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Original Paper

Media Information, Investor Attention, Stock Price Changes and Liquidity: An Empirical Analysis Based on the Technology Enterprise Search Index

Yinchun Xu[1] & Anyiran Zhang[1*]

[1] Silc Business School, Shanghai University, Shanghai, China

[*] Anyiran Zhang, Silc Business School, Shanghai University, Shanghai, China

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Abstract

With the development of Internet media, the information asymmetry between listed companies and individual investors has been greatly improved. However, the impact of information on the stock market is relatively complex, and that is different on disparate industries. This paper takes the stock data of science and technology enterprise BOE as a sample. Firstly, use text mining to measure media information and investor attention, and then construct multivariate regression model by adjusting the non-linear and heteroscedasticity to analyze correlation between media information, investor attention and stock price changes as well as stock liquidity. Also, breakpoint regression model is made. Finally, the influence mode is obtained, and combined with the actual situation, the relevant suggestions are put forward.

Keywords

media information, investor attention, stock prices, technology companies

1. Introduction

1.1 Background

The continuous development of mobile Internet and social media has widened the information channels of investors and improved the convenience of information access, and their research value is becoming increasing prominent. The news on social media has a certain guiding effect on the focus of investor attention, and some irrational investment decisions from the limited attention are likely to affect the company's stock price (Han, Lv, & Yin , 2017) (Note 1). On the other hand, if investors are willing to invest in listed companies, they tend to pay more attention to these companies, search for relevant

information on the Internet, and sort out the information as the basis for decision-making (Song & Peng, 2019) (Note 2). In addition, the price pressure hypothesis proposed by Barber and Odean (2008) (Note 3) emphasizes that individual investors will purchase familiar stocks based on the limited available information, which also shows the influence of investor attention and media information on stocks.

As the main body of high-tech development, science and technology enterprises have been a hot spot in Chinese capital market in recent years, and their growth has been closed concerned. However, there are few researches on investor attention, market value and liquidity. Therefore, this paper focuses on the impact of media information and investor attention on stock price changes and liquidity, and conducts multivariate regression with the stock data of BOE (000725) in 2019. The empirical results show that there is a significant positive correlation between investor attention and the change of stock price, while the correlation between media information and stock price change is small. However, two indexes are positively correlated with stock liquidity, but the mutual term is negative significant.

1.2 Literature Review

Internet media are the main information source for individual investors and have an important impact on their decision-making. The propaganda of the news media reduces the asymmetric information and greatly increases the trading volume of the stock. However, the excessive dependence of investors on information results in the increase of stock volatility, which makes the effect of yield rate be not obvious (Liu & Xu, 2017). (Note 4) In addition, Wang, Shang, and Wang (2019) (Note 5) pointed out that the impact of media information on the stock market is different in different industries. The public opinion index is also relatively independent and is not affected by the number of news media reports.

However, the empirical and theoretical analysis conducted by other domestic and foreign scholars presented that the stock market is closely related to investor attention and media information. Merton (1987) (Note 6) first put forward the concept of investor attention, and he believed that the expansion of the relative size of investors will reduce the cost of capital and increase the market value of the company. Ding and Hou (2015) (Note 7) considered that that investors obtain the relevant information can improve the problem of information asymmetry, which is conducive to improving liquidity. Besides, Xu and Chen (2005) (Note 8) pointed out that even if some investors invest according to their attention, increasing the uncertainty of the market. The impact is mostly upward momentum, and the price will form an upward trend, thus affecting the trading activities of stock market. Yu and Zhang (2012) (Note 9) also acknowledged the upward force, but they believed that the instability of the force would eventually make the stock return to the corresponding market value.

For the quantitative indicators about investor attention, there are some differences in the current research. Based on the assumption that investors pay attention to public information passively, some studies choose advertising expenditure (Grullon, Kanatas, & Weston, 2004) (Note 10) and media reports (Fang & Peress, 2009) (Note 11) as indicators to explore their impact on stock liquidity and earnings. However, Da, Engelberg, and Gao (2011) (Note 12) believed that search is the confirmed degree of concern, and only when people intentionally search for relevant stocks can they show the

degree of concern. Therefore, they used search index as a quantitative index of investor attention.

