ISSN 1648-0627 print
ISSN 1822-4202 online

VILNIAUS GEDIMINO TECHNIKOS UNIVERSITETAS
VILNIUS GEDIMINAS TECHNICAL UNIVERSITY

Verslas: teorija ir praktika
Business: Theory and Practice

2009
10(3)

Vyriausiasis redaktorius Romualdas GINEVIČIUS
Editor-in-chief Romualdas GINEVIČIUS

VGTU
LEIDYKLA
Vilnius TECHNIKA 2009

VERSLAS: TEORIJA IR PRAKTIKA
2009, 10 t., Nr. 3
http://www.btp.vgtu.lt

Vilniaus Gedimino technikos universiteto
mokslo žurnalas.
Straipsniai lietuvių, anglų, vokiečių kalbomis.
Žurnalas pradėtas leisti 2000 metais.
Kasmet eina 1 tomas (4 numeriai).

BUSINESS: THEORY AND PRACTICE
2009, vol. 10, no. 3
http://www.btp.vgtu.lt/en

Research Journal of Vilnius Gediminas
Technical University.
Articles in Lithuanian, English, German.
The journal has been published since 2000.
1 vol. (4 issues) per year are published.

Visi žurnale publikuojami straipsniai recenzuojami redakcinės kolegijos narių arba jų paskirtų ekspertų

All papers published in Journal "Business: Theory and Practice" are peer-reviewed by members of Editorial Board or by its appointed experts

KORESPONDENCIJA
Straipsnių rankraščius ir kitą korespondenciją siųsti
žurnalo „Verslas: teorija ir praktika"
vyriausiajam redaktoriui R. Ginevičiui arba atsakingajai
sekretorei M. Tvaronavičienei adresu:
Vilniaus Gedimino technikos universitetas,
Įmonių ekonomikos ir vadybos katedra,
Saulėtekio al. 11, LT-10223 Vilnius, Lietuva.
Tel. +370 5 274 5000, faksas +370 5 270 0114,
El. paštas *romualdas.ginevicius@adm.vgtu.lt*
El. paštas *manuela@vv.vgtu.lt*

EDITORIAL CORRESPONDENCE
including manuscripts for submission
should be addressed to
Editor-in-chief of "Business: Theory and Practice"
R. Ginevičius, or managing editor M. Tvaronavičienė,
Vilnius Gediminas Technical University,
Saulėtekio al. 11, LT-10223 Vilnius, Lithuania.
Tel.: +370 5 274 5000; Fax: +370 5 270 0114.
E-mail: *romualdas.ginevicius@adm.vgtu.lt*
E-mail: *manuela@vv.vgtu.lt*

VERSLAS: TEORIJA IR PRAKTIKA
2009, 10 tomas, Nr. 3
http://www.btp.vgtu.lt
Viršelis dailininkių *Ramunės Razmienės, Astos Rudminaitės*
Redaktorės *Rita Malikėnienė, Emilija Endziulaitienė*
Maketuotoja *Ramunė Razmienė*
2009 09 22. 10,00 sp l.
Vilniaus Gedimino technikos universiteto leidykla „Technika"
Saulėtekio al. 11, 10223 Vilnius, *http://leidykla.vgtu.lt*
Spausdino UAB „Baltijos kopija", Kareivių g. 13B, 09109 Vilnius, *http://www.kopija.lt*

VERSLAS: TEORIJA IR PRAKTIKA
BUSINESS: THEORY AND PRACTICE

2009
10(3): 204–213

SUSTAINABLE DEVELOPMENT ACROSS CENTRAL AND EASTERN EUROPE: KEY FACTORS DRIVING THE ECONOMIC GROWTH OF THE COUNTRIES

Giedrė Lapinskienė[1], Manuela Tvaronavičienė[2]

Vilnius Gediminas Technical University, Saulėtekio al. 11, LT-10223 Vilnius, Lithuania
E-mails: [1]gielap@gmail.com; [2]manuela@vv.vgtu.lt

Received 09 February 2009; accepted 02 July 2009

Abstract. Sustainable development is the leading concept of our days, and it is measured by a number of various indicators. The paper analyses sustainable development indicators (Eurostat database), taking Central and Eastern Europe as the research object. The suggested hypothesis implies that, in a particular region, there might be a set of sustainable development indicators reflecting the factors strongly influencing GDP. The results obtained outline the main issues relating to economic development of Lithuania and other Central and Eastern European countries and demonstrate similar development trends in the region.

