

Stock Spams: An Empirical Study On Penny Stock Market

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This survey appears in extension of a previous exploratory survey (Bouraoui, 2008) dedicated to the impact of stock spams on volumes. The interest of the present research is to study the impact on stock prices while taking into account the evolution of volatility over time through a GARCH modelling. We use the methodology of event studies on a sample of hundred ten firms of penny stocks over the period from February 2006 to June 2008. Our results show that sending stock spams has generated significant variations and positive returns during the first three days of the event.

Field of research: Financial markets, Equities, Financial econometric

1. Introduction

Stock spam is a new technique used by the creators of undesirable mail. These messages, also named «pump and dump» are widely distributed and take the shape of non justified stock advices. In those e-mails, spammers are raising the level of false financial analysts in order to encourage potential investors to invest in some stocks. Unlike classic spam which has the subject of meetings, diet products, services of tourism...etc, stock spam permits to his author to win a lot of money in a short time, with a totally illegal way. Thus, the spammer wishing to become rich, buy the stocks whose prices is very low and will endeavor then to make it climb, and in order to push up the value of a stock, lies and manipulation are processes that have already proved his worth. Finally, he has only to pocket a comfortable increment.

A multiform phenomenon, stock spam has experienced these recent years an unprecedented development. According to Sophos, one of the biggest publisher's worldwide security solutions and computer control, this type of messages represents between 15% and 20% of all spam sent, against hardly 1% in 2005. It is henceforth interesting to wonder what is their impact on share prices. To do this, we will use the methodology of the event studies; it is a method that permits to analyze the reactions of a market to a given event. In the words of Rival (2006), event studies, originally, were implemented in motion to verify the theory of the efficiency of financial markets, and more precisely in its semi strong form. Then, they were quickly used for other purposes; today, this methodology is fluently used to test informational impact of different events, notably announcements of alliances or mergers and acquisitions

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((Hubler and Meschi, 2000), (Guards, 2003), Woolridge and Snow, 1990)), announcements of results ((Walrus, 1981), (Bamber and Cheon 1995)), stock repurchase (May and Tchemeni, 2000), etc...

Recently, a new event is added to the list: it's the event of stock spams. To our knowledge, only three studies have been conducted on this topic: Bohme and Holz (2006), Frieder and Zitterain (2007) and Bourraoui (2008). Frieder and Zitterain (2007) have focused instead on the working of this phenomenon and what can bring benefits and losses respectively for spammers and investors. They found that spammer makes in two days an average benefit of 4.9% of the share price, while the investor, having obeyed the advice contained in messages, sees its investment in two days dropped by 8%. Bourraoui (2008) has studied the evolution of transactions volumes following the announcement of the event and he found positive and significant changes in volumes during the entire event window. Finally, Bohme and Holz (2006) tested the effect of this event on the market activity. Using a regression model, they noted that volumes have increased by an average of 215.2%. This figure drops to 154.1% when the message is transmitted outside the opening hours of market. The impact on returns was also studied; by implementing the event study methodology, they found that share prices climbed of 1.7% the first day of the campaign. But, Bohme and Holz (2006) have studied the impact on returns as while considering that the variance is constant over time. In other words, the arrival of new information does not modify the risk of the security in question. However, some works notably those of Brown and Warners (1985) and Ohlson and Penman (1985) show that the variance of the mean abnormal returns can be influenced by several factors such as the modification of stock's rhythm of transactions following the event. In order to raise this problem, we propose a GARCH modelling that takes into account this fact and permits thus to calculate a variance for every day of the event window.

