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Abstract

Stock return is influenced by information release, dissemination, and acceptance. Rumor clarification is supposed to reduce asymmetric information and abnormal stock return. In this research, we extracted 4134 rumor-clarification pairs from 687,429 postings in social media, and quantified the language used in these messages, along with online firm behaviors, to study the effect of clarifications on stock returns. Our findings include (1) the digitalized rumor clarification messages affect the abnormal returns of the relevant stocks; (2) Such influence can be quantified and measured by the emotion polarity of rumor clarification; (3) Firm's online clarification behaviors may have no influence on abnormal returns except for the total response number of rumor clarification for a listed company. In particular, investors prefer to trust the clarifications from the companies with frequent online interactive engagements.

Keywords: rumor clarification, credibility, digital platform, listed firms behaviors

Introduction

Stock market movement is influenced by information release, dissemination, and acceptance in the public. However, market information is full of true and false information. Here, uncertain information, so-called rumor, is referred as an unofficially confirmed message[1]. As a plausible organization of information, rumors seriously disrupt investor trading decisions, trigger extreme volatility in securities markets, and may even result in financial crisis (Buckner, 1965).

With the popularity of Web 2.0, the volume and spreading speed of information are increasing dramatically. Accordingly, the effect of rumors on stock markets is substantially amplified. Sometimes, it shakes stock markets with a surprising plunge. A good example is the market quaver after a fake tweet

[1] Rumor is also referred as hearsay, and believed as a kind of paradoxical organization information which is not confirmed by listed firms and characterized by high distortion, fast transmission, high false reliability, rapid feedback, high selectivity, and strong purpose. (Buckner 1965).

about Obama being hurt. Specifically, on April 23, 2013, a posting on Twitter account of the Associated Press reported explosions at the White House that injured President Obama. This tweet briefly roiled the financial markets and caused the DJIA to tumble down 100 points with 2 minutes. In fact, rumor in social media has become a great threat and a critical destabilizing factor affecting the stability of stock markets.

Realizing the destructive effect of rumors on securities markets, governments of different countries have taken precautions to reduce their negative influences for a long time. As early as 1934, the "United States Securities Exchange Act" banned to use rumors to manipulate stock trading. In 2003, the Council of the European Union and the European Conference promulgated the "Market Misconduct Act". It strictly prohibited to spread false or misleading signs of financial instruments. Unfortunately, rumor and stock markets are coexistent even with these strict bans in law. Since rumors cannot be thoroughly wiped off from markets, some governments like china, release specific laws[2] to force listed companies to clarify misleading and influential reports in mainstream media. However, the procedure of publishing official clarification is complicated and time-consuming for listed firms. Only a small number of rumors in mainstream media are clarified in time, let alone a great number of rumors burgeoning in social media. Realizing the limitations of such traditional regulatory methods in the era of social media, many stock-oriented electronic information platforms have come out to post rumor clarification announcements. These platforms typically allow investors to post their suspicions on certain news and encourage listed firms to verify the authenticity of these information. Some representative platforms include StockTwits, EliteTrader, and Estimize[3]. With an expectation to reduce the asymmetry of market information and maintain the stability of stock markets, China Securities Regulatory Commission (CSRC) demands its Stock Exchanges to launch such interactive information platforms[4] .

Theoretically, information transparency enhanced by the rumor clarification leads to the stability of stock markets. In traditional finance, a stock price is always driven by "unemotional" investors to equal the firm's rational present value of expected future cash flows (Fama 1965). Stock investors are constantly updating their beliefs on the future business value, although they will disagree on the direction of the company's business value with new information. Therefore, information transparency enhanced by the rumor clarification can increase the stability of stock markets by reducing such discrepancy of investors. However, investors are irrational and modern behavioral finance studies attribute non-randomness stock movements to investors' cognitive and emotional biases (DeLong et al. 1990; Shleifer and Vishny 1997). Is it possible that the verification of rumor authenticity causes the fluctuations of investors' sentiments which increases impulsive investing behaviors and stock volatility? Do the frequent information exchanges caused by rumor and its clarification result in information overload of investors? Will this disable the role of rumor clarification in reducing information asymmetry ? It is of great necessity to understand the role of rumor clarification in social media so that Securities Regulatory Commissions can take an appropriate action on this new born thing in the era of social media.

In this article, we quantify the language used in rumor clarification messages, along with firm behaviors in rumor-clarification e-platforms, to study their impacts on stock markets. This is achieved by adopting the method of Tetlock (2007), who examines how qualitative information - in particular, the fraction of negative words in a widely-read news about the stock market - is incorporated in aggregate market valuations. In particular, we extend that analysis and address the impact of sentiment words (negative and positive) in rumors and rumor clarification messages which is up to 4134 messages extracted from 687,429 postings released in three major financial rumor clarification platforms in China between August, 2012 and January, 2014. Our findings include (1) the digitalized rumor clarification messages affect the abnormal returns of the relevant stocks; (2) Such influence can be quantified and measured by the emotion polarity of rumor clarification; (3) Firm's online clarification behaviors may have no influence on abnormal returns except for the total response number of rumor clarification for a listed company. In particular, investors prefer to trust the clarifications from the companies with frequent online interactive engagements. The timely clarification and detailed response of the listed firms do not show their influence on markets.

