Research on Multiple Structural Breaks of A-share Market Based on Bai-Perron and Modified ICSS Test

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Abstract

The paper mainly aims to find the number and the reasons for the structural breaks in the A-share market by using the Bai-Perron test and the modified ICSS test. Through summarizing the important economic events, corresponding to the structural break period, this paper explains the reasons and factors of structure change. The empirical results show that the impact of an event may cause the financial time series to be non-stationary and change the structure on both the mean and variance level or one of them. The modified ICSS algorithm is more suitable for the analysis of the A-share market volatility than the BP test. Seven structural breaks of ICSS test show the features of the A-share market such as liquidity under the new normal of the economy, de-leverage effect and so on.

Keywords: multiple structural breaks, Bai-Perron test, modified ICSS test, A-share market

1. Introduction

With the deepening of globalization and marketization, financial market anomalies are emerging both in China and other countries. On December 9, 2014, A-share market was severely shaken, Shanghai Composite Index closed 5.43% by more than 160 points, and the circuit breaker mechanism also had a huge impact at the beginning of 2016. China's A-share market shows new features, such as active hot money flow into trading, sharp increase in leverage trading. Because the sudden events will lead to great changes in time series, the series cannot meet the traditional assumption of linear regression, that is, all variables change stably in the observation period. The endogenous structural break test applies to the multiple breakpoints due to sharp changes in time series. Therefore, we can find out which factors will affect the structural change of China's A-share market by testing the structural breakpoints of mean and variance. Considering these factors, we should take operational measures or risk prevention to avoid the systematic risk of China's financial market.

The literature on the test of structural breakpoints can be divided into two aspects. One is from the number of breakpoints, and the other is to study from the nature of breaks. In terms of the number of breaks, after Perron proposed a one-point test method, other researchers extended it to two or even more points (Perron, 1989). Lee and Strazicich supplemented the original exogenous structural break test method, increasing the number of breaks tested to two(Jewell, Lee, and Tieslau, 2003). Yao estimates the number of mean breaks in financial time series by using the Bayesian information criterion (Yao, 1988). Liu, Wu, and Zideak tested multiple breaks in the linear model according to the least square method (OLS) and used the Schwartz model selection criteria (LWZ) to estimate the number of structural breaks (Liu, Wu, and Zidek, 1997). With the continuous emergence of financial anomalies, Bai and Perron proposed a test method for multiple breaks of mean structure in financial time series, which is the most widely used method so far (Bai and Perron, 1998; Perron, 2003). There are also many studies on the application of the mean break test in financial time series, such as David and Mark, Mc Millan and Thupayagale (Rapach, 2006; Mcmillan and Thupayagale, 2011). From the perspective of the nature of breaks, from the exogenous subjective judgment of scholars to the endogenous test of data, the test was further extended from the structural break test of the mean equation to the structural break test of variance equation. Brown, Durbin, and Evans proposed the central cumulative sum of squares (CUSUM-SQ) algorithm, which mainly searched for more structural breaks through iteration (Brown, 1975). Inclan and Tiao argue that the CUSUM algorithm cannot find multiple structural breaks effectively, and the improved algorithm is called the iterative cumulative sum of squares (Inclan and Tiao, 1994). With the optimization of metrology and algorithms, some scholars have further expanded the algorithms (Sansó, Aragó, and Carrion, 2004;Bos and Hoontrakul, 2002;Malik, 2003; Ewing and Malik, 2005).

Although the Chinese research on the stock market started relatively late, it has developed rapidly. From the perspective of the mean break, Wang Shaoping tested the CNY exchange market and found two cases of mean break (Wang and Li, 2003). Ba Shusong used the BP test to test the mean point of the Chinese stock market and the real estate market, and then analyzed the linkage between the two markets by applying the Granger causality test to different intervals(Ba, Tan, and Zhu, 2009). Wu Zhenxin used the BP test to explore the linkage of the structural changes between the three markets in the EUA, BRENT crude oil and London stock markets (Wu, Wan, Wang, et al, 2015). Sun Lijun used the first-order autoregressive BP model to study the structural breaks of China's CPI index and PPI index, and analyzed the mechanism of the interaction between CPI and PPI index through FTPL theory (Sun, Sheng, and Duan, 2016). From the perspective of the break of variance, Chen Zhan and Qi Yue, Liao Kezhi constructed a modified ICSS algorithm combined with the GARCH model to judge and predict the volatility breaks of China's futures market and stock market. They also conducted an in-depth analysis of the impact factors that affect volatility (Lin, Chen, and Chen, 2016; Qi and Liao, 2018).