The object of this paper is to study the impact of the stock spams on returns while taking into account the evolution of volatility during the time. For this aim, the structure of the paper is organised as follows:

2. Stock spams
3. Event studies methodology
4. Data
5. Empirical results

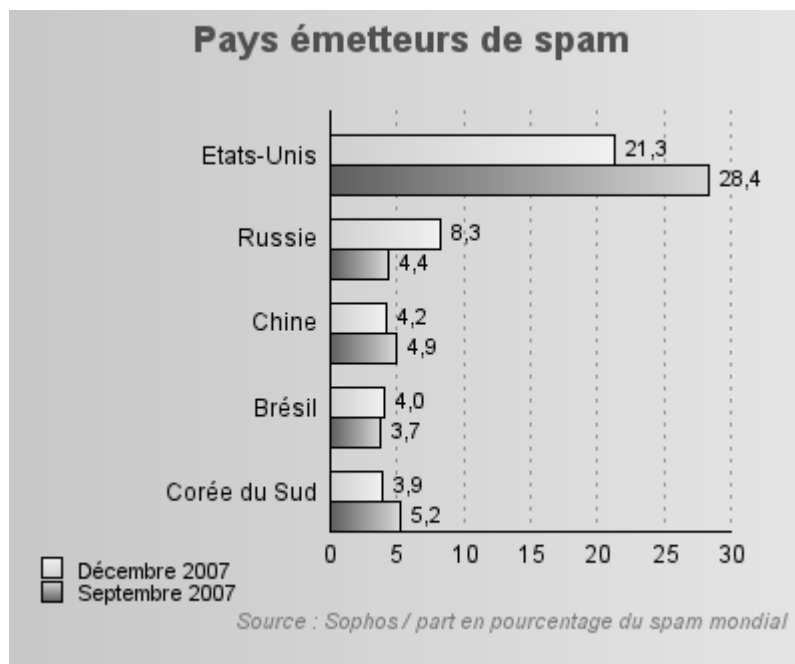
2. Stock Spams

The boom and the success of Internet are largely due to the easiness of communicating through e-mails. However, the content of information circulating via this means has not always evolved in the right direction, and many people have quickly understood how to use these resources abusively. The spam, english word of compuspeak, also known as spamming, mail-rubbish or UBE (unsolicited bulk e-mails) refers to sending mass advertising messages for commercial ends. Repetitive food to the origin and little unsavory used extensively by U.S forces for the food of soldiers who were quickly dripped, spam has come to designate by analogy undesirable messages circulating on internet. According to Frieder and Zittrain (2007), this scourge represents over 65% of traffic e-mail. Spams are known and widespread essentially in the USA. A classification established by Sophos shows

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clearly the major position occupied by the USA on the issue of spam with a percentage of 21.3% away from Russia which follows only 8.3%.

Fig 1: The main issuing countries of spam



Source: Sophos

The thematics or topics of spam are very varied; BitDefender, a specialist society in the field of security, classified by order the main subjects of most distributed spam over the 2007's year, and she found that spam speaking about stock exchange is at the head of the list:

Table 1 : Topics of spam

Rank	Topic
1	Stock exchange
2	Drugs
3	Pornography
4	Infringement of patent
5	Financial loans
6	Phishing
7	Pirated software
8	False job offers
9	Meetings web site
10	False diplomas

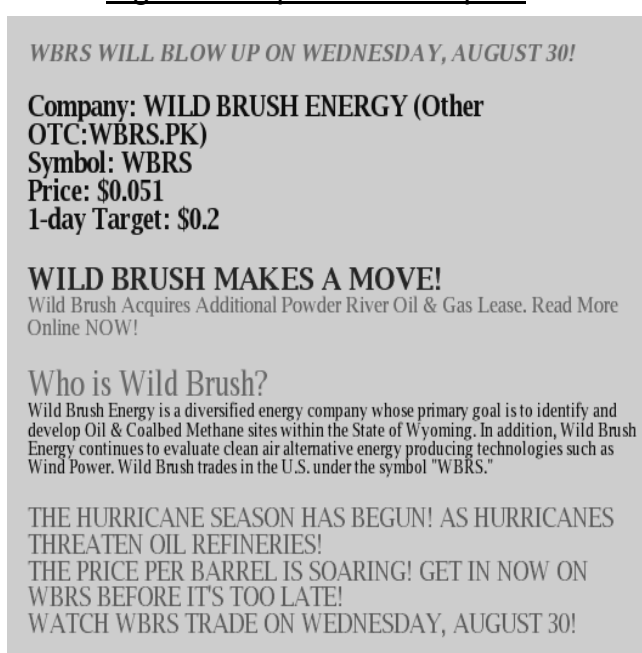
Source: BitDefender

The pump and dump operates in three stages. First, the spammer starts by buying gradually, not to push up the share price, a large number of stocks. Then, he

