

Spatial harmonization of economic cycles: statistical confirmation of European-Russian interference in real sectors of economy (Пространственное согласование экономических циклов: статистическое подтверждение российско-европейского взаимовлияния реальных секторов экономики)*

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Статья посвящена теоретическим и методическим проблемам выявления и оценки циклических процессов в реальном секторе экономики. Представлены результаты анализа и моделирования пространственной гармонизации среднесрочных циклов в европейских и российских промышленных сферах.

Ключевые слова: типы экономических циклов, декомпозиция временных рядов, совпадение фаз экономических циклов, пространственная гармонизация экономических циклов, статистическая значимость.

Introduction

In the latest book by the well-known scientist Othmar W. Winkler, which was kindly presented by him to the author of this article at the meeting of 58th ISI Congress in Dublin (August, 21st-26th 2011), we see the proof of the importance of the investigation goals represented below. Professor Winkler notes: "The recent growing integration of the economies of all countries is creating new situations that have never before existed. Obviously the idealized stereotype of the "business cycle" is rapidly becoming a thing of the past. How to handle statistically the internationally connected irregularities of economic development is beyond our present knowledge"¹.

The received results of econometric modeling have shown that in Samara region (part of the Russian Federation) some local indices reacted to the global financial crisis considerably earlier than in the country in general.

Firstly it concerned the industry price production indices and especially the price indices of oil and electricity production and distribution.

The terms of the openness of Samara's local economy to the European economy suggest that cyclic dynamics interact in space.

We have put forward the hypothesis about spatial harmonization of economic cycles. The idea of the interdependence of all the types of economic cycles is presented in scientific literature. For example, in

1937 in his famous book "The big cycles of conjuncture" Russian academician Kondratieff pointed out: "... the increases of small-scale cycles of the period of decreasing the phase of big cycle will not have such intensity as in the period of the increasing wave of a big cycle"².

The crises of small cycles are supposed to be sharper and depressions are longer during the slowdown phase of the long-term cycle.

The effect of harmonizing the phases of economic cycles is the following: the observed fluctuations of economic activity are the result of integrating waves of different cycles.

We mean the following types of cycles:

1. Big cycles which are called Kondratieff cycles with the phase from 50 to 60 years.
2. Medium-term cycles:
 - Juglar-cycle with the phase from 7 to 11 years and
 - Kitchin -cycle - about 3 years.
3. Short-term cycles are less than 1 year, not seasonal - we have studied them in our research during the last few years³.

In statistical literature we also find references to the effect of "morphological nesting" of economic cycles: it means the interdependence of the increase and decrease phases of cycles on different levels of economic system.

We can see the illustration of this idea in figure 1: the coincidence of the peaks of different cycles.

The research of the effect of spatial (cross-country) harmonization of economic cycles is of

* Журнал продолжает публикацию статей на английском языке.

