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METHOD FOR DETECTION OF INTERDEPENDENCES IN THE DYNAMICS OF ECONOMIC DEVELOPMENT INDICATORS AT REGIONAL AND NATIONAL LEVELS

In the article the method of evaluation of economic development based on the methods of synthesis and gradual specification is suggested. The main four stages of procedures implementation for assessment of the regional economic development are defined. The detailed procedures on identification of interdependencies in the dynamics of economic development at the regional and national levels are elaborated by stages. The assertion on existence of interdependencies in the dynamics of economic development at regional and national levels within long and short period is articulated. Under existence of close interrelation between linear regression models the forecasting indicators of economic development in regions and Ukraine were suggested.

Key words: region, country, economic development indicators, interdependence.

Introduction. The stability of the dynamics of economic phenomena in the regional economy is connected with general level of economic development. Highly developed countries are characterized by instability of regional systems, while countries with lower level of development are characterized by stable regional systems. This hypothesis is proved by the results of research based on the theory of economic growth and hypotheses set up by other researchers[1][2].

The most important studies are based on the analysis of economies of developed countries, especially the USA. The results refers to the relationship between differentiation of economy and economic stability, as well as between instability and economic growth[3].

Literature review. Development of regions are the subject of research of many economists' scientific works. Thus, the theoretical study of regional development was considered by L. Guryanova[4], V. Zhovtanetskyy, B. Zablocki[5], J. Naumenko[6], Y. Prytula, N. Kuzenko[7], I. Storonyanska[8], V. Chuzhykov[9] and others.

Relationships at the level 'region – country' have been for a long time the object of research because they are crucial for the development of two objects – both for a region and for a country. Issues concerning

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regional development at the macro level are considered by J. Barsky[1], J. Drobush[2], V. Kovalchuk[3], M. Mironenko[4]. The directions of research of modeling of regional development as country elements in the context of current economic reforms are developed by V. Tomareva-Patlahova[5].

Unsolved problems. However, nowadays there is no comprehensive research and methods aimed at analyzing the economies of less developed countries and developing countries. Also the existing methods of analysis are not universal. Therefore, in order to examine the state of Ukraine's economy at the regional level, it is advisable to form a methodology based on the methods of synthesis and gradual specification.

Problem statement. The main objective of the article is formalization of the methods of regional economic development evaluation and practical implementation of procedures to identify interdependencies of dynamics of economic development at regional and national levels.

Results of research. To formalize the results of practical application of methods of economic development evaluation we use general indicators of dynamics of development the parameters of specific areas of the state economy. The application of dynamics indicators allows revealing long-term trends and trends of individual elements, and allows detecting short-term changes in the processes of growth and development.

We suppose that the limitations of studies aimed at identifying the effects of stability and instability and its relationship with economic growth according to the techniques described in the literature are insufficient. Therefore, in terms of objectives set out in the article, we consider it appropriate to carry out a systematic research of dynamics of individual elements of economic development (some of its peculiarities) and making conclusions concerning its relations and characteristics of the economy of regions in Ukraine. It allows identification of signs and causes of changes in dynamics of indicators and its possible consequences.

We propose to carry out evaluation of economic development based on the methodology of four stages (Fig. 1).