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circulates by mail a misinformation on the value of stocks in order to encourage potential investors. In this context, the spammer can pretend that confidential data have been filtered on the activity of a corporation, and that on the basis of those data, when they will be made public; the share price rises sharply and very quickly. Internauts believe this information and they buy stocks with important quantities, which will sharply increase stock prices. Finally, the dishonest speculator, to the origin of these movements, sells the stocks initially bought at low price in order to make juicy increments. Even with a very low return rate, around a few percent, it generates a considerable turnover and is at the origin of real fortunes. The following figure illustrates a stock spam example encouraging investors to buy the WBR.S.PK stock; an American corporation specialized in the development of energy and oil.

Fig 2: Example of stock spam



Source : securitieinfo

Being in constant increase, the volume of these waves of spam leads us to ask the following question: does stock spam affect really the share prices? And in the affirmative, they affect them positively or negatively? After verifying that they have a significant and positive impact on volumes of transactions in a previous survey, we focus in this work on the survey of returns. In this context, Bohme and Holz (2006) have conducted an empiric study on the U.S market between November 2004 and February 2006. On the basis of 7606 messages, 111 stocks have been targeted. However, when they applied the methodology of event studies, they supposed that the variance is independent with regard to time, which can alter the results. To remedy this, we introduce modelling GARCH (1, 1) in order to take into account the evolution of the variance at the announcement of the event. But in what consists the methodology of event study? This is the object of the next section.

3. Event Studies Methodology

The methodology of event studies consists, in a first time, to highlight a reaction of market actors, then in a second time to explain it. In finance, it is an inescapable technique that permits to analyze the behaviour of stock exchange to the arrival of information. It is based on the idea that financial markets react immediately to new information that may affect the future profitability of the corporation [Hubler and Meschi (2000)]. The origin of event studies goes back to the 30's where Dolley (1933) published a survey that examines the impact of a stock split on prices. At that time, the results achieved by applying this methodology failed to reach a satisfactory sophistication level, since some hypotheses and models of evaluation have been frequently violated. Towards the end of the 60's, Ball and Brown (1968) and Fama, Fisher, Jensen and Roll (1969) have made further improvements by incorporating the latest developments in evaluation of assets, in particular the market model. Since, this methodology has been extensively used. Classically, we grant to Fama, Fisher, Jensen and Roll (1969) the paternity of the current form of event studies.

The analysis of returns around the date of event is important insofar as it permits to conclude in term of market efficiency. The major part of event studies was interested in this variable to measure the impact of new information on market (Fama, Fisher, Jensen and Roll, 1969), (Lamoureux and Poon, 1987), (Franz, Rao and Tripathy, 1995), (Dann, 1981), (Scholes, 1972), (Kraus and Stoll, 1972). The methodology of event studies permits to examine the variations of prices, and therefore the evolution of returns around an event. The impact on financial asset's price is measured by the abnormal return or the gap between the observed return and the theoretical return. The procedure for implementing this methodology is summarized in three stages:

3.1. 1st Stage: Event's Definition

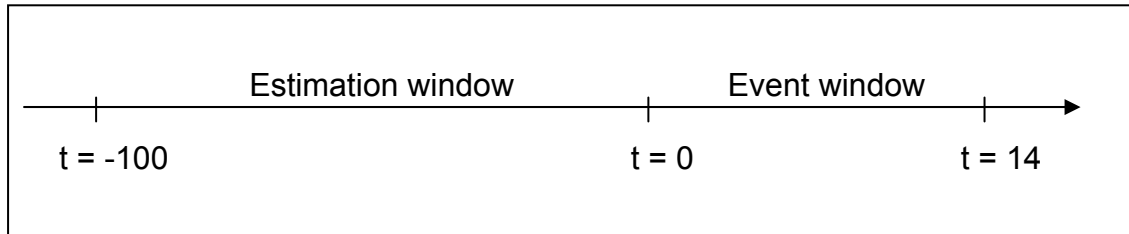
The first stage in the methodology of event studies consists in defining the event and identifying the period during which it will be studied, named "event window" or "period of test". In this work, as mentioned in the introduction, the event is stock spam. Regarding the event window, and in the difference of works studied mergers and acquisitions or earnings announcements that take a period of test centred around the date of event (Hubler and Meschi, 2000), we choose an event window of 15 days length, that starts on the date of sending spam and spreads until the fourteenth day. Indeed, stock spam is an advertising message, which brings a private and little known information. Therefore, we cannot fear information's flight of the type that can precede, for example, the official announcement of mergers and acquisitions. Bohme and Holz (2006) led the same type of reasoning; they chose an event window that begins on the date of announcement and lasts until the fourth day. However, a short window may not reveal all the information necessary to study the event. For this, we have widened the event window until 15 days in order to study the event in its whole.

3.2. 2nd Stage: Calculation Of Abnormal Returns

To assess the impact of an event, it is necessary to calculate an abnormal return or an excess return due to the event. The abnormal return is the difference between observed return less normal or theoretical return, which means the one that we would normally observed in the absence of event. This return or this norm must be modelled over a period preceding the period test called "period of evaluation" or "estimation window". The estimation window precedes the event window. It has

usually a length equal to at least three times the event window to have a sufficient number of observations for the estimation procedure. In our survey, we retain the 100 observations preceding the date of event. It is necessary to be sure especially that both windows do not overlap to avoid that the impact of event is not in the valuator and to elude that study is so biased. The event window and the estimation window can be illustrated like follows:

Fig 3: Event window and estimation window



There are several methods or norms to calculate the theoretical return. The major ones are:

- The return of a representative market index: in this case, expected returns are the same for all stocks and equal to the return of the market index $R_{m,t}$.
- The mean return observed on estimation window: the theoretical return is a constant and equal to the arithmetic average of returns observed on estimation window:

$$K_i = \frac{1}{L} \sum_{j=-1}^{j=L} R_{i,t}$$

Where K_i : Norm or theoretical return of security i.

$R_{i,t}$: Observed return of security i on date t.

L: Length of estimation window.

- The market model: The origin of market model dates back to 1952 when Markowitz (1952) found that every financial asset has two proportional characteristics: a certain return and a level of risk associated with fluctuations in stock prices. It is on the basis of this model that Fama, Fisher, Jensen and Roll (1969) have supported to make some improvements to the methodology of event studies. In this model, the expected firm return is a linear function of the market return.

For any security i, we have:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

Where R_{it} : The return of security i on date t.

R_{mt} : The market return measured by a general market index on date t.

ε_{it} : Random variable expressing a residual return reflecting the characteristics of security i which are specific to it and that do not depend on market.

α_i, β_i : Firm-specific parameters.

Considering its ease of implementation, most research on event studies use the market model to estimate theoretical outputs (Fama, Fisher, Jensen and Roll, 1969), (Bamber, 1986), (Doukas and Travlos, 1988), (Dyckman, Philbrick and Stephan, 1984), (Halpern, 1983)... In addition, Brown and Warner (1980, 1985) find that simple models such as the market model are well specified in most cases and relatively

effective. For these reasons, we choose this method to model theoretical returns. Once, the event is defined and abnormal returns are calculated, it is necessary to set up the appropriate statistical tests in order to conclude the significance or not of the impact. That is what we present in the next stage.

3.3. 3rd Stage: Statistical Tests

Through this study, we will use two statistical tests: the classic test of Student (parametric test) and the rank test (non-parametric test). Both tests will be more explained and presented during their implementation. We will now concentrate on the application of this methodology on our database.

4. Data

Our sample includes 110 firms of penny stocks chosen from different sectors of activities (multimedia, energy, biology, international distribution, telecommunications) which have been the subject of spam between February 2006 and June 2008. We have collected such data from the website < <http://www.spamnation.info/stocks/> >.

