification (G01~G12, G21, and H01~H05), and P_b is the total number of patents of the market in the classification (G01~G12, G21, and H01~H05). The samples were obtained with keywords; therefore, it was impossible to acquire all patent lawsuits; moreover, there might have been an error in the time before and after the event day. In addition, the samples whose data could not be obtained with the event study were removed, as were the samples that could not fit the model.

3.2. Index Measurement

Measurement of market commonality:

Market commonality is used to measure the market share and importance of a certain patent and to indicate the extent of relevance and overlapping in the whole market. It is presented in the form of standardization [13,15], as shown in Equation (1):

$$M_{a,b} = \sum_{j}^{n} \left[\frac{P_{aj}}{P_a} \times \frac{P_{bj}}{P_j} \right] \tag{1}$$

where $M_{a,b}$ refers to the market commonality of the "a" and "b" companies, P_{aj} indicates the number of the "j" (ordinal number) patents of the "a" company, P_{bj} represents the number of the "j" (ordinal number) patents of the "b" company, P_a symbolizes the number of patents of the "a" company in the market, and P_b is the number of patents of the "b" company in the market. A higher $M_{a,b}$ leads to stronger market commonality.

Measurement of resource similarity:

When classifying the intensity of patent technology according to RPA [16,30], the resource similarity reflects the similarity of resources, as shown in Equation (2):

$$RPA_{ja} = 100 \times \tan \mathrm{h} \left[\ln \left(\frac{P_{ja}}{\sum_{j}^{n} P_{ja}} \right) \div \left(\frac{\sum_{j}^{n} P_{ja}}{\sum_{j}^{n} \sum_{a}^{n} P_{ja}} \right) \right] \tag{2}$$

where RPA_{ja} refers to the intensity of patent technology of the "j" category for the "a" company, and P_{ja} indicates the number of patents of the "a" company in the "j" category. If RPA is above 0 and becomes higher, then the intensity will be stronger; otherwise, the intensity will be weaker. If the gap of RPA is higher than 15, then the difference between the two will be significant.

3.3. Asymmetric General Autoregressive Conditional Heterogeneous Variation

The patents were classified according to market commonality and resource similarity. With the average of the two indices as the boundary, four quadrants were created. Finally, the competitor analysis architecture [15] was explored to see if the plaintiff and the defendant companies generated abnormal returns in their stock price on the suing day and on the publication day.

The returns in the Taiwan stock market are not stationary, and the temporal sequence features leptokurtic, volatility clustering, and leverage. To solve the relevant problems, Engle and Engle and Ng [41,42] proposed a solution function: the autoregressive conditional heteroscedasticity (ARCH). Aside from allowing the shareholders' rate of return to change with time, the function can capture

the leptokurtic features of samples. Nonetheless, there are still many limitations on ARCH; hence, Bollerslev [43] generalized the model into the GARCH model, which is used by most scholars today. More specifically, the model can describe variance with a few parameters; moreover, it allows and can capture the effects of the fluctuation in the early stage on the current fluctuation, thus making the limitations of ARCH more flexible. Despite the fact that the transition from ARCH to GARCH has allowed variance to be inconstant, it is still impossible to estimate the returns of the stock market with full accuracy.

Engle found that the returns of the stock price are asymmetric. If the market is influenced by information, then returns become positive or negative. However, the responsive effects of the two mutually offset each other and are never zero or asymmetric. Noticing the problem in a later stage, Glosten et al. [44] improved the model so that it could describe asymmetry. Wang et al. [45] used the bivariate EGARCH with the DCC model to estimate the dynamic risk of patent litigation between market leaders (e.g., Apple) and market challengers (e.g., HTC) in the smartphone industry. However, this work first targeted all the patent litigation samples of Taiwan's technology industry in the past 20 years, and then classified the samples on a large scale, according to the dynamic competition framework. Under the comparison of the four groups, the difference between abnormal returns and accumulated abnormal returns was compared. Further, for the special samples of the whole group, the volatility was estimated through univariate GJR-GARCH. The improved model is the GJR-GARCH model; therefore, this research applied GJR-GARCH to theoretically and practically estimate the effects of patent lawsuits on stock returns and fluctuation. With the model developed by Glosten et al. and Wang et al. [44,45], this paper projected the samples to the dynamic coopetition model to estimate theoretically and practically consistent or inconsistent returns and risks.

$$R_{i,t} = \omega_0 + \omega_1 X_{i,t} + \varepsilon_{i,t} \tag{3}$$

$$h_{i,t} = \alpha_0 + \alpha_1 X_{i,t} + \beta_1 \varepsilon_{i,t-1}^2 + \beta_2 h_{i,t-1}^2 + \beta_3 S_{t-1} \varepsilon_{i,t-1}^2 \tag{4}$$

$$S_{t-1} = \begin{cases} 1, & \text{if } \varepsilon_{i,t-1} < 0 \\ 0, & \text{if } \varepsilon_{i,t-1} \geq 0 \end{cases}$$

where $R_{i,t}$ refers to the stock returns of patent litigation samples during the observation period, h_t is the stock returns volatilities of patent litigation samples, and $X_{i,t}$ indicates a dynamic correspondence. In the case of theoretical and practical consistency, the virtual variable is set as "1", while in the case of theoretical and practical inconsistency, the virtual variable is set as "0". Additionally, ω_1 and α_1 refer to shareholders' return and risk coefficients, respectively, in the case of theoretical and practical consistency.