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[2] In 2006, China Securities Regulatory Commission (CSRC) released Administrative Measures for the Disclosure of Information of Listed Companies. It requires "listed companies to pay attention to the media reports and take the initiative to verify the authenticity of the report".

[3] StockTwits: www.stocktwits.com; EliteTrader: www.elitetrader.com; Estimize: www.estimize.com.

[4] Shanghai Stock Exchange launched eHuDong platform (sns.sseinfo.com) in July, 2013, Shenzhen Stock Exchange launched HudongYi platform (irm.cninfo.com.cn) in January 2010.

Related Work

The efficient markets theory (EMT) of financial economics states that the price of an asset reflects all relevant information that is available about the intrinsic value of the asset in a well-developed financial market (Fama 1965). The degree of information transparency in a market directly determines its stability. Rumors as a "noise" in the securities market seriously blur the transparency of information. Therefore, rumors are considered as one of the important risk sources to the stability of stock markets.

The earliest study on the effect of rumors on stock markets can be traced back to the work of Rose in 1951 in which she theoretically described the mechanism of rumors and concluded that rumors are able to cause the changes of stock prices but it is hard for investors to get excess returns (Rose 1951). Before the era of Internet, rumors are disseminated through various kinds of newspapers and Journals including Wall Street Journal, Business Week, Forbes, Fortune, et cetera (Davies and Canes 1978; Syed 1989; Liu 1990; Pound and Zeckhauser 1990; Barber and Loeffler 1993). For instance, Davies and Canes (1978) found that there are significant stock movements driven by the rumors published in the column of Heard on the Street (HOTS) in Wall Street Journal. In particular, positive rumors bring significant positive abnormal daily returns, while negative rumors make significant negative abnormal daily returns. Similarly, Barber and Loeffler (1993) studied the stocks recommended by HOTS, and found that these stocks have obvious abnormal returns on the day of rumor release but do not obtain long-term abnormal returns. Palmon et al. (1994) investigated the rumor column of "Inside Wall Street (IWS)" from Business Week, and found that good rumors affect stock trading volume significantly while bad rumors do not have. The average abnormal return rates are significant for both bad and good rumors on the day and the next day of rumor releasing. Mathur and Waheed (1995) also analyzed the IWS column on Business Week and found that there are abnormal returns before and after the rumor release date. Pound and Zeckhauser (1990) took a further by mining the impact of rumors on stocks in terms of rumor content, and found the rumors related with mergers and acquisitions cause fluctuations in stock markets though investors cannot obtain excess returns. Liu et al. (1990) studied rumor impact on stocks in terms of trading volume and stock price by analyzing two types of rumors, i.e., one is related with a single listed firm and the other is associated with multiple firms. He found that rumors targeted on a single firm have stronger influence on stocks than ones with multiple companies. Palmon et al. (2009) collected rumors from three major business magazines (Business week, Forbes, Fortune) published between 2000 and 2003, and explored the impact of rumor on stock markets in terms of releasing time, rumor content and writing style. It found that the rumors related with management and acquisition have significant impact on stock movements. Zhao et al. (2010) investigated the rumor news in Chinese stock markets, and found most of them are good news which have a strong impact on Chinese stock movements. All of these studies focuses on the rumors in paper media which has limited rumor numbers and slow spread speed comparing with social media.

With the technological advancement fertilizing vibrant creation, sharing, and collaboration among Web users, the impact of media on stock markets has been increasingly prominent. Many studies have investigated the effect of eMedia on stock movements (Li et al. 2016; Li et al. 2014a; Li et al. 2014b; Bollen Mao and Zeng 2011). Some researchers took a further step on analyzing the effect of financial rumors in eMedia on stock markets. Clarkson, Joyce, and Tutticci (2006) found that there is significant abnormal returns and trading volume on the day and the day before rumor releasing in hot copper forum. Spiegel, Tavor and Templeman (2010) investigated the rumors in three websites (Sponsor, Bursa and Trading for Living) and found the abnormal stock return is obtained during the event day and the five preceding days.

Most previous studies have focused on the effect of rumors on stock movements. However, few investigated the reactions of investors when a rumor is verified by authorities. Huberman and Regev (2001) found that the price of listed firm involved with bad rumors is hard to recover to represent its real market value even though the rumor is clarified. Marshall et al. (2009) presented that stock price can be rallied within 5 days after clarifying the relevant rumors. Zhao et al. (2010) also found that stock prices are hard to restore to its previous level after the listed firms issued the clarification announcement. Zhang and Liu (2012) analyzed the effectiveness of the wording in clarification announcements and found that detailed clarification information helps to mitigate the impact of rumors and the stock price tends to return to normal levels after 30 trading days. Yang and Luo (2014) analyzed the impact of rumors on stock returns under different market conditions. Their findings show that the average cumulative abnormal income after clarification is positive in bull market and negative in bear market. All of these

works still focuses on the official rumor clarification announcement. However, only a small portion of rumors is clarified by these official clarification announcements in mainstream media.

