Research on Sector Rotation of China's A-share Market by using Stock Data

Zhiqi Sun[1][a], Wenzheng Li[2][b], Ning Jiang[3][c] and Huan Zhao[4][d]
[1]*Finance, Shandong University of Finance and Economics of China, Jinan, Shandong, China*
[2]*The management of the cultural industry, Shandong University of Finance and Economics of China, Jinan, Shandong, China*
[3]*International Engineer, Anhui Polytechnic University, Wuhu, Anhui, China*
[4]*Traffic Engineering, Harbin Institute of Technology at Weihai, Weihai, Shandong, China*

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Abstract: Taking the data of China's A-share stocks in 2019 as the research object, this paper analyzes the correlation between the price volatility of different stocks by Spearman correlation coefficient, and finally classifies it by clustering algorithm to determine the real existence of the sector. Use Python to randomly sample stock from each sector, calculate the price increase and decrease, daily rate of return. Weight the stock market value to calculate the daily rate of return of the sector and use it for time series analysis, draw the time series plot to determine the existence of sector rotation.

1 INTRODUCTION

With the development of the stock market, people began to gradually find that there is a correlation between the rise and fall of some stocks, and these stocks are called a sector. When the stock market rises and falls, some sectors usually rise or fall first, while others rise and fall one after another. This phenomenon is called "Sector Rotation". Sector rotation is often expressed as a phenomenon of stock market in China. In the process of market development, the investment hotspot shifts from one industry or several industries to another. However, it remains to be explored whether this phenomenon really exists and whether investors can make use of the sector rotation phenomenon to make profits.

2 RELATED WORK

At present, domestic research mainly includes the following two aspects.

2.1 Identification of Sector Rotation

Firstly, it is to identify the sector rotation phenomenon, including qualitative and quantitative aspects.

For qualitative dentification of sector history phenomenon, He Chengying (2001) (He, 2001) first made a theoretical analysis of the "sector phenomenon" in China's stock market, and through the relative yield index CR and its variance, gave a quantitative index reflecting the intensity of sector phenomenon. The study shows that the larger the variance CR is, the smaller the sector rotation is.

For quantitative identification of sector phenomenon, Wang Ning (2009) (Wang, 2009) used Kendall synergy coefficient to study 30 secondary industries of CSRC in China's stock market, found that there were obvious industry sector phenomena in China's stock market. Liu Yan and Li Xingping (2013) (Liu, 2013, Li, 2013) used correlation analysis and Granger causality analysis to empirically study the relationship between 22 industry sectors. It is found that there is Granger causality between various

[a] https://orcid.org/0000-0002-8483-2706
[b] https://orcid.org/0000-0002-3742-7353
[c] https://orcid.org/0000-0002-1286-0839
[d] https://orcid.org/0000-0003-4799-0649

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industry sectors, and the relationship between industry sectors is changeable at different stages. Liang Ye (2014) (Liang, 2014) made an empirical study on 32 industry sectors in Shanghai and Shenzhen stock markets by multidimensional scaling method, and found that the phenomenon of industry sectors was obvious.

In addition, there are some scattered studies that believe that other factors, such as capital flow, The banker's hype can also explain the phenomenon of hot spot switching and sector rotation.

2.2 Sector Rotation as Investment Strategies

At present, there are also some studies that analyze sector rotation as investment strategies, including qualitative and quantitative aspects.

First, a qualitative understanding, such as Zhang Wei (2001), divides market stocks into high-priced stocks, medium-priced stocks and low-priced stocks from the perspective of technology investment, and holds that in the rising market, the high-priced stocks begin to rise first, followed by the medium-priced stocks. Finally, it is the low-priced stock sector.