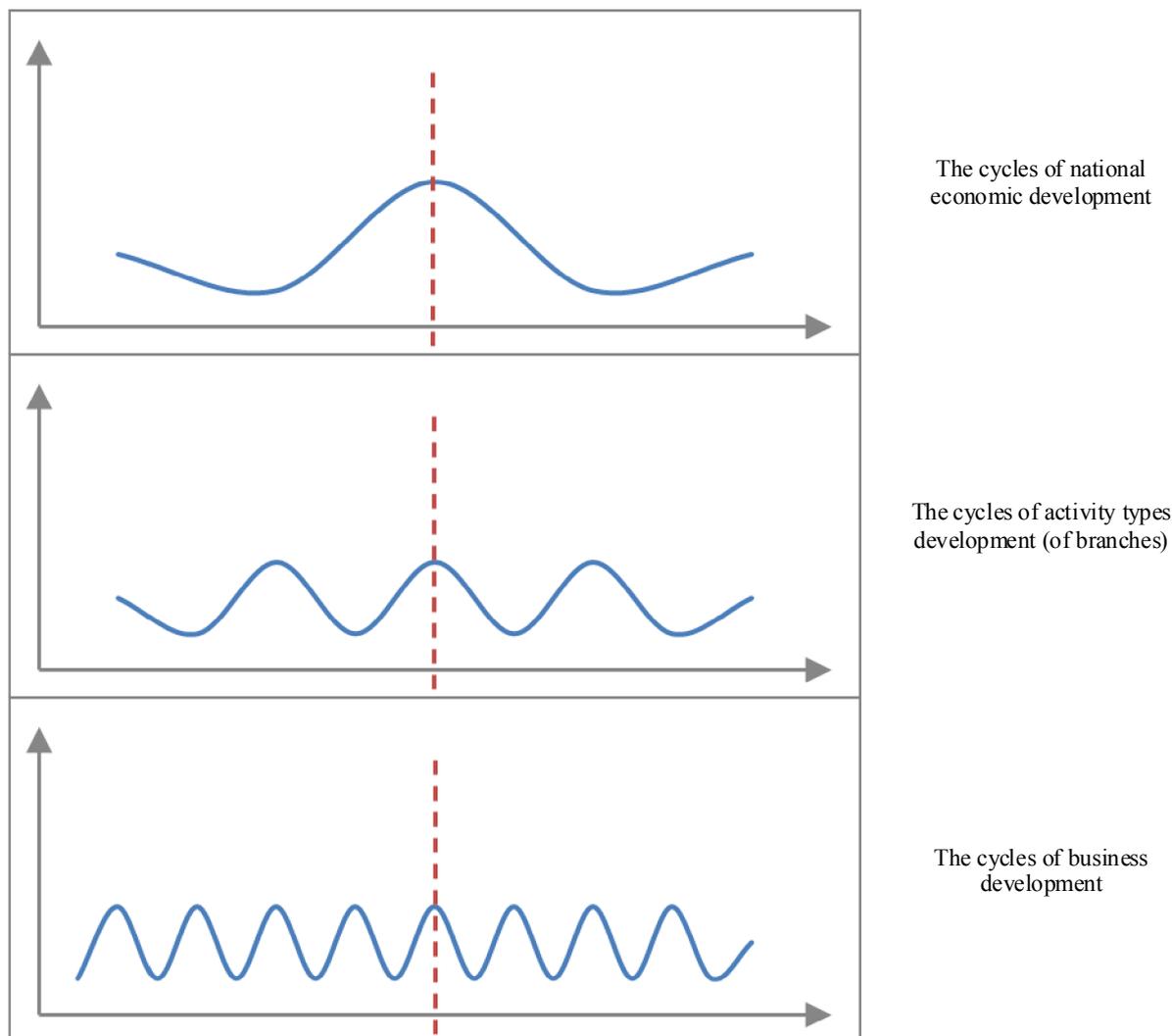


Fig. 1. The effect of harmonizing the phases of economic cycles on various levels of economics

current importance. In case this effect is proven it should be taken into account while developing the leading indicators of the phases of economic cycles on macro and regional levels.

Our research is devoted to the statistical analysis of the interference of medium-term economic cycles of the EU and the Russian Federation.

Source of data

Eurostat data is used:

a) Industry production indices (IPI) of different types of economic activity (NACE Rev.2) - monthly data:

- seasonally adjusted data;
- from 1999M01, last update 2011M05 (149 time points);

b) Industry production price indices (IPPI) of different types of economic activity (NACE Rev.2) - monthly data:

- gross data;
- from 1999M01, last update 2011M05 (149 time points).

Rosstat data is used:

a) Industry production indices (IPI) of different types of economic activity - monthly data (Rosstat -94):

- seasonally adjusted data;
- from 1999M01, last update 2011M05 (149 time points);

b) Industry production price indices (IPPI) of different types of economic activity - monthly data:

- not seasonally adjusted;
- from 2002M02, last update 2011M05 (113 time points).

Time period: from January 1999 to May 2011. So we had 149 time points of every time series for Europe (EU-27) in general.

For the Russian Federation (RF) we had the relevant data base, but the rows of industry price production indices were shorter: 113 time points for every type of activity.

Analysis methods

The methodology was based on time-series decomposition approach.

Approximation of cyclic component has been implemented by the methods of the decomposition of time-series to Fourier harmonics after trend excluding. approximation of cyclic component with the help of Fourier series:

$$\bar{y}_t = a_0 + \sum_{k=1}^m (a_k \cos kt + b_k \sin kt).$$

Equation parameters: a_0, a_k, b_k
 k is calculated by the method of maximum Likelihood with the help of STATISTICA software.

Analysis results

With a relatively high degree of statistical significance we have discovered the cycle with the period 5.8 years in the dynamics of the industry production index of European Union countries. It was explained as Juglar-cycles.

In whole the model is shown in figure 1 and in figure 2 you can see the distribution of the residuals after the removal of both cycles. It suits well the normal distribution.

As you can see in figure 3, there is the correspondence of the medium-term cycles in the dynamics of production in general and the production of machinery and equipment, because it is the main type of economic activity of European countries.

In figure 4 we see the effect of harmonization: the bottom of big cycle crises coincides with the lowest points of the decreasing phase of both medium-term cycles. It was the result of the EU.

On the Russian database we have got only three significant models of cyclic dynamics for industry production indices (Fig.5):

- gas production;
- electricity production and distribution;
- machine-building and equipment production.

