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AN APPROACH TO THE EVALUATION OF REGIONAL INEQUALITIES: A CASE STUDY OF LITHUANIAN COUNTIES

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Abstract. The indicators for the evaluation of regional development processes are influenced by a great number of interrelated factors. While investigating sustainable or unsustainable growth, the relation between employment and workplaces, the alternation of the quality of life and the status of health, etc. must be taken into consideration. It is quite complicated to find an appropriate evaluation mechanism for the recognition of regional inequalities. As the alternation of the processes of restructuring and development is quite fast, new relationships, which are observed in the period of the contemporary crisis, influence new types of the consequences of economic development as well as the methods for its evaluation. The paper aims to assess the extent of regional inequalities by using an approach to the evaluation of some differences among developing regional areas based on the NUTS 3 level. The results of the application of the mentioned methodology are demonstrated by evaluating the processes of regional development in Lithuania. The application of the state-of-the-art scientific methods and tools allows to provide empirical evidence regarding the dynamic processes of regional development. The evaluation of statistical data allows to recognize the inequalities; econometric methods are used for the analysis of the changes of *per capita* incomes and their basic components as well as the level of labour productivity and employment rate. The proposed approach allows to evaluate the levels of inequality, especially by using the statistical data regarding the income growth in the Lithuanian regions, and the rise of labour productivity gap. Econometric models used to analyse the impact of the capital/labour ratio on labour productivity are discussed in the paper. Calculated technical progress parameters show that annual growth of technical progress is, in fact, the highest in leading regions with strong economies of agglomeration and technological development and that the Lithuanian regional policy is relatively ineffective in raising technological progress growth.

JEL Classification: P000, P510.
Keywords: indicators of sustainability, regional economic inequality, evaluation, econometrics, the European Union, statistical data of Lithuanian counties.
Reikšminiai žodžiai: darnaus vystymosi indikatoriai, regioninė ekonominiai netolygumai, įvertinimas, ekonometrija, Europos Sąjunga, statistiniai Lietuvos apskričių duomenys.

Introduction

In the modern theory of regional development a lot of emphasis has been put on the phenomena of localization and agglomeration that have an effect on private business decisions on investment in particular regions (Fujita and Thisse, 2002; Van Oort, 2002; Martin, 2002; Buračas, 2007; Mačys, 2008). Emerging economies of localization and agglomeration bear the key significance as they allow the local en-

terprises to gain profit from the advantages of such developments.

European directives have been introduced in the area to support the framework to tackle restructuring during the last two decades. The Council Directive 98/59/EC on the approximation of the laws of the Member States of the European Union (EU) relating to collective redundancies aims at regulating such redundancies and introducing special obligations for employers in terms of social dialogue and measures. The Directive 2002/74/EC relates to issues regarding social guarantee funds (salaries, benefits, etc.) for workers whose company has filed for bankruptcy or liquidation.

Empirical studies have been focused on the existence and determination of regional inequalities in the EU (Pagano, 1993; Button and Pentecost, 1995; Sala-i-Martin, 1996). A short discussion of recently published results regarding this issue would be valuable in order to gain some perspective. The basic factors for regional development that are usually found in the works of the adherents of the neoclassical theory are the following: capital, land and workforce (Cass, 1995). The definition of capital includes not only financial and material resources but also all human factors. It is in the neoclassical theory that regional development is determined by a constant growth of workforce and capital as well as technological changes within a given period of time. Over the past decades regional integration and disparities in the EU have been widely discussed in order to provide an empirical understanding of the processes.

The single existing tool to measure restructuring and display its statistics is the European Restructuring Monitor, created in 2001 by the European Monitoring Centre on Change. But the picture of these processes developed by defining six main types of restructuring (bankruptcy/closure, internal restructuring, merger/acquisition, off-shoring, relocation, outsourcing) is limited by its methods and the size of collective dismissals considered (Gazier and Bruggeman, 2008; Triomple, 2009).

The main long-term goal of Lithuania's national regional policy, coinciding with the regional policy of the EU, is the reduction of regional social and economic differences. Therefore, in this paper the assessment of the consequences of the underway regional policy, i.e. the inconsistencies of regional development, current convergence and its determinants will be presented.

The goal of the present research is to provide the assessment of regional inequalities by using an approach to the evaluation of some differences among developing regional areas based on the NUTS 3 level. The results are demonstrated by the evaluation of regional districts of Lithuania, i.e. counties.

1. The Issues of Regional Development Monitoring and Evaluation Possibilities

The neoclassical finding (Solow, 1956; Cass, 1965) is that in the poorer regions the output *per capita* should grow faster than in the wealthier regions, which gives rise to the so-called convergence hypothesis. Other things being equal, the premise of this hypothesis is that the possibilities for growth are greater in those regions that are not advanced. Several factors are indicative of convergence: migration of labour from poor to rich regions tends to increase salaries in the regions of departure and reduce them in the regions of destination (Barro and Sala-i-Martin, 1995). Moreover, the diffusion of new technology might result in spillover effects which benefit poor regions (Bergstrom, 1998).

