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REGIONAL UNEVENNESS OF ECONOMIC DEVELOPMENT IN UKRAINE AND THE EU: MODELS OF ANALYSIS
РЕГИОНАЛЬНАЯ НЕРАВНОМЕРНОСТЬ ЭКОНОМИЧЕСКОГО РАЗВИТИЯ В УКРАИНЕ И ЕС: МОДЕЛИ АНАЛИЗА
РЕГІОНАЛЬНА НЕРІВНОМІРНІСТЬ ЕКОНОМІЧНОГО РОЗВИТКУ В УКРАЇНІ ТА ЄС: МОДЕЛІ АНАЛІЗУ

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Анотація. В даний час країни і регіони є об’єктами впливу соціально-економічних загроз, що мають різне походження. Однією з найбільш важливих з них є істотна регіональна нерівномірність економічного розвитку, яка призводить до загострення соціальної напруженості в суспільстві, зниження рівня соціальної безпеки. Такі загрози притаманні не тільки окремим країнам, а й міжрегіональним об'єднанням, таким як Європейський Союз. Це призводить до небажання країн-донорів витрачати все більшу частину свого доходу на підтримку розвитку країн-акцепторів. Проблема регіональної нерівномірності була вивчена багатьма вченими. Проте, структура нерівномірності не досліджена досить повно. Метою роботи є побудова економіко-математичних моделей аналізу регіональної нерівномірності економічного розвитку. Об'єктами дослідження є системи макро- та мезорівнів. Макрорівень представлений Європейським Союзом та його країнами-членами. Мезорівень представлений Україною та її регіонами. Валовий внутрішній продукт на душу населення (для ЄС) і валовий регіональний продукт на душу населення (для України) були обрані в якості ключових індикаторів нерівномірності розвитку.

Пропоновані моделі засновані на припущеннях теорії кумулятивного зростання і методах дисперсійного аналізу. Застосування запропонованих моделей дозволяє позиціонувати окремі території в

системі координат «рівень розвитку - рівень нерівномірності»; виділяти центри економічного зростання, проблемні регіони і групи регіонів з однорідним характером змін в економічному розвитку; здійснювати порівняльний аналіз тенденцій нерівномірності економічних систем на макро- і мезо- рівнях.

Ключові слова. Теорія кумулятивного зростання, модель, аналіз, середньоквадратичне відхилення, валовий регіональний продукт, валовий внутрішній продукт, регіональна нерівномірність.

Аннотация. В настоящее время страны и регионы подвергаются социально-экономическим угрозам, которые имеют различное происхождение. Одной из наиболее важных из них является существенная региональная неравномерность экономического развития, которая приводит к обострению социальной напряженности в обществе, снижению уровня социальной безопасности. Такие угрозы присущи не только отдельным странам, но и межрегиональным объединениям, таким как Европейский союз. Это приводит к нежеланию стран-доноров тратить все большую часть своего дохода на поддержание развития стран-акцепторов. Проблема региональной неравномерности была изучена многими учеными. Тем не менее, структура неравномерности не исследована достаточно полно. Целью работы является построение экономико-математических моделей анализа региональной неравномерности экономического развития. Объектами исследования являются системы макро- и мезоуровней. Макроуровень представлен Европейским Союзом и его странами-членами. Мезоуровень представлен Украиной и ее регионами. Валовой внутренний продукт на душу населения (для ЕС) и валовой региональный продукт на душу населения (для Украины) были выбраны в качестве ключевых индикаторов неравномерности развития.

Предлагаемые модели основаны на предположениях теории кумулятивного роста и методах дисперсионного анализа. Применение предложенных моделей позволяет позиционировать отдельные территории в системе координат «уровень развития – уровень неравномерности»; выделять центры экономического роста, проблемные регионы и группы регионов с однородным характером изменений в экономическом развитии; осуществлять сравнительный

анализ тенденций неравномерности экономических систем на макро- и мезо- уровнях.

Ключевые слова. Теория кумулятивного роста, модель, анализ, среднеквадратическое отклонение, валовой региональный продукт, валовой внутренний продукт, региональная неравномерность.

Annotation. Nowadays countries and regions suffer from socio-economic threats, which have different origins. One of the most crucial ones is notable regional unevenness of development, which leads to aggravation of social tension in society, decline in the level of social safety. These kinds of threats are not only inherent in individual member countries but also inter-regional associations, such as the European Union. This leads to a reluctance of donor countries to spend an increasingly greater share of their income on supporting the acceptor countries' development. The regional unevenness problem has been studied by many scientists. However, the structure of unevenness hasn't been researched fully enough. The research aims to construct economic and mathematical analysis models of economic development regional unevenness. The objects of the research are macroeconomic and mesoeconomic systems. The macro level is presented by the European Union (EU) and its member countries. The meso level is presented by Ukraine and its regions. Gross domestic product per capita (for the EU) and gross regional product per capita (for Ukraine) have been selected as key indicators of unevenness development. The proposed models are based on the cumulative growth theory assumptions and variance analysis methods. The models make it possible to position separate territories within the system of coordinates «development level – unevenness level»; select the canters of economic growth, problem regions and groups of regions with homogeneous nature of changes in economic development; carry out a comparative analysis of unevenness trends at macro and meso levels.

Keywords. Theory of cumulative growth, model, analysis, standard deviation, gross regional product, gross domestic product, regional unevenness.

Introduction. The current stage of development of economic systems is accompanied by the deployment of crises of various origins. So Ukraine is

faced with the problem of a significant differentiation of development levels of individual regions and territories, which is one of the main causes of acute social tension, falling social security. Problems of this nature are not confined to individual countries, but they are peculiar to inter-regional associations, such as the European Union. This leads to a reluctance of donor countries to spend increasingly more of their income on maintain an adequate development level of acceptor countries.

Literature survey. The problem of uneven development of territories has been studied by many domestic and foreign scientists.

The theory of cumulative growth, which is a synthesis of neo-Keynesian, institutional, economic and geographical models can be accentuated. These models are based on the use of scale and specialization effects whose synergy can lead to a new qualitative transformation in the system. This area of theoretical approaches to the study of regional economic growth is based on the concept of "mutual and cumulative conditionality" of the Swedish scientist G. Myrdal [1, p. 565-575]. Specialization and economies of scale may eventually lead to the growth and strengthening of certain benefits of a region – the growth pole on the background of decline in other regions. A similar theory of "backward and forward linkages" introduced by A. Hirschman confirms an irregular mode of a country’s economic growth. This is caused by uneven nature dependent localization of economic development resources. At the same time, this theory supports the "unbalanced growth", which can give an impetus to mobilization of potential reserves for the benefit of the territorial development [2].

The concept of "growth poles" was put forward by the French economist F. Perry, who has proved that economic growth is activated at some points or poles of growth and with a variable intensity it is distributed through various channels [3, p. 60-65]. In other words, the regional growth does not ensure convergence of the levels of economic development of the territories, although some equalization is possible through the development channels of distribution of "increase effects".

The theory of "growth poles" was further developed in the works of P. Pottier, J. R. Lasuen, J. Friedman, T. Hagerstrand. [3-5].

The content of foreign theories of regional economic growth and development has been most comprehensively analyzed in the work by Y. Hajiyev [6, p. 49-52]

There are works of domestic scientists dealing with specific aspects of uneven regional development. Thus, V. Ermachenko has been exploring unevenness as a factor of tourist flows in Ukraine [7, p. 98]. E. Rayevneva and O. Krupa [8, p. 54-64] examined the uneven economic development of regions in terms of their investment appeal. Regions are divided into homogeneous groups in the system of axes “investment potential – investment risk” estimated by the standard deviation.

Various economic and mathematical methods and models are widely used to solve problems of estimation, analysis and forecasting of regional differentiation.

M. Malkina has conducted a study of factors of inter-regional divergence of real incomes of the Russian Federation population on the basis of the Gini coefficient, Theil's entropy measure, Atkinson index and other indicators [9, p. 113-115].

T. Klebanova, L. Guryanova, S. Svetunkov, O. Sergienko in their works analyzed the unevenness development of regions based on convergence models, simulation, scenario modelling and mathematics of complex numbers [10, 11, 13, p. 269-277, 14, p. 408-421, 15, p. 471-479]. The papers of Ukrainian scientists have rejected the hypothesis of convergence of regional development processes in Ukraine [12, p. 29-32].

In most of the studies the estimate the uneven development of territories was determined for each time (year) separately, the unevenness structure has not been investigated.

Research setup. The goal of this research is to build models of evaluation and analysis of regional unevenness of economic development in Ukraine and the European Union. This will help highlight the centres of economic growth areas, problem areas, carry out a comparative analysis of the unevenness structure.

In this study, the authors propose to carry out analysis at meso and macro levels. The meso level is represented by a separate region of Ukraine with a separate EU country being a macro level object.

The objects of study are the 24 regions of Ukraine, except for the temporarily occupied territory of the Autonomous Republic of Crimea and 31 European Union countries. The research period is limited to the years from 2000 to 2013. Thus, the study period does not only include the years of relative economic stability but the financial crisis of 2007 – 2008 and the years of overcoming its consequences. This allows the authors to explore the phenomenon of uneven economic development over a long period and under different conditions.

