ESTIMATION OF UNEVEN DEVELOPMENT OF LITHUANIAN REGIONS

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The researchers have aimed to analyse the processes of divergent development of Lithuanian regions by estimating the basic parameters of the process of inter-regional stratification.

We have carried out an estimation of the process of differentiation using three parameters: per capita gross regional product (further GRP), per worker GRP and per capita foreign direct investment (further FDI) in a separate region.

Using these indicators and the economic classical convergence–divergence approaches of analysis, the principal dimensions of the unequal development of territorial units in Lithuania have been assessed.

Key words: regional convergence, regional divergence and interregional disparities

Introduction

During the process of reform, the socio-economic situation of separate regions in Lithuania has been influenced by a set of new factors. These include: the rate and scale of economic transformations; the development of market sectors; foreign economic co-operation; mutual relationship of each separate region with the Central Government; and ability to adapt to new conditions and to make good use of them. All these factors have promoted the growth of regional differentiation.

The issue of uneven development of the Lithuanian regions has been actively discussed for the last ten years when it became possible to refer to the county level statistics. A new push for discussions emerged at the end of 1999 after Lithuania had been invited to negotiate its membership in the EU, therefore the necessity to form the policy of regional development as one of the requirements arose. During the last decade, the subject of development of Lithuanian regions has been actively discussed, however, a more detailed analysis of the tendencies of

uneven economic growth in Lithuanian regions, covering a longer-term period, is lacking.

In 2000, the Regulation of Regional Development which declares acceleration of a well-balanced development of separate regions and a decrease of social and economic disparities among the Lithuanian regions as one of the goals was prepared and launched, with agencies of regional development established. A measured extent of Lithuania's uneven development of administrative territorial entities would be a sufficiently good indicator enabling to ground the effectiveness of a pursued regional policy.

In the article, we will statistically evaluate Lithuania's uneven regional economic growth by using a system of indicators, and the object of the research is the process of convergence–divergence in the economy of regions.

Beyond the theories of regional economic convergence, there are a number of other approaches attempting to explain the reasons why regional growth disparities exist and persist. Theories of regional underdevelopment and polarised growth regard underdevelopment as self-perpetuating, in contrast with convergence theories which claim that the less favoured regions can bypass the problems accruing due to their underdevelopment and enter a path of stable economic growth. The latter theories (for example, neoclassical approach) indirectly state that free market conditions tend to eliminate the regional economic disparities through the price mechanism, while regional growth is mainly the outcome of technical progress and of efficient allocation of recourses.

Authors give a qualified approval to conclusions of these theories and maintain that without conceptual regional politics, in conditions of market economy, the territorial differentiation of Lithuania's regions is the bigger the faster is its economic growth.

Problem of regional underdevelopment and its estimation

Regional development questions have attracted the attention of diverse groups of scholars during the past fifty years. The topics that were initially of interest only to economists and geographers are now being investigated by sociologists, political scientists, and researchers from other social science disciplines. This growing interest to regional development studies is due in part to the recognition that the processes driving innovation and national economic growth are fundamentally spatial in nature.

Regional economies are not uniform. Local-specific factors like sectoral composition, history of development, geography, the degree of their integration to the national and international economy, etc. affect the growth prospects of each region. In general, three types of regions can be identified: prosperous or growing, stagnating or declining, and underdeveloped or developing.

Most of the theories of regional growth focus on one or two specific factors in their task to describe the growth process and lack a holistic analysis. In this sense, it would be more appropriate to refer to them as "models" rather than as "theories".

Most of the early theories of regional economic growth were spatial extensions of neoclassical economic theories of international trade and national economic growth. Together, these early neoclassical theories predict that over time the differences in the price of labour and other factors across regions will diminish and tend toward convergence. This prediction has generated considerable controversy among theorists, particularly in light of the apparent tendency toward international divergence between the per capita incomes of industrialized nations and less developed nations. Early

theories of regional economic development emerged out of this controversy and can be distinguished from one another in terms of differences in the theoretical predictions regarding interregional convergence or divergence in per capita incomes and factor prices over time.

The concept of convergence, even in its weaker formulation as long-run constant per capita income growth rates, or conditional convergence, has come under attack from many sides. One criticism is largely empirical. The field of development economics emerged in the post–WorldWar II period in recognition of the growing economic disparities between industrialized nations and less developed countries. Although empirical studies (Perloff et al., 1960; Williamson, 1965) supported a trend toward economic convergence at the regional scale, at least in the United States, critics pointed to the persistent poverty in most less developed countries as an evidence that some regions of the world were not conforming to the predictions of the neoclassical growth models.

Another criticism focuses on the unrealistic assumptions underlying neoclassical growth theories, particularly those having to do with the assumption of constant returns to scale, zero transportation costs, etc.

One response to the convergence critique has been to directly incorporate the prediction of divergence into extant theories of regional economic growth. Here two such theories are examined: cumulative causation theory and growth pole theory. These theories of polarised growth are proposed to explain the existence of regional economic disparities and to describe the process of regional growth. Unlike other (Marxist, socio-economic and the vicious-cycle) approaches these theories were not initially proposed to explain national economic growth. This is probably one of the reasons why these theories are most popular among the different approaches that have been employed by policy-makers in order to assist regional development.

Mydral (1957) argues that increasing returns to scale produces clustering of economic activity within the regions that are first to industrialize. Moreover, the process of growth tends to feed on itself through a process of cumulative causation. Although underdeveloped regions offer the advantage of low-wage labour, these benefits tend to be offset by the agglomeration economies found in the industrialized regions. Kaldor (1970) elaborates on and expands Myrdal's theory of cumulative causation by introducing ideas from export base theory and the concept of an efficiency wage. Like Myrdal, Kaldor assumes that increasing returns to scale gives early industrializing regions an advantage in international trade. Cumulative causation sets in when an exogenous shock increases the worldwide demand for an industrial good. Actual monetary wages may be the same in all regions, but efficiency wages, defined as monetary wages divided by a measure of labour productivity, tend to be lower in industrialized regions due to scale economies. Since regions with lower efficiency wages can produce more output, which in turn leads to further reductions in the efficiency wage (and so on), growth may build on itself without bound.

The growth pole theory of regional economic growth places Myrdal's theory of cumulative causation into a spatial context. Perroux's (1950) "space as force" view of spatial interaction, which defines space as a type of network that is held together by centripetal forces, has formed the basis of most growth pole theories. In Perroux's (1950) original formulation, a growth pole referred to linkages between firms and industries. "Propulsive firms" are those that are large

relative to other firms and generate induced growth through interindustry linkages as the industry expands its output. Hirschman (1958) argues similarly in his discussion of backward and forward linkages amongfirms. Boudeville (1966) is credited for placing Perroux's formulation into geographic space. For Boudeville, a growth pole is defined in terms of the presence of propulsive firms and industries that generate sustained regional growth through linkages with other firms in a region.

