Correlation and Impact of SSEC and SZI Empirical evidence based on VAR model

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Abstract. Today, the world economy is experiencing globalization and diversification, and China's economy is also developing rapidly, also the development speed of the capital market has been significantly improved. Among them, the impact of the development of the securities industry on China's capital market cannot be ignored. As the two major stock exchanges in China, the Shanghai Stock Exchange and the Shenzhen Stock Exchange are not to be underestimated in the securities market. Therefore, the Shanghai Securities Composite Index (SSEC) and the Shenzhen Securities Component Index (SZI) represent the direction of China's stock market to a certain extent. Therefore, this paper will start from the perspective of SSEC and SZI, select the data for a total of 10 years from 2009-2018, and try to construct the VAR model, and finally draw the impulse response function graphs of both of them. The basic conclusions of the study are the SSEC has a relatively large impact on the capital market, while the SZI has a relatively small impact on the capital market. Therefore, the inspiration for investors is that the SSEC is more informative and useful when making investments.

Keywords: SSEC, SZI, Capital Markets, Trend Characteristics, Influencing Mechanisms.

1. Introduction

As an important part of the national economy, the capital market has a significant impact on a country's economic development and social stability. In the capital market, the stock market, as one of the most representative and active markets, plays an important role in guiding resource allocation, promoting enterprise development and enhancing economic vitality. In China, the SSEC and the SZI, as the two major stock market indices, carry the important mission of the capital market.

The SSEC is the main stock market index of the Shanghai Stock Exchange in China, compiled and published by the Shanghai Stock Exchange. It covers most of the listed companies on the Shanghai Stock Exchange and represents the overall performance and trend of the Chinese stock market. The SZI is the main stock market index of the Shenzhen Stock Exchange in China, compiled and published by the Shenzhen Stock Exchange. It includes most of the listed companies on the Shenzhen Stock Exchange and reflects the overall condition and trend of the Shenzhen stock market. As the two major indices, the ups and downs and performance of the SSEC and the SZI have an important impact on the entire Chinese stock market as well as the capital market. Therefore, it is of great theoretical and practical significance to study the correlation between the SSEC and the SZI, also their impact on the capital market. First of all, understanding the correlation between these two indices can help us reveal the overall operating law and behavioral characteristics of the stock market. By analyzing their correlations, we can understand the linkage and dependence of the market, so as to better predict the market trend and risk. Second, exploring the impact of the SSEC and the SZI on the capital market helps us to gain insight into the extent to which micro and macro factors in the stock market contribute to market volatility. This is important for investors to formulate investment strategies, regulators to formulate policies and academics to study market behavior.

Over the past few years, China's capital market has undergone many significant changes and developments. From marketization reforms, strengthening of capital market regulation to reforms of trading mechanisms, these changes have been important references for the performance and impact of both the SSEC and the SZI. However, despite a large number of studies focusing on the SSEC and

the SZI, relatively few studies have been conducted on the correlation between them and their impact on the capital market.

2. Research Methodology

2.1. Vector autoregression model (VAR)

VAR model is a model proposed by Sims in 1980, which is mainly used to predict and analyze the relationship between several research variables of the same system that have interdependent influences, and it is a commonly used method for multivariate time series analysis. VAR model is based on the principle of Vector autoregression (VAR), which captures the dynamic relationship and mutual influences among multiple time series variables by jointly modeling them.

The basic form of the VAR model can be expressed as:

$$Y_t=\alpha+\Pi_1 Y_{t-1}+\Pi_2 Y_{t-2}+\ldots+\Pi_p Y_{t-p}+U_t \quad (1)$$

In the above equation, Y_t is a k-dimensional vector representing a time series containing k economic variables, α is a vector of constants, Π_1, Π_2, ... ,Π_p is a k×k matrix of coefficients, p is the lag order of the model, and U_t is a k-dimensional error vector representing unobservable disturbance terms.

2.2. Augmented dickey-fuller (ADF)

ADF (Augmented Dickey-Fuller) is a commonly used method of time series analysis, used to test whether a time series has a unit root. ADF test of the original hypothesis is the existence of a unit root. The unit root indicates that the variable has a non-stationary, its mean and variance are not fixed over time.

