Empirical valuation of economics cycles synchronization in BRICS

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Abstract. For this paper, we studied BRICS countries' GDP in constant prices for the period from 1980 to 2013, including the periods of world economic crises. The data was examined as a time series and researched using the GARCH-model technique. This empirical analysis has shown a relatively high level of interrelatedness between countries like Brazil and India, India and South Africa, South Africa and Brazil, whereas there was no substantial interrelation observed between Russia's economy and other BRICS countries. Russia's largest connections are with its closest neighbor, China, and India, while its most minor connections are with South Africa and Brazil. As a result, it can be concluded that business cycle synchronicity and economical integration among the BRICS countries is minimal.

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Introduction

Today, the global economy is undergoing a series of transitional processes. One of the biggest topics causing a stir in the scientific community is the issue of stimulating growth and increasing efficiency in the global economy; much attention has been directed at the issue of developed and developing countries' economic cycles having a mutual impact on each other [1-20], especially in terms of overcoming gaps in production output. Before the 2009 crisis, at a time when economies of the Asia-Pacific region were developing markedly and the price of raw materials was climbing constantly, the decoupling hypothesis (about the economic cycles of developing countries becoming more separated from those of developed countries) became very relevant [21]. However, since the 2009 crisis, several articles have appeared asserting a decrease or disappearance of the decoupling effect after the crisis[22, 23], although there still are some noting the effect's presence, for example [24, 25].

Also relevant are the questions concerning the pros and cons of globalization and the development of various unions, for example, BRICS. These are also discussed in the literature, and here, too, opinions diverge. Some research notes the presence of "spillover effects" resulting from developing countries joining such unions [25, 26], while other researchers have expressed apprehension regarding the positive effects of such unions [27,28]

In this article, we aim to research the extent of synchronicity among the BRICS countries' economic cycles, and concurrently to investigate the possibility of "spillover effects". The more synchronicity exists among the economic cycles of developing countries engaged in trade/economic unions (such as BRICS), the more positive effects of globalization are noted.

On the other hand, given the current circumstances of sluggish economic growth in countries with developing economies, lowered prices for raw materials, and developing countries' economic cycles transitioning into a phase of decline, it is important to research more thoroughly the cyclical components of economic growth in the BRICS countries, especially those where economic growth is profoundly linked with raw materials (Russia, Brazil, and South Africa) rather than with industrial production (China, India).

Therefore, the second section of this article inspects the mutual connectedness of the economic cycles of the BRICS countries. The methodological basis of our empirical analysis is based on a model of autoregressive conditionally-heteroskedastic processes, which allows us to reveal any mutual connection between the GDP in constant price of BRICS countries. The third section provides and discusses the statistical results of the research. The fourth section analyzes the results and the contradictions which arose, and makes an attempt to explain them.

Methods

1

Decoupling hypothesis for BRICS countries

The global economy has entered a new phase of development. Countries with developed economies have been gradually growing in strength since the 2009 crisis. At the same time, countries with developing economies have encountered two problems: first, sluggish growth; second, harsher conditions in the global financial system resulting in capital flowing out and national currency devaluing. Earlier, it was possible to witness evidence that the business cycles of developing countries were growing independent of those of developed countries (the decoupling phenomenon). However, that was when the developing countries' economic cycles were rising, whereas today, the situation is different, and developing countries must adapt to the current phase of decline in their economic cycles. In such conditions, it is unlikely to find evidence substantiating the decoupling phenomenon, although there still exists some research to support such an idea [29].

Therefore, in order to eliminate the influence of financial markets, inflation, and currency exchange rates on the economic cycle, we chose to use GDP in constant price as the subject of empirical analysis in our research. Macroeconomic variables (like inflation) are also in part based on the economic cycle. This is the most traditional approach, and we intentionally did not scrutinize a large set of interrelated macroeconomic variables.



Sources: IMF. World Economic Outlook database. 2013 [30]

Figure 1. GDP growth rates of BRICS countries from 1981 to 2013

In figure 1, we see charts of the GDP in constant price of BRICS countries from 1981 to 2013 годы. Just from looking at the shapes of the graphs, it is obvious that the data sets show different dynamics, meaning that a complete synchronization of economic cycles will not be observed.

Methodology of Empirical Analysis 2.

Next, we investigated the "GDP growth rates of BRICS countries" data set as a time series. Based on pairings of GDP time series, generalized autoregressive conditional heteroskedastic models were created (GARCH(1,1)). GARCH models have

become popular in economic literature since the end of the 1980s and are currently widely used for empirical evaluation of interrelatedness between economic processes expressed in terms of time series.

The model is as follows. Let there be a regression of time series v_t on all other time series, where all of the time series in ved fit the conditions of a stationary process:

$$y_t = x_t \beta + u_t \tag{1}$$

This means that a tendency toward clustering can be observed in the data points of these series with large or small deviations from the average. In other words, periods of stability alternate with periods of agitation.