To conclude, the convergence–divergence debate is no longer simply an academic debate when viewed in light of policy issues related to efficiency and equity. If one accepts the convergence hypothesis, then one can assume that lagging regions will tend to grow faster and approach the standards of living in developed regions over time, and inequities will be resolved in the long run simply by improving the functioning of the market. If, on the other hand, there are substantial market imperfections (researchers advocate this approach) in regional trade and knowledge diffusion, as suggested by Stiglitz (1989), then market inefficiencies will result in interregional inequities. The appropriate strategy for improving interregional efficiency and / or equity depends on the nature of the original source of divergence, its speed and the benefits and costs of diverting the path of growth in the other direction.

The earliest interests in the assessment of the process of convergence are found in the works of Easterlin (1960), Borts and Stein (1964). They focus on the so-called σ-convergence that enables to size up whether dispersion of per capita GRP is decreasing in the course of time. In more recent works by Barro and Sala-i-Martin (1991, 1992, 1999), Mankiw and others (1992), also Vohra (1996), β-convergence is analysed by measuring whether regions with a smaller initial per capita GRP were growing faster than regions with a larger initial per capita GRP.

To measure the uneven economic growth of regions, classical evaluation methods of income distribution can also be applied. The obtained results to be trustworthy, the selected concentration statistics have to fulfil the conditions that are characterised and formulated into five axioms in Atkinson's (1970, 1983), Cowell's (1985), Sen's (1973) works.

Practical evaluation of uneven economic growth and identification of its determinant factors are necessary in the formation of regional national development policy and while planning appropriate means to reduce the uneven economic and social development.

The publication "Territorial Outlook", prepared by the Organization for Economic Cooperation and Development, states that the selection of indicators enabling to evaluate disparities of interregional development depends upon the goals of public policy. In the majority of cases, this goal is economic growth. In this case, typical indicators could be the growth of output, the change in one employee's level of produced output, wage, full employment, investments, etc.

The article aims to evaluate the process and rate of uneven economic development of the Lithuanian regions, applying the classical method of economic convergence–divergence process. For the assessment, the index of GRP per capita and per employed person in a region was applied. Each indicator of the territorial inequality reflects only one dimension. A multidimensional index would enable to reveal the nature of disparity in the interregional development, but then we would have to consider which indicators ought to be taken into account and what is their comparative weight.

Estimation of the comparative weight of regions in the economy of the country

The Lorenz curve and the Gini coefficient as concentration standards would enable to evaluate the comparative weight of regions as territorial-administrative entities in the Lithuanian economy as well as their economic power in the economy regardless of the population size in each of them.

The Lorenz curve was developed by O. Lorenz as a graphical representation of income distribution. It portrays observed income distributions and compares this to a state of perfect income equality. It can also be used to measure the distribution of GRP. The Gini coefficient is a measure of inequality developed by the Italian statistician Corrado Gini. It is usually used to measure income inequality, but can be used also to measure any form of uneven distribution. The Gini coefficient is a number between 0 and 1 where 0 corresponds to perfect equality and 1 corresponds to perfect inequality. The Gini coefficient is calculated as a ratio of the areas on the Lorenz curve diagram. If the area between the line of perfect equality and the Lorenz curve is A and the area underneath the Lorenz curve is B, then the Gini coefficient is A / (A+B).

According to Figure 1, which reflects GDP distribution among the Lithuanian regions, it is possible to claim that the input of administrative-territorial entities into the country's economy is very uneven. The total annual value added of five counties (Alytus, Marijampolė, Tauragė, Telšiai and Utena) where GDP comparative parts are the smallest amounts to only 20 per cent of the whole country production output, while a comparative part of the single Vilnius county during the period ranges from 28 to 35 per cent.

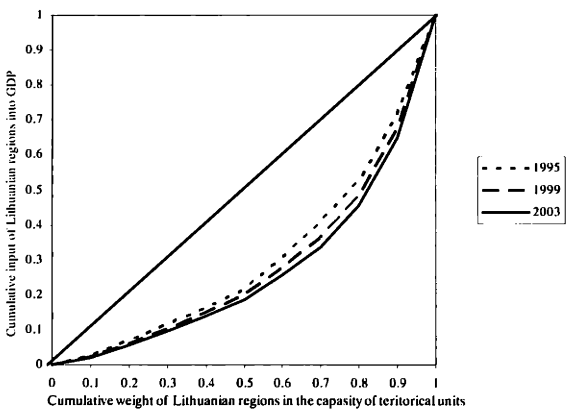


Figure 1. Lorenz curve of GDP distribution in Lithuanian regions in 1995–2003

Source: the data for the graph are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

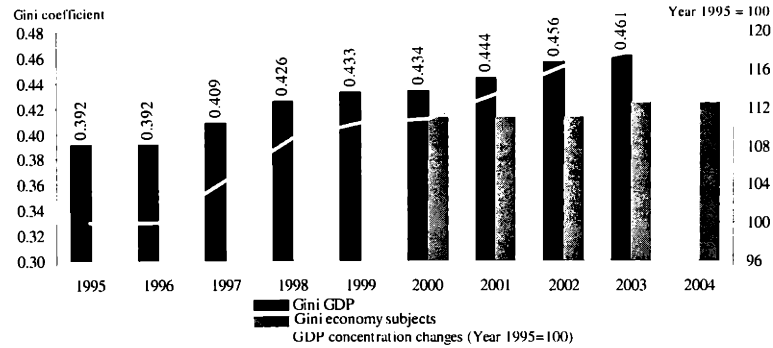


*Figure 2. **Distribution of economy subjects and GDP among Lithuanian counties based on Gini coefficient and its variations over the period 1995–2004***[1]

Source: the data were taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

The two most economically productive regions of Vilnius and Kaunas, in their own turn, create about 50 per cent of the total value added. The uneven distribution of GDP among regions is inclined to change. In Figure 1, during the period of 1995–2003 the Lorenz curves are receding from the absolute straight line reflecting an increasing uneven regional input into the country's economy.

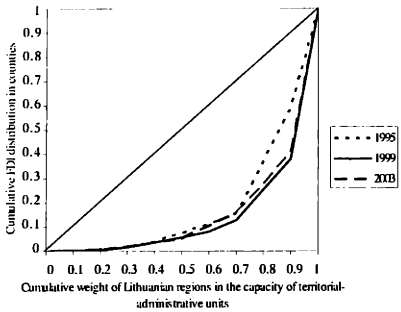
For the evaluation of the Gini coefficient, the Lorenz curve was directly used. Firstly, to characterise the empirical Lorenz curve (F(x)), a polynomial function was applied. The approximation degree of the obtained cumulative distribution function F(x) was estimated with the determination coefficient R^2 (functions with the determination coefficient over 0.9 were chosen for the calculation). Since the function of absolute linearity can be described by the dependence y = x, the Gini coefficient was estimated with the help of determinate integrals

$$G = \frac{\int_0^1 (x)dx - \int_0^1 (F(x))dx}{\int_0^1 (x)dx} = 1 - \frac{\int_0^1 (F(x))dx}{\int_0^1 (x)dx}$$

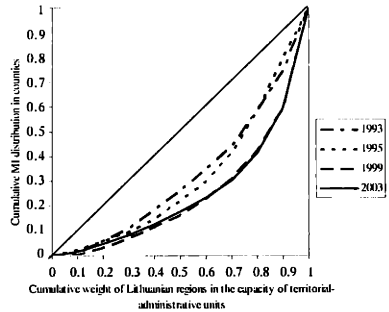
(Dikhanov, 1996). The estimated Gini coefficients enable us to evaluate the rate of the regional divergence process more precisely (see Figure 2).