In addition, the existing research concerning the impact of investor attention tends to start from the overall stock market, and the conclusions are not applicable to specific fields. Xu (2019) (Note 13) made an empirical analysis based on the data samples of 17 coal industry listed companies, and found that there is a significant positive correlation between the investor attention and the stock return and liquidity of coal listed companies. However, Chen (2019) (Note 14) thought that considering the influence of negative information is significantly greater than that of investors' attention, the stock price shows more dynamic fluctuations, thus affecting the trading volume.

To sum up, scholars have done more research on the impact of investor attention on the overall stock market, but relatively few in the field of science and technology, and there are some divergence in quantitative indicators. The main innovation of this paper is that the media information and investor attention are differentiated, selecting Baidu media index and search index as the quantitative indicator of media information and investor attention respectively. Besides, BOE, a science and technology enterprise, is taken as an example for research. This paper assumes that there is a positive correlation between media information and investor attention on the stock price and liquidity.

2. Method

2.1 Data Source and Sample Selection

Based on the above hypotheses, in order to further explore the relationship between media information, investor attention and stock price changes, liquidity, this paper uses econometric model and Stata software to conduct OLS regression analysis. The explanatory variables in this paper are the weekly price change index (ln pps) and liquidity rate (Vol). The explanatory variables are Baidu search index (ln ia) and information index (ln mi) of technology enterprises. The control variables are the release of financial statements (report), net assets per share (aps) , total market value (ta), and market return (mrr). The relevant information of BOE stock in 2019 is selected to construct cross-sectional data, and the original data are collected from WIND information financial database. Table 1 shows the variables, corresponding characters and meanings of the empirical analysis.

Table 1. Variable Description

Variables	Abbreviation	Remarks
Stock price	ln pps	Stock closing price per share in the corresponding week (RMB, logarithm)
Volume	vol	Number of transactions in a week (ten thousand)
Net assets per share	aps	The value of current corporate assets divided by the number of shares (RMB)
Gross Market Value	ta	Calculate the market value within a week based on quarterly

		data (100 million RMB)
Financial report	report	Dummy variable, the corresponding week contains the date of the financial report announcement is 1, otherwise it is 0
Market rate of return	mrr	Current market rate of return (Shenzhen Component Index, percentage)
Search index	ln ia	Enterprise's Baidu search index, logarithmic processed
Media Index	ln mi	Enterprise's Baidu Media Index, logarithmic

2.2 Variable Selection

2.2.1 Explained Variables

This paper takes the weekly price index and volatility as explanatory variables, in which the volatility is represented by the stock trading volume per week.

2.2.2 Explanatory Variables

The explanatory variables are information index and Baidu search index. Since Baidu is the largest Chinese information aggregation platform, this paper uses Baidu media index to measure the power degree of media information. As a record of investors' active access to information, search index has no direct connection with media information to a certain extent, so search index represents investor attention. Because there is no direct output path for these two indexes, they are processed by manual adjustments.

2.2.3 Control Variables

Referring to the research of Yang and Guo (2019), this paper considers the impact of the publication time of enterprise financial statements on investors' expectations, and selects other three factors that affect the fluctuation of enterprise stock price, including net assets per share, total market value and market rate of return.

2.2.4 Regression Model

The initial model is as follows:

$$\ln pps = \beta_0 + \beta_1 aps + \beta_2 ta + \beta_3 report + \beta_4 mrr + \beta_5 \ln ia + \beta_6 \ln mi + \varepsilon_1$$

$$vol = \gamma_0 + \gamma_1 aps + \gamma_2 ta + \gamma_3 report + \gamma_4 mrr + \gamma_5 \ln ia + \gamma_6 \ln mi + \varepsilon_2$$

3. Result

3.1 Descriptive Statistics

The descriptive statistical characteristics of the variables involved in the empirical part are shown in Table 2.