The penny stock is an Anglo-Saxon term referring to securities whose share price is extremely low. This anglicism simply means that stocks cost only some "penny". Generally, the stock price is underneath 5 dollars, and firms which are touched are very small firms or not known. Another common point between these firms is that their shares are all negotiated on over the counter markets, notably the Over-The-Counter Bulletin Board (OTCBB) and the Pink Sheets, which are strongly less regulated in comparison with NYSE or AMEX. These markets do not have a physical place; they are represented only by a computer network which displays real-time share prices and selling prices. Stocks quoted on these markets are highly speculative and illiquid; that is why they are targeted by advertising campaigns.

The second stage of the event studies methodology is to calculate abnormal returns. These are assessed as follows:

$$AR_{i,t} = OR_{i,t} - R_{i,t} \quad ; \text{ where}$$

- $AR_{i,t}$: abnormal return of security i on date t .
- $OR_{i,t}$: observed return of security i on date t .
- $R_{i,t}$: theoretical return of security i on date t .

For each security and for each day of the event window, the theoretical return must be calculated using the market model in the following way:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

Parameters α_i , β_i are from the estimated market model on the estimation window. When the market return and considering the nature of the sample on which our study carries (small corporations not known), we choose as market index Russell Microcap Index (IWC). It is a stock market index composed of the smallest American corporations according to their market capitalisations. On the subject of stock spam, Bohme and Holz (2006) and Frieder and Zitterrain (2007) have also adopted this index in addition to two others for calculating the market return. Abnormal returns

series allow us to calculate later those mean abnormal return of all securities every day of the period of test as follows:

$$MAR_t = \frac{1}{110} \sum_{i=1}^{i=110} AR_{i,t} \quad ; t = 0, 1, \dots, 14$$

Once means abnormal returns are calculated, it is question to implement the last stage of the methodology of event studies to test the significance of means abnormal returns.

5. Empirical Results

5.1. Student Test

In order to study the possible impact of stock spam on returns, we use a first parametric test: Student test. The statistic of this test is calculated as follows:

$$\theta_t = \frac{MAR_t}{\sigma_t} \quad \text{where } \sigma_t \text{ is the mean abnormal return's standard deviation on}$$

date t of the event window.

To take into account the evolution of volatility over time, we model variance with a GARCH model elaborated by Bollerslev (1986). This modelling allows calculating for every date of the event window a variance which takes into account the impact of information. The classic writing GARCH (1.1) is:

$$\sigma_t^2 = \hat{\alpha}_0 + \hat{\alpha}_1 MAR_{t-1}^2 + \hat{\beta} \sigma_{t-1}^2 \quad ; \text{Where}$$

- $\sigma_t^2, \sigma_{t-1}^2$: Conditional variance respectively on date t and t-1.

- $\hat{\alpha}_0, \hat{\alpha}_1$ and $\hat{\beta}$: Parameters should be estimated on estimation window (see appendix)

- MAR : Mean abnormal return. As we search a global result of all securities for each date of the event window, the error term here is MAR and not AR as it is habitually made.

The results of the Student test are grouped in Table 2 and Figure 4. In view of these results, we note a significant and positive impact on stock prices during the first three days of the event (respectively +3,01 %, +2,43 % and +5,61 %). The impact is mainly observed during the third day (t=2) where the highest return is recorded. This can be explained by the fact that the number of spam sent during this day is more important than the first two days of the event, creating so an additional request of these securities from investors. An examination of the evolution of MAR through Figure 4 shows that this significant rise in returns is immediately followed dices the fourth day of event (t=4) by an inverse corrective movement which brings back mean abnormal return on its stabilized trend between -1,41 % and +0,49 %. This suggests that the effect of event disappeared beyond the 3rd day. The modelling GARCH (1.1) puts forward, in parallel with the increase of returns, a rise in volatility. So, the emergence of new information which is in our case the message of spam increases prices volatility and as a result revives activity on penny stocks market. These results

