

The Evidence of Institutional Investors' Herd Behavior and the Research on Market Simulation

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Abstract: In the context of vigorously developing China's securities market institutional investors in the period of economic transition , this paper does the empirical research on the herd behavior from the view of the interaction between individual and institutional investors. This paper adopts the standard deviation of trading volume the cross-section to measure herd behavior. The results show that no matter what the market is in bull status and bear status , institutional investors perform herd behavior and with the expansion of the shareholding scale in a bull market , the herd behavior is higher , which suggests that the vigorous development of institutional investors has not eliminated herd behavior. This paper further confirms that there is the endogenous volatility in the market based on an artificial stock market. Finally it is demonstrated the herd behavior of institutional investors cause abnormal fluctuations in the market.

Key words: herd behavior; volatility; institutional investors

1 Introduction

Currently , China social economy is in a transitional period. China stock market is in a special period which is different from the markets of developed countries. With the implementation of the split share structure reform , the more and more large state-owned enterprises are to be listed. Non-standard companies are forced to restructure or phase out from the market as the strengthening of supervision. At the same time , the structure of the investors has changed a lot. Insurance funds gain access to the market , the joint venture fund , QFII , quality brokerage have become mainstream institutional investors and are gradually nurtured. And the institutionalization of investors has become the development trend of China's securities market. Since the establishment of it China open-end fund in 2001 , the only open-end fund net asset value , 2008 has accounted for 42.02% of the market capitalization in 2008^[1]. The rapid increase of institutional investors has made institutional investors in the stock market into practitioners and theorists. The

herd behavior of institutional investors and the interaction between individual investors and institutional investors were researched to discover whether institutional investors on China's stock market played a stabilizing roller or not.

Herd behavior is a special kind of irrational behavior. Lakonishok , Shleifer and Vishny^[2] defined herd behavior as some investors at the same time adopt the same strategy to buy or sell the same stock along with other investors. While Avery and Zemsky^[3] defined herd behavior as market trends making the investor with private information contrary to it choose to follow it.

In recent years , domestic scholars tend to discuss the presence or absence of herd behavior in the securities market , as well as the herd behavior's reasons and the correlation between institutional investors and market stability.

Song J and Wu C F^[4] used the stocks gains dispersity indicators to confirm herd behavior phenomenon exists in China's stock market and measure the herd behavior of China's securities market , concluding that the herd behavior in China is more serious than the Unit-

Received 08 January 2013

This paper is supported by the National Nature Science Foundation under Grant No. 71201124

ed States market. Sun P Y , and Shi D H^[5] further examined the herd behavior of China's securities market based on the improved model and got the conclusion that exists a certain degree herd behavior in the situation of frequent policy interventions and asymmetry information. Liu C Y , Hu F and Wang H^[6] chose QFII as research object to examine the herd behavior in the context of split share reform , and to verify a high degree of herd behavior exists in the small and medium-sized stocks. Most of the previous studies are around the existence and cause of the herd behavior , and the study object is the entire market or pure research institutional investors such as fund , but in recent years , the study focused on the differences of herd behavior between individual investors and institutional investors. Chen G J and Tao K^[1] used the cross-section of trading volume standard deviation to study the difference of herd behavior between institutional investors and individual investors. The results show that the herd behavior of institutional investors take full advantage of information , while individual investors' herd behavior has much more irrational factors. However , there is little research on irrational behavior conduction mechanism of the herd behavior.

Above all , this paper will conduct empirical studies on herd behavior in the situation of the interaction between individual and institutional investors , and further introduce calculate finance research methods , to explore the sources of market volatility by using a simulation model. Finally , confirmed herd behavior of institutional investors accounting for a major stake corrects the abnormal fluctuations in the market.