The following objectives were set in accordance with the goal of the study:

- to identify the key indicators that will help assess the level of economic development of the territories;
- to build assessment and analysis models of the regional unevenness level;
- to select the centres of economic growth, the problem regions, and groups of regions with homogeneous nature of changes in economic development;
- to make a comparative analysis of the unevenness structure at macro and meso levels.

The analysis of the publications has shown that indicators which are most frequently used for regional development assessment and analysis can be divided into three groups: economic, social and political. The level of regional development is determined by comparing regional indicators (development indicators) with the national average, or with those of other regions (sometimes with other countries' indicators) [16, p. 321].

The main economic indicators are gross domestic product (GDP), gross regional product (GRP), gross national product (GNP), gross value added (GVA) or national income (ND) per capita. The level of economic development is also characterized by indicators of the branch structure (production in industry, production in construction, production in agriculture), financial indicators (general and sector levels of investment, including per capita), indicators of scientific and technical progress (turnover from innovations, total R&D expenditure) and others. It is also crucial to take into

account indicators of institutional changes (change of the form of ownership, restructuring, etc.).

Within this paper the authors suggest to use GRP per capita for regions of Ukraine and GDP per capita for EU countries.

The assessment model of regional unevenness is proposed to be build according to the algorithm shown below (see Fig. 1).

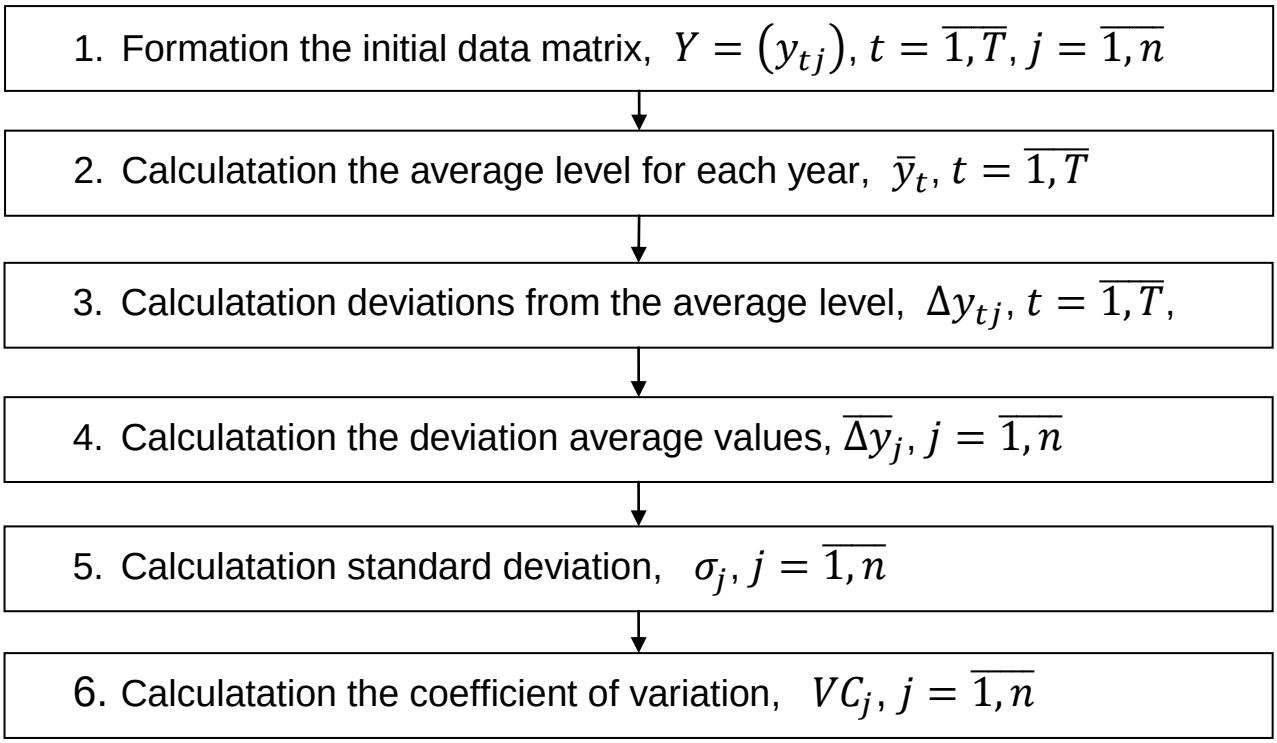

Fig. 1. Algorithm for constructing the assessment model of regional unevenness of economic development

Let us consider the stages of the algorithm in more detail.

Firstly, the initial data matrix $Y = (y_{tj})$ is formed, where y_{tj} is the value of GRP per capita (UAH) or GDP per capita (EUR) in the year t, ($t = \overline{1,T}$) in the region j, ($j = \overline{1,n}$).

Secondly, the average level of development of territories is calculated for each year as an average GRP or GDP value according to the formula:

$$\bar{y}_t = \frac{\sum_{j=1}^{n} y_{tj}}{n}, \qquad t = \overline{1,T}.$$

Thus a general indicator is got to characterize a typical level of regions' development per unit of a homogeneous whole in each year.

Thirdly, the deviation of GRP from the average level is calculated for each region:

$$\Delta y_{tj} = y_{tj} - \bar{y}_t, \qquad t = \overline{1,T}, j = \overline{1,n}.$$

Fourthly, the average deviation for each region is determined:

$$\overline{\Delta y_j} = \frac{\sum_{t=1}^{T} \Delta y_{tj}}{T}, \qquad j = \overline{1,n},$$

Fifthly, the standard deviation (SD) is calculated. It is the best dispersion indicator.

$$\sigma_j = \sqrt{\frac{\sum_{t=1}^{T} \left(\Delta y_{tj} - \overline{\Delta y_j}\right)^2}{T-1}}, \qquad j = \overline{1,n}\,.$$

Sixthly, the value of the variation coefficient (or relative standard deviation) is determined. The coefficient of variation (VC) is defined as a ratio of the standard deviation to the mean. It shows the extent of variability in relation to the mean of the values:

$$VC_j = \left|\frac{\sigma_j}{\overline{\Delta y_j}}\right| \cdot 100\ \%, \qquad j = \overline{1,n}.$$

Findings. The proposed algorithm was applied for the regions of Ukraine and the European Union. The initial data sets were formed according to the open excess information of the State Statistics Service of Ukraine and the European Statistical Committee [17, 18].

Let’s consider the results. Fig. 2 – Fig 3 shows the dynamics of the average values of GRP and GDP per capita in Ukraine and the EU, respectively. Additionally, the median was calculated. It shows the number separating the higher half of a data sample from the lower half.

According to Fig. 2 and Fig. 3 the median values are lower than the average ones. This shows the uneven distributions of values and a strong shift towards smaller values.

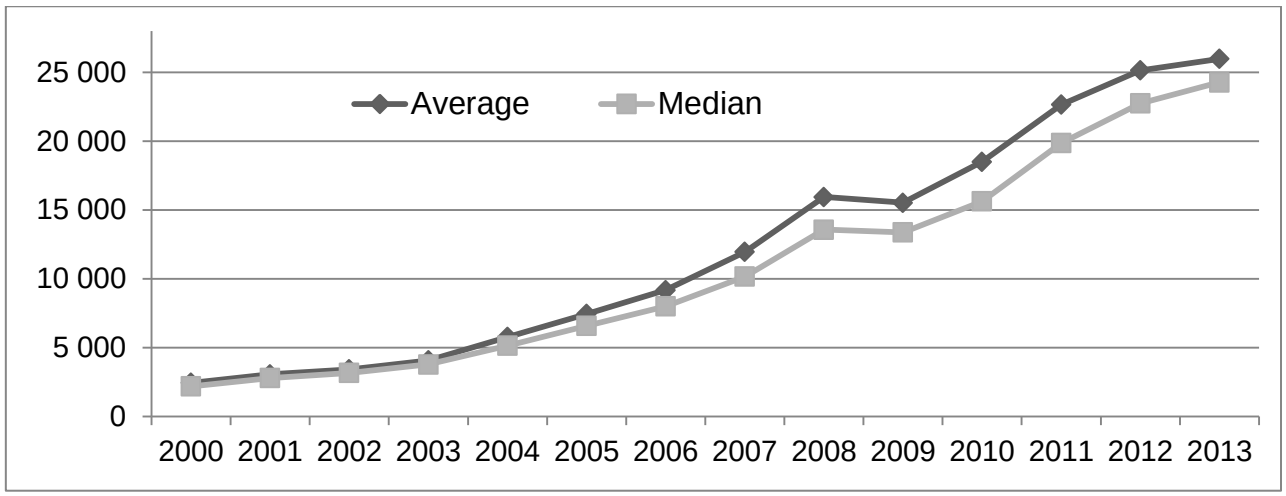

Fig. 2. The dynamics of the GRP per capita average and median values in Ukraine

The flat segment of the graph of average values of GRP is the consequences of the financial crisis of 2008 – 2009 years for Ukraine (see Fig. 2). During the same period the trend changed direction for the EU (see Fig. 3).

