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ASYMMETRY EVALUATION AND RISK MEASURE OF ECONOMIC DEVELOPMENT OF THE REGIONS OF UKRAINE

The dynamics of asymmetry evaluation is calculated and illustrated using the Theil index for 27 regions of Ukraine and 6 macro-regions, into which the country was divided in some way, and the risk measure of the economic development during the period from 2004 to 2011 is defined.

Introduction

National economy is an economically and organizationally unified system of interconnected branches and spheres of human activities, which are inherent in the corresponding proportionality, interdependent accommodation in the area bounded by state borders.

The term "asymmetry" (differentiation, discrepancy, imbalance etc.) is used to determine the spatial separation processes. The asymmetry reflects some (predominantly negative) aspects of unevenness: the inharmonious changes in the dynamics of economic development and the disparity in statistics; it involves giving information not only about the positive or negative unevenness of the development, but also about its stable expression in the time and space. As far as the asymmetry of a country's economic space is concerned, even distribution of the kinds of activities or industry branches on the territory of a country is not considered an ideal as their uneven distribution is an inevitable feature of any economic space.

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In the context of the problem under consideration, the asymmetry is understood as a measure of inter-regional differences in levels of economic development (economic activity) and quality of life.

In this work we calculated the averaged figure $T_{T,L}$ between the first and the second Theil indices and defined risk measure of economic development of the regions of Ukraine.

2. Calculation of asymmetry evalution and risk measure for 27 regions of Ukraine

The most complete quantitative assessment of unevenness is given by the so-called indicators of total entropy [1]:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\mu}\right)^{\alpha} - 1\right],$$

where y_i - index of the ith sample member, $i = 1, \ldots, n$; μ - average for the sample.

The parameter α can take any value from - ∞ to +∞. It determines the weight that is given to differences in income distribution at different intervals. Empirical studies often limit to two values of α: 0 and 1, which form the values of the relevant properties below (Theil index).

In the distribution of socio-economic benefits entropy means deviation from perfectly equal distribution.

Let us imagine that the population is divided into n regions, and each of ith regions corresponds to p_i - population and y_i - indicator of productive activities in the region (Gross regional product - GRP), then [2]:

1. The indicator in the formula (1) when α=1 is called the first Theil index or the Theil T - measure:

$$GE(1) = T_T = \sum_{i=1}^{n}\frac{y_i}{y}\ln\left(\frac{y_i}{y}\bigg/\frac{p_i}{p}\right),$$

where y - GDP of the country; p - population of the country.

2. The indicator in the formula (1) when α=0 is called the second Theil index or the Theil L - measure:

$$GE(0) = T_L = \sum_{i=1}^{n}\frac{p_i}{p}\ln\left(\frac{p_i}{p}\bigg/\frac{y_i}{y}\right).$$

The lower the value of the data index is, the lower the level of inequality of distribution is.

The economic interpretation of data indexes is that the first Theil index shows the regional distribution of income among the population, and the second one shows the population by income. The Theil index increases with increasing degree of inter-regional asymmetries.

GRP is considered as an economic indicator whose values were taken from the State Statistics Committee of Ukraine [3]. Ukraine was divided into 27 regions. The time interval under consideration is the period from 2004 to 2011. We apply formulas (1) and (2) and calculate the arithmetic mean of these indicators, that is:

$$T_{T,L} = \frac{1}{2}\left[\sum_{i=1}^{n} \frac{y_i}{y} \ln\left(\frac{y_i}{y}\bigg/\frac{p_i}{p}\right) + \sum_{i=1}^{n} \frac{p_i}{p} \ln\left(\frac{p_i}{p}\bigg/\frac{y_i}{y}\right)\right]$$

The calculation results are presented in the table:

Average Theil index							
Year	2004	2005	2006	2007	2008	2009	2010	2011
$T_{T,L}$	0,114759	0,112272	0,114666	0,131419	0,123869	0,120657	0,120721	0,106047
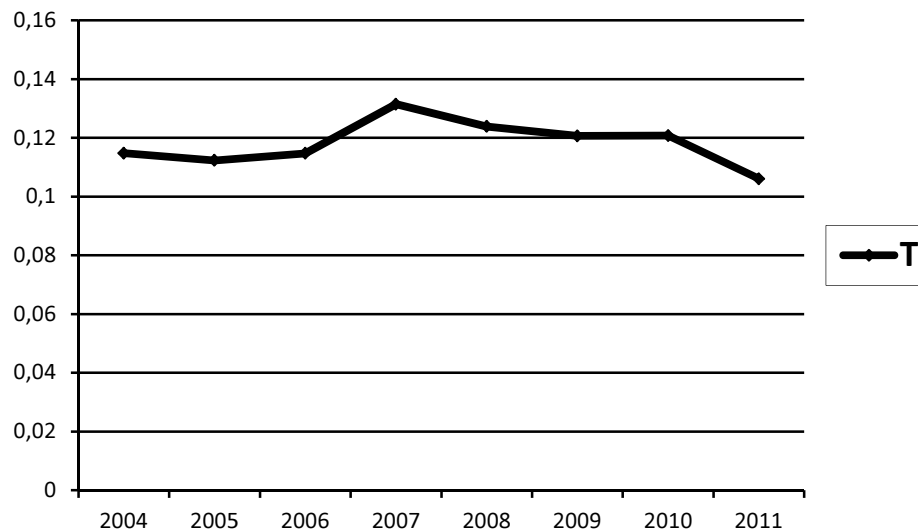
Thus, the graph shows that the Theil index was increasing up to the period of 2007. It means that by 2007 the uneven economic development of regions of Ukraine was increasing. However, after the economic crisis taken place in 2008, the rate of unevenness decreases.

An important characteristic of the danger or rather the measure of possible danger is the frequency with which it can occur, that is, the concepts of risk. As a risk measure we take the attitude of the standard deviation of a random variable to the mathematical expectation of a random variable for which the risk is determined [4, p. 233]:
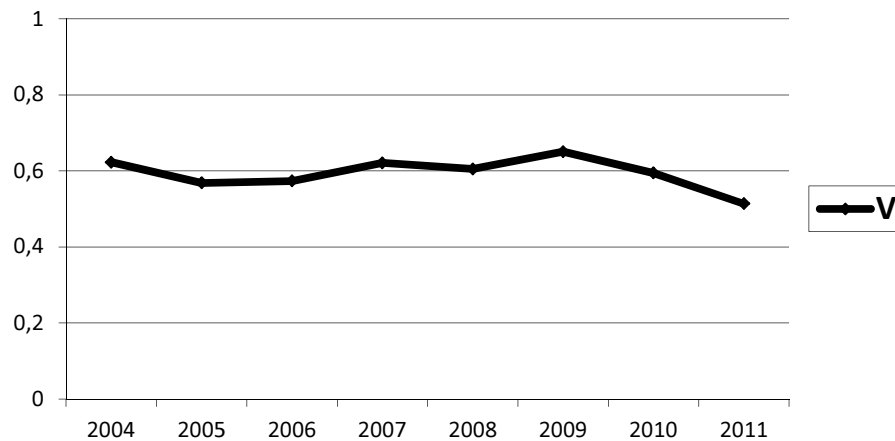
$$V = \frac{\sigma}{Ex} = \frac{\sqrt{Dx}}{Ex};$$

where
Dx – the variance of the corresponding random variable,
Ex - the expected value of a random variable.

Risk measure							
Year	2004	2005	2006	2007	2008	2009	2010	2011
V	0,622662	0,568499	0,573245	0,620996	0,604866	0,650375	0,594420	0,513651

The results show that the area of risk, that is a zone of total loss market, is quite high but acceptable, and after 2009 the measure of risk decreases, which indicates an improvement in the economic situation.

3. Calculation of asymmetry evalution and risk measure for 6 macro-regions of Ukraine

Now let us define what has a more negative impact on the economy of Ukraine's regions: the region in general or specific areas of the country. Therefore, we calculate the average Theil index and risk measure of economic development of 6 macro-regions of the country.

Region	Areas belonging to region
Western	Volyn, Transcarpatian, Lviv, Ivano-Frankivsk, Rivne, Ternopil, Chernivtsi regions
Central	Wynnytsia, Zhytomyr, Kiev, Khmel'nyts'k, Cherkasy, Chernihiv regions; the city of Kiev
Pridniprov'ya	Dnipropetrovs'k, Zaporizhia, Kirovograd regions
Kharkyvshchyna	Poltava, Sumy, Kharkiv regions
Black Sea Region	Mykolayiv, Odesa, Kherson regions; Autonomy Republic of Crimea, the city of Sevastopol
Donetchchyna	Donets'k, Luhans'k regions

Macro-regions were allocated by the following signs which, in some way, can be determined as principles of zoning:

1. Specialization of a region in national division and labor integration.
2. Close social and economic, demographic and cultural interconnection of a region area with the main core – its largest city with the most population.
3. Possibility to implement territorial control within the region and to coordinate social, economic and demographic processes on the sub-Ukrainian level.