In conclusion, Chinese scholars have more literature on endogenous structural breaks of single or two points, but there are few studies on multiple and variance structure breaks. In particular, the use of mean and variance tests of structural breaks to focus on the characteristics of China's A-shares is less. By using the test method of the structural break, different test methods of structural break are constructed respectively based on the most basic mean and variance of the series. Endogenous structural breaks divide the time series into different intervals. Combined with the major economic events in the financial market, this paper expounds the influencing factors of the structural break and analyzes the inducement of the break according to the real situation, which is of practical significance for preventing systemic risks and the stable development of China's financial market.

2. Multiple Endogenous Structural Breaks Test

2.1. Bai-Perron Test

The unit root test is the representative of current econometrics stationarity test and the basis of subsequent modeling. But in reality, some emergencies such as the introduction of policies, economic crises, and other major social events will cause structural breaks in the data generation process (DGP) rather than smooth. The main idea of structural break is that if a process of generating data for an economic variable change, it is considered that a structural break has occurred. Firstly, the Bai-Perron test method adds the break factor to the data generation process, overcoming the defect that the traditional unit root test method cannot test the structural break. The Sup Wald test method was used to perform the significance test. A number of different statistics were constructed to check the number of structural breaks and the time corresponding to the position, and the critical value was obtained by the simulation test. The first test is called the $\sup F_T(k,q)$ test. The original hypothesis H0 is that there is no structural break. The alternative hypothesis H1 is that there exists any subjectively given number k of structural breaks. The statistics tested is as follows:

$$F_T(\lambda_1 \ldots \lambda_k; q) = \left(\frac{T-(k+1)q-p}{kq} \right) \frac{\delta' R' (R(\bar{Z}' \hat{M}_X \bar{Z})^{-1})^{-1} R\hat{\delta}}{SSR_k} \tag{1}$$

Among them,

$$T_i = [T\lambda_i](i = 1, \ldots, k), M_X = I - X(X'X)^{-1}X' \tag{2}$$

R is the conventional matrix that conforms $(R\delta)' = (\delta'_1 - \delta'_2, \ldots, \delta'_k - \delta'_{k+1})$ and SSR_k is the sum of squares of residuals in alternative hypotheses.

The second test is called Double Maximum test. The original hypothesis H0 is that there is no structural break, and the alternative hypothesis H1 is that BP test general set m=5 (the highest number of structural changes is preset). Now construct two statistics:

$$UD_{\max} F_T(M,q) = \max_{1 \le m \le M} a_m \sup_{(\lambda_1, \ldots, \lambda_m) \in \Lambda_\varepsilon} F_T(\lambda_1, \ldots, \lambda_m; q) \tag{3}$$

$$WD_{\max} F_T(M,q) = \max_{1 \le m \le M} \frac{c(q,\alpha,1)}{c(q,\alpha,m)} \times \sup_{(\lambda_1, \ldots, \lambda_m) \in \Lambda_\varepsilon} F_T(\lambda_1, \ldots, \lambda_m; q) \tag{4}$$

$UD_{\max}$ and $WD_{\max}$ can be used to determine whether there is a structural break. If so, it is necessary to use the $\sup F_T(l+1|l)$ statistics to determine the number of breaks. The statistic is the detection of the l+1th statistic based on the detected l statistics. $\sup F_T(l+1|l)$ is defined as follows:

$$\sup F_T(l+1|l) = \{S_T(\hat{T}_1, \ldots, \hat{T}_l) - \min_{1 \le i \le l+1} \inf_{\tau \in \Lambda_{i,\eta}} S_T(\hat{T}_1, \ldots, \hat{T}_{i-1}, \tau, \hat{T}_i, \ldots, \hat{T}_l)\} / \hat{\sigma}^2 \tag{5}$$

Among them, $\Lambda_{i,\eta} = \{\tau; \hat{T}_{i-1} + (\hat{T}_i - \hat{T}_{i-1})\eta \le \tau \le \hat{T}_i - (\hat{T}_i - \hat{T}_{i-1})\eta\}$, $\hat{\sigma}^2$ is a consistent estimate of the variance based on the original hypothesis.