Table 2. Descriptive Statistics of Variables

Variables	Observations	Mean	Sd deviation	Min	Max
ln pps	50	1.298574	.1392675	.9516578	1.543298
vol	50	2876.01	1829.005	268.9	7803.56
aps	50	2.49145	.0073	2.47	4.68
ta	50	3182.721	102.15	3040.28	3404.12
report	50	.06	.2399	0	1
mrr	50	0.00734	.6914	-.0612	.0647
ln ia	50	8.5884	.4427	7.7571	10.0871
ln mi	50	12.46507	.6914	11.0151	13.6887

3.2 Regression Results

After confirming the regression conditions and exogenous assumptions, the influencing factors are analyzed by Stata. Firstly, the stock price is taken as the dependent variable, and the investor attention and media information are used as independent variables for regression (see column 2 of Table 3). Next, remove the hypothesis relation between media information and investor attention, and regress the stock price on investor attention separately (see column 3 of Table 3). Finally, regress stock trading volume on media information and investor attention (see column 5 of Table 3). In order to avoid the lag of the influence of information, this paper also regresses the stock price and trading volume with the index last week (see columns 4 and 6 of Table 3). In addition, considering the heteroscedasticity problem (see Figure 1), the regression results are robust (see Table 3).

Table 3. OLS Robust Regression Test Results

	The influence of variables on stock price			The influence of variables on trading volume	
	Pps (t)		Pps (t+1)	Vol (t)	Vol (t+1)
aps	*6.728801***	*6.517708***	*5.041597***	*123915.5***	*47671.29*
	(1.584477)	(1.589719)	(1.694494)	(38424.63)	(40911.12)
ta	.0008514***	.000887***	.0008926***	1.346377	6.772463**
	(.0001171)	(.0001149)	(.0001252)	(2.83892)	(3.02263)
report	.0451048	.0313139	.0284166	2071.209**	-356.6434
	(.0408836)	(.0398632)	(.0437223)	(991.4542)	(1055.612)
mrr	.4990557	.3821202	.541301	1909.369	-3387.583
	(.367555)	(.359758)	(.393076)	(8913.455)	(9490.253)
lnia	.1625143***	.1477666***	.1610303***	-241.5601	1081.371

	(.0303086)	(.0284173)	(.0324131)	(735.0045)	(782.5673)
lnmi	-.0234158		-.0208925	197.9077	460.0559
	(.0177189)		.0189492	(429.6944)	(457.5003)
_cons	-19.28599***	-19.03695***	-15.21947***	-310669***	-152333***
	(3.643671)	(3.669529)	(3.896668)	(88361.47)	94079.42
Obs.	50	50	50	50	50
Adj R-squared	0.7884	0.7848	0.7418	0.2785	0.1852

Standard errors are in parenthesis.

*** p<0.01, ** p<0.05, * p<0.1.

Source	SS	df	MS	Num
				F(2
Model	2.1593e+14	2	1.0797e+14	Pro
Residual	1.8945e+14	47	4.0309e+12	R-s
				Adj
Total	4.0538e+14	49	8.2732e+12	Roo

usq	Coef.	Std. Err.	t	P>|t|

Figure 1. Heteroscedasticity Test of Stock Price Regression

From the regression test results of BOE's stock price and liquidity, it is found that variable coefficients of the net assets per share, total assets and investor attention are significant at the confidence level of 99%. However, the media index is not significant. As for related index regression for date next week, the conclusion is still unchanged.

Furthermore, breakpoint regression model is used to analyze the effect of search index on stock price. The results of the two regression models based on current and lag data are shown in Table 4 and Table 5.

