

Network Forum Investor Sentiment, Sentiment Volatility And Stock Market---An Empirical Analysis Based on Multivariate GARCH-BEKK Model

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Abstract: Based on the text of posing on the network forum, we establish a set of keyword dictionary to measure the long and short investors' sentiment effectively, then we investigate the mutual relations between investor sentiment and the trading market through a Multivariable BEKK-GARCH model of abnormal long and short investors sentiment, returns and abnormal trading volume. The results show that abnormal sentiment of long investor has a negative impact on the returns and a positive impact on the abnormal trading volume; While abnormal sentiment of short investor has no impact on the return and a negative impact on the abnormal trading volume. Otherwise, there is the negative volatility effect from abnormal sentiment of long investor to returns and abnormal trading volume, the positive volatility effects from abnormal sentiment of short investor to returns, and no volatility effects from abnormal sentiment of short investor to abnormal trading volume. In addition, network forum investor sentiment is a factor affecting the trading market. The analysis of forum information plays a certain role in presenting market risk and improving efficiency in making investment decision.

Introduction

Investor sentiment theory was first put forward by De Long. The investor sentiment, a significant topic in Behavioral Finance, aptly portrays investor's mental activities and reflects investor's expectation to market, which plays an important role in decision-making for investors. In the opinion of De Long et al.(1990), owing to the mutual influence and unpredictability of investor sentiments, irrationally pricing cannot be eliminated, so investor sentiments become systemic risk of financial assets' equilibrium price and affect returns and fluctuations. The research of Lee, et al. (2002) further proved that investor sentiments are systemic risk factors which influence prices. Zongxin Zhang etc. (2013) found that new information led to the adjustment of investors' subjective beliefs, which further influenced the change of investor sentiments and then reflected with the fluctuation of stock prices. Pessimism and optimism to stock markets are both included in investor sentiments. Since investor sentiments influence fluctuation of risks and returns in stock market, how do they play a role in affecting stock price and fluctuation? Which one leads market risk, Pessimistic sentiment or optimistic sentiment?

Sentiments are defined as a belief of wrong expectation to future cash flows and investment risk, which are caused by the irrelevant information about capital values in the capital market and by the future uncertainty. This kind of erroneous beliefs leads irrational behavior by noise traders and incorrectly pricing. Individual investors are always influenced by sentiments and then behavioral biases and cognitive biases occur during the process of trading. Analyzing investor sentiments has theoretical and practical significance in risk reduction and promoting a stable trading markets.

Zhigao Yi etc. (2009) thought that sentiments can promote investors to reach unanimity under the interactive mechanism and then influence investors' decision. According to the 34th China Internet

Development Report by CNNIC, by June 2006, the number of retail investors in China reached 632 million; the popularity rate of internet reached 46.9%. As a social media providing platforms for retail investors to express opinions and get information, stock forums have strong interactivity, large quantities of information, fast update speed, so they can reflect the investors' responses to stock markets in time. Besides, retail investors can influence stock markets through posting and adding comments on the forum. Therefore, this paper will extract investors' sentiments based on forums and put them into the analysis of stock prices fluctuation and market risks, which is absolutely a significant breakthrough and innovation compared to the angle of traditional analysis.

In summary, this paper focuses on whether postings on forums measure different investor sentiments efficiently? whether investor sentiments can influence the return and fluctuation in stock markets and how it works? Further more, whether two different investor sentiments, pessimistic sentiment or optimistic sentiment, have the same effect on the fluctuation of stock price? Market risk comes from long investor or short investor? These problems are what this paper discusses.

Literature Review

Studies have shown that investor sentiments based on social media are well correlated with stock market. Tetlock (2007) linked comment column on Wall Street Journal with return and volume in stock market and then found that the upper-middle-level pessimistic sentiments indicate price falling, but excessively high or low pessimistic sentiments indicate high volume. Fotak (2008) divided long and short suggestions on finance blogs in 2006 into long-term and short-term suggestions in order to study their effects on stock prices and trading volume, from which he found that suggestions on blogs could lead abnormal trading volume and negative abnormal return. Dayong Dong (2012) initially tentatively used information on forum to prove that there is bidirectional fluctuation spillover effect between returns in stock market and abnormal posting volume. However, Dong's main purpose is to test the information dissemination between trading market and stock forum, so he did not analyze contents of postings in detail. Therefore, there is no research on whether and how investor sentiments based on stock forums can affect market returns, trading volume and fluctuations.