In Figure 2, the Gini coefficients indicate a significant and continuous divergence process of the Lithuanian regions. During the period 1995–2003, the Gini coefficient increased from 0.39 to 0.46, i.e. about 18 per cent (the average annual growth rates were around 2 per cent). The divergence process itself was not steady, the peaks being reached during the periods 1996–1998 and 2000–2003. The periods coincide with the country's rapid economic growth. The estimated correlation coefficient between the

[1] Regional data on registered and active economy subjects are available from year 2000. Indicators are calculated as of 1 January of each year.



a) FDI concentration in 1995 – 2003 [2]



b) MI concentration in 1993 – 2003

Figure 3. Concentration of investments in Lithuanian counties

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

GDP and its concentration in the regions (according to the Gini coefficient) equals to 0.97. Such a high correlation permits to assume with the probability of 99.5 per cent that there is a strong link between the total economic growth and the divergence process in the regions and that the former directly determines the latter, i.e. the economic development in Lithuania is extremely uneven from the territorial point of view.

The uneven distribution of productive forces could be demonstrated by the extent of concentration of registered and active economy subjects in different counties. The estimated Gini coefficient for the period 2000–2002 (see Figure 2) on the average equals 0.41 and for the period 2003–2004 0.42. The Gini coefficient strongly correlates with the figure of registered economy subjects in the country (coefficient 0.97, reliability 97.5 per cent) and this once more reinforces the argument that the results of economic growth reveal territorial disparities.

At the municipal level, the concentration of active economy subjects reflects even bigger disparities: the active business subjects are apt to concentrate in major cities of the country. The estimated Gini coefficient for years 2000–2002 was equal to 0.59, for 2003 to 0.6, and for 2004 to 0.61. On 1 January 2004, 55 per cent of all active economy subjects were registered in five cities: Vilnius, Kaunas, Klaipėda, Šiauliai and Panevėžys, whereas the population there reaches 39.5 per cent of the whole country's population (based on the data from "Lithuanian Counties: the Process of Social and Economic Development").

A good indicator of the economic development of the regions would be the territorial distribution of direct foreign (FDI) and material (MI) investments. In developing countries, where labour productivity is low and industrial technologies and facilities are obsolete, only investments can stimulate the economic growth and work efficiency by implementing new modes

[2] FDI data are submitted at the end of the year.

Table 1. Distribution of FDI and MI in the Lithuanian regions in 1993–2003[4]

Indicators		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
In counties	Gini FDI			0.626	0.621	0.678	0.699	0.710	0.729	0.740	0.714	0.688
	Gini MI	0.350	0.399	0.374	0.486	0.491	0.495	0.512	0.552	0.589	0.519	0.500
	Gini FDI/per capita			0.343	0.341	0.425	0.464	0.457	0.481	0.494	0.472	0.432
	Gini MI/per capita	0.098	0.149	0.097	0.186	0.208	0.202	0.214	0.251	0.302	0.217	0.203
In municipalities	Gini FDI								0.920	0.924	0.921	0.914
	Gini FDI/per capita								0.639	0.653	0.644	0.618
	Gini MI								0.779	0.796	0.735	0.720
	Gini MI/per capita	...	...	...	...	...	...	...	0.395	0.447	0.351	0.323

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

and means of production. Attraction of investments is a relevant indicator of regional economic growth depending on production growth, business infrastructure, political decisions related to taxation, privatization, reduced bureaucracy. Every country should regulate investments so that they are directed towards the most underinvested territories. The regional distribution of investments is one of the most relevant issues of a territorially well-balanced development.

The uneven presence of factors necessary for foreign investments in the territories influenced the uneven regional distribution of investments (see Figure 3a and Table).

In 1995, when FDI data became available by regions, the Gini coefficient which estimated its concentration was 0.63 (FDI per capita was 0.34). The concentration of FDI reached its peak in 2001 when the coefficients were respectively 0.74 and 0.5, i.e. increased by 18 and 44 per cent over a five-year period (the average annual growth rate was 2.7 and 6.6 per cent respectively). Since 2002, the uneven regional FDI distribution began decreasing, but the reason might have lied in the change of the FDI calculation method.[3]

Analysing FDI in smaller territorial administrative units, i.e. in municipalities, a far higher degree of concentration is visible; here the estimated Gini coefficient exceeded 0.9, and the FDI per capita was 0.6 since the year 2000.

Analysing FDI by the type of activity, it becomes obvious that the majority of investments in 1995–2003 went to the sectors of industry and services. According to the statistical yearbook of the Lithuanian counties, industrial investments concentrate in the field of manufacturing where about 40 per cent goes to the food industry and 10 per cent to the textile. In the sector of public services, investments concentrate in trade (comparative part is decreasing) and intermediation services (comparative part is increasing). In the sector of trade, most of investments go to wholesale and in the sector of intermediation to financial intermediation. The sectors of wholesale, financial intermediation and food industry attract around 40 per cent of all FDI. Thus, having the distribution of FDI

[3] Since 2002 FDI and MI data have been registered by investment address, previously – by enterprise registration address.

[4] The inequality of distribution of FDI has been estimated since 1995 as before that year the data had not been collected. The distribution of FDI and MI at the level of municipalities has been analysed since 2000, because the changing number of municipalities and size of territories did not allow to measure the distribution of investments.

over activity sectors and the plans for economy development on hand, it is possible to predict the potential geographical locations for investments.

The fact that most of the enterprises are concentrated in the five major cities of Lithuania increases the attraction for investments in the cities. The material facilities and infrastructure created there are equally important in attracting investments. Even though some of the light and food industry enterprises emerged in other Lithuanian cities and towns and this is a premise enabling to distribute the foreign investments more evenly, high concentration nonetheless persists. This tendency is very likely to survive in the future, particularly when the comparable part of investments is increasing in the sector of services, the territorial concentration of which is higher than of the industry. Hence, it is possible to state that foreign direct investments depend upon the concentration of industry and service sectors in the counties. The bigger an industry centre, the greater chances to attract investments. The sector of agriculture, which is large enough in Lithuania according to the generated value added, receives almost no foreign direct investments. The situation is complicated by high production costs which result from the low work efficiency; in the absence of a possibility to make a profit foreign capital bypasses this branch of economy.

