

SUSTAINABILITY OF LITHUANIAN REGIONS: APPLICATION OF COMPOSITE INDEX

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ABSTRACT

Sustainable development has become one of the most discussed issues on national, regional and international levels. Together with policy development, the need to assess the current situation and the achieved progress in sustainability has arisen. In Lithuania integrated evaluations of sustainability are rather rare, therefore this paper aims to apply composite index for Lithuanian regions – counties. Research focuses on four regions of Lithuania: ones with the highest and with the lowest GDP values over the period of 2000–2010. The analysed indicators were normalized calculating T values and recalculating some of indicators to have them in the same direction and applying equal weight basis approach. The results reveal rather different development of selected regions. In all areas analysed (economy, environment, health and social issues) Vilnius County has improved most. Meanwhile situation in Tauragė region has only worsened. Though not only economic issues are important then assessing the development course, regions with higher economic development favour in general and their development is more stable and sustainable.

KEYWORDS: *sustainable development, regions, Lithuania, sustainability indicators.*

JEL CODES: Q 01

Introduction

Sustainable development and related issues has come to the political agenda since 1987 with the Brundland report (WCED, 1987). Different sustainability aims and targets are expressed in numerous international documents (Agenda 21 [1992], Johannesburg Implementation Plan [2002]) and regional as well as national sustainable development strategies (EU Sustainable development strategy [2001, 2006], Lithuanian National development strategy [2003, 2009]) and other documents. Attention to sustainable and even development of the regions is given at all policy levels and is one of the main aims of sustainable development declared in the National strategy for sustainable development of Lithuania (2009).

Together with policy development, the need to assess the current situation and the achieved progress in sustainability has arisen. However, the development of Lithuanian regions has been evaluated only on descriptive separate indicators basis (Juknys, 2008) or rather short period of time (Ginevičius, Podvezko, 2009; Brauers, et al., 2010). And very often only economic issues are stressed then comparing the regions, especially on the political level.

Therefore this paper aims to apply composite index for selected Lithuanian regions with different GDP levels and evaluate their development over the period of 2000–2010. The main tasks of the paper are to evaluate changes of separate indicators, calculate sub-indexes and the composite index as well as to assess their changes during the period under analysis and shortly discuss the probable importance of economic issues on the overall development of regions. The object of the paper is 4 Lithuanian regions with highest

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(Klaipėda, Vilnius counties) and with lowest (Marijampolė and Tauragė counties) GDP on average over the period of 2000–2010.

Methods used in the paper include comparative literature review, data gathering and analysis, descriptive statistics and normalization, sub-index and composite index calculation, as well as comparative analysis.

1. Theoretical aspects of index application for sustainable development assessment

As already mentioned, together with policy development, the need to assess the sustainability issues has arisen. In most cases sets of various indicators are foreseen and monitored and are used as tool for further policy making and improvement. As, according to the J. Spangenberg (2002a, 2002b), indicators of sustainability should be based on all pillars of sustainability, to cover all dimensions of sustainability composite indices are usually constructed (Čiegis, Ramanauskienė, 2011) allowing generic evaluation of various aspects (Kumar Singh et al., 2009). Such composite indices are also seen as a tool for the assessment of sustainable development in general.

However, selection of proper indicators and construction of indexes is one of the assessment challenges. Especially the later should be treated carefully as can become very subjective or meaningless (Hueting and Reijnders, 2004) by losing some information due to the high level of aggregation and normalization, transformation (Kumar Singh et al., 2009). To avoid this, uncertainties should be minimized and controlled (Floridi et al., 2011). Another critical aspect of index construction is restricted availability of the data needed as well as indicators selection might be influenced by country peculiarities (Böhinger and Jochem, 2007). Despite some critique a number of various indices and composite indicators have been developed and different methodologies have been applied for sustainability assessment as some reviews reveal: Living planet index, Ecological footprint, Environmental sustainability index, Human development index, Well-being index, City development index Innovation index, Living planet index and others (Böhinger and Jochem, 2007, Kumar Singh et al., 2009, Mori and Christodoulou, 2012).

