

Impact of the infringement lawsuit announcements on the firms quoted value and their trade partners: an empirical analysis to the pharmaceutical and biotechnological sector.

Christian Ben Lakhdar^{✉*}

Our study shows that the pharmaceutical firms and the biotechnological firms are sensitive to the infringement lawsuit announcements. The assets return lowers significantly of 6.33% on average. The biotechnological firms are more sensitive to this kind of announcements than the pharmaceutical firms. Our study also shows that there are spillover effects on the trade partners of the firms practising these announcements. We argue that these announcements cast doubt on the future and current patent quality.

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[✉] Université Paris 1 Panthéon-Sorbonne, Laboratoire d'économie publique (LAEP), 106-112 Bd de l'hôpital 75013 Paris, ESSEC Programme Doctoral, Cergy-Pontoise 95021. Christian.benlakhdar@malix.univ-paris1.fr, Tél : 01.44.07.81.03, Fax : 01.44.07.81.02.

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1. Introduction

Since Fama, Fisher, Jensen and Roll (1969) and Fama (1970, 1991), event studies have become the predominant methodology for determining the effects of an event on the distribution of security returns. Indeed, those authors developed a methodology that captures the financial market reaction ability to events and informations relating to them.

The sharing out (Campbell and Shiller 1998, Charest 1978), the market time (Henrikson 1984, Connolly 1989), or the impact of rating agency announcements (Ramdani 1999), or again FDA approval (Campart and Pfister 2001) were and are still a study object using event-study analysis. Moreover, law and regulation authority's decisions became study object, on one side about financial market reaction, on the other side about the efficacy of this measures born of judicial constraints or regulator constraints.

Muoghalu, Robinson and Glascock (1990), with an event-study analysis on pollution trial show that powers where fines and monitoring of authorities in charge of pollution control have no deterrence on some enterprises. This no deterrence effect is detected by the lack of spillover effects on the enterprises which are around the firm in trial. In other words, a pollution trial drops the quoted value of the offender firm by 1.228% on average but have not significant effect on quoted value of other enterprises in the same sector.

Bhagat, Brickley and Coles (1994) assess the financial losses of the firms bringing of the lawsuits and explain why, under the pressure of the costs generated by the lawsuit, often the defendant accepts an settlement. An interesting result of this study is that the lawsuit announcements for patent infringement generate the most significant stock exchange losses. The defendant loses 1.20% of quoted value significantly while the plaintiff loses only 0.9% (nonsignificant). However, the authors do not study possible spillover effects on the trade partners of the infringed firms.

Following Griliches (1981) and Cockburn and Griliches (1988), a firm's stock price should be the expected discounted value of the net income which will be derived from its assets. Thus, the firm's stock price translate the clear anticipated value generated potentially by its tangible and intangible assets. In this article, we'll suppose that we can consider the pharmaceutical firms and the biotechnological firms as being intangible assets portfolio. We will suppose that the assets' valorization of this industry goes through the greater or lesser detention of firms' patents and firms' licences. Jaffe (1986) and Blundell, Griffith and Van Reenen (1999) show besides that a significant link exist between firms quoted value, on one hand with patents, in other hand with innovations. Hall (1999) shows that the correlation between market value and intangible assets is highly significant for high technology industry.

The object of our study is to measure the impact of the infringement lawsuit announcements on the quoted value of the pharmaceutical firms and biotechnological firms, it is also to determine possible spillover effects of this lawsuit announcements.

We show that on average the market value of pharmaceutical firms and biotechnological firms drops by 6.33% (significant : Z-test = -9.33) following infringement lawsuit announcements. Within a framework where biotechnological firms sell licences to the pharmaceutical firms or within a framework of R&D partnership, when pharmaceutical firms announce infringement lawsuit, the partner biotechnological firms also suffer from this announcement effect. One of the reasons we advance to explain the existence of these spillover effects is the uncertainty created on the real value of intangible assets by those announcements. In other words, the infringement lawsuit announcements issue from the

licensee or from the R&D partner creates uncertainty on the patent scope held by the biotechnological firm or creates uncertainty on its future production 's quality.¹