Keywords: sustainable development, economic growth (GDP), Central and Eastern Europe, Lithuania.

DARNUSIS VYSTYMASIS CENTRINĖJE IR RYTŲ EUROPOJE: PAGRINDINIAI EKONOMINIO AUGIMO ASPEKTAI

Giedrė Lapinskienė[1], Manuela Tvaronavičienė[2]

Vilniaus Gedimino technikos universitetas, Saulėtekio al. 11, LT-10223 Vilnius, Lietuva
El. paštas: [1]gielap@gmail.com; [2]manuela@vv.vgtu.lt

Įteikta 2009-02-09; priimta 2009-07-02

Santrauka. Šiuo metu darnusis vystymasis yra pagrindinė ilgalaikė visuomenės vystymosi ideologija. Ji gali būti vertinama įvairiais rodikliais. Straipsnyje analizuojami Centrinės ir Rytų Europos darniojo vystymosi rodikliai (Eurostat duomenų bazė). Remiantis iškelta hipoteze, tam tikrame regione turėtų būti išskirtiniai darniojo vystymosi rodikliai, darantys didžiausią poveikį ekonominiam augimui. Gauti rezultatai pabrėžia pagrindines sritis, darančias įtaką ekonominiam vystymuisi Lietuvoje ir kitose Centrinės bei Rytų Europos šalyse, atskleidžia panašias vystymo tendencijas regione.

Reikšminiai žodžiai: darnusis vystymasis, ekonominis augimas (BVP), Centrinė ir Rytų Europa, Lietuva.

1. Introduction

Sustainable development is the leading concept of our days embracing economic, social and environmental dimensions (Brundtland 1987). The measuring and management of this process is a difficult task because the concept varies, depending on the changing conditions of life. The measurement of social and economic development of a country is a complex phenomenon, which is described by a set of criteria (Podvezko 2008). Many international institutions presented the assessment systems of indicators to measure the sustainability around the world. Despite the main pillars, classifications and sets of indicators differ across various institutions. The problems of analytical analysis based on these indicators were considered by a number of scholars (Grybaitė, Tvaronavičienė 2008; Tvaronavičienė *et al.* 2008).

For many years, GDP has been presented as the main variable showing the level of economic development for a particular country, but it could not reflect the welfare of the country. It is important to ensure that all indicators of sustainable development should change positively. However, there are some indicators having the strongest impact on the development level of every region. Finding the most important variables could simplify the process of monitoring and help to determine areas and policy for future development.

It is assumed that the most important sustainable development indicators are those which are most closely connected with economic growth (expressed as GDP growth).

The aim of this paper is to identify the set of key sustainable development indicators (from Eurostat database) having the strongest impact on the growth of the whole region of Central and Eastern Europe. Correlation and regression analyses are used for estimating the effect of variables. The countries development level will be evaluated based on the calculated regression equation in the context of Central and Eastern Europe.