Meanwhile, the adaption of user engagement in social media effectively reduces the barriers of communication between investors and listed companies via comments, votes, and so forth. Powered with these new techniques, investors have begun to utilize social media to post their concerns and look for the official confirmation from listed companies. Many stock-oriented electronic information platforms have come out for rumor clarification and attracted a large number of eye-balls of investors. Panorama Network (www.gtarsc.com) is a good exemplar which is one of the largest rumor clarification platforms in China and has the daily page views up to 7,000,000. With an expectation to reduce the asymmetric market information, China Securities Regulatory Commission (CSRC) encourages Shanghai Stock Exchange and Shenzhen Stock Exchange to launch their own interactive information platform for rumor clarification. However, according to information overload theory (Paredes 2003), investors tend to be partial blind with bias if they are facing with overwhelming information. In addition, based on behavior finance, emotional investors may take irrational reactions to new information like rumor clarification messages (Tetlock 2008). Will such online communication between investors and listed firms improve the information accuracy and hence enhance the information efficiency of the stock market? The real function of online communication between investors and companies and the company's strategy to deal with such new things are yet to be explored. One of the great challenges is how to collect such huge amount of online information and quantify these textual contents to comprehensively and deeply understand their impacts on stock abnormal returns.

Theoretical Background and Hypotheses

Complex information makes up stock market, which is one of the main factors to promote price changes. When market participants cannot communicate with each other freely, they collect their information piecemeal. This information "never exists in concentrated or integrated form" (Hayek 1945). Instead of relying on analysts' advice, investors increasingly use digital platform to get the truth when uncertain information appearing, a trend facilitated by the emergence of social media and the associated creation and investment of user-generated content (Chen et al. 2014). In particular, the information exchange manner based on the digital network has been developed in the internet age. Digital platform has become increasingly popular as a venue both to communicate questions and to collect information on financial securities. Moreover, digital platform has the nature of diversity, independence, decentralization, and aggregation. Therefore, Digital platform can set up a "bridge" between listed companies and investors to promote information exchange in financial markets (Xu and Zhang 2013).

Many studies have investigated the effect of eMedia on stock movements (Li et al. 2016; Li et al. 2014a; Li et al. 2014b; Bollen Mao and Zeng 2011). Some researchers took a further step on analyzing the effect of financial rumors in eMedia on stock markets and found abnormal stock returns (Clarkson, Joyce, and Tutticci 2006; Spiegel, Tavor and Templeman 2010). However, most previous studies have focused on the effect of rumors on stock movements, few investigated the reactions of investors when a rumor is verified by authorities. Specifically, Huberman and Regev (2001) found that the price of listed firm involved with negative rumors is hard to recover to represent its real market value even though the rumor is clarified. Marshall et al. (2009) presented that stock price can be rallied within 5 days after clarifying the relevant rumors. Zhao et al. (2010) also found that stock prices are hard to restore to its previous level after the listed firms issued the clarification announcement. Zhang and Liu (2012) analyzed the effectiveness of the wording in clarification announcements and found that detailed clarification information helps to mitigate the impact of rumors and the stock price tends to return to normal levels after 30 trading days. All of these works still focus on the official rumor clarification announcement. However, only a small portion of rumors is clarified by these official clarification announcements in mainstream media. The effect of digitalized rumor clarification on stock markets in social media is yet to be explored. Based on the discussion above, the first hypothesis is formally stated as:

H1: The information disclosure of digital platform has effect on the stock markets.

In Efficient Market Hypothesis (EMH), a stock price is always driven by "unemotional" investors to equal the firm's rational present value of expected future cash flows. In other words, investors of the stock

market are "rational" and they efficiently respond to new information regarding the stock market products. Investors' decisions in the market fully reflect the effects of any information revealed (Fama 1993). Unfortunately, some studies show that substantial stock market movements cannot be captured ideally by the quantitative measures of firms' fundamentals (Cutler, James, and Summers 2010). This is because the actual market is not as efficient as explained by the EMH and investors are inevitably emotional.

In fact, investors are not as aggressive in forcing prices according to fundamentals as traditional financial theories would suggest (Shleifer and Vishny 1997). Recent studies in behavioral finance show that emotion does influence investment decisions. The behavioral models of asset pricing pioneered by De Long et al. (1990) introduced the concept of 'irrational noise traders' in financial markets, formally demonstrating the relationship between noise trader sentiment and asset prices. Tetlock (2007) carried out one of the pilot studies by extracting the sentiment polarity of news articles in Wall Street Daily in terms of the portion of emotional words and found that negative news is statistically associated with downward pressure on the relevant stocks. Das and Chen (2007) revealed that message sentiment on Yahoo! financial discussion boards is related to stock movements. Bollen, Mao and Zeng (2011) found that public mood as measured from tweets is correlated or even predictive of DJIA values. Similarly, Karabulut (2013) found that Facebook's Gross National Happiness (GNH) has the ability to predict changes in both daily returns and trading volume in the US stock market. In particularly, an increase of one standard deviation in GNH is associated with an increase of 11.23 basis points in market returns over the next day. These empirical literatures show investor sentiment may persist in financial markets and influence stock movements. In reality, irrational investors may underact to the clarification announcements of listed companies with a belief that it is better to believe the rumor rather than not (Zhao et al. 2010). Such preconceived emotion and irrational behaviors of investors may make rumor clarification impotent. Based on the discussion above, the second hypothesis is formally stated as:

H2: The emotional factors of rumor clarifications affect the abnormal returns of the relevant stocks.