According to the sequential process constructed by $\sup F_T(l+1|l)$ statistic, the number of breaks can be determined. Besides, BIC and LWZ are supplemented by reference to determine the number of breaks to help improve the accuracy of the model.

2.2. Modified ICSS Test

Financial series often exhibit the distribution of leptokurtosis and fat tails. If the residual a_k is subject to a normal independent and identical distribution, the assumption of the ICSS algorithm in the financial market is too harsh. In this way, the number and position of structural changes cannot be well detected. ICSS algorithm is improved and the condition is relaxed to that a_k is independent and homogeneous distribution, that is $a_k \sim iid(0, \sigma^2)$ .At this time, $IT \sim \sqrt{\frac{\eta_4 - \sigma^4}{2\sigma^4}} \sup |W^*(r)|$ and $\eta_4 = E(a_k^4) < \infty$. Only when $\eta_4 = 3\sigma^4$, *IT* obeys the brown distribution in the original ICSS algorithm. New statistics $\kappa_1 = \sup \left| \frac{B_k}{\sqrt{T}} \right|$ and $B_k = \frac{C_k - \frac{k}{T} C_T}{\sqrt{\hat{\eta}_4 - \hat{\sigma}^4}}$. At this time $\hat{\eta}_4 = \frac{1}{T} \sum_{t=1}^{T} r_t^4$ and $\hat{\sigma}^2 = \frac{C_T}{T}$ .They also proved that the κ_1 statistic asymptotically follows a Brown bridge.

Either the IT statistic or the κ_1 statistic above is because a_k is at least independently and identically distributed. If the variance of the disturbance term is assumed to be constant, then both of the above methods are feasible. However, in practical application, the fluctuation of many economic series presents periodical change, that is, the nature of heteroscedasticity. Sanso proposed κ_2 test statistic for the original statistic: $\kappa_2 = \sup \left| \frac{G_k}{\sqrt{T}} \right|$ and $G_k = \frac{1}{\sqrt{\hat{\omega}_4}} (C_k - \frac{k}{T} C_T)$.

Here $\hat{\omega}_4$ is a consistent estimate of ω_4, and $\omega_4 = \lim_{T \to \infty} E\left(\frac{1}{T} \left(\sum_{t=1}^{T} (a_t^2 - \sigma^2) \right)^2 \right)$. The function of $\hat{\omega}_4$ is as follows:

$$\hat{\omega}_4 = \frac{1}{T} \sum_{t=1}^{T} (a_t^2 - \hat{\sigma}^2)^2 + \frac{2}{T} \sum_{l=2}^{m} \omega(l,m) \sum_{t=l+1}^{T} (a_t^2 - \hat{\sigma}^2)(a_{t-l}^2 - \hat{\sigma}^2) \quad (6)$$

Among them, $\omega(l,m)$ is the lag window, $\omega(l,m) = 1 - \frac{l}{m+1}$ and *m*represents the window width. Sansó chose the selection method proposed by Newey-West. Finally, Sansó et al. compared the above three statistics and obtained the following distribution: $IT \sim \sqrt{\frac{\omega_4}{2\sigma^4}} \sup |W^*(r)|$, $\kappa_1 \sim \sqrt{\frac{\omega_4}{\eta_4 - \sigma^4}} \sup |W^*(r)|$, $\kappa_2 \sim \sup |W^*(r)|$. It can be seen from the distribution that the κ_2 statistic is better than the other two statistics. The Monte Carlo simulation and the empirical method proved that the κ_2 statistic test was better, and the κ_2 statistic was also chosen as the judgment basis of the variance break test.

3. Empirical Analysis

3.1. Data Selection and Processing

With the deepening of China's market-oriented reform, China's macroeconomic changes may have significant stage and non-linear characteristics, rather than the traditional stable time series.

Since the structural break may cause the failure of the traditional unit root test, the Bai-Perron test and the modified ICSS algorithm test are used. The daily frequency data were selected for analysis from August 23, 2005 to October 31, 2018. First, the reform of non-tradable shares on August 23, 2005 deepened the reform of the real supply-demand relationship in the capital market and improved the market-oriented pricing mechanism. This allows non-tradable shares to be listed and the investment threshold and environment are optimized and improved. Secondly, considering the requirements of the empirical test on the sample period and the number of observed values, the validity and accuracy of empirical test can be improved by the high data frequency and long sample period. The CSI 300 index was selected, and the original data was derived from the Wind database. The data were processed as follows: $E_t = 100 * \log(E_t / E_{t-1})$.