In scientific literature various alternatives to check the convergence hypothesis are suggested. Two concepts are usually used in evaluating the pattern of regional differences: the speed of convergence (β-convergence) and the analysis of regional output *per capita* dispersion (σ-convergence). In estimating β-convergence, the "convergence equation" or the so called Barro (1991) regression is the chosen method that provides a cross-section of regions within countries with a growth rate of output *per capita* over a given period of time. Convergence is implied if the coefficient of initial output *per capita* is negative and statistically significant. The σ-convergence theory is based on time series analysis and focuses on the evolution of output *per capita* dispersion (Barro and Sala-i-Martin, 1991, 1992). Sala-i-Martin (1996) identified that σ-convergence is sufficient but not necessary for β-convergence. This suggests that the lack of σ-convergence is not an indication of the absence of β-convergence.

According to the endogenous growth theory (Romer, 1993, 1994, 1996; Lucas, 1988), countries or regions could not converge even in a world of constant returns and exogenous growth (as put in the neoclassical growth model), given that the countries or regions differ in a way they allocate their resources over time or that they do not have access to the same technology. This leads us to the conclusion that inequalities in regional development are not only a result of varying rates of capital accumulation, as the traditional Solow model concludes, but also stem from differences in technology. Thus, we need to take into account that productivity growth across regions differs mainly because of the presence of technological gaps or capital deepening effects (Romer, 1993; Bernard and Jones, 1996a, 1996b; Caree et al., 2000; Andrés and Boscá, 2000). Nonetheless, the creation of knowledge through learning is a pivot of endogenous growth formulation. Through the process of learning, the knowledge base

of a regional labour force becomes a continuous and internally created source of competitive advantage and monopoly power (Romer, 1990; Lucas, 1988). Such a mode of internal learning allows to establish a new infrastructure and, concurrently, enhance development. Through learning it is possible to envision how closed regional economic systems could survive, develop and sustain themselves (Stimson, Stough, Roberts, 2006).

In the theories of endogenous growth, the level of technical progress is considered to be a part of the production function under the label of "learning by making" or a "specific growth factor", which raises the overall productivity of other factors (Barro, 1991). This specific growth factor may be human capital defined as a totality of knowledge obtained from research and development. Unlike the neoclassical approach to regional convergence, in the endogenous theories technology plays the key role in determining divergence.

Endogenous development models are usually used to examine agglomerated but not metropolitan areas, which are comprised of small or medium-sized enterprises. Entrepreneurship, flexibility of productivity, the economies of the counties and other additional factors are typical of local economies, where all of the aforementioned characteristics work as a catalyst for the development process. There are quite a few options of the adaptation of this model (i.e. models of industrial districts, regional innovation systems) (Amstrong and Taylor, 2000; Iacoponi et al., 1995; Cooke et al., 2004; Ascheim and Isaksen, 2002). Industrial district is an example of the intensification in local industrial relations, which is a long-term process that forms indissoluble network of positive and negative external relations along with historic-cultural heritage. The regional policy must be concentrated on endogenous development, promotion of cooperation, development of regional innovation systems and preservation of local environment.

In Lithuania, though a small country, territorial differences of nature and society are rather pronounced. The period of economic transition highlighted the disparities of economic and social development. The goal to integrate into the EU accelerated Lithuanian regional policy-making. In this paper a region is perceived as a political and administrative unit (in between the national government and a municipality), which ensures endogenous and balanced development of the regional economies, increases international competitiveness and develops regional identity (Svetikas, 2004).

2. The Main Components of the Evaluation of Regional Inequalities

2.1. Possibilities of the Evaluation of Regional Convergence

During the last decades there was an increase in empirical research into the EU regional disparities and their convergence. To name few, there are Pagano's (1993), Button and Pentecost's (1995), Barro and Sala-i-Martin's (1995) and other papers that apply regression analysis for the investigation of regional disparities and convergence. The analysis is based on the neoclassical growth theory or, to be more precise, on the Sollow's approach, by which regional relations of productivity, expenditure factors and technological progress are investigated.

As already have been mentioned, this theory suggests that all the regions of equal pace in technological progress converge in the direction of a balanced income *per capita* model. Given that several regions undergo similar levels of production, technology, retrenchment and population growth, these regions will converge towards the same income *per capita* level.

There are two types of convergence: β-convergence and σ - convergence.

σ-convergence represents the common measure of income disparities. It gauges the dispersion of regional income in a given period of time. If the dispersion decreases over time, there is σ - convergence.

β-convergence may be observed only in the cases when the regions lagging behind start to grow faster than the leading ones, i.e. when GDP or regional income accrues faster in the lagging regions rather than in the leading ones. That may be exemplified by the negative ratio between the capital income growth and the capital income level at the initial point. The existence of β-convergence signals allow σ-convergence to be traced. The absolute β-convergence can be tested by the following (1) equation:

$$(1/T)\ln\left(\frac{Y_r^t}{Y_r^{t-1}}\right) = \beta_0 + \beta_1 \ln Y_r^{t-1}; \qquad (1)$$

Note: T is an interval of time under investigation from 0 to *n*;

$\frac{Y_r^t}{Y_r^{t-1}}$ is a vector, inclusive of regional income growth *r* at a particular moment *t*;

Y_r^t is a vector, inclusive of regional income *r* at a particular moment *t*;

Y_r^{t-1} is a vector, inclusive of regional income *r* at a particular moment *t-1*;

β_0, β_1 are coefficients.

