Analysis of the Co-Movement of Economic Growth of BRICS Countries

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ABSTRACT

The sustained and steady growth of the BRICS economy is of great significance to the development of the world economy. This paper studies the co-movement of BRICS economic growth. The research based on the economic data of BRICS countries in 2001-2016. Firstly, the graphic method is used to describe the existence of co-movement. Then Pearson and Spearman correlation coefficients and rolling correlation are designed to measure the co-movement of economic growth of BRICS countries. The results show that the economic growth of the BRICS countries has a common driving force. The economic growth of most BRICS countries has obvious common trends, and there are characteristics of national differentiation and time differentiation in them. The conclusions highlight the importance of greater economic cooperation among BRICS countries. And all of the BRICS countries should maintain the economic stability and jointly defend the international crisis.

Keywords: Co-movement, Economic growth, BRICS countries

1. INTRODUCTION

With the continuous improvement of the economic strength of the BRICS countries, the sustained growth of the world economy emphasis more on the contribution of BRICS countries. BRICS consists of five highly dynamic and potential emerging market countries, namely, Brazil, Russia, India, China and South Africa, which is a new model for multilateral cooperation in emerging countries.

With the increase of the proportion of the BRICS economy and the deepening of economic globalization, it is necessary to study the co-movement of economic growth of BRICS countries. For the BRICS countries, the fluctuation of economic growth among member countries has an important impact on the sustained and steady growth of the internal economy of the BRICS countries. For the whole world economy, the fluctuation of economic growth of the BRICS countries have an important impact on the world economic fluctuations.

2. LITERATURE REVIEW

Previous studies have shown that the international transmission of economic fluctuations is the central issue of the co-movement of international economic growth. As for the analysis of the co-movement of economic growth, Dornbusch (1980) established the feedback model firstly to analyze the interaction mechanism of each country's economy [1]. Stockman & Tesar (1995) put forward the theory of international business cycles to study the co-movement of economic fluctuations [2]. But for the existence of international economic co-movement, Dellas, et al. (1993) [3] and Cardia, et al. (2004) [4] come to the opposite conclusion. The former believes that the characteristics of economic fluctuations among countries are very obvious.

For the transmission mechanism of international economic co-movement, the research is mainly focus on the follow three aspects. Firstly, the international trade channels. Frankel (1998) [5] and Yi, et al. (2006) [6] found the bilateral trade intensity of developed countries is positively related to the bilateral correlation of economic cycles. Secondly, the international capital channel. Candelon, et al. (2011) [7] studied the financial liberalization and story linkage effects in emerging economies. Thirdly, the industrial structure channel. Song, S.F., et al. (2011) [8] argued that China's industrial structure is linked to economic fluctuations. While Martins, et al. [9] argued that there is no significant relationship between industrial structure and economic fluctuations.

The existing literature mainly uses the method of mapping analysis method and correlation coefficient method to explore the problem of co-movement, and the research objects are mainly concentrated in developed countries and regions. Therefore, this paper hopes to make contributions in the following two aspects: Firstly, the research object innovation. Different from the existing literature, which mainly study the economic cycle fluctuations in developed countries, this paper focuses on the economic growth of BRICS countries and their co-movement problem. Second, the research method innovation. This paper build Pearson and Spearman rolling correlation coefficient, and verifies the existence of co-movement of BRICS economic growth.

3. RESEARCH DESIGN

3.1. Theoretical Analysis

BRICS, as representatives of emerging market countries, are similar in terms of market, resources, factors, economic structure and development level. First, the economic fundamentals are similar. By 2016, the proportion of the tertiary industry in the BRICS countries reached more than 50%. And these countries have great potential for economic development in the future. Second, the international status and interests are similar. Russia has the largest land area in the world. The population of China and India is the first and second in the world. Russia is called "the world gas station", Brazil is the "raw material factory of the world", India is the "office of the world", South Africa is the bellwether of Africa's economy and has a large middle class population. Thus, the BRICS countries have common economic fundamentals and interests in the world.

