Noise Trading and Chinese Stock Market Volatility

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Abstract

There is noise trading in China's stock market. This paper studies the relationship between noise trading and volatility of Chinese stock market, taking Shanghai Stock Exchange 50 index stocks as samples. First by behavioral finance it explains the reasons of the existence of noise trading. And then based on the VAR model, using the monthly data of the Shanghai Stock Exchange 50 Index from January 2013 to March 2018, this paper constructs the noise trading sequence. Through the stationary test, impulse response analysis, variance decomposition and Granger causality analysis, the dynamic relationship between noise trading time series and stock market fluctuation series is studied. The empirical results show that noise trading has a significant impact on stock market volatility. The more noise traders there are, the more volatile the Chinese stock market is. Finally, this paper puts forward some suggestions for the steady and healthy development of Chinese stock market.

Keywords

Noise trading, Stock market volatility, VAR, Behavioral finance.

1. Introduction

The emergence and development of behavioral finance has certain inevitability, which provides a reasonable explanation for the anomalies in financial market. Behavioral finance assumes that there are irrational investors in the market. Because investors are irrational, there are noise transactions in the market, and investors are also exposed to noise trading risks. "Noise" in financial theory was first put forward by Black in 1986. Noise is the opposite of information and the transmission of information will be affected by various factors. Investors accept information asymmetry, and therefore make different judgments about stock value. They treat noise as information to produce noise trading.

In the efficient market hypothesis, Frideman and Fama propose that the influence of noise traders on the market is non-exist, and the irrational behavior of noise traders causes the market prices to deviate from basic value. But rational traders will use reverse arbitrage to bring prices back to their underlying value. De long Shleifer et al. (1990) point out in the DSSW model, noise traders can exist in financial market for a long time, and rational traders are reluctant to withdraw from the market in the face of the high risk of noise trading, thus bringing higher profits to noise traders. At the same time, noise traders often overreact or underreact to the information, which makes the fluctuation of asset price too big. Kyle (1989) finds that the equilibrium price of asset depends on the historical information of informed traders and the current information shock. Noise trading is directly proportional to the impact of information, higher price volatility thus follows. Yang Ji and Wu Yuetao (2003) believe that noise trading is a double-edged sword. On the one hand, noise traders realize the liquidity of hand-held securities and increase the activeness of market transactions. On the other hand, excessive noise trading has a negative impact on market efficiency. Shao Yun (2016) builds a regression model using stock amplitude as explained variable. The empirical results show that there is a positive

correlation between noise trading and market volatility in Chinese stock market, and when noise trading increases, the stock price deviates from its actual value.

Since its establishment 28 years ago, Chinese stock market has grown from a closed experimental field to an extremely important part of the market economy in terms of optimizing the allocation of resources. Since 1990-2017, the Shanghai Composite Index has had annual amplitude of more than 100 percent in the past eight times. It is worth noting that if the amplitude of Shanghai Composite Index is relatively small for several consecutive years, then the stock index will usher in a relatively large rise. For example, Chinese A-share market rose sharply in 2014-2015 after four consecutive years of sluggish stock index amplitude in 2010-2013. Overall, the index grew rapidly in the short term and then experienced violent fluctuations. Stock transaction is actually a process of price rediscovery. If prices are in line with market, stocks will return to their intrinsic value after moderate fluctuations. And if prices deviate from fundamentals, overshoot when rising, and overshoot when falling, the resulting stock index ups and downs are abnormal and harmful. Therefore, it is of great significance for the healthy development of financial market to control the risks caused by noise trading and stock market volatility.

2. Behavioral Financial Analysis of the Existence of Stock Noise Trading

2.1 Bounded Rational Individual Behavior

Overconfidence: Most people are overly optimistic about their knowledge, competence and their ability to anticipate the future. Investors tend to be blindly optimistic about their trading levels, and believe that their stock yields are at their highest. Continuing holding can no longer lead to higher returns, so they choose to sell confidently. Investors in bull markets tend to be more prone to overconfidence.