Constructed indices are applied on global, regional, national and local levels. For example M. Floridi et al. (2011) applied composite sustainability index for 20 Italian regions covering 66 indicators and using Z scores and find out that regions better dealing with socio-economic issues were performing not so well in environmental issues. Another integrated sustainability index has been applied on different levels in Lithuania: on national level (Čiegis, Ramanauskienė, 2011), local regional level (Šimanskienė et al., 2011) and even on sector level (Štreimikienė, Mikalauskiene, 2009). The research of L. Šimanskienė et al. (2011) has showed that despite some improvements in 2007, in 2008 integrated index composed from 9 indicators declined due to the environmental degradation in Klaipėda County, though social and economic issues have improved. R. Ginevičius and V. Podvezko (2009) applied multiple criteria methods and estimated that during the 2003–2007 period Vilnius and Klaipėda regions were among most rapidly and stable developing regions, and Tauragė and Marijampolė regions were among the slowest ones. Applied for the regional development evaluation and covering 16 objectives MOORA method (Brauers et al., 2010) have showed that Tauragė region was the second worst region concerning general well-being of the Lithuanian regions. Marijampolė County performed much better according these authors, and Klaipėda and Vilnius regions were ranked as the best performing regions according well-being in 2008.

2. Construction of composite index

As the indicators and indices are useful tool for policy making, and decisions making as well as progress assessment, the composite index (based on City development index principles (UN, 2001)) was applied for the regions of Lithuania in order to determine the course of the regions' development. Though regions can be characterized from geographical, political, social, ethnical economical perspective, usually boundaries of the region are determined by the administrative division of the country (Ginevičius, Podvezko, 2009). This concept of the region was used in the paper.

Usually then assessing the progress and achievements economy issues are dominating. Hence, from the point of sustainability social and environmental aspects should be taken into account. To highlight the importance of these aspects for sustainability, the regions with highest and with the lowest gross domestic product (GDP) per capita over 2000–2010 has been chosen for the deeper analysis. According to the data of Statistical office of Lithuania during this period the Vilnius and the Klaipeda regions have been selected as the regions with the highest GDP/cap amounting on average to 32 889 LTL/cap and 21 911 LTL/cap respectively. And the regions of Tauragė and Marijampolė were selected as the regions with the lowest GDP/cap values, respectively 10 995 LTL/cap and 13 747 LTL/cap on average over the 2000–2010 period.

For the composite index the following indicators presented in Table 1 were selected and composed the sub-indices and the final composite index. Selection and grouping of the indicators was based on literature review and author's opinion on importance and interconnection of the indicators as well as data availability, which quite often has been very restricted.

Table 1. Selected indicators and composition of the index

Indicator	Sub-index	Composite index
GDP, LTL/cap	Economy	Composite sustainability index
Unemployment rate, %		
Recipients of social allowances, %		
Wastewater treated to the standards, %	Environment	
Water consumption in household sector, m ³ /cap/yr		
Emission of NO _x , kg/cap		
Infant mortality, number/1000 live births	Health	
Life expectancy		
Hospitals/100 000 inh.		
Libraries/100 000 inh.	Social environment	
Post-secondary education, % of 25–64 age population		
Crimes/100 000 inh.		
Natural population increase/decrease per 1 000 inh.		

All the indicators of each year were standardized using T scores obtaining values from 0 to 100 using this formula:

$$T = 50 + 10 \left(\frac{x - \bar{x}}{s} \right), \quad (1)$$

where: x is value of indicator of a given year;

\bar{x} – mean value of a given indicator;

s – standard deviation of the given indicator.