This clustering is explained by a model in which the variance of error u_t is dependent on the instances preceding:

$$\sigma_t^2 = \alpha_0 + \alpha_t u_{t-1}^2 + \dots + \alpha_p u_{t-p}^2$$

A more generalized model for aligning the variance of errors was proposed in [31-33]:

 $\sigma_{t}^{2} = \alpha_{0} + \alpha_{t} u_{t-1}^{2} + \dots + \alpha_{p} u_{t-p}^{2} + \gamma_{1} \sigma_{t-1}^{2} + \dots + \gamma_{p} \sigma_{t-p}^{2}$ (3)Since the initial time series are not

stationary, we must use a logarithm on the GDP indices of two countries. Let X_t be the difference in the natural logarithms of the indices of GDP growth of two countries:

$$X_t = \frac{\ln GDP1_t}{GDP1_{t-1}} - \frac{\ln GDP2_t}{GDP2_{t-1}}, \quad (4)$$

where *GDP1*, is the GDP in constant price of the first country at moment in time t,

 $GDP2_t$ is the GDP in constant price of the second country at moment in time t.

In this case, the model of aligning the rate of increase in the two indices is:

$$\Delta X_t = Const + \mu X_{t-1} + \varepsilon_t , \qquad (5)$$

where $\Delta X_t = X_t - X_{t-1} . \qquad (6)$

$$\Delta X_t = X_t - X_{t-1}.$$

The variable μ signifies the speed at which the rates of increase in the two countries' GDP become aligned, and also indicates the level of integration of the two time series.

Results

We evaluated the GDP in constant price for BRICS countries in the period from 1981 to 2013. However, since data for Russia was unavailable until 1992, we used information from 1993 to 2013 to investigate the pairings between Russia and other BRICS countries.

The results of the evaluation are depicted in Table 1.

BRICS country	μ	R-squared	Instances Observed	F-statistic
Russia - Brazil	-0,36	0,24	20	5,69
Russia – India	-0,56	0,30	20	7,85
Russia - China	-0,43	0,29	20	7,25
Russia – South Africa	-0,41	0,25	20	5,98
South Africa - India	-1,24	0,63	32	50,44
South Africa – Brazil	-0,80	0,50	32	29,80
South Africa – China	-0,59	0,34	32	15,40
India – China	-0,68	0,36	32	16,67
Brazil - China	-1,00	0,50	32	30,05
Brazil - India	-1,17	0,60	32	47,00

Table 1. Results of GARCH(1,1) evaluation of time series

From the results of empirical analysis shown in table 1, we can see that the greatest Rsquared has been observed by investigating the relationship between the GDPs of South Africa and India. The R-squared of the time series depicting the GDPs of South Africa and Brazil is also high. These results show that these countries have the most synchronized economic cycles of all the BRICS countries. It follows that "spillover effects" may also result from cooperation between these countries. The relationship between the GDPs of Brazil and India is also quite strong.

As for Russia, the most significant synchronization of economic cycles and integration was observed between Russia and its neighbor China, as well as between Russia and India. However, it is necessary to take note of the limits in ved in such a small quantity of data. Russia is a relatively young state and the number of data points was limited to 20. This may have negatively affected the authenticity of the results. Nevertheless, the F-statistic data show that the result can be accepted as sound.

Next, since we had achieved a stationary process out of the data sets in question and applied a logarithm, it was considered necessary to show the period of lag between the two countries. The first country's period of lag in relation to the second country in each pair is presented in Table 2.

Table 2. Periods of lag between the time series	Fable 2	Periods of la	g between	the time series
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BRICS Countries	μ	Period of Lag	
		Years	Months
Russia - Brazil	-0,36	0,70	8,37
Russia - India	-0,56	0,57	6,85
Russia - China	-0,43	0,65	7,80
Russia - South Africa	-0,41	0,66	7,96
South Africa – India	-1,24	0,29	3,47
South Africa - Brazil	-0,80	0,45	5,39
South Africa - China	-0,59	0,55	6,65
India – China	-0,68	0,51	6,08
Brazil - China	-1,00	0,37	4,41
Brazil - India	-1,17	0,31	3,72

In this way, the minimal period of synchronization of economic cycles can be observed between South Africa and Brazil, as well as South Africa and India. This indicates that their economies are linked the most of all the BRICS countries. At the same time, Russia has the largest periods of lag with the other BRICS countries, which raises doubts regarding the possibility of Russia taking a leading role in integrating the BRICS countries in an economic sense, though not a political one.

Discussion

This research shows that, in addition to having common characteristics and problems (in vement in developing markets, having unstable exchange rates, depending on global capital flow, depending heavily on the price of goods, having unstable financial systems), the BRICS countries are also inadequately integrated with each other. As a result, we can hardly support the decoupling hypothesis.

In this way, our research indirectly supports the range of studies that have demonstrated a significant decrease in the decoupling effect since the 2009 crisis [22,23].

Conclusion

We researched the level of synchronization in the economic cycles of BRICS countries. We attempted to define how synchronized the BRICS countries' economic cycles are and whether or not the "decoupling effect" could be observed after the 2009 crisis. The results of our analysis showed that there is an insignificant level of synchronization among the BRICS countries' economic cycles and that a relatively higher level of interrelatedness was demonstrated between Brazil and India, India and South Africa, and South Africa and Brazil. Therefore, we can not in confidence confirm the existence of the "decoupling hypothesis" in the BRICS countries. In the future, we plan to study the cyclic components of the economies of BRICS countries using different methods: optimal band-pass filtering, Hodrick-Prescott filtering and spectral analysis. We also intend to investigate the BRICS countries' interactions using different macroeconomic variables.

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