The basic principle of ADF is to assume that the measurement process of the time series follows the following autoregressive model:

$$\Delta Y_t=\alpha+\beta T+\gamma Y_{t-1}+\delta_1 \Delta Y_{t-1}+\ldots+\delta_p \Delta Y_{t-p}+\varepsilon_t \quad (2)$$

In the above equation, Y_t denotes the observed value of the time series, ΔY_t denotes the first-order difference, T is the time-trend term, α, β, γ, and δ denote the coefficients of the model, p denotes the lag order, and ε_t is the error term.

2.3. Impulse response function (IRF)

The impulse response function describes the reaction of an endogenous variable to a residual shock. Specifically, it describes the effect on the current and future values of the endogenous variable when a shock of one standard deviation in size is applied to the random error term. This method of analysis becomes the impulse response function (IRF).

2.4. Variance decomposition

Variance decomposition describes the ratio of the intensity of shocks from each variable in a VAR model to the total change in a variable, so it is called a variance decomposition. The variance of each variable in the VAR model is the finite sum of the variances of the new interest rates of these variables, with the variance of each variable as the denominator and the variance of the new interest rate of this variable as the numerator, thus constituting a variance decomposition called the relative contribution of variance.

3. Data Selection & Processing

3.1. Data selection

In this paper, we select the monthly data of SSEC and SZI 2009-2018, which are obtained from China Statistical Yearbook (2009-2018).

3.2. Data processing

3.2.1. ADF test

In this paper, time series data is selected for the study. Time series data is a set of data arranged in chronological order, using time series data, need to test its smoothness. Because this paper studies the interaction between the SSEC and the SZI, the time series should be smooth. The selected SSE Composite Index is SH and the SZ Composite Index is SZ, and the two sets of time series are tested for smoothness under the operating environment of Eviews11, and the results are shown in Table 1.

Table 1. ADF test results for SH and SZ series

Var	ADF test statistic	Prob.	1% level	5% level	10% level
SH	-2.553640	0.1057	-3.486551	-2.886047	-2.579931
SZ	-2.406608	0.1421	-3.486064	-2.885863	-2.579818

According to the results given in Table 1, the p-values of the sequences SH and SZ are greater than 0.1, indicating that they still cannot reject the original hypothesis at the 10% significant level, that is to say, there is a unit root in the sequences SH and SZ, and they have not passed the smoothness test.

Therefore, the following two sets of data will be further processed, taking the difference method to obtain the first-order difference series dSH, dSZ of SH, SZ respectively, and then the smoothness test of the series will be carried out again. The results are shown in Table 2 below.

Table 2. ADF test results for dSH and dSZ series

Var	ADF test statistic	Prob.	1% level	5% level	10% level
dSH	-7.360999	0.0000	-3.486551	-2.886047	-2.579931
dSZ	-9.646421	0.0000	-3.486064	-2.885863	-2.579818

3.2.2. Data processing results

According to Table 2, the first-order difference series of SH and SZ, dSH and dSZ, are able to reject the original hypothesis and pass the smoothness test at the 10% significance level. Therefore, dSH, dSZ are selected as the proxy series of SSEC and SZI before proceeding to the next study.

4. Empirical Analysis

4.1. Construction and testing of VAR models

4.1.1. Determination of the lag order

Given that the selected sample data are monthly data, the maximum lag of the variable is 12. As can be seen from Table 3, the AIC value is minimized to 29.45010 at a lag order of 8 and the SC value is minimized to 29.67312 at a lag order of 2. In case of differences in the optimal lag order given by the SC and the AIC, the lag order of the variable is generally determined with the help of

the Likelihood Ratio statistic (LR). The LR test value gives the optimal identification when p=8, which means the lag order is 8. Therefore, the lag order of the VAR model in this study will be determined as 8.