3.2. Empirical Analysis

3.2.1. Graphic method

In view of the international approach to test the existence of co-movement. Graphic method was used to describe the existence of co-movement. The time series data for the economic growth of BRICS countries were obtained from the 2001-2016 US dollar-denominated GDP after the CPI deflator. The data comes from the World Development Indicators Database (WB WDI database) of Word Bank.
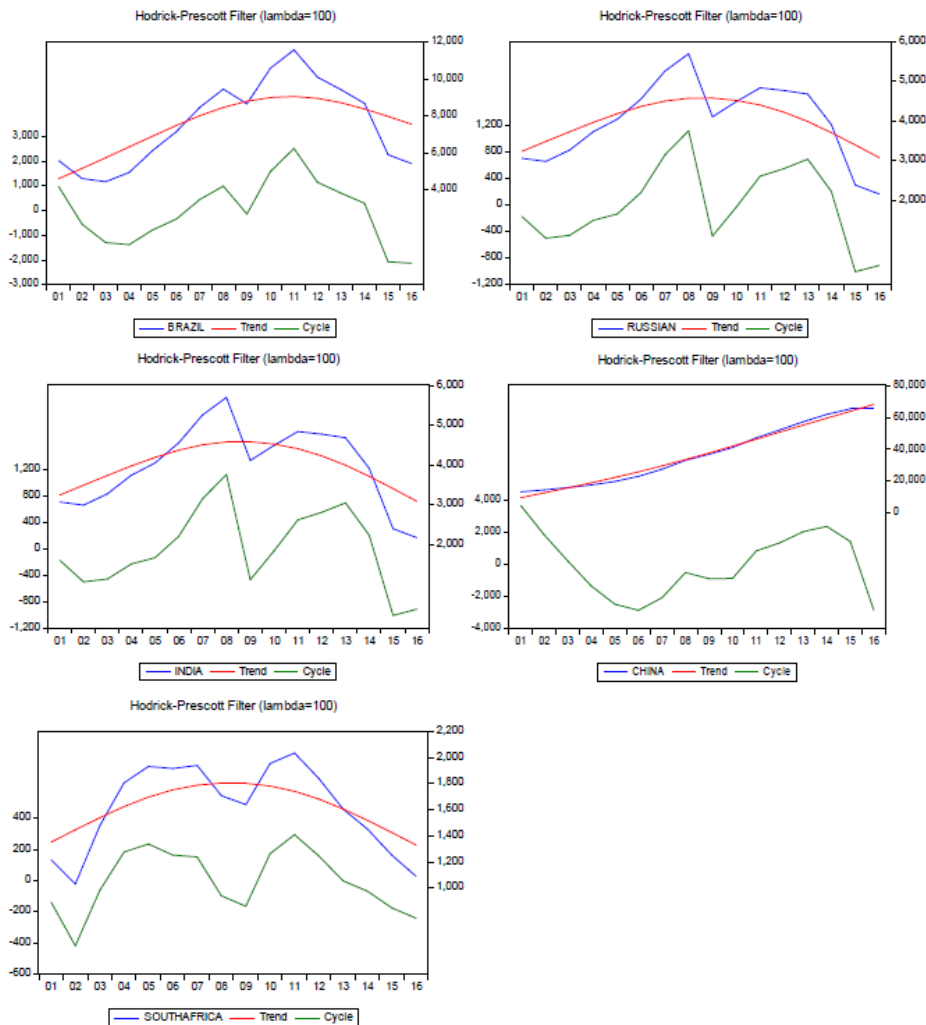

Figure 1 Economic growth fluctuation curve of BRICS in 2011-2016

Through the observation of the BRICS economic growth synergies chart (Figure 1), it can be seen that there are two peaks in 2008 and 2012, and two troughs of 2002 and 2009 (The trough of China's economic growth is in 2006 and 2009). Although countries are not the same time to reach peaks and troughs exactly, it can still be seen that the rising and falling trends are basically overlapping over several periods of time. Thus, there may be a certain degree of co-movement of BRICS economic growth. Figure 1 shows that countries have reached a trough in 2009, and the specific time is very similar. It may because of the 2008 financial crisis mainly. The BRICS economy suffers from the deterioration of the internal and external economic environment. Despite the degrees of the shock are different, the economic fluctuation of each country still tends to be consistent on the macro level.

3.2.2. Correlation coefficient method

The correlation coefficients of economic growth fluctuations in BRICS countries are calculated to accurately reflect the size of economic growth co-movement of each country. (Table 1). The Pearson and Spearman correlation coefficients are calculated simultaneously. As can be seen from Table 1, the economic growth between most BRICS countries has significant co-movement, such as the Pearson and Spearman correlation coefficients for economic growth in Brazil and other BRICS countries are significant at 10% confidence level (bilateral). The Pearson and Spearman correlation coefficients of economic growth in some country groups (Russia and South Africa, China and India) are significant at 1% confidence level (bilateral). The economic co-movement among a small group of BRICS countries are not significant. Such as, Russia and China, Russia and India.

Table 1 Correlation coefficient of the co-movement of BRICS economic growth in 2001-2016

		Brazil	Russia	India	China	South Africa
Brazil	Pearson correlation coefficient	1	0.756***	0.702***	0.441*	0.624***
	Spearson correlation coefficient	1	0.774***	0.618**	0.488*	0.626***
Russia	Pearson correlation coefficient	0.756***	1	0.264	-0.088	0.803***
	Spearson correlation coefficient	0.774***	1	0.215	0.068	0.756***
India	Pearson correlation coefficient	0.702***	0.264	1	0.865***	0.297
	Spearson correlation coefficient	0.618**	0.215	1	0.885***	0.303
China	Pearson correlation coefficient	0.441*	-0.088	0.865***	1	-0.123
	Spearson correlation coefficient	0.488*	0.068	0.885***	1	-0.009
South Africa	Pearson correlation coefficient	0.624***	0.803***	0.297	-0.123	1
	Spearson correlation coefficient	0.626***	0.756***	0.303	-0.009	1

Note: *, * *, and * * mean significant at the statistical levels of 10%, 5% and 1%.