Foreign scholars have done some research on how to get sentimental information from large quantities of unstructured text information and their research results have provided theoretical and technical references and supports for this paper. Changqin Quan (2010) chose blogs as objects and data sources of expressing sentiments. Then he constructed emotional corpus that have been annotated manually and studied expression of sentiments in Chinese. With experiments on expressing sentiments in texts, he found that emotional key words could reflect 69% of sentiments and the rest 39% of sentiments needed more analysis on grammar and semantics. O'Leary (2011) proposed to use readers' alternative labeling information to measure sentiments expressed in blogs rather than rely on labeling information provided by blogs themselves. Loughran (2011) constructed an alternative negative words list and found that these words had significant correlation with financial variables such as daily return, trading volume and fluctuation of return rate that day 10-k companies declared, supporting that these words can effectively measure tones and sentiments.

Therefore, this paper makes a text analysis with postings on forums, establishes indexes that can effectively measure sentiment of long-short investors and studies how do investor sentiments influence return and fluctuation. It is first time to measure individual investor sentiments based on stock forum through text analysis techniques, and empirically analyze how do sentiments influence return and fluctuation in China stock market, which is the main innovation point of this paper.

Study Methodology

Samples and Data

This paper selects daily returns and daily trading volume of the Shanghai Composite Index as the

basic data of market, which are from CSMAR database. The sample covers 884 trading days from January 7th, 2010 to August 30th, 2013. The sentiment of long-short investors is based on the text in the posing on Eastmoney^① forum bar about SSE Composite Index.

The establishment of keyword dictionary of “the long sentiment” and “the short sentiment” and Measuring sentiment

This paper downloads the content of posting on Eastmoney forum bar about SSE Composite Index from January 7th, 2010 to August 30th, 2013 by programming the web crawler. Then make a word segmentation and frequency statistics of the posting content to select the keywords that represent the investor sentiment and behavior artificially by the procedure of frequency statistics, 394 keywords in total. Finally, put these words into two categories by repeatedly comparing. This paper defined these keywords that reflect negative sentiment such as pessimism, panic, anxious and bearish as a dictionary of “the short sentiment”, 202 keywords in total. On the contrary, define these keywords that reflect positive sentiment such as optimism, happy, promising and bullish as a dictionary of “the long sentiment”, 192 keywords in total.

The establishment of the variables

This paper discusses the lead-lag relationship that investor sentiment based on the forum have on the returns and the trading volume. Namely the effect that the investor sentiments in one day have on the market in the next day. The daily trading volume, the sentiment of long-short investor are measured by the logarithmic volume and the logarithmic sentiment respectively as followed:

$$Vol_t = \ln(vol_t) \quad (1)$$

$$L_sent_t = \ln(l_sent_t) \quad (2)$$

$$S_sent_t = \ln(s_snet_t) \quad (3)$$

Table 1. The basic descriptive statistics on variables

Variables	Mean	Std. dev.	Max	Min	Skewness	Kurtosis	ADF
Vol_t	13.686	0.1146	14.783	12.899	0.1152	-0.2931	40.26[0.001]
L_sent_t	4.9816	0.3698	6.4815	2.7080	-0.3711	-0.2555	69.52[0.001]
S_sent_t	5.0102	0.5309	6.7440	2.3025	-0.2980	-0.1817	73.79[0.001]

The descriptive statistics are shown in Table 1. All the variables were tested at the 1% level of significance, indicating that all the series are stationary series, so they can apply to ARMA model. In the ARMA(p,q) model, the order of autoregressive(p) and moving average(q) is determined in line with AIC and SC criterion. The ARMA model and parameter estimation are as follows:

Model 1: The ARMA(2,1) model of trading volume(Vol_t):

$$Vol_t = \mu_{Vol} + \phi_{11}Vol_{t-1} + \phi_{12}Vol_{t-2} + \theta_{11}\varepsilon_{t-1} + \varepsilon_{Vol_t} \quad (4)$$

Model 2: The ARMA(5,1) model of the long sentiment(L_sent_t):

$$L_sent_t = \mu_{L_sent} + \phi_{21}L_sent_{t-1} + \phi_{22}L_sent_{t-2} + \phi_{23}L_sent_{t-3} + \phi_{24}L_sent_{t-4} + \phi_{25}L_sent_{t-5} + \theta_{21}\varepsilon_{t-1} + \varepsilon_{L_sent_t} \quad (5)$$