Some results of this study consolidate and refine those of Bhagat, Brickley and Coles (1994), but other points contradict their study. Whereas in the study of this authors the plaintiff's quoted value drops by a nonsignificant way, the results which we obtain for the pharmaceutical firms and the biotechnological firms tend to show that this fall is greater and significant. The study of Bhagat, Brickley and Coles displays a loss of 0.09% on quoted value of firm complaining of infringement, our results being of -9.43% (significant with 9.33 for a corrected sample)² and following this result we can think that pharmaceutical firms and biotechnological firms look sensitive with infringement lawsuit announcements although the biotechnological firms seem to be more sensitive. This consolidates the vision we have of pharmaceutical firms and biotechnological firms as patents and licences portfolio and our results underline the fact that the patent value depends on their current or expected scope. In their study Bhagat, Brickley and Coles show that the defendants are most touched by the lawsuit announcements, the results which we obtain seem to show the opposite.

Section 2 presents the event-study analysis, section 3 presents the used data. The results of our work are presented in section 4. Section 5 concludes the paper.

2. Methodology.

We use the standart version of event-study analysis presented by Campbell, Lo and MacKinlay (1994, chapter 4) in order to analyse the pharmaceutical and biotechnological reaction assets to the patent infringement lawsuit announcements. To highlight this reaction, we consider the normal returns of each firms for each day that we subtract from the returns generated at the time of the event period. The normal profitability is estimed starting from a market model developed by Fama, Fisher, Jensen and Roll (1969) and Fama (1970, 1991), this model is more known under the name of CPAM, the Capital Asset pricing model.

The model considering the normal returns of the firm concerned is written :

$$R_{j,t} = \alpha_j + \beta_j R_{m,t} + \varepsilon_{j,t}$$

Where $R_{j,t}$ is the return of the security j in time t and $R_{m,t}$ is the market return in time t . α_j and β_j are the estimated parameters, and $\varepsilon_{j,t}$ is the error term for the security j in time t . This model is examined during a 120 days period, commonly called the estimation window $[T_0+1, T_1]$. Thus the market model parameters are estimated over the 120 days prior to the event.

We suppose that, without event or singular information, the relation between firm's asset return and market return is stable. Then the market return can be used to estimate the normal return of the firm's security. To highlight the impact of a new information on the market, and especially on the firm's security, prediction error are emphasized. The excess return, or prediction error (PE), for security j on day t is computed by subtracting the return predicted by the market model from the actual return. Prediction errors taken as abnormal return are written for the security j in time t :

$$PE_{j,t} = R_{j,t} - (\alpha_j + \beta_j R_{m,t})$$

¹ Uncertainty of as much less reduced than the firms often choose alternative dispute resolution agreeing on settlement which do not slice institutionaly on the patent scope.

² This significant assets drop can appear amazing, then we can wonder why firms suit for patent infringement. Like Lanjouw and Schankerman (1998), we can say as explanation that the innovation of the high technology firms are cumulative innovations and thus that the interest is not the defense of a single patent but in the defense of future potential innovations.

Thus abnormal returns are estimated on a 40 days period, a event window of $[T_1+1, T_2]$. When abnormal returns are estimated, they are cumulated over various intervals.

$$CPE = \sum_{t=T_1j}^{T_2j} PE_{j,t}$$

To determine the event impact on our sample, cumulated abnormal returns are aggregated for the whole sample and divided by the number of securities :

$$MCPE = 1/N \sum_{j=1}^N CPE_j$$

The Mean Cumulative Prediction Error is the typically presented measure of the average prediction error for a sample of firms. The expected value of the MCPE is zero in the absence of abnormal performance. The test statistic for the MCPE is the mean standardized cumulative prediction error, the Z-Test. To compute this statistic, each PE is standardized by its estimated standart deviation $s_{j,t}$ as follow :

$$SPE_{j,t} = PE_{j,t} / s_{j,t}$$

The SPE's are then cumulated for the same intervals as the CPE's, yielding Standardized Cumulative Prediction Errors (SCPE) :

$$SCPE_j = \sum_{t=T_1j}^{T_2j} SPE_{j,t} / (T_2j - T_1j + 1)^{0.5}$$

The Z-Test for a sample of N securities is :

$$Z = \sum_{j=1}^N SCPE_j / (N^{0.5})$$

Each SCPE is assumed to be distributed unit normal in the absence of abnormal performance. Under this assumption, Z is also unit normal, and is an appropriate test statistic for the MCPE's.