However, Table 1 can not reflect the process of the change of their co-movement. Therefore, a rolling correlation coefficient of 10 years is designed (see Table 2). The formula is as follows.

$$\rho_{k,t} = \frac{COV(Y_{k,t}^1, Y_{k,t}^2)}{\sqrt{\mathrm{var}(Y_{k,t}^1) * \mathrm{var}(Y_{k,t}^2)}}$$

As can be seen from Table 2, the co-movement of the 2001-2016 years of economic growth in the BRICS countries show two characteristics. One is that the rolling correlation coefficient of economic growth in some country groups are decreasing gradually. Such as Brazil and India, Brazil and China, Russia and India, Russia and China, India and China, India and South Africa, China and South Africa and so on. This shows the co-movement of economic growth among these countries has been decreasing. Another is that the rolling correlation coefficient of economic growth in

some country groups firstly decreases and then increases, and shows the characteristic of "U". For example, the rolling correlation of economic growth between Brazil and Russia, Brazil and South Africa, Russia and South Africa dropped to a minimum in 2013-2014 years, then began to rise. It shows that the co-movement of economic growth among these countries decreases first and then increases, and then maintains strong co-movement.

In general, these rolling correlation coefficients include shocks caused by the 2008 financial crisis, reflecting the impact of different degrees of shocks in different countries. In the first stage of the sample (2001-2012), the economic growth of the BRICS countries has strongly co-movement. Russia and South Africa, with the smallest rolling correlation coefficient, also reach more than 0.4. However, with the persistence of the crisis shock, the co-movement of BRICS

economic growth occurs differentiation in the latter stage of the sample (2004-2016). The economic growth of some BRICS countries has continued to decline, and some countries are rising after reaching their lowest point.

Table 2 Rolling correlation coefficient of the co-movement of BRICS economic growth in 2001-2016

Time		2001-2010	2002-2011	2003-2012	2004-2013	2005-2014	2006-2015	2007-2016
B-R	P	0.79	0.77	0.71	0.58	0.36	0.62	0.81
	S	0.81	0.78	0.67	0.56	0.38	0.43	0.58
B-I	P	0.93	0.97	0.97	0.96	0.89	0.41	-0.10
	S	0.87	0.94	0.95	0.89	0.78	0.44	0.09
B-I	P	0.95	0.97	0.92	0.82	0.62	-0.04	-0.48
	S	0.93	0.98	0.95	0.82	0.62	0.08	-0.36
B-S	P	0.57	0.61	0.51	0.10	0.10	0.63	0.90
	S	0.61	0.69	0.55	0.29	0.22	0.54	0.78
R-I	P	0.80	0.76	0.66	0.49	0.10	-0.32	-0.56
	S	0.83	0.77	0.65	0.53	0.10	-0.24	-0.42
R-C	P	0.69	0.63	0.51	0.32	-0.17	-0.63	-0.77
	S	0.81	0.73	0.61	0.44	-0.10	-0.54	-0.79
R-S	P	0.71	0.66	0.45	0.01	0.28	0.73	0.85
	S	0.69	0.59	0.41	0.13	0.32	0.58	0.75
I-C	P	0.94	0.94	0.90	0.80	0.73	0.65	0.56
	S	0.96	0.96	0.93	0.78	0.70	0.59	0.53
I-S	P	0.75	0.72	0.57	0.15	-0.05	-0.08	-0.13
	S	0.78	0.79	0.67	0.47	0.27	0.21	0.07
C-S	P	0.55	0.54	0.35	-0.26	-0.56	-0.67	-0.73
	S	0.67	0.69	0.43	-0.12	-0.44	-0.60	-0.72

4. CONCLUSION

Based on the data of BRICS countries in 2001-2016, this paper uses the graphic method to reflect the existence of the co-movement of economic growth. Then, Pearson and Spearman correlation coefficient and the rolling correlation coefficient are designed to validate the existence of the co-movement of the BRICS economic growth. The research shows that the economic growth of the BRICS countries has obvious common trends. And there are different both between nationals and between times, which may be due to the different degrees of impacts of the 2008 financial crisis. The conclusions highlight the importance of greater economic cooperation among BRICS countries. And all of the BRICS countries should maintain the economic stability and jointly defend the international crisis.

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