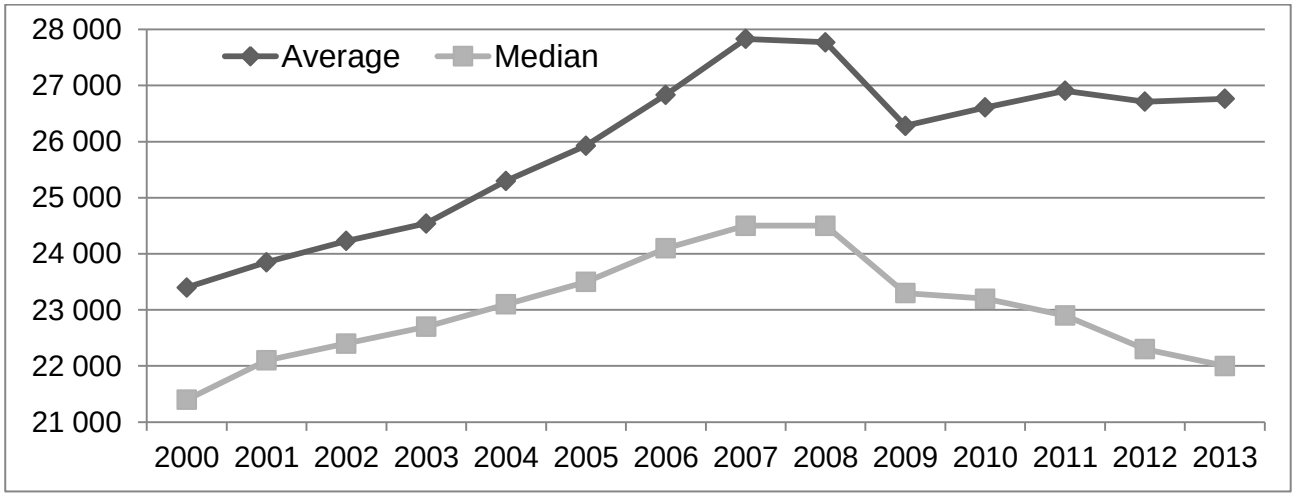

Fig. 3. The dynamics of the GRP per capita average and median values in the EU

The results of calculating the average values deviations from the average level were obtained for the period of 2000-2013. In Ukraine, positive average deviations were found in the following regions: Dnipropetrovsk, Donetsk, Poltava, Kyiv, Zaporizhzhia, Kharkiv, Odesa, Luhansk and Mykolaiv . These regions are industrial ones and have a strong transport infrastructure. In the EU, positive average deviations were found in the following countries: Italy, Iceland, Germany, Ireland, Sweden, Switzerland, Norway, Luxembourg,

the United Kingdom, France, Belgium, Finland, Austria, the Netherlands and Denmark.

The Indicator SD gives a convenient way to demonstrate disparities in the level of economic development of individual regions, as well as make inter-regional comparisons. In Ukraine, the highest values of standard deviation are demonstrated by the following regions: Donetsk, Poltava, Kiev, Dnipropetrovsk, Zakarpattia, Chernivtsi and Ternopil. In the EU the highest values of standard deviation are shown by Italy, Iceland, Germany, Ireland, Sweden, Switzerland, Norway, Luxembourg, Slovakia, Portugal, Greece, Cyprus, Spain.

The calculated values of the variation coefficient in the period of 2000 - 2013 for Ukraine are presented in Table 1.

Table 1

The coefficients of variation for the period of 2000 - 2013

№	Region	VC	№	Region	VC	№	Region	VC
1	Zaporizhzhia	54,44	9	Kirovohrad	71.61	17	Dnipropetrovsk	80.04
2	Cherkasy	58,38	10	Vinnytsia	72.92	18	Volyn	81.38
3	Donetsk	64,32	11	Chernivtsi	74.07	19	Sumy	82.54
4	Zhytomyr	65.07	12	Chernihiv	75.17	20	Ivano-Frankivsk	83.51
5	Odesa	65.64	13	Poltava	75.25	21	Rivne	86.58
6	Ternopil	67.71	14	Kherson	75.94	22	Mykolaiv	99.13
7	Kharkiv	69.62	15	Zakarpattia	76.83	23	Kyiv	108.52
8	Khmelnytsk	71.44	16	Lviv	78.12	24	Luhansk	152.24

The values of variation are very high, thus it is 108.5 % for the Kiev region, 152.2 % for Lugansk, 99.1 % for Mykolaiv, while for the other regions this value varies from 54 % to 87 %. This indicates a significant level of spread of GRP per capita in Ukraine and the lack of uniformity and a constant trajectory of economic development of regions.

A model of the regional unevenness analysis has been built on the basis of the graphical method. The average deviation of GRP or GDP per capita of the average level ($\overline{\Delta y_j}, j = \overline{1,n}$) and standard deviation ($\sigma_j, j = \overline{1,n}$) have been used as initial indicators.

The initial set of indicators was formed according to the following assumptions. If the average values of the deviations are positive, then the

level of development can be considered high (or at least above average). Negative values indicate that the level of development is below average.

The standard deviation may be interpreted as a measure of balance, a measure of evenness of development. High values (above a certain threshold) indicate the presence of imbalance of the territory development. Low values demonstrate a balanced, steady development.

When calculations of $\overline{\Delta y_j}$ and σ_j are made, each region (or country) may be presented as a point in two-dimensional space. The obtained set of points should be divided on four relatively homogenous groups (quadrants) with the following characteristics:

Quadrant I – a positive average value and a high standard deviation.

Quadrant II – a positive average value and a low average deviation.

Quadrant III –a negative average and a low average deviation.

Quadrant IV – a negative average and a high average deviation.

The application of the proposed model to the EU is analyzed below (Fig. 4).

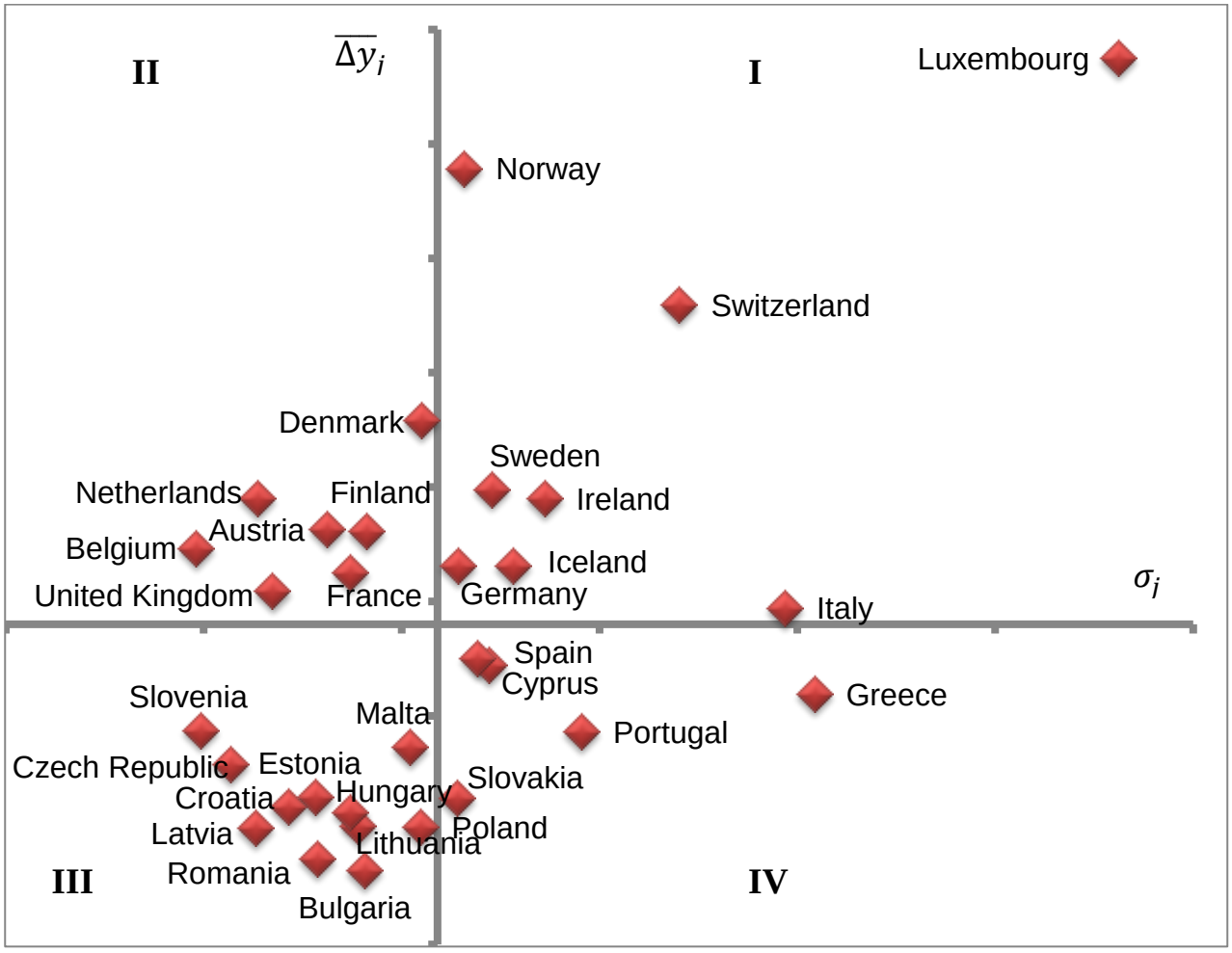

Fig. 4. Implementation of Unevenness Model of Analysis

Average values of both indexes for each quadrant are presented in Fig. 5.