3. The Data.

Our sample is composed of about thirty pharmaceutical and biotechnological firms which announced or which were the subject of infringement lawsuit announcements in specialized newspapers. We extract these announcements of *Dow Jones Newswire* and the *Chemical News Database*, these newspapers come from the *Abiproquest* and *Reuters Database*. We use also the *Financial Pharmaceutical Bulletin* as a source of information.

With respect to the plaintiffs, we have 28 infringement lawsuit announcements over the period of 1991 to 2001. Only 23 are exploitable, some infringement announcements being not sufficiently distant in time to allow a estimation window of the event or other events coming to disturb the estimate during this period (mergers, sharing out...). We will also investigate a corrected sample of 17 infringement lawsuit announcements. This corrected sample gives the same importance to the firms announcing patent infringement lawsuit by eliminating the redundant announcements, and this in order to take not into account habits gotten by the financial markets with the announcements of certain firms.

In order to examine the impact of infringement lawsuit announcements on the firm quoted value and to discriminate the results by categories, we will test the whole sample then the pharmaceutical firms in a subsection and biotechnological firms in another subsection. The existing spillover effects will be highlighted in a second section.

The sample of the accused firms is composed of 22 defendants and undergoes the same proceeding of exploitation as the plaintiffs. The sample concerning the defendants is eventually made of 20 exploitable cases and a corrected sample of 14 cases.

The financial data are extracted from *Datastream* and are daily. The study relates to the American market only, thus the unit is the Dollar and it is the price index of firm's asset which is used. The market index used to estimate the pharmaceutical firms' market model is the *S&P 500 Drugs and Others* or the *Dow Jones Industries*. The price index used to estimate biotechnological firms' market model is the *Nasdaq Biotechnology*.

4. The results

4.1. Direct impact of the announcement effect.

4.1.1. Pharmaceutical firms and biotechnological firms.

The event window extends over 40 days, which means 20 days before the event and 20 days after. The results are presented for various periods in the event window, the various periods allow to show the evolution of the infringement lawsuit announcement impact. The results for the pharmaceutical firms and biotechnological firms considered in the whole are retranscribed in table 1.

Table 1 : Pharmaceutical firms and biotechnological firms' infringement lawsuit announcement impact				
Period	N=23 (total sample)		N=17 (corrected sample)	
	MCPE	Z-test	MCPE	Z-test
-20 to 20	-6.33	-9.33*	-9.43	-9.33*
-20 to -2	-2.7	-4.85*	-3.7	-3.96*
-5 to -2	2.2	-0.0007	3.3	0.99
-1 to 0	0.17	-1.09	0.21	-1.74***
1 to 5	-0.39	-6.05*	0.1	1.95**
1 to 20	-3.5	-3.49*	-5.45	-4.25*
MCPE : Mean Cumulative Prediction Error, * significant level 1%, ** to 5%, *** to 10%				

During the whole event period, the asset price of the pharmaceutical firms and biotechnological firms loses 6.33% on average, significant to -9.33. When we consider the corrected sample estimates, this loss in the assets' value becomes -9.43% significant also to -9.33. Pharmaceutical and biotechnological sector appears to have a significant sensitivity to the infringement lawsuit announcements. We can explain this sensitivity by the fact that the value of the firms of this sector comes primarily from the patent portfolios held by this firms. Whereas the patent guarantees a monopoly of exploitation, the infringement lawsuit announcement makes the financial market doubts about the persistence of monopoly position for the firm in question. The infringement lawsuit announcements casts fear on the financial markets about the passage of a monopoly position to a duopoly position with less profits. Therefore, the assets price drops of the firms considered in this article testify to the efficiency and the rationality of the financial markets.

Nevertheless, this adaptation to new potential environment is only done gradually for the period observed. The most significant falls of assets price appear over periods -20 to -2

and 1 to 20, they are respectively -2.7% (Z-test : -4.85) and -3.5 (Z-test : -3.46). The periods surrounding the event only show a slight significant fall of -0.39% over period 1 to 5.