Those T values which increase indicated unsustainable trends were recalculated to have all indicators in one “direction”. And increase of the value indicates improvement. All indicators were included into sub-indices on the equal weight basis. Calculated sub-indices have been included into final composite index on equal proportions as well (Table 1).

Based on the data of the department of Statistics of Lithuania, research covers development changes in Klaipėda, Marijampolė, Tauragė and Vilnius regions over the period of 2000–2010.

3. Indicators of development and sub-indices of Lithuanian regions

3.1. Economy indicators and sub-index

Economy related indicators and their changes are presented in the Table 2. Over the period under analysis gross domestic product (GDP) has been increasing in all regions. The most pronounced growth nearly 2.5 times was registered in Vilnius County and 96 % growth was characteristic for Marijampolė County. Despite this growth differences between the regions has only increased. If in the beginning of the period under analysis GDP/cap in Tauragė County was 2 times, in the end of the period already – 2.41 times lower the level of Vilnius County. Marijampolė County also had 2.38 times lower GDP/cap than Vilnius County and 34 % lower GDP/cap than Klaipėda County in 2010.

Some growth trends, hence negative from point of sustainability, were observed in the number of recipients of social allowances. This indicator has especially increased from 2008 and the biggest increase (nearly 60 %) is registered in Tauragė County amounting to 8.2 % of all population of this region. However, the unemployment rates were highest in Klaipėda (18.2 %) and Vilnius counties (16.2 %) in 2010. Also it should be noted that all economy related indicators have been influenced by financial crisis and after peak values in 2007 or 2008 have decreased/worsened in 2009.

Table 2. Economy related indicators and sub-index in 2000 and 2010

Indicator		County							
		Klaipėda		Marijampolė		Tauragė		Vilnius	
		2000	2010	2000	2010	2000	2010	2000	2010
GDP, LTL/cap	Real values	14 635	32 200	9 212	18 100	7 755	15 500	17 913	43 200
	T values	45,03	60,74	40,18	48,13	38,87	45,80	47,96	70,58
Unemployment rate, %	Real values	14,2	18,2	14,7	15	13,6	11,3	17,3	16,2
	T values	41,46	33,16	40,42	39,79	42,70	47,77	35,03	37,31
Recipients of social allowances, %	Real values	2,93	4,33	3,94	6,06	5,22	8,23	2,55	3,54
	T values	49,51	41,71	43,89	32,12	36,74	20,02	51,59	46,09
Economy sub-index	T values	45,33	45,2	41,5	40,1	39,44	37,76	44,86	51,32

Source: Statistic of Lithuania, author's calculations

Due to different trends of separate indicators, the economy sub-index indicate that over the period of 2000–2010 economic situation has improved only in Vilnius County (Table 2, bold values), other counties have showed rather moderate results. The economy sub-index in Vilnius region amounted to 51.3, in Klaipėda region – 45.3, in Marijampolė region – 40.1, and in Tauragė – 37.7 in 2010. Though GDP/cap values have been increasing in all counties, in some cases like Klaipėda or Tauragė counties other indicators (unemployment rate or number of social allowance recipients) have influenced final results.

3.2. Environmental indicators and sub-index

From the environmental indicators most significant improvement is registered in waste water treatment (Table 3). In all counties under analysis the amount of wastewater treated to the standards has reached not less than 95%. The maximum 100 % of wastewater treated has been reached in Marijampolė County. Water consumption has been decreasing also in all counties except Vilnius region with some slight increase. The highest water consumption has been registered in this county amounting to 39 m³/cap/yr in 2010.

Relative NO_x pollution has decreased in Vilnius County (29 %) and Tauragė County has shown some stable levels. Meanwhile in Klaipėda county pollution increased about 20 % and in Marijampolė nearly two times. The later could be associated with intense transport flows and changes in energy sector. Despite that air pollution in Marijampolė County (1.45 kg NO_x/cap) was lower than in Klaipėda (1.7 kg NO_x/cap) and Vilnius County (2.24 kg NO_x/cap) in 2010.