2 An empirical research on the herd behavior

2.1 Sample and data selection

Shanghai A-share market from January 1 , 2005 to September 30 , 2010 was selected as the research object in this paper , including 719 stocks , clear of incomplete data during the sample period. Data frequency is counted by date. The basic data are from

RESSET (www. resset. cn) and CCER (Chinese stock market price and return database) . The institutional investors and individual investors are divided by shareholders' nature. This paper argues that other types of companies , besides the fund brokerages and other institutions , which hold large amounts , possess specialized financial to make investment decisions , executive have the specialization of institutional investor's characteristics , so they also can be deem as institutional investors. Therefore , in this paper , institutional investors include funds , securities firms , brokerage financial products , QFII , insurance companies , social security funds , enterprise annuity , trust companies and other companies. The individual investor is a natural person. This paper selected data samples covering the period of financial crisis at the end of 2007 , including the whole market cycle , and the non-tradable share reform with the far-reaching influence also be covered in. In the previous study , mostly studies choose stock investment funds as institutional investors 'replace variable and the main reason is that completed top view data service has been stopped on January 1 , 2009 to offer all the data of institutional investors. Therefore the data are difficult to obtain , many scholars use the securities investment funds as institutional investors represented. But this paper defines institutional investors as generalized institutional investors. So , data are more complete and representative comparing with the one obtained by any previous studies.

The stock sample selection is based on the following principles: select listed companies prior to January 1 , 2005; eliminate stocks with insufficiency monthly data.

2.2 The measurement of herd behavior

This paper uses the method of Li , Rhee and Wang^[7] (the standard deviation of trading volume the cross-section) to measure herd behavior

$$\sigma_{i,t} = \sqrt{\frac{\sum_{j=1}^N [Vol_{i,j,t} - \mu(Vol)_{i,t}]^2}{N-1}} \quad (1)$$

Where $\sigma_{i,t}$ represents the standard deviation of cross-

sectional trading volume of investor group i (institutional investors, individual investors) at t ; $Vol_{i,j}$ represents the trading volume of j stock which is traded by investor group i at t ; $\mu(Vol)_i$ stands for the cross-sectional average trading volume of investors i group at t .

The sample period is divided into three stages: bull market from January 1, 2005 to September 30, 2007

bear market from October 1, 2007 to December 31, 2008; and total stock from January 1st, 2005 to September 30, 2010 is the total stock stage. Then, this paper separately provides descriptive statistics for each of these three stages of the stock market. All chose stocks are divided into five groups for statistics in the order of average daily flow of the market value. The basic statistics of each stage are as follows:

Table 1 Shanghai a shares basic statistics in a bull phase

| Portfolio | Closing price /Yuan | Turnover rate | Turnover | Tradable market cap | Flow of equity | Average revenue |
|-----------|---------------------|---------------|-----------|---------------------|----------------|-----------------|
| 1 | 6.029 252 | 0.032 46 | 1 849 427 | 308 649 337 | 53 824 104 | 0.001 365 |
| 2 | 6.385 463 | 0.031 219 | 3041019 | 546 300 743 | 89 198 320 | 0.001 379 |
| 3 | 7.316 919 | 0.031 229 | 4 494 476 | 842 153 608 | 128 358 782 | 0.001 483 |
| 4 | 8.879 821 | 0.027 252 | 5 294 071 | 1 331 498 967 | 171 286 506 | 0.001 724 6 |
| 5 | 12.48 318 | 0.024 319 | 9 744 373 | 3 833 970 561 | 382 422 537 | 0.002 05 |
| Total | 8.218 927 | 0.029 296 | 4 884 673 | 1 372 514 643 | 165 018 049 | 0.001 6 |

Table 2 Shanghai a shares basic statistics in a bear phase

| Portfolio | Closing price /Yuan | Turnover rate | Turnover | Tradable market cap | Flow of equity | Average revenue |
|-----------|---------------------|---------------|-----------|---------------------|----------------|-----------------|
| 1 | 8.263 918 | 0.025 996 3 | 2 169 956 | 626 468 155 | 81 093 430.23 | -0.002 98 |
| 2 | 9.098 084 | 0.027 44 | 4 020 663 | 1 169 659 755 | 146 492 569 | -0.003 29 |
| 3 | 10.651 91 | 0.024 852 | 5 151 497 | 1 791 276 556 | 206 048 324.4 | -0.003 24 |
| 4 | 13.594 98 | 0.022 47 | 6 219 994 | 2 982 895 982 | 272 240 506.2 | -0.003 58 |
| 5 | 22.814 99 | 0.018 813 | 9 918 912 | 9 327 030 669 | 579 702 284.8 | -0.004 03 |
| Total | 12.884 78 | 0.023 914 | 5 496 204 | 3 179 466 223 | 12.884 78 | -0.003 42 |