The left-hand side of the equation represents the average annual growth *r* of the regional income in T years. The regions lagging behind show greater growth rate than the leading regions when $\beta_1 < 0$. That is, β-convergence becomes apparent.

As mentioned above, β-convergence occurs when the regions lagging behind start to grow faster than the leading ones. This is illustrated by a negative relationship between the growth of capital income and the level of capital growth in the initial period. σ-convergence is a general measure of income disparities. It measures the dispersion of regional income at a certain moment. If the dispersion decreases over time, the observation of σ - convergence process continues. Hereinafter β-convergence and σ-convergence throughout Lithuanian regions will be discussed.

As β-convergence exposes, the regions with the lowest level of GDP per employed person experienced the highest average GDP growth per employed person. Calculated β coefficients are as follows: in -0,058401 for the years 1995 – 2006, -0,041011 for the years 1995 – 2000, and -0,0149242 for the years 2000 – 2006. To draw the conclusions from the whole period, it can be alleged that β-convergence comprised 5,8 % annually, though in the period of 2000 – 2006 Lithuanian regional convergence slowed down significantly in comparison to the period of 1995 – 2000, when the overall economic performance of Lithuania was on the decline. The slower convergence may be explained by an increase in productivity and technology development in the more evolved regions which allowed them to attract investment.

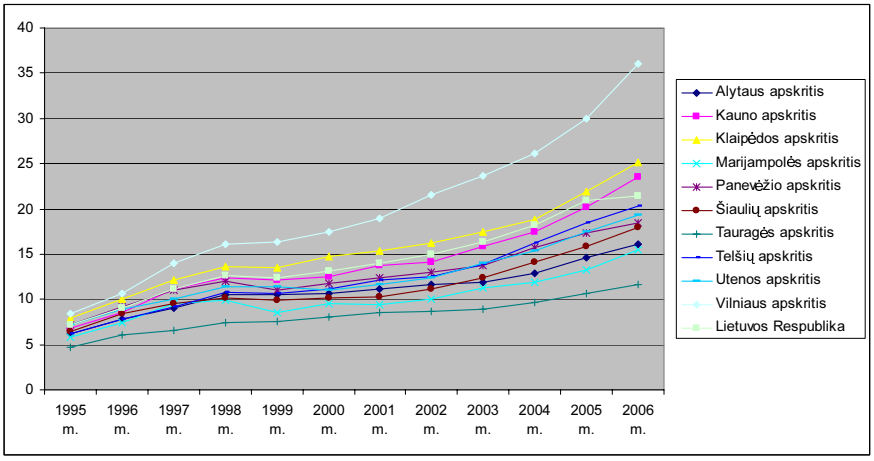
The σ-*convergence* analysis is based on econometric calculations. An unconditional convergence among all the regions was observed in the period of 1995 – 2006, which is precisely the reason for the analysis of σ-convergence, i.e. the analysis of the disparities of the measured GDP per employed person throughout the regions. By the same token, concrete regions grouped according to their strategies may be investigated. Such an analysis would reflect the rates of convergence in different regional groups.

2.2. Examples of the Evaluation of Differences in the Lithuanian Counties

The main source of data for the analysis of the Lithuanian regional economic condition is provided by the Department of Statistics to the Government of the Republic of Lithuania. Some of the very important indexes (i.e. GDP by counties) have been calculated since 1995 and annual data until the year 2006 is available. Meanwhile, other relevant data for the period until 2007 is available. Yet, in order to ensure the consistency of the research, the data of different periods (e. g. 1995- 2006) are analysed.

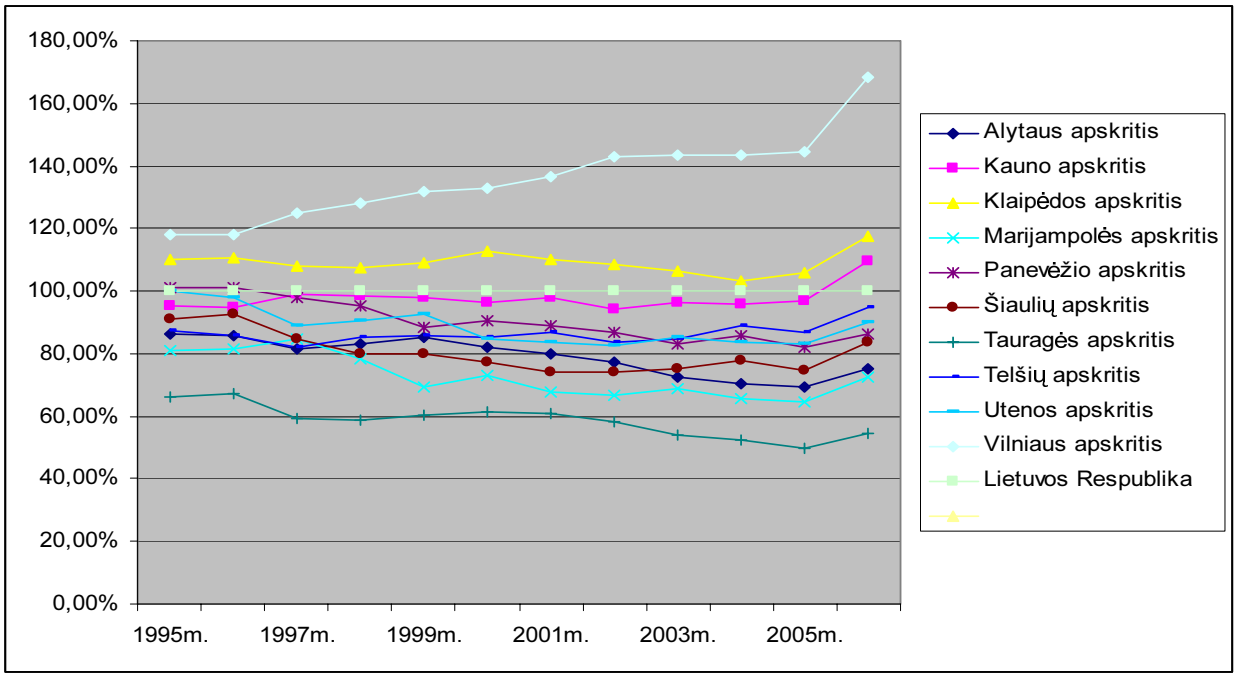
GDP is an index that reveals the economic level of a particular territory. For the present research the following definition of GDP is used: GDP is the total market value of all final goods and services produced in a country in a given year (e. g. equal to total consumer, investment and government spending, plus the value of exports, minus the value of imports). The variation of GDP *per capita* within a particular territory for a period between 1995 and 2006 is presented in Figure 1.