Table 3. Determination of the lag order

Lag	LogL	LR	AIC	SC	HQ
0	-1625.663	NA	30.42361	30.47357	30.44386
1	-1573.493	101.4139	29.52324	29.67312*	29.58400**
2	-1569.746	7.144633	29.52796	29.77776	29.62923
3	-1568.539	2.255623	29.58017	29.92989	29.72194
4	-1560.229	15.22320	29.49960	29.94923	29.68188
5	-1556.200	7.228507	29.49907	30.04862	29.72185
6	-1550.489	10.03419	29.46709	30.11656	29.73038
7	-1547.373	5.358002	29.48362	30.23301	29.78741
8	-1541.580	9.745443*	29.45010*	30.29941	29.79440
9	-1539.067	4.133513	29.47789	30.42712	29.86270
10	-1536.388	4.306968	29.50258	30.55173	29.92789
11	-1535.839	0.861551	29.56709	30.71616	30.03291
12	-1533.596	3.438568	29.59992	30.84891	30.10624

4.1.2. Granger causality test

During the study of economic variables, some of the variables are correlated with each other, but the significance is not strong. Therefore, exploring whether the change in one variable is the root cause of the change in another variable has become a central issue that needs to be explored urgently in economic research [1]. Granger causality is used to explore whether the current values of other variables are affected by the lagged terms of the variables [2]. The prerequisite for Granger causality test is that the time series must be smooth, and the above dSH and dSZ series are both smooth, so the Granger causality test can be performed, and the results are shown in Table 4.

Table 4. Granger causality test results

Null Hypothesis	F-statistic	Prob.
dSH does not Granger cause dSZ	-7.360999	0.0000
dSZ does not Granger cause dSH	-9.646421	0.0000

As shown in Table 4, there is Granger causality between the SSEC SZI. In order words, there is a dynamic and interactive influence between the SSEC and the SZI. So far, on the basis of the above, the lagged 8-period VAR model about SSEC and SZI is successfully constructed.

4.1.3. VAR model smoothness test

In the process of VAR model construction, the model root modes are all less than 1, and the AR roots are all in the unit circle, indicating that the VAR system has good smoothness [8]. The variance decomposition analysis and impulse response function analysis can be further developed. The AR root diagram of the VAR model constructed in this study is shown in Figure 1, and it can be seen that the unit roots are all in the unit circle, which indicates that the constructed VAR system has good flat stability and the test is passed.

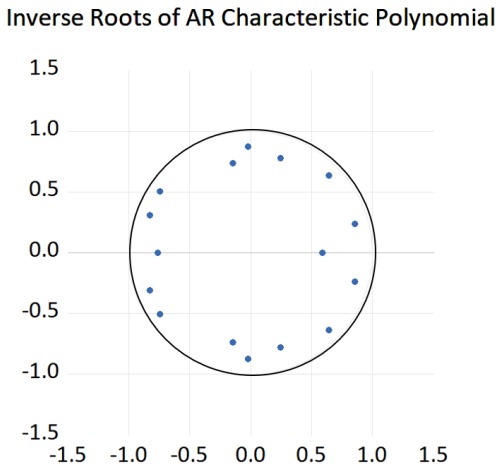

Figure 1. AR root plots in the VAR model

4.2. Estimated results

4.2.1. Impulse response function

Figure 2 and Figure 3 show the impulse response plots and the corresponding synthesized plots of the VAR models of the SSEC and the SZI established in this paper. According to the results given in Figure 2, the fluctuation of SSEC caused by the change of SZI is more intense at the beginning, and the shock effect disappears gradually after the 9th period. While the change of SZI caused by the change of SSEC is also more intense at the beginning, but the shock disappears gradually after the 7th period, which indicates that the reaction speed of the capital market to a certain degree needs to be improved. According to the results given in Figure 3, it can be seen from the impulse response synthesized graph that the impact of the SSEC on China's capital market is larger, whether it is the impact on itself or the SZI. The impact of the SZI on the SSEC is smaller.