Table 3. Environment related indicators and sub-index in 2000 and 2010

Indicator		County							
		Klaipėda		Marijampolė		Tauragė		Vilnius	
		2000	2010	2000	2010	2000	2010	2000	2010
Wastewater treated to the standards, %	Real values	12	99	28	100	13	95	10	99
	T values	51,16	59,90	52,80	59,98	51,34	59,47	50,97	59,86
Household water consumption, m ³ /cap/yr	Real values	38,24	25,77	27,25	24,85	19,14	16,76	38,58	39,00
	T values	35,65	54,66	52,40	56,07	64,77	68,40	35,12	34,48
Emission of NO _x , kg/cap	Real values	1,43	1,70	0,80	1,45	0,68	0,68	3,16	2,24
	T values	50,55	46,40	59,99	50,19	61,80	61,79	24,51	38,40
Environment sub-index	T values	45,79	53,65	55,06	55,41	59,30	63,22	36,86	44,25

Source: Statistic of Lithuania, author's calculations

Despite some negative trends, overall environmental situation is improving and environmental sub-index has been increasing in all counties under analysis (Table 3, bold values). However, better environmental situation is registered in counties with not such pronounced economy level and growth: Tauragė and Marijampolė counties amounting respectively to 63.2 and 55.4 in 2010. These counties also had higher index values in the beginning of the period under analysis, but the situation in Marijampolė region has improved rather slightly to compare to the achievements of other counties. Despite improvements, to compare to the other counties the worst situation is in the Vilnius County: environmental sub-index in this county amounts only to 44.25.

3.3. Health protection indicators and sub-index

Health related indicators have been improving over the period with some exception with the number of hospitals (Table 4). The later could be related to the health system reform and closure or reunification of some hospitals, especially in the more distinct areas.

Table 4. Health related indicators and sub-index in 2000 and 2010

Indicator		County							
		Klaipėda		Marijampolė		Tauragė		Vilnius	
		2000	2010	2000	2010	2000	2010	2000	2010
Infant mortality, number/1000 live births	Real values	10,5	4,0	7,2	4,4	8,1	7,4	5,8	3,7
	T values	30,91	62,17	46,78	60,24	42,45	45,81	53,51	63,61
Life expectancy	Real values	72,4	74,13	71,53	73,59	71,41	71,56	72,36	73,79
	T values	56,16	72,00	48,20	67,06	47,10	48,48	55,80	68,89
Hospitals/100 000 inh.	Real values	6,70	5,05	4,74	3,36	7,41	4,81	5,14	4,59
	T values	69,11	51,63	48,43	33,85	76,62	49,13	52,63	46,77
Health sub-index	T values	52,06	61,93	47,80	53,72	55,39	47,81	53,98	59,76

Source: Statistic of Lithuania, author's calculations

Other two indicators under analysis have shown positive trends. In all counties, except Tauragė region, infant mortality has decreased significantly (around two times) amounting to 3.7–4.4 infant deaths per 1000 live births. Life expectancy has been also increasing with most pronounced growth (2.8 %) in Marijampolė County. For this indicator Tauragė county also has shown slowest improvement. Different pace of improvement and different starting points resulted that the highest life expectancy was registered in Klaipėda County (74.1) and the lowest in Tauragė County (71.5) in 2010 (Table 4).

Overall health index was highest in Klaipėda County (61.93), followed by Vilnius region (59.76). Marijampolė County has reached only the initial (2000) levels of development of the leading regions amounting to 53.72 in 2010. And the situation has even worsened and health index has decreased in Tauragė County; despite this region have had the best starting position in 2000.