Series	Description	Cycle phases
Series1	IPI Manufacturing EU-27	$\varphi_1 = 5,8$ years $\varphi_2 = 2,5$ years
Series2	IPI Manufacture of machinery and equipment n.e.c. EU-27	$\varphi_1 = 5,5$ years $\varphi_2 = 2,5$ years

In addition, the cycle with the period 2.5 was distinguished in the time series of the first residuals. Probably, Kitchen cycle has become apparent in this result.

Y axis - is the calculated values (IPI EU-27) based on the equation

$$y'_t = 1.001 + 0.00044 \cdot \sin(0.21 \cdot t) - 0.0032 \cdot \cos(0.21 \cdot t) + 0.00036 \cdot \sin(0.09 \cdot t) - 0.0025 \cdot \cos(0.09 \cdot t)$$

Multiple correlation coefficient $R=0.575$.

Despite the seasonally adjusted time series, these cycles reflect the latent seasonal factors.

Statistical models which have been conditioned by the initial data after trend removal show us the presence of Juglar and Kitchin cycles in European production and only seasonal cycles in Russian production.

It can be generally explained by the fact that the history of modern market economy is relatively new in our country and there have been low renovation rates of fixed capital in the last decades.

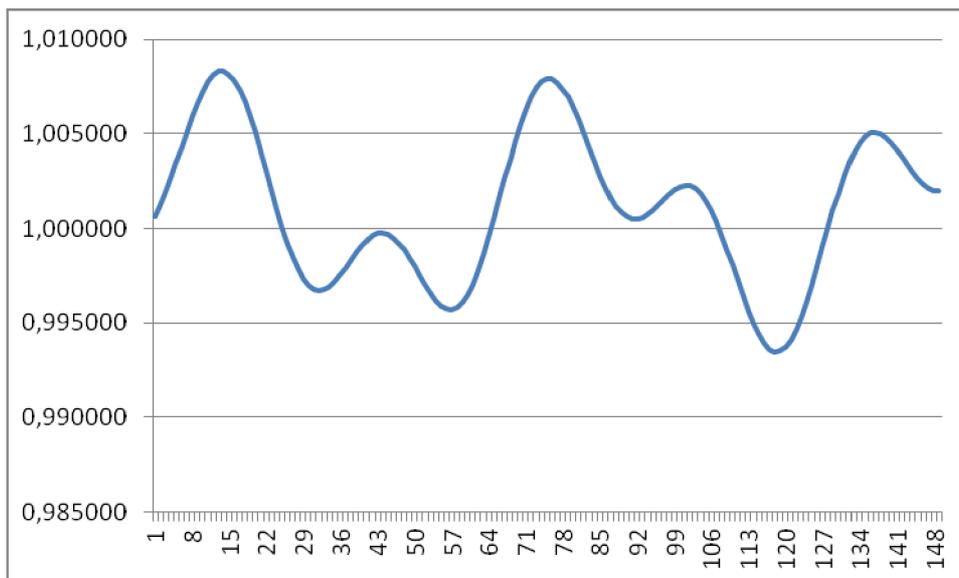


Fig. 2. The model of medium-term conjuncture cycles in the dynamics of industry production index EU-27 (1999M01-2011M05)