To calculate we use the calculation formula of [5], decompose the total interregional asymmetry index into two components, reflecting inter-macro-regional and intra-macro-regional economic asymmetry. Intra-macro-regional component reflects inequality between regions belonging to the same group, and inter-macro-regional component reflects inequality between regions belonging to different macro-regions.

If we break the whole number of regions into K macro-regions, each of which is composed of J_k regions, the index becomes a sum of two components. Then, in general, the Theil index is as follows:

$$T = T_V + T_M$$

where

T_M - weighted average inter-macro-regional index of inequality,

T_V - weighted average intra-macro-regional index of inequality.

Hence the first Theil index is:

$$T_T = \sum_{k=1}^{K} \frac{y_k}{y} \cdot T_k + \sum_{k=1}^{K} \frac{y_k}{y} \cdot \ln\left(\frac{y_k}{y} \bigg/ \frac{p_k}{p} \right), \text{ where } T_k = \sum_{j=1}^{J_k} \frac{y_{kj}}{y} \cdot \ln\left(\frac{y_{kj}}{y_k} \bigg/ \frac{p_{kj}}{p_k} \right).$$

The second Theil index is:

$$T_L = \sum_{k=1}^{K} \frac{p_k}{p} \cdot T_k + \sum_{k=1}^{K} \frac{p_k}{p} \cdot \ln\left(\frac{p_k}{p} \Big/ \frac{y_k}{y}\right), \quad \text{where} \quad T_k = \sum_{j=1}^{J_k} \frac{p_{kj}}{p} \cdot \ln\left(\frac{p_{kj}}{p_k} \Big/ \frac{y_{kj}}{y_k}\right),$$

T_k - intra-macro-regional index of macro-region k, $k = 1,...,K$;

K - quantity of separated macro-regions;

J_k - quantity of regions in the macro-region k;

y_{kj} - indicator of region j, that is in the macro-region k, $j = 1,..., J_k$;

p_{kj} - population of region j, that is in the macro-region k;
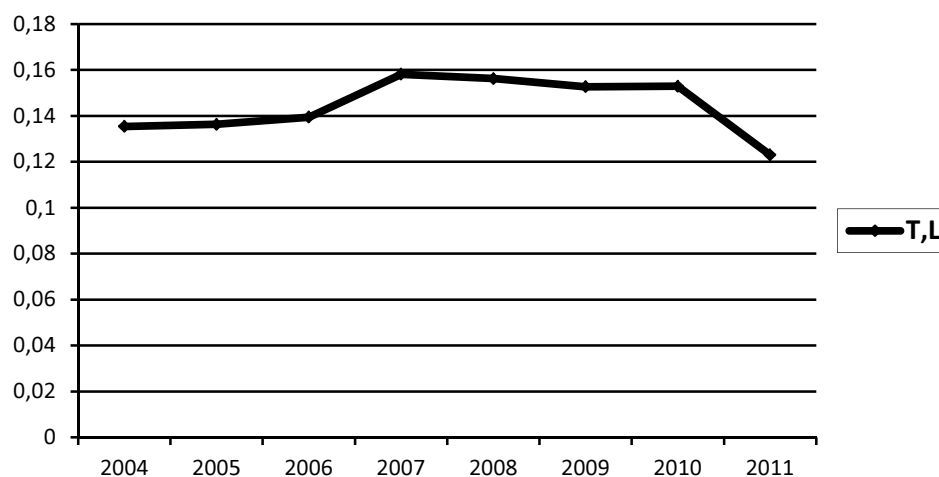
y_k - indicator of the macro-region k;

p_k - population of the macro-region k.

