

Research on the Impact of Negative Public Opinion on the Stock Price of Listed Companies Based on Multiple Linear Regression

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Abstract—Network negative public opinion events often have a short-term and profound impact on the stock price of companies listed on the A-share plate, which has attracted the attention of investors and society. Based on this background, this paper analyzes the impact of network negative public opinion events on the stock price of A-share listed and puts forward the coping strategies of listed companies to deal with negative public opinion events. Firstly, this paper summarizes the importance of the research in theory. Secondly, by selecting appropriate sample data for empirical regression analysis, it concludes that when public opinion events occur in listed companies, the nature of public opinion events, the popularity of public opinion, the negative emotional tendency of Internet users, and the scale of enterprises have a significant impact on the company's stock price. (Abstract)

Keywords-component; negative public opinion; listed company; price of the stock (key words)

1 INTRODUCTION

At present, with the rapid development of network new media, we media represented by microblog and blog has become the main media of public opinion communication. Internet public opinion events also increased sharply, in which negative Internet public opinion accounted for a high proportion and spread rapidly, and its impact on listed companies and their value gradually increased, which is worthy of our attention and research. For example, Kangmei pharmaceutical's 30 billion financial fraud (2019), visual China black hole event (2019), and other such events cause widespread concern in the society every year.

"Negative public opinion" refers to the well-founded criticism and questioning reports of the Internet users or the media on the enterprise, thereby damaging the future performance or development prospects of the enterprise. The impact of negative public opinion on listed companies can be measured by stock price fluctuation, and the drastic change of stock price will have a great impact on society. Therefore, it is of great significance to study the main factors affecting stock price change.

2 RESEARCH STATUS

Among the various factors of negative public opinion affecting stock price fluctuation, academia focuses on news reports. Predecessors mainly studied how the content of news reports affects stock price fluctuation. Q. C. Shi and L. Y. Xu found that the report of negative public opinion will aggravate the stock price fluctuation, and the report of positive public opinion will alleviate the stock price fluctuation [1]. X. Deng found that when a listed company has a negative public opinion event, a positive response attitude, high corporate reputation, and rapid and effective measures can reduce the impact of the event on the company [2]. D. K. Zhang and J. Y. Qi found that during the enterprise emergency crisis, the influence of group public opinion hurt the enterprise stock price. The greater the influence of group public opinion, the greater the impact on the enterprise stock price [3]. Antulio N. Bomfim found that the relevant economic policies adopted by the United States will not have an obvious effect on the fluctuation of stock price, and investors in the stock market often have certain emotions because of the policy, which will eventually be transformed into the fluctuations affecting stock price in the stock market [4]. Previous literature has studied many factors affecting stock price changes, such as media reports, responsible attitude, corporate reputation, public opinion heat, investor sentiment, and so on. Based on this, this paper studies the influencing factors of stock price fluctuation of listed companies and enriches the research in the field of the stock price of listed companies.

3 RESEARCH HYPOTHESIS

3.1 Nature of public opinion events (N)

Network public opinion events in listed companies are generally caused by company operation problems or personal problems, and the impact of different event subjects is also different. This paper holds that the nature of public opinion events is an important factor affecting the stock price of listed companies. Therefore, the nature of public opinion events is $\in \{0,1\}$, in which 0 indicates that the nature of Events belongs to personal problems and 1 indicates that the nature of Events belongs to corporate operation problems.

Internet public opinion events of listed companies will trigger public opinion in the stock market. Compared with personal problems, Internet public opinion events caused by company operation problems can attract the attention of Internet users and relevant stakeholders. When there are problems in the company's operation, stakeholders will reduce the consumption of the products of the listed company, which will hurt the operation. In this case, investors will not be optimistic about the company's future operation and development. In the stock market, a large number of investors are likely to sell the stock, resulting in the decline of the stock price. Therefore, this paper puts forward the following assumptions:

Hypothesis 1: the nature of public opinion events has a positive impact on stock prices.