Figure 1. The dispersion of GDP *per capita* by counties (Lith. *apskritis*) during the period of 1995 - 2006, in thousands of LTL (Source: data of the Department of Statistics of Lithuania)



The highest GDP rates are observed in the counties of Vilnius and Klaipėda. GDP *per capita* in Kaunas County is very similar to the average GDP *per capita* in the Republic of Lithuania. It should be noted that the lowest GDP level is observed in the county of Tauragė. Only the counties of Vilnius, Klaipėda and Kaunas exceeded the average level of GDP *per capita* in 2006 (68,2%, 17,7% and 9,8% respectively). GDP *per capita* in the counties of Tauragė and Marijampolė comprised less than 75% of the country's average, as a result, it could be claimed that these regions are the most lagging behind. This is depicted in Figure 2.

Figure 2. GDP *per capita* in comparison to the average (%) of the Republic of Lithuania (1995-2006)



Telšiai County is prominent for the most rapid growth of GDP *per capita* (excluding the three aforementioned rapidly growing regions). Namely, in the county located in central Lithuania an annual increase in GDP by 11,6% has been observed since 1995. However, such a growth was induced by the oil refinery of national importance; therefore, the evaluation seems more positive than it actually is in reality. In essence, the activity of the oil refinery encourages an increase in the level of economic development in Telšiai, but if the oil supply ceased, the results of economic performance would dramatically change. Therefore, the indexes of the Telšiai County should be greeted with caution.

GDP *per capita* is a combination of several components in which every single element is apt for an economic interpretation. In Table 1 the estimation of every single index is presented, where the benchmark is the newest average rate of GDP in Lithuania. It is obvious, that the divergence of the components of GDP *per capita* is widespread among the Lithuanian counties. The highest labour productivity (in comparison to the Lithuanian average) has been reached only in Vilnius County; the highest employment level is observed in the counties of Alytus, Marijampolė, Tauragė and Vilnius; the demographical factor is almost the same throughout the whole the country.

Table 1. Estimation of the components of GDP *per capita* in comparison to the Lithuanian average of the year 2006

Counties	**GDP per employed person in comparison to the Lithuanian average, %**	**Level of employment in comparison to the Lithuanian average, %**
Alytus County	75-100	>100
Kaunas County	75-100	75-100
Klaipėda County	>100	75-100
Marijampolė County	<75	>100
Panevėžys County	75-100	75-100
Šiauliai County	75-100	75-100
Tauragė County	<75	>100
Telšiai County	75-100	75-100
Utena County	75-100	75-100
Vilnius County	>100	>100
The Republic of Lithuania	100	100

The GDP *per capita* breakdown shows that its most important component is GDP per employed person. Generally speaking, competitiveness depends on productivity. At this point some conclusions may be drawn in order to understand why labour productivity is considered to be at the core of the competitiveness analysis. Concurrently, labour productivity, in its simplest expression, is an amount of resources necessary for the production of a certain unit. Thus, labour productivity is an important indicator of competitiveness but does not explain it. The distribution of labour productivity varies significantly throughout different counties in Lithuania. The counties of Vilnius and Klaipėda stand out due to their high productivity rate exceeding the national average, whereas, labour productivity rates in the counties of Alytus, Marijampolė and Tauragė are below 75% of the national average.

The growth of the general GDP *per capita* pertains to the growth of the components of GDP *per capita* within a certain period of time (i.e. the level of labour productivity, employment and demographical factor). The evaluation of the regional GDP *per capita* variations leads us to the conclusion that the growth of labour productivity and employment is positively correlated with the GDP *per capita*.

In the long-term perspective the level of employment adversely affected the counties of Kaunas and Panevėžys, meanwhile in the short-term perspective (2001-2006) it contributed to the growth of GDP in these counties. The decline in workforce (i.e. the demographical factor) had a negative influence on a number of counties (Kaunas, Klaipėda, Utena, Panevėžys, Telšiai). What is more, the demographical factor had a negative impact on Šiauliai County in the long-term perspective. In Table 2 the counties are arranged in a descending order based on the level of GDP *per capita*. Such a ranking allows to clearly distinguish the leading counties.