3.4. The Competitor Analysis Architecture Corresponds to the Dynamic Coopetition Model

The abovementioned research refers to the metrological research on GJR-GARCH; in contrast, this section focuses on how the variables of the competitor analysis architecture correspond to that of the dynamic coopetition model, as shown in Figure 2. This study first explores the level of market commonality between companies or the strength of similarity of company resources in the market through an analytical framework, to determine whether companies are direct, indirect, or potential competitors under dynamic competition—so that decision-makers can prepare in advance for coping strategies. This article then further analyzes the positioning of the architecture through competitors and projects it into a dynamic competition model [9,10], observes whether the theory and actual strategy (i.e., reporting/not reporting) are consistent, and analyzes when the two are consistent or inconsistent with regard to the situation of changes in rewards and risks.

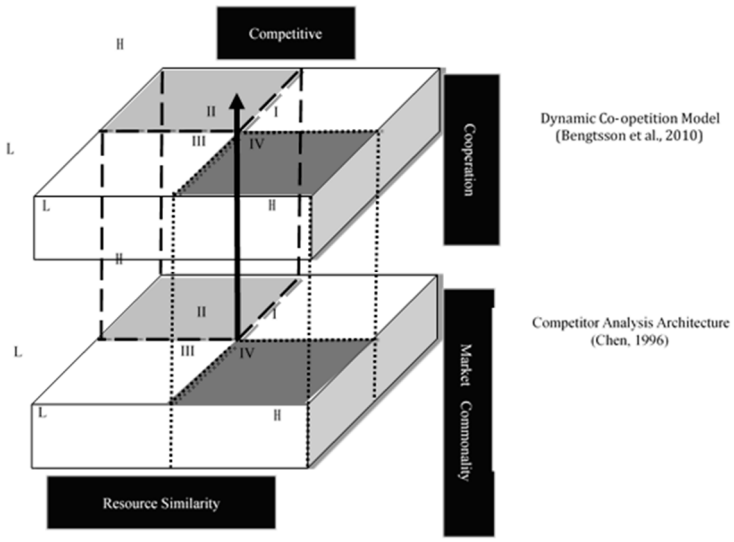

Figure 2. The competitor architecture corresponds with the dynamic coopetition model.

After the samples were located in the competitor analysis architecture, they were projected to the dynamic coopetition model. If they are in a "low competition and high cooperation" relationship (second quadrant), then there should be cooperation or authorization, in theory. In reality, however, there is a lawsuit; hence, the theory is inconsistent with practice. In contrast, when the samples are in a "low cooperation and high competition" relationship (fourth quadrant), there should be a lawsuit in theory, and in fact, there is a lawsuit. Hence, the theory is consistent with practice. Therefore, the samples of consistency and inconsistency were distinguished, and the GJR-GARCH was adopted to discuss the relationship between returns and risks.

4. Empirical Results

4.1. ARs and CARs of Patent Litigation

4.1.1. ARs of the Patent Litigation Publication and Suing Days

In Table 1, the publication day was taken as the event day, and the event information about the patent lawsuit was detected, and it had a greater influence on the defendant than on the plaintiff. On the fourth day and the first day prior to the event day of the defendant's abnormal returns, there were negative abnormal returns. This means that there was a sign of advanced information disclosure and that it was embodied in the stock price. The effect was the greatest on the day of the event, with a significant abnormal return of −2.774%. On the first and the second days after the event, there was also a negative response. The information about a lawsuit had significant negative effects on the cumulative abnormal returns on the fourth day (−1.308%) and the fifth day (−8.839%) after the event, and there was a significant response (−9.103%) on the second day after the event. The results show that shareholders seemed to be pessimistic about the whole lawsuit, believing that the information about the patent lawsuit would have an impact on their companies. Nevertheless, there was a significant response from the plaintiff from the second day to the fourth day after the event. This demonstrates that the information had little effect on the plaintiff and that there was a positive response in abnormal returns since the fourth day after the event.