Model 3: The ARMA(1,2) model of the short sentiment(S_sent_t):

^① East money is one of the biggest BBS of finance and economics in china.

$$S_sent_t = \mu_{S_sent} + \varphi_{31}S_sent_{t-1} + \theta_{31}\varepsilon_{t-1} + \theta_{32}\varepsilon_{t-2} + \varepsilon_{S_sent_t} \quad (6)$$

Table 2. The regression results of ARMA(p,q)

	Constant	φ_{i1}	φ_{i2}	φ_{i3}	φ_{i4}	φ_{i5}	θ_{i1}	θ_{i2}
Model 1	13.70926	1.31905	-0.3427				0.70739	
ARMA(2,1)	(186.95)	(16.89)	(-4.75)				(11.18)	
	[0.000]	[0.000]	[0.000]				[0.000]	
Model 2	4.94809	1.32917	-0.15033	-0.22999	0.21253	-0.16369	4.94809	
ARMA(5,1)	(18.05)	(29.35)	(-2.66)	(-4.17)	(3.82)	(-4.35)	(32.42)	
	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]	[0.000]	[0.000]	
Model 3	5.00527	0.97174					0.48849	0.17140
ARMA(1,2)	(29.44)	(100.73)					(13.95)	(4.94)
	[0.000]	[0.000]					[0.000]	[0.000]

The regression results of table 2 show that all the parameters pass the significant test. So the residual(ε_{Vol_t}) is defined as abnormal trading volume ($AVol_t$), the residual($\varepsilon_{L_sent_t}$) is defined as the abnormal sentiment of long investor(AL_sent_t), and the residual($\varepsilon_{S_sent_t}$) is defined as the abnormal sentiment of short investor(SL_sent_t).

Empirical model

This paper applied the multivariate GARCH-BEKK model to study the relationship among the four variables, that is returns, abnormal trading volume and the abnormal sentiment of the long-short investors. BEKK model was proposed by Engle and Kroner(1995), whose advantage is to ensure that the covariance matrix should satisfy positive definite condition and less number of parameter estimation. This paper sets up quarternary BEKK model as follows:

$$\begin{cases} R_t = \mu_r + \gamma_1 R_{t-1} + \eta_1 AVol_{t-1} + \kappa_1 AL_sent_{t-1} + \lambda_1 AS_sent_{t-1} + \varepsilon_{1t} \\ AVol_t = \mu_{AVol} + \gamma_2 R_{t-1} + \eta_2 AL_sent_{t-1} + \kappa_2 AS_sent_{t-1} + \varepsilon_{2t} \\ AL_sent_t = \mu_{AL_sent} + \gamma_3 R_{t-1} + \eta_3 AVol_{t-1} + \kappa_3 AS_sent_{t-1} + \varepsilon_{3t} \\ AS_sent_t = \mu_{AS_sent} + \gamma_4 R_{t-1} + \eta_4 AVol_{t-1} + \kappa_4 AL_sent_{t-1} + \varepsilon_{4t} \end{cases} \quad (7)$$

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon_{t-1}'A + B'H_{t-1}B \quad (8)$$

Where equation (7) is the mean equation of BEKK model, equation (8) is the variance equation. R_t , $AVol_t$, AL_sent_t , AS_sent_t and μ_r , μ_{AVol} , μ_{AL_sent} , μ_{AS_sent} represent daily logarithmic return, daily abnormal trading volume, daily abnormal sentiment of long investor, daily abnormal sentiment of long investor and the mean value of the four variables in the sample interval. ε_t is 4x1 error vector, the corresponding conditional covariance matrix is H_t . I_{t-1} represents information set at $t-1$ time. The residual hypothesis obeys multivariate GED(generalized error distribution) distribution. The variance equation (8) is shown as follows:

$$\begin{bmatrix} h_{11,t} & h_{12,t} & h_{13,t} & h_{14,t} \\ h_{21,t} & h_{22,t} & h_{23,t} & h_{24,t} \\ h_{31,t} & h_{32,t} & h_{33,t} & h_{34,t} \\ h_{41,t} & h_{42,t} & h_{43,t} & h_{44,t} \end{bmatrix} = \begin{bmatrix} c_{11} & 0 & 0 & 0 \\ c_{21} & c_{22} & 0 & 0 \\ c_{31} & c_{32} & c_{33} & 0 \\ c_{41} & c_{42} & c_{43} & c_{44} \end{bmatrix}^T \begin{bmatrix} c_{11} & 0 & 0 & 0 \\ c_{21} & c_{22} & 0 & 0 \\ c_{31} & c_{32} & c_{33} & 0 \\ c_{41} & c_{42} & c_{43} & c_{44} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix}^T (\epsilon_{1,t-1} \epsilon_{1,t-1}^T) \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \quad (9)$$

