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Research on the Volatility of Stock Returns in China's A-share Market

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Abstract

In the wave of economic globalization and rapid Internet development, the securities market plays an increasingly prominent role in the modern economic system. The capital market mainly involves medium- and long-term investment activities, and the securities market is the core component of the capital market, closely related to the development of the capital market. The securities market not only provides an investment and trading platform for the capital market, but also serves as an important venue for long-term capital flows. This paper selects the return data of the CSI 300 Index and the CSI 500 Index in China's A-share market from April 2, 2014 to September 30, 2024, and uses GARCH models to study their return volatility. The results show that the daily returns of the CSI 300 Index and the CSI 500 Index exhibit significant variability and volatility clustering in time series analysis, with distribution characteristics of leptokurtosis and fat tails, obvious GARCH effects, and the impact of past volatility on subsequent volatility declining over time. In addition, the active trading of the CSI 300 Index brings higher liquidity to the stock index futures market, and this liquidity is also an important factor leading to index volatility.

Keywords

Investment; Volatility; Securities Market.

1. Introduction

In the wave of economic globalization and rapid Internet development, the securities market plays an increasingly prominent role in the modern economic system. The degree of financial market development reflects a direct impact on a country's real economy, and this impact is mutual. In the financial system, the capital market is very important. The capital market mainly focuses on medium- and long-term capital investment. As a key component of the capital market, the securities market is closely related to its development. The securities market not only builds the trading framework of the capital market, but also serves as a key platform for long-term capital flow. The functions of the capital market are not limited to providing long-term financing and investment channels; it is also closely connected with the capital supply of the money market through securities issuance. The trading activity of the securities market has a significant impact on the capital demand and interest rate levels of the money market. In the national economic system, the capital market plays a core role. It is responsible for transforming financial capital into real economy capital and coordinating the supply and demand of capital through the market price mechanism, thereby playing a crucial driving role in economic growth.

2. Theoretical Basis

2.1. GARCH Model

The GARCH model is a statistical tool used to measure and forecast the volatility of time series. It is an advanced version of the ARCH model. In the financial field, the GARCH model is

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particularly favored and is often used to study the return volatility of financial assets such as stocks, bonds, and foreign exchange[1-3].

The core idea of the GARCH model is that the conditional variance volatility of a time series is affected not only by historical volatility but also by historical information. This model can effectively capture the volatility clustering phenomenon, that is, large fluctuations are often followed by large fluctuations, while small fluctuations are usually followed by small fluctuations.

The variance equation is:

$$\sigma^2 = \omega_0 + \sum_{i=1}^{p} \alpha_i {\mu_{t-i}}^2 + \sum_{i=1}^{q} \beta_i {\sigma_{t-i}}^2$$

The mean equation is:

$$y_t = \lambda x_t + \mu_t$$

2.2. Theoretical Basis of Volatility

2.2.1. Stock Price Volatility Theory

Stock price volatility, that is, the daily fluctuation of stock prices, is an inherent feature of all stock markets. It not only reflects the dynamic changes of stock prices but is also an important criterion for measuring the maturity of a stock market. Deeply understanding and describing these volatility characteristics is crucial for stock market participants when making investment decisions, and it is equally important for market regulatory agencies in performing regulatory duties and formulating relevant policies. At the same time, shareholders of listed companies play a core role in the process of pursuing profit maximization, providing a stable and reliable economic foundation for their daily life and work.

Abnormal volatility refers to stock price fluctuations exceeding the normal range, while the operation pattern of the stock market is often inconsistent with the overall direction of the national economy. Severe stock price fluctuations may lead to serious bubbles in the stock market and may even deviate from the fundamental direction of the national economy for a long time. This situation may trigger a financial crisis and pose a threat to economic stability.

Usually, when we say the stock market is stable, we mean that the stock market is in a relatively stable state, meaning that stock prices fluctuate within a reasonable range, which helps maintain the healthy and sustainable development of the economy. A stable stock market can provide investors with a predictable environment, thereby encouraging long-term investment and promoting the effective allocation of capital, which is crucial to the healthy development of the entire economic system.

2.2.2. Characteristics of Return Volatility

Within the framework of traditional financial time series models, these models are widely used in the estimation of financial asset pricing and are consistent with market efficiency theory, making them particularly convenient in practical applications. In the stock market or the broader capital market, fluctuations in financial asset prices do not occur in isolation but show a certain positive correlation. Specifically, when the market experiences a period of high volatility, it is often followed by another period of high volatility, and vice versa. This volatility pattern shows a clustering trend over time. Stock market volatility seems to tend to break out intensively during specific periods, and periods of high volatility and low volatility often alternate, forming a cyclical pattern. This persistence of volatility, especially when subjected to external shocks, is significantly different from the normal distribution assumption of financial

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asset returns. In reality, the return distribution of financial assets often exhibits leptokurtosis and fat tails, that is, the probability of extreme values (whether extremely high or extremely low returns) is much higher than predicted by the normal distribution. This characteristic has important implications for risk management and investment decisions[4,5].

