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Study on the Dynamic Correlation between Chinese and American Financial Markets

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ABSTRACT

With the deepening of the economic globalization and finance liberalization, the financial links between open economies are becoming closer and closer, and the interconnectivity between international financial markets is gradually increasing. With the support of DCC-GARCH model, the paper conducts an empirical study towards the dynamic correlation between American and Chinese stock markets. The result indicates that the logarithmic return series of Shanghai Composite index and S&P 500 index both show apparent volatility clustering and constancy. The correlation between them shows significant time variability, but the dynamic degree of their correlation is relatively low.

INTRODUCTION

In recent years, the opening of China's financial market has been accelerated and China has become more closely connected with the international financial market. This is mainly due to two aspects: first, China's active participation in the process of economic globalization. China's entry into the WTO in December 2001 not only deepened the opening of its domestic economy to the outside world, but also promoted the opening of financial markets, especially capital markets. Second, the introduction and implementation of a series of opening-up policies in China's financial market. In the course of world economic integration, China and the United States, as the largest developing country and the largest developed country respectively in the world, have always attracted much attention for bilateral economic and trade cooperation.

LITERATURE

Basically, the researches on interconnection between international financial markets of domestic and foreign scholars can be divided into two aspects: firstly, researches based on the economic fundamentals such as financial connection, trade connection, etc. For instance, Andersen et al. (2007) (and others) found that the high degree of interconnectedness of the stock, bond and foreign exchange markets among the US, UK and Germany is closely connected to the macroeconomic fundamental. Secondly, 'financial contagion' triggers the interconnection of international financial markets. For example, through the analysis to the former financial crisis, Caramazza et al. (2004), Conolly and Wang (2003) figured out a conclusion that financial crisis induced the obvious ascent in correlation among international financial capital markets. At the same time, Diebold and Yilmaz (2009) empirically analyzed the mean and volatility spillovers on the stock returns of 7 developed financial markets and 12 emerging financial markets. The study proved that there were significant mean and volatility spillovers among the selected financial markets, and they had different features. Yan and Zhao (2016) study the impact brought by the launch of Shanghai-Hong Kong Stock Connect on the co-movement between the mainland and Hong Kong financial markets, and the result demonstrates that after the launch of Shanghai-Hong Kong Stock Connect, the dynamic correlation coefficient between the mainland and Hong Kong financial market improves remarkably.

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Regarded as the largest developing and developed country respectively, what is the relationship between the changes in financial markets between China and the United States? Under the circumstances of changing international situation and endless hot issues, could there be time-varying inside the relationship between Chinese and American financial markets? Through studying these questions, the understanding of the linkage between American and Chinese financial markets will be deepened, which makes the study in this article practical and important.

RESEARCH

Method of Research

With the continuous deepening of global integration, it is easier for capital to transfer among different international financial markets, and the financial shocks can be transmitted among the financial markets more smoothly. Thus, when analyzing the correlation between financial markets in America and China, not only should we start from the correlation of the changing tendency of income level in different financial markets, but also need to focus on the transmission of risk in different financial markets. Based on this, this article, with the multivariate DCC-GARCH model, studies and corroborates the dynamic correlation between Chinese and American financial market. Multivariate DCC-GARCH model is as follows:

$$H_t = D_t \hat{Q}_t^{-1} D_t$$
$$\varepsilon_t = D_t^{-1} r_t$$
$$D_t = diag(\sqrt{h_{11,t}}, \cdots, \sqrt{h_{nn,t}})$$
$$\hat{Q}_t = diag(\sqrt{q_{11,t}}, \cdots, \sqrt{q_{nn,t}})$$

Within them, $\hat{Q}_t$ obey $Q_t = (1-a-b)\bar{Q} + a\mu'_{t-1}\mu_{t-1} + bQ_{t-1}$, $\bar{Q}$ is the unconditional variance matrix, a and b are the coefficients of DCC model and meet the condition that $a+b<1$. The influence of previous standard deviation on correlation coefficient can be reflected by the variation of the DDC coefficient a; and constancy of the correlation coefficient can be reflected by the DDC coefficient b.

