Testing for relationships between Shanghai and Shenzhen stock markets: A threshold cointegration perspective

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HIGHLIGHTS

- We reveal the evidence of cross-correlations between the two stock markets.
- Our main findings show that the two markets are cointegrated.
- We show the evidence of long-term equilibrium in the first regime.
- The rate convergence to long-term equilibrium is not uniform.

ARTICLE INFO

ABSTRACT

We investigate the relationships between Shanghai and Shenzhen stock market, and reveal the evidence of cross-correlations between the two stock markets. Our main findings show that Shanghai and Shenzhen stock market are cointegrated, and also present the evidence of strong error-correction effect in the short-rate equation, whereas the point estimate for the error-correction term is small and not statistical significance in the long-rate equation. Finally, Shanghai stock market ECT coefficient shows the evidence of long-term equilibrium in the first regime, while in the second regime the coefficient of correction term is larger than that of the first regime, indicating the rate convergence to long-term equilibrium is not uniform.

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1. Introduction

Since the Chinese stock market emerged, it has experienced impressive growth. There are many descriptive studies for investigating the development of China's stock market (e.g., Refs. [1–3]). The institutional features of Chinese stock market could be described as follows,[1]

(a) Considering the globalization, China's government gradually announced the financial policy of allowing local citizens to buy B share, and non-tradable shares have circulated since 2008,[2] indicating that this important government policy has profoundly changed the microstructure of China's stock market [2].

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[1] The institutional detail would be seen in http://www.sse.com.cn/sseportal/en/home/home.shtml and http://www.szse.cn/main/en/.
[2] Lin et al. [1] found that the shares structures of Shanghai and Shenzhen stock market were one-third publicly traded, one-third state-owned and the last privately-owned.

(b) The specially microstructure of Chinese stock markets: the initial public offering (IPO) of Shenzhen stock market in China has been suspended since 2002. And the SSE Composite Index was listed (A shares and B shares) at Shanghai Stock Exchange.
(c) Investors have some unique sentiment features of a drop in confidence increasing market volatility. And the markets present segmentation between domestic and foreign investors, different purchasing cost, and high transfer rates; a certain degree of segmentation exists, indicating that arbitrage opportunities are impossible for investors to. Moreover, the investor non-rationality behaviors could affect stock market microstructures [1].

For the institutional described above, investigating the microstructures of the stock markets are obviously necessary. Indeed, Market microstructures investigate how prices either diverge from, or converge to long-term equilibrium. Until now, econophysicists have found many meaningful methods to test the market microstructures. We seek to investigate the correlation and long-term equilibrium between the two previously segmented markets. Firstly, we study the long memory property in financial markets. In fact, the existences of long-range dependence indicate market inefficiency. The first welfare theorem of economics reveals the sources of inefficiency in markets. Under some strict assumptions, any market equilibrium is tautologically efficient. Thus, equilibriums do not arise imply that the market are not efficient, and show that the market system itself is some sort of market failure. Then as the market become more and more efficiently, it seems that we could find out the dynamics mechanisms of long-term equilibrium.

With this in mind, our paper has two main works. One of the works is capture the long-range dependence (correlation) between the markets, and then under the efficient market assumptions, the other works is to seek the long-term equilibrium between the markets. Peters [4,5] tried to capture the scaling properties of financial markets structures, and also presented a simple model to investigate the long memory property based on DFA analysis. In fact, scaling properties is still an interesting topic for studying. Recently, Lim, Brooks, and Hinich [6] also examined the long memory of 10 Asian emerging stock markets, and provided the evidence of weak-form efficiency. A great number of econophysicists also seek to detect the dependences (or correlations) in the financial markets [7–14].

Despite the growing researches in the long-range dependence (correlation), several interesting issues should be carefully studied. The long-term equilibrium regarding the microstructure of the market in Chinese stock markets have not been carefully investigated. In particular, the extreme value in the return series has never been scrutinized. In practice, our investigations on the long-term relationship between Shanghai and Shenzhen stock market have interesting implications. We reveal that the stock markets between the two stock markets are cointegrated; on the other hand, the cointegrations are quite asymmetric, and the rate convergence to the equilibrium is not uniform in two regimes. In the view of threshold vector error correction model, the cointegrations may reduce the possibility of huge market volatility. The same issue has been extensively studied in the current literatures concerned the long run relationship [15], particularly in the energy markets [16]. Besides the early studies on energy markets, such as [17,18], several fields have also been studied, such as foreign exchange markets [19–22] and financial markets [12,14]. Considering the structural breaks in cointegrating vector, Peri and Baldi [23] investigated the long-term relationships between vegetable oil market and diesel markets, and found the evidence of the asymmetric cointegration. However, when the long-term correlations change because of structure break, the cointegrating vector could be not suitable for study. It seems that the cross-correlations should be tested before the cointegrated model applied.

Overall, we firstly investigate the cross-correlations and long memory [24,25], then introduce the extreme value adjustment procedures to capture those properties, and employ threshold vector error correction model, which considers a vector error-correction model (VECM) with one cointegrating vector and a threshold effect depended on the error-correction term, to characterize the long-run relationship between Shanghai and Shenzhen stock market, and our secondly contribution focus on the long-term equilibrium.

Finally, our findings indicate that Shanghai and Shenzhen stock market are cointegrated. Specifically, the cointegrations are quite asymmetric, and the rate convergence to the equilibrium is not uniform in two different regimes. The empirical results also conclude that the market integration between Shanghai and Shenzhen has a tendency of getting closer, both in the short-term and long-term.

The remainder of our paper is organized as follows. The methodology is summarized in the Section 2. In Section 3, we show the data and provide the extreme value adjustment procedure. We show the preliminary analysis and empirical results in Sections 4 and 5, respectively. Some discussions in the Section 6; then, we conclude in the last section.

2. Methodology

2.1. Cross-correlations statistic

We employ the cross-correlation statistic to test the cross-correlations two different return series due to the nonstationarity [24,26,27]. The cross-correlation statistic could be described as follow:
There exists two time series, $\{x_t\}_{t=1,\dots,N}$ and $\{y_t\}_{t=1,\dots,N}$, and the cross-correlation statistics can be described as follows:

$$Q_{cc}(m) = N^2 \left(\sum_{i=1}^{m} \frac{C_i^2}{N-i} \right) \tag{1}$$