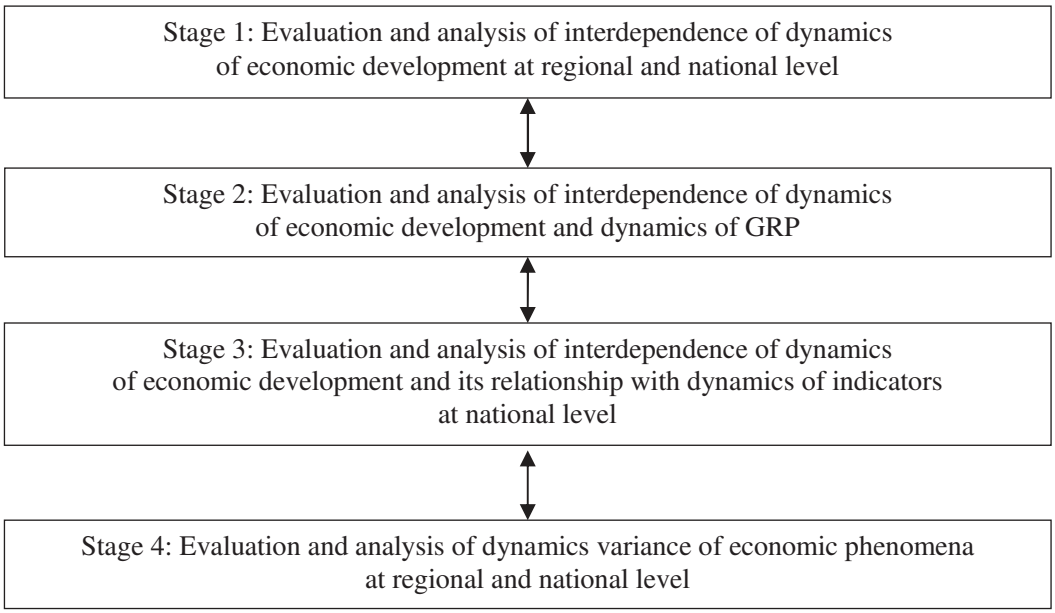

Figure 1. Evaluation method of economic development
Source: elaborated by the author

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The basis for the research of regional development is the results of interdependencies analysis of dynamics of individual indicators of economic development. Sequential stages is the basis of the methods offered for evaluating of economic development. Because of practical use of the methodology offered the specific assessment (correlation, variance, etc.) would be received. It allows making multidimensional analysis of the research object and submitting the results of the research in different sections.

Elements of the research are based on the analysis of interdependencies to determine the strength, direction and nature of the interdependencies between different data sets about the dynamics of economic phenomena.

In addition to analyzing interdependencies dynamics of economic phenomena, we consider it appropriate to determine the level of dispersion of dynamics of the phenomena in different regions and the country as a whole. Differentiation of the dynamics indicators and its deviations beyond the stable dynamics provides additional prove the necessity of the research the economic development of Ukraine. The conclusions on the methodic applications are the basis for synthetic characteristics and attempt of determination of regional differences reasons and identification of the factors that conditioned the dynamics of economic development of Ukraine.

We provide practical performance of the stage on identification of dynamics interdependencies of economic development at regional and national levels. According to the methods of economic development evaluation within the stage 1 execution, it is necessary to analyze the relationship between dynamics of individual indicators of regional development and dynamics of GDP per capita in the country in general according to the sequence (Fig. 2).