In order to refine the analysis and to perceive the differences in sensitivity to the infringement announcements, the pharmaceutical firms and the biotechnological firms are categorized to show the possibility for intrinsic characteristics to this sector.

4.1.2. *The pharmaceutical firms.*

The results of the infringement lawsuit announcements of the pharmaceutical firms are stated in the table 2.

Table 2 : Pharmaceutical Firms' Lawsuit Announcement Impact				
Period	N=13 (total sample)		N=9 (corrected sample)	
	MCPE	Z-test	MCPE	Z-test
-20 to 20	0.5	-11.76*	1.2	-11.16*
-20 to -2	-1.05	-6.3*	-0.8	-4.1*
-5 to -2	-0.1	-0.1	-0.3	1.01
-1 to 0	0.4	-2.01*	0.79	-3*
1 to 5	-0.22	-7*	0.1	-0.67
1 to 20	1.1	-3.45*	1.2	-4.05*

MCPE : Mean Cumulative Prediction Error, * significant to 1%

During the whole event period, pharmaceutical firms don't suffer from asset price's fall, on the contrary, assets' price significantly rises by 0.5% on average (1.2% for the corrected sample). However, a significant fall is noted during the 20 previous days the event. From -20 to -2 , the asset price falls by 1.05% and by 0.8% for corrected sample. These falls can mean that information is known before the announcement, that is before the publication of the specialized newspapers or the choice of the event date is not the right one. In a general way, the assets price of the pharmaceutical industry falls after a infringement lawsuit announcement (-0.22% significant to -7) but quickly absorbs the shock without suffering from strong falls. Several explanations can be advanced for this results.

The financial markets know the pharmaceutical firms' skills to regulate the legal problem. Indeed, pharmaceutical firms have generally a ground legal experience and have qualified legal services, this legal background makes them less vulnerable to the legal constraints (Png 1987).

Another argument is that the importance of their patent portfolio annihilates the consequences of the infringement of only one patent. The patent portfolio's diversification of the pharmaceutical firms makes less sensitive the firms assets' return to the infringement announcement.

However, these arguments do not seem to be verified for the biotechnological firms.

4.1.3. *Biotechnological firms.*

Biotechnological firms seem to be more sensitive to infringement lawsuit announcements. Assets price drops on average by 21.42% (Z-test : -1.76) on the period -20

to 20 (see table 3). The fall of asset price of biotechnological firms comes after the infringement lawsuit announcement : there's no significant fall during the period -20 to -2 and there is a nonsignificant increase of assets price during the period -5 to -2. The results of the period -20 to 13 (not retranscribed in the table 3) are the following : -14.81% (Z-test : -1.84) and -19.72% (Z-test : -2.59) for the corrected sample. The negative reaction of the financial markets to the infringement lawsuit announcements is emphasized when we take into account the event day and the following days the event. Thus, the real suspicion of the financial markets toward the biotechnological firms announcing infringement lawsuit is underlined by an estimate carried out on more restricted windows. We note assets price falls by 60% to 70%.

Table 3 : Biotechnological Firms' Infringement Lawsuit Announcement Impact				
Period	N=10 (total sample)		N=8 (corrected sample)	
	MCPE	Z-test	MCPE	Z-test
-20 to 20	-15.2	-0.73	-21.42	-1.76***
-20 to -2	-5.4	0.17	-7.99	-0.25
-5 to -2	5.4	0.1	7.47	0.38
-1 to 0	-0.23	0.64	-0.44	0.64
1 to 5	-0.63	-1.19	0.09	-1.02
1 to 20	-9.58	-1.37	-12.99	-1.96**

MCPE : Mean Cumulative Prediction Error, ** significant level to 5%,
*** significant level to 10%

This reaction can be explained, like in the subsection 4.1.1, by the risk of losing the monopoly position by plaintiff firms. This is more realistic if the infringed firm sells itself his products. Another explanation is relating to the quality of patent produced by the firms. For the financial markets, an infringement lawsuit announcement generates doubt about the patent scope. Actually, the patent can be infringed for two reasons. First, the patent is announced infringed because the innovation is easy to improve. Second the patent is infringed because its quality is high and the innovation is attractive for the infringers. In other words, what about the court decision ?