Population, Sample and Survey Form

In the article, we take the dynamic correlation between American and Chinese stock market as the starting point, and the data used in the article is from January 1 2009 to December 31 2017 from Shanghai composite index (SZ) and S&P 500 index (SP). Data is also from wind database. The changing tendency during the analysis period is showed in the figure 1 below. As it is shown on the figure, the SZ is based on the left ordinate, and SP is based on the right ordinate.

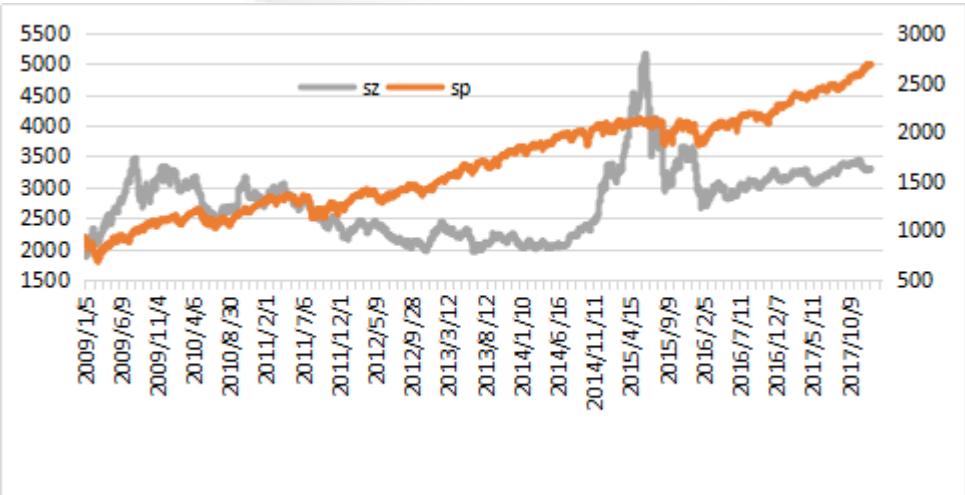

Fig. 1. The changing tendency of SZ and SP

From Figure 1, the changing tendencies of SZ and SP are not constantly according: the relation between them is time-varying, that is, as time goes on, the correlation between them is also varying. This variation is reflected not only in the degree of correlation, but also in the direction of the correlation.

Data Analysis

Generally speaking, when studying the interconnection between the stock markets, the logarithmic return rate of the index is often taken as the analysis target. Following this approach, the article firstly take the logarithm of SP and SZ, then process the data with the first order difference and obtain the logarithmic return sequences of SP and SZ.

Statistical Analysis

Their descriptive statistics is as follows. (Table 1)

Table 1. The Descriptive Statics of Sequences

	$D\ln sz_t$	$D\ln sp_t$
Mean	0.0003	0.0005
Std. Dev.	0.0149	0.0107
Median	0.0007	0.0007
Maximum	0.0604	0.0684
Minimum	-0.0887	-0.0690
Skewness	-0.7924	-0.1568
Kurtosis	8.0165	8.6361
Jarque-Bera	2439.0360	2808.0300
Probability	0.0000	0.0000
Sample Capacity	2115	2115

From Table 1 we can learn that the descriptive statistics of logarithmic return sequence of SZ ($D\ln sz_t$) and the logarithmic return sequence of SP($D\ln sp_t$) are relatively close. Specifically speaking, the mean values of logarithmic return sequence of SZ ($D\ln sz_t$) and logarithmic return sequence of SP ($D\ln sp_t$) are 0.0003 and 0.0005 in turn; the standard deviations are 0.0149 and 0.0107 in turn; the medians are both 0.0007; the maximums are 0.0604 and 0.0684 respectively; and the minimums are -0.0887 and -0.0690 in turn. Their skewness is both below 0 and peaks are both above 3. Jarque-Bera statistic values are a bit larger, and their corresponding adjoint probabilities are both close to 0. Thus, neither of these logarithmic return sequences fit the normal distribution, instead, they both manifest the typical fat-tailed distribution, which fits the condition of the volatility modeling.

EMPIRICAL ANALYSIS

Use the DCC-MVGARCH model to study the dynamic linkage: first of all, construct the single argument for both logarithmic return sequences; then figure out the standard deviation: divide the residual obtained in GARCH process by conditional variance; and at last, estimate the dynamic linkage coefficient with the standard deviation in maximum likelihood estimation method.