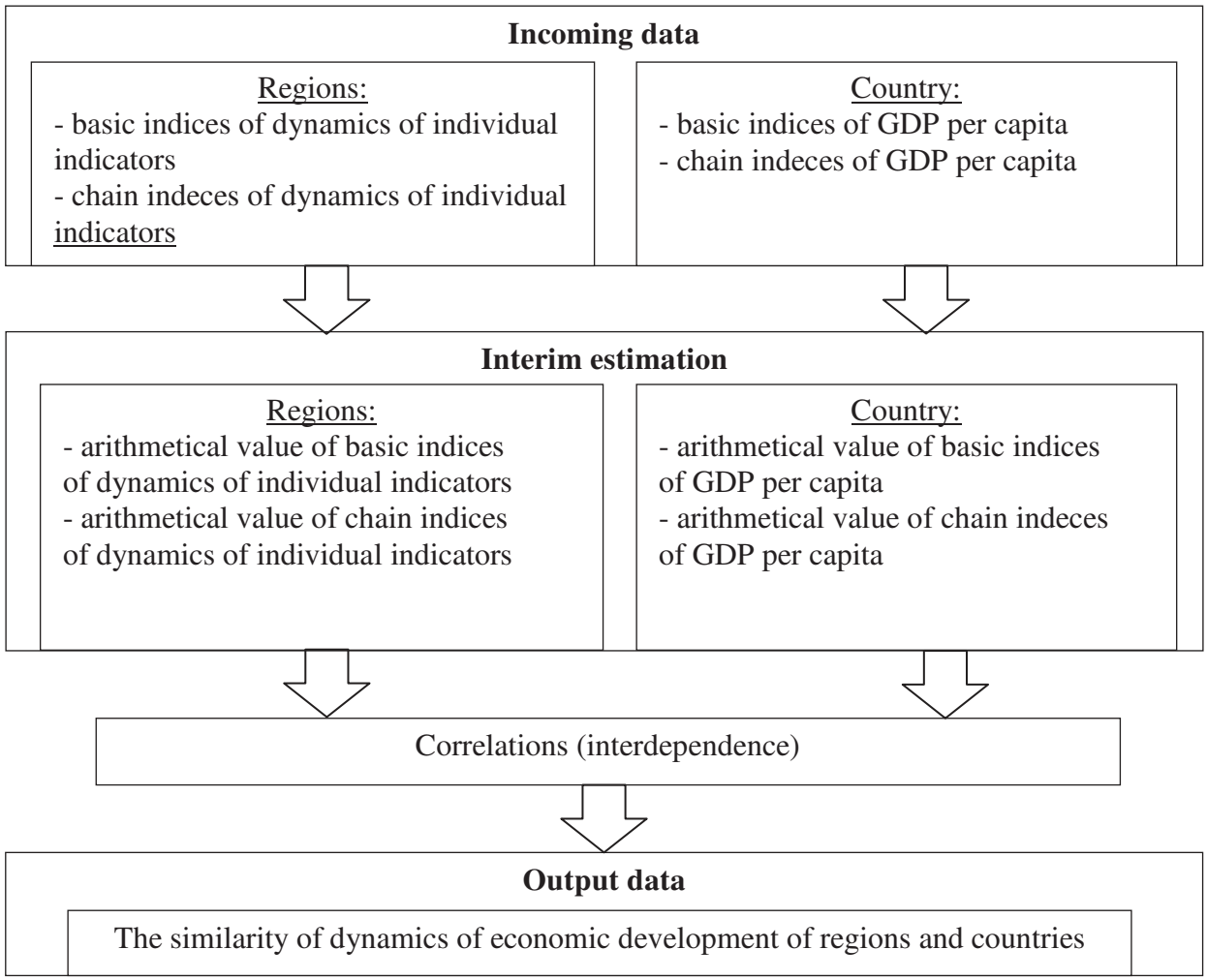

Figure 2. The sequence of stage 1 of evaluation methods of regional economic development
Source: developed by the author

The recommended sequence of stage 1 of evaluation methods of regional economic development allows revealing the similarities (coincidence level) of dynamics of economic development of regions and countries. This level defines in two dimensions: long-term trends (using basic indices of dynamics – Formula 1) and short-term trends (using chain indices of dynamics formula 2). The higher the degree of similarity of dynamics of such indices, the higher the level of interdependence, the more stable is the economic development.

$$I_{б1} = \frac{y_{t_1}}{y_{t_0}} * 100\%, \quad I_{б2} = \frac{y_{t_2}}{y_{t_0}} * 100\%, \quad \ldots \quad , I_{бn} = \frac{y_{t_n}}{y_{t_0}} * 100\%; \tag{1}$$

$$I_{л1} = \frac{y_{t_1} - y_{t_0}}{y_{t_0}} * 100\%, \quad I_{л2} = \frac{y_{t_2} - y_{t_1}}{y_{t_1}} * 100\%, \quad \ldots \quad , I_{лn} = \frac{y_{t_n} - y_{t_{n-1}}}{y_{t_{n-1}}} * 100\%; \tag{2}$$

where $y_{t1}, y_{t2}, \ldots, y_{tn}$ – indicator of period;

y_{t0} –indicator in base period.