The variance of information disclosure behaviors of listed companies may lead to different investor responses and thereby affect their market performance. In particular, Buskirk (2012) found that more frequent disclosure does accelerate the rate at which information is impounded into price. Researchers also found that the quantity of disclosure matters firm performance. Francis et al. (2002) found that the increase in average word counts over time is correlated with an increase in the inclusion of detailed income statements and balance sheets in earnings announcements. Therefore, Buskirk (2012) measured the quality of information in terms of word count and found that more detailed disclosure tends to be accepted by sophisticated investors and thus lowers information asymmetry. Hirschey, Smith and Wilson (2015) suggested that the timeliness of restatement detection and disclosure is associated with greater financial reporting credibility following by the restatements. Based on the above, our third hypothesis is stated as:

H3: The platform clarification behaviors of listed companies have influence on stock abnormal returns.

Data and Method

Data and Sample

There are three main e-platforms for rumor-clarification in China with about 1.62 million independent visitors daily. That is, Panorama Network, eHuDong platform and HudongYi platform. The Panorama Network (www.gtarsc.com) is one of the largest rumor clarification platforms in China. The eHuDong platform (sns.sseinfo.com) is launched by Shanghai Stock Exchange in July 2013, and the HudongYi platform (irm.cninfo.com.cn) is launched by Shenzhen Stock Exchange in January 2010.

Our dataset consists of rumor data, rumor clarification data and stock transaction data. Rumor and rumor clarification data are collected from Panorama Network, eHuDong and HudongYi platform. On these e-platforms, each listed firm maintains its own discussion area. User can post a rumor in the discussion area of the firm which is involved with this rumor, and the representative of the firm post official response to the inquiry. We made a crawler to automatically download these rumor and rumor

clarification pairs. There are 4134 pairs extracted 687,429 postings for 1391 listed firms during the period between August 30, 2012 to January 1, 2014. In addition, stock transaction data including market value, turnover, current ratio, stock price, market return, and volatility were collected from the China Stock Market & Accounting Research (CSMAR) database[5].

In this work, similar to the study of Lu et al. (2010), rumors released within the business hours (from 9:30 am to 3:00 pm) of the exchanges on t day are considered as the messages of t day, and rumors released after 3:00pm on t to 9:30am on t+1 are reckoned as the messages of t+1 day.

Data Analysis Method

This study applied an event study method to investigate the rumors and rumor clarifications on stock movements. Essentially, an event study is a statistical method that study on the impact of an event on the firm value. The event study period is divided into pre-event estimation period and event period as shown in Figure 1. Pre-event estimation refers to a period of time before an event (here, rumor and rumor clarification) occurs, which is applied to train the parameters of models. The event period is the influential period of the event (Ahern 2009). Typically, the pre-event estimation period is longer than the event period. Here in this study, the pre-event time is between [-160, -22], and the event period is [0, 10]. In fact, Brown (1980) found that rumors can only affect stock prices for a short period of time and it is almost no effects for investors with long-term goal. Most studies show that the valid impact period is the rumor announcement day (Barber and Loeffler 1993).

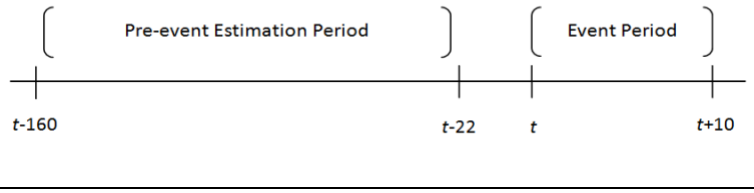

Figure 1. Pre-event estimation period and event period

The Risk-return trade-off has always been one of the most important measures in financial study (French et al. 1987; Amit and Livnat 1988). In this study, we adopted stock price return to evaluate the risk-return trade-off. The estimated stock returns are calculated as follows:

$$R'^{O}_{i,t} = \alpha_i + \beta_i R_t^{m,f} + \delta_i SMB_t + h_i HML_t + \varepsilon_{i,t} \quad (1)$$

where $R'^{O}_{i,t}$ is the return of stock i on the t^{th} day during the pre-event estimation period, $R_t^{m,f}$ denotes the market profitability on the t^{th} day during the pre-event estimation period, S_t is the scale factor which stands for "small market capitalization minus big market capitalization" on the t^{th} day during the pre-event estimation period, H_t is the net asset market value ratio factor which stands for "high book-to-market ratio minus low book-to-market ratio" on the t^{th} day during the pre-event estimation period, and t is the day calculated during pre-event estimation period. S_t and H_t are used to measure the historic excess returns of small capitals over big capitals and of value stocks over growth stocks.