The leverage effect is a financial concept that describes the different degrees of response of market volatility to positive and negative shocks. The traditional view is that the impact of negative shocks on market volatility is more profound and lasting. This phenomenon is widely known as the "feedback effect," which reveals how unfavorable news triggers a series of chain reactions. The existence of this leverage effect not only has a profound impact on investors' decision-making behavior but also provides an important reference for financial regulation and risk management. Understanding and quantifying this effect is of considerable importance for building more robust investment strategies and maintaining the stability of financial markets.

2.3. Measurement of Return Volatility

Return volatility is a stochastic process. After referring to most articles, there are generally two methods for measuring returns: logarithmic return and simple return. On this basis, this paper chooses the logarithmic return as the calculation method for stock returns, namely:

$$r_t = \log(p_t) - \log(p_{t-1}) = \log(\frac{p_t}{p_{t-1}})$$

3. Data Preparation

The CSI 300 Index is a key indicator of China's A-share market, compiled and published by China Securities Index Co., Ltd. The index takes December 31, 2004 as the base date and sets the base point at 1000 points, aiming to show the trend of stock price changes and market operation status in China's securities market. The weight of constituent stocks is determined based on the proportion of each stock's free-float market capitalization to the total free-float market capitalization. As the "barometer" of China's stock market, the CSI 300 Index gathers the core assets of the A-share market, and its constituent stocks cover leading enterprises in various industries. This index basically reflects the overall performance of China's stock market and has become a key tool for investors to monitor market dynamics. The CSI 300 Index is also a representative broad-based index in the A-share market, depicting the overall performance of core leading listed companies in the whole market and representing the overall trend of the A-share market. Therefore, this paper selects the CSI 300 Index as the research object.

The CSI 500 Index, launched by China Securities Index Co., Ltd., is a key small- and medium-cap stock index in China's stock market. It focuses on showing the stock performance of small and medium-sized enterprises in the A-share market. During the compilation process, the index excludes the constituent stocks of the CSI 300 and the top 300 stocks by market capitalization, and selects 500 stocks with relatively large market capitalization from the remaining A-shares. The selection of sample stocks follows strict standards: main board stocks must be listed for more than one quarter, ChiNext stocks for more than three years, and ST stocks are excluded. In addition, stocks with the lowest daily average turnover in the bottom 20% are also excluded, and finally the top 500 stocks by daily average total market capitalization are selected. The CSI 500 Index covers a wide range of industries, with industrials, raw materials, and information technology constituting its main weighted industries. The index is dominated by technology growth enterprises such as electronics, computers, and new energy, and also includes cyclical growth sectors such as non-ferrous metals and chemicals, as well as consumer enterprises such as food and beverages and pharmaceuticals. The market capitalization distribution of the CSI 500 Index is mainly concentrated between 10 billion and 30 billion yuan, which makes it more

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representative in reflecting emerging industries in a transition economy. The index has a certain representativeness. The CSI 500 Index provides investors with an effective tool to observe and invest in small- and medium-cap stocks and has high investment cost-effectiveness and market influence. It occupies an important position in asset allocation and is a choice that investors cannot ignore. Therefore, this paper selects the CSI 500 Index as the research object.

4. Empirical Analysis

Empirical Analysis Based on GARCH(1,1) Model

We selected the daily return series of the CSI 300 Index and the CSI 500 Index for comparative analysis and used the GARCH(1,1) model in Stata for estimation. The results are shown in the following tables.

Table 1. Estimation results of GARCH (1,1) model for CSI 300 Index

Variable	Coefficient	Std.Error	Z-Statistic	p-value
arch1	0.089	0.005	17.43	0.000
garch1	0.907	0.005	186.36	0.000
Constant	0.000	0.000	5.41	0.000

Table 2. Estimation results of GARCH (1,1) model for CSI 500 Index

Variable	Coefficient	Std.Error	Z-Statistic	p-value
arch1	0.085	0.005	16.33	0.000
garch1	0.903	0.005	165.74	0.000
Constant	0.000	0.000	7.06	0.000

The lag-1 coefficient of the ARCH term of the CSI 300 Index is 0.089, with a standard error of 0.005, a z-value of 17.43, and a p-value of 0.00001. This indicates that the ARCH effect is statistically very significant, meaning that the squared error of the previous period has a significant impact on current volatility. The lag-1 coefficient of the GARCH term is 0.907, with a standard error of 0.005, a z-value of 186.36, and a p-value of 0.000. This also indicates that the GARCH effect is statistically very significant, meaning that the variance of the previous period has a very strong impact on the current variance. The statistical significance of this constant term indicates that even without past volatility information, the model still predicts a certain variance. Overall, it shows that the return series of the stock market exhibits significant volatility clustering.