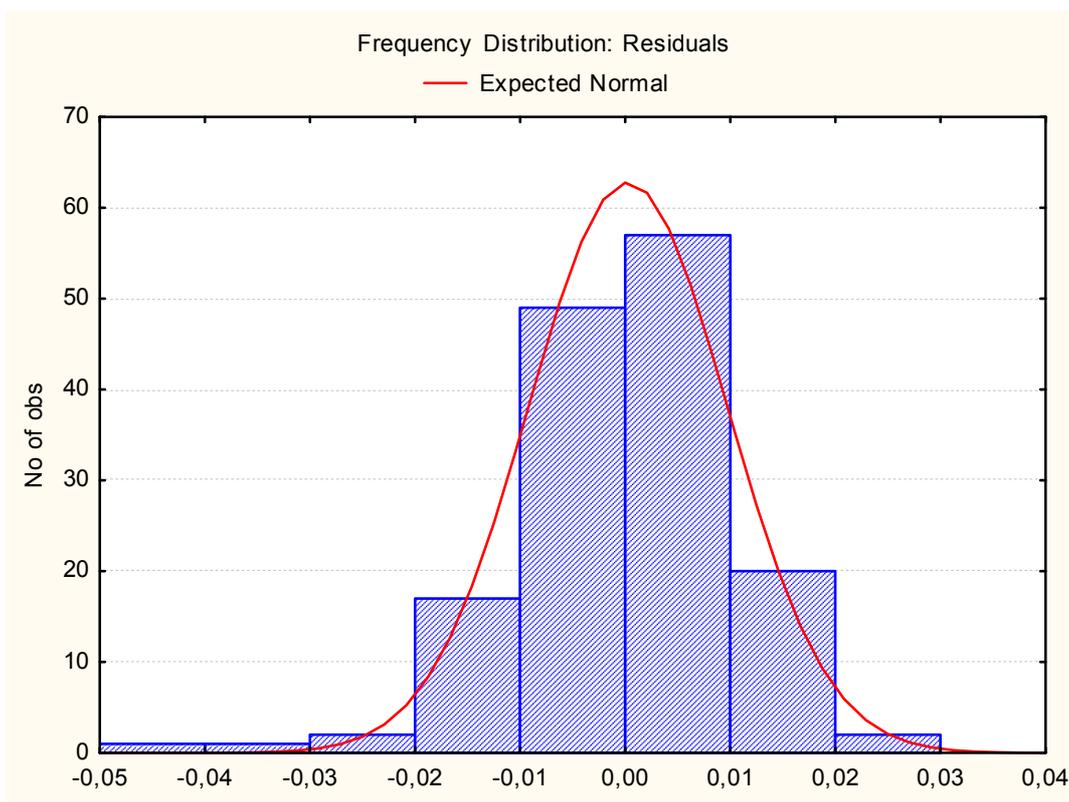


Fig. 3. The histogram of EU-27 residuals distribution

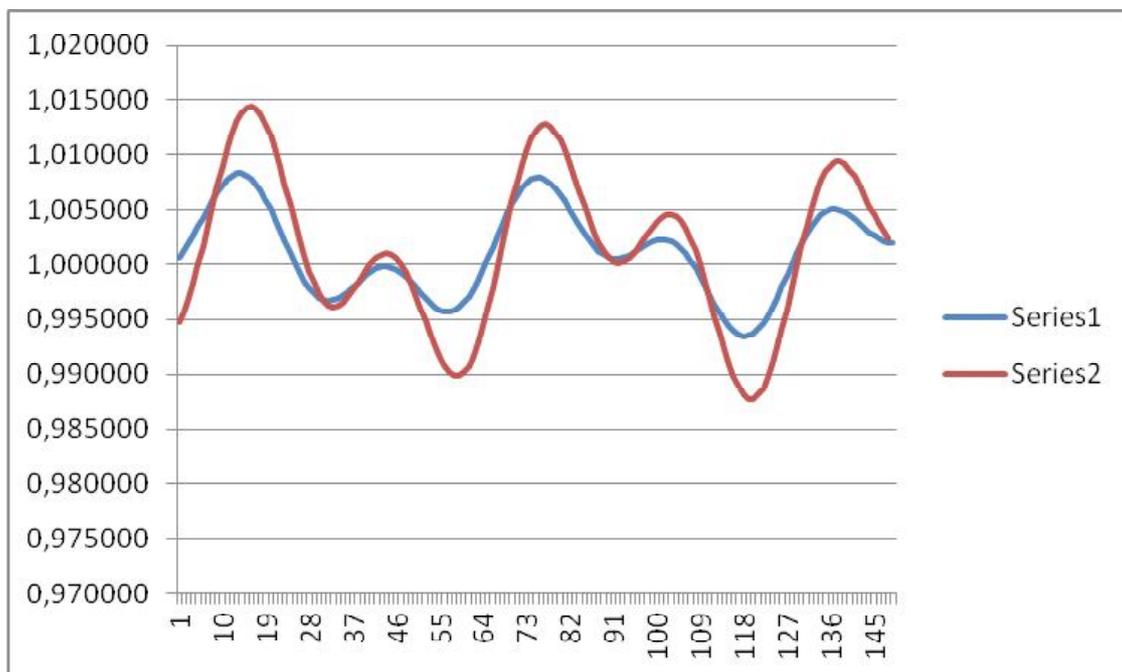


Fig. 4. The models of medium-term conjuncture cycles