Disposal effects: People's intuitive evaluation of gains and losses depends on reference points, and the selection of reference points depends on previous empirical background. When making a profit, individual investors use the highest price during their shareholding period as a reference point because they are greedy, so that they will not profit when the stock price is higher. When loss occurs, individual investors use buying rate as a reference point due to fear, so they cannot stop losses and fall into long-term losses.

2.2 Bounded Rational Group Behavior

Herding behavior: Market participants do not rely on the information they have mined, but choose to imitate and follow the behavior of others completely. Investors mimic each other, buying when others buy and selling when others sell, which can amplify the impact of external stock price shock and create a price bubble. Herd behavior exists widely in Chinese securities market. Institutional investors make use of advantages of information and public opinion to attract individual investors to follow the trend and stimulate their enthusiasm of positive feedback behavior, and then use sleep-flock effect to manipulate the market.

2.3 Inefficient Market

Limited arbitrage: Behavioral finance believes that, under the restriction of practical conditions, there is no completely unlimited arbitrage in the market. When the price deviation of an asset occurs, it is risky and cost to design a strategy to correct the error, and the rational arbitrager has limited ability to eliminate the deviation of the asset price from value. There is a systematic overreaction in stock price. When the past price and yield have a predictive effect on the future, it will lead to the stock price reversal and price inertia.

3. The Empirical Analysis of the Relationship Between Noise Trading and Stock Market Volatility

3.1 Construction of Indicators

According to the theoretical models of De Long et al. (1990), there is under-reaction and over-reaction in noise trading, which causes the asset prices deviate from the fundamentals and increases the uncertainty of profits. As the proportion of noise traders increases, the expected returns of assets will increase, and the volatility of returns will also increase. Through above ideas, this paper removes the fundamental factors of stocks from the returns on assets, and measures the noise trading through the volatility of returns that are orthogonal to the fundamentals.

The data in this paper selects Shanghai Stock Exchange (SSE) 50 index and Shenzhen Component Index. The SSE 50 index is based on a scientific and objective method to select 50 most representative stocks with large scale and good liquidity in Shanghai securities market. It can be said that the SSE 50 index can reflect the overall situation of a group of high-quality enterprises with the most market influence and well reflects the comprehensive performance of China's securities market. The Shenzhen Component Index is an index of 40 stocks that are traded at Shenzhen Stock Exchange. The two indexes are very similar in terms of composition, sample size and so on. Therefore, it can be assumed that both have similar fundamental factors. The data of sample period is from January 2013 to March 2018 for a total of 63 months.

First, calculate the monthly returns of two indices according to the following formula.

$$R_{sh} = \frac{P_{sh,t} - P_{sh,t-1}}{P_{sh,t-1}} \tag{1}$$

$$R_{sz} = \frac{P_{sz,t} - P_{sz,t-1}}{P_{sz,t-1}} \tag{2}$$

R_{sh} and R_{sz} represent the monthly returns of the SSE 50 index and Shenzhen Composite Index respectively. P_{sh} and P_{sz} represent the closing index of the SSE 50 index and Shenzhen Composite Index respectively.

Then, based on the assumption that noise trading is independent of the fundamental factors, noise trading time sequence of the SSE 50 index is constructed by the following linear regression.

$$R_{sh,t} = \alpha + \beta R_{sz,t} + \varepsilon_{sh,t} \tag{3}$$

Where $\alpha + \beta r$ is the income related to fundamental factors and ε is the income independent of fundamental factors (or orthogonal to fundamental factors). The non-fundamental factors reflected in the residual part are the noise parts in the transaction. This paper uses the residual square to construct the noise sequence of the SSE 50 index.

$$e_{sh,t} = \frac{\varepsilon_{sh,t}^2}{100} \tag{4}$$

On the basis of Jones et al. (1994), this paper uses the relative change of the transaction price of stock indexes to measure the stock market volatility.

$$V_{sh,t} = \frac{P_{sh,t}^h - P_{sh,t}^l}{P_{sh,t}^l} \tag{5}$$

$V_{sh,t}$ denotes the volatility of SSE 50 index in the t period. $P_{sh,t}^h$ denotes the highest index in the t period, and $P_{sh,t}^l$ denotes the lowest index in the t period.