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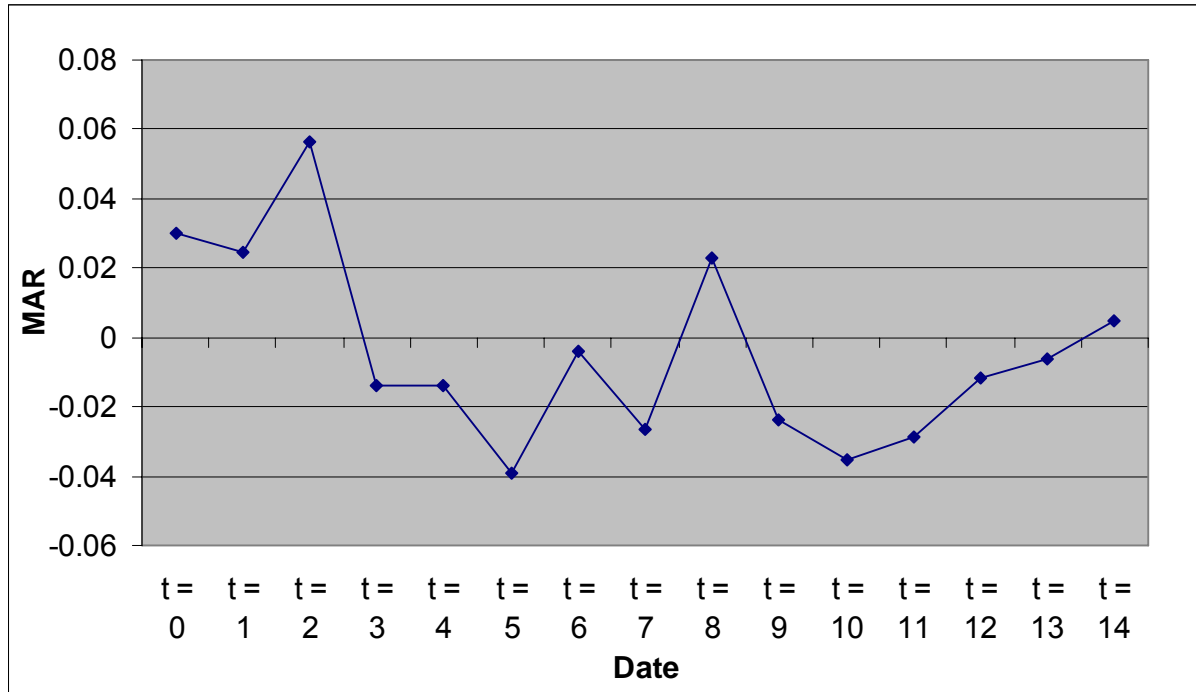
invalidate those got by Bohme and Holz (2006) who find negative and significant variations of returns generated by stock spam. This fact is explained by the simple reason as mentioned at the beginning of this article that these 2 authors have assumed that volatility is independent of time, and therefore it is constant over the entire event window, which is not the case of this work. Finally, the fact to have significant mean abnormal returns the first day of the event reveals a certain efficiency within the market of penny stocks, since the incorporation of information in prices occurs with an instantaneous way.

Table 2: Mean abnormal returns (%), conditional variance (%) and statistics of Student

Date	MAR _t (%)	σ_t^2 (%)	θ_t
0	3,01	0,008	3,340***
1	2,43	0,019	1,747*
2	5,61	0,038	2,844**
3	-1,41	0,093	-0,462
4	-1,36	0,078	-0,488
5	-3,93	0,067	-1,519
6	-0,39	0,084	-0,136
7	-2,64	0,068	-1,010
8	2,29	0,069	0,869
9	-2,35	0,066	-0,908
10	-3,54	0,065	-1,385
11	-2,84	0,092	-0,935
12	-1,16	0,089	-0,388
13	-0,61	0,074	-0,224
14	0,49	0,061	0,201

*** Sig. Level 0,1% , ** Sig. Level 1%, * Sig. Level 10%

Fig 4: Evolution of mean abnormal returns



However, we cannot be satisfied with these results because the test of Student is a parametric test which requires, among other hypothesis, that returns have a normal distribution, despite that we have used logarithmic data to come closer to normality. In order to improve and give more robustness to our results, we apply a second test: it is the rank test.