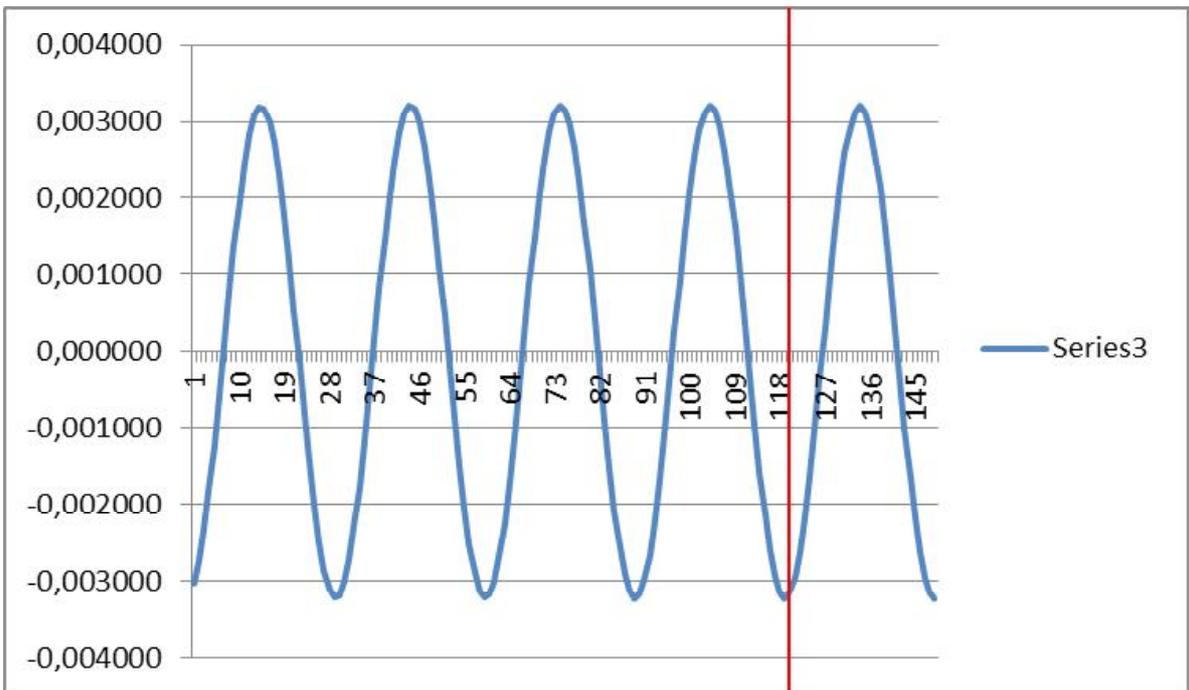
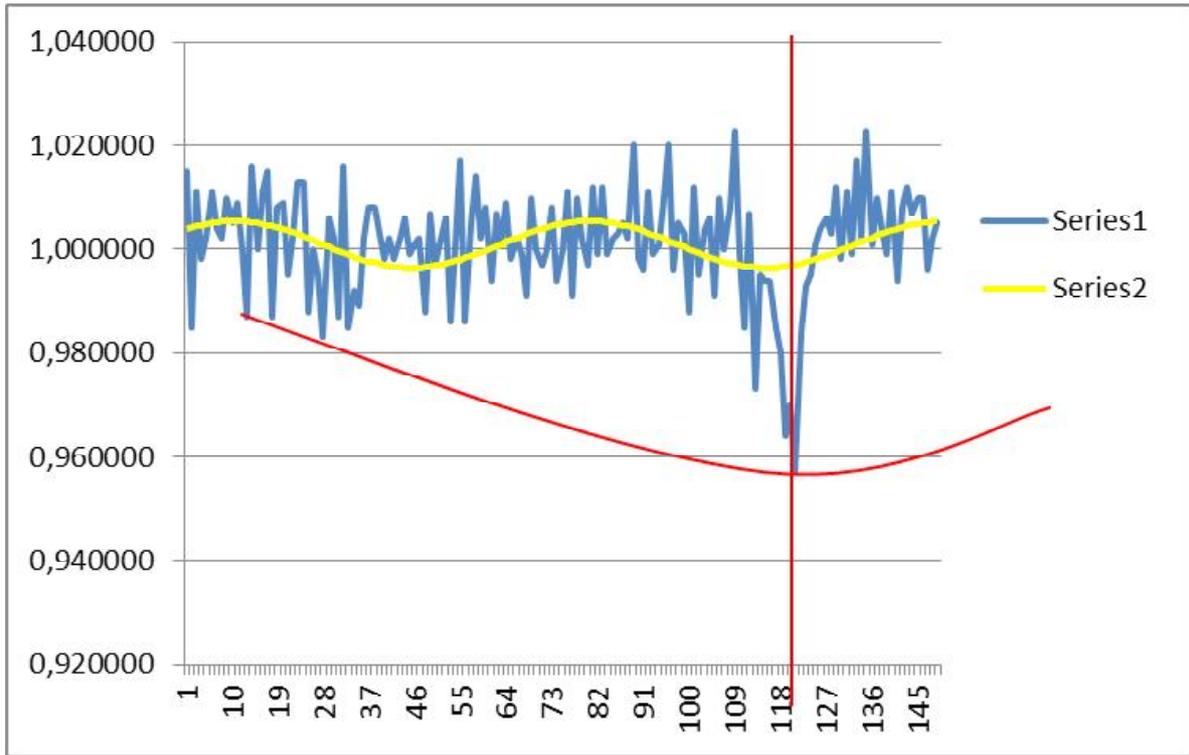


Fig. 5. Harmonization of the phases of big and medium-term conjuncture cycles of EU-27 industry production index (IPI)