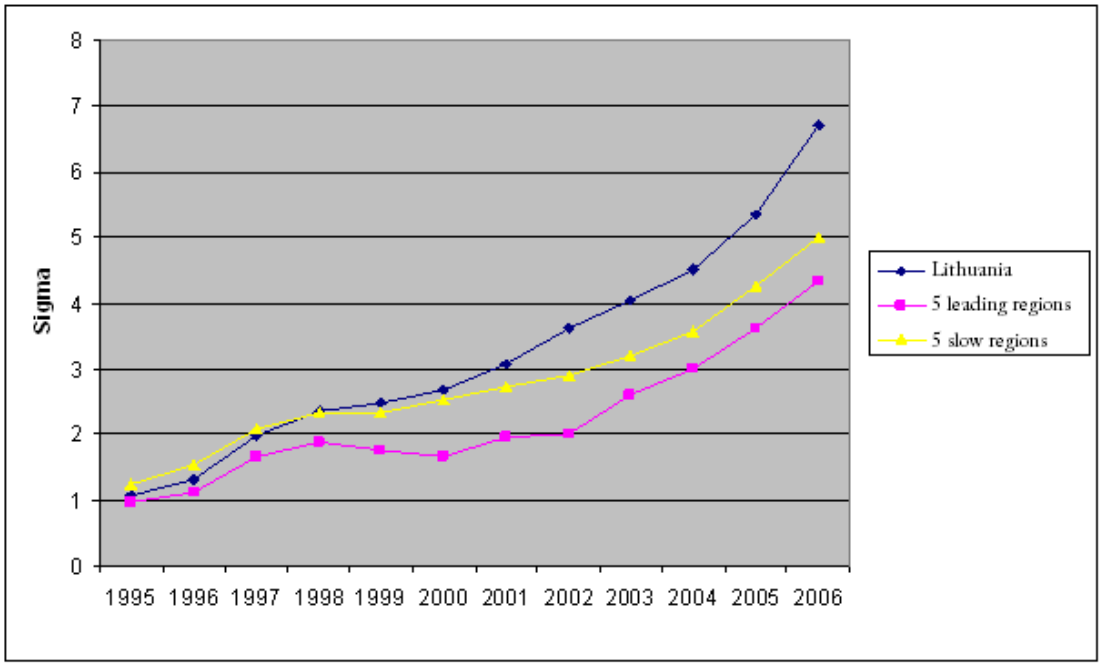
Table 2. The structural changes of the components of GDP *per capita* by counties, 1995 - 2006 and 2001 – 2006, %

	GDP per capita, LTL		**GDP per employed person, LTL**		**Level of employment**		**Demographical factor**	
Average annual shift, %	1995 – 2006	2001 – 2006	1995 – 2006	2001 – 2006	1995 – 2006	2001 – 2006	1995 – 2006	2001 – 2006
Vilnius County	14,5%	13,8%	14,5%	10,2%	0,1%	2,5%	-1,2%	0,3%
Kaunas County	12,0%	11,4%	12,1%	8,8%	-0,1%	1,2%	-1,2%	-1,1%
Telšiai County	11,6%	11,0%	11,4%	7,0%	0,2%	3%	-0,3%	-0,4%
Klaipėda County	11,3%	10,2%	12,2%	8,6%	0,1%	2,4%	-0,8%	-0,6%
Republic of Lithuania	10,6%	8,8%	12,2%	8,8%	0,1%	2,5%	0,4%	0,9%
Šiauliai County	9,9%	11,8%	10,6%	8,4%	0,2%	3,3%	-0,5%	0,4%
Utena County	9,5%	10,6%	9,8%	7,8%	0,1%	2,6%	-0,3%	-0,5%
Marijampolė County	9,4%	10,6%	10,4%	7,4%	0,4%	3,5%	0,7%	0,2%
Panevėžys County	9,4%	8,4%	11,2%	8,6%	-0,2%	1,6%	-1,8%	-2,1%
Alytus County	8,8%	7,2%	9,6%	5,4%	0,5%	4,4%	0,7%	0,1%
Tauragė County	8,7%	6,4%	8,0%	4,0%	0,9%	3,0%	1,1%	0,8%

While observing the data of two different periods (1995 – 2006; 2001 – 2006) and evaluating the structural changes of regional GDP per employed person in a given period of time and, it becomes apparent that in the general long-term period labour productivity increased more rapidly than in the recent years (2001-2006). It can be agreed that since 2001 the growth of labour productivity slackened. What is more, it should be born in mind that this element is one of the most important components of GDP *per capita* (the welfare measure) growth in the country. The differentiation is traceable in both short-term and long-term periods: the components of GDP *per capita*, such as labour productivity, employment and demographical factor, vary in the degree of impact throughout the counties. In more dis advantaged areas labour productivity provides an explanation for a relatively low GDP *per capita* growth and, consequently, the levels of employment and demographical factor gain the upper hand in the situation (especially the ratio of employment and workforce and the ratio of workforce and population), which reveals the situation of the employed persons, the workforce and the whole population.

Figure 3 shows σ-convergence in Lithuania as well as in the regions with the highest and lowest GDP *per capita*.