The counties' statistical outlook states that in 2003 the biggest portion of FDI (60 per cent) goes to the Vilnius County, and more specifically to the city of Vilnius (98 per cent of it). The rest of the county gets the remaining 2 per cent. Klaipėda County absorbs 11.3 per cent of all investments, out of which 72 per cent go to the city of Klaipėda. Kaunas County receives 13.5 per cent of all FDI, 88 per cent of which goes to the city of Kaunas. The remaining counties share only 15 per cent of the FDI, and investments here are not so strictly concentrated in county centres as in the above-mentioned cases.

Analysing the distribution of MI (see Figure 3, chart b, and Table), it is possible to state that the degree of concentration of MI here is lower than that of FDI both on the level of counties and municipalities. Up to the year 2002 the concentration was increasing, but recently it has dropped which could be the result of the change in the method of calculation. Seventy per cent of the investments are concentrated in Vilnius, Kaunas and Klaipėda counties. The data on the sources of MI and the directions of investments are presented only on the country level, therefore it is impossible to perform a more detailed analysis.

According to the Statistical Yearbook of the Lithuanian Counties, in 1995–2003 Telšiai County invested the biggest part of its GRP (18 per cent); then economically strongest regions of Klaipėda, Vilnius and Kaunas follow with 17.8, 16.5 and 12.3 per cent, respectively. The least was allocated by the weakest regions: Šiauliai and Marijampolė – 9 per cent each and Tauragė – 7 per cent; consequently, most of the generated GRP went to consumption, and the accumulation of investments was not sufficient. For the investments to enable the renovation of economy (where new production facilities exceed the depreciation of the old) they have to reach at least 25–30 per cent of the GRP. In the developing regions this percentage must be even higher.

The calculated correlation between the Gini GDP and the Gini FDI per capita (0.79) gives a clear view that the distribution of FDI and GDP interact with each other. Similar dependence is visible for GDP and MI distribution (the correlation coefficient equals 0.62).

In the countries that develop rapidly, the overall amount of investment reaches 40 per cent

from GDP. Lithuanian regions like Klaipėda and Vilnius in 1998–2001 accumulated 15–20 per cent of total value added for investment and stimulated a 25.5 per cent and 52.8 per cent economic growth, respectively. The regions that invested less than 10 per cent from all income weakly promoted their economic activity.

Analysis of the convergence–divergence process of the Lithuanian regional economy based on per capita GDP

After the restoration of independence, there were expectations that the development of the market would level up all greater regional disparities. However, it soon became obvious that the metropolitan areas had more benefit from the market economy – owing to short distances, large sales market potential and the accessibility of capital markets. The insufficient mobility of the capital and labour force in the country predetermined the steady structural unevenness to become the reason of regional disparity. It has become obvious that in rural areas the income per capita is lower, the level of unemployment is higher, the dependence on agriculture is stronger, there are more obsolete technologies and more of slowly developing branches of industry.

The course and rate of the uneven development of Lithuanian regions were evaluated by applying the classical methods of convergence–divergence process analysis. For the estimation, the indicator of regional per capita GDP (GDP_u) and per one employed person GDP (GDP_g) was used.

The analysis starts from R. Barro and X. Sala-i-Martin's suggested evaluation of the β – convergence process. With per capita GDP data in different country regions, we can nominate $\gamma_{i,t,t+T} \equiv \frac{\log\left(\frac{y_{i,t+T}}{y_{i,t}}\right)}{T}$ as an annual growth rate of per capita GDP in region i during the period from t to $t+T$, and $\log(y_{i,t})$ is the logarithm of per capita GDP in region i during period t. On creating a linear model of regression $\gamma_{i,t,t+T} = \alpha+\beta\log(y_{i,t})+\varepsilon_{i,t}$ and receiving $\beta < 0$, we may assert that the data in our disposition disclose an absolute b-convergence. The data for the regression may be used in two different ways depending on whether we consider T equal to the whole period of analysis or only to one year.

In the first stage, analysing per capita GDP and annual growth rate, we obtain the following results (see Figure 4).

In the computed regression equation (where the independent variable is a region GDP_g's logarithm at a time period T and the dependent variable is a region GDP_g's logarithm of annual growth rate), the obtained β coefficient is negative (0.144). However, in the Lithuanian regions the absolute β-convergence process that takes place due to the rapid growth of the least developed areas, is not evident for three reasons:

(1) the obtained equation of regression is not statistically significant due to the small determination coefficient ($R^2 = 0.2$), though the hypothesis of the equality of the â coefficient to zero while using Student's test is rejected;

(2) instead of the annual GDP_g growth in the region, an average GDP_g growth within a certain period may be used. In such a way, it is possible to evaluate whether in neglected regions where the initial GDP_g (year 1995) was lower, this indicator was growing more rapidly and was catching up with the regions of a high initial GDP_g level. The results of the analysis are shown in Figure 5.

Figure 5 gives a clear view of the regions where the initial GDP_g was higher; the growth rate of this indicator was also higher ($\beta = 0.11$). The coefficient of determination

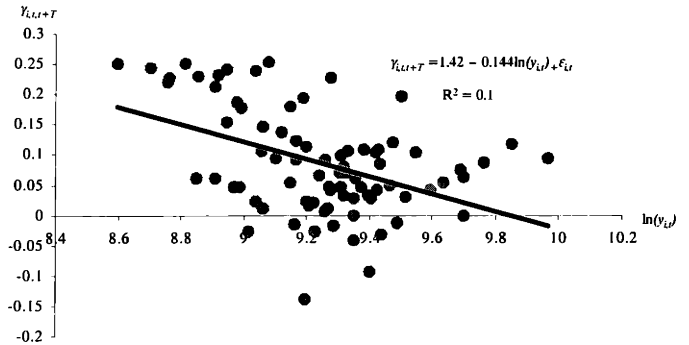


Figure 4. Estimation of the process of a-convergence in the Lithuanian regions based on annual GDP growth rate.

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

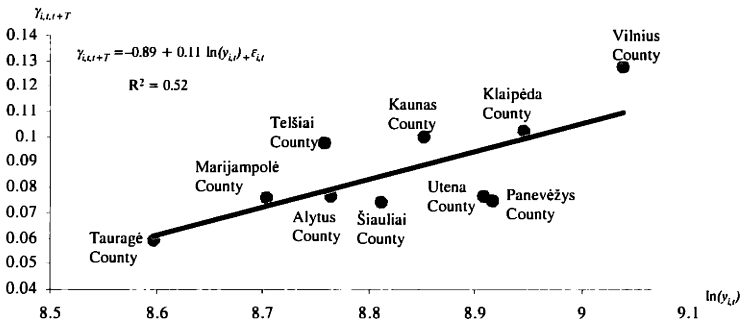


Figure 5. The estimation of ā-convergence process in the Lithuanian regions based on the average growth rate of GDP$_g$ in 1995–2003

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

of this regression equation was equal to 0.52, so statistically it is more significant than the previous equation; the hypothesis of the coefficient β being equal to zero when applying the Student's test could also be dismissed. According to the calculation, it may be asserted that there exists an absolute β divergence based on GDP_g in Lithuania;

(3) a higher percentage of the annual GDP_g growth in less prosperous regions may have been obtained owing to the low initial indicator from which the increment was calculated (e.g., an increase from 8 to 10 will make 25 per cent and from 20 to 24 only 20 per cent). For this reason, in the more prosperous areas the growth of absolute GDP_g will result in a relatively smaller percentage than in the less prosperous regions with a low initial GDP_g indicator.

