

The Impact of Financial Liberalization and Trade Dependence on Stock Market Linkages between China and the US

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Keywords: Financial Liberalization, Trade Dependence, DCC-GARCH Model, VAR Model, Stock Market Linkages.

Abstract. Economic globalization is gradually strengthening linkages between capital markets in various countries. The United States and China, as the world's first and second largest economy, we study the linkages between their stock markets and provide significant implications for national regulators and investors. This study selects the Shanghai Stock Exchange Composite Index and the Standard & Poor's 500 Index to respectively represent the stock markets in China and the United States. The DCC-GARCH model is used to capture the dynamic correlation coefficient between the stock markets. The multiple regression analysis and the VAR model are used to explore financial liberalization and trade dependence, and to investigate their impact on the linkages between Chinese and US stock markets. This study found that because China's overall financial liberalization is low, it has an inhibiting effect on the linkages between Chinese and US stock markets. The closer the trade links between China and the US, the stronger the linkages between their stock markets. Three macroeconomic indicators, GDP growth rate difference, CPI difference, and interest rate difference are not good explanations for linkage changes between the stock markets.

Introduction

In 2019, China and the United States resumed "trade war" negotiations with substantial progress being made in Sino-US economic and trade consultations. Together with other positive effects, the Shanghai Stock Exchange (SSE) Composite Index rebounded after hitting 2464 points on January 3, 2019, while the US S&P500 Index rebounded after hitting a low of 2351 points on December 24, 2018. Since October of 2018, the SSE Composite Index's trend shows a high degree of consistency with that of the S&P500. This similarity is attracting the attention of domestic and international scholars to inquire and study the existence of a linkage and its internal mechanism.

A stock market linkage refers to the phenomenon where stock markets in different countries follow a common trend. Xu *et al.* [1] believe the linkage between stock markets provide investors a reference for investment behaviors, assist their rational allocation of global assets, and diversify investment risks. While also providing market regulators information to formulate reasonable policies, prevent risks, and maintain national financial stability.

Early domestic and foreign researchers mainly used different econometric methods to study the time-varying characteristics of the linkage between China and US stock markets. Scholars have found that the stock market linkage of China and other countries in the world has strengthened after the implementation of Qualified Foreign Institutional Investors (QFII) and Qualified Domestic Institutional Investor (QDII) programs. Li *et al.* [2] discover, after the implementation of the QFII and QDII programs, the linkage between China stock markets and other major national stock markets in the world is continuing to grow. Pan *et al.* [3] and Zhang *et al.* [4] find that implementation of the QFII and QDII programs is gradually increasing the linkage between China and US stock markets. Zhang *et al.* [5] discover that after the financial crisis, the stock markets of China and US were, on a whole, positively correlated, and the correlation strength was on the increase.

Recently, domestic and international scholars have begun to focus on the internal mechanisms that affect the linkage between China and US stock markets. Pretorius [6] shows that macro fundamentals can explain the linkage between the stock markets. Bekaert *et al.* [7] argue that financial liberalization can promote the flow of international capital, thereby strengthening the linkages between financial markets of various countries. Beine *et al.* [8] propose that trade and financial liberalization reforms positively impacts cross-border stock market linkages. Domestic scholars are also starting to pay attention to the internal mechanism of stock market linkage. You *et al.* [9] discover that as China's financial liberalization continues to deepen, its links with other economies in the world are getting stronger. Liu *et al.* [10] and You *et al.* [11] find that financial liberalization and trade liberalization would strengthen the linkage between stock markets. Yang *et al.* [12] propose that macroeconomic factors and financial variables in US are the main elements affecting the linkage changes between China and US stock markets. Gong *et al.* [13] show that the acceleration of China's financial liberalization does not attribute to the linkage between China and US stock markets, and it is mainly caused by the close trade links between the two countries. For research on China and US stock market linkages, domestic and international scholars mainly focus on the time-varying characteristics and internal mechanisms of the linkages. Scholars studying the internal mechanism are mainly observing the influence of relevant factors on linkage, while few are analyzing the degree of influence of related factors on linkage.