The second is the quantitative analysis of the sector rotation strategy. For example, Huang Yin (2019) (Huang, 2019) obtained different dimensions of sector data by processing China's A-share data, and trained the neural network for different data to obtain the optimal quantitative investment strategy based on Recurrent Neural Network. Yu Zeqi (2019) (Yu, 2011) quantified investment strategy of industry sector rotation based on regression model. The regression model is used to quantitatively study whether there is real investment value in the sector rotation strategy, taking the market itself as the research object.

Through reading the literature, it is found that although there are many researchers on sector rotation at present, there are not any research on sector rotation identification by using stock data to establish a model. Therefore, this paper mainly establishes a model through many stock data, explores the existence of sectors and sector rotation, and illustrates the problem through data.

3 DENTIFICATION OF SECTOR

In previous studies, people default that sectors exist, but whether sectors really exist has not been verified. In this section we use stock data to verify the authenticity of sectors through mathematical models and algorithms.

3.1 Model Preparation

1)Python package such as Glob, Pandas and Openpyxl is used to read the file name, filter the data, and store the rise and fall of each stock in the new xlsx file.

2) Pearson correlation coefficient is used to measure whether two data sets are on a line, that is, to measure the linear relationship between distance variables. When both variables are normal continuous variables and there is a linear relationship between them, Pearson correlation coefficient is often used to describe the degree of correlation between them. The specific calculation formula is as follows:

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2} \cdot \sqrt{\sum_{i=1}^{n}(Y_i - \bar{Y})^2}} \quad (1)$$

3) Spearman Grade correlation coefficient is used to estimate correlation between variables The correlation between variables can be described by monotone function. The formula is as follows:

$$\rho = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{N(N^2 - 1)} \quad (2)$$

4) K-Mean clustering algorithm is a kind of iterative clustering algorithm. The K-Mean clustering algorithm for solving the problem includes the following steps:

Pre-dividing the data into K groups, randomly selecting K objects as initial cluster centers, then calculating the distance between each object and each seed cluster center. After that assign each object to the nearest cluster center. Cluster centers and the objects assigned to them represent one cluster. Every time a sample is assigned, the cluster center of the cluster is recalculated according to the existing objects in the cluster. This process will be repeated until a certain termination condition is met.

The termination condition can be that no (or minimum number) objects are reassigned to different clusters, no (or minimum number) cluster centers change again, error sum of squares local minimum.

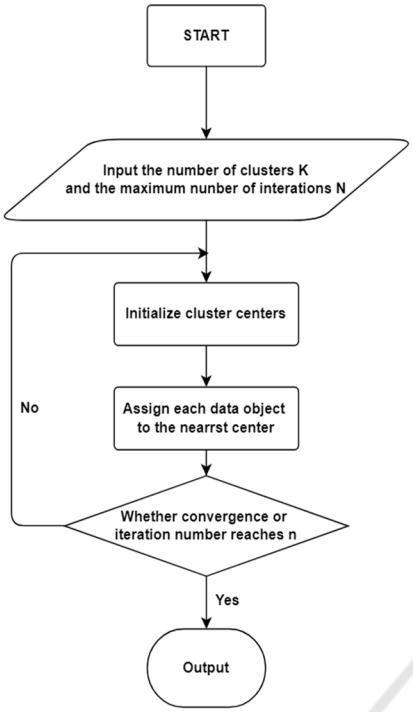

Figure 1: Clustering flow chart.

3.2 Establishment and Solution of Model

1) Process the data through python and obtain Stcok1.xlsx. The document contains the data of the price increase and decrease of all stocks from January 1, 2019 to December 31, 2019. Then carry out the correlation analysis.

2) Process original data series through SPSS to get matrix scatter plot which shows that there is no obvious linear relationship between variables, so Pearson correlation coefficient cannot be used. We can only use Matlab to get Spearman grade correlation coefficient to analyze.

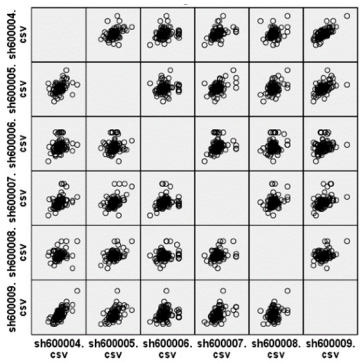

Figure 2: Matrix scatter plot.