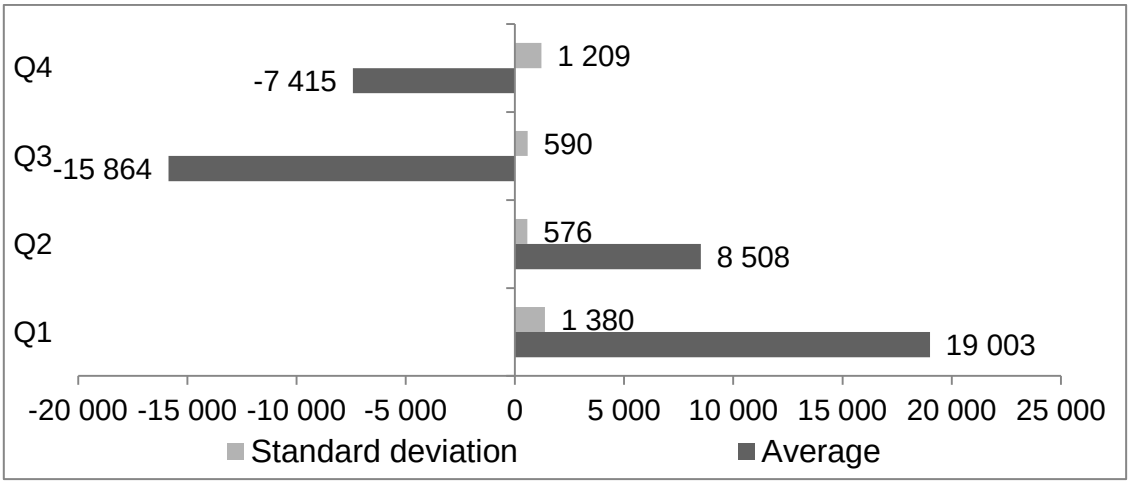

Fig. 5. Average values for the quadrants

Let's analyze the obtained results. The values of deviation are almost the same for quadrant I and quadrant III (-19 003 and -15 864 respectively). These values indicate a significant difference between the GDP of these countries from the EU average level. However, if members of the first quadrant may be described as leaders (positive deviation), the third quadrant consists of outsiders (negative deviation). Similar considerations are also valid for the couple "quadrant II – quadrant IV". Their values of deviation are almost identical too and only differ in the sign.

The second and the third quadrants consist of countries, which have inverse vectors of development according to their means. But they may be characterized as stable ones according to their variances (576 – for quadrant 2 and 590 – for quadrant III). Quadrant I and quadrant IV are unstable zones, because of relatively high variances. Additionally, the values of instability are equal, but opposite, as in the case with the third and second quadrants.

When comparing situations in the third and fourth quadrants you can see that the average value of $\overline{\Delta y_j}$ for quadrant III is almost two times higher than for quadrant IV. As the variances in quadrant III are less, its situation may be characterized as consistently negative.

Let's consider the situation in each quadrant.

The first quadrant consists of the following countries: Italy, Iceland, Germany, Ireland, Sweden, Switzerland, Norway and Luxembourg. The situation within the quadrant is shown in Fig. 6-7.

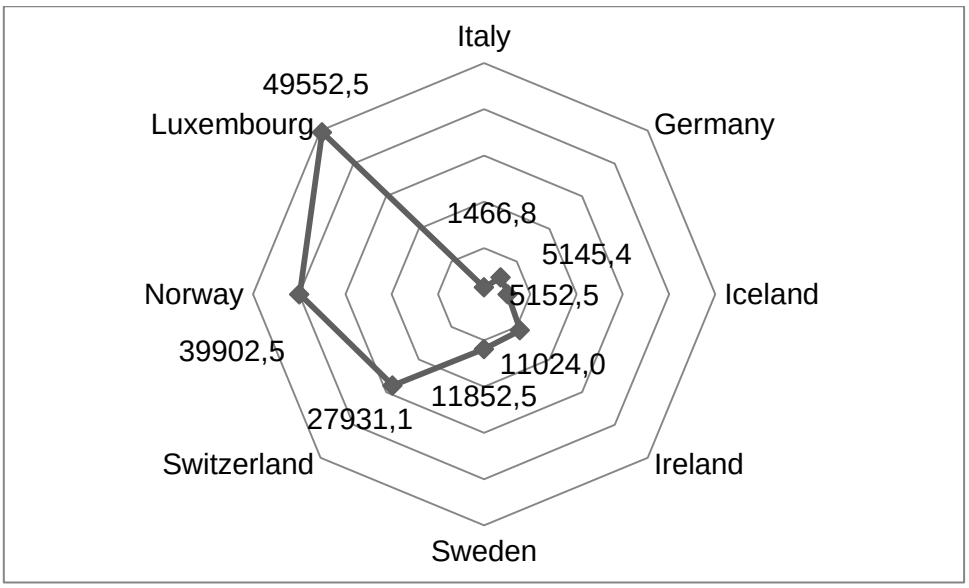

Fig. 6. Average deviation $\overline{\Delta y_j}$ - quadrant I

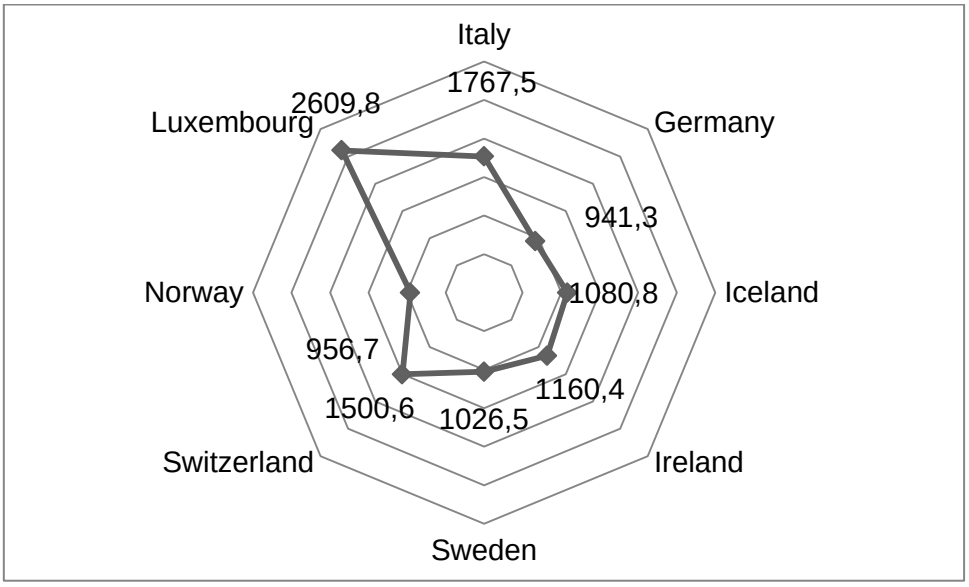

Fig. 7. Standard deviation σ_j - quadrant I

According to Fig. 6, such countries as Luxembourg, Norway and Sweden have demonstrated maximum values of $\overline{\Delta y_j}$. This means their GDP levels consistently greatly exceeded the average EU level. The highest variance was calculated for Luxembourg. Other countries have lower variances. But their values are high compared with those from quadrant II and quadrant III.

For the majority of countries (except Italy, Sweden and Switzerland) the dynamics of Δy_{tj} indexes can be described adequately by polynomial functions. Sweden and Switzerland have demonstrated upward linear trends while Italy has shown a downward linear trend.

For most countries you can see an increase in the values of Δy_{tj} compared with 2000 level (by 19.07 % for Ireland, by 25.34 % for Sweden, by 4.27 % for Norway, by 11.61 % for Sweden, by 9.47 % for Luxemburg, anomalous growth of 72 % was demonstrated by Iceland). Italy has shown a negative growth of approximately 135 %. As it is situated very close to the x-axis in Fig. 4, this country may change its quadrant in the near future.

The second quadrant includes the following countries: the United Kingdom, France, Belgium, Finland, Austria, the Netherlands and Denmark.

The situation within the quadrant is shown in Fig. 8 - 9.