5.2. Wilcoxon Signed Rank Test

This second test is used to lift completely the hypothesis of normality. This is a non parametric test whose model does not specify the conditions which have to fulfil the parameters of the sample, unlike the parametric tests. This test takes into account both sign and amplitude of abnormal variation; the day j of the event window the most affected by the event is the one which has the biggest positive (negative) abnormal variation. Campart and Pfister (2002) have used this test to assess the impact of litigations in pharmaceutical industry on stock returns. The authors found satisfactory and similar results to the test of Student.

The principle of the Wilcoxon signed rank test is the following: firstly, all the positive and negative variations of returns are arranged in ascending order without taking into account their signs. Then, we calculate the sum of positive variation's ranks as follows:

$$T^+ = \sum_1^n R_i \times d_i \quad \text{Where}$$

- T^+ : sum of positive variation's ranks

- n : size of sample

- R_i : rank of variation

- $d_i = 1$ if the variation is positive

- $d_i = 0$ if the variation is negative

Finally, the statistic of the test is so reckoned:

$$Z_{rang} = \frac{T^+ - \frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}}} \sim N(0,1)$$

Table 3 displays similar results to those obtained previously with the test of Student. The stock spam affect returns significantly and positively during the first three days of the event. The date ($t=2$) mark the presence of the greater abnormal variation of returns, and therefore it is the most affected date by the event. This can be interpreted as mentioned above with the test of Student by the increase of transaction movements on securities targeted by spam during the day. From the 4th day, the event generates negative abnormal returns. However, they are not significant or rather the amplitude of positive abnormal variation on a given day between ($t=3$) and ($t=14$) is more important than the negative abnormal variation. That is, in our looks, logic insofar as after an increase in prices during three consecutive days, these have to fall or record a downward trend to return to their stable levels and to mark, as a result, the end of event.

Table 3: Wilcoxon Signed Rank Test

Date	T ⁺	Z _{rang}
0	3752	2,072**
1	3667	1,820*
2	3837	2,323**
3	2660	-1,162
4	2579	-1,402
5	2623	-1,272
6	3224	0,508
7	2575	-1,414
8	3601	1,624
9	2552	-1,482
10	2706	-1,026
11	2657	-1,171
12	2980	-0,214
13	2685	-1,088
14	2635	-1,236

** sig. Level 5% , * sig. Level 10%

6. Conclusion

This article aims to investigate the impact of stock spam messages sent between February 2006 and June 2008 on returns of 110 corporations of penny stocks, while taking into account the evolution of volatility during the studied period. For this purpose, we have implemented the methodology of event studies to compute abnormal returns. We have also introduced a modelling GARCH (1.1) to calculate a variance for every day of the event window. Our results found on the basis of Student test (parametric test) and Wilcoxon signed rank test (non parametric test) reveal positive and significant mean abnormal returns during the first three days following the announcement of the event. Stock spams affect the behaviour of financial actors who react favourably to information contained in messages. Although penny stock market is constituted by corporations that are very little known and with low capitalization, we can affirm that it is efficient insofar as the integration of information operated in a fast way. These results confirm those obtained by Bourouai (2008) who also found positive and significant mean abnormal volumes following the sending of advertising messages speaking about stock exchange. This paper show us, compared to the study of Bohme and Holz (2006), that the business of stock spam is thriving and continues to bring money for spammers. Indeed, with more recent data (from February 2006 to June 2008) than those of Bohme and Holz (from November 2004 to February 2006), we thought that investors were warned that this is a scam and will no longer rely on these messages. However, we find that investors still continue to believe in such information due to asymmetry of information. Finally, this work could be extended by a research studying the impact on other variables, notably spread, volatility ...in the intention of a better recognition of all variables that may be affected by such event.

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