3.2 Public opinion heat (H)

The higher the popularity of public opinion, the stronger the Internet users' attention to public opinion events, which leads to the greater fluctuation of negative public opinion on the stock price of listed companies. Therefore, this paper takes the public opinion heat as one of the

indicators of influencing factors and uses references [5] and [6] for public opinion heat calculation.

(1) Firstly, the network public opinion index is constructed to describe the popularity of microblog public opinion from four indexes: microblog release volume (O), forwarding volume (T), comment volume (C), and praise volume (L). These data are counted in days, and their corresponding relationship with time is shown in Table 1.

TABLE 1. STATISTICS OF PUBLIC OPINION DATA OF A MICROBLOG

<i>Day 1</i>	<i>Day 2</i>	...	<i>Day m</i>
$o_{1,1} \quad t_{1,1}, c_{1,1}, l_{1,1}$	$o_{2,1} \quad t_{2,1}, c_{2,1}, l_{2,1}$...	$o_{m,1} \quad t_{m,1}, c_{m,1}, l_{m,1}$
$o_{1,2} \quad t_{1,2}, c_{1,2}, l_{1,2}$	$o_{2,2} \quad t_{2,2}, c_{2,2}, l_{2,2}$...	$o_{m,2} \quad t_{m,2}, c_{m,2}, l_{m,2}$
$\vdots \quad \vdots$	$\vdots \quad \vdots$	\vdots	$\vdots \quad \vdots$
$o_{1,n} \quad t_{1,n}, c_{1,n}, l_{1,n}$	$o_{2,n} \quad t_{2,n}, c_{2,n}, l_{2,n}$...	$o_{m,n} \quad t_{m,n}, c_{m,n}, l_{m,n}$

$$\text{Microblog release on day I: } O_i = n \quad (1)$$

$$\text{Forwarding volume on day I: } T_i = \sum_{j=1}^n t_{i,j} \quad (2)$$

$$\text{Comments on day I: } C_i = \sum_{j=1}^n c_{i,j} \quad (3)$$

$$\text{Praise amount on day I: } L_i = \sum_{j=1}^n l_{i,j} \quad (4)$$

According to the above formula, the expression of microblog public opinion heat $H(i)$ on day I is:

$$H(i) = W_1 \times O_i + W_2 \times T_i + W_3 \times C_i + W_4 \times L_i \quad (5)$$

Where, W_k ($k = 1,2,3,4$) are the weights of microblog publishing volume, forwarding volume, comment volume, and praise volume respectively, which are calculated by information entropy.

(2) Using information entropy to calculate index weight

① There are m evaluation objects and n evaluation indexes. The original index matrix is $R=(r_{i,j})_{m \times n}$, expressed by formula (6):

$$R = \begin{bmatrix} r_{1,1} & \cdots & r_{1,n} \\ \vdots & \ddots & \vdots \\ r_{n,1} & \cdots & r_{n,n} \end{bmatrix} \quad (6)$$

② Generally speaking, there are differences in the types and dimensions of different evaluation indicators. To eliminate the impact of these differences, they are transformed into dimensionless and consistent standard index values, and the evaluation indicators are dimensionless:

$$\text{Benefit index: } s_{i,j} = \frac{r_{i,j} - \min(r_{i,j})}{\max(r_{i,j}) - \min(r_{i,j})} \quad (7)$$

$$\text{Cost index: } s_{i,j} = \frac{\max(r_{i,j}) - r_{i,j}}{\max(r_{i,j}) - \min(r_{i,j})} \quad (8)$$

Among them, $\max(r_{i,j})$ and $\min(r_{i,j})$ are the maximum and minimum values of the index evaluation value respectively. This paper adopts benefit index, that is, the larger the value, the better.