Figure 3. Levels of σ–convergence during the period of 1995-2006 (Note: the leading regions are: Vilnius, Kaunas, Klaipėda, Šiauliai, Telšiai)



This research does not reveal σ-convergence in the context of the whole Lithuania, yet it proves the existence of the relation among the leading regions: in the leading regions a less widespread dispersion is observed in comparison to the regions lagging behind. However, in a given period of time σ-divergence is observed in both leading regions and regions lagging behind.

To conclude, noteworthy is the fact that even though in Lithuanian regions β-convergence was observed (i.e. the regions with the lowest GDP per employed person exceeded the national average), the presence of σ-divergence testifies the unabated gap among regions.

3. Factors of Regional Inequality in Labour Productivity

Often the GDP *per capita* is the most useful indicator to determine regional competitiveness, which, although not in its entirety, shows the average welfare of the regional population. In the following analysis, GDP has been broken down to its components, which is depicted in the equation (4) (Ronald, 2002, p.36):

All the interpretations and their respective units are as follows (see the equation (4)):

- Labour productivity (GDP per employed person);
- Level of employment (the number of employed persons divided by the working-age population);
- Demographical factor (working-age population divided by the population at large).

The breakdown of the GDP *per capita* reflects the importance of two key components in the equation: GDP per employed person (which is almost the same as labour productivity) and overall working population in relation to the working-age population (i.e. the level of employment). Generally speaking, competitiveness depends on the levels of productivity and employment. At this point it becomes clear why productivity is at the core of the competitiveness analysis. By the same token, productivity, in its simplest meaning, is an amount of resources necessary to produce a certain unit. Therefore, productivity is the key indicator of competitiveness.

As it has already been established while discussing the divergence and convergence throughout

$$\frac{GDP}{Inhabitants} = \left(\frac{GDP}{Employment}\right) * \left(\frac{Employment}{Laybour\ \ Fource}\right) * \left(\frac{Laybour\ \ Fource}{Inhabitants}\right) \quad (4)$$

Lithuanian regions, labour productivity plays the key role not only as the main component of GDP *per capita* but also as a stimulus for its growth. Consequently, the dependency of labour productivity on other factors will be investigated in this paper. According to the neoclassical growth theory, production depends on capital, workforce and the technology development in economics that can be characterized by the technological progress. All of the three factors have an effect on the function of production, whereas technology development is distinguished separately, as it is conditioned by capital and workforce. An econometric relationship between the three factors may be estimated (5):

$$Y = F(A, K, L) \quad (5)$$

Note: Y = Production; A = Technical efficiency or total factor productivity; K = Capital resources; L = Workforce.

This relationship may be embodied in Cobb-Douglas production function (6):

$$Y = AK^{\alpha}L^{\beta} \quad (6)$$

Note: α = capital elasticity parameter; β = workforce elasticity parameter; $\alpha + \beta = 1$.

When the technological progress increases gradually (in a constant growth rate), Cobb-Douglas production function is to be expanded by an additional variable, which represents technological progress. This is how the equation (7) is obtained:

$$Y = Ae^{gt}K^{\alpha}L^{\beta} \quad (7)$$

Note: g = constant parameter of technological progress growth over time t.

When both hand sides of the equation are divided by workforce L and taken to the logarithm, the following equation (8) is produced:

$$\ln\left(\frac{Y}{L}\right) = \ln A + g * t + \alpha * \ln K + \beta * \ln L - \ln L \,. \quad (8)$$

Because $\alpha + \beta = 1$, if instead β we inserted $1 - \alpha$, contracted the similar members and settled right hand side of the equation, the following equation (9) would be produced:

$$\ln\left(\frac{Y}{L}\right) = \ln A + g * t + \alpha * \ln\left(\frac{K}{L}\right). \quad (9)$$

If the variable of technological knowledge is added to the error of the model, the regression relationship between productivity per capital (or per employed person) and technological advance of every separate Lithuanian region and Lithuania in general is pronounced in the following equation (10):

$$\ln\left(\frac{Y_r^t}{L_r^t}\right) = \alpha * \ln\left(\frac{K_r^t}{L_r^t}\right) + g * t + \varepsilon_t; \quad (10)$$

Note: $\frac{Y_r^t}{L_r^t}$ = vector, inclusive of regional work r productivity at a particular moment t;

$\frac{K_r^t}{L_r^t}$ = vector, inclusive of regional capital per employed person r at a particular moment t;

α = elasticity parameter of capital per employed;

g = constant parameter of technological progress growth;

t = period ranging from 0 to n;

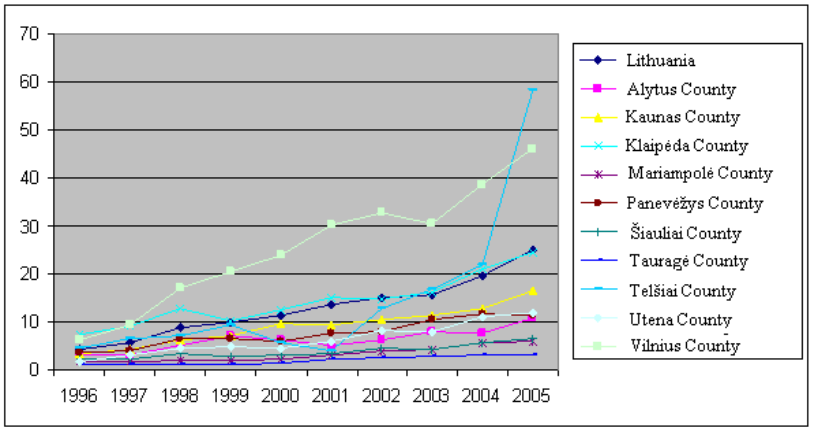
ε_t = error of the model.