To investigate the interdependencies the statistical data for all regions and for Ukraine in general is processed. The following economic indicators are calculated:

A. Real incomes per capita, UAH.

B. Foreign direct investment (share capital) per capita, USD.

C. Number of students per 10 thousand population.

D. Number of employed persons aged 15-70 per thousand population.

E. Capital investment per capita, UAH.

F. Retail trade turnover per capita, UAH.

G. Number of specialists who perform scientific and technical work per 10 thousand.

H. Exports of goods per capita, USD.

I. Gross innovation product per capita, UAH.

J. Gross regional product per capita, UAH (Gross domestic product per capita in Ukraine, UAH).

Using indices of dynamics it should be calculated an average arithmetical mean for nine indicators from A to I (individual values for region and for Ukraine).

In order to calculate average values of dynamics indices of nine indicators (A-I) in 2006-2016 and indices of GDP per capita in Ukraine, correlation indices were calculated.

Pearson correlation criterion as the criteria of correlation is defined (formula 3):

$$r_{xy} = \frac{\sum_{i=1}^{n} \left(x_i - \bar{x}\right) * \left(y_i - \bar{y}\right)}{\sqrt{\sum_{i=1}^{n} \left(x_i - \bar{x}\right)^2 * \left(y_i - \bar{y}\right)^2}} \tag{3}$$

where x_i – value of indicator;

y_i – value of GDP per capita, UAH;

$\bar{x}$ – average value of indicator;

$\bar{y}_i$ – average GDP per capita, UAH;

n – sample size.

Interpretation of the values of Pearson correlation criterion: Rxy = 0 – there is no relationship between parameters, 0 <| Rxy | <0.2 – there is hardly any linear relationship between the parameters, low level of interdependency, 0.2 ≤ | Rhy | <0,4 – there is a linear relationship, but it is very small, 0.4 ≤ | Rxy | < 0.7 – the relationship between indicators is moderate, 0,7 ≤ | Rxy | < 0.9 – the relationship between

indicators is considerable, $0.9 \leq | Rxy | < 1$ – the relationship between indicators is very strong, $| Rxy | = 1$ – there is an absolute correlation[1].

Results of correlation values calculation of average basic indices of indicators dynamics and base index of dynamics of GDP per capita in Ukraine in 2006-2016 by Pearson criterion is shown in Table 1. The materials from the official website of the State Statistics Service of Ukraine[2]was the background for calculation.

Table 1

Correlation of average basic indices of dynamics and basic index of GDP per capita in Ukraine in 2006-2016

Indicators	A	B	C	D	E	F	G	H	I
Value of index of linear correlation by Pearson criterion	0.924	0.953	-0.987	-0.929	-0.332	0.989	-0.980	0.401	-0.072

Source: calculated by the author

We see that there is hardly any relationship between basic indices of indicator dynamics (-0.072). Thus, one might argue that a basic change in GDP per capita in Ukraine does not depend on basic changes in gross innovation products per capita in regions of Ukraine. The weak inverse relationship between the basic dynamics of indicator E is revealed. It means that in the period there was a weak correlation between the basic dynamics of GDP growth per capita and the reduction of basic capital investment per capita. It is noteworthy that this relationship is undesirable for an economy because an effective economic activity requires capital investments, replacement of fixed assets, investments attracting for its modernization. Only in such way, it is possible to fulfill the conditions for extended reproduction and economic efficiency increase. It is necessary to neutralize the weak correlation between these indicators by forcing the effects of other indicators of economic development.

It was detected the moderate dependence (level 0.401) between the basic index of dynamics of exports and GDP and per capita. The existence of such interdependence is an evidence of appropriateness of support and export-oriented regions development. It will increase the efficiency of the economy of Ukraine.