③ Calculate the proportion of the i -the evaluation object index value under the j -the index:

$$p_{i,j} = \frac{s_{i,j}}{\sum_{i=1}^m s_{i,j}} \quad (9)$$

④ Calculate the entropy of index j :

$$e_j = -k \sum_{i=1}^m p_{i,j} \ln p_{i,j}, \quad k = \frac{1}{\ln m} \quad (k > 0, 0 \leq e_j \leq 1) \quad (10)$$

⑤ Further normalizing $1-e_j$, the entropy weight of the j -the index is:

$$w_j = \frac{1-e_j}{\sum_{j=1}^n (1-e_j)} = \frac{1-e_j}{n - \sum_{j=1}^n e_j} \quad (0 \leq w_j \leq 1, \sum_{j=1}^n w_j = 1) \quad (11)$$

The popularity of Internet public opinion reflects the attention of Internet users, media, and the government to information sources. The higher the popularity, the stronger the attention, and then have a greater impact on listed companies. For example, in the "visual China black hole" event, once the event occurred, it immediately aroused fierce discussion among Internet users. The company's share price reached the word limit a few days after the event. It can be seen that the higher the popularity of public opinion, the greater the impact on the share price of listed companies. Therefore, this paper puts forward the following assumptions:

Hypothesis 2: public opinion heat hurts stock price.

3.3 Netizens' negative emotional tendency (NET)

According to the definition of negative public opinion, the negative emotional tendency of Internet users has an important impact on the fluctuation of stock prices. Therefore, this paper takes the negative emotional tendency of Internet users as one of the indicators of influencing factors. The emotional tendency is an important factor affecting the trend of public opinion events, and the content of microblog comments includes all the emotions expressed by Internet users. Therefore, the given formula is as follows: the proportion of negative emotional tendency of Internet users on day I is $P_{-,i}$:

$$P_{-,i} = \frac{Q_{-,i}}{Q_{E_i}} \quad (12)$$

Where $Q_{-,i}$ represents the number of microblog comments with the negative emotional tendency of netizens on day I , and Q_{E_i} represents the total number of microblog comments sent by netizens on day I .

Z. Y. Jiang and W. R. Ma provide theoretical basis and decision support for the government to effectively control network public opinion emergencies through emotional tendency analysis and public opinion tracking of network public opinion [7]. For example, in the "Changchun longevity fake vaccine" incident, due to the nature of the incident and its bad nature, there was a lot of abuse on the Internet, which made the incident last for more than a month from its emergence to extinction. It can be seen that the negative emotions of Internet users have a great

impact on public opinion events, thus affecting the stock price of listed companies. Therefore, this paper puts forward the following assumptions:

Hypothesis 3: Internet users' negative emotional tendency hurts stock price.

3.4 Company size (CS)

Q. D. Li believes that the popularity and risk resistance of large-scale companies are often in direct proportion to the trust and support of investors. When these companies issue more common shares, more investors pay attention to these shares. The more relevant departments strengthen the supervision of such shares, the less the stock price will be manipulated. On the contrary, the smaller the scale, the higher the stock price volatility [8]. The larger the company, the more mature and optimized its operation and management, the stronger its profitability and anti-risk ability, and the stronger its stability in market changes and stock index fluctuations. For example, in the "Gree rice cooker" incident, although the chairman's wrong remarks caused heated discussion among netizens, the stock price returned to normal on the third day after the incident. Therefore, this paper puts forward the following assumptions:

Hypothesis 4: company size has a positive impact on stock the price.