The suing day was taken as the event day, and its response was weaker than that of the publication day. On the day prior to the event, the defendant showed a positive abnormal return of 0.895% (shown in Table 1, Panel B). This indicates that investors thought that it was a piece of good news that enterprises were informed. However, on the first and the second days after the event, there were significant negative abnormal responses. This shows that the event was regarded as a piece of bad news in the market after the event. It was not until the fifth day that there was a significant abnormal return of

1.394%. Moreover, there was a significant negative response in cumulative abnormal returns for four consecutive days after the event. For the plaintiff, there was an abnormal return of 0.826% only on the fourth day prior to the event. From then, until the day prior to the event, there were significant cumulative abnormal returns. In other words, the market showed a positive attitude toward the company that filed the patent lawsuit, and there was an advanced response in the stock price.

Table 1. ARs and CARs of patent litigation (publication day and suing day).

Panel A. ARs and CARs of Patent Litigation on the Publication Day								
	Plaintiff		**Defendant**		**Plaintiff**		**Defendant**	
Period	**ARs**	***t*-Value**	**ARs**	***t*-Value**	**CARs**	***t*-Value**	**CARs**	***t*-Value**
−5	0.150	0.354	−0.476	−0.987	0.150	0.354	−0.476	−0.987
−4	−0.007	−0.018	−0.832 *	−1.724	0.142	0.238	−1.308 *	−1.917
−3	−0.108	−0.255	−0.368	−0.762	0.034	0.047	−1.676 **	−2.005
−2	0.389	0.919	−0.560	−1.159	0.423	0.500	−2.236 **	−2.316
−1	−0.347	−0.821	−1.375 ***	−2.849	0.076	0.080	−3.610 ***	−3.346
0	0.486	1.149	−2.774 ***	−5.747	0.562	0.542	−6.384 ***	−5.400
+1	−0.366	−0.865	−1.213 **	−2.514	0.196	0.175	−7.597 ***	−5.950
+2	−0.724 *	−1.711	−1.505 ***	−3.119	−0.528	−0.441	−9.103 ***	−6.669
+3	−0.748 *	−1.768	0.624	1.292	−1.276	−1.006	−8.479 ***	−5.856
+4	0.890 **	2.105	0.210	0.435	−0.386	−0.288	−8.269 ***	−5.418
+5	0.361	0.853	−0.570	−1.181	−0.025	−0.018	−8.839 ***	−5.522
Panel B. ARs and CARs of Patent Litigation on the Suing Day								
	Plaintiff		**Defendant**		**Plaintiff**		**Defendant**	
Period	**ARs**	***t*-Value**	**ARs**	***t*-Value**	**CARs**	***t*-Value**	**CARs**	***t*-Value**
−5	0.648	1.471	−0.164	−0.362	0.648	1.471	−0.164	−0.362
−4	0.826 *	1.874	−0.055	−0.122	1.474 **	2.365	−0.219	−0.342
−3	−0.083	−0.187	−0.440	−0.972	1.391 *	1.823	−0.659	−0.840
−2	0.476	1.081	0.112	0.247	1.867 **	2.119	−0.547	−0.604
−1	0.128	0.290	0.895 **	1.976	1.995 **	2.025	0.347	0.343
0	−0.489	−1.110	−0.356	−0.785	1.506	1.396	−0.008	−0.007
+1	0.401	0.911	−2.107 ***	−4.653	1.908	1.637	−2.115 *	−1.765
+2	−0.622	−1.411	−0.924 **	−2.041	1.286	1.032	−3.039 **	−2.373
+3	−1.041 **	−2.362	0.377	0.834	0.245	0.186	−2.661 *	−1.959
+4	−0.349	−0.791	−0.095	−0.209	−0.104	−0.074	−2.756 *	−1.925
+5	0.654	1.484	1.394 ***	3.078	0.550	0.377	−1.362	−0.907

Note: *** For a level of 1% significance; ** for a level of 5% significance; * for a level of 10% significance.

As a whole, it was found that there were both positive and negative responses in the abnormal returns of the plaintiff, and that most of the abnormal returns of the defendant were negative. This demonstrates that the market is positive about companies that file a patent lawsuit in a patent litigation. Additionally, this article found that the suing day caused significant responses in advance to the stock of the plaintiff, while the defendant showed a significant response on the publication day. This implies that the plaintiff receives the information at an earlier time, while the defendant gets the news after the event. Therefore, the plaintiff exhibits a quicker response in the stock price than the defendant.