Table 4. Results of Current Regression Model

Variables	Coefficient	S.E	T-statistic	P value
lnia<=8.216628				
lnia	0.148181	0.038764	3.822666	0.0004
lnia>8.216628				

lnia	0.170496	0.036529	4.66746	0.0000
Non-Breaking Variables				
c	-23.36491	3.724267	-6.273693	0.0000
aps	7.831065	1.548365	5.057636	0.0000
ta	0.001305	0.000131	9.932242	0.0000
report	0.007739	0.035587	-0.217468	0.8289
mrr	0.001774	0.003227	0.549536	0.5855
R-squared=0.800802，Adj R-squared=0.772346				

Table 5. Results of Lag Regression Model

Variables	Coefficient	S.E	T-statistic	P value
Lnia (-1)<=8.216628				
Lnia (-1)	0.132652	0.045598	2.909137	0.0058
Lnia (-1)>8.216628				
Lnia (-1)	0.155696	0.043117	3.61104	0.0008
Non-Breaking Variables				
c	-22.8082	5.173422	-4.408727	0.0001
Aps (-1)	9.078848	2.328501	3.89901	0.0003
Ta (-1)	0.000261	0.000206	1.268122	0.2117
Report (-1)	0.041795	0.040262	1.038069	0.3052
Mrr (-1)	0.007771	0.003528	2.202723	0.0332
R-squared=0.789570, Adj R-squared=0.758776				

According to Table 4, the adjust goodness of fit is 77.2346%. As lnia = 8.216628 is a significant breakpoint, the data is divided into two segments. The impact of search index on current stock price is significant and positive. When search index is less than or equal to 8.216628, the coefficient is 0.148181, and when it is greater than 8.216628, the coefficient is 0.170496. The data of lag period in Table 5 shows that the adjust goodness of fit is 75.8776% and the impact is similar with the above. When search index is less than or equal to 8.216628, the coefficient is 0.132652 and when it is greater than 8.216628, the coefficient is 0.155696. Two breakpoints analysis shows that the higher search index will bring about the greater impact of the search index on both current and lag stock price. By comparing the regression analysis of the current period and the lag period, it is found that the coefficient of the search index in the current period is larger than that in the later period.

In the stock trading volume, the influence of both media information and investor attention is not significant. That is because of collinearity problem. After adding the cross term lnmi * lnia, the independent variables lnmi, lnia and the cross term are related to the stock liquidity at the significance

level of 1%. The stock liquidity correlation index regression in a week shows that the conclusion is still unchanged. At the same time, heteroscedasticity is also considered so that the following results are from robust regression (see Table 6, Figure 2). Next part will integrate the research hypothesis and analyze the internal relationship of potential influencing factors.

Table 6. OLS Robust Regression Test Results of Vole after Adjustment

	Vol（after adjustment)	Vol (t+1)
aps	82325.26**	9702.512
	36255.62	30357.11
ta	3.823445	9.03384***
	2.883845	2.675115
report	1694.394	-700.6476
	1220.903	672.7689
mrr	82.718123	24.21774
	65.27617	91.27304
lnia	41535.14***	39220.37***
	8522.442	9349.323
lnmi	27308.25***	25209.77***
	5367.367	6285.8
lnmi*lnia	-3198.724***	-2920.195***
	634.1179	742.2028
_cons	-568667.7***	-387866.5***
	86673.07	97353.07
Obs.	50	50
Adj R-squared	0.5723	0.4556

Standard errors are in parenthesis.

*** p<0.01, ** p<0.05, * p<0.1.

Source	SS	df	MS	Num
				F(2
Model	6.2106e+13	2	3.1053e+13	Pro
Residual	8.8424e+13	47	1.8814e+12	R-s
				Adj
Total	1.5053e+14	49	3.0720e+12	Roo

usq	Coef.	Std. Err.	t	P>|t|

Figure 2. Heteroscedasticity Test of Volume Regression

4. Discussion

4.1 Analysis for Stock Price

After controlling other variables affecting the stock price, we find that the coefficient of investor attention is always positive and maintains a strong significance level. With other conditions unchanged, for every 1% increase in the search index (investors' attention), BOE's stock price is expected to rise by 0.16% this week and about 0.10% next week, which remain unchanged after eliminating the influence of media information. That means increasing investor attention will lead to the increase of BOE's stock demand and the decrease of bid ask spread. Besides, small and medium-sized investors, who are the main body in the capital market, often make investment decisions after keyword search and information analysis while facing complex capital market environment. Therefore, the information reflected by the search index is highly related to the actual investment. That investor attention always has a strong correlation with the stock price for two weeks reflects investors pay more attention to the stock and raise the expectation of stock price means great recognition on business activities and profitability of enterprises, which will last for some time.