$$+ \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} \end{bmatrix}^T \begin{bmatrix} h_{11,t-1} & h_{12,t-1} & h_{13,t-1} & h_{14,t-1} \\ h_{21,t-1} & h_{22,t-1} & h_{23,t-1} & h_{24,t-1} \\ h_{31,t-1} & h_{32,t-1} & h_{33,t-1} & h_{34,t-1} \\ h_{41,t-1} & h_{42,t-1} & h_{43,t-1} & h_{44,t-1} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} \end{bmatrix}$$

Where α_{ij} is the ARCH coefficient. When $i=j$, it represents the influence degree from the prior information to the market. When $i \neq j$, it represents the influence degree from the volatility of series i to the volatility of series j , reflecting the ARCH effect of fluctuation. β_{ij} is the GARCH coefficient, representing the vitality of volatility transmission between series i and series j , reflecting the GARCH effect of fluctuation.

Empirical Analysis

The basic descriptive statistics on variables

Table 3. the basic descriptive statistics on variables

	R_t	$AVol$	AL_sent	AS_sent
Mean	-0.0004	0.0009	0.0089	0.0051
Std. dev.	0.0001	0.0332	0.1128	0.1875
Skewness	-0.3186	0.6086	-0.1963	-0.0402
Kurtosis	1.8238	1.2548	8.2014	1.7592
J-B	137.32 [0.000]	86.682[0.000]	106.65 [0.000]	1908.2[0.000]
Q(1)	0.1363[0.712]	0.0003[0.985]	0.0100[0.920]	0.0015[0.969]
Q(5)	4.5982[0.467]	0.6158[0.987]	0.2200[0.999]	1.7936[0.877]
Q(15)	14.401[0.495]	5.9958[0.980]	12.474[0.643]	18.965[0.215]
Q²(1)	0.4122[0.521]	0.0274[0.868]	12.211[0.000]	0.3343[0.563]
Q²(5)	7.4571[0.189]	4.1192[0.532]	34.876[0.000]	9.8889[0.078]
Q²(15)	23.400[0.076]	28.740[0.017]	124.30[0.000]	76.476[0.000]
ADF	30.03[0.000]	444.27[0.001]	458.91[0.001]	445.21[0.001]

The basic descriptive statistics, the auto correlation test, stationary test and normality test are shown in Table 3. The normality test results (J-B) of R_t , $AVol$, AL_sent and AS_sent show that these four series refuse hypothesis of normal distribution. The test of Q- statistic shows that there is no auto correlation for these four variables. But the Q^2 -statistic shows that all the variables have auto correlation with a high order. That is to say, time-variant and aggregation exist in the fluctuation of all the variables. Besides, the ADF test shows that all the variables are stationary series.

The parameter estimation of quarternary BEKK-GARCH

Table 4. The parameter estimation of quarternary BEKK-GARCH

	Parameter estimation	Std. dev.	T-statistic	p
μ_r	-0.00204545	0.00038789	-5.27325	0.000
$R_t\{1\}$	0.35418595	0.04578096	7.73653	0.000
$AVol_t\{1\}$	0.00012225	0.00260049	0.04701	0.962
$AL_sent\{1\}$	-0.00234755	0.00139349	-1.68465	0.092
$AS_sent\{1\}$	0.00084351	0.00117225	0.71956	0.471
μ_{AVol}	0.06232608	0.00627535	9.93189	0.000