If we calculate the average Theil index using the formula:

$$T_{T,L} = \frac{1}{2}\left[\sum_{k=1}^{K} \frac{y_k}{y} \cdot T_k + \sum_{k=1}^{K} \frac{y_k}{y} \cdot \ln\left(\frac{y_k}{y} \Big/ \frac{p_k}{p}\right) + \sum_{k=1}^{K} \frac{p_k}{p} \cdot T_k + \sum_{k=1}^{K} \frac{p_k}{p} \cdot \ln\left(\frac{p_k}{p} \Big/ \frac{y_k}{y}\right)\right]$$

we obtained the following results :

| Year	2004	2005	2006	2007	2008	2009	2010	2011
$T_{T,L}$	0,135423	0,136321	0,139433	0,158137	0,156226	0,152666	0,152919	0,123032

Thus the analysis shows that, comparing with previous data of average Theil index; these figures are higher, indicating that certain macro-regions influence the economic development of the country. On the dynamics of Theil index we see that

the asymmetry of economic development of 6 macro-regions of Ukraine was increasing by 2007. Since 2008, Theil index gradually has been decreasing and therefore we can say that the asymmetry of economic development is reducing.

By calculating the risk measure of economic development of macro-regions, we have the following results:

Year	2004	2005	2006	2007	2008	2009	2010	2011
V	0,572030	0,665274	0,669656	0,699788	0,703343	0,699682	0,699630	0,604539
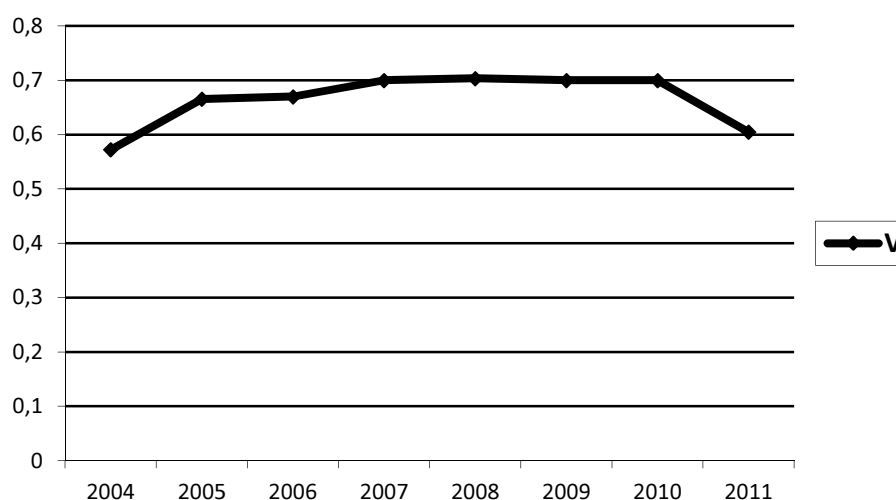
The results indicate that the area of risk of macro-regions is much higher than of 27 regions of the country. As for driving dynamics, the risk measure of economic development was more or less stable to 2010, and then rapidly decreases. Again we are confided that the certain population areas – macro-regions – have a greater impact on the economy of regions.

Characteristic features of modern development of Ukraine are the following: strengthening of inter-regional socio-economic inequality and rising asymmetry in the development of certain regions. This inhomogeneity and imbalances of economic space of the country leads to economic domination of some regions over others.

It should be noted that the socio-economic differentiation in a varying degree is common to all the countries in the world regardless of their administrative-territorial location and level of socio-economic development, i.e. no country can achieve absolute security.

Thus the analysis revealed that the Theil index is really an assessment of unevenness. Its advantage for estimating interregional economic asymmetry is its independence of the absolute scale of income and population. From the calcula-

tions it follows that the development of economy of Ukrainian regions is albeit slowly but more or less stabilized.

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Abstract:

Thus the analysis revealed that the Theil index is really an assessment of unevenness. Its advantage for estimating interregional economic asymmetry is its independence of the absolute scale of income and population. From the calculations it follows that the development of economy of Ukrainian regions is albeit slowly but more or less stabilized.

Ewaluacja asymetryczna i miara ryzyka rozwoju gospodarczego wybranych regionów Ukrainy

Kwestia szacowania dynamiki asymetrii rozwoju jest jednym z problemów obecnych we współczesnej ekonomii. W artykule rozważono i zilustrowano tę problematykę przy wykorzystaniu współczynnika Theila na przykładzie Ukrainy, która została podzielona w określony sposób na 27 regionów i 6 makro-regionów. Zdefiniowano i wyznaczono także ryzyko rozwoju gospodarczego w latach 2004-2011.

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