Table 3 Shanghai a shares descriptive statistics in the whole sample period

| Portfolio | Closing price /Yuan | Turnover rate | Turnover | Tradable market cap | Flow of equity | Average revenue |
|-----------|---------------------|---------------|------------|---------------------|----------------|-----------------|
| 1 | 7.696 842 | 0.0343 37 | 2 908 997 | 638 271 136 | 85 128 199 | 0.000 592 |
| 2 | 8.242 81 | 0.037 792 | 4 904 461 | 1 113 653 551 | 145 816 626 | 0.000 52 |
| 3 | 9.312 432 | 0.030 851 | 6 068 045 | 1 661 757 412 | 197 443 314.4 | 0.000 567 |
| 4 | 10.782 85 | 0.028 128 | 7 913 949 | 2 590 680 652 | 281 424 489.7 | 0.000 470 8 |
| 5 | 16.354 15 | 0.023 257 | 12 096 628 | 7 742 414 441 | 608 266 022.3 | 0.000 515 |
| Total | 10.477 82 | 0.030 873 | 6 778 416 | 2 777 133 235 | 263 615 730 | 0.000 532 9 |

Table 4 The proportion of investors in Shanghai stock market

| Proportion | Bull market | | Bear market | | The whole period | |
|-------------|------------------------|---------------------|------------------------|---------------------|------------------------|---------------------|
| | Institutional investor | Individual investor | Institutional investor | Individual investor | Institutional investor | Individual investor |
| Portfolio 1 | 0.705 747 | 0.294 253 | 0.892 032 | 0.107 968 | 0.846 664 | 0.153 336 |
| Portfolio 2 | 0.812 925 | 0.187 075 | 0.904 304 | 0.095 696 | 0.896 871 | 0.103 129 |
| Portfolio 3 | 0.856 418 | 0.143 582 | 0.928 875 | 0.071 125 | 0.915 249 | 0.084 751 |
| Portfolio 4 | 0.945 485 | 0.054 515 | 0.918 384 | 0.081 616 | 0.923 918 | 0.076 082 |
| Portfolio 5 | 0.911 682 | 0.114 536 | 0.953 164 | 0.046 836 | 0.965 84 | 0.034 16 |
| Total | 0.846 451 | 0.158 792 | 0.919 352 | 0.080 648 | 0.909 708 | 0.090 292 |

It can be seen in Table 1, in bull market, with the increasing scale, the closing price of the market, trading volume, and the average revenue all increased, while the turnover decreased gradually, corresponding to Table 4, it presents that the proportion of institutional investors increases, shareholding increased, and the stake of individual investors reduced; It can be drawn through the Table 2 as the scale increasing, the closing price and trading volume increased, compared with the reducing turnover and lowering average yield. In the same corresponding situation, the stake of institutional investors was still increasing and the stake of individual investors continued to reduce. In Table 3, in the entire sample period, with the expansion of the scale, the closing price and trading volume increased while turnover increased firstly and then decreased, the trend of average in-

come was just opposite with the trend of turnover. The corresponding institutional investors held the increasing proportion of shareholdings and the proportion of individual investors declined. Therefore, it can be concluded that, no matter the market is at a bull or bear, with the expansion of the scale, the proportion of institutional investors goes up, and institutional investors is biased in favor of the low turnover of stocks and the average yield presented anti anisotropy in the bull or bear market.

2.3 The empirical results

This section does the empirical research on herd behavior, which is produced by institutional investors' interaction indifferent market environments and the results are shown in Table 5.