3.4. Social environment indicators and sub-index

Social development also has been uneven in the Lithuanian counties (Table 5). The most significant achievement is registered in the post-secondary education. However leading counties were those with strong County centres and having universities. Number of libraries has been decreasing in all regions, except Tauragė region; the later could be influenced probably not with the opening of new libraries, but more with migration rates. If emigration rate in Vilnius region was 29.9 persons per 1000 inhabitants, in Tauragė County this indicator was significantly higher amounting to 41.6 in 2010, i.e., more than 1.5 times higher.

Positively should be evaluated decreased number of crimes in most of counties, except Vilnius region with some increase during the 2000–2010 period. The highest number of crimes was also characteristic for Vilnius County in 2010; hence in the beginning of the period Klaipėda County was identified as a county with highest number of the crimes (Table 5).

Table 5. Social issues related indicators and sub-index in 2000 and 2010

Indicator		County							
		Klaipėda		Marijampolė		Tauragė		Vilnius	
		2000	2010	2000	2010	2000	2010	2000	2010
Libraries/100 000 inh.	Real values	30,2	29,7	61,1	59,4	69,7	71,3	25,5	23,2
	T values	41,84	41,63	57,44	56,58	61,74	62,58	39,48	38,32
Post-secondary education, % of 25 – 64 age population	Real values	9,72	17,5	7,8	9,25	6,23	8,42	14,79	25,26
	T values	45,17	60,43	41,42	44,26	38,33	42,62	55,12	75,63
Crimes/100 000 inh.	Real values	2754	2038	1921	1736	1686	1791	2678	2946
	T values	40,07	51,87	53,79	56,84	57,67	55,94	41,32	36,91
Natural population increase/decrease	Real values	0,5	-0,3	-1,1	-3,1	-0,6	-4,5	-1,3	0,7
	T values	68,38	63,51	58,64	46,46	61,68	37,93	57,42	69,60
Social sub-index	T values	48,86	54,36	52,82	51,04	54,85	49,77	48,33	55,11

Source: Statistic of Lithuania, author's calculations

Natural change of population also varied between the counties and if Klaipėda, Marijampolė and Tauragė regions have showed negative tendencies, Vilnius County has improved situation and now has positive natural population increase (0.7). The highest natural decrease (-4.5) is registered in Tauragė region. As already mentioned, this region has the lowest GDP, high number of social allowances recipients and consequently high migration rates leading to low birth rates.

Summing up the results of social indicators reveal that counties with relatively higher level of post-secondary education and more or less positive natural population increase have shown the most pronounced

improvement, hence having lower starting positions. These are Klaipėda (54.34) and Vilnius (55.11) counties. Social index of Marijampolė County has decreased slightly over the period under analysis and the most pronounced drop (10 %) of social development is registered in Tauragė County.

4. Composite index of sustainability in Lithuanian regions

Results of the composite index indicated that regions which have shown improvement in all 4 (Vilnius County) or at least 3 (Klaipėda County) sub-indexes have been developing in more sustainable way. The overall composite index has increased in Vilnius County (14 %), Klaipėda County (12 %), and Marijampolė County (2 %) (Fig. 1). However, situation in Tauragė region has worsened (5%) and only in environmental sphere positive changes has been taking place over 2000–2010 in this county (Table 3). It is seen that the composite index of Tauragė County fluctuated most during the period under analysis and experienced rather difficult episodes already in the beginning of 2000's then index values were lower the level of 2000 (Fig. 1).

The development of the regions was much more pronounced until the global financial crisis. During the 2000–2008 the composite index in Vilnius County increased 17 %, in Klaipėda County – 15 %, in Marijampolė County – 7 %, and Tauragė County – 3 % (Fig. 1).