$R_i\{1\}$	3.48190371	0.67612762	5.14977	0.000
$AL_sent\{1\}$	0.08086496	0.03009224	2.68724	0.007
$AS_sent\{1\}$	-0.13608196	0.02330037	-5.84033	0.000
μ_{AL_sent}	0.07906921	0.00923271	8.56403	0.000
$R_i\{1\}$	-5.43313539	1.08334658	-5.01514	0.000
$AVol_i\{1\}$	-0.03084664	0.05789086	-0.53284	0.594
$AS_sent\{1\}$	0.07550491	0.02890841	2.61187	0.009
μ_{AS_sent}	0.08932383	0.01289389	6.92761	0.000
$R_i\{1\}$	-12.83322507	1.14355392	-11.22223	0.000
$AVol_i\{1\}$	0.05303872	0.08811701	0.60191	0.547
$AL_sent\{1\}$	-0.00918758	0.03399685	-0.27025	0.786
c_{11}	0.01178397	0.00069129	17.04644	0.000
c_{21}	0.02149176	0.01392456	1.54344	0.122
c_{22}	0.17804962	0.00730623	24.36957	0.000
c_{31}	-0.05235129	0.01436645	-3.64400	0.000
c_{32}	0.15487170	0.01136423	13.62800	0.000
c_{33}	0.00002983	0.01407338	0.00212	0.998
c_{41}	-0.26518564	0.01906281	-13.91115	0.000
c_{42}	0.07510377	0.01792891	4.18898	0.000
c_{43}	0.00001678	0.01633091	0.00103	0.999
c_{44}	0.00000563	0.01375785	4.09313e-004	0.999
α_{11}	0.69119804	0.07058109	9.79296	0.000
α_{12}	3.66913087	0.84547511	4.33973	0.000
α_{13}	-4.66018553	1.22539897	-3.80299	0.000
α_{14}	-15.84904623	1.79723443	-8.81857	0.000
α_{21}	0.02465036	0.00384415	6.41243	0.000
α_{22}	-0.15949765	0.05112081	-3.12001	0.001
α_{23}	-0.61222330	0.06352979	-9.63679	0.000
α_{24}	-0.79797880	0.10124171	-7.88192	0.000
α_{31}	0.00211039	0.00231903	0.91003	0.362
α_{32}	0.35555798	0.03362100	10.57547	0.000
α_{33}	0.70718162	0.04383568	16.13256	0.000
α_{34}	0.49326076	0.06513542	7.57285	0.000
α_{41}	-0.00198764	0.00185142	-1.07357	0.283
α_{42}	-0.16821514	0.02784418	-6.04130	0.000
α_{43}	-0.39726140	0.03521656	-11.28053	0.000
α_{44}	-0.30231137	0.04884017	-6.18981	0.000
β_{11}	0.40494406	0.11230546	3.60574	0.000
β_{12}	0.10342677	1.13737058	0.09093	0.927
β_{13}	6.88349429	1.23779963	5.56107	0.000
β_{14}	12.68898031	2.24185956	5.66002	0.000
β_{21}	-0.01042728	0.00953905	-1.09312	0.274
β_{22}	0.32360023	0.11384797	2.84239	0.004
β_{23}	-0.40440739	0.10407616	-3.88569	0.000
β_{24}	0.16109050	0.21272373	0.75728	0.448
β_{31}	-0.00574990	0.00163999	-3.50606	0.000
β_{32}	-0.13810859	0.03022030	-4.57006	0.000
β_{33}	0.76220086	0.02891354	26.36138	0.000
β_{34}	-0.18770798	0.03576986	-5.24766	0.000

β_{41}	0.00853036	0.00132847	6.42119	0.000
β_{42}	0.03235920	0.02985749	1.08379	0.278
β_{43}	0.12301453	0.02885566	4.26310	0.000
β_{44}	0.91155474	0.03750820	24.30281	0.000
Shape	0.28362396	0.00946325	29.97110	0.000

From the perspective of the mean equation of returns, abnormal trading volume is not significant at the 10% significance level, which illustrates that the abnormal trading volume can't explain the returns. The regression coefficient of abnormal sentiment of long investor passes the significant test, which illustrates abnormal sentiment of long investor has an impact on the returns, The regression coefficient is negative, that is to say, the bullish expectation of investors based on network forum is not realized, the market will fall instead, It can be explained that in such a Chinese market lack of short system, there are game between individual investors and institutional investors, individual investors are often misleading by information asymmetry, cognitive bias and herd behavior, so that they are in the inferior position in the stock market. The regression coefficient of abnormal sentiment of short investor does not pass the significant test, which illustrates abnormal sentiment of short investor based on network forum has no impact on the returns, that is to say, the negative sentiment of investors on the forum can not affect the stock price.