Basic indices of all other indicators of regional development showed a very strong dependence and its impact on the basic change of GDP per capita in Ukraine. The direct linear relationship between GDP per capita basic index and dynamics basic indices of indicator A (gross income per capita, 0.924), indicator B (foreign direct investment per capita, 0.953) and indicator F (retail trade turnover per capita, 0.989) is found. So to achieve an economic growth of Ukraine the regional development policies should be based on improvement of wellbeing of population, rendering assistance to small (private) business and cooperation with foreign investors (for medium and large businesses). The inverse linear correlation of basic indices of dynamics of GDP per capita was revealed. There are such values of regional development indicators as indicator C (number of students per 10 thousand population, -0.987), indicator D (number of employed persons aged 15-70 per thousand population, – 0.929) and indicator G (number of specialists who perform scientific and technical work per 10 thousand, -0.980). Such relationship is caused by the crisis in the economy of Ukraine and situational approach to management of its development. Countries with developed economies have the opposite relationship between these indicators. Therefore, the current basic growth of GDP per capita with simultaneous reduction of the basic indicators of regional development C, D and G is temporary. It would be negative for economics of Ukraine if this tendency remains in the long term. It might cause the degradation and decline of economy. Therefore, the regional development policy should be directed to reducing the relationship between basic dynamics of change in these indicators and change the nature of this relationship. For this highly skilled personnel (as the result

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of getting higher education), personnel that influence the innovative recovery of the economy and increase of the employment rate of working population should ensure the growth of GDP per capita due to expansion and improvement of economic processes in which they participate. Interdependence revealed in Ukraine indicates the increase in the share of resource economy and the decrease in the share of knowledge-based economy as it contributes to the development of the welfare of the population.

The value of the average basic index of dynamics of the regions of Ukraine in 2006-2016 is shown in Figure 3.