4.1.2. ARs and CARs of Patent Litigation (Plaintiff) on the Publication Day and the Suing Day in the Different Quadrants

This paper used resource similarity and market commonality in the dynamic competitor architecture to define the orientation of the samples (i.e., the plaintiff and the defendant) in the dynamic market. As seen in Table 2, the plaintiff was in the third quadrant (i.e., weak resource similarity and market commonality) on the publication day. It was found that the plaintiff showed significant negative

abnormal returns on the third day after the event. This means that the patent lawsuit strategy was negative for nonparticipators of the market or for enterprises that turn into indirect or potential competitors. Nonetheless, if market commonality became stronger or the plaintiff was in the second quadrant (i.e., weak resource similarity and strong market commonality), then the negative effects became greater and the market response came earlier: There was a significant abnormal return of −2.153% on the fourth day prior to the event. In other words, when the dynamic orientation was not that the participants of the market turned into direct or indirect competitors, the stock price of the plaintiff further declined. Conversely, if the resource similarity was increased to turn the market orientation into potential competitors or when it was in the fourth quadrant (i.e., strong resource similarity and weak market commonality), the significant negative response in abnormal returns disappeared.

Table 2. ARs and CARs of patent litigation (plaintiff) on the publication day the suing day in the different quadrants.

Panel A. ARs of Patent Litigation (Plaintiff) on the Publication Day and the Suing Day												
	Quadrant II				**Quadrant III**				**Quadrant IV**			
Period	**Publication Day**		**Suing Day**		**Publication Day**		**Suing Day**		**Publication Day**		**Suing Day**	
−5	−0.074		−0.215		−0.330		1.474	**	0.624		0.279	
−4	−2.153	**	1.464		0.281		−0.697		0.409		1.800	***
−3	−0.851		0.279		0.348		0.297		−0.265		−0.486	
−2	1.069		−0.700		0.052		0.824		0.465		0.571	
−1	−0.052		−0.809		−0.225		1.163	*	−0.542		−0.380	
0	0.194		0.053		0.296		−1.212	*	0.736		−0.099	
+1	−0.546		−0.022		0.031		0.275		−0.647		0.629	
+2	−0.696		−0.250		−0.752		0.134		−0.708		−1.317	*
+3	0.729		0.063		−1.845	***	−1.437	**	−0.274		−1.076	
+4	0.067		−2.299	**	1.130		−1.252	*	0.941		0.947	
+5	1.301		0.991		0.111		0.321		0.283		0.807	
Panel B. CARs of Patent Litigation (Plaintiff) on the Publication Day and the Suing Day												
	Quadrant II				**Quadrant III**				**Quadrant IV**			
Period	**Publication Day**		**Suing Day**		**Publication Day**		**Suing Day**		**Publication Day**		**Suing Day**	
−5	−0.074		−0.215		−0.330		1.474	**	0.624		0.279	
−4	−2.227		1.249		−0.049		−0.697		1.033		2.079	**
−3	−3.078		1.528		0.299		0.297		0.768		1.593	
−2	−2.009		0.828		0.351		0.824		1.233		2.164	
−1	−2.061		0.018		0.126		1.163	*	0.691		1.784	
0	−1.867		0.071		0.422		−1.212	*	1.427		1.685	
+1	−2.414		0.049		0.454		−0.275		0.780		2.314	
+2	−3.110		−0.202		−0.299		0.134		0.072		0.996	
+3	−2.381		−0.139		−2.144		−1.437	**	−0.202		−0.079	
+4	−2.313		−2.438		−1.014		−1.252	*	0.739		0.867	
+5	−1.013		−1.447		−0.904		0.321		1.022		1.674	

Note: second quadrant: strong market commonality and weak resource similarity. Third quadrant: weak market commonality and weak resource similarity. Fourth quadrant: strong resource similarity and weak market commonality. *** For a level of 1% significance; ** for a level of 5% significance; * for a level of 10% significance.

The reason why the event day was divided into the publication day and the suing day in this study is that the plaintiff showed more responses to the suing day, because it received information at an earlier time. The publication day occurred sometime after the event, which means that the plaintiff's market response was more consistent with the trend in the response period. The plaintiff's response in abnormal returns on the suing day was significant. For instance, the number of days with a significant response of the third quadrant (i.e., weak resource similarity and market commonality) was larger

than that of the publication day, and there was a significant abnormal return of −1.212% on the day of the event, the fifth day, and the day prior to the event, as well as the third day and the fourth day after the event. This means that the response in stock was positive before the patent lawsuit was filed. In other words, there was a trend of optimistic market response, and there were significant cumulative abnormal returns on the fifth day and the day prior to the event. This implies that companies believed that the patent lawsuit strategy was beneficial for them; otherwise, they would not have adopted it, for the strategy requires a high cost and takes much time. However, when the market commonality of companies became stronger or was in the second quadrant (i.e., weak resource similarity and strong market commonality), its market response was the same as that of the publication day, but there was more of a response. For example, there was an abnormal return of −2.299% on the fourth day after the suing day. However, if enterprises increased another index (e.g., resource similarity) in the fourth quadrant (i.e., strong market commonality and weak resource similarity), then there was a significant response in abnormal returns of 1.800% on the fourth day prior to the event, showing a significant increase of 0.326% in abnormal returns in comparison to the greatest positive response before the event in the third quadrant. Moreover, there was also a significant cumulative abnormal return on the fourth day prior to the event. The positive response before the event turned into a negative response after the event, and there was a significant response in abnormal returns of −1.317% on the second day after the event.