Table 5 The standard deviation statistics of cross-section trading volume

| | Bull market | Bear market | The whole period |
|-------------|-------------|-------------|------------------|
| Portfolio 1 | 17.028 24 | 17.301 25 | 19.649 42 |
| Portfolio 2 | 17.238 31 | 17.924 26 | 20.130 86 |
| Portfolio 3 | 18.171 54 | 18.229 49 | 20.338 32 |
| Portfolio 4 | 18.024 73 | 18.583 67 | 20.722 78 |
| Portfolio 5 | 18.844 24 | 19.271 24 | 21.424 2 |
| Total | 17.861 41 | 18.261 98 | 20.453 12 |
| p | 0 | 0 | 0 |

As can be seen from Table 5 , regardless of the market situation , there are always herd behavior. With the expansion of the scale , the degree of herd behavior is weaker. Compared with the bear market , the bull market as a whole shows a relatively strong herd behavior. It can be concluded that there is a positive correlation between herd behavior and the market environment. When institutional investors hold the majority of shares , the herd behavior not only belong to the individual investors , the influence of institutional investors' herd behavior is even more serious.

3 The research on the correlation between herd behavior and market volatility based on experimental finance

This paper argues that institutional investors' trading behavior reflects the unique characteristics during the emerging and transitional period of China's securities market. The institutional investors do not completely analyze basic value , due to the occupational characteristics of the institutional investors , that is the investor pursues the best ratio of income-risk. On the other hand , owing to the existence of principal-agent , they pursued their own maximum interests , led to make irrational behavior. So the paper argues that the investors of China's stock market are divided into two categories: The first one , the relatively rational investors , viz , institutional investors , their wide range of information channels , and have hired someone who has access to information or the ability of information mining professionals; The second one is finite rational investors represented by individual investors who have less information or cannot take full advantage of information even if they have valuable information due to limited knowledge and capacity. They often rely on the trend of chart to make investment decision.

Assume that irrational behavior of investors leads to herd behavior and herd behavior exacerbates market volatility. This paper refers to the artificial stock model of Westerhoff^[8] to do the empirical study on the endogeneity of stock fluctuation and modify the model

according to the high turnover characteristics of the Chinese market. The model is modified as follows:

$$\lambda_t^Y = \begin{cases} 0.1 \frac{1}{5} \sum_{i=1}^5 |P_{t-i+1} - P_{t-i}| < 0.05 \text{ and } |P_t - P_{t-1}| < 0.1 \\ 0.2 & \text{else} \end{cases} \quad (2)$$

Then , time series of the Shanghai Composite Index (SHCI) was simulated by using Matlab 7.0 to verify whether the model is able to realistically simulate transaction status of the real-market. The number of samples is 1500 in every simulated time series. Figure 1 and Figure 2 respectively shows the time series and return series of Shanghai Composite Index from January 1 , 2005 to September 30 , 2010 , a total of 1396 observation points. Figure 3 and Figure 4 are the simulated time series based on the artificial stock market (ASM) .