4 RESEARCH DESIGN AND RESULT ANALYSIS

4.1 Select variables

(1) Explained variable

Combing previous studies on stock price fluctuation and observing the changes of stock price after public opinion events, this paper believes that if the fluctuation difference between the stock and the sector is greater than $\pm 1\%$ and the stock return is negative, public opinion will have an impact on the stock. Therefore, the research time of each stock is not fixed: $t+x$, t is the time point of public opinion outbreak, x is the number of days until the public opinion event has little or no impact on the stock price. The research object of this paper is the stock price fluctuation of listed companies. Therefore, the stock price volatility of the listed companies in the x trading days is chosen as the explained variable (dependent variable). This index can reflect the ability of enterprises to deal with public opinion. The calculation formula of stock price fluctuation is:

$$\text{Stock price fluctuation} = (\text{The closing price of event stationary day} - \text{The stock price at the outbreak point}) / \text{The stock price at the outbreak point} \quad (13)$$

Due to the particularity of the stock market, the stock price at the breaking point of historical events cannot be queried, so it is replaced by the closing price or opening price close to the breaking point of events. Therefore, the following rules are set: if the event occurs at 0:00-9:30 of the day, the closing price of the previous day is used as the stock price at the breaking point of events; If the event occurs between 9:30 and 15:00, the opening price of the day shall be used as the stock price at the outbreak point of the event; If the event occurs between 15:00 and 24:00, the closing price of the day shall be used as the stock price at the outbreak point of the event.

(2) Explanatory variables

According to the research hypothesis, the explanatory variables of this paper are the nature of public opinion events, public opinion heat, netizens' negative emotional tendency, and company size.

① Nature of public opinion events (N)

This paper holds that the nature of public opinion events is an important factor affecting the stock price of listed companies. Therefore, the nature of public opinion events is $\in \{0,1\}$, in which 0 indicates that the nature of Events belongs to personal problems and 1 indicates that the nature of Events belongs to corporate operation problems.

② Public opinion heat(H)

$$H(i) = W_1 \times O_i + W_2 \times T_i + W_3 \times C_i + W_4 \times L_i$$

Among them, O_i , T_i , C_i and L_i are the microblog release volume, forwarding volume, comment volume, and praise volume on the day i , and W_k ($k = 1,2,3,4$) are the weights of microblog release volume, forwarding volume, comment volume, and praise volume respectively.

③ Netizens' negative emotional tendency (NET)

The popular microblog and popular comments in microblogs represent the views more recognized by netizens in the public opinion field. Therefore, this paper uses the popular comments in popular microblogs to analyze the emotional changes of netizens. In the microblog, select the keyword "sunflower murder" and the category "popular" for advanced retrieval to obtain the relevant microblogs every day after the occurrence of public opinion. Sort according to the popularity, select the top 5 microblogs, and analyze their comments. This paper also adopts the heat ranking method for comments, excludes irrelevant or nonsubstantive comments, obtains the first 50 comment samples under each microblog, that is, a total of 250 comment samples, and calculates the proportion of negative comments.

$$\text{Netizens' negative emotional tendency} = \text{Negative comments in comment samples} / 250 \quad (14)$$

④ Company size (CS)

This paper selects the company size as the explanatory variable, that is, the natural logarithm of the company's total assets at the end of the period.

$$\text{Company size} = \text{Ln}(\text{Total assets of the company at the end of the period}) \quad (15)$$

(3) Control variables

The change and fluctuation of stock prices are affected by a variety of company characteristics and market factors. To accurately analyze the impact of negative public opinion on stock price, study the existing literature and introduce as many relevant variables that affect the stock price as possible, to separate the parts that have nothing to do with negative public opinion in stock price fluctuation. The control variables are the return on assets and the asset-liability ratio of listed companies. Return on assets is the financial ratio to measure the company's return on capital per share. Investors use this index to measure the company's production profit. Generally speaking, the higher the value of this index, the better the company's performance, and the more it attracts investors' attention and investment intention, which helps to stabilize the fluctuation of stocks. Investors evaluate whether there are risks in the solvency and financial situation of

the enterprise through the asset-liability ratio. If the solvency of the enterprise is very poor, the finance of the enterprise will face great risks, resulting in reducing the confidence of investors.

$$\text{Return on assets} = \text{Net profit} / \text{Average total assets} \quad (16)$$

$$\text{Asset liability ratio} = \text{Total liabilities} / \text{Total assets} \quad (17)$$

To sum up, the explained variables, explanatory variables, and control variables studied in this paper are shown in Table 2.