According to what has been mentioned above, the plaintiff showed a different response before the event, on the day of the event, and after the event, under the effects of different combinations of resource similarity and market commonality. Moreover, the market made different responses to the information about patent lawsuits on the suing day and on the publication day. The response of the plaintiff on the suing day was stronger than that on the publication day, and different degrees of resource similarity and market commonality triggered different responses in abnormal returns.

A patent lawsuit is a time- and money-consuming strategy. Different stances in a lawsuit lead to different abnormal returns. Moreover, the event day also influences responses. For instance, the defendant showed responses in the stock price on the publication day, while the suing day had a greater effect on the plaintiff.

In Table 2, it can be seen that the defendant's response in abnormal returns was more significant on the publication day than on the suing day. When it was in the third quadrant (i.e., weak market commonality and resource similarity), there were significant negative abnormal returns on the fourth day prior to the event, on the day of the event, and the day after the event, and there was a trend of gradual decline. However, following the fourth day prior to the event (−1.786%), the market showed significant cumulative abnormal returns until the fifth day after the event (−9.639%), with the greatest decline on the second day after the event. In other words, the market showed a negative attitude before the event, on the day of the event, and after the event, and the response was significantly reflected in the stock price. If market commonality among enterprises was strong or was in the second quadrant (i.e., weak resource similarity and strong market commonality), then the negative cumulative abnormal returns were effectively reduced and appeared on the third day and the fifth day after the event. Therefore, on the publication day, a stronger market commonality reduces negative cumulative abnormal returns.

If the resource similarity of companies was strong or it was in the fourth quadrant (i.e., strong resource similarity and weak market commonality), then the number of days with significant abnormal returns and the reduction increased. There was a significant negative response on the fourth day, on the second day, and on the day prior to the event, as well as on the day of the event and on the second day after the event. Moreover, the cumulative abnormal returns began to be negative from the second day prior to the event (−2.583%) to the fifth day after the event (−13.617%). It is obvious that stronger resource similarity of a patent lawsuit leads to a greater effect of the information on the stock price of the defendant. If enterprises were definite competitors or in the first quadrant (i.e., strong resource similarity and market commonality), then the cumulative impact was alleviated, but the influence

remained unchanged. Compared to the other three quadrants, the negative effect did not decrease, but there was further decline on the day prior to the event and on the day of the event. Despite the fact that the number of days when cumulative abnormal returns were reduced increased, the most significant decline was −9.706% on the day of the event.

4.1.3. ARs and CARs of Patent Litigation (Defendant) on the Publication Day and the Suing Day in the Different Quadrants

There were different responses in the quadrants on the suing day and on the publication day for the defendant. In Table 3, if the defendant was in the third quadrant (i.e., weak market commonality and strong resource similarity) on the suing day, it showed a significant positive response on the day prior to the event and a significant response in cumulative abnormal returns from the suing day to the day of event. The market response was also greatly different from what it had been. While non-participants of the market regarded the information as a piece of good news, the investors might have believed that the patent lawsuit could improve the corporate reputation in the market, and thus showed a positive response. However, on the day after the event, the information effect turned out to be −2.671%, which indicates that the information of a patent lawsuit still had an impact on the stock price of the defendant.

Table 3. ARs and CARs of patent litigation (defendant) on the publication day and the suing day in the different quadrants.