Fig. 8. Average deviation $\overline{\Delta y_j}$ – quadrant II

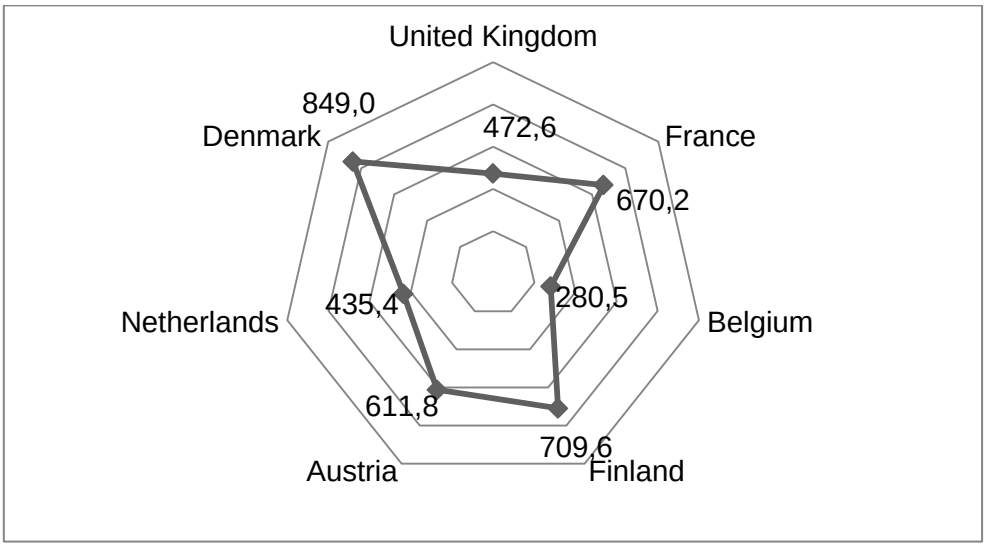

Fig. 9. Standard deviation σ_j.– quadrant III

A leading position in this quadrant belongs to Denmark. This country has the highest values of $\overline{\Delta y_j}$ and σ_j and demonstrates a great potential.

The United Kingdom has the lowest value of the $\overline{\Delta y_j}$ index. Its position in Fig. 4 is very close to the x-axis, its Δy_{tj} values are always the lowest (see Fig. 10). That is why it may change the quadrant.

A positive growth of Δy_{tj} compared with the 2000 year level is only presented by the United Kingdom (4.67 %), Finland (8.95 %) and Austria (12.48 %) (Fig. 10). Other members of the quadrant have negative growth values. The highest negative growth of 22.18 % is demonstrated by France. For Denmark it is 11.51 %, for Netherlands it makes 4.95 %, for Belgium it is 3.78 %.

All participants of the quadrant have shown high standard deviations. All series can be adequately presented only by polynomial functions. Thus forecasting values may fluctuate and show either increase or decrease.

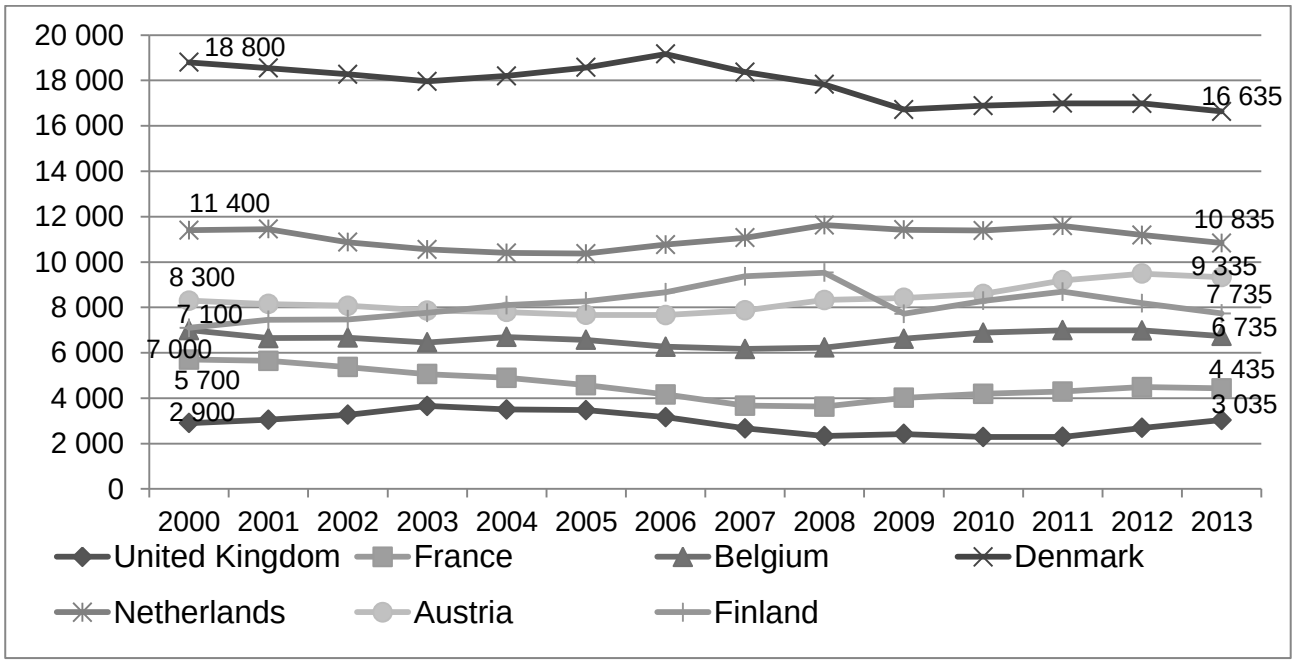

Fig. 10. Dynamics of Δy_{tj}– quadrant II.

The third quadrant consists of Bulgaria, Romania, Latvia, Poland, Lithuania, Hungary, Croatia, Estonia, Czech Republic, Malta and Slovenia. The results are shown in Fig. 11 – 12.

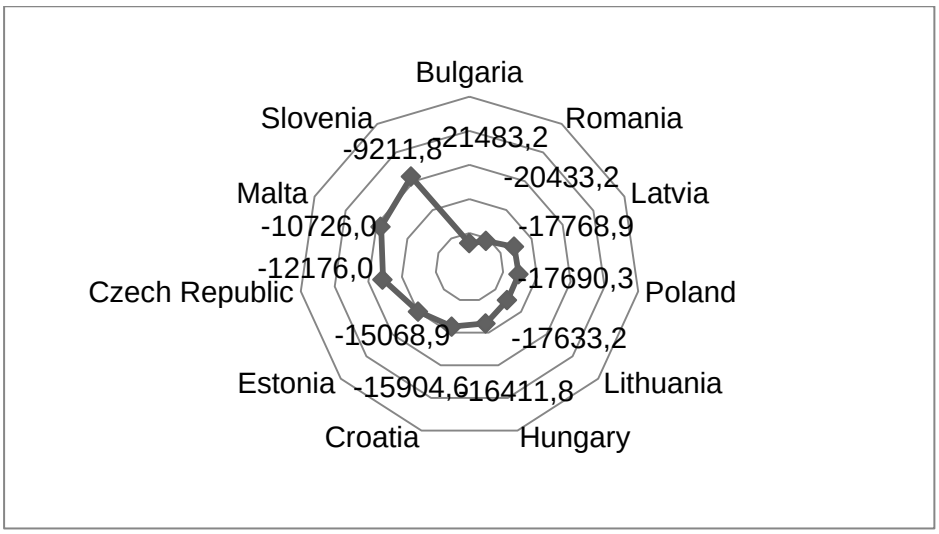

Fig. 11. Average deviation $\overline{\Delta y_j}$ – quadrant III

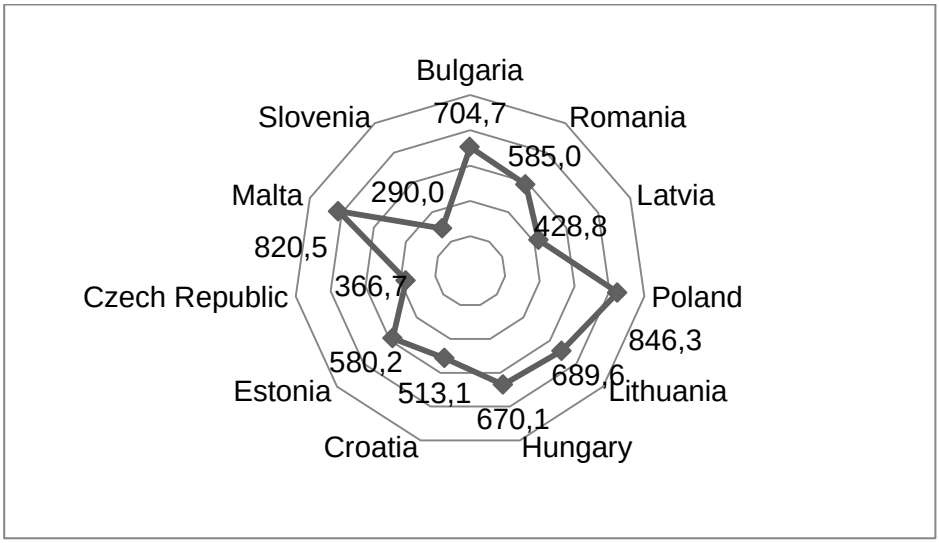

Fig. 12. Standard deviation σ_j.– quadrant III

Bulgaria and Romania have the highest values of $\overline{\Delta y_j}$. A relatively better situation is with Slovenia (-9 211.8), Malta (-10 726) and the Czech Republic (-12 176).

The analyzed quadrant consists of members which demonstrate high standard deviations. However, Slovenia is an exception among those countries with a relatively low value (Fig. 12).