Utilize the DDC-MVGARCH model with the support of winrats 8.0 software and the conditional variance equation of logarithmic return sequences can be calculate.

The conditional variance equation of logarithmic return sequence of SZ ($D\ln sz_t$) is:

$$\sigma_t^2 = 2.0624e-4 + 4.7123e-7 + 0.0486\varepsilon_{t-1}^2 + 0.9500\sigma_{t-1}^2$$

And the conditional variance equation logarithmic return sequence of SP ($D\ln sp_t$) is:

$$\sigma_t^2 = 7.1762e-4 + 2.3821e-6 + 0.1256\varepsilon_{t-1}^2 + 0.8524\sigma_{t-1}^2$$

It can be seen from the estimated coefficients of these conditional variance equations, the logarithmic return sequences of both Shanghai composite index and S&P 500 index have volatility clustering and continuity.

Estimate DDC model with the maximum likelihood estimation method. The result is shown in Table 2.

Table 2. Estimation of DCC Model

Variable	Coefficient	Std. Dev.	T statistic	Probability
Theta(1)	0.0115	0.0095	1.2127	0.2252
Theta(2)	0.9160	0.0678	13.5120	0.0000

It can be learned from Table 2 that coefficient a equals 0.0115, which means that fluctuation of market rate of return changes the dynamic coefficient in relatively low degree. B equals 0.9160, which is approximate to 1, showing that the dynamic linkage between Chinese and American stock markets will last for a long period. In conclusion, the dynamic linkage phenomenon between Chinese and American markets is quite apparent.

As time goes on, the correlation between stock markets in China and America also fluctuates. Figure 2 shows the dynamic linkage coefficient in two markets.

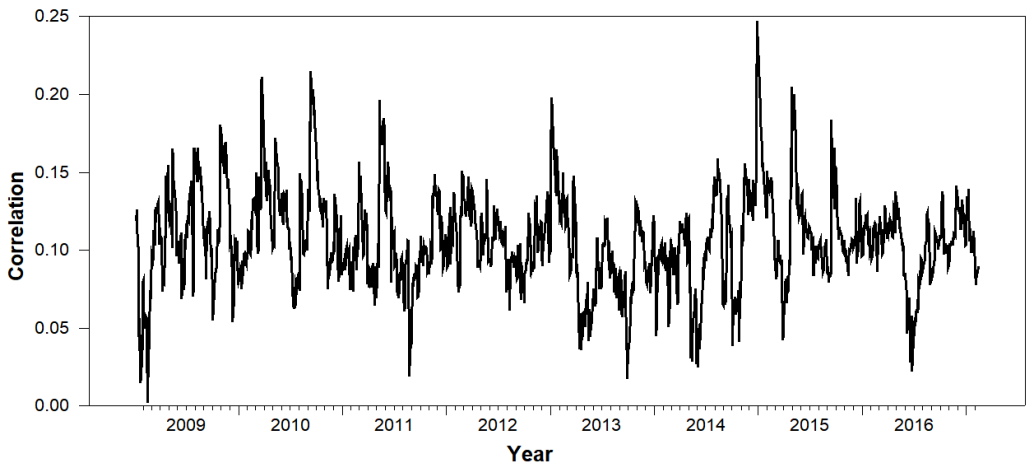

Fig.2. The Changing Tendency of the Linkage Coefficient between Chinese and American Finance Market

From Figure 2, we can see that the dynamic linkage coefficient is time-varying in some degree, but the overall level of interactivity between the two markets is relatively low with the mean value around 0.12.

CONCLUSIONS

In the article, the DCC-MVGARCH model is used and the dynamic correlation between Chinese and American financial markets during 2009-2017 period is empirically studied with the logarithmic return sequence of Shanghai composite index and the logarithmic return sequence of standard S&P 500 index. The result shows that both the logarithmic return sequences of Shanghai composite index and standard S&P 500 index contain the significant volatility clustering and continuity, and their linkage mechanism is time-varying. However, the dynamic correlation between the two is at a relatively low degree in general.

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