In addition, when the investor attention index reaches ln8.22, that is to say, after 3678 searches of the index, there will be a breakpoint on the impact on the stock price, which will increase the impact on the current stock price and the stock price in the lag period. The information dissemination has the scale benefit to the investors' decision-making. When the search index reaches 3678 times within a week, the information is more easily accepted by investors, and the enterprise unit publicity cost is reduced with the further expansion of profit margin. For smaller coefficient in a week, it is because the stock price of science and technology companies changes rapidly, so investors should consider the timeliness when using information. Due to the weakening of the timeliness of information, the impact of investor attention on the stock price gradually becomes smaller. Furthermore, we can predict that with the in-depth application of the Internet in the science and technology enterprises, the impact of investor attention on the stock price will be more obvious in the future.

However, there is relatively small correlation between media information and stock price, which may be due to its wide range but less targeted stock content in the process of searching information. In addition, the media information, as the main section outside the market, despite of strong timeliness, can not reflect the complete and actual business situation of enterprises. In particular, the characteristics of highly uncertain growth path of technology and science enterprises make it more difficult to judge the market value. Also, there exists deficiencies in the domestic capital market, and the information disclosure mechanism is relatively imperfect, bringing about incomplete rational results.

4.2 Analysis for Stock Liquidity

In terms of liquidity, we find that investor attention and media information have a significant impact on stock liquidity after solving the collinearity problem between investor attention and media information. The reason of strong correlation may be that the stock prices of science and technology enterprises such as BOE fluctuate greatly in 2019, and individual investors are relatively cautious and pay more close attention to media information when making investment decisions. In addition, BOE, as an emerging enterprise in the capital market, has a short history of development and is greatly affected by the external environment, which may be another reason for investor discretion.

As for significant role of media information and investor attention, it can be explained that with the increase of investor attention and media information, investors are disturbed by the noise and do what the others are doing to generate herding behavior (herding effect), which leads to the increase of stock liquidity. This effect lasts for a period of time and makes the liquidity expectation increase at the same time. The negative coefficient of interaction also shows that in GEM, too much media information and investor attention will have a negative impact on the trading volume. However, there might exist intraday adjustment problems effecting the reality and correctness in the calculation of volume.

4.3 Conclusion and Suggestions

Taking BOE as an example, this paper analyzes the relationship between media information, investor attention and stock price as well as stock liquidity, and verifies the significance of correlation by OLS regression. Meanwhile, combined with the basic operation situation and the external environment, the control variables of financial statements, net assets per share, total market value and market return are supplemented. The empirical results show that there is a strong positive correlation between investor attention and both recent and future stock price of science and technology enterprises. Secondly, using breakpoint regression model, it is found that 3678 times of search index are breakpoints in the analysis of current and lag data, and the effect of investor attention is lager when search times exceed breakpoint. Thirdly, investor attention and media information have positive and significant effects on stock liquidity, but the interaction term is negative significant. All in all, the conclusions are consistent with the previous hypothesis and supplemented.

In view of the small correlation between media information and the stock price of science and technology enterprises, we suggest that investors should carefully refer to the content related to the stock price in the media information, and choose the investment object rationally based on the current

overall investor attention. On the other hand, science and technology enterprises need to stimulate the market regularly, make effective use of the timeliness of information to increase income. They can also find a balance between the positive effects of scale effect and negative effect of excessive attention while using various publicity channels and increasing the attention of investors and media, so as to achieve higher market performance in the current and future with lower financing cost.

The future research can optimize the impact mechanism between investor attention and science and technology stock prices, establish more advantageous proxy variables of investor attention by using data mining technology and neural network. In terms of stock liquidity, the problem of adjusting the intraday market can be considered to make the measurement more accurate.

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