3.2 The Stationary Test of Noise Trading and Volatility of SSE 50 Index

First, we use Eviews to estimate the noise sequence. Taking R_{sh} as an explained variable and R_{sz} as an explanatory variable for OLS estimation, the regression result is as follows:

$$R_{sh,t} = 0.0039 + 0.0686 R_{sz,t} + \varepsilon_{sh,t} \tag{6}$$

(12.9602)

Second, the residual sequence generated by the regression equation is calculated according to equation (4), and the noise trading sequence is generated.

Finally, the noise trading time sequence and the volatility time sequence are tested by ADF to verify whether the two sets of data are stable.

Table 1. ADF test results

noise trading sequence		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.875306	0.0000
Test critical values:	1% level	-4.113017	
	5% level	-3.483970	
	10% level	-3.170071	
volatility sequence		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.245839	0.0003
Test critical values:	1% level	-4.113017	
	5% level	-3.483970	
	10% level	-3.170071	

The unit root results show that the ADF statistics in the two tables are less than the critical values of three different test levels, so we reject the original assumption of non-stationary. Therefore the SSE 50 index noise trading sequence and stock volatility sequence are stationary series.

3.3 The Correlation Test Between Noise Trading and Volatility of SSE 50 Index

The Pearson correlation coefficient method is used to test the correlation between noise trading and stock market volatility. The coefficient ranges from -1 to 1. 0 means no correlation, negative value means negative correlation, and positive value means positive correlation.

Table 2. Pearson correlation test

		e_{sh}	V_{sh}
e_{sh}	Pearson Correlation	1	0.341^{**}
	Sig.(2-tailed)		0.006
	N	63	63
V_{sh}	Pearson Correlation	0.341^{**}	1
	Sig.(2-tailed)	0.006	
	N	63	63

**. Significant correlation on 0.01 level (Two-tailed).

In the Pearson correlation test, the relationship between the two variables reaches 1% significance level. The statistical result shows that there is an obvious internal positive relationship between the noise series and the stock market volatility series.

3.4 Establishment of VAR Model

According to the analysis above, it can be concluded that both noise trading sequence and volatility time sequence are stationary, so we can establish the VAR model and describe the dynamic interaction between the two variables. In order to estimate VAR, the order of VAR model should be determined according to the information criterion. In this paper, the optimal delay order is 3, so the VAR (3) model is established and regressed.

$$e_{sh} = a_{10} + b_{11}e_{sh,t-1} + b_{12}e_{sh,t-2} + b_{13}e_{sh,t-3} + c_{11}V_{sh,t-1} + c_{12}V_{sh,t-2} + c_{13}V_{sh,t-3} + e_{1t} \quad (7)$$

$$V_{sh} = a_{20} + b_{21}e_{sh,t-1} + b_{22}e_{sh,t-2} + b_{23}e_{sh,t-3} + c_{21}V_{sh,t-1} + c_{22}V_{sh,t-2} + c_{23}V_{sh,t-3} + e_{2t} \quad (8)$$

Among them, e_{sh} is noise trading sequence and V_{sh} is stock market fluctuation sequence. e_{1t} and e_{2t} are structural shocks acting on the relevant variables, respectively.