The abnormal return ($AR_{i,t}$) of stock i on the t^{th} day during event period is defined as

$$AR_{i,t} = R'^{O}_{i,t} - R^{O}_{i,t} \quad (2)$$

[5] The CSMAR database (www.gtarsc.com) is the largest and most accurate financial and economic database in China. It is composed of stocks, funds, bonds, financial derivatives, listed companies, economy, industry, high frequency data and personalized data services.

where t is the day measured relative to the event, t = 0, 1, ..., 9, 10. Here, day "0" is the day on which the rumor clarification announcement is released, $R'^{O}_{i,t}$ is actual return on the t^{th} day during the event period, $R^{O}_{i,t}$ is the estimated return on the t^{th} day of the event period in terms of returns in pre-event estimation period.

Therefore, the abnormal return of t^{th} in event period, $\overline{AR_t}$, is calculated by

$$\overline{AR_t} = \frac{1}{n_i}\sum_{i=1}^{n_i} AR_{i,t} \tag{3}$$

where n_i is the number of stocks traded on t^{th} day, $t \in [0,10]$. The cumulative abnormal return (CAR_{t_1,t_2}) between t_1 and t_2 , is formulated as the sum of the abnormal return ($\overline{AR_t}$) between t_1 and t_2 :

$$CAR_{t_1,t_2} = \sum_{t=t_1}^{t_2} \overline{AR_t} \tag{4}$$

In this study, t-tests are applied to examine whether the abnormal return and the cumulative abnormal return are significantly convinced. Specifically, $T(t,t)$ and $T(t_1,t_2)$ are t-statistics for $\overline{AR_t}$ and CAR_{t_1,t_2}, and defined as

$$T(t,t) = SAR \cdot \sqrt{n_i} \tag{5}$$

$$T(t_1,t_2) = SCAR \cdot \sqrt{n_i} \tag{6}$$

Here, SAR and $SCAR$ are calculated as follows:

$$SAR = \frac{1}{n_i}\sum_{i=1}^{n_i} \frac{AR_{i,t}}{S_i} \tag{7}$$

$$SCAR = \frac{1}{n_i}\sum_{i=1}^{n_i}\sum_{t=t_1}^{t_2} \frac{AR_{i,t}/S_i}{\sqrt{t_2-t_1+1}} \tag{8}$$

where S_i is the residual standard deviation of stock i obtained from our regression model as shown in formula (1). SAR is the standardized abnormal return and $SCAR$ is the standardized cumulative abnormal return.

To deeply understanding the mechanism on how the digitalized rumors and clarifications affect stock markets, we adopt ordinary least squares (OLS) equation to explore the relationship between cumulative abnormal return (CAR) and its determinants. We are particular interesting on the emotions of rumors and clarifications, and the online media behaviors of listed firms. Specifically, we consider the following determinants.

The circulation market value (MV), turnover rate (TO) and current ratio (CR) have been effectively proved to be important factors affecting Securities markets (Bhide 1993; Datar et al. 1998; Mulyono and Khairurizka 2009). Therefore, we selected these three variables as the basic model to exam the impact of cumulative abnormal return occurred by rumor clarifications.

The potential role of investor sentiment in financial markets has received considerable attention. As Baker and Wurgler (2006) argue, "Now, the question is no longer, as it was a few decades ago, whether investor sentiment affects stock prices, but rather how to measure investor sentiment and quantify its effects." Therefore, we added emotional factor, clarification emotion (CE), as a measure to evaluate the effect of textual information (i.e. rumor clarification) on stocks as suggested by Tetlock (2007). CE is the emotional polarity of rumor clarification, the potential role of investor sentiment in financial markets has received considerable attention.

The variance of information disclosure behaviors of listed companies may lead to different investor responses and thereby affect their market performance. Response time (Time), clarification detail (Detail) and response number (Attention) can be good indicators of the information disclosure behaviors of listed companies (Buskirk 2012; Francis et al. 2002). Utilizing these variables is able to measure the effect of these behaviors on stock movements.

According to the above discussion, we adopted cumulative abnormal return (CAR) as the explanatory variable, and the ordinary least squares (OLS) equation describing the relationship between CAR and its determinants are:

$$CAR = \alpha + \beta_1 MV + \beta_2 TO + \beta_3 CR + \delta_1 CE + \varphi_1 Time + \varphi_2 Detail + \varphi_3 Attention + \varepsilon \quad (9)$$

Research Result

Statistical Description

Table 2. Summary Statistics of the digital platform dataset

	Characteristics	Amount	Percentage
Emotion of Rumors	Positive	2863	69.10%
	Negative	1280	30.90%
Rumor words	Average	138	-
Emotion of Rumor Clarifications	Good	2171	52.40%
	Bad	1972	47.60%
Rumor clarifications words	Average	121	-
Positive rumor	Good clarifications	1512	36.50%
	Bad clarifications	1429	34.50%
Negative rumor	Good clarifications	1090	26.30%
	Bad clarifications	112	2.70%
Rumor Contents	R&M&A	286	6.90%
	PI	253	6.10%
	LAW	112	2.70%
Confirming	Same sentiment	1392	33.60%
	Different sentiment	2751	66.40%
Market Cycle	Bull Market	1400	33.80%
	Bear Market	501	12.10%
Market Classification	SSE Main Board	311	7.50%
	SZSE Main Board	1094	26.40%
	SME Board	1471	35.50%
	GEM Board	1268	30.60%
The Total Number of Listed Companies		1391	100%
The Total Number of Sample		4134	100%