From the perspective of the mean equation of abnormal trading volume, the parameter estimations of returns, abnormal sentiment of long investor and abnormal sentiment of short investor pass the significant test at 1 percent. The coefficient of return is positive, which indicates the returns have an positive impact on the abnormal trading volume. So the price rising in the market early can make investors to participate in the stock market actively, while a falling market make investors to have a cautious attitude. The positive abnormal sentiment of long investor indicates the abnormal sentiment of long investor early have a positive impact on the abnormal trading volume, that is to say, an optimistic sentiment expression will make investors to increase the demand for the stock. The negative abnormal sentiment of short investor indicates the abnormal sentiment of short investor early have a reverse impact on the abnormal trading volume.

From the perspective of the mean equation of abnormal sentiment of long investor, the parameter estimations of return is significant at 1 percent, but the abnormal trading volume is not significant, which indicate the ups and downs in the market will have an impact on the investors' sentiment, the abnormal trading volume information does not. All the regression coefficients are negative, indicating that the market rising will weaken sentiment's optimism, but also will reduce more pessimistic emotion expression. It can be explained that the market rise likely make investors to shift their focus, investors will participate in discussion such as fundamental or other information. From the perspective of the mean equation of abnormal sentiment of short investor, the parameter estimations of return is significant negative at 1 percent. the market decline will make investor to express more pessimistic sentiment. It can be explained when the market is falling, investors can not find the real reason that market is down, then their discussions contain the abuse, sadness sentiment and so on. The parameter estimation of abnormal sentiment of short investor is significant positive at 1 percent, while the long investor sentiment does not pass significance test.

From the perspective of the variance equation, the coefficient of β_{11} , β_{31} , β_{41} is significant at 1 percent, and β_{21} is not significant at 10 percent, which indicate the return volatility is not only influenced by itself early fluctuations, but also influenced by abnormal investor sentiment fluctuation fluctuation. $\beta_{31} < 0$, it means abnormal sentiment volatility of long investor will have an reverse impact on the return volatility, $\beta_{41} > 0$, it means abnormal sentiment volatility of short investor will have an positive impact on the return volatility. That is to say, abnormal sentiment volatility of long investor can reduce the market fluctuations efficiently, and abnormal sentiment volatility of short investor can increase the market fluctuations efficiently. So abnormal sentiment of short investor based on forum is a factor that influence market risk. $\beta_{13} > 0$, $\beta_{14} > 0$, It means the return volatility has a positive impact on the abnormal investor sentiment volatility, the change of return is an influence factor that make investors sentiment to change. $\beta_{13} > \beta_{14}$, which indicates the

market volatility have more intense impact on the abnormal sentiment volatility of short investor than long investor.

Conclusion

This paper makes a text analysis with the posing on Eastmoney forum bar about SSE Composite Index, establishing a set of keyword dictionary to measure sentiment of long and short investor effectively, then we investigate the effect that the abnormal sentiment volatility of investors have on the market through a Multivariable BEKK-GARCH model of abnormal long and short investors sentiment, returns and abnormal trading volume. The main conclusions are as follows:

(1) The abnormal sentiment of long investor based on forum have a negative impact on the returns and a positive impact on abnormal trading volume; The abnormal sentiment of short investor have a negative impact on abnormal trading volume and no impact on the returns. The returns have a negative influence on the abnormal sentiment of long and short investors, while the abnormal trading volume have no influence on the abnormal sentiment of long and short investors.

(2) The abnormal sentiment volatility of long investor based on forum have a negative impact on the volatility of returns and abnormal trading volume; The abnormal sentiment volatility of short investor based on forum have a positive impact on the volatility of returns and no impact on the volatility of abnormal trading volume. The volatility of returns have a positive impact on the abnormal sentiment volatility of long and short investor, while the volatility of abnormal trading volume have a negative impact on the abnormal sentiment volatility of long investor and no impact on the abnormal sentiment volatility of short investor.

The empirical results show that the expression of investor sentiment on the forum can influence the stock market further. With the rapid development of the network, the influence will become deeper and deeper. As a developing country, the development of financial markets is not mature enough relative to the developed countries, and the system risk is relatively high, so this research is very important. From the point of risk supervision, the results of this paper can provide a new perspective of supervision to the regulators, provide supervision basis for regulatory the information dissemination of network media. It is significant to the supervision of network media, financial market stability and the healthy development of the capital market. About the practical significance of the research, It can provide decision-making basis and an effective research method to the institutional and individual investors.

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