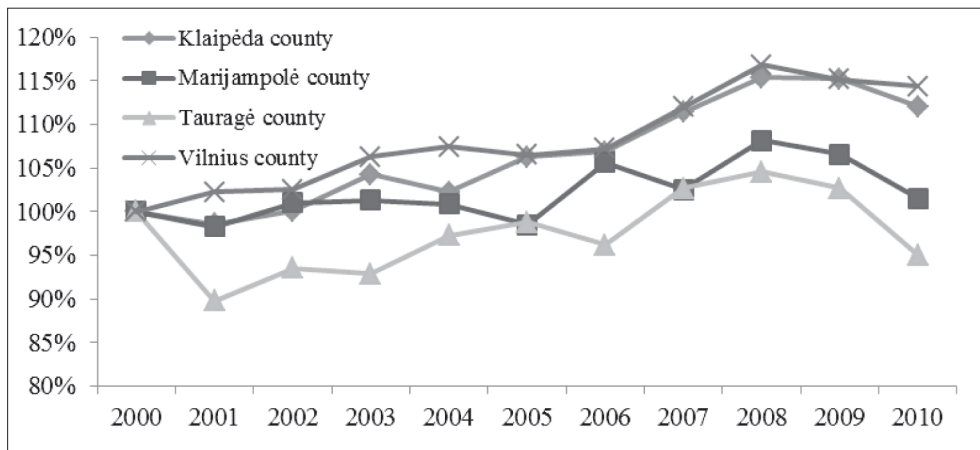


Figure 1. Changes of composite index of different regions of Lithuania over 2000–2010 period

Source: author's calculations

Hence, all counties under analysis have experienced negative impact of global financial crisis and from 2008 composite index had decreased in all regions. The most reactive in his case was Tauragė County (8 %), which has been demonstrating rather week development comparing to the other regions. The 5 % drop is registered for Marijampolė region, 3 % – in Klaipėda region and only 1 % – in Vilnius region. Summing up, this suggests that lacking behind regions are also most vulnerable ones and their sustainability is more challengeable.

The other important issue is that at the beginning of the period under analysis, both Klaipėda (48) and Vilnius (46) counties had lower values of composite index than Tauragė and Marijampolė regions, but have developed much faster and at the end of the period reached the highest values (Fig. 2). And oppositely, Tauragė County with the highest (52) index value in 2000 have experienced negative changes leading even to the decrease of composite index amounting to 49.6 in 2010. Marijampolė County remained more or less on the same development levels fluctuating from 48.46 to 53.32 over the whole period under analysis.

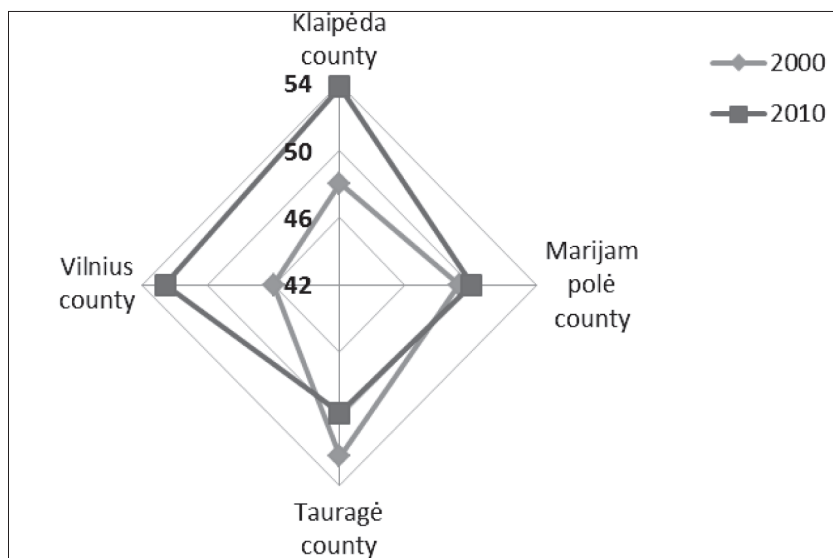


Figure 2. Composite index of different regions of Lithuania in 2000 and 2010
Source: author's calculations

Conclusions

During the 2000–2010 only Vilnius region have demonstrated positive economic development. Hence, if positive economy development was characteristic only to Vilnius county, environmental situation has improved in all counties under analysis. It should be mentioned that better environmental situation is registered in counties with not such pronounced economy growth. And oppositely, the better economic situation was observed, the lower environmental sub-index values were registered.