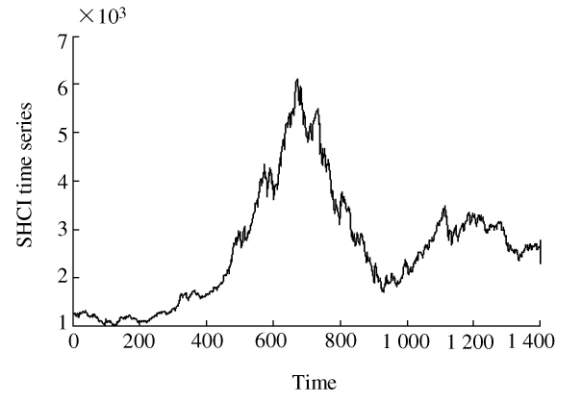


Figure 1 SHCI time series

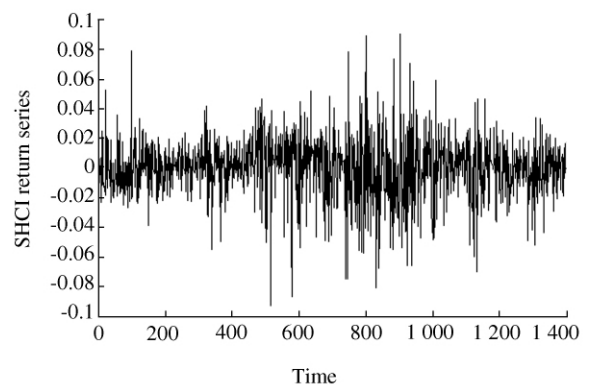


Figure 2 SHCI return series

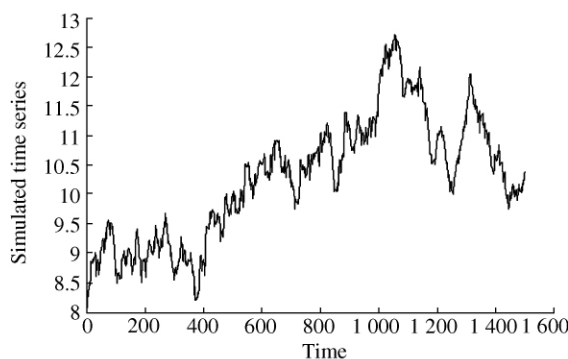


Figure 3 The simulated time series

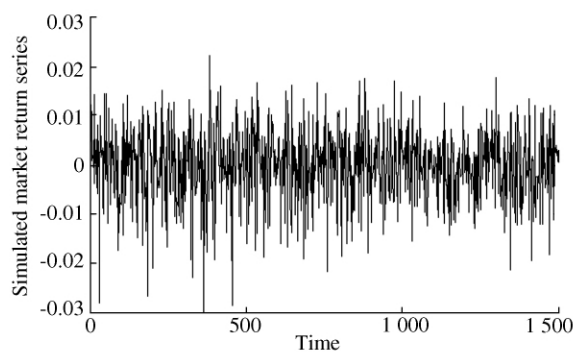


Figure 4 The simulated market return series

The model parameters are assumed to be as follows:

$$\lambda^m = 1 \quad \lambda^x = 1 \quad \alpha = 0.5 \quad \sigma_\varepsilon = 0.08$$

Initial value is given as:

$$P_0 = P_{f\rho} = 8.02$$

$$[P_1 \ P_2 \ P_3 \ P_4 \ P_5] =$$

$$[8.05 \ 8.08 \ 8.14 \ 8.24 \ 8.28]$$

Table 6 The yield descriptive statistical characteristics of Shanghai composite index and artificial stock market

| | Mean | Std. Dev. | Skewness | Kurtosis | Jarque-Bera | Probability |
|------|----------|-----------|------------|-----------|-------------|-------------|
| SCHI | 0.000 54 | 0.019 172 | -0.341 235 | 5.573 704 | 412.089 8 | 0.000 000 |
| ASM | 0.000 17 | 0.006 614 | -0.407 207 | 3.991 048 | 102.840 3 | 0.000 000 |

According to Table 6, it can be seen that the artificial stock market return series and the Shanghai composite index return series have similar statistical characteristics; Combining with Figures 1 ~ 4, the artificial stock return series show the same clustering volatility, peak and fat tail and yield autocorrelation characteristics. Under the particular framework of the research, the artificial stock market does not introduce external shocks, while it can produce the same market volatility characteristics, which indicates that the market itself owns fluctuations endogeneity. This endogeneity stems from the interaction between the traders' game. According to the income standard deviation of the two markets, the volatility of the real stock market is high. So, the research indicates that, in the real market, the herd behavior of institutional investors produces abnormal fluctuations in the market and undermines the stability of the stock market.

4 Conclusions and implications

Based on the definition of generalized institutional in-

vestors, this paper does the research on the existence of herd behavior of institutional investors and verifies the source of stock market volatility through artificial stock market. Through this research, the following conclusions are given:

1) According to the definition about generalized institutional investors, It was found that China now stands at the phenomenon of institutional investors dominated the market;

2) Herd behavior exists in China securities market when China is experiencing economic transition, and also in the context of generalized institutional investors accounting for a major stake, the intensity of the herd behavior associates with the market environment and the stock size;

3) This paper confirms market volatility is endogenous by constructing artificial stock market, this volatility is generated by the inherent transaction between investors, comparing with the reality of the artificial market, the real market volatility is more seri-

ous, which reflects that the herd behavior of institutional investors exacerbate market fluctuations, and thus produce abnormal fluctuations in the market;

4) At present, the herd behavior of institutional investors is produced by some irrational behavior. So, it is the urgent need for government to regulate the development of institutional investors.

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