Table 2 is a statistical description of our dataset. We applied machine learning techniques to filter out 4134 samples related with 1391 listed companies from more than 1.8 million discussion threads. We further identified the sentiment polarity of the filtered rumor and rumor clarification pairs. For rumors, the percentage of positive rumors reaches up to 69.10% and the percentage of negative rumors is 30.90%. For rumor clarification, the good ones are 2171 (52.4%), and the bad ones 1972 (47.60%). Good clarification refers to a positive confirm to a rumor with positive sentiment polarity or a negative confirm to a rumor with negative sentiment. Bad clarification refers to a negative confirm to a rumor with positive sentiment polarity or a positive confirm to a rumor with negative sentiment. In fact, most of confirmations rebut the corresponding rumors. The number of rumor and rumor clarification pairs in the bull market are larger than those the bear market. A good explanation is that the optimistic attitudes in bull market condition tend to make investors overact to news. Such herd behaviors provides arbitrage opportunity for rumormongers (Kaminsky, et al. 1999). In addition, most rumor-related firms come from Shenzhen Securities Exchange (SZSE, SME, and GEM) and only 7.50% comes from Shanghai Securities Exchange (SSE). Since Shanghai Securities Exchange focuses on the blue-chip stocks and Shenzhen

Securities Exchange mainly consists of small and middle size firms, we conclude that rumors and rumor clarifications favor non-blue-chip stocks companies.

Research Experiment

A comparative study of abnormal return of rumors and rumor clarifications

Table 3. Abnormal return of Rumors and Rumor Clarifications

Rumors			Rumor Clarifications		
DAY	**RAR**	**RCAR**	**DAY**	**CAR**	**CCAR**
0	-0.00152***	-0.00152***	**0**	-0.00104***	-0.00104***
1	0.000243	-0.00128***	**1**	0.000119***	0.00092***
2	-0.00102***	-0.0023***	**2**	-0.00143***	-0.00235***
3	-0.00039**	-0.00269***	**3**	-0.00074**	-0.00309***
4	0.000631***	-0.00206***	**4**	-0.00023	-0.00332***
5	-0.00079***	-0.00285***	**5**	-0.00277**	-0.00609**
6	-0.0025*	-0.00535**	**6**	-0.00056*	-0.00665**
7	-0.00102***	-0.00637**	**7**	-0.000081	-0.00675**
8	-0.0031**	-0.00947***	**8**	-0.0036**	-0.01033*
9	-0.00086*	-0.01033**	**9**	0.000076	-0.01026
10	-0.00159*	-0.01192*	**10**	0.000361*	-0.0099**

In this section, we conduct a comparative study of abnormal return and cumulative abnormal return of rumors and rumor clarifications, summarized in Table 3. RAR is the abnormal returns within a certain time after the release of rumors. RCAR is the cumulative abnormal returns within a certain time after the release of rumors. CAR is the abnormal returns within a certain time after the release of rumor clarifications. CCAR is the cumulative abnormal returns within a certain time after the release of rumor clarifications. We estimate abnormal returns and cumulative abnormal returns within ten days after rumors and rumor clarifications releasing based on Fama-French (1993) three-factor model in our event study methodology. Meanwhile, we set the pre-event estimation window to [-160, -22] trading days to fully conduct our regression analysis.

In this study, we focus on the short-term effect of digitalized rumors and clarifications, and examine their effect on stock markets within 10 days after information is released. Previous studies show the existence of the short-term effect of rumors. We find that such short-term effect is also applied to the digitalized rumors and clarifications. This provides a concrete support for the increasing in influences of socialized Web information on stock markets (Luo et al. 2013; Siganos et al. 2014). Ideally, the releasing of clarifications increase information transparency of the markets and reduces the abnormal returns. However, we find a negatively increase in the cumulative abnormal returns (CCARs) within 10 days after the clarifying of the relevant rumors ($p<0.01$). The abnormal returns of rumor clarification (CARs) are statistically significant for the first four days as being shown in Table 3. In addition, we calculate the rate of change of abnormal returns, where the calculation is based upon the abnormal return within each day. We use the abnormal return on the $(t+1)^{th}$ day by subtracting the abnormal return on the t^{th} day and dividing by the abnormal return on t^{th} day. Then, we find that the rate of change is significantly increased within the [+1, +2] and [+8, +9] time windows after the releasing of rumor clarifications. For rumors, the significant increase does occur within the [+1, +2] time windows. In Figure 2, the cumulative abnormal return of both rumors and rumor clarifications present a decreasing trend. Clarifications play as stimulus of rumors that can increase the abnormal returns of markets and do not prompt the stock prices to return to the normal level. One of the good explanations is that such digitalized clarification does not have sufficient credit to earn trusts of investors. That is, investors tend to believe in rumors itself rather than their clarifications.