According to the results of our work, uncertainty reigning around the patent scope advocates for a fold of the investors of the assets of biotechnological firms announcing infringement lawsuits. Those results are similar to the study of Austin (1991). This author find that when a patent filling is announced in the press, this patent is more valued than a patent not announced in the press.

4.2. Spillover effects on the trade partners.

We consider as trade partners, on the one hand the firms which sold licences with others firms, in the other hand firms which are engaged in R&D agreements. In this subsection, we test the existence of spillover effects resulting from firms announcing infringement lawsuits. To test this phenomenon, we use the framework of the R&D partnership agreements proposed by Jungmittag, Reger and Reiss (2000 : 201). The results are presented in table 4.

On the event window -20 to 20, the existence of negative spillover effects seems difficult to highlight. On the one hand, an average cumulated fall of 1.41% of the firms assets price is noted (significant to 3.02), on the other hand for the corrected sample, a rise is

noted (1.5% significant to 3.06). Thus, a generalization of these spillover effects isn't obvious to admit, definitely the spillover effects will depend of the firms' characteristics (size, level of R&D advance and research type). Nevertheless, two periods can show such spillover effects.

The prior period to the infringement announcement emphasizes falls of trade partners firms' assets price : -3.47% and -4.66% both significant. These falls can mean two things. First, like in the subsection 4.1.2, the event date is not correct (or the information is known before the announcement).

Period	N=12 (total sample)		N=9 (corrected sample)	
	MCPE	Z-test	MCPE	Z-test
-20 to 20	-1.41	-3.02*	1.5	-3.06*
-20 to -2	-3.47	-3.15*	-4.66	-3.73*
-5 to -2	0.5	-0.28	-2.96	-1.24
-1 to 0	1.1	0.02	1.1	-0.05
1 to 5	6.12	1.2	8.17	1.4
1 to 20	0.7	0.31	3.83	0.76
5 to 20	-6.26	-1.53	-4.8	-1.27
10 to 20	-4.57	-1.17	-3.46	-0.91
-10 to 10	1.9	-2.93*	1.17	-3.98*
-10 to 0	-2.06	-3.93*	-5.1	-5.21*

MCPE : Mean Cumulative Prediction Error, * significant level to 1%

Second, when financial markets have suspicions on an infringement announcement, the investors withdraw from firms potentially concerned by the infringement lawsuit announcement.

The second period shows that the financial market reacts in a negative way to partnership agreements with firms announcing infringement lawsuits. The periods 5 to 20 and 10 to 20 show negative abnormal returns : -6.26% (nonsignificant to 1.53) and -4.57% (nonsignificant to -1.17). To explain these nonsignificant impacts of the infringement announcements, it should be noted that tested firms are not directly connected to the object of infringement. In other words, the infringed patent cannot result from or cannot be in connection with partnership agreements, only a case in our sample is a one of exclusive licensee (Schering Plough / Biogen).

The relation that we also emphasize is about the firm size. We test R&D agreements between both large pharmaceutical and biotechnological firms and small biotechnological firms. Classification between large and small firms is included in Jungmittag, Reger and Reiss (2000). The spillover effects impact is not assessed on the R&D agreements between large firms, thus we understand better the effects emphasized in this paper. Indeed, Png (1987) and Lerner (1995) show that the firms' size is a significant variable of the behavior and the management of the legal conflicts. In order to reduce the legal difficulties that the small firms can face, and to reduce the uncertainty on the patent quality which these legal conflicts create, Grignon (2001) recommends the use of insurance covering the costs generated by the legal procedures. This solution is possible when the infringed firm is the patent owner, like in the subsection 4.1.3.

Another solution would be to create contractual clauses forcing the internalization of the spillover effects. The spillover effects internalization by both large pharmaceutical and

biotechnological firms can allow not to deteriorate the small biotechnological firms' incentive to innovate through the valorization of their current and future intangible assets.³ Nevertheless, it remains difficult to estimate if the small biotechnological firms suffer in their incentive to innovate from the spillover effects. This difficulty to estimate is shown by Feinberg and Rousslang (1990: 80). However, Lanjouw and Schankerman (1998) empirically emphasize that the infringement lawsuit costs influence the incentive to innovate and the firms' contractual decisions.