3) Make Descriptive statistics of the data using Matlab, finding that there is no big error. Then, calculate the correlation coefficient and the P value corresponding to the correlation coefficient, save the correlation coefficient and P value as a File, processing data through conditional format-gradation using Excel, the results are as follows:

1.0000	0.2889	0.4026	-0.0269	0.1470	0.2331	0.3360	0.2236	0.5226
0.2889	1.0000	0.4086	0.3310	0.5185	0.2523	0.6663	0.4043	0.2287
0.4026	0.4086	1.0000	0.1850	0.3648	0.3023	0.5533	0.5466	0.4553
-0.0269	0.3310	0.1850	1.0000	0.3547	0.1948	0.2617	0.2360	0.0714
0.1470	0.5185	0.3648	0.3547	1.0000	0.3011	0.4949	0.4891	0.1829
0.2331	0.2523	0.3023	0.1948	0.3011	1.0000	0.2805	0.5111	0.2338
0.3360	0.6663	0.5533	0.2617	0.4949	0.2805	1.0000	0.5216	0.3890
0.2236	0.4043	0.5466	0.2360	0.4891	0.5111	0.5216	1.0000	0.3877
0.5226	0.2287	0.4553	0.0714	0.1829	0.2338	0.3890	0.3877	1.0000

Figure 3: Conditional format-gradation result 1.

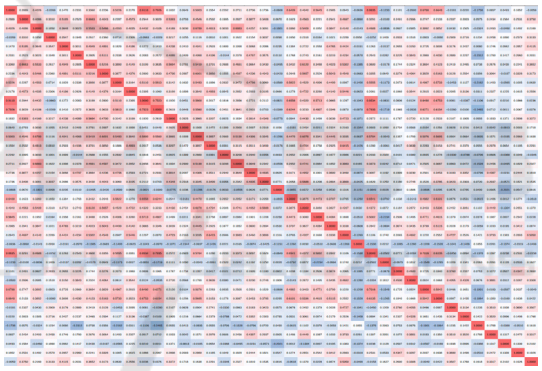

Figure 4:Conditional format-gradation result 2.

The deeper the red, the stronger the correlation. From the above figure, we can preliminarily judge the existence of sectors, and guess that there are 9 sectors in total. Then, we use SPSS to verify the classification of sectors.

Transpose the data of Stock1.xlsx to carry out K-means clustering analysis using SPSS. The results are as follows:

Table 1: Number of cases.

1. Number of cases in each cluster		
Clustering	1	167
	2	1
	3	905
	4	1
	5	379
	6	147
	7	433
	8	202
	9	289
effective		2524
lost		2

It can be seen from the results that although the cluster is divided into 9 sectors, there are only 7 effective sectors, sector 2 and sector 4 only have 1 object. So we can came to the conclusion that the sectors really exist and these stocks are divided into 7 stock sectors.

4 IDENTIFICATION OF SECTOR ROTATION

As we have found that sectors really exist, whether the sector rotation phenomenon is still unknow, In this section we use stock data to verify the authenticity of sectors rotation through mathematical models and algorithms.

4.1 Model Preparation

Use python randomly take 10 stocks from each sector as sample tickets, and take out the daily price increase and decrease of the sample tickets from June 1st to December 31st, 2019. Use pandas library to calculate the daily rate of return; So time series analysis of daily total rate of return of each sector is obtained by weighting stock market value.

$$F_i = \frac{V_i}{\sum_{i=1}^{10} V_i} \tag{3}$$

$$R_i = \frac{C_i}{V_i} \quad , i = 1,2,3 \cdots 10 \tag{4}$$

$$ROA_N = \sum_{i=1}^{10} F_i \times R_i \quad , N = 1,2,3 \cdots 7 \tag{5}$$

4.2 Model Establishment and Solution

Using python to calculate results and save them as Stock3.xlsx. Partial data is shown as follows:

Table 2: ROA data (1-5).