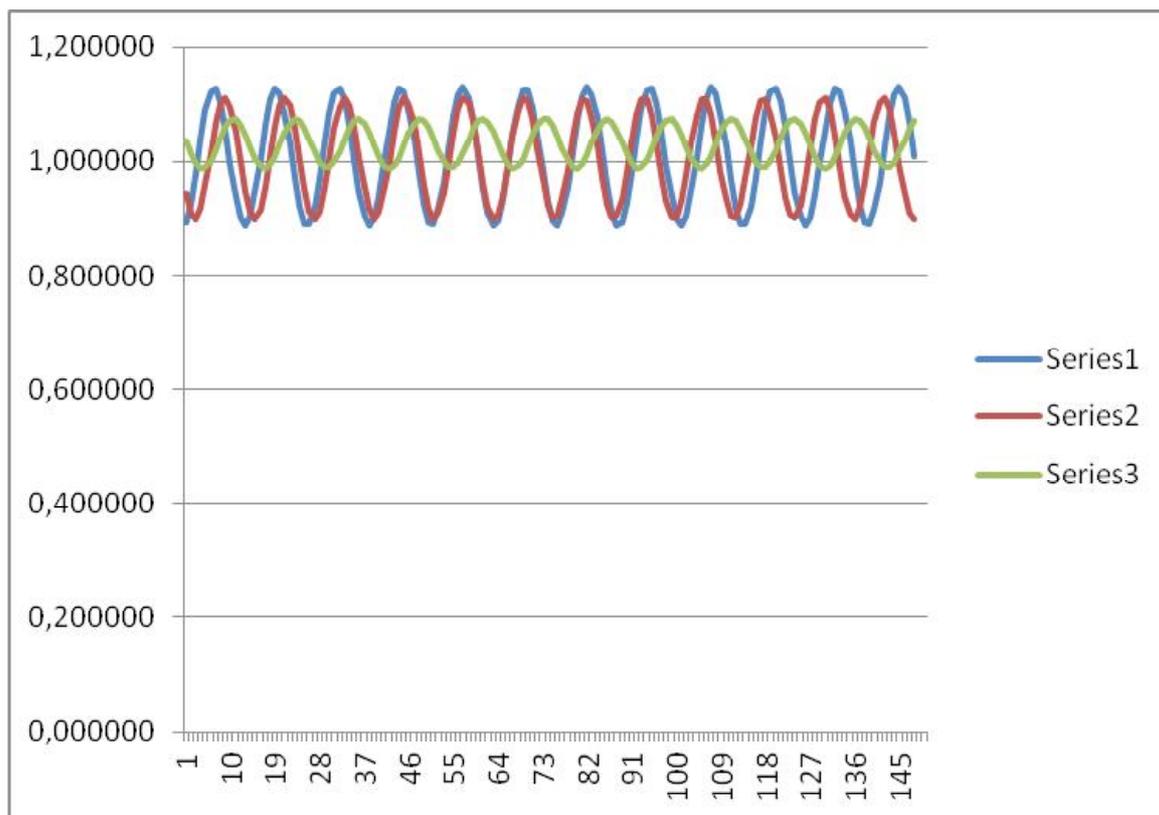


Fig. 6. The graphs of cyclic changes of production prices in Russian Federation (IPPI RF) for gas production (series 1), electricity production and distribution (series 2), machine-building and equipment (series 3) ($R=0,37840,535$)