In the subsequent stage of this research, which seeked to evaluate the uneven development of the Lithuanian regions, the analysis of σ-convergence hypothesis was applied.

The concept of σ-convergence, suggested by Easterlin (1960) and Borts and Stein (1964), may be characterised in the following way: a group of regions converge according to ó if the cross-regional dispersion of per capita GDP declines over time: $\sigma_{t+T} < \sigma_t$, where σ_t is the standard regional log ($y_{i,t}$) deviation within the period t (Sala-i-Martin, 1996). The author does not provide the formula of calculation of the standard deviation, i.e. he does not emphasize whether the calculated means have to be simple or weighted (weights here are population sizes across the regions) and whether the indicator of the arithmetic mean has to represent the country. According to Foster and Ok (1999), there are practical cases when the dispersion of general distribution is declining and σ_t is increasing, which leads to a doubt whether the latter statistics gives a full account of σ-convergence. Instead, the adjusted weighted variant of standard deviation ought to be employed:

$$\sigma_t^w(\log y_{i,t}) = \sqrt{\sum_{i=1}^{n} p_{i,t}\left(\log y_{i,t} - \log \mu_{y_t}^w\right)^2},$$

where $\log \mu_{y_t}^w = \sum_{i=1}^{n} p_{i,t} \log y_{i,t}$ is the weighted average of log ($y_{i,t}$), and $p_{i,t}$ are the corresponding weights. See results in Figure 6.

The findings displayed in Figure 6 allow to assert that Lithuania's regions diverge according to ó. The process of divergence is continuing, but its rate is declining. The fastest uneven development occurred in 1996–1998 (with the average annual increment of 28 per cent), a slower development took place in 1998–2002 (with the average annual increment of 8.8 per cent), whereas the remaining period is marked with the lowest divergence rate (the average annual increment is 3 per cent). During the whole research period the indicator reflecting σ-convergence increased almost 2.5 times, implying that over an incomplete decade the inequality of the Lithuanian regions according to GDP_g increased to the same degree.

The rest of the indicators of uneven economic development are presented in Table 2.

The three generalised entropy (GE) indicators presented in the table above permit us to identify the uneven distribution of GDP_g in separate regional groups. The indicators that belong to the GE class have a common estimation formula:

$$GE(\alpha) = \frac{1}{\alpha^2 - \alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_{i,t}}{\mu_{y_t}}\right)^{\alpha} - 1\right],$$

where n is the number of regions, $y_{i,t}$ is the indicator of year t in region i, $i \in (1, 2, ..., n)$, μ_{y_t} is the arithmetic mean of $y_{i,t}$: $\mu_{y_t} = \frac{1}{n}\sum_{i=1}^{n} y_{i,t}$. The values

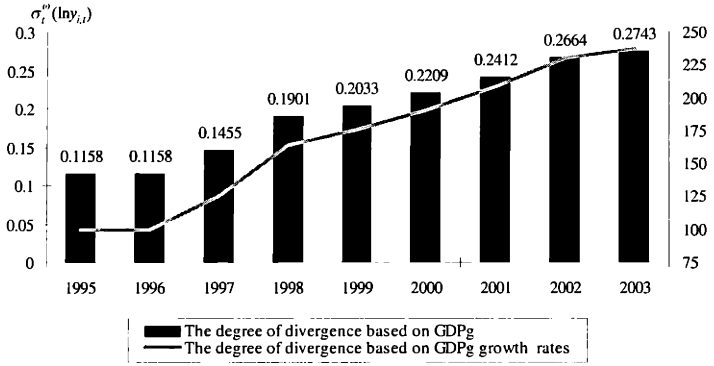


*Figure 6. **Estimation of the process of ó divergence in Lithuania's regions in 1995–2003***

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

*Table 2. **The indicators of uneven economic development of the Lithuanian regions based on GDP$_g$ during 1995–2003***

Indicator	1995	1996	1997	1998	1999	2000	2001	2002	2003
GE(0)	0.103	0.099	0.125	0.144	0.147	0.163	0.177	0.187	0.196
GE(1)	0.102	0.099	0.123	0.146	0.151	0.170	0.184	0.199	0.206
GE(2)	0.339	0.338	0.351	0.368	0.373	0.384	0.395	0.411	0.417
G	0.053	0.054	0.073	0.097	0.105	0.111	0.124	0.138	0.143

Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

of GE (α) may range from zero to ∞, where zero represents an absolute evenness of regions according to the analysed criterion. The greater is the value of GE, the higher the inequality. The distribution indicators belonging to class GE are easily decomposed into relative measures of inequality among and within the regions: $I_{joint} = I_{within\ groups} + I_{between\ groups}$. The parameter α in the GE class represents the weight that is given to distances between $y_{i,t}$ values at different parts of distribution and can take any real value. For lower values of α, GE is more sensitive to changes in inequality in the group of regions with the lower value of the indicator $y_{i,t}$, higher values of α are more sensitive to changes in inequality in the group of regions with a higher value of the indicator $y_{i,t}$.

The most frequently used values of α are 0, 1 and 2, hence, a value of $\alpha = 0$ gives more weight to the inequalities within the group of weaker regions. $\alpha = 1$ applies equal weights across the distribution on the disparities of the regions under research, while $\alpha = 2$ gives proportionally more weight to inequalities within the econo-

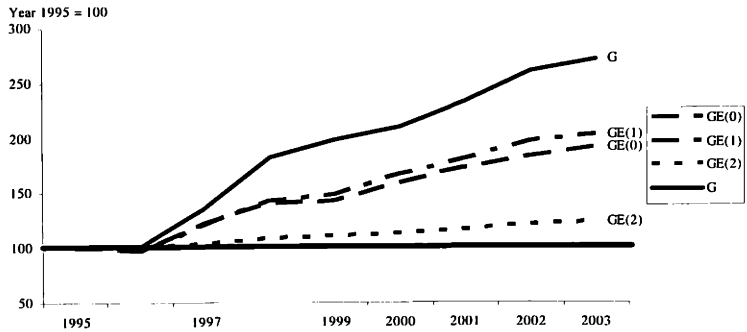


Figure 7. Indicators of growing rates of uneven economic development in separate Lithuanian regions

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

mically prosperous regions. GE indicators with α parameter 0 and 1 have become two Theil's (1967) inequality measurement indicators: the mean log deviation and the Theil's index.