Regression models, constructed for every separate region and the whole country on the basis of this equation, would contribute to the determination of the dependence of work productivity on capital per employed person and on the factor of technological advance. If the derived relationships bore a meaning, the conclusion would be that increasing the capital and encouraging technological advance can help to augment regional productivity; what is more, the separate parameters would reveal their influence on the process.

Regression models derived from the equation (10) reflect the relationship between labour productivity and capital per employed person as well.

In this case study the sum of direct foreign and material investments is approximated to the material capital. Due to the fact that the analysis of material investments is based on diverse sources of data, a comparison with the previous annual data is not possible. Therefore, this paper is based only on the previous annual data. The Department of Statistics provides data regarding direct foreign investments in separate regions for the period 1996-2005; thus, the amount of information is restricted. The fluctuations of capital per employed person (1996-2005) are depicted in Figure 4. Apparently, the smallest investments were received by the counties of Tauragė, Marijampolė, Šiauliai and Alytus in 2004 and 2005. Thus, the regions lagging behind also receive the smallest share of capital *per capita*. The highest levels of investment are observed in the counties of Vilnius, Klaipėda and Telšiai. In 2005 the biggest share of capital *per capita* was observed in Telšiai County. The reason lies in the fact that in that year the level of direct foreign investment in Telšiai County was rather high (higher levels were observed only in the counties of Vilnius, Kaunas and Klaipėda), and the percentage of working population in this area was significantly lower. To summarize the analysis of the dispersion of capital per employed person in the Lithuanian counties, it can be claimed that the lion's share of investments is received by the leading regions, while the less developed regions attract less investment, consequently, this leads to the increasing gap between the counties.

Figure 4. Variation of capital *per capita* in the period 1996-2006 (in thousands LTL)



By using the above formula (10), regression relationship of productivity with capital and technological advance was obtained and adapted to the case study of the separate Lithuanian counties and the whole country (when regional data elements were embodied in the vectors). The results of the regression analysis are enlisted in Table 3.

Regression equations demonstrate how the labour productivity is affected by the change of capital per employed person and technological advance. Capital per employed person and labour productivity are expressed as a logarithm. The implication is that the capital coefficient indicates the percentage by which labour productivity would increase when capital per employed person augments by 1%.

Table 3. Results of the regression analysis of the data of the separate counties and the whole country (based on the 1995-2005 data)

Counties	Regression equations
Alytus County	$\log\left(\frac{BVP}{L}\right) = 9{,}08 + 0{,}29 * \log\left(\frac{K}{L}\right) + 0{,}03 * t$
Kaunas County	$\log\left(\frac{BVP}{L}\right) = 9{,}22 + 0{,}45 * \log\left(\frac{K}{L}\right) + 0{,}07 * t$
Klaipėda County	$\log\left(\frac{BVP}{L}\right) = 9{,}09 + 0{,}29 * \log\left(\frac{K}{L}\right) + 0{,}08 * t$
Marijampolė County	$\log\left(\frac{BVP}{L}\right) = 9{,}97 + 0{,}12 * \log\left(\frac{K}{L}\right) + 0{,}04 * t$
Panevėžys County	$\log\left(\frac{BVP}{L}\right) = 8{,}78 + 0{,}46 * \log\left(\frac{K}{L}\right) + 0{,}01 * t$
Šiauliai County	$\log\left(\frac{BVP}{L}\right) = 9{,}32 + 0{,}26 * \log\left(\frac{K}{L}\right) + 0{,}04 * t$
Tauragė County	$\log\left(\frac{BVP}{L}\right) = 9{,}44 + 0{,}1 * \log\left(\frac{K}{L}\right) + 0{,}03 * t$
Telšiai County	$\log\left(\frac{BVP}{L}\right) = 9{,}85 + 0{,}3 * \log\left(\frac{K}{L}\right) + 0{,}06 * t$
Utena County	$\log\left(\frac{BVP}{L}\right) = 9{,}56 + 0{,}1 * \log\left(\frac{K}{L}\right) + 0{,}06 * t$
Vilnius County	$\log\left(\frac{BVP}{L}\right) = 9{,}22 + 0{,}38 * \log\left(\frac{K}{L}\right) + 0{,}12 * t$
The Republic of Lithuania	$\log\left(\frac{BVP}{L}\right) = 9{,}54 + 0{,}15 * \log\left(\frac{K}{L}\right) + 0{,}05 * t$

The results of the research show that the augmentation of physical capital encourages the regional increase in productivity. Noticeably, the rise in the capital per employed person quite significantly influences the rise of labour productivity levels. The coefficients of the capital per employed person range from 0,10 to 0,45 in different counties. The analysis of the impact of capital per employed person (in per cent) on productivity brings us to the conclusion that the increase in capital per employed person mostly conditions labour productivity in the counties of Vilnius, Kaunas and Panevėžys. The most insignificant influence is traced in the counties of Telšiai, Tauragė and Utena.