Panel A. ARs of Patent Litigation (Defendant) on the Publication Day and the Suing Day								
	Quadrant I		**Quadrant II**		**Quadrant III**		**Quadrant IV**	
Period	**Publication Day**	**Suing Day**	**Publication Day**	**Suing Day**	**Publication Day**	**Suing Day**	**Publication Day**	**Suing Day**
−5	−0.639	−2.828	−0.180	1.656 *	−0.432	0.577	−0.743	−1.279 **
−4	0.943	−2.294	−0.102	0.133	−1.354 *	0.739	−1.840 **	−0.384
−3	−1.410	−2.420	0.870	0.817	−0.858	−0.420	−0.512	−0.321
−2	0.046	−0.220	−0.014	−1.274	−0.331	0.798	−1.675 *	0.057
−1	−4.207 **	−2.033	0.702	1.271	−1.008	1.803 ***	−2.465 ***	0.595
0	−4.439 **	−3.470 *	−2.848 ***	1.996 **	−2.349 ***	−0.023	−2.362 **	−0.919
+1	2.053	−1.453	−1.270	−1.544	−2.396 ***	−2.671 ***	−1.411	−1.868 ***
+2	−1.958	−0.602	−1.078	−1.456	−1.125	−1.056	−2.150 **	−0.511
+3	2.754	0.213	−0.479	−0.453	0.543	1.002	0.755	−0.027
+4	1.989	−0.775	1.280	−2.681***	−0.499	1.069	−0.924	0.032
+5	−0.364	3.354 *	−1.812 **	1.424	0.168	1.022	−0.291	1.013
Panel B. CARs of Patent Litigation (Defendant) on the Publication Day and the Suing Day								
	Quadrant I		**Quadrant II**		**Quadrant III**		**Quadrant IV**	
Period	**Publication Day**	**Suing Day**	**Publication Day**	**Suing Day**	**Publication Day**	**Suing Day**	**Publication Day**	**Suing Day**
−5	−0.639	−2.828	−0.180	1.656 *	−0.432	0.577	−0.743	−1.279 **
−4	0.305	−5.122 *	−0.282	1.790	−1.786 *	1.315	−2.583 **	−1.663 *
−3	−1.105	−7.542 **	0.588	2.606	−2.644 **	0.895	−3.096 *	−1.984 *
−2	−1.060	−7.761 **	0.574	1.333	−2.975 **	1.693	−4.770 **	−1.927
−1	−5.266	−9.795 **	1.276	2.604	−3.982 **	3.495 **	−7.235 ***	−1.332
0	−9.706 **	−13.265 ***	−1.572	4.600 **	−6.331 ***	3.472 **	−9.597 ***	−2.252
+1	−7.653	−14.718 ***	−2.843	3.056	−8.726 ***	0.801	−11.007 ***	−4.120 **
+2	−9.610 *	−15.320 ***	−3.921	1.600	−9.851 ***	−0.254	−13.158 ***	−4.631 **
+3	−6.857	−15.107 ***	−4.400 *	1.147	−9.308 ***	0.748	−12.403 ***	−4.658 **
+4	−4.868	−15.883 ***	−3.120	−1.535	−9.807 ***	1.816	−13.326 ***	−4.626 **
+5	−5.232	−12.529 **	−4.932 *	−0.111	−9.639 ***	2.838	−13.617 ***	−3.613 *

Note: second quadrant: strong market commonality and weak resource similarity. Third quadrant: weak market commonality and weak resource similarity. Fourth quadrant: strong resource similarity and weak market commonality. *** For a level of 1% significance; ** for a level of 5% significance; * for a level of 10% significance.

The second quadrant (i.e., strong market commonality and weak resource similarity) shared the same response as the third one, but the effect of the former was greater. On the fifth day prior to the event and on the day of the event, there were significant positive abnormal returns, and there

were significant cumulative effects on these two days. On the fourth day after the event, there was also a negative abnormal return (−2.681%), which developed from a positive one. If the extent of inter-enterprise resources changed, the responsive effect was different. In the fourth quadrant (i.e., strong resource similarity and weak market commonality), for example, the responsive effect was not as strong as that on the publication day, but the market still showed a negative response. On the fifth day prior to the event and on the day after the event, there were significant abnormal returns; at the same time, there were significant cumulative abnormal returns on the fifth day prior to the event (−1.279%), on the fourth day prior to the event (−1.663%), on the third day prior to the event (−1.984%), and from the day after the event (−4.120%) to the fifth day after the event (−3.613%), with the most significant decline on the third day after the event (−4.658%). It seems that stronger resource similarity enhanced the negative impact. If enterprises were definite competitors and were in the first quadrant (i.e., strong resource similarity and market commonality), then the decline deteriorated. The extent of the decline on the day of the event was greater than that in other quadrants. There were significant responses in cumulative abnormal returns from the fourth day prior to the event (−5.122%) to the fifth day after the event (−12.529%), with the most significant negative response (−15.883%). It can be seen that the suing day of the lawsuit had the most significant effect on definite competitors.

4.2. Estimation of GJR-GARCH

The second quadrant of Table 4 indicates weak resource similarity and strong market commonality, and the relationship between the two concerned parties of a lawsuit should be direct or indirect rivals. It is as if different enterprises have different technical strengths in the same market. Therefore, in theory, enterprises should choose authorization, but in reality, they sue each other. According to this paper, if there is inconsistency between decision and theory, then there would be a significant reduction of risk, and a significant negative response and asymmetry in return. In other words, strong market commonality significantly reduces fluctuation in the case of inconsistency between decision and theory, but it also greatly reduces the returns of the plaintiff.

Table 4. Second quadrant estimation results of GJR-GARCH after projection of dynamic competing.