Health aspects have been improving also in all, except Tauragė, regions. Especially positively should be treated increase in life expectancy and decrease in infant deaths. Despite that, social issues remain quite problematic, especially in the counties with weak economic situation. Only Klaipėda and Vilnius regions achieved some progress in this area. As already mentioned relatively more vulnerable regions reacted to the global financial crisis more than relatively stable with higher GDP level regions.

On the one hand, analysis have revealed that not only economic issues are important then assessing the sustainability. But on the other it have showed, if environmental issues seem to be depended on economic development only in some cases, it is more obvious that economic issues play a crucial role on social aspects and directly and indirectly on the health indicators, too. Hence, overall conclusion could be made, that regions with higher economic development favour in general and their development is more stable. Or otherwise, economic development is needed to achieve certain level of health, social and environment protection in order to achieve more stable and sustainable development.

Research also has revealed that composite index is beneficial for the comparison on the regions and the assessment of achieved progress. However, high level of aggregation should be taken into account and challenging hot spots on the sub-index level or individual indicator level should be identified for the problem solving. Therefore more detail analysis involving more indicators (for ex. level of debts or number of suicides and so on) and more Lithuanian regions would be beneficial for sustainability assessment and adequate policy making.

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LIETUVOS REGIONŲ DARNUMAS: SUDĖTINIO INDEKSO TAIKYMAS

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Santrauka

Darnus vystymasis – viena pagrindinių diskutuojamų temų nacionaliniu, regioniniu ir pasaulio mastu. Darnumo vertinimas aktualus ir regionų vystymuisi. Kaip numato Lietuvos nacionalinė darnaus vystymosi

strategija, darnus regionų vystymasis yra vienas iš darnaus vystymosi tikslų. Tačiau Lietuvos atveju dažnai regionų vystymosi vertinimas remiasi tik aprašomąja pavienių rodiklių analize, o apibendrintas vertinimas taikomas retai. Todėl šio straipsnio tikslas – pritaikyti sudėtinį darnumo indeksą Lietuvos regionų – apskričių – vystymuisi įvertinti. Tyrimo objektas – 4 Lietuvos regionai: 2 regionai, kurių didžiausias (Klaipėdos, Vilniaus) ir 2 – mažiausias (Marijampolės ir Tauragės) BVP vidurkis per visą 2000–2010 laikotarpį. Analizuoti darnumo rodikliai buvo normalizuoti, perskaičiuojant juos į T balus ir suvienodinant jų kryptis. Sudėtinis indeksas apskaičiuotas lygių svoriu principu įtraukiant visus subindeksus, kurie savo ruožtu lygių svorių principu buvo sudaryti iš atitinkamų rodiklių. Rezultatai parodė, kad regionai vystėsi gana netolygiai. Visuose analizuojamuose aspektuose (ekonomika, aplinka, sveikata, socialinė aplinka) pažanga stebima tik Vilniaus apskrityje. Tuo tarpu Tauragės apskrityje situacija tik prastėjo, nors šio regiono geriausia aplinkos būklė. Vis dėlto, nors lyginamų regionų BVP/1 gyv. skyrėsi net kelis kartus, bendras vystymosi rodiklis taip labai nesiskyrė. Tyrimas parodė, kad ne vien ekonominiai aspektai yra aktualūs vertinant vystymosi eigą, tačiau labiau ekonomiškai išsivystę regionai vis dėlto vystėsi tolygiau ir darniau.

PAGRINDINIAI ŽODŽIAI: *darnus vystymasis, regionai, Lietuva, darnumo rodikliai.*

JEL KLASIFIKACIJA: Q 01