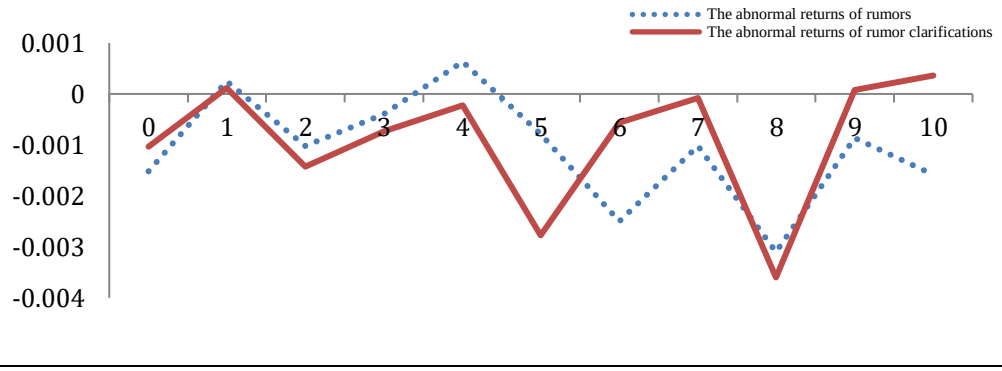

Figure 2: The abnormal return of rumors and rumor clarifications within 10 trading days after releasing date

The influencing factors of cumulative abnormal return of rumor clarifications

Table 4. The cumulative abnormal return of rumor clarifications

	The cumulative abnormal return of rumor clarifications (CCAR)			The cumulative normal return of rumor clarifications (CCNR)		
	0-3	0-5	0-10	0-3	0-5	0-10
MV	.0066841*** (0.000)	.0087648*** (0.000)	.035854*** (0.000)	.0273645*** (0.000)	.053261*** (0.000)	.138241*** (0.000)
TO	.4677353*** (0.000)	.6129374*** (0.000)	.7643927*** (0.000)	.5123779*** (0.000)	.6568823*** (0.000)	.7521593*** (0.000)
CR	1.413232*** (0.001)	2.183669*** (0.000)	3.523181*** (0.000)	-.04393822*** (0.000)	-.4675443*** (0.002)	-0.955427*** (0.000)
CE	.0097687** (0.033)	.0146573** (0.027)	.0217534** (0.011)	.0029377** (0.049)	.0057789** (0.010)	.0142644*** (0.000)
Time	.00164399 (0.759)	.0023181 (0.688)	.0089227 (0.202)	.0053733*** (0.000)	.011894*** (0.000)	.037737*** (0.000)
Detail	.001333 (0.688)	.0026884 (0.571)	.0062684 (0.363)	-.00196652 (0.282)	-.00284774 (0.119)	-.0081748*** (0.004)
Attention	-.0036941 (0.481)	-.0054888** (0.049)	-.01983748*** (0.008)	-.0158223*** (0.000)	-.0287793*** (0.000)	-.0899985*** (0.000)
Cons	-.1452433*** (0.000)	-.2435364*** (0.000)	-.5863747*** (0.000)	-.697655*** (0.000)	-.7434523*** (0.000)	-2.325678*** (0.000)
R2	0.0022	0.0015	0.0009	0.0338	0.0267	0.0112

This table reports the results from two OLS regressions (CCAR and CCNR) regressed on circulation clarification emotion (CE), response time (Time), clarification detail (Detail), and total response number (Attention) to assess the effect of the sentiment of rumors and clarifications, and online behaviors of listed firms. The CCAR is the cumulative abnormal return within a certain time after the release of rumor clarifications; The CCNR is the cumulative normal return within a certain time after the release of rumor clarifications. Specifically, response time is denoted as "Time" in terms of the time difference between posting an inquiry and generating an answer (rumor clarification). Clarification detail, denoted as "Detail", is the number of words in rumor clarification. Total response number, denoted as "Attention", is the amount of rumor clarifications for a listed company. All regressions include three basic control variables for numerous firm's characteristics such as market value (MV), turnover rate (TO) and current ratio (CR). The p-value are reported and highlighted with parentheses.

We analyze the CCAR and CCNR regressions that include clarifications and online behaviors of listed firms in greater detail. In the first set of regressions, we use each stock's cumulative abnormal return (CCAR) as the dependent variable, where the basic model is the benchmark for expected return. To ensure that our results do not depend heavily on the benchmarking process, we run a second set of regressions in which we use each stock's cumulative normal return (CCNR) as the dependent variable. We also run our experiments in terms of different time intervals. In particular, 0-3, 0-5, 0-10 stands for three different periods within 3, 5 and 10 trading days after rumor clarification, respectively.