2. Theoretical background

A great number of economists have tried to understand the economic processes and create models which could help to manage the growth of economy since ancient times. Adam Smith with the 'Wealth of Nation' saw the realization of the economies of large-scale production as an important source of growing national prosperity can be considered to be a predecessor of growth theories (Greenwald 1994). Jumping from classical scholars (Smith, Malthus, Ricardo) to the theories of neoclassical economists (Harrod and Domar, Hicks, Solow), it is seen that growth theory economists have tried to define a systematic frame for the equilibrium paths of the economy. Solow, the best-known neoclassical scholar, presented a model where economic growth was stimulated by changing the constant capital output ratio by a richer standard of the technology in the equilibrium model (Solow 1988). J. A. Schumpeter, with his business cycle theories based on innovation, and John von Neumann, with mathematical theories of economic growth, as well as many other researchers made a valuable contribution to the development of fundamental macro economy theories. The latest theories of macro economy are associated with the intense work on growth theory in the late 1980s and 1990s known as endogenous growth theory. The early contributions here were by Romer and Lucas. Paul Romer (1994) emphasized that economic growth is an endogenous outcome of an economic system, not the results of forces that impinge from outside. R. Lucas (2003) argued that there were economic gains from providing people with better incentives to work and to save, not from better fine-tuning of spending flows. Not going into theoretical considerations about the factors driving economic growth, the paper concentrates on the factual interplay between economic growth and sustainable development indicators in order to find the main variables determining the economic growth in Central and Eastern Europe.

3. The process of selecting sustainable development indicators impacting GDP

The analysed sample is Central and Eastern European countries, including Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. All of them, except Bulgaria and Romania, joined the EU in 2004 (the latter two countries – in 2007). In recent years, these countries have demonstrated the high growth rates. Therefore, to ensure further growth, sustainable development policy should be pursued.

The analysis has four phases. Firstly, all variables from the Eurostat sustainable development database were reviewed and only those satisfying the conditions were chosen for analysis: i.e. Lithuanian data is available, the same data sets cover more than one country, data are gathered annually in the period from 1998 without intervals, the variables are statistically measured.

Secondly, according to the aim of the paper, correlation analysis was used as a statistical method to define the relationship between GDP and the sustainable development indicators considered. Correlation coefficients were calculated using the log change of sustainable development indicators and the log change of GDP (in constant prices) for Lithuanian data. The results of calculations were obtained using MS Excel. They are presented in Appendix 1.

Thirdly, the correlation results were evaluated for statistical significance and economic logic. In many sources, the correlation coefficient of |0,30| is described as a minimal level for the relationship to be valid, but this is only true

for large data samples (higher than 50 items). For a small data sample (as in this work), the significance of the correlation coefficient can be determined by using standard distribution calculated by Student t test (Mason *et al.* 1999). Alternatively, a simple formula to determine the approximate critical value of the correlation coefficient at 0.05 level of significance was introduced (Walsh 2008):

$\frac{2}{\sqrt{n}}$, where n is the number of data items.

Accordingly, the calculated threshold for the correlation coefficient in the presented data sample is |0,63|. Hence, the following criterion is used to shortlist indicators: at least one country in the Baltic states (the Baltic states are taken as countries developing in a similar way) should have a coefficient of more than |0,63|; the relationship between the variables should follow the with economic logic. Only the indicators satisfying the criteria defined were chosen. They are presented in Appendix 2. Correlation results are displayed in Fig. 1.

Four of these indicators have not met up the correlation criteria defined, but they are included based on economic logic. The correlation between the employment rate by