The situation in dynamics has worsened for Bulgaria (by -4.73 %), Croatia (by -7.56 %), Hungary (by -7.551 %), Malta (by -1.71 %), Romania (by -1.58 %), Slovenia (by -2.81 %) and Croatia (by -7.56 %)(Fig. 13).

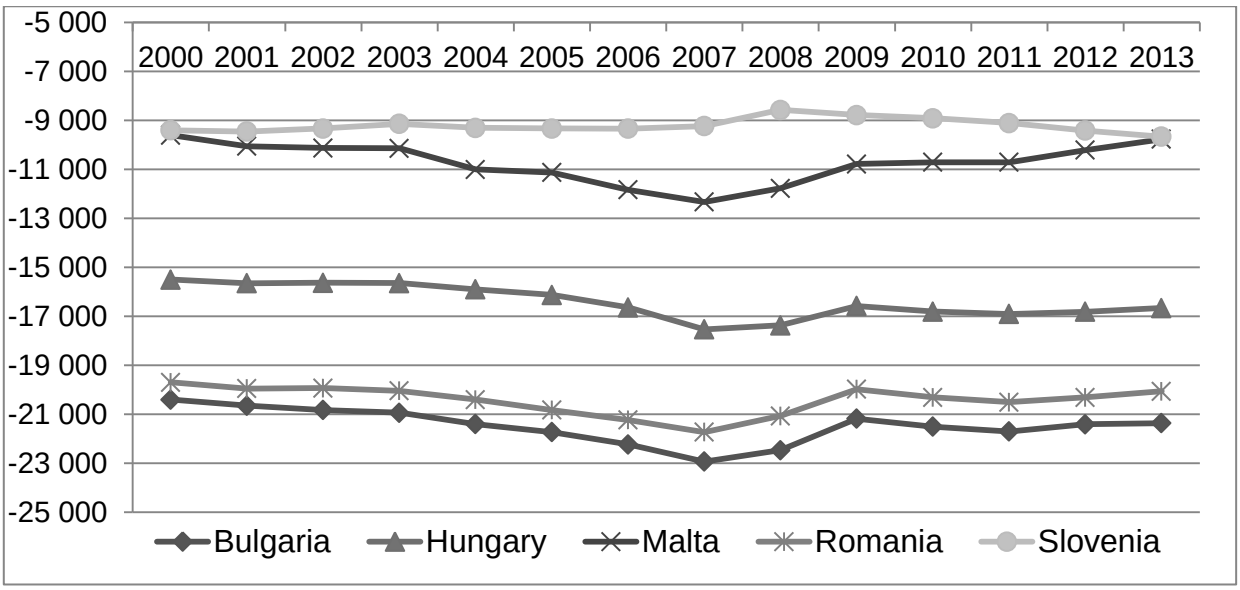

Fig. 13. The worsened dynamics of Δy_{tj} - quadrant III

The dynamics of Δy_{tj} is perfectly described by polynomial functions (Fig. 13) and has the same fluctuations. Visual analysis makes it possible to track a similar deterioration trend until 2007. Then all lines except Slovenia tend to grow. Actually, Slovenia has demonstrated a return to the 2000 level. This situation was not probably due to real improvements within the country. The reason is in its stable position against deterioration in other countries.

A relative growth of Δy_{tj} is shown by the rest of quadrant members. The highest levels of growth are for Lithuania (12.28 %), Estonia (11.62 %) and Latvia (7.89 %). For the Czech Republic and Poland those levels are 4.35 % and 1.97 %, respectively. All trends may be described as polynomial functions only.

Quadrant IV consists of Slovakia, Portugal, Greece, Cyprus and Spain.

For its member countries the GDP levels are the lowest. The high levels of standard deviations give reason to assume an unstable position of these countries (Table 2).

Table 2

Characteristics of the quadrant IV

Index	Slovakia	Portugal	Greece	Cyprus	Spain
Average deviation	-15162	-9340,3	-6068,9	-3568,9	-2933,2
Standard deviation	939,513	1253,86	1842,24	1019,64	991,626

The levels of Δy_{tj} have demonstrated a dramatic fall for the majority of countries. The series are adequately described by linear functions for Spain, Cyprus and Portugal. As for Greece the best variant is a polynomial function. The greatest reductions in Δy_{tj} against the 2000 level have been demonstrated by Spain (-138.23 %) and Cyprus (-112.15 %). A better situation is for Greece (-71.80 %) and Portugal (-49.51 %).

Slovakia has shown a linear upward trend. Its relative growth of Δy_{tj} equals approximately 13 %. But the absolute value of Δy_{tj} still remains the worst (-13 564.5 in 2013).

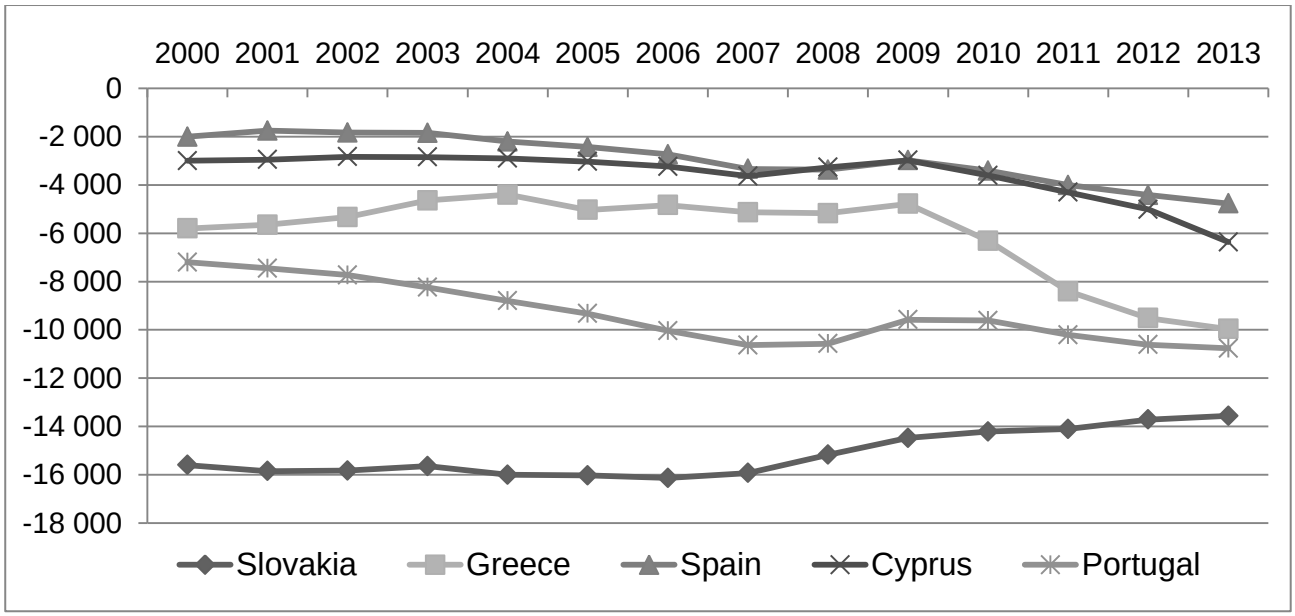

Fig. 14. Dynamics of Δy_{tj} - quadrant IV

The application of the proposed model to Ukraine is analyzed below (Fig. 15).