As shown in Table 4, the regression results of MV, TO and CR are statistically significant ($p<0.01$) in three different periods. The regression result for CE is statistically significant ($p<0.05$) in three different periods for both the CCAR and CCNR tests. This result is consistent with our previous experiments. That is, even though the release and spread of digitalized rumor clarification do provide more information for markets, it still interferes emotions of investors and causes fluctuations in stock returns.

For the control variable of "Time", results from the CCAR and CCNR are inconsistent, even though the cumulative normal return of "Time" is statistically significant. This indicates that time differences between posting an inquiry and generating an answer (rumor clarification) do not affect stock returns.

For the control variable of "Detail", results from the CCAR and CCNR are both statistically insignificant. It shows that elaboration on clarifications have little connection with the credibility of listed firms and they fail to earn the trust of investors to improve the information transparency.

For the control variable of "Attention", results of the CCAR and CCNR are both strongly significant with the time widows [0, +5] and [0, +10]. By frequently response to those rumors, listed firms gradually earn attentions from investors and hence affect the cumulative abnormal returns. Xu and Zhang (2013) showed that the digitalized information like Wikipedia tends to obtain attentions from investors and reduce the information asymmetry in markets. In this study, we find that listed firms may take a good strategy in social media platforms to affect their market performances.

In general, for the behaviors of listed firms in rumor-clarification e-platform, it can be observed that the prompt response and high quality of response do not affect stock returns obviously and have little connection with the credibility of listed firms. Nonetheless, the companies which frequently response rumors with official clarification announcements earn attentions of investors. That is to say, listed firms may take a good strategy in social media platforms to earn the trust of investors to improve the information transparency and firms' credibility.

Experimental summary

Based on the above analysis, there are three interesting findings:

- Rumor clarification in social media do affect the stock abnormal returns (H1). Rumor clarifications are expected to affect abnormal returns of stock markets by reducing the information asymmetry of markets. In this study, we found that the actual functionality of rumor clarification platforms is limited and somehow contradicts the original purpose of setting up these e-platforms. In actual fact, rumor clarification in social media provides a second chance for rumor dissemination and might further magnify the stock abnormal returns. This could be explained by the bias of the irrational inventors on new information (DeLong et al. 1990; Shleifer and Vishny 1997).

- Even though rumor clarification coverage via social media is amplified, investors are reluctant to accept clarification contents (H2). Irrational investors may underact to the clarification announcements of listed companies with a belief that it is better to believe that the rumor exists than it does not (Zhao et al. 2010). Even though the release and spread of digitalized rumor clarification do provide more information for markets, it still interferes emotions of investors and causes fluctuations in stock returns. This is corroborated by our experiment that the sentiment polarity of clarification messages does not affect investors in terms of CCAR.

- The platform behaviors of list companies have limited influence on abnormal returns, contrary to our hypothesis (H3). In this study, we examine three main online behaviors of the listed firms, that is, response time, total response number, and clarification detail. However, we found that listed firm's online clarification behaviors including response time and clarification detail have limited or even no influence on abnormal returns. Only the companies which frequently response rumors with official clarification announcements may earn attentions of investors.

Conclusion & Future Work

Where is a market, there is a rumor. Rumors, as a plausible organization of information, greatly increases the abnormal price volatility. Powered by social media, the volume and influential range of rumors have been tremendously enlarged. With an expectation to reduce the asymmetric market information and maintain the stability of stock markets, Securities Regulatory Commissions have been seeking efficient ways to eliminate the negative effect of rumors. Many rumor-clarification e-platforms have been burgeoning as an effort to eliminate rumors with an expectation to increase information transparency and hence reduce market risk. As for the mainland of China, daily independent visitors of three main rumor-clarification platforms have been reached up to 1.62 million.

In this study, we found that the actual functionality of these e-platforms is limited and somehow contradicts the original purpose of setting up these e-platforms. In particular, rumor clarification is not well accepted by market participants. Even the positive clarification of rumors does not reduce stock abnormal return. In actual fact, rumor clarification in social media provides a second chance for rumor dissemination and might further magnify the stock abnormal return. This could be explained by the bias of the irrational inventors on new information (DeLong et al. 1990; Shleifer and Vishny 1997).

Theoretically, information transparency enhanced by the rumor clarification will decrease abnormal returns of stock markets and increase market efficiency. Rumor clarifications are expected to decrease abnormal returns of stock markets by reducing the information asymmetry of markets. In this study, we examine three main online behaviors of the listed firms, that is, response time, total response number, and clarification detail. However, we found that listed firm's online clarification behaviors including response time and clarification detail have limited or even no influence on abnormal returns. Only the companies which response rumors frequently may affect the stock market performance when the clarifications attract enough investor attentions.

Market transparency refers to the ability of participants to observe information about the trading process. Greater transparency will increase the efficiency of securities markets. In efficient market, rich information increases information transparency (Madhavan Porter and Weaver 2005). In this study, we argue that information bias of irrational investors may block valuable information which results in further market fluctuations, if the market lacks of sufficient credits. Information and credibility enhance information transparency interactively. In order to utilize rumor-clarification e-platforms, Securities Regulatory Commission is strongly suggested to start from building the brands of these e-platforms rather than emphasizing the scales of these e-platforms at the initial stage.

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