The Second Quadrant (Strong Market Commonality and Weak Resource Similarity)						
Event Date	**Firm**	**Return**	**Volatility (t)**	**Volatility ($t-1$)**	**Residuals ($t-1$)**	**Asymmetric ($t-1$)**
9 May 2013	WADO	−0.162	3.45×10^{-4} ***	1.66×10^{-4}	-9.69×10^{-5} ***	-4.01×10^{-5} ***
		(356.037)	(4.54×10^{-5})	(2.33×10^{-4})	(7.52×10^{-6})	(3.03×10^{-6})
4 June 2006	VLA Technologies	-3.22×10^{-4}	6.00×10^{-11}	2.63×10^{-5}	2.85×10^{-5} ***	1.12×10^{-5} ***
		(0.145)	(4.30×10^{-10})	(7.06×10^{-5})	(3.42×10^{-6})	(5.98×10^{-7})
16 June 2002	MediaTek Inc.	−0.268 ***	-1.12×10^{-7} *	3.07×10^{-4}	4.83×10^{-4} ***	2.34×10^{-4} ***
		(0.099)	(6.49×10^{-8})	(2.93×10^{-4})	(2.90×10^{-5})	(1.17×10^{-5})
25 December 2009	MediaTek Inc.	−0.519 ***	-7.26×10^{-10}**	3.64×10^{-4} **	4.52×10^{-4} ***	4.02×10^{-4} ***
		(0.018)	(3.56×10^{-10})	(1.63×10^{-4})	(2.31×10^{-5})	(1.92×10^{-5})

Note: *** For a level of 1% significance; ** for a level of 5% significance; * for a level of 10% significance. Standard error in parentheses.

The fourth quadrant implies weak market commonality and strong resource similarity, and the relationship between the two concerned parties of a lawsuit should be potential competitors. Although both parties share highly related resources and the extent of market overlapping is small, the resource similarity is strong, which gives easy access to mutual markets. Therefore, in theory, enterprises should choose to compete with rivals. In the case of patent infringement, enterprises should file a lawsuit to protect creative achievements. As shown in Table 5, there is a significant increase in market fluctuation in the case of consistency between theory and practice. Moreover, the consistency also triggers a positive or negative response in the return of enterprises, as well as significant asymmetry, as was the

case in the fourth quadrant (i.e., strong resource similarity), which might turn the information about a patent lawsuit into positive news.

Table 5. Fourth quadrant estimation results of GJR-GARCH after projection dynamic competing.

The Fourth Quadrant (Strong Resource Similarity and Weak Market Commonality)						
Event Date	**Firm**	**Return**	**Volatility (t)**	**Volatility ($t-1$)**	**Residuals ($t-1$)**	**Asymmetric ($t-1$)**
5 December 2000	UMC	−0.018	8.73×10^{-8} ***	2.70×10^{-4}	2.91×10^{-4} ***	7.74×10^{-5} ***
		(0.052)	(9.69×10^{-9})	(1.78×10^{-4})	(1.47×10^{-5})	(4.05×10^{-6})
13 November 2002	HON HAI	0.151 ***	5.66×10^{-8} ***	2.76×10^{-4}	2.77×10^{-4} ***	9.97×10^{-5} ***
		(0.039)	(5.87×10^{-9})	(2.20×10^{-4})	(1.36×10^{-5})	(5.39×10^{-6})
7 November 2005	HON HAI	0.411 ***	2.51×10^{-10} ***	1.32×10^{-6}	1.78×10^{-5} ***	6.08×10^{-6} ***
		(0.046)	(2.64×10^{-11})	(3.62×10^{-6})	(8.98×10^{-7})	(3.61×10^{-7})
15 February 2006	EMINENT	0.104 ***	5.56×10^{-8} ***	2.93×10^{-4}	5.06×10^{-4} ***	5.90×10^{-4} ***
		(0.014)	(6.16×10^{-9})	(3.93×10^{-4})	(2.52×10^{-5})	(3.04×10^{-5})
18 February 2006	CML	0.057	1.42×10^{-7} ***	1.72×10^{-4} *	1.09×10^{-7} ***	2.97×10^{-8} ***
		(0.064)	(1.52×10^{-8})	(1.03×10^{-4})	(2.34×10^{-8})	(2.12×10^{-9})
30 September 2008	ProMOS TECHNOLOGIES	−0.261 ***	5.23×10^{-13}	1.07×10^{-4} ***	7.20×10^{-7} ***	1.93×10^{-7} ***
		(0.047)	(0.00×10^{0})	(4.05×10^{-5})	(3.86×10^{-8})	(9.49×10^{-9})
8 October 2008	EPISTAR	0.057	1.42×10^{-7} ***	2.11×10^{-4} *	2.85×10^{-4} ***	4.57×10^{-5} ***
		(0.064)	(1.52×10^{-8})	(1.17×10^{-4})	(1.44×10^{-5})	(2.43×10^{-6})
19 October 2010	HON HAI	−0.067 **	2.60×10^{-8} ***	4.91×10^{-4} *	2.18×10^{-4} ***	1.04×10^{-4} ***
		(0.028)	(2.74×10^{-9})	(2.54×10^{-4})	(1.07×10^{-5})	(5.60×10^{-6})
3 August 2015	GPTC	−0.978 ***	4.44×10^{-17}	3.73×10^{-4} ***	-2.95×10^{-8} ***	-1.40×10^{-7} ***
		(0.005)	(0.00×10^{0})	(5.34×10^{-5})	(1.45×10^{-9})	(6.81×10^{-9})

Note: *** For a level of 1% significance; ** for a level of 5% significance; * for a level of 10% significance. Standard error in parentheses.