Up to now, we considered the impact of the infringement lawsuit announcement on the transmitters of these announcements and their trade partners. The following section presents the impact of these announcements on the infringement accused firms.

4.3. Impact on the defendant.

As shown in table 5, the defendants usually negatively undergo the legal proceedings for infringement announcements.

Table 5 : Infringement Lawsuit Announcements' Impact on the Defendants.				
Period	N=20 (total sample)		N=14 (corrected sample)	
	MCPE	Z-test	MCPE	Z-test
-20 to 20	-1.76	-0.49	-24.93	-1.34
-20 to -2	-2.81	-0.40	-3.94	-0.45
-5 to -2	-1.73	-0.33	-3.35	-0.24
-1 to 0	-1.85	0.12	-0.8	0.26
1 to 5	9.64	0.06	3.66	0.02
1 to 20	2.89	-0.21	-20.14	-1.15
5 to 20	-4.96	-0.28	-23.01	-1.18
10 to 20	-10.08	-0.29	-23.06	-1.15
-10 to 10	0.81	0.03	-5.79	0.16
-10 to 0	-10.13	-0.08	-5.51	0.18

MCPE: Mean Cumulative Prediction Error.

Both pharmaceutical firms and the biotechnological firms implied in infringement lawsuit announcements suffer from a drop of their assets price. For example, we can see during the period -20 to 20 that the defendants incur a cumulated loss of 1.76% of the asset price (nonsignificant) or a loss of -20.14% during the period 1 to 20 (corrected sample). These results, considering the preceding results, could consolidate the intuitive idea according to which the financial markets react always in a negative way to the infringement lawsuit announcements. Nevertheless, the nonsignificativity of these last results can moderate this intuitive idea. The financial markets seem less inclined to sanction the defendants than the indictors. This lack of sanction is verified when the firms are implied in several infringement lawsuits. Indeed, over the period -20 to 20, the corrected sample estimates show a cumulated loss of assets price by 24.93% whereas this loss is only 1.76% for total sample. These estimates were made separately for the pharmaceutical firms and the biotechnological firms.

³ C. Robbins-Rith (2001) insists on the importance of the biotechnological firms' financing. During R&D phase to the FDA approval, 500 millions dollar are necessary in average, and this knowing that firms work on various project of which none could succeed. Thus, the least sign of mistrust of the investors can lead biotechnological firms to either limiting their research project, or to go bankrupt.

Over the period -20 to 20, the pharmaceutical firms' assets price fall by 1.9% (nonsignificant) for the total sample and by -28.64% (nonsignificant) for the corrected sample. It is almost the same for the biotechnological firms, their assets price drops by 1.55% (nonsignificant) for the total sample and by -18.26% (nonsignificant) for the corrected sample.

This great disparity in the results between total and corrected sample allows to say that the financial markets modulate their reaction according to the frequency of the charges undergone by the firms. Finally, this disparity in the results and their nonsignificativity can mean that the financial markets sanction less the defendants than the indictors. So, the defendants benefit from the uncertainty of patent scope and not the plaintiffs.

5. Conclusion

Both pharmaceutical and biotechnological firms show a great sensitivity to the patent infringement lawsuit announcements. However, the biotechnological firms are more sensitive. Younger and smaller than the pharmaceutical firms, having only a small experiment of the legal conflicts and a reputation which must be build, the biotechnological firms suffer from the uncertainty created around their intangible assets, namely their patents.

If this sensitivity is detected directly through the impact of their infringement lawsuit announcements, it seems that it is also detected through the R&D partnership agreements or the sales of licences. There are spillover effects resulting from the patent infringement lawsuit announcements. The financial markets sanction negatively the trade partners of firms announcing infringement lawsuits. Thus, financial markets' rationality put to the test the current or expected patent scope of the partner biotechnological firms. In other words, through the devalorization of biotechnological firms' assets, financial markets worry about the detention or about the ability of good quality patent output, i. e. great scope.

The infringement marked firms also suffer from a drop of the assets price, however it would seem that the infringement lawsuit announcement impact is less significant for the defendants than for the plaintiffs. The plaintiffs would support the burden of proof.

Thus, economics and business in the new millenium will be that of the management of the intangible assets and that of the management of the legal conflicts costs.

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