The results of the calculation enable us to assert unambiguously that GDP_g-based inequality is far smaller (2.6 times on the average during the research period) in neglected regions in comparison to the prosperous ones. However, the disparity came down from 3.3 times in 1995 to 2.1 times in 2003. It came as a result of a faster process of divergence in the least favoured regions in comparison to the richest ones (see Figure 7, where the changes of indicators estimated in Table 2 during the research period are presented and where the figures of 1995 are equal to 100).

Estimating the indicator of GE (1), equal weight is given to gaps among the regions under research, and this indicator doubled twice during the time of the research. The estimated Gini coefficient reflects the general extent of uneven GDP_g distribution, and its value has the same change direction as the above-analysed σ-convergence indicator (see Figure 6). The estimated correlation coefficient between GDP_g and the Gini coefficient is equal to 0.964. This shows a strong direct relationship between these indicators with a 99.5 per cent accuracy, i.e. the bigger the increase of GDP_g in Lithuania, the more unevenly it distributes across the regions.

The curves in Figure 7 suggest that there is no polarisation in Lithuania, because inequality based on GDP_g in separate regional groups is not declining. Notionally, it is possible to make such an equation for all class GE indicators: $I_{joint} = I_{within\ groups} + I_{among\ groups}$. As mentioned earlier, findings of the plot highlight that $\Delta G(0)+\Delta G(2) = \Delta G(1)$; hence we may suggest that the country's overall tendency of unequal development between regions based on GDP_g is determined not by a growing gap between the economically most and least developed regions, but by the growing inequality inside the groups of these regions.

All findings of concentration suggest that the GDP_g gap among the regions in the course of time is widening, consequently, the process of divergence in Lithuania is taking place. Interregional disparities measured by the GDP_g coefficient of Gini in the majority of cases were growing faster than economy itself: during the period 1995 through 2003, GDP per capita grew by 120 per cent and the Gini coefficient increased by 170 per cent.

All of the above analyses performed with the help of the Gini coefficient based on GDP_g have produced the following prognosis of unequal economic development across the Lithuanian regions: the predicted Gini coefficient for 2004 is 0.161 (with a reliable 95 per cent interval and possible ±0,014 change range), for 2005 – 0.173 (with a reliable 95 per cent interval and a possible ±0,014 change range). A small deviation of prognosis (MAPE=5.13%) enables to assert quite reasonably that, first, if the established conjuncture and, second, a direct interdependence between the rate of economic growth and the regional distribution of this growth do not change, the gap across the Lithuanian counties will be widening in the future, too.

Analysis of convergence–divergence process based on GDP per employed person in the economy of the Lithuanian regions[5]

For the practical evaluation of the uneven economic development of the Lithuanian regions it is important to define the rate of the convergence–divergence process based on GDP per employed person. In the first stage, it is relevant to check the hypothesis of β-convergence. Figure 8 illustrates the obtained results.

[5] Reliable data for this analysis are available from year 1998.

In accordance to the plotted regression equation that reveals statistical dependence between the initial (1998) level of GDP_u in the counties and the average annual growth rate of the indicator during the study period, one cannot assert that an absolute β-divergence based on GDP_u does exist, since $\beta = 0.016$. The determination coefficient of the plotted regression equation equals 0.044, i.e. it does not statistically significantly define a linear dependence between the initial level of GDP_u and the subsequent average annual growth rate of the indicator. Table 3 presents the remaining indicators that reveal the process of convergence–divergence based on GDP_u.

Indicators in Table 3 and their variations in Figure 9, as compared with 1998, disclose the process of divergence in the Lithuanian regions assessed by GDP_u. Analysing the index of σ–convergence it is obvious that its rate of variation partly correlates with the changes of GDP_u on the level of the whole country (the coefficient of correlation is 0.74, reliability 95 per cent). Over the period of economic decline, the coefficient of concentration lowered. In the beginning of the economic recovery, it remained constant, but in 2002 it grew by almost 27 per cent. This jump may be explained by the different growth rates of the regions: the leading ones have absorbed FDI and making use of new technologies raised their labour productivity, while the weakest regions only partly took advantage of the economic improvement.

The differences between the processes of σ-convergence assessed by GDP_g and GDP_u (according to the former, the interregional inequality is more pronounced) may be the result of the discrepant unemployment level in the Lithuanian counties as well as of the different structure of the population age. With low levels of unemployment and a small number of

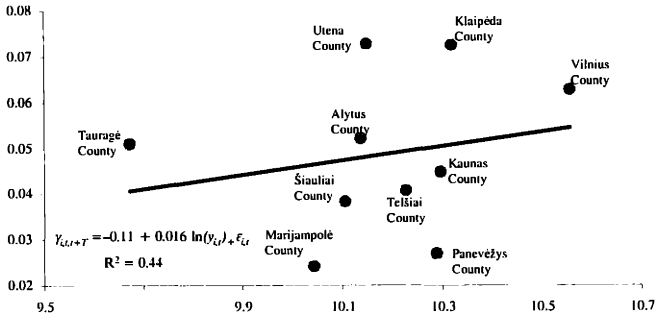


Figure 8. Estimation of the process of β-convergence in the Lithuanian regions according to the average increase of GDP_u over 1998–2003

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

Table 3. Indicators of uneven economic growth of the Lithuanian regions assessed by GDP_u over the period 1998–2003

Indicators	1998	1999	2000	2001	2002	2003
$\sigma_i^w(\log y_{i,t})$	0.205	0.193	0.197	0.192	0.243	0.249
GE(0)	0.158	0.150	0.147	0.143	0.160	0.184
GE(1)	0.151	0.143	0.143	0.147	0.164	0.181
GE(2)	0.377	0.370	0.370	0.367	0.395	0.399
G	0.099	0.091	0.095	0.097	0.123	0.120

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

unemployed persons the difference between the GDP_g and GDP_u in the region would not be great (such a situation may emerge in metropolitan regions where the unemployment level in urban areas is especially low, with lots of young people coming from other regions); on the other hand, with a high level of unemployment and a great number of the unemployed, the difference between GDP_g and GDP_u will be greater (this may emerge in the least prosperous regions which are abandoned by young people in favour of the largest cities).

In different groups of regions the rates of development vary: in the group of regions with economic retardation the disparity over the discussed period grew 1.16 times, whereas in the group of the most prosperous regions only 1.06 times; therefore, the difference between the

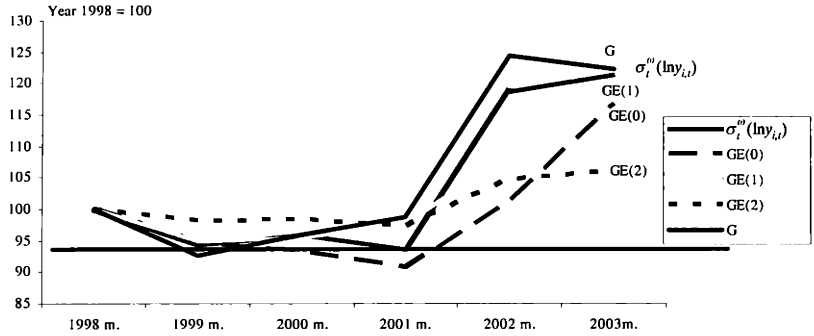


Figure 9. Growing rates of uneven development of the Lithuanian regions assessed by GDP_u indicators

Source: the data are taken from the publications "Lithuanian Counties: the Process of Social and Economic Development" issued by the Department of Statistics to the Government of the Republic of Lithuania.

inequality of the economically wealthiest and the poorest regions decreased from 2.4 times in 1998 to 2.2 times in 2003.