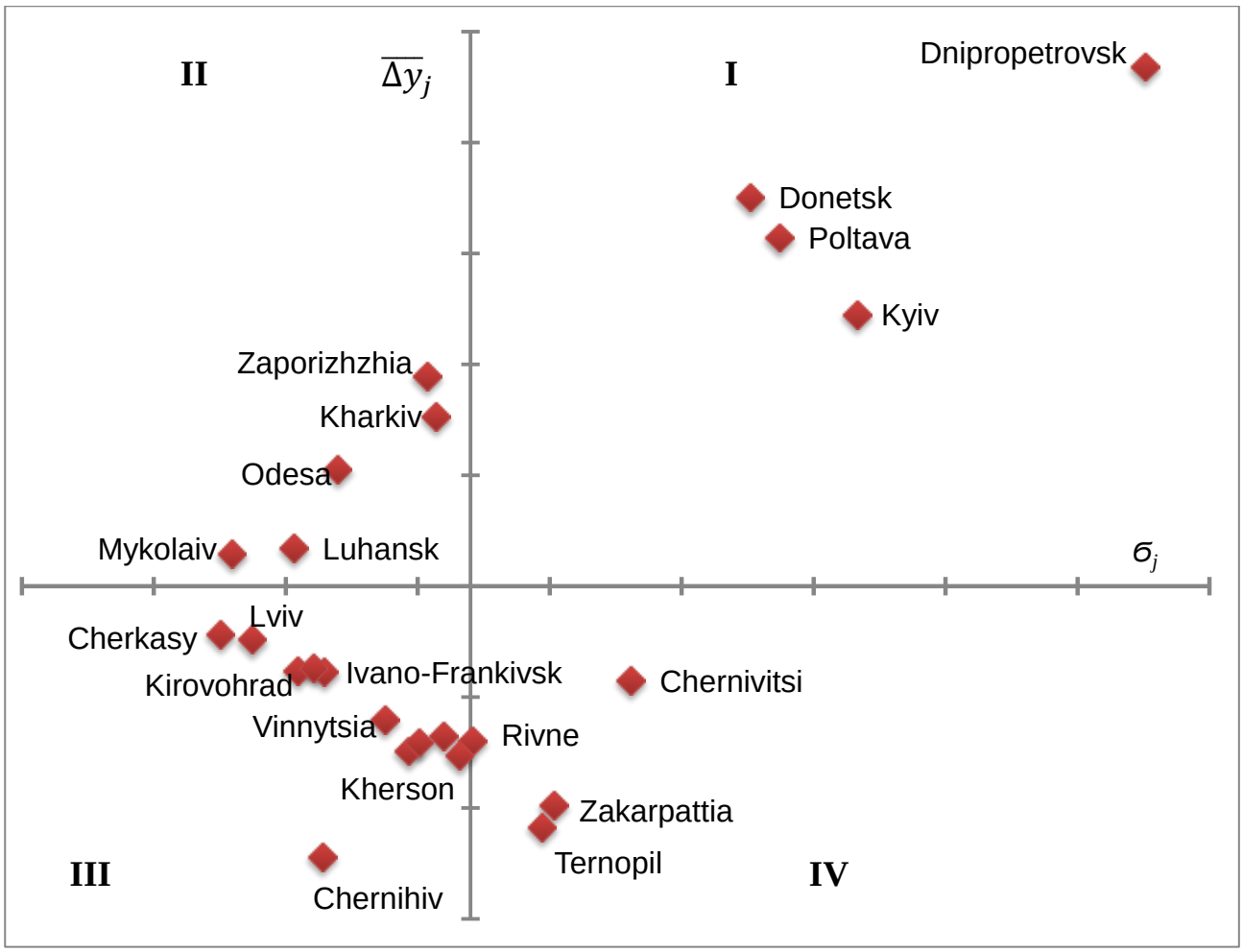

Fig. 15. Implementation of the regional unevenness analysis model

Consider the characteristics of the regions, placed in each of the quadrants.

Donetsk, Poltava, Kiev, and Dnepropetrovsk regions are in quadrant I. These regions are not only characterized by significantly higher levels of development in the researched period but also by a high level of deviation from the national average, high dynamic changes (Fig. 16 shows the dynamics of the levels of deviations from the average GRP per capita values). But these changes are with a "+" sign and have a stable trajectory. These regions are leading industrial regions, which produce "growth impulses". The advantages of these regions may eventually increase.

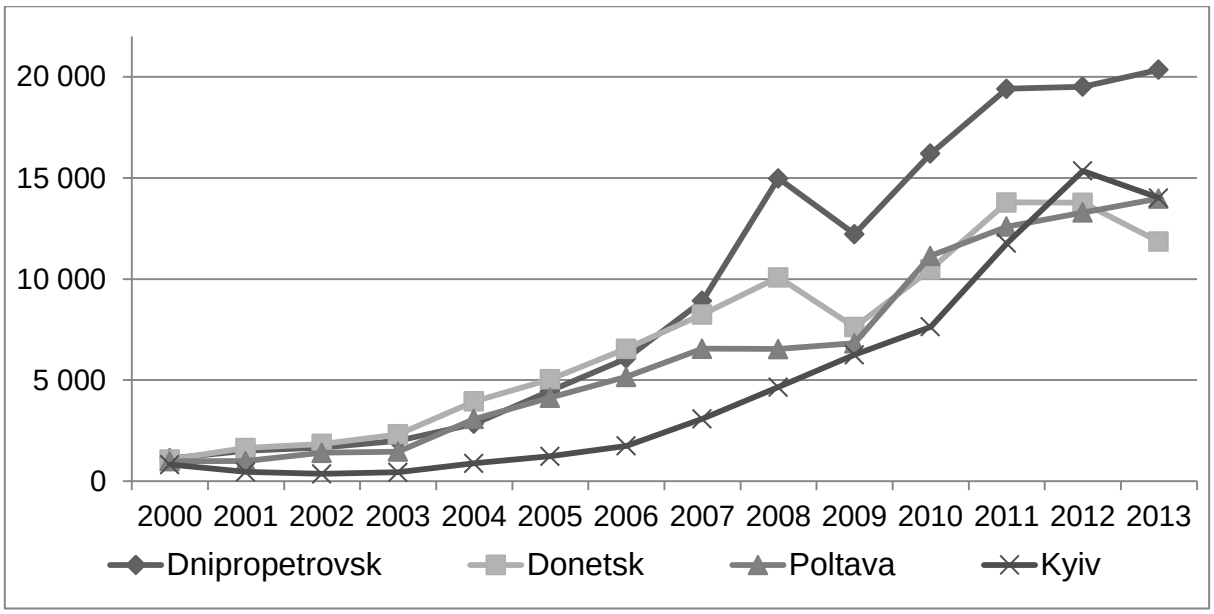

Fig. 16. The dynamics of average annual value deviations for regions in quadrant I

In quadrant II got Mykolaiv, Luhansk, Odesa, Zaporizhzhia and Kharkiv regions. These are the regions with the value of GDP that is above average and balanced development. These are industrial regions with a developed transport infrastructure, bordering the regions-leaders. Due to this they have growth potential. Fig. 17 shows the dynamics of the levels of GRP per capita deviations from the average data.

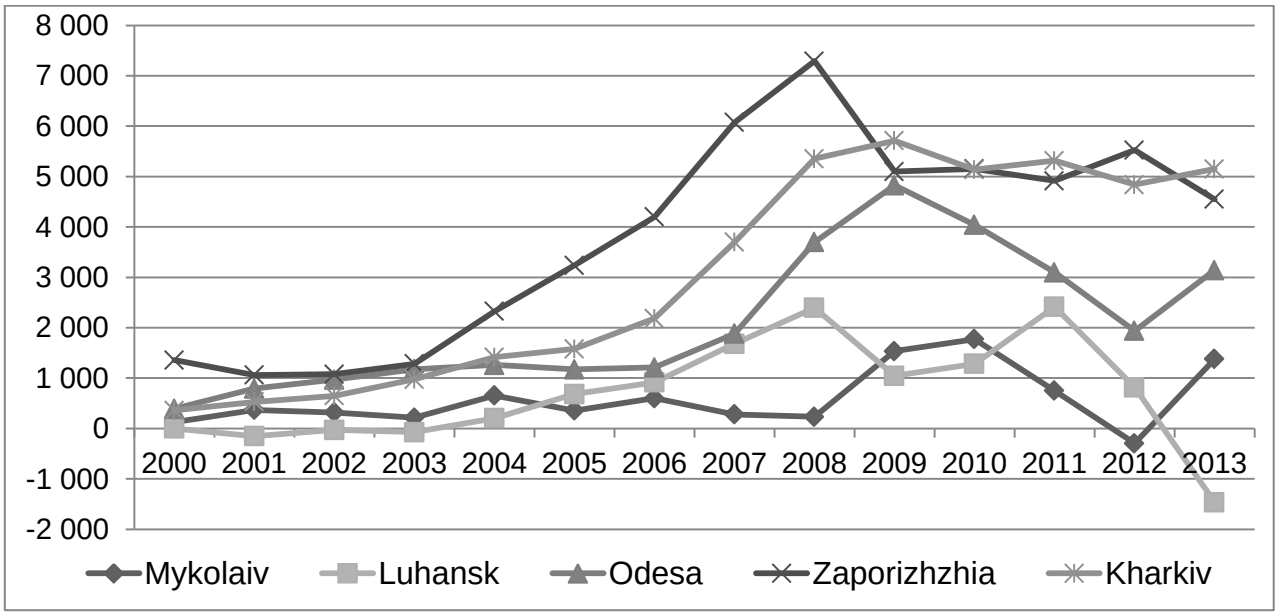

Fig. 17. The dynamics of average annual value deviations for regions in quadrant II

The trajectory of economic development has been stable for these regions until 2008 - 2009. The positive deviations indicate that these regions have a certain potential for development. However, a small measure of deviation indicates the need for additional resources to enable these regions to go to the group of the leading regions. This is especially true of the Kharkiv region and Zaporizhzhia region which are stable ones with a growth potential.

Vinnytsia, Volyn, Zhytomyr, Ivano-Frankivsk, Kirovohrad, Lviv, Sumy, Kherson, Khmelnytskyi, Cherkasy and Chernihiv regions belong to quadrant III. These are the regions with lower-middle and low standard deviation levels. For these regions the degree of deviation is insignificant, but these deviations show a negative dynamics (Fig. 18).