3.2. Descriptive Statistics

First, descriptive statistics were made on the daily return series of CSI 300 after non-tradable shares reform. The results were analyzed as shown in table 1.

Table 1

Descriptive Statistics of the Daily Closing Rate of CSI 300 Index after the Reform of Non-Tradable Shares

Series	Mean	Standard Deviation	Skewness	Kurtosis	Jarque-Bera	P-Value
CSI 300	0.0165	0.7698	-0.5704	6.7057	2007.666	0.0000

From the mean value, the mean value of the CSI 300 index after non-tradable shares reform is positive, with high volatility and standard deviation of 0.7698. In terms of skewness and kurtosis, the kurtosis of the series is 6.7057 over 3, which conforms to the feature of "high peak and fat tail ". The skewness of the CSI 300 index is -0.5704. On the whole, there are many trading days when the return of the CSI 300 index is higher than the average. Jarque-Bera statistic measures the difference between the series and the normal distribution from two aspects of skewness and kurtosis, and its definition is as follows:

$$JB = \frac{N-n}{6}[S^2 + \frac{1}{4}(K-3)^2] \quad (7)$$

Among them,*N* is sample size, *S*is skewness value,*K* is kurtosis value, *n* is the number of estimated coefficients used to generate the sample series.When the sample data are original, $n = 0$ and the original hypothesis is that the data obeys normal distribution $JB \sim \chi^2(2)$. The P-values corresponding to JB statistics are all 0, indicating that the return series does not follow normal distribution significantly.

3.3. Bai-Perron Test

Bai-Perron structural break test was used to test the daily return rate series for structural breaks, and the maximum allowable test number of breaks $m = 5$ and ε was 0.15. The results are shown in table 2.

Table 2

Bai-Perron Test Results

Test statistic	CSI 300	Test statistic	CSI 300
$\sup F_T(1)$	19.4461***	$\sup F_T(2\mid 1)$	1.8552
$\sup F_T(2)$	9.9394***	$\sup F_T(3\mid 2)$	3.2231
$\sup F_T(3)$	9.4488***	$\sup F_T(4\mid 3)$	0.9672
$\sup F_T(4)$	7.1059***	$\sup F_T(5\mid 4)$	0.0000
$\sup F_T(5)$	4.7042**	Number of Breaks	
$UD_{\max}$	19.4461***	*BIC*	1
$WD_{\max}$	19.4461***	*LWZ*	0
		Sequential	1
Time of Structural break			
T_1		2007.10.16（517）	

Note. Statistics $UD_{\max}$ and statistics $WD_{\max}$ are used to determine whether there is a structural break in the test series. The original hypothesis H0 is that there is no break in the time series.

The statistic $\sup F_T(l+1|l)$ is used to determine the number of breaks. The original hypothesis H0 is that there are l structural breaks. *** means rejecting the original hypothesis at the significance level of 1%, and ** means rejecting the original hypothesis at the significance level of 5%. The number in parentheses indicates the location of the sample at the point of structural break in the series. First, analyze whether there are structural breaks in the series according to statistics $\sup F_t(k)$. With reference to the critical value provided by Bai-Perron (2003), the values of series $\sup F_T(1)$, …, $\sup F_T(5)$ are all larger than the critical value at the 1% confidence level. It is concluded that there are significant structural breaks in the CSI 300 sample. It can be found from the statistics $D_{\max}$, $UD_{\max}$ and $WD_{\max}$ are significant at the 1% level, further indicating that structural breaks do occur within the sample.

Secondly, the number of structural breaks in the series was determined by the test results of statistics $\sup F_T(l+1|l)$. $\sup F_T(2|1)$ is not significant, but $\sup F_t(k)$ is significant at the 1% confidence level. At the same time, the minimum Bayesian Information Criterion (BIC) also indicates that there is a structural break, the location of the occurrence point is 517, and the corresponding time point is October 16, 2007. At this time, the sub-prime mortgage crisis broke out in the United States, which intensified the risk contagion and diffusion in the global financial market. The trade exports in China's economic troika declined significantly, and the average return level of China's stock market was seriously impacted and had a structural break.