This phenomenon could be explained by the uneven rates of development of neglected regions, i.e. some of them (Telšiai, Panevėžys, Alytus) managed to achieve fast growth rates over the research period, while other regions (Tauragė, Marijampolė, Utena) produced only a slight growth. The growth rates in the group of the most favoured regions have been rather steady, therefore the gap that existed in the beginning of the considered period remained practically unchanged.

Conclusions

The research of the quantitative assessment of the degree of uneven economic activity in Lithuanian regions was carried out using the classical methods of convergence–divergence analysis. The results of this research provide an opportunity to identify and assess the evolution and rate of the divergent regional development in Lithuania. For estimation, we have selected two basic indicators which reflect economic performance: gross regional product per capita and per worker. All the used distribution indexes reflect the constantly growing regional disparities. Moreover, the rate of this process is not steady and correlates with the economic cycles.

(1) Results of assessment of the β-convergence process based on per capita GDP

In the presented regression equation (where the independent variable is a region GDP_g's logarithm in 1995 and the dependent variable is GDP_g's logarithm of average growth rate during the study period), the obtained β coefficient is positive (0.11). The coefficient of determination of this regression equation equals 0.52, hence statistically it is significant and the hypothesis of the coefficient β being equal to zero when applying the Student's test has been rejected. On the ground of these calculations it may be asserted that there exists an absolute β divergence based on per capita GDP_g in Lithuania.

(2) Results of assessment of the σ-convergence process based on per capita GDP

The regions in Lithuania diverge according to ó. The process of divergence is continuous, but its pace is slowing down. The fastest unequal development took place in 1996–1998 (the average annual increase amounted to 28 per cent), a slower one occurred in 1998–2002 (with the average annual increase of 8.8 per cent), and the latter was marked by the slowest rate of divergence (annual increase of 3 per cent). Over the period of analysis, the indicator reflecting ó-convergence grew 2.5 times, implying that during a period of incomplete ten years the inequality of the Lithuanian regions based on per capita GDP grew by the same degree.

(3) Results of assessment of the β-convergence process based on GDP per employed person

According to the equation of regression that disclosed a statistical correlation between the initial level of GDP_u in counties (year1998) and the average annual growth rate of the indicator in the study period, it is impossible to assert that an absolute β-divergence based on GDP_u is evident, because $\beta = 0.016$. The coefficient of determination of the presented regression equation is equal to 0.044, i.e. it does not statistically significantly characterise a linear dependence between the initial level of GDP_u and a subsequent average annual growth of GDP_u.

(4) Results of assessment of the σ-convergence process based on GDP per employed person

Analysing the indicator of σ-convergence it is obvious that its rate of variation partly correlates with the changes of GDP_u on the level of the whole country (the coefficient of correlation is 0.74, reliability 95 per cent). Over the period of economic decline, the coefficient of concentration decreased. At the beginning of the economic recovery it remained unchanged, but the rise of the coefficient by 27 per cent in 2002 may be explained by different growth rates of the regions: the leading ones have absorbed FDI and making use of new technologies raised their labour productivity, whereas the weakest regions only partly took advantage of the economic improvement.

All findings of concentration suggest that the GDP_g gap between regions in the course of time is widening, consequently, the process of divergence in Lithuania is taking place. Inter-regional disparities measured by the GDP_g coefficient of Gini in the majority of cases were growing faster than the economy itself: during the period 1995 through 2003, GDP per capita grew by 120 per cent and the Gini coefficient increased by 170 per cent.

The calculated correlation between the Gini GDPg and the Gini FDI per capita (0.79) gives a clear view that the distribution of FDI and GDP interact with each other. A similar dependence is obvious between GDP and MI distribution (correlation coefficient equals 0.62).

REFERENCES

1. Atkinson, A. B. (1970). On the measurement of inequality. Journal of Economic Theory 3: 244–263.

2. Atkinson, A. B. (1983). Social Justice and Public Policy, MIT Press.

3. Barro, R. J., Sala-i-Maratin, X. (1999). Economic Growth. Cambridge, MA: MIT Press.

4. Barro, R., J., Sala-i-Martin, X. (1991). Convergence across states and regions. Bookings Papers on Economic Activity 1: 107–182.

5. Barro, R., J., Sala-i-Martin, X. (1992). Convergence. Journal of Political Economy 100, 2: 223–251.

6. Borts, G., Stein, J. (1964). Economic growth in a free market. New York: Columbia University Press.

7. Boudeville, J. R. (1966). Problems of regional economic planning. Edinburgh: Edinburgh University Press.

8. Cowell, F.A. (1985). A Fair Suck of the Sauce Bottle or, What Do you Mean by Inequality. Economic Record 61: 567–569.

9. Dikhanov, Y. (1996). Decomposition of inequality based on incomplete information. A paper contributed to the IARIW 24th General Conference. Lillehammer, Norway, August 18–24.

10. Easterlin, R.A. (1960). Interregional differences in per capita income, population, and total income, 1840–1950, in Trends in the American economy in the nineteenth century. A report of the National Bureau of Economic Research. Princeton: Princeton University Press.

11. Foster, J. E., Ok, E.A. (1999). Lorenz dominance and the variance of logarithms. Econometrica 67, 4 (July): 901–907.

12. Hirschman, A. O. (1958). The strategy for economic development. New Haven, CT: Yale University Press.

13. Kaldor, N. (1970). The case of regional policies. Scottish Journal of Political Economy 17, 3: 337–348.

14. Mankiw, N. G., Romer, D., Weil, D.N. (1992). A contribution to the empirics of economic growth. Quarterly Journal of Economics 107: 407–437.

15. Mydral, G. (1957). Economic theory and underdeveloped regions. London: Duckworth.

16. Perloff, H. S., Dunn, E. S. Jr., Lampard, E. E., Muth, R. F. (1960). Regions, Resources and Economic Growth. Baltimore: Johns Hopkins University Press.

17. Perroux, F. (1950). Economic space: Theory and applications. Quarterly Journal of Economics, 64, 1: 89–104.

18. Sala-i-Martin, X. (1996). The classical approach to convergence analysis. The Economic Journal 106 (July): 1019–1036.

19. Sen, A. (1973). On Economic Inequality. Oxford: Clarendon Press.

20. Stiglitz, J. E. 1989. Markets, market failures, and development. American Economic Review 79, 2: 197–203.

21. Theil, H. (1967). Economics and Information Theory. North-Holland, Amsterdam.

22. Vohra, R. (1996). How fast do we grow? Growth and Change 27: 47–54.

23. Williamson, J. G. (1965). Regional inequality and the process of national development: A description of the patterns. Economic Development and Cultural Change 13, 4: 158–200.