3.4.1 Stationary Test of VAR Model

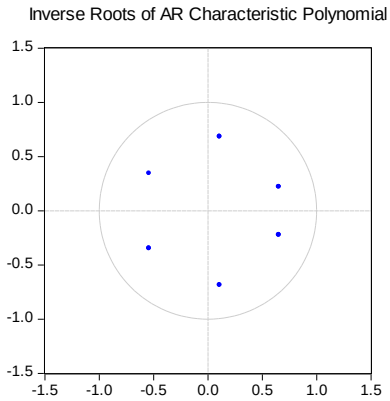

Fig 1. AR root diagram

The AR root diagram shows that all eigenvalues fall within the unit circle, so the VAR (3) model is stable and can be used for impulse response analysis and variance decomposition analysis.

3.4.2 Impulse Response Analysis

The coefficients of the regression equation in VAR model reflect a local dynamic relation, which cannot capture the comprehensive complex interaction process. The impulse response function can reflect the dynamic influence path among the variables more comprehensively. Results of our runs are summarized in Figure 2, where the horizontal axis represents the number of lag periods of the impact action, and the vertical axis represents the impulse response function value.

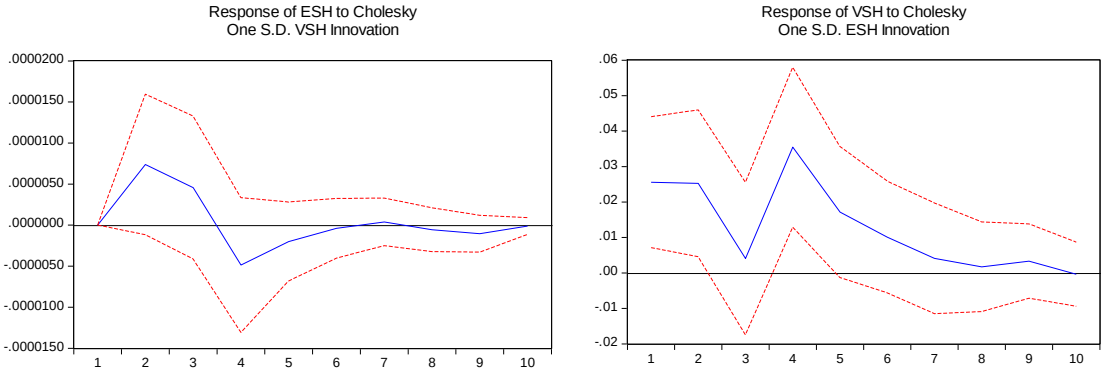

Fig 2. Impulse response function

When the stock market volatility has a positive impact on noise trading, noise trading is first positively fluctuating, reaching the maximum value in the second period. The third period begins to negatively fluctuate until the fourth period reaches its extreme value, then the influence weakens and gradually tends to the steady development trend. This indicates that the market responds to the noise after a certain period of time, making the price return to value gradually. Rational arbitrageurs make the price return to market value. With the increase of the number of noise traders, the influence of market fluctuation on noise trading is reduced.

After noise trading impacts on the stock market volatility, the fluctuation of stock price changes with the level of noise trading, and the impact intensity of the variables stabilizes after 6-7 periods, which reflects that the market has reached a consensus on the impact of the news, and the variables keep moving in the same direction. This should also confirm the conclusion of Shao Yun (2013) from the empirical test, which shows that noise trading has a significant impact on the volatility of the stock market.

3.4.3 Variance Decomposition

Variance decomposition can further evaluate the contribution of noise trading and stock market volatility to the prediction variance.