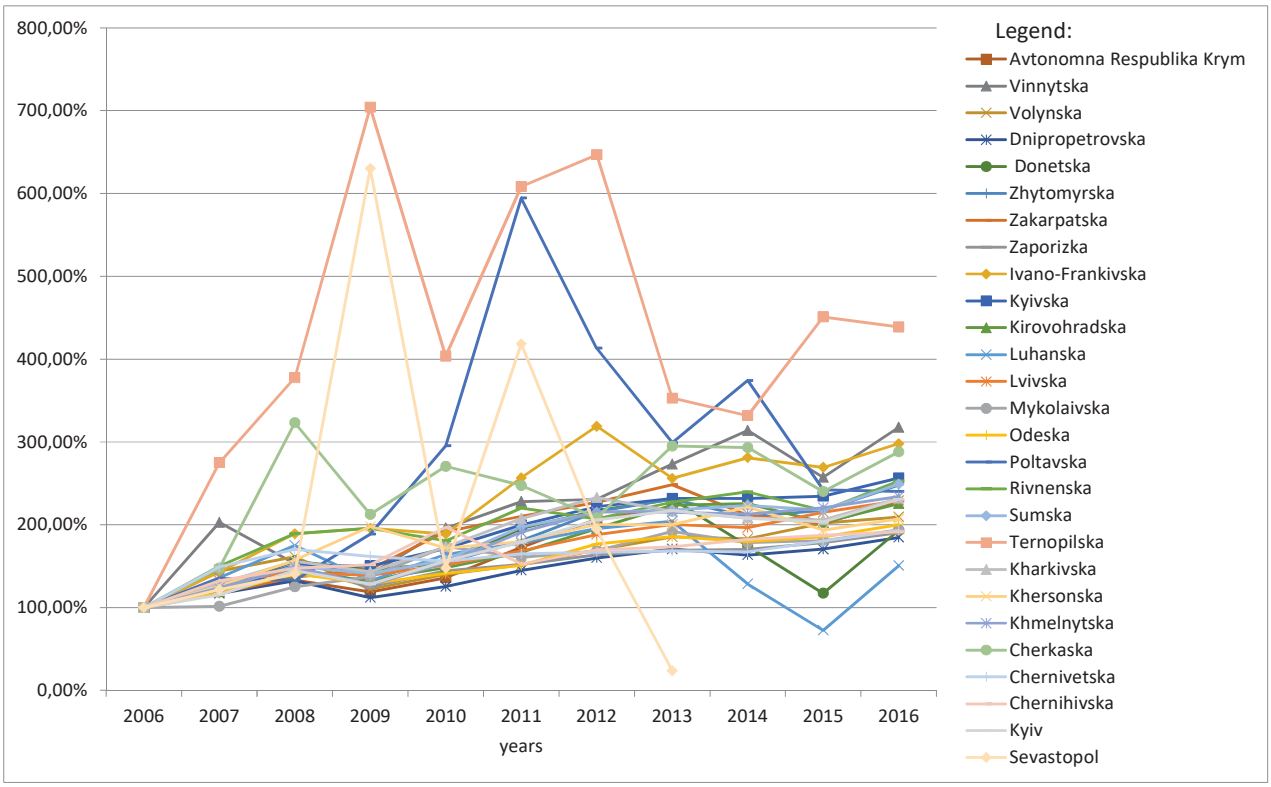

Figure 3. Average basic dynamics of indixes in the regions of Ukraine in 2006-2016. (2006 = 100%)

Source: prepared by the author

In majority regions of Ukraine there is a convergent evolution observed. However, there are regions with average basic dynamics of the indices that deviate significantly from the overall dynamics. These regions are Ternopil, Poltava and Sevastopol (up to 2013), and Cherkassy and Ivano-Frankivsk region, but the latest development in 2015-2016 was convergent with other regions of Ukraine.

The next stage of practical approbation of the methods of evaluating of economic development is evaluation and analysis of dynamics of economic development at regional and national level due to indicators dynamics and chain index of GDP per capita in Ukraine in 2006-2016 by the criterion of Pearson (Table 2).

Table 2

Correlation of average basic indices of dynamics and basic index of GDP per capita in Ukraine in 2006-2016

Indicator	A	B	C	D	E	F	G	H	I
Value of index of linear correlation by Pearson criterion	0.500	0.605	0.466	0.311	0.139	0.939	0.383	0.909	0.440

Source: calculated by the author

The correlation between average chain index of indicators dynamics and chain index of GDP per capita in Ukraine in 2006-2016 differs significantly from the correlation of average basic index of dynamics of the similar indicators.

There is almost no correlation between the chain index of dynamics of indicator E and GDP per capita (0.139). There is a weak correlation between the chain index of dynamics of indicator D and indicator G and GDP per capita (0.311 and 0.383 respectively). For the majority of indicators of regional development there is a moderate correlation between chain indices of dynamics and GDP per capita (for A – 0.500, for V – 0.605, for C – 0.466, for I – 0.440). There is a strong dependence only between chain indices of dynamics of the indicator F (0.939) and indicator H (0.909) and GDP per capita.

The main difference between the results of research of the correlation of average base index of dynamics and average chain indices of dynamics and GDP per person is only positive correlation in all the indicators. The only indicator with the same correlation of base index of dynamics and GDP per capita and average chain index and GDP per capita dynamics is the indicator F (volume of retail trade turnover per capita). As a result, it may be inferred that the relationship between the volume of retail trade turnover per capita and GDP per capita is extremely strong. So according to the regional development policies it is necessary to promote small business development and activities of individual entrepreneurs.

The value of average chain dynamics of the indicators of regions of Ukraine in 2006-2016 is shown in figure 4.