NETOLYGAUS LIETUVOS REGIONŲ VYSTYMOSI VERTINIMAS

Diana Cibulskienė, Mindaugas Butkus, Kristina Matuzevičiūtė

Santrauka

Netolygaus regionų vystymosi klausimai pradėti aktyviai tirti užsienio valstybių autorių moksliniuose darbuose. Dažniausiai šių darbų objektas yra regionų stratifikacijos proceso dinamika, veiksniai, lemiantys konvergenciją ir divergenciją, rinkos ir vyriausybės poveikio įvertinimas (Williamson, 1995; Alonso, 1980; Barro ir Sala-i-Martin, 1995). Teoriniai tarpregioninių skirtumų dinamikos tyrimai yra paremti pagrindiniais makroekonominio augimo modeliais, kuriuose išskiriami nepriklausomi kintamieji: BVP, tiesioginių užsienio investicijų apimtis, materialinių, privačių ir valstybinių investicijų apimtis.

Netolygaus Lietuvos regionų ekonominio augimo problema buvo aktyviai analizuojama pastaruosius dešimt metų, kai atsirado galimybė remtis statistika apskričių lygmeniu, tačiau pasigendama detalios ir ilgą laikotarpį apimančios netolygaus Lietuvos regionų ekonominio augimo tendencijų analizės. Straipsnyje regionų ekonominio išsivystymo skirtumai analizuojami naudojant apskrityse sukuriamo BVP, tenkančio vienam gyventojui ir vienam užimtajam, rodiklius, nes jie tiksliausiai apibūdina ekonomikos būklę. Lietuvos regionų vystymosi įvertinimui tirti naudotas statistinių rodiklių rinkinys, paremtas tiek regionų ekonomikos konvergencijos ir divergencijos procesą vertinančiais rodikliais (β-konvergencija ir σ-konvergencija), tiek klasikiniais pajamų nelygybės bei koncentracijos matais (apibendrintos entropijos, Džini, variacijos). Šie rodikliai yra pakankamai geras indikatorius, leidžiantis pagrįsti vykdomos regioninės politikos efektyvumą. Tyrimo rezultatai rodo, kad:

(1) β-konvergencijos proceso vertinimo rezultatai pagal BVP vienam gyventojui: sudarytoje regresijos lygtyje (nepriklausomas kintamasis – BVP_g 1995 m. regione logaritmas, priklausomas kintamasis – vidutinio BVP_g augimo tempo per analizuotą laikotarpį logaritmas) gautas ā koeficientas yra teigiamas (0,11). Šios regresijos lygties determinacijos

koeficientas lygus 0,52, taigi ji statistiškai reikšminga, hipotezė apie ā koeficiento lygybę nuliui naudojant Stjudento kriterijų atmetama. Remiantis šiais skaičiavimais galima teigti, kad Lietuvoje egzistuoja absoliutinė regionų β-divergencija pagal BVP vienam gyventojui.

(2) σ-konvergencijos proceso vertinimo rezultatai pagal BVP vienam gyventojui: Lietuvos regionai diverguoja pagal σ. Divergencijos procesas yra nenutrūkstamas, tačiau jo tempai mažėja. Sparčiausias netolygus vystymasis užfiksuotas 1996–1998 m. (vidutinis metinis prieaugis sudarė 28 proc.), lėtesnis – 1998–2002 m. (vidutinis metinis prieaugis – 8,8 proc.), o paskutinis į analizę įtrauktas laikotarpis pasižymėjo mažiausiais divergencijos tempais (metinis prieaugis sudarė 3 proc.). Per visą analizuotą laikotarpį σ-konvergenciją atspindintis rodiklis padidėjo beveik 2,5 karto, tai leidžia teigti, jog per nepilną dešimtmetį tiek pat padidėjo ir Lietuvos regionų netolygumas pagal BVP vienam gyventojui.

(3) β-konvergencijos proceso vertinimo rezultatai pagal BVP vienam užimtajam: naudodami sudarytą regresijos lygtį, kuri atskleidžia statistinę priklausomybę tarp pradinio (1998 m.) BVP_u lygio apskrityse ir vidutinio metinio šio rodiklio augimo tempo analizuojamu laikotarpiu, negalime teigti, kad egzistuoja absoliutinė β-divergencija pagal BVP_u, kadangi $\beta = 0{,}016$. Sudarytos regresijos lygties determinacijos koeficientas lygus 0,044, t. y. ji statistiškai reikšmingai neapibūdina tiesinės priklausomybės tarp pradinio BVP_u lygio ir vėlesnio vidutinio metinio BVP_u rodiklio augimo.

(4) σ-konvergencijos proceso vertinimo rezultatai pagal BVP vienam užimtajam: analizuojant σ-konvergenciją įvertinantį rodiklį pastebima, kad jo kitimo tempas iš dalies koreliuoja su BVP_u pokyčiais visos šalies mastu (koreliacijos koeficientas lygus 0,74 (95 proc. patikimumas). Ekonomikos nuosmukio (1998–2000 m.) laikotarpiu koncentracijos koeficientas sumažėjo. Ekonomikos atsigavimo (2001 m.) pradžioje koeficientas išliko nepakilęs, o jo didėjimas 2002 m. beveik 27 procentais gali būti paaiškintas skirtingais regionų augimo tempais: pirmaujantys regionai, pasitelkę TUI ir kartu naujas technologijas, galėjo ženkliai padidinti darbo našumą, o atsiliekantys regionai tik iš dalies pasinaudojo ekonomikos augimu.

Atlikus netolygaus Lietuvos regionų ekonominio augimo prognozavimą pagal BVP_g Džini koeficientą, gauti tokie rezultatai: 2004 m. prognozuojamas Džini koeficientas 0,161 (su 95 proc. pasikliautinu intervalu, galimos svyravimų ribos ±0,014), o 2005 m. – 0,173 (su 95 proc. pasikliautinu intervalu, galimos svyravimų ribos ±0,014). Maža prognozavimo paklaida (MAPE = 5,13%) leidžia pakankamai pagrįstai teigti, kad iš esmės nesikeičiant susiklosčiusiai konjunktūrai ir išliekant tiesioginei priklausomybei tarp šalies ekonominio augimo tempo ir regioninio šio augimo pasiskirstymo, atotrūkis tarp Lietuvos apskričių didės ir ateityje.

Iš visų apskaičiuotųjų koncentracijos rodiklių matyti, kad regionų atotrūkis pagal BVP_g laikui bėgant didėja. Tarpregioniniai skirtumai, matuojami BVP_g Džini koeficientu, daugeliu atveju didėjo sparčiau nei augo ekonomika: per 1995–2003 m. BVP išaugo 120 proc., o Džini koeficientas padidėjo 170 proc., taigi Lietuvoje vyksta netolygaus regionų vystymosi procesas.

Įteikta 2005 m. rugsėjo mėn.