TABLE 2. VARIABLES DEFINITION

Type	Code	Variable name	Definition
Explained variable	GJ	Stock price fluctuation	Stock price fluctuation x trading days after public opinion event
Explanatory variables	N	Nature of public opinion events	Public opinion events are caused by personal problems or business problems
	H	Public opinion heat	Netizens' attention to the public opinion event
	NET	Netizens' negative emotional tendency	Proportion of netizens' negative comments on the public opinion event
	CS	Company size	Natural logarithm of the company's total assets at the end of the period
Control variables	ROA	Return on assets	Net profit / Average total assets
	LEV	Asset liability ratio	Total liabilities / Total assets

4.2 Data source and preprocessing

(1) Data sources

This paper selects 30 listed companies with major network public opinion events in China's A-share market in the recent three years as the research sample. The microblog data during the event study period are crawled through web crawler technology. The main economic data are from the relevant stock databases Dongfang fortune.com and cninfo.com.

(2) Data preprocessing

To avoid the impact of too large or too small data on the regression model and eliminate the difference of data order of magnitude, this paper uses the maximum and minimum normalization method to normalize the index of public opinion heat.

4.3 Model building

After variable selection and data preprocessing, we can build an empirical model. This paper selects two control variables to empirically discuss their impact on the stock price fluctuation of listed companies from four aspects: the nature of public opinion events, the popularity of public opinion, the negative emotional tendency of Internet users, and the size of the company. Therefore, a multiple linear regression model is constructed, as shown in the formula:

$$GJ = \beta_0 + \beta_1 N + \beta_2 H + \beta_3 NET + \beta_4 CS + \beta_5 ROA + \beta_6 LEV + \varepsilon \quad (18)$$

Among them, β_0 is a constant term, and $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ is the regression coefficient of the independent variable in the model, ε is the error term.

4.4 Regression analysis and result discussion

This paper takes the nature of public opinion events, public opinion heat, the negative emotional tendency of Internet users, company size, return on assets, and asset-liability ratio as independent variables, and stock price changes as dependent variables for multiple linear regression. The specific results are shown in the table below.

(1) Descriptive statistics

Descriptive statistics are carried out with relevant software, and the specific data are shown in Table 3.

TABLE 3. DESCRIPTIVE STATISTICS OF VARIABLES

Variables name	Minimum	Maximum	Average value	Standard deviation
GJ	-0.8668	-0.0023	-0.22833	0.2087289
N	0	1	0.60	0.498
H	0.0000	1.0000	0.092023	0.2133799
NET	0.7640	1.0000	0.941600	0.0647167
CS	1.1346	8.1026	4.865797	1.6070561
ROA	-3.0508	1.5776	-0.21979	0.9117420
LEV	0.1335	2.2901	0.662013	0.4295096

From the descriptive statistical results, we can draw the following conclusions: from the dependent variable stock price fluctuation, negative public opinion has a certain impact on the stock price of listed companies. The maximum negative fluctuation of stock price decreased by 86.68% and the minimum decreased by 0.23%. From the perspective of company size, the size of listed companies in China will be different, but the average value is large, indicating that the selected listed companies are relatively large as a whole.

(2) Correlation analysis

To avoid the influence of correlation between variables, SPSS software is used for correlation analysis, and the results are shown in Table 4.

TABLE4. CORRELATION ANALYSIS OF VARIABLES

	GJ	N	H	NET	CS	ROA	LEV
GJ	1						
N	-0.350	1					
H	-0.372*	-0.075	1				
NET	-0.401*	-0.240	0.261	1			
CS	0.406*	-0.060	0.253	-0.320	1		
ROA	0.127	-0.276	0.090	0.010	0.193	1	
LEV	0.247	0.121	-0.091	.059	0.059	0.254	1

It can be seen from table 4 that the correlation between variables is small, so it has no impact on the regression results.