According to what was mentioned above, the decisions by enterprises and the information generated have a great effect on the stock price. In the case of consistency or inconsistency, there is significant fluctuation. However, the response in return is significantly positive in the case of consistency, while it is significantly negative in the case of inconsistency. In sum, the authors of this paper believe that enterprises must take multiple factors into consideration in decision making, for a patent lawsuit is a strategy that requires much time and a high cost.

5. Conclusions

This study found that the effect of the suing day on the plaintiff was significant, which is in accordance with previous academic studies in that consistency between theory and practice has a significant effect on abnormal returns. The publication day of the information about patent infringement lawsuit had a significant effect on the defendant, and there were signs of significant abnormality and accumulation of shareholder wealth. The authors of this paper believe that the extent of the response on the day of the event depends on investors' possession of asymmetric information. The plaintiff receives the information about a patent lawsuit at an earlier time, while the defendant does not show a response in the stock price until they receive the information; after all, strategies are somewhat confidential for companies. Since the court's real prosecution date (i.e., the suing day) and the date disclosed by the mass media (i.e., the publication day) reveal the major information of the plaintiff (and the defendant company) listed, this does indeed lead investors—and even relevant legal entities—to make wrong investment decisions because of the difference in the announcement times.

Resource similarity and market commonality were adopted to distinguish samples. Stronger market commonality led to more negative abnormal returns after the suing day, which had significant effects on the plaintiff, as defined. This means that if both parties of a lawsuit are mutually indirect competitors in the market, then filing a patent infringement lawsuit lowers the stock price, and enterprises try to cooperate due to consideration of the authorization of a patent. However,

if resource similarity is strong, then the negative abnormal returns would be effectively reduced. This demonstrates that if both parties of a lawsuit are potential competitors, then a patent lawsuit would be a strategy worth consideration for the prosecutor. Moreover, as far as the suing day—which has the farthest-reaching effect on the defendant—is concerned, strengthening the response in one of the two indices would have an opposite effect on the plaintiff. Moreover, if both parties are definite competitors, then the response of negative abnormal returns is the strongest among the quadrants. Therefore, the authors of this paper believe that it is appropriate for the plaintiff to file a patent lawsuit when resource similarity is strong, while the defendant will suffer less harm caused by a lawsuit when market commonality is strong. In the case of inconsistency between the plaintiff's orientation and actual behavior, the stock price will show significant fluctuation and there will be negative abnormal returns. In the case of consistency, there may be a positive response in the stock price. This paper also found that there will be negative returns and a significant reduction in fluctuation when enterprises should cooperate with others and authorize the use of a patent, but instead choose to file a patent lawsuit. Nevertheless, when enterprises should compete with rivals and actually implement the strategy of infringement lawsuit, the return has a significant positive correlation with fluctuation in most cases.

According to the findings of this research, the response in the stock price and abnormal returns tends to be negative when enterprises face a patent lawsuit. However, if investors find that the companies they invest in face a patent lawsuit, then it is possible to observe the market or resource relationships among them. For instance, if a company is the defendant and shows strong resource similarity, or it is the plaintiff and shows strong market commonality, then there will be a significant negative response in the stock price. Hence, it is suggested that investors should evade risks through other financial products in order to minimize the loss of shareholder wealth. The United States is the main sample of patent wars; however, Taiwanese technology manufacturers, mainly SMEs in the global supply chain, face patent litigation experience and empirical evidence from different angles, and this article also extends to the univariate model (through univariate because of the different patent war samples, the setting of the multivariate model), and then, considering the multiple relationships with the amount of conditional variability between patent litigation samples, can provide considerable research experience in many developing countries or industries.

Author Contributions: Investigation, F.-J.Y. and J.-T.S.; Methodology, Y.-H.W. and J.-T.S.; Formal Analysis, J.-T.S. and Y.-H.W.; Conceptualization, K.-H.S. and Y.-H.W. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Ministry of Science and Technology of Taiwan, under Contract No. MOST 108-2410-H-034-055.

Acknowledgments: The authors thank the reviewers for their useful discussions.

Conflicts of Interest: The authors declare no conflict of interest.

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