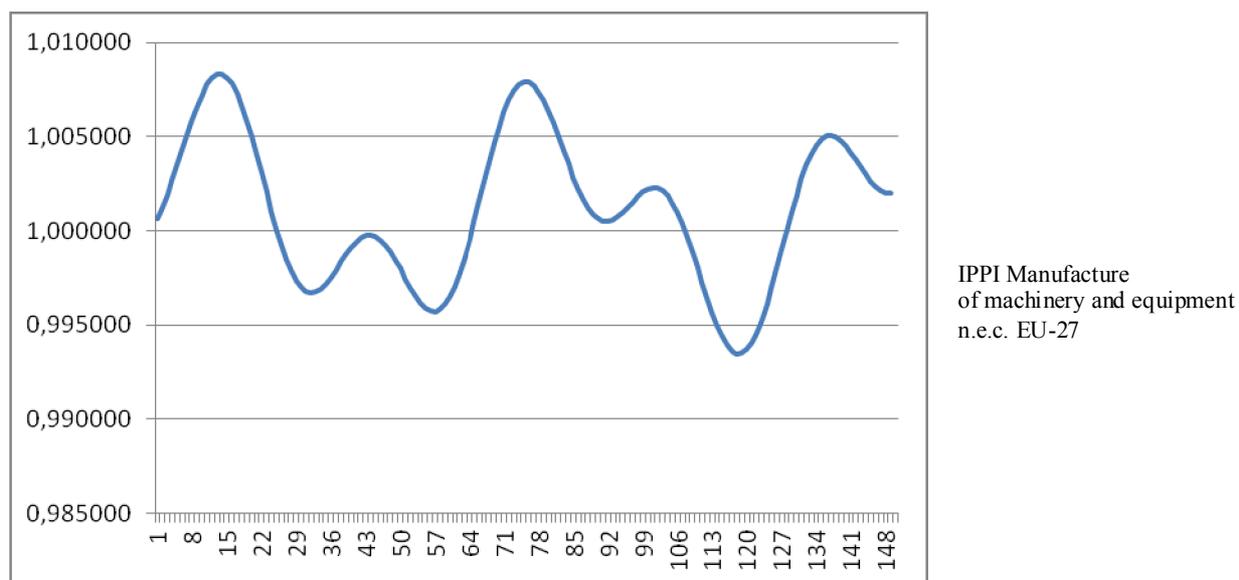
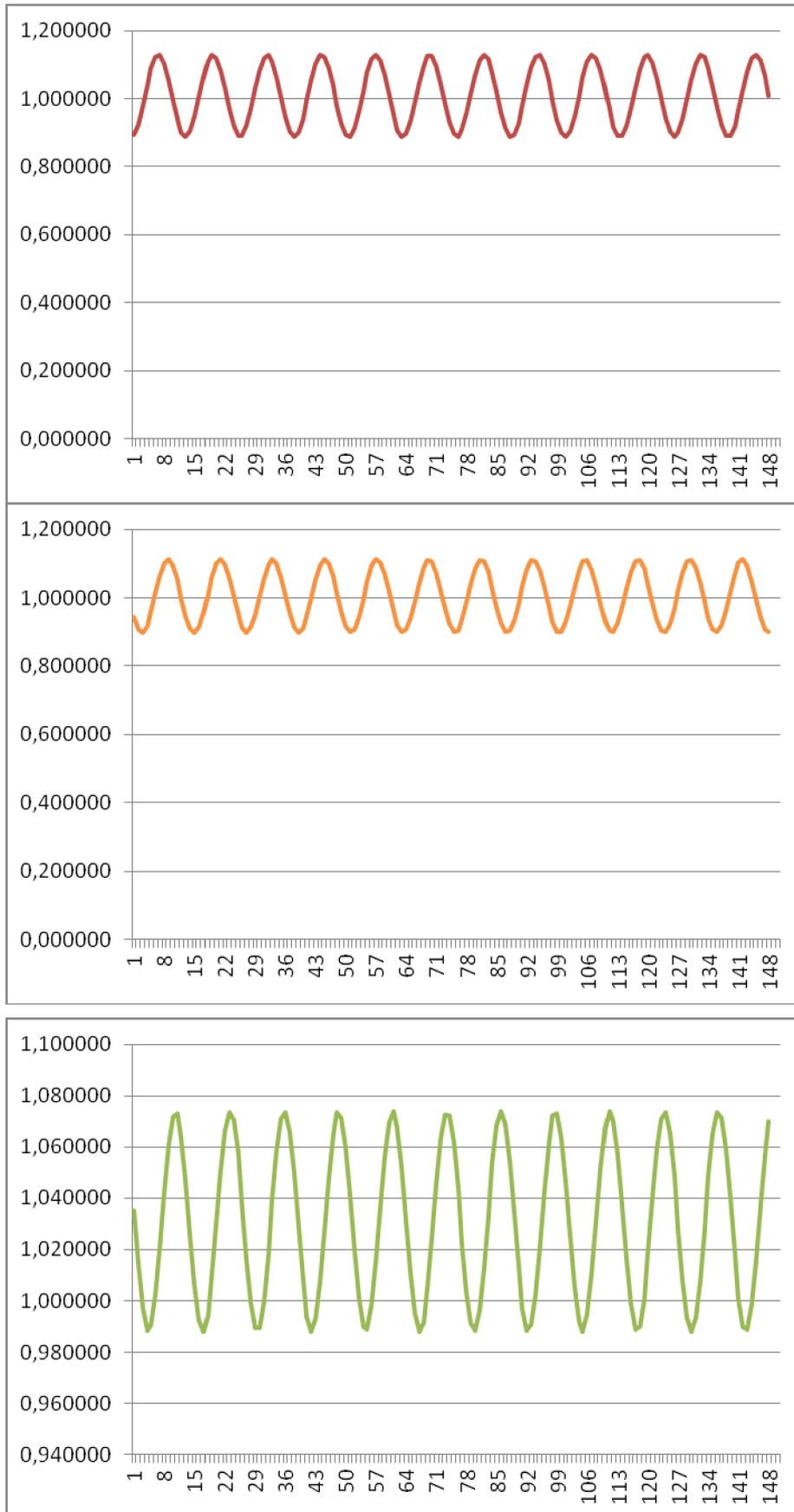


Fig. 7. The coincidence of cyclic dynamic models of IPPI of real sector of economy in EU and RF (surce)



IPPI Manufacture of gas; distribution of gaseous fuels through mains (RF)

IPPI Electric power generation, transmission and distribution (RF)

IPPI Manufacture of machinery and equipment n.e.c. (RF)

Fig. 7. The coincidence of cyclic dynamic models of IPPI of real sector of economy in EU and RF (ending)

Analyzing the data from figure 6 we cannot say definitely that there is the effect of space harmonization between the industry production indices of EU and the relevant indices of different types of activity in Russian Federation.

of the European economy. We also have the opposite influence on them.