(3) Multiple regression results and analysis

TABLE 5. REGRESSION ANALYSIS RESULTS

Model	Coefficient		T	Sig.	Collinearity statistics	
	B	Standard			Tolerance	VIF
(constant)	.553	.491	1.126	.272		
N	-.211	.057	-3.704	.001	.806	1.241
H	-.377	.135	-2.787	.010	.778	1.285
NET	-	.472	-2.163	.041	.692	1.445
CS	.049	.019	2.655	.014	.730	1.370
ROA	-.028	.031	-.913	.371	.809	1.236
LEV	.146	.064	2.278	.032	.854	1.171
R ²	0.659					
Adjusted R ²	0.569					

As shown in Table 5, tolerance and variance expansion factor (VIF) are important indicators to measure the collinearity between variables. In this model, tolerance values are greater than 0.1 and VIF are less than 10, indicating that there is no multilinear relationship between variables. The adjusted R² of this model is 0.569, which is significant at the significance level of 0.001, indicating that the regression equation fits well. The model expression is: $GJ = 0.553 - 0.211N - 0.377H - 1.022NET + 0.049CS - 0.0278ROA + 0.146LEV$. The following conclusions can be drawn from the results of regression analysis.

- ① The nature of public opinion events has a significant impact on the stock price of listed companies. The sig value is 0.001, and hypothesis 1 is true. The negative public opinion caused by the company's operation problems has a greater impact on the stock price of listed companies, and its stock price is more likely to fall.
- ② The popularity of public opinion has a significant negative impact on the stock price. The sig value is 0.1, and hypothesis 2 is true. For listed companies, when online public opinion occurs, the higher the popularity of public opinion, the greater the possibility of stock price decline.
- ③ Netizens' negative emotional tendency has a significant negative impact on the stock price. The sig value is 0.41, and hypothesis 3 is true. For listed companies, when Internet public opinion occurs, the higher the negative emotion on the Internet, the greater the impact on the stock price and the greater the possibility of stock price decline.
- ④ The company size has a significant positive impact on the stock price. The sig value is 0.14, and Hypothesis 4 is true. For listed companies, in the event of network public opinion, the larger the scale of their assets, the higher the possibility of a better share price.

5 CONCLUSION

This paper aims to explore the impact mechanism and degree of network negative public opinion on the A-share market. Therefore, 30 listed companies with negative network public opinion events in the A-share market in recent three years are selected as the research sample to study the influencing factors of stock price changes from the perspective of negative public opinion, and make an empirical analysis and research. Based on the current research on stock price fluctuation, this paper analyzes the impact of the nature of public opinion events, public opinion heat, netizens' negative emotional tendency, and company size on stock price fluctuation. The results show that these four factors have a significant impact on stock price volatility, and the nature of public opinion events has the greatest impact. According to the conclusion, this paper puts forward the following suggestions on public opinion governance of listed companies:

(1) Strengthen supervision. Negative public opinion events caused by business problems have a significant negative impact on the stock price of listed companies. The China Securities Regulatory Commission (CSRC) and other regulators should strengthen the punishment for violations of laws and regulations, not only the economic punishment such as top punishment but also the administrative punishment.

(2) Improve the public opinion management ability of enterprises. According to the research conclusion, the popularity of public opinion and the negative emotional tendency of Internet users have a significant negative impact on the stock price. Enterprises themselves should strengthen the ability of public opinion monitoring and management. With the advent of we media era, public opinion events of listed companies break out frequently. When negative public opinion events occur, some enterprises treat negatively or try to cover up the facts, to deepen the conflict of interest between them and the majority of investors. Listed companies should strengthen internal control, bring network public opinion into the scope of the daily management of the company, actively respond to negative public opinion events with the help of Internet platforms, and guide public opinion in a good direction in an appropriate way.

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