3.4. Modified Test of ICSS Algorithm

The modified ICSS algorithm was used to find the structural breakpoints of variance. In the sample interval from August 23, 2005, to October 31, 2018, the CSI 300 Index experienced seven variance structural breaks, as shown in Table 3.

Table 3

Variance Structure Breakpoints of CSI 300 Index

Series	Number of Breaks	Break Position	Corresponding Time Period	Standard Deviation
Daily Return Rates of CSI 300	7	162	2005.7.21~2006.4.27	0.4387
		330	2006.4.28~2007.1.05	0.6753
		1001	2007.1.08~2009.10.09	1.1342
		1333	2009.10.12~2011.2.22	0.7063
		2079	2011.2.23~2014.3.21	0.5706
		2668	2014.3.24~2016.8.15	0.8517
		3029	2016.8.16~2018.2.05	0.2922
			2018.2.06~2018.10.31	0.6248

Deepening non-tradable shares reform mainly solves three major problems: the imbalance between supply and demand in the capital market, the contradiction between the interests of large and minority shareholders, and the inflexibility of control rights. The non-tradable shares reform is based on the mechanism of market-oriented incentive and restraint. It optimizes the self-restraint mechanism and the effective third-party external supervision mechanism to adapt to the new situation of the development of the capital market. In the process, some large events and impacts lead to structural changes in the data generation process. Not all events will cause structural breaks in the time series. The modified ICSS algorithm is used to filter out the impact of general events and can effectively detect the structural breaks. The method structural breakpoints for testing the CSI 300 Index were April 27, 2006 (162), January 5, 2007 (330), October 9, 2009 (1001), and February 22, 2011 (1333), March 21, 2014 (2079), August 15, 2016 (2668), and February 5, 2018 (3029).Further, after the reform of non-tradable shares, the interval between each adjacent two structural breaks is plotted on the daily yield series of the CSI 300 Index. The fluctuation ranges are depicted by the bandwidth within ±3 standard deviations.

Figure 1
The Daily Return Series of CSI 300 Index after the Reform of Non-Tradable Shares

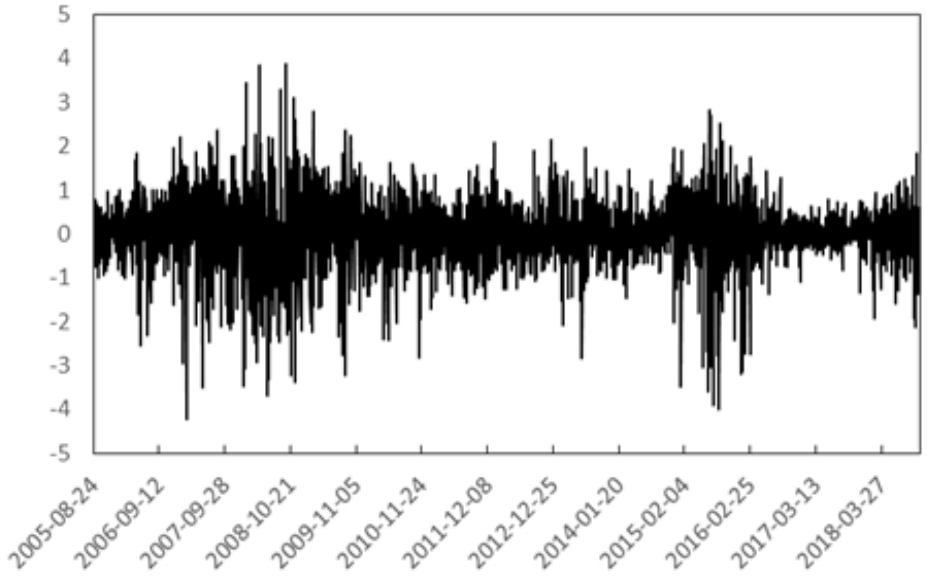

Figure 2
The Daily Return of CSI 300 Index after the Reform of Non-Tradable Shares within ±3 Standard Deviations