The results shown here have only an initial and exploratory meaning. It must be developed for different countries and regions in matrix form. But

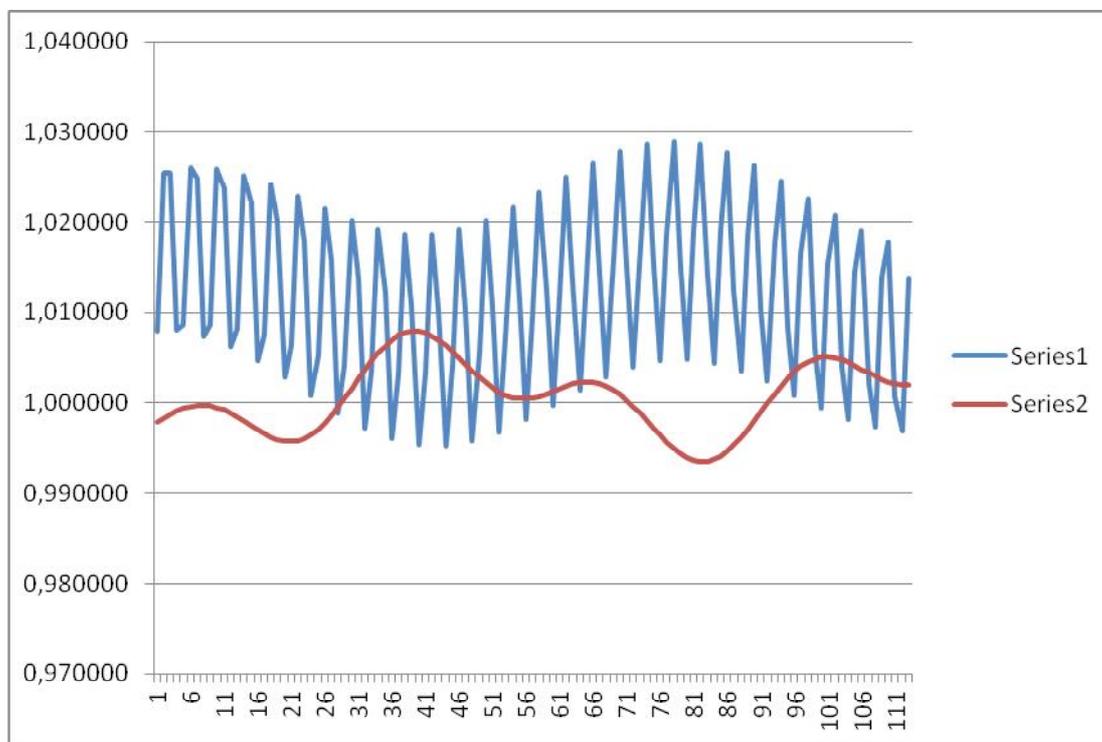


Fig. 8. Harmonization of medium-term cycles of electricity production and distribution price indices in RF (Series1) and industry production indices in EU-27 in general (Series2)

This effect becomes more evident when we match medium-term cycles of electro-energy production prices in Russian Federation and production indices in EU (Fig. 8).

We conclude that statistical regularities prove the effect of harmonizing various types of cycles. We can speak about the effect of spatial harmonization of cycles, although medium-term conjuncture cycles of energy producers' prices in Russia are not the result of the similar conjuncture changes in production volume in our country. However, we prove that the dynamics of prices for energy products in Russian medium-term cycles are the consequence of Juglar and Kitchin cycles in the production sector

we consider our results important because they open new directions for further development of econometric modeling for forecasting goals.

The leading indices of cyclic dynamics should be developed on the basis of econometric models which include the effect of interference of cycles in real sectors of economy of European countries, Russia as a whole and its regions.

¹ Othmar W. Winkler Interpreting economic and social data // A foundation of descriptive statistics. Springer-Verlag, Berlin; Heidelberg, 2009. P. 104.

² Kondratieff N.D. Big cycles of conjuncture and forecasting theory. M., 2002. P. 33, 90.

³ Zarova E.V. Statistic indicators of short-term economic cycles in region development. Samara, 2010.

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