The lag-1 coefficient of the ARCH term of the CSI 500 Index is 0.085, with a standard error of 0.005, a z-value of 16.33, and a p-value of 0.00001. This indicates that the ARCH effect is statistically very significant, meaning that the squared error of the previous period has a significant impact on current volatility. The lag-1 coefficient of the GARCH term is 0.903, with a standard error of 0.005, a z-value of 165.74, and a p-value of 0.00001. This also indicates that the GARCH effect is statistically very significant, meaning that the variance of the previous period has a very strong impact on the current variance. The statistical significance of this constant term indicates that even without past volatility information, the model still predicts a certain variance.

The volatility persistence coefficient is the sum of the coefficients of the ARCH and GARCH terms. When the volatility persistence coefficient is less than 1, the return series will continue to be affected by external shocks, and the duration is positively correlated with the volatility persistence coefficient. The volatility persistence coefficient of the CSI 300 Index is 0.996, lower than 1, and that of the CSI 500 Index is 0.985, also lower than 1. However, the volatility

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persistence coefficient of the CSI 300 Index is greater than that of the CSI 500 Index, indicating that the CSI 300 Index is affected by sustained shocks for a longer time and is more vulnerable when facing external shocks.

5. Summary

5.1. Conclusion

Observing the daily return time series of the CSI 300 Index and the CSI 500 Index, it can be found that their volatility has significant variability and clustering effects, and the series distribution characteristics are leptokurtosis and fat tails. These are typical manifestations of the GARCH effect. In addition, the influence of historical volatility on the subsequent market shows a gradually weakening trend. The active trading of the CSI 300 Index further enhances the liquidity of the stock index futures market, and this liquidity is also an important factor driving index volatility.

Under the sample conditions selected in this paper, China's A-share market has a significant volatility clustering effect, and China's A-share market is highly vulnerable to shocks. Overall, the constituent stocks of the CSI 300 Index show stronger risk resistance than those of the CSI 500 Index. The CSI 300 Index is composed of mature listed companies in Shanghai and Shenzhen. Compared with the small- and medium-sized enterprises included in the CSI 500 Index, they have stronger risk resistance and a more complete system. In addition, both the CSI 300 Index and the CSI 500 Index show an inverse leverage effect, that is, the impact of positive news on the index is greater than that of negative news.

5.2. Suggestions

In China's securities market, the improvement of the information disclosure system is crucial to ensuring the healthy and stable development of the market. With the development of the capital market and the evolution of the securities market system, the business scope of the securities industry is expected to further expand. Securities companies need to shift from the traditional brokerage business model to a diversified profit model centered on wealth management, and develop and provide innovative financial products and services such as margin trading, refinancing, and stock pledge repurchase.

Strengthen the market-oriented construction of securities. The government should clarify its boundaries of authority and responsibility, focus on strengthening supervision and cracking down on illegal and irregular acts, and ensure the fairness and justice of market trading order. By establishing and improving the legal and regulatory system and improving regulatory efficiency and transparency, the government can more effectively prevent and resolve market risks and protect the legitimate rights and interests of investors.

References

[1] Sha, N., Chandrasekar, K., Dileep, M. R., et al. (2019). Stock volatility in Muscat Securities Market. *International Journal of Recent Technology and Engineering (IJRTE)*, 8(2s11), 3953–3962.

[2] Paola, V. D. (2024). ESG news, stock volatility and tactical disclosure. *Research in International Business and Finance*, 68.

[3] Zhang, J., & Mu, N. (2026). Research on stock volatility based on investor sentiment and two-dimensional Ising model. *Open Journal of Applied Sciences*, 16(5), 1901–1915.

[4] Buntz, B. (2018). IoT cybersecurity problems could increase stock volatility. *SQL Server Pro*.

[5] Jenq, P., & Jenq, J. (2017). Parallel prediction of stock volatility. *Journal of Systemics, Cybernetics and Informatics*, 15(5), 70–73.