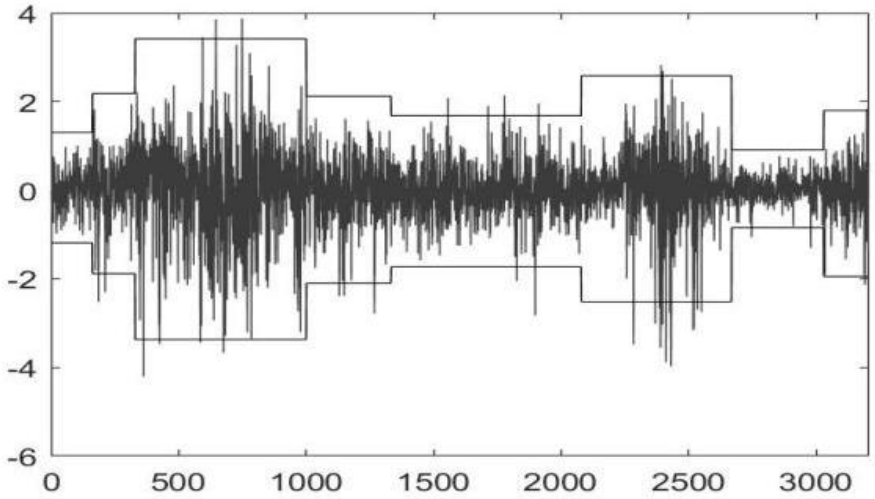

Figure 2 directly reflects the staged division of the series according to the breaks verified by ICSS algorithm. According to the results, the number of structural breaks occurred in some time periods was higher. The structural break of variance has its reasons. Further investigation is needed to investigate the major events occurring at the structural breaks and their nearby time points, as shown in table 4.

Table 4

Major Events Combing of CSI 300 Yield Series Variance Structure Break Test

2006.4.27	2006.4.16 China Securities Regulatory Commission (CSRC) planned to solicit public opinions on Administrative Measures for the Issuance of Securities by Listed Companies, which would be implemented on May 8, 2006.
2007.1.5	2007.2.27 The Shanghai and Shenzhen stock markets fell sharply, with each index falling more than 8 percent. 2006.5 billion yuan was clinched in two markets and A-share market value reduced more than a trillion. 2007.4.2 The global fallout from the subprime crisis in the United States became increasingly apparent.
2009.10.9	2009.6.6 Shenzhen Stock Exchange issued Growth Enterprise Market Listing Rules, which are tentatively scheduled to take effect on July 1, 2009. 2009.10.30 The Chinext opened with an average first-day increase of 106%. 28 stocks were suspended from trading on the first day.
2011.2.22	2011.2.18 The central bank raised the deposit reserve ratio for financial institutions by 0.5 percentage points from February24. China's commercial banks' capital adequacy ratio rose to 12.2%. This is the second time since mid-January and the eighth time since 2010 the central bank raised the deposit reserve ratio. 2011.2.23 The Ministry of Human Resources and Social Security, China Banking Regulatory Commission, China Securities Regulatory Commission, and China Insurance Regulatory Commission jointly promulgated the newly revised Management Method of Annuity Fund of Enterprises, which releases the proportion of enterprise annuity investment in stocks to 30%.
2014.3.21	2014.4.10 The China Securities Regulatory Commission (CSRC) approved the Shanghai-Hong Kong Stock Connect program as a pilot connectivity mechanism and launched the stock connect jointly on November 17. 2014.5.9 The State Council issued the New Nine Opinions on deepening capital reform, which reflects the importance the state attaches to the capital market.
2015.8.10	2015.8.11 The People's Bank of China adjusted the quotation mechanism of the RMB exchange rate against the US dollar, and market makers provided the central parity quotation to the China Foreign Exchange Trading System with reference to the closing rate of the interbank foreign exchange market last day. This adjustment increased the market flexibility of the central parity rate and truly reflected the current relationship between supply and demand in the foreign exchange market. 2015.11.30 The International Monetary Fund added CNY to the SDR basket.
2016.8.15	2016.8.24 The CBRC supervised the normal and reasonable development of online loan behavior and established information disclosure to regulate intermediary institutions. 2016.11.29 The CBRC issued two documents for public comments on the management of investment fund companies and the regulation of risk control indicators. A series of policy trends reflected that regulators were pushing the asset management industry to deleverage and control risks.
2018.2.5	After Trump signed punitive tariffs on Chinese products at the White House on March 22, 2018, China immediately announced plans to impose tariffs of about $3 billion on imports from the United States In march, all three major stock indexes on the Shanghai and Shenzhen stock exchanges fell. The Shanghai Composite index fell 3.39%, Shenzhen Component index fell 4.02%, and ChiNext index fell 5.02%. U.S. stocks fell sharply, affecting global stocks and commodities.