Time	ROA1	ROA2	ROA3	ROA4	ROA5
2014-12-31	-0.035	0.052	0.078	0.273	-0.033
2014-12-30	-0.027	-0.130	-0.088	-0.137	-0.015
2014-12-29	0.007	-0.023	-0.069	-0.172	0.066
2014-12-26	0.103	0.110	0.131	0.073	-0.010
2014-12-25	0.289	0.039	0.043	0.184	0.103
2014-12-24	-0.177	0.141	0.129	0.065	0.159
2014-12-23	-0.280	-0.127	-0.013	-0.176	-0.153
2014-12-22	0.179	-0.440	-0.028	-0.297	-0.128
2014-12-19	0.194	-0.108	-0.123	-0.130	0.068
2014-12-18	0.013	-0.050	-0.051	0.132	-0.016
2014-12-17	0.153	-0.059	-0.156	-0.087	-0.035
2014-12-16	0.149	0.038	0.074	0.125	-0.076
2014-12-15	-0.080	0.101	0.052	0.021	0.050
2014-12-12	-0.070	0.037	-0.018	0.001	0.069

Analyze total rate of return (ROA) of each sector using the time series and draw the time series diagram as follows:

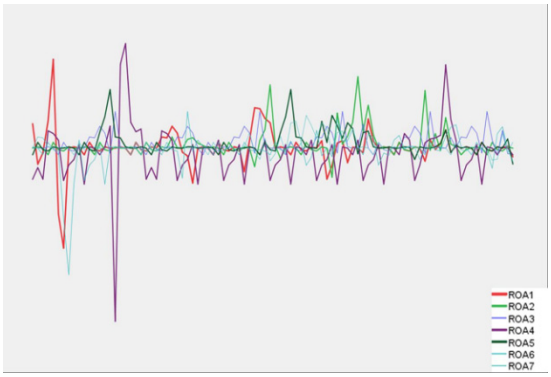

Figure 5: Time series one.

The preliminary results show that sectors 1, 2, 4, 5 have strong sector rotation. Now remove the redundant sectors, and verify the sector rotation by analyzing sectors 1, 2, 4 and 5.

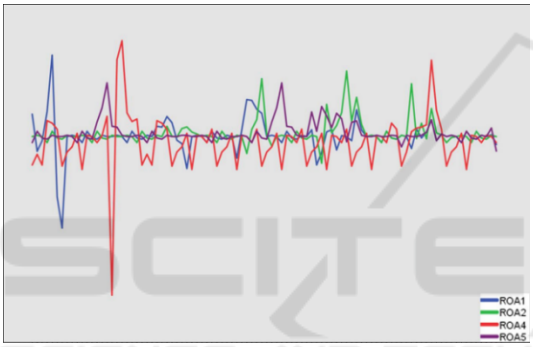

Figure 6: Time series two

By analyzing the four sectors, it can be clearly seen that when the stock market rises and falls, some sectors usually rise or fall first, while other sectors rise and fall successively, that is, the phenomenon of sector rotation.

5 CONCLUSIONS

Taking the stock market in 2019 as the research background, this paper selects the stock data traded in Shanghai and Shenzhen A-share markets as the research object. Through empirical analysis, it shows that there is a phenomenon of sector rotation in China's A-share market. When the stock market rises and falls, some plates usually rise or fall first, while others rise and fall one after another. There is a strong correlation between the yield of each rotating sector. Therefore, for investors, it is necessary to pay attention to the information and development released by different industries, the information and development of one industry may fluctuate to other industries.Then there will be a sector rotation phenomenon, and investors can obtain excess returns accordingly, which is also a problem worthy of further exploration.

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