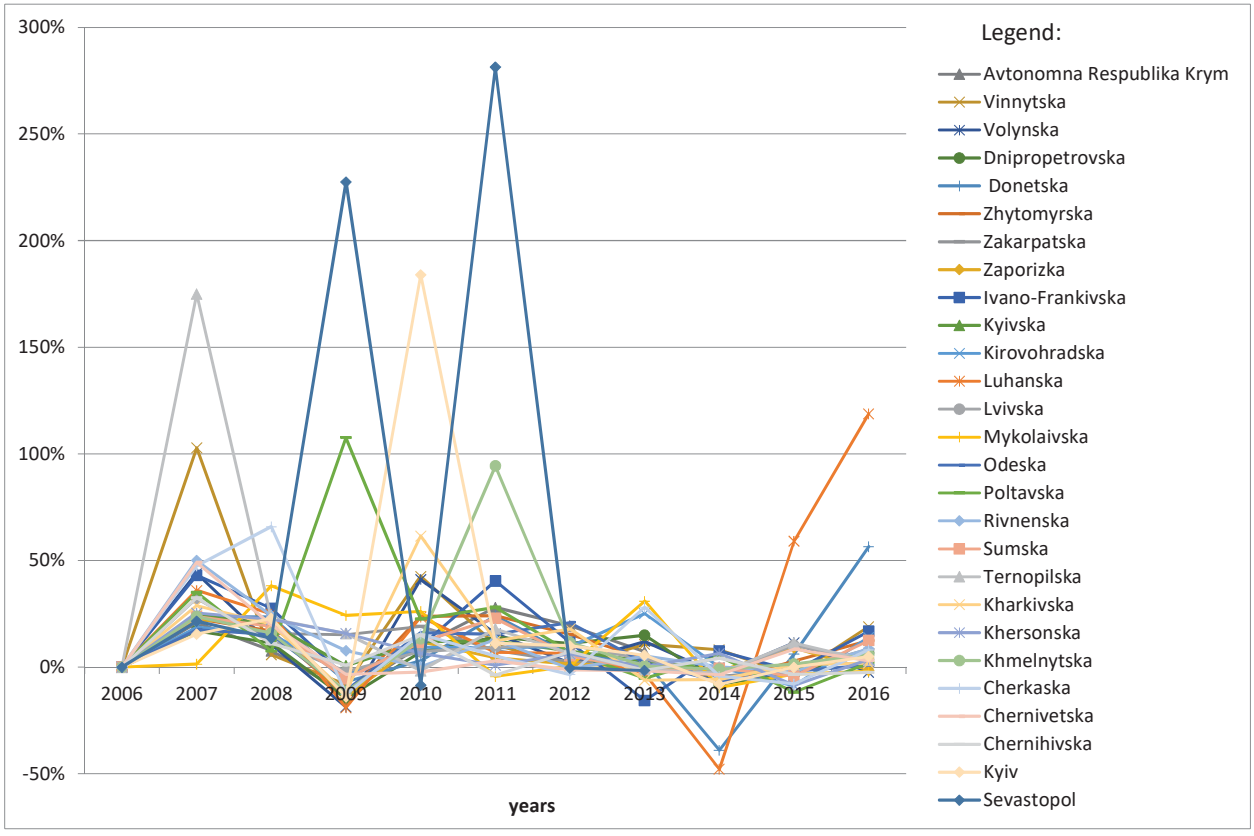

Figure 4. Average chain indixes of dynamics in regions of Ukraine in 2006-2016 (2006 = 0%)

Source: prepared by the author

The analysis of regional development based on average chain indixes of indicators dynamics in 2006-2016 shows that in most regions there is a convergent development. Exceptional was just a period in 2014-2016 in Donetsk and Lugansk regions. The main reasons for this were the temporary occupation of the territory, insufficient statistical data accuracy and significant decrease of population in these regions. It should be noted that Donetsk and Luhansk regions were the most densely populated regions in Ukraine until 2014, so internal migration from these regions affected significantly the dynamics of chain indices of indicators dynamics.

In different years, there was an emergence of leader regions. The average chain indices of indicators dynamics of them are significantly higher than the average chain indices of dynamics in other regions. In 2007 it was Ternopil and Vinnytsya regions, in 2009 and 2011 it was the city of Sevastopol and Poltava region, in 2010 it was Kyiv.

Conclusions and prospects for further research. After execution of the stage 1 of the developed technique of evaluating the economic development of regions (as for analyzing the interrelations of the indicators of economic development at regional and national level), it was revealed the correlations between the basic indices of dynamics of the indicators of regional development and basic indices of dynamics of GDP per capita. In case of the close linear relationship, it is possible to construct regression models for forecasting the economic development in Ukraine and finding the ways to achieve it.

In further researches, it is advisable to focus on thorough evaluation of methods for other stages of economic development and practical application of the results obtained during the formation of regional development policy.

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