Source: Data collation

From the perspective of macro-economic environment, the financial crisis is a big shock in the global economic environment. The corresponding period time of variance structure break happened to be from January 2007 to October 2009. The world financial crisis broke out completely and major stock markets fell sharply, with obvious volatility spillover and risk contagion effects. The Shanghai Composite index fell as much as 69.85 percent from its peak of 6,124.04 to 1,664.93. Investment expectations were pessimistic. Investors lost confidence in the market and panic. China's economic trade exports have been depressed for several quarters.

In order to stimulate the trading volume of the stock market and end the unilateral decline trend of the stock market, the stamp duty was adjusted twice in 2008. In April, the stamp duty was adjusted from 3‰ to 1‰. In September, the unilateral levy policy was adopted to reduce transaction costs. Two major changes to the stamp duty led to minor callback in the stock market, but ultimately failed to stop the market from falling further. To avoid the risk of a hard landing of the crisis, the Chinese government introduced measures in November 2008 to expand domestic demand and promote sustained and steady economic growth. The central government approved a total investment plan of 4 trillion yuan, adopted loose monetary policy and cut interest rates five times within 100 days. Thanks to the concerted efforts of the whole country, China's GDP grew by 7.1% in the first half of 2009, which is conducive to the sustained development of the Chinese economy and the recovery of the world economy.

From the micro perspective of domestic policy control, the two variance structural breaks from March 21, 2014, to August 15, 2016, and from August 15, 2016, to February 5, 2018, correspond to the policy control from releasing liquidity to financial deleveraging in China. In 2014, the central bank declined deposit reserve ratio twice to drop the deposit-loan ratio. In the third quarter of 2014, to guarantee the liquidity of commercial banks and other financial institutions, the People's Bank of China has implemented MLF operation of 399.5 billion yuan with a term of one year and an interest rate of 3.2%. This is the 10th time the central bank has activated the multilateral fund. The central bank released nearly 400 billion yuan of liquidity through SLF, MLF, and PSL in September. In October, the central bank released a total of 269.5 billion yuan in base money, including joint-stock commercial banks, urban and rural commercial banks and other financial institutions, with a term of three months and an interest rate of 3.5%. In 2016, to implement the general policy of economic development, the Central Economic Work Conference explicitly called for deleveraging. In 2015, the scale of margin trading and over-the-counter capital allocation increased rapidly, and the behavior of shareholders borrowing money or indirectly investing in stocks led to the sharp rise of the stock market directly. But as the launch of deleveraging measures in June, China Banking and Insurance Regulatory Commission and China Securities Regulatory Commission conducted a comprehensive screening research and management in highly leveraged institutions and asset classes within the scope of their regulatory, and the stock market collapsed.

The number of structural breaks of the A-share market variance based on the Modified ICSS method is greater than the BP average breaks. The main reason is that deleveraging leads to a huge impact on the A-share market variance volatility. This reflects the A-share market economy in China shows the characteristics of the change under the new normalcy. The manifestations of periods are respectively three-year liquidity relaxation since 2014, financial deleveraging since the end of 2016, and the capital relief in 2018.

4. Conclusion and Revelation

BP test and modified ICSS test are used to analyze the return rate series of CSI 300 index. Since the full circulation reform in 2005, there have been multiple structural breaks in China's A-share market. According to the time position corresponding to the structural break, this paper finds out the corresponding economic events and analyzes them. By comparing the two test results, it is found that modified ICSS of China's A-share market is more explanatory than BP test, and the conclusions are as follows: First, when conducting structural break tests on financial time series, it is necessary to consider the change of structural break both on mean and variance. Some shocks cause sudden changes both in mean and variance, while some events cause sudden changes in one of them. When studying the impact of financial markets, it is needed to consider both kinds of nature of the breaks, so as to analyze the influencing factors more accurately. Second, the impact of major economic events on the volatility of the A-share market is multi-path. From a direct point of view, A-share yield fluctuations can be affected and the supply and demand relationship of A-share market can be changed through domestic stock market policies. For example, the reduction of state-owned shares has stopped. From an indirect point of view, the international environment and China’s macroeconomic policies affect the volatility of A-share yield from various channels, such as the profitability of enterprises, capital liquidity and so on. Furtherly, it shows that the market-oriented reform of China's A-share market is deepening, and its transmission path and effect with the real economy and the world economic environment are more significant.

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