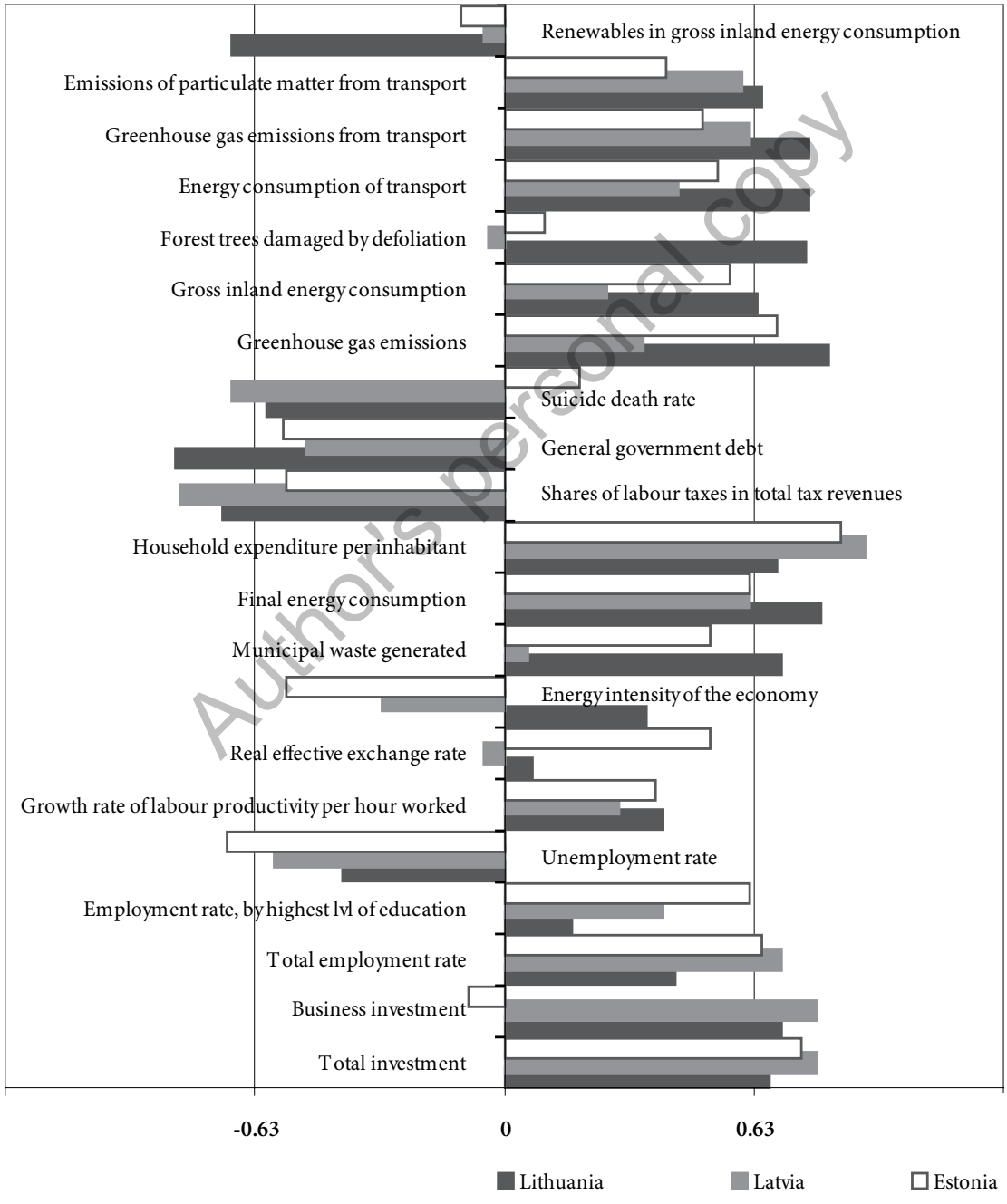

Fig. 1. Correlation between GDP growth and sustainable development indicators in the Baltic states

highest level of education attained and GDP shows positive trends – the better results could lead to higher GDP. As the Lithuanian strategy is aimed at creating knowledge society, this indicator could be very important, therefore, it is included in further analysis. It is evident that higher rate of labour productivity per hour worked should result in higher GDP. The calculated correlation coefficient is below the threshold set. However, it is still demonstrating positive trends. Real effective exchange rate (REER) can be used to assess the competitiveness of the state's currency. It should be noted that national currency in all Baltic states is historically pegged to base currency (USD, SDR, EUR), while policy of exchange rate of other Central and Eastern European countries is different. Therefore, in the Baltic states, the relationship is not so straightforward, though for other countries it might be economically important. Economic logic should indicate negative correlation, implying that the increase of competitiveness (decrease in REER) causes GDP growth in Eurozone countries. Energy intensity shows the amount of energy needed to produce one unit of economic output. The calculated correlation coefficient is below the threshold set, but in sustainable development context, it is important to monitor the impact of this variable on the development of Eastern European countries. The results of correlation analysis between GDP and sustainable development variables define the key indicators, which have a strong impact on the economic growth in the Baltic states.