What regards the impact of capital per employed person on labour productivity (in per cent), it could be said that the rise in capital has a significant positive effect on the growth of productivity levels in both leading regions and the regions lagging behind.

Technological advance is also significant for labour productivity; however, its impact is weaker in comparison to the impact of the capital per employed person. The coefficient ranges from 0,01 to 0,12. The calculated technical progress parameters show that annual growth of technical progress is, in fact, the highest in leading regions (Vilnius, Klaipeda, Kaunas) with higher agglomeration of economies and technological development. What is more, Lithuanian regional policy was proved to be relatively ineffective in raising technological progress growth.

To summarize the results of the regression analysis, it can be argued that the increase in capital positively and significantly affects productivity growth, regardless of whether the region is leading or lagging behind. Although the impact of technological advance on productivity is significantly lower than the impact of the capital per employed person, it still has a positive effect on the growth of productivity levels. The stimulation of the growth of these two indicators would allow to increase regional productivity.

Since technological progress is a significant indicator of increasing labour productivity, it is necessary to assess the factors that affect the growth of different parameters of technological progress. Once the technological advance has been evaluated, the exogenous variables (mainly factors of agglomeration economy) may be determined.

Conclusions

In the context of all counties, both employment and level of labour productivity have a relation to GDP *per capita*. This is mainly due to the fact that both indicators belong to the same cause of the economic growth, i.e. in more developed regions economies are more active, the levels of population activity are sufficiently high, and, consequently, these regions can be distinguished by their large workforce and remarkable labour productivity. Thus, labour productivity rather than employment occurs to be the key element of GDP. The increase in the number of labour market participants may have some influence in a short-term period, yet, even if migration is disregarded, there exists a natural limitation the continuance such an effect within a certain period of time. Hence, labour productivity stands out as the main component conditioning the growth of GDP *per capita*.

Remarks on the suitability of neoclassical theory to the case study of Lithuania: the regression dependency reflects a significant relationship between productivity and capital per employed person as well as the technological advance factor. Generally, productivity levels show a tendency to augment due to increases in both capital and technological development. Yet, the response to the changes of exogenous variables differs throughout the counties. Therefore, it should be born in mind that in order to raise regional productivity, both the encouragement of investments and the stimulation of technological advance should be taken into consideration. The technological advance strongly depends on human and physical capital, i.e. the numbers of the students of universities and other institutions of higher education as well as investments in academic research and development. Yet, in more comprehensive studies additional variables should be sought for in order to develop a more thorough understanding of the factors relevant to technological advance. Therefore, further investigations into the issue are necessary in order to reveal the influence of the increasing investments in academic research and development as well as the promotion of higher education.

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REGIONŲ NETOLYGAUS VYSTYMOSI VERTINIMO METODAS: LIETUVOS APSKRIČIŲ ANALIZĖ

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Santrauka. Regionų vystymosi procesus vertinantys rodikliai yra susiję su daugeliu tarpusavyje susijusių veiksnių. Norint tinkamai įvertinti regionų vystosi darnios ar nedarnios veiklos požymius, reikia nagrinėti tokius gana sudėtingus savo struktūra veiksnius kaip ekonominis augimas, užimtumo ir darbo vietų santykis, gerovės ir gyvenimo kokybės kaita, regiono gyventojų sveikatos būklės pokyčiai ir kita.

Norint rasti tinkamą regioninių skirtumų atpažinimo ir vertinimo sistemą, reikia spręsti gana sudėtingus rodiklių sąveikos, restruktūrizavimo ir plėtros procesų analizės uždavinius. Kadangi regioninio vystymosi procesų kaita nagrinėjamu laikotarpiu gana sparti, atsiranda nauji santykiai, kurie mus įpareigoja analizuoti veiksnius, darančius įtaką ir ekonominės krizės laikotarpiu. Nagrinėtina įtaka naujai atsirandančių santykių kaitai ir ekonominiam vystymuisi. Straipsnyje aptariami metodai, leidžiantys įvertinti regioninio vystymosi netolygumų mastą. Autoriai siūlo taikyti regionų vertinimo metodą, grindžiamą besivystančių regionų trijų lygių skirtumų lyginimo metodika. Šio metodo taikymo rezultatai pateikiami vertinant Lietuvos apskričių vystymosi procesus. Vertinant regionų plėtros procesus taikomos priemonės grindžiamos empiriniais ir dinaminiais daugiakriteriais statistiniais komponentais. Vystymosi netolygumai yra atpažįstami iš statistinių duomenų įvertinimų, taikant tam tikrus ekonometrinius metodus. Analizuojami pajamų, tenkančių vienam gyventojui, pokyčiai, jų struktūra, darbo našumo ir užimtumo lygis. Siūlomas metodas, naudojant Lietuvos regionų statistinius duomenis ir pajamų augimo, darbo našumo atotrūkio didėjimo, techninės pažangos rodiklius leidžia vertinti regionų vystymosi netolygumo lygį. Straipsnyje apžvelgiami užsienio investicijų, kapitalo pritraukimo faktoriai, darbo santykį, darbo našumą analizuojantys ekonometriniai modeliai. Gauti vertinimo rezultatai parodo pirmaujančių ir atsiliekančių regionų techninės pažangos skirtumus.

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