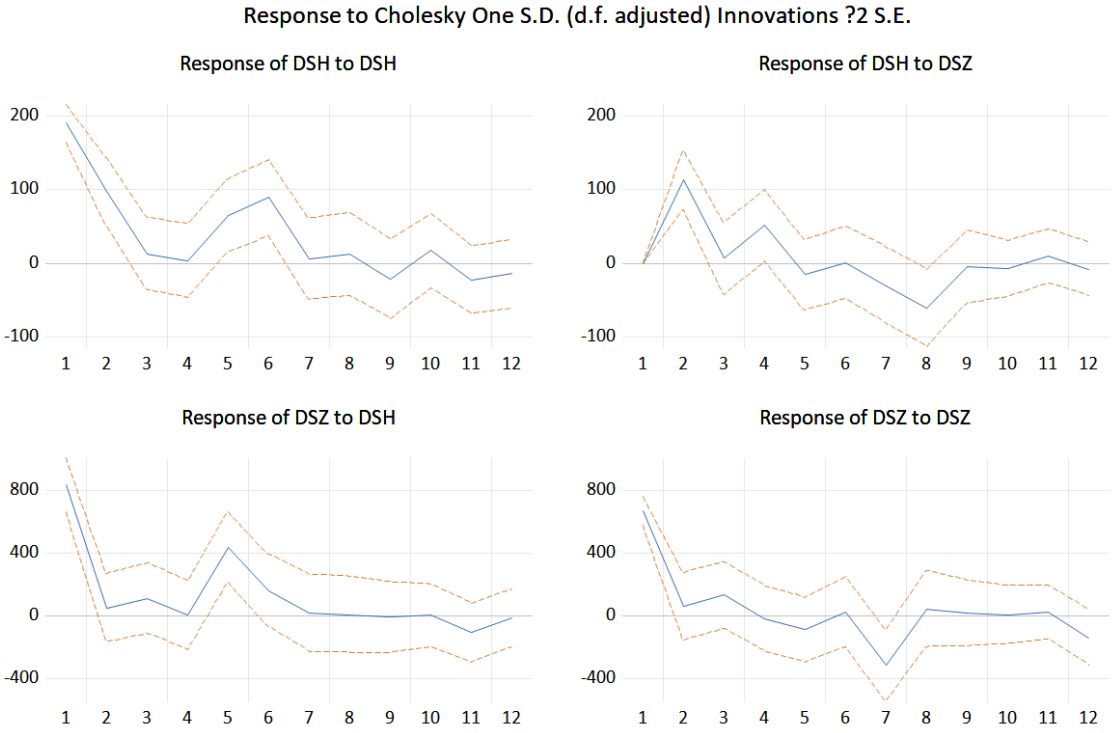

Figure 2. Diagram of impulse response

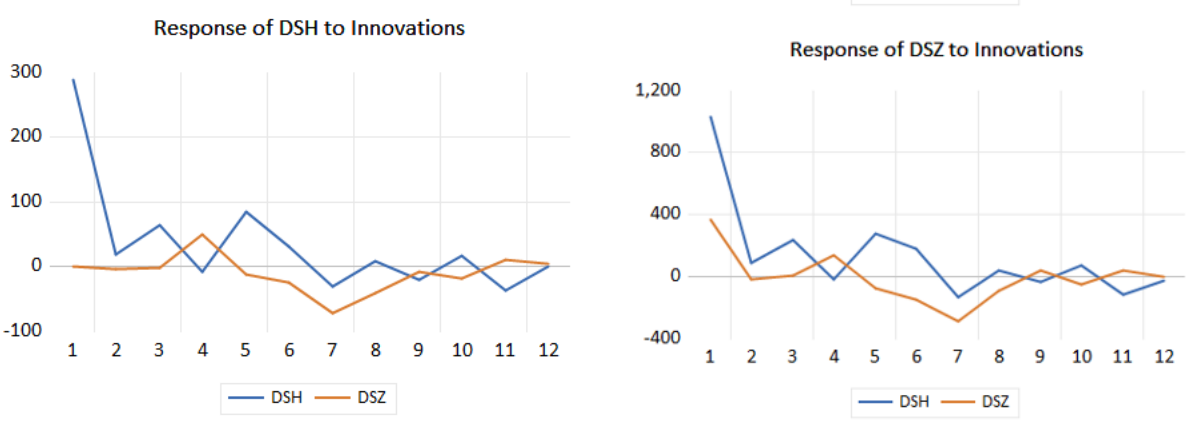

Figure 3. Impulse response synthesis plot

4.2.2. Variance decomposition

Variance decomposition can disentangle the contribution of each structural shock affecting the change of endogenous variables to explore the degree of importance under different structural shocks. On the basis of the VAR model, quantitative research is carried out on the relationship between the impact of different variables. As shown in Table 5, the SSCE is affected to change, and its impact due to its own shock's accounts for about 74%, while the SZI contributes about 26% of the impact.