At the fourth stage of this investigation the most valuable set of variables from Appendix 2 is found using the regression analysis. The statistical approach allows us to forecast the dependable variable (GDP) using independent variables. This process is called the regression analysis. The multiple regression case extends the equation to include additional independent variables (Čekanavičius, Murauskas 2002). A general formula for pooled data regression analysis with fixed effect estimation is as follows:

$$Y_{it} = \alpha + X_{it}\beta_{it} + \varepsilon_{it}, \quad \text{where}$$

Y_{it} is a dependent variable for country i at time t;
X_{it} is an independent variable for country i at time t;
i is the country's number;
t is time period;
α is a fixed coefficient;
β is regression coefficient;
ε_{it} is estimation error coefficient.

A general formula is widely used in various economic calculations, e.g. the New Global Competitiveness index by World Economic Forum calculates weights based on the regression of the pooled data set on country GDP per capita (Martin *et al.* 2008). The data on ten Eastern European countries (Bulgaria, Czech Republic, Estonia, Hungary Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia) for all indicators from Appendix 2 for the period from 1998 to 2007 is entered into Eviews software database (2000). After several estimations of regression coefficients, minimal data set was defined. The calculated result of the analysis is presented in the standard statistical form produced by software (Table 1).

As shown in the above table when any coefficient (column two) is statistically close to zero it means that the variable associated with this coefficient is not important in determining the dependent variable. After some basic analysis, the coefficients, which can be equal to zero with probability higher than 5%, were excluded from further calculations. Probability of a coefficient statistically not different from zero is calculated by the software and shown

Table 1. The regression analysis of the chosen sustainable development indicators

Dependent Variable: Real GDP
Method: Pooled Least Squares — Included observations: 10 after adjustments
Date: 04/17/09 Time: 12:15 — Cross-sections included: 10
Sample (adjusted): 1998–2007 — Total pool (balanced) observations: 100

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.021135	0.002878	7.343504	0.0000
Energy intensity of the economy	–0.233946	0.041922	–5.580505	0.0000
Household expenditure per inhabitant	0.222965	0.042994	5.185947	0.0000
Growth rate of labour productivity per hour worked	0.000994	0.000428	2.321334	0.0224
Unemployment rate	–0.054495	0.009843	–5.536396	0.0000
Gross inland energy consumption	0.260752	0.044452	5.865883	0.0000
R-squared	0.726159	Mean dependent var		0.051056
Adjusted R-squared	0.711593	S.D. dependent var		0.024796
S.E. of regression	0.013317	Akaike info criterion		–5.741488
Sum squared resid	0.016669	Schwarz criterion		–5.585178
Log likelihood	293.0744	F-statistic		49.85287
Durbin-Watson stat	1.789463	Prob(F-statistic)		0.000000

in the column "Prob." in Table 1. Energy intensity of the economy, household expenditure per inhabitant, growth rate of labour productivity per hour worked, unemployment rate and gross inland energy consumption are all statistically significant. R-squared for the estimated equation is 0.73 (the coefficient of determination is the percentage of the variation expressed by the equation).

Therefore, the regression analysis shows that only five out of twenty one indicators, which passed the correlation analysis, were chosen based on regression analysis. These indicators are seen to be most important, strongly influencing the economic growth in the Central and Eastern Europe region.

4. Specifying the main determinants' impact on economic growth in Central and Eastern European countries

The identified indicators are incorporated into a regression equitation in order to test the model and determine the impact of the above on a particular country. A general multiple regression formula may be rewritten for the specified estimated model using five chosen sustainable development indicators and estimated coefficients to calculate the simulated GDP growth. A specific formula and methods of calculating GDP growth in Lithuania for the year 2007 are presented below:

$$dlog(GDPLT,2007) = \alpha+\beta1,LT*dlog(D1LT) + \beta2,LT*dlog(D2,LT) + \beta3,LT*D3,LT + \beta4,LT*dlog(D4,LT) + \beta5,LT*dlog(D5,LT);$$

$$dlog(GDP) = 0.021 - 0.234* - 0.096 + 0.223*0.110 + 0.001*5.700 - 0.054* - 0.264 + 0.261* - 0.022 = 0.082.$$

The result is close to actual GDP numbers (0.085). Similarly, the data on the remaining countries were calculated and presented in Table 2. It should be noted that the results in the table are derived directly from the formula, (e.g. GDP change is presented as log difference), therefore, the actual GDP change in percentage should be recalculated based on the results presented. In the next graph, the recalculated GDP changes (in percent) are given.