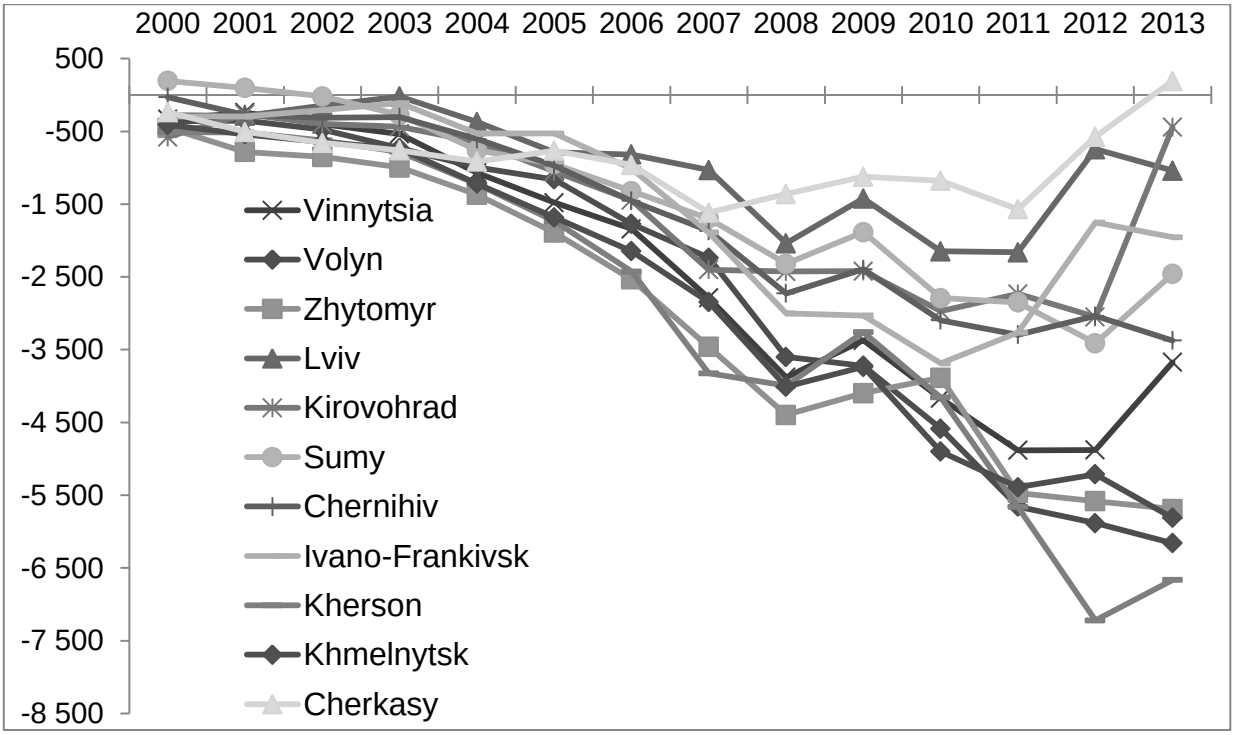

Fig. 18. The dynamics of average annual value deviations for regions in quadrant III

Ternopil, Zakarpattia, Rivne and Chernivtsi are in quadrant IV. These are the regions with the lowest level of economic development and a negative dynamics (Fig. 19).

Potentially, these regions are a threat to the economic security of the country. These regions are outsiders.

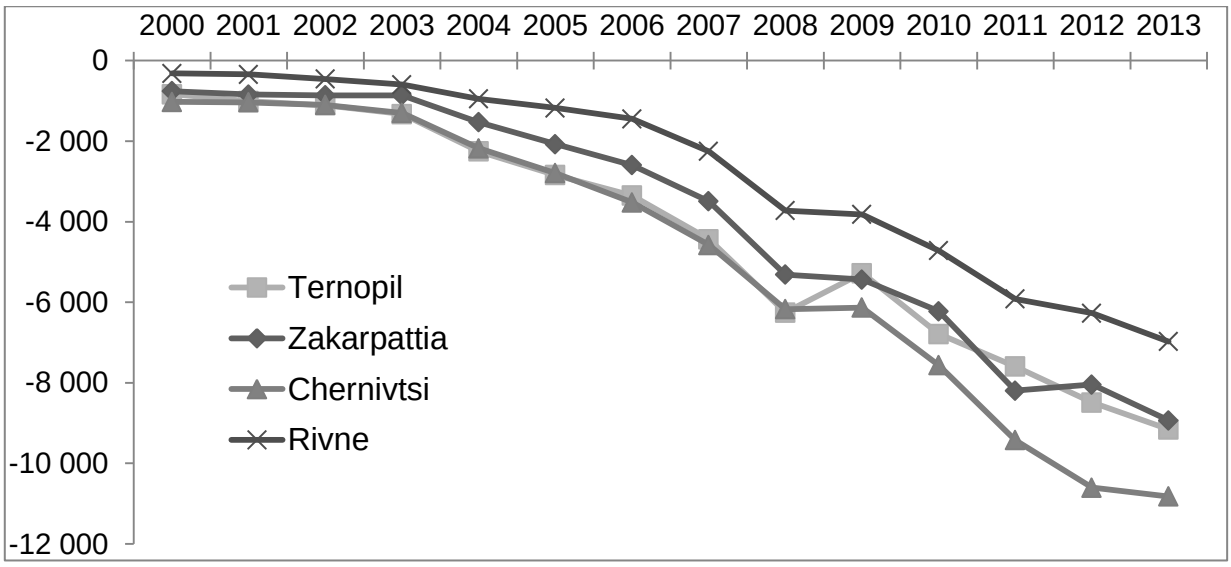

Fig. 19. The dynamics of average annual value deviations for regions in quadrant IV

According to the retrospective analysis conducted for Rivne only, it had situated within quadrant 3 until 2012. However, its declining trend dropped the region into quadrant 4.

Finally, let's analyze the structure of quadrants for the EU and Ukraine (Fig. 20).

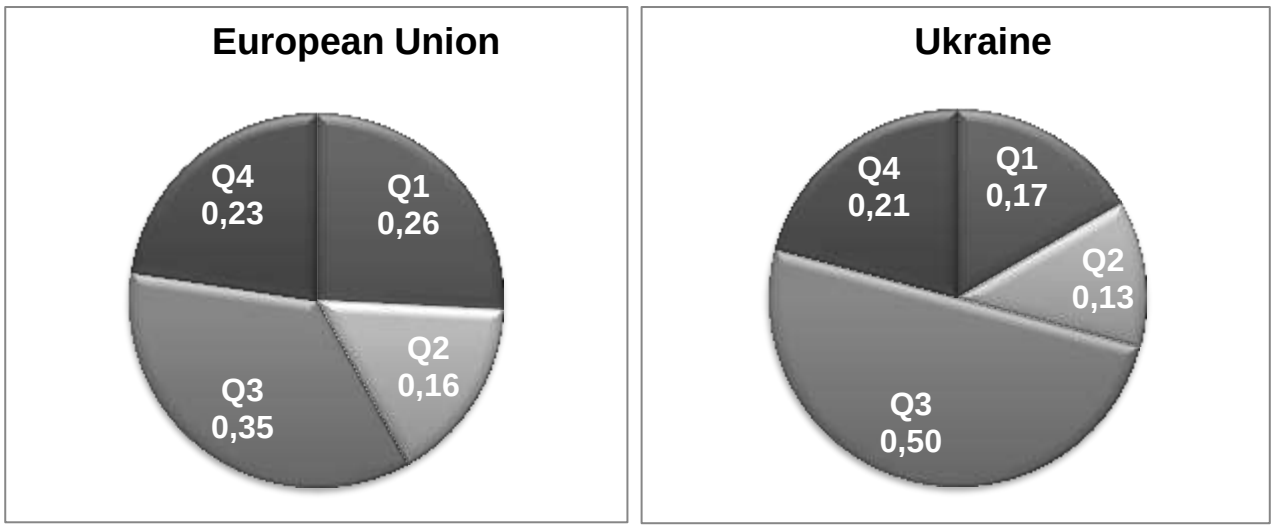

Fig. 20. The quadrants structure

In both cases members of quadrant 1 and quadrant 2 demonstrate the highest level of socio-economic development. The members of quadrant 2 are relatively stable. The members of quadrant 1 produce "growth impulses". The advantages of these members may eventually increase. The higher a share of these two quadrants, the better economic situation of the system as

a whole. The share of the first and the second quadrants equals 48 % for the EU and 38 % for Ukraine. That means a more even distribution for the EU.

In both cases, the third quadrant is the most numerous one. Its share equals almost one third for the EU. But in case of Ukraine this value equals 50 %. So, half of regions of Ukraine do not demonstrate growth potential.

In general, the structures are comparable with each other.

Conclusions.

The absence of intersections on the graphs of Δy_{tj} shows a relative stability of the composition of the quadrants over time for the EU. However, in case of Ukraine the structure of quadrants may be changed.

The model suggested by authors allows carry out analysis of quadrants structure in dynamics. It also makes it possible to determine those regions which are situated near axes and may migrate from the present quadrant. Those regions do not demonstrate a stable position. Thus it is crucial to investigate the opportunity of changing their membership and select the factors that may support such changes.

The results obtained by the authors correspond to the cumulative growth theory. The levels of economic development of regions are not aligned with the times. With specialization and economies of scale, the limited advantages of the industrial areas can grow and be multiplied with time. The distribution of this effect in the regions or the so-called "divergent effects" lead to the fact that the benefits of individual areas, growth poles, lead to their catalyzed development and of greater stagnation of the adjacent regions against this background.

Future research directions.

Regional unevenness of development often leads to aggravation of social tension in society, decline in the level of social safety. That is why it is crucial to construct and implement a set of models that will produce short-term and long-term forecasts of the level of unevenness. Moreover, such models should be able to determine the most significant factors which cause the unevenness.

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