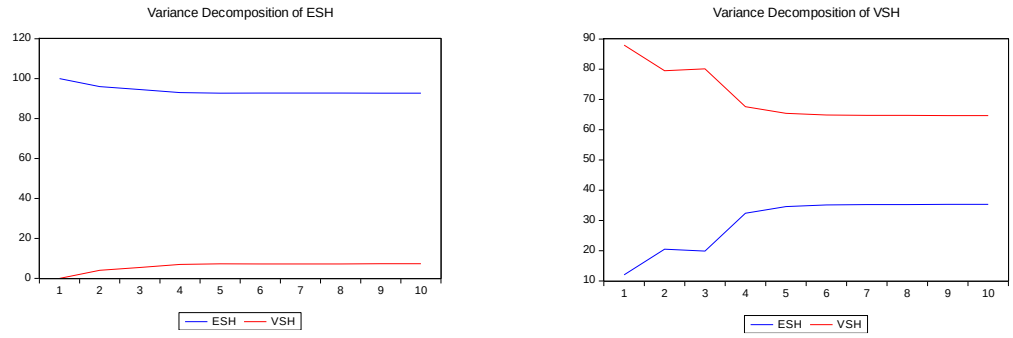

Fig 3. Variance decomposition diagram

Figure 3 shows the contribution of two variables to the variance of one of the variables, where the self-variable contributes most to its own variance and is located at the top. In the left, stock market volatility has a very weak effect on noise trading, so it may not cause the noise trading change. In the right, noise trading contributes significantly to the variance of stock market volatility, and the change of noise trading will significantly affect stock market volatility.

3.5 Granger Causality Test

In order to verify the conclusion of variance decomposition in the previous section, the Granger causality test is used to analyze whether there is a causal relationship between variables and the direction of influence. In this paper, the variable data used in the analysis is stable, and the AIC information criterion and SC information criterion are used to determine the lag order.

Table 3. Results of Granger test

Null Hypothesis	F-Statistic	P value	Conclusions
e_{sh} does not Granger Cause V_{sh}	2.60573	0.0368	Reject null hypothesis
V_{sh} does not Granger Cause e_{sh}	1.65720	0.1636	Accept null hypothesis

Note: when P < 0.05, the null hypothesis is rejected.

Using Granger causality test, Lu Yang (2009) finds that the mutual causality between noise trading and Chinese stock market volatility. The results in this paper are different and show that, at the confidence level of 95%, the noise trading in the sample interval is the Granger cause of the stock market volatility, while the stock market volatility is not the Granger cause of the noise trading, and there is a one-way causal relationship between the two.

4. Conclusions and Policy Recommendations

4.1 Conclusions

This paper studies the relationship between noise trading and stock market volatility. The empirical results show that there is a large amount of noise in China's stock market, and noise trading further affects the volatility of stock market. The positive correlation between the two indicates: the more noise traders there are, the more volatile the Chinese stock market is. Noise trading in Chinese stock market has strong externality, but whether the fluctuation of stock market is the source of noise trading is not found in this paper, which is also a controversial part of domestic research. Therefore, in order to make China's stock market steady and healthy development, we need to take measures to control noise.

4.2 Policy Recommendations

Carry out effective investor education and advocate correct values and investment ideas. Investors themselves have psychological weakness and cognitive biases, which infringe their investment rights in the securities market. In the case of information and capital being at a disadvantage, they can resist market risks only by constantly accepting learning and improving their own quality and practical ability. At the same time, in order to avoid blindly creating more noise risks for the market, investors

should broaden their horizons, reduce dependence on the stock market, and create a better life with diligence and wisdom.

Standardize the information disclosure system and establish a new financial hedging mechanism. Investors' rationality is limited. In order to avoid interest groups using information to manipulate the market, managers of the securities market should improve the transparency and quality of information disclosure when formulating and disclosing relevant information, so as to arouse the positive reactions of investors. At the same time, create a broader free market for investors, develop new financial securities products, and prevent the occurrence of financial risks.

Give full play to self-regulatory function of market and establish self-recovery mechanism of securities market. China's stock market has also been called the "policy market", the government's policy signal on macroeconomic regulatory intentions will have an impact on the fundamentals of stock market. Investments' behavior is too much affected by the policy. When the group behavior deviates, the proper and reasonable adjustments of government are necessary. However, the intensity of intervention must not be too large, so that the "invisible hand" of market can return to rational according to economic rules, and gradually establish the self-recovery mechanism for securities market.

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