As the model results are close to actual data (see Fig. 2) (the discrepancies are not discussed in this paper), it could be useful to consider them in detail for further analysis of the specific aspects of economic development in Central and Eastern Europe. The impact of particular separate indicators on GDP growth in the considered countries of Central and Eastern Europe is shown in Fig. 3.

Table 2. Comparison of estimated and actual GDP changes (based on the data for 2007)

	Indicator (changes), D	Country										Coefficient, β
		Bulgaria	Czech	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia	Slovakia	
	Real GDP	0.060	0.058	0.061	0.011	0.095	0.085	0.064	0.061	0.065	0.099	
	C											0.021
1	Energy intensity	−0.033	−0.041	−0.131	−0.046	−0.086	−0.096	−0.015	−0.034	−0.050	−0.094	−0.234
2	Household expenditure	0.084	0.054	0.122	0.032	0.205	0.110	0.048	0.128	0.024	0.061	0.223
3	Labour productivity per hour	2.800	3.900	5.700	1.300	6.300	5.700	−15.500	6.200	4.000	6.400	0.001
4	Unemployment rate	−0.266	−0.306	−0.227	−0.013	−0.125	−0.264	−0.370	−0.132	−0.203	−0.188	−0.054
5	Gross inland energy consumption	0.028	0.020	−0.025	−0.008	0.029	−0.022	0.046	0.041	0.006	−0.012	0.261
	Model estimation for Real GDP	*0.072*	*0.069*	*0.091*	*0.039*	*0.108*	*0.082*	*0.052*	*0.082*	*0.055*	*0.070*	

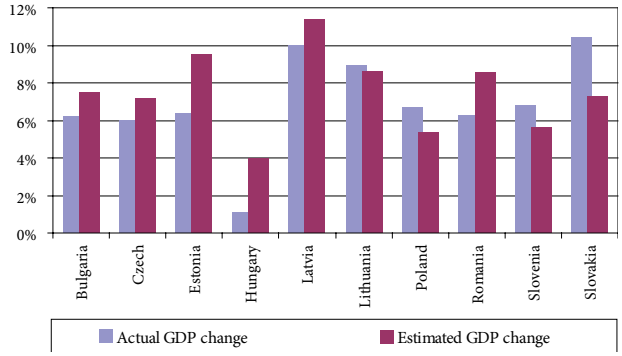

Fig. 2. A comparison of actual results with the model estimation for GDP growth

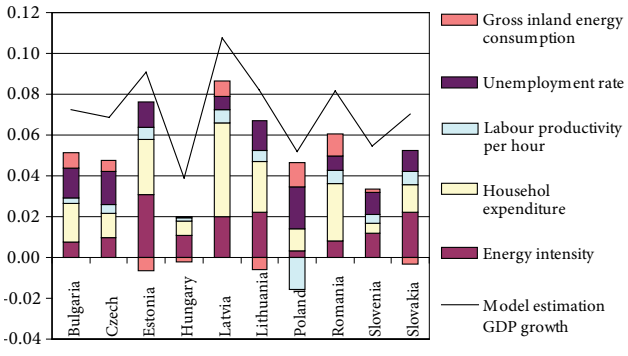

Fig. 3. Cumulative impact of sustainable development processes described by five indicators on the GDP growth estimated

Comparing Lithuanian position to that of other Central and Eastern European countries, it can be observed that the impact of the chosen indicators is very similar in the Baltic states. The household expenditure is the main determinant in Lithuania, similar to Romania, Estonia and Latvia. Household expenditure refers to