In summary, according to the analysis of empirical results, whether for its own impact or for the impact of the capital market, the Shanghai stock exchange market's impact is higher than the impact of the Shenzhen stock exchange market, so most investors will tend to choose the changes in the SSCE to judge the trend of the general market, so as to determine their investment strategy.

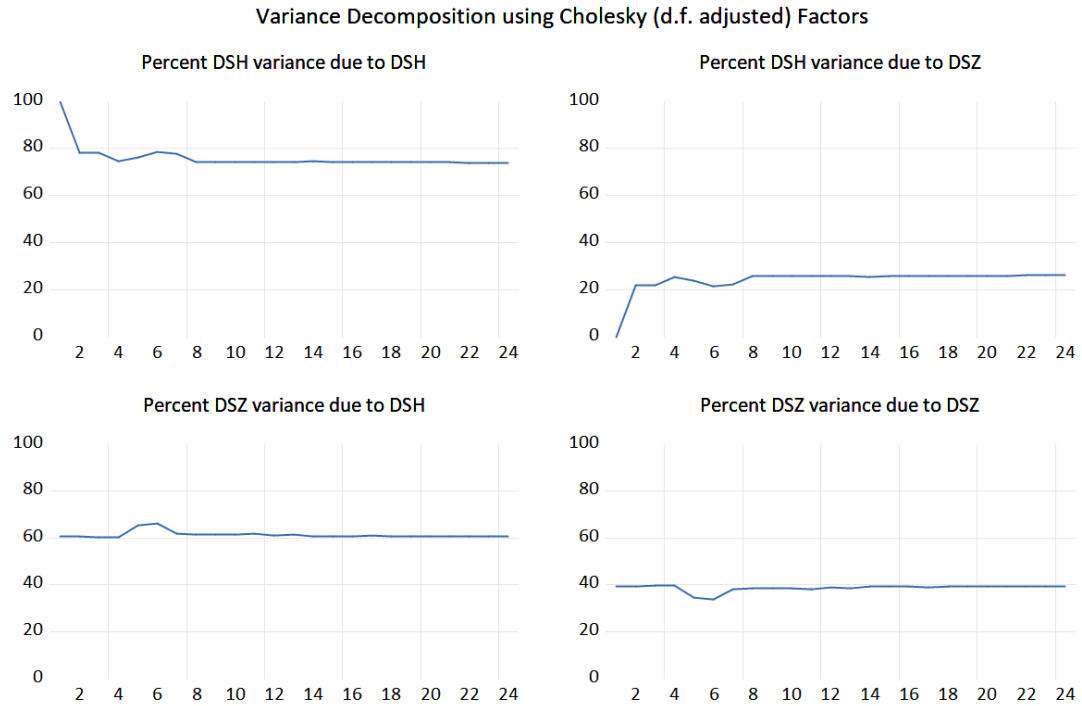

Figure 4. Graphical representation of variance decomposition

5. Summary

This paper focuses on the dynamic interaction between SSEC and SZI, also their impact on China's capital market. By selecting the monthly data of SSEC and SZI from 2009 to 2018, Granger causality test is conducted after verifying the smoothness, and it is concluded that the correlation between

SSEC and SZI is very large, with the quality of mutual influence. Then the VAR model is further established, and the impulse response function plot and synthetic plot of the SSEC and SZI are drawn after passing the smoothness test, and the variance decomposition analysis is carried out. To summarize, the SSEC has a greater impact on China's capital market, and to a certain extent, it can better refract the quotations of China's securities market, therefore, the inspiration for investors is that the SSEC has more reference value and significance when making investment.

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