This paper mainly studies the internal factors affecting the linkage between China and US stock markets and the degree of influence of these factors from three aspects: China's financial liberalization, trade dependence between China and US, and macroeconomic factors. This study finds that financial liberalization creates a restraining effect on the linkage between China and US stock markets. The main reason is the large difference of financial openness between China and US. The closer the trade links between China and US, the stronger the stock market linkage between the two countries. Macroeconomic factors are not good explanations of the linkages between the stock markets of China and US.

Data and Methods

Financial Liberalization (CFLI)

Zhuang [14] and Fan [15] constructed the China's Financial Liberalization Index (CFLI) by subjectively measuring the impact of relevant reform events on financial liberalization and adopting a stepwise cumulative valuation method using principal component analysis. As each person has a different understanding of the importance of an event, this method is somewhat subjective. Considering the objectivity of the data and referencing related literature, the degree of financial liberalization in this paper is drawn from the Index of Economic Freedom published by The Heritage Foundation in the United States.

Trade Dependence (TRADE)

After China's accession to the WTO, China's trade liberalization has gradually deepened, and trade links with various countries in the world have increased, becoming the world's largest exporter. In general, the closer the trade between two countries, the stronger the linkage between their stock markets. According to Pretorius [6], the definition of trade dependence is represented with Eq. 1.

$$\text{TRADE}_{ijt} = \frac{Z_{ijt} + M_{ijt}}{Z_{it} + M_{it}} + \frac{Z_{ijt} + M_{jit}}{Z_{jt} + M_{jt}}. \quad (1)$$

In Eq. 1, Z_{ijt} and M_{ijt} represent the import and export from China to US in the t -th period, whereas, Z_{it} and M_{it} are China's total imports and total exports in the t -th period. The data are collected from the China Economic Database and US Census Bureau's websites.

Other Control Variables

Considering data availability and to better reflect the macroeconomic factors of China and US, this paper uses the variation in GDP growth rate, inflation rate, and interest rate to reflect the macro differences of China and US. The difference in GDP growth rate is defined as the absolute difference of the GDP growth rate of each quarter in China and US. The difference in inflation rate is defined as the absolute difference of Consumer Price Index (CPI) for China and US. The interest rate difference is defined as the absolute difference between the US federal funds rate and China's interbank pledged repo rate. The data comes from the Wind database.

Methods

Chiang's [16] statistical analysis shows a significant change in the correlation of stock returns in various countries after China joined the WTO, so the research period of this paper is set between January 1, 2002 and December 31, 2018. Using the SSE Composite Index and S&P 500 Index to represent the stock markets of China and US, with data from Yahoo Finance, the daily rate of return is calculated as $r_t = 100 \times (\ln P_t - \ln P_{t-1})$. This study uses the Dynamic Conditional Correlation - Generalized Auto Regressive Conditional Heteroskedasticity (DCC-GARCH) model to extract the dynamic linkage between the stock markets of China and US. (cf. Tsai *et al.*, [17]; Wang *et al.*, [18]) Using multiple regression analysis and Vector Autoregression Model (VAR) model to analyze the impact of financial liberalization and trade dependence on the linkage between China and US stock markets.

Empirical Analysis

Descriptive Statistics

Descriptive statistics are performed on the yields of the SSE Composite Index (SCI) and Standard & Poor's 500 Index (S&P500), China's Financial Liberalization Index (CFLI), trade dependence (TRADE), and three other macroeconomic indicators (GDP, CPI, and IR). The results are listed in Table 1.

Table 1. Basic Statistical Characteristics of Model Indicators.

| Variable | SCI | S&P500 | CFLI | TRADE | GDP | CPI | IR |
|-----------|---------|---------|---------|--------|--------|--------|---------|
| Mean | 0.0105 | 0.0199 | 53.0625 | 0.2701 | 0.1012 | 1.3707 | 2.1903 |
| Median | 0.0550 | 0.0598 | 52.6000 | 0.2694 | 0.1006 | 1.1330 | 2.1128 |
| Std. Dev. | 1.5938 | 1.1850 | 1.8080 | 0.0248 | 0.0378 | 0.9538 | 1.3066 |
| Minimum | -9.2561 | -9.4695 | 51.0000 | 0.2103 | 0.0344 | 0.0000 | 0.0016 |
| Maximum | 9.0345 | 10.9572 | 57.8000 | 0.3324 | 0.1830 | 4.5230 | 11.5217 |

The results in Table 1 show that, between 2002 and 2018, the average yield of the S&P 500 Index is slightly higher than that of the SSE Composite Index, and the S&P500 yield was less volatile. The average value of China's financial liberalization index for 2017 was 53.06, with a maximum of only 57.8. The world's top financial liberalized country, Hong Kong, is stable at around 90, indicating that China's financial openness is relatively low.

DCC-GARCH Model and Multiple Regression

After the data is tested for stability, the DCC-GARCH model is used to capture the dynamic correlation coefficients of the stock markets in China and US. The results are shown in Fig. 1.

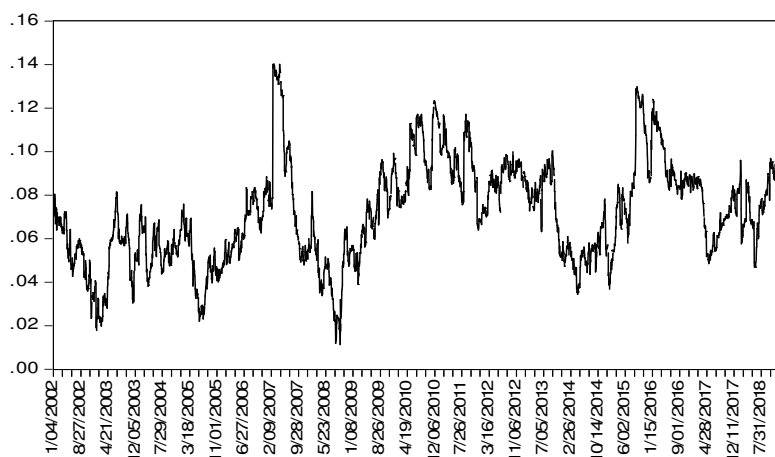


Figure 1. Dynamic Correlation Coefficient between the SSE Composite Index and S&P500 Index.

Since the financial liberalization index is an unstable time series, the dynamic correlation coefficient of the two major stock indexes captured by the DCC-GARCH model is regressed with the financial liberalization growth rate, trade dependence, and indicators representing macro fundamentals. As shown in Table 2.

Table 2. Regression Results.

| Index | ΔCFLI | TRADE | GDP | CPI | IR | C |
|-----------------|---------------------|-----------|-----------|------------|-----------|------------|
| Effect | -0.2701*** | 0.3375*** | 0.0418*** | -0.0040*** | 0.0032*** | -0.0240*** |
| <i>p</i> -value | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |

Note: Financial liberalization index growth rate $\Delta\text{CFLI}_t = \ln(\text{CFLI}_t - \text{CFLI}_{t-1})$.

The regression results show that the growth coefficient of China's financial liberalization index is negative, indicating an accelerated pace of China's financial liberalization, which inhibits the linkage between China and the US stock market, this result is inconsistent with economic theories. The coefficient of trade dependence is positive and significant, in accord with economic theories, indicating that as trade dependence increases, so does the linkage between China and US stock markets. The coefficient of GDP growth rate difference and interest rate difference is positive, which is inconsistent with economic theories, while the coefficient of CPI difference is negative, consistent with economic theories.

VAR Model and Impulse Response Analysis

To further analyze the impact of China's financial liberalization, degree of trade dependence, and macroeconomic differences between China and US on the linkage between China and US stock markets, this paper uses the VAR model to perform empirical analysis. We first determine the optimal lag order for VAR model estimation. According to the corresponding statistic and minimum information criterion, the optimal lag order selected is the first-order, as shown in Table 3.

Table 3. Determination of Lag Order.

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|-----|----------|-----------|-----------|------------|------------|------------|
| 0 | 23706.88 | NA | 2.82e-13 | -11.87122 | -11.86176 | -11.86786 |
| 1 | 70051.64 | 92527.02 | 2.38e-23* | -35.06619* | -35.00000* | -35.04272* |
| 2 | 70071.91 | 40.40183 | 2.40e-23 | -35.05831 | -34.93539 | -35.01473 |
| 3 | 70090.38 | 36.77826 | 2.42e-23 | -35.04953 | -34.86988 | -34.98584 |
| 4 | 70127.26 | 73.28504* | 2.42e-23 | -35.04997 | -34.81359 | -34.96617 |
| 5 | 70138.45 | 22.21990 | 2.45e-23 | -35.03754 | -34.74444 | -34.93364 |

To further clarify the correlation between Sino-US stock market linkage and various influencing factors, a first-order VAR model was established. According to the estimation result of the VAR model, the expression between the linkage and each influencing factor is expressed as Eq. 2.

$$DCC_t = 0.9878 \times DCC_{t-1} - 0.0053 \times \Delta CFLI_{t-1} + 0.0080 \times TRADE_{t-1} + 0.0015 \times GDP_{t-1} + 1.9267e^{-5} \times CPI_{t-1} + 2.7302e^{-5} \times IR_{t-1} - 0.00150. \quad (2)$$

As express in the VAR model, the linkage between China and US stock markets and the first-order lag term of China’s financial liberalization index growth rate is positively correlated with the first-order lag term of trade dependence, which is consistent with the multiple linear regression results. The correlation between China-US stock market linkage and three macroeconomic indicators is inconsistent with economic theories.

A stable VAR model is a requirement to perform impulse response and variance decomposition. Otherwise, the impulse is divergent, will not conform to the actual economic system, and cannot be further explained and analyzed. The robustness test results of the VAR model are shown in Fig. 2.

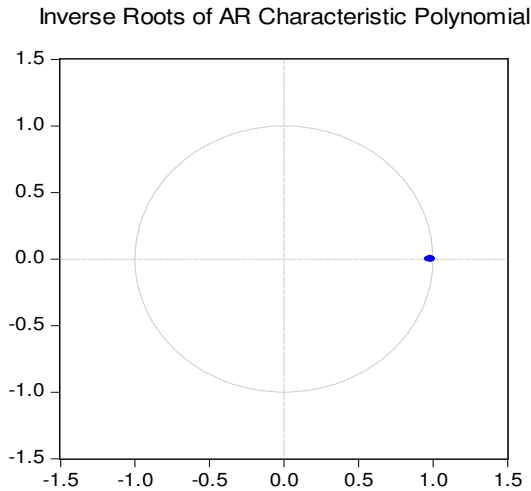


Figure 2. VAR Model Robustness Test.

All eigenvalues of the VAR model are located within the unit circle, and the established VAR model is stable, which indicates its applicability for impulse response analysis and variance decomposition. The impulse response is mainly used to analyze the impact of an endogenous variable on the error term, that is, the impact on the current and future values of the endogenous variable when a standard deviation of the random error term is applied. The results of the impulse response analysis are shown in Fig. 3.

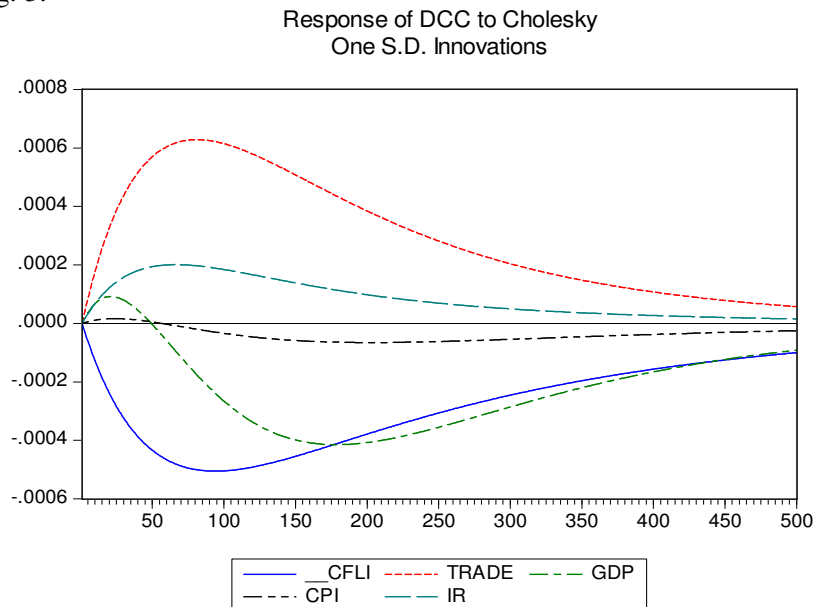


Figure 3. Impulse Response Analysis.

The impulse response graph shows that when a standard deviation impact occurs, the growth rate of China's financial liberalization index has a negative reaction to the linkage between China and US stock markets. Trade dependence has a positive impact on the linkage between China and the US stock market, gradually reaching a maximum and then falling towards a stabilized point. The three macro fundamental variables all have a positive impact on the linkage between China and US stock markets, but the GDP growth rate and CPI differences have, over time, led to a negative impact.

To further observe the importance of different structural impacts, the contribution of each structural impact to variable changes is analyzed by the variance decomposition method. The results of variance decomposition are shown in Fig. 4.

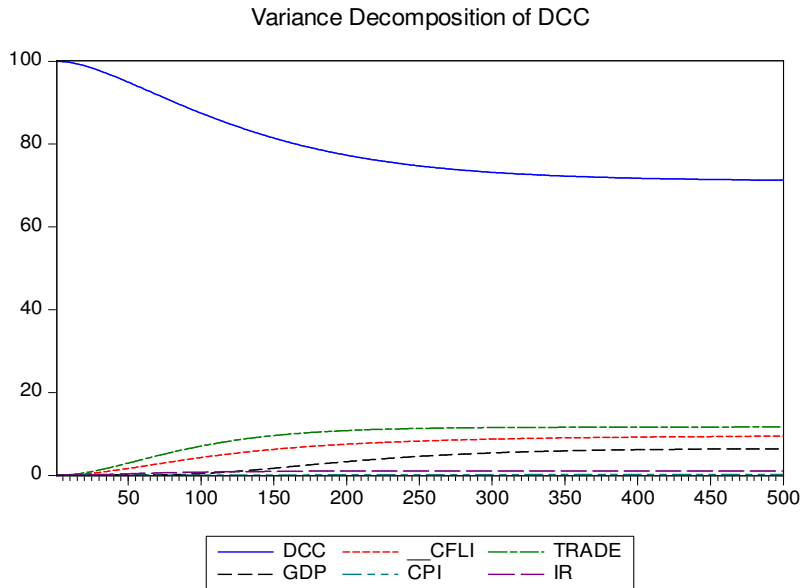


Figure 4. Variance Decomposition.

The variance decomposition results show that the linkage change between China and US stock markets is mainly affected by its own volatility. The contribution of trade dependence to the linkage change of Sino-US stock market is 11.66%. The contribution of the growth rate of China's financial liberalization index to the linkage change is 9.44%. The contribution of the difference in GDP growth rate to the linkage change is 6.42%. The difference between CPI and interest rate has little contribution to the linkage change between China and US stock market linkage.

Result Interpretation

Based on the comprehensive multiple linear regression and VAR model results, China's financial liberalization growth rate and trade dependence explain the linkages between China and US stock markets to a certain extent. The three macroeconomic indicators, GDP growth rate difference, CPI difference, and interest rate difference between China and US are not main influencing factors affecting the linkage change between China and US stock markets.

The acceleration of China's financial liberalization restrains the linkage between China and US stock markets. It may be due to the big gap between China and US's level of financial liberalization. China's level of openness in the financial sector is still relatively low. Exchange rate and interest rates marketization, and the internationalization of the Chinese yuan is still in progress. Capital accounts are not fully open, and capital projects are not fully exchangeable, resulting in a relatively small role foreign investors can play in the price discovery mechanism of China's stock markets. Investors in China are unmaturred compared to foreign rational investors. The speculative atmosphere is still serious, which weakens the process of China's liberalization and accelerates the promotion of Sino-US stock market linkage.

The linkage between China and US stock markets has a positive relationship with trade dependence, indicating that as trade between the two countries becomes closer, the linkage between

the stock markets will also strengthen. The main reason is that after China joined the WTO in 2001, trade barriers between China and US have gradually decreased, trade has become more frequent, the import and export trade between the two countries has rapidly grown, and the economic ties have become stronger. This leads to a stronger linkage of stock market between the two countries.

The three macroeconomic indicators are not good explainers for linkage changes between China and US stock markets. It may be because the United States is already the most developed country in the world, and its economy is in a leading position in the world. The US financial market also dominates the world financial market, it has already passed the stage of rapid economic development, and its GDP growth rate is lower than that of China, which is in the development stage. Although China ranks second in the world in terms of economy, second only to the United States, the degree of financial market developments is still far from the United States. The development of the economy and financial markets is unbalanced. China's stock market has not attained the role of an "economy forecaster". Therefore, the macroeconomic indicators are not the main reason for the linkage changes in the China and US stock markets.

Conclusion

With the DCC-GARCH model, this study captures the dynamic correlation coefficient between China and US stock markets after China's entry into the WTO. It explores the factors affecting linkage change through multiple regression analysis, and further explores China's financial liberalization, trade dependence, and three macroeconomic indicators through the VAR model to understand the extent to of their impact on the linkage between China and US stock markets. This study finds the following.

First, China's financial liberalization growth rate and trade dependence can explain the linkage change between China and US stock markets to an extent, but the three macroeconomic indicators, GDP growth rate difference, CPI difference, and interest rate difference, are not main impacts on the linkage changes of China and US stock markets.

Second, the acceleration of China's financial liberalization process has a certain inhibitory effect on the linkage between China and US stock markets. It may be caused by the different degree of China's financial liberalization compared to that of the United States. Foreign capital plays a smaller role in the China stock price discovery mechanism. The increase in trade dependence between China and US will strengthen the linkage between China and the US stock markets. As the trade between the two countries become closer, the linkage between their stock markets will continue to strengthen.

China has taken many measures to promote the development of its financial liberalization, however, there is still a large gap compared with developed countries, such as the United States. In the future, China should continue to deepen the reforms of financial liberalization and narrow the gap with the United States in terms of the degree of financial marketization, but at the same time, China should also pay attention to the spread of financial risks. While attaching importance to financial liberalization, we should also improve relevant laws and regulations, preserve controllability and graduality of market openness, prevent systemic risks, and maintain national financial stability.

Acknowledgement

This work was supported by the Hundred Talents Program for High-Level Taiwanese Talents Introduction of Fujian Province, China; the Natural Science Foundation of Fujian Province, China (Grant No. 2017J01800); and the Science and Technology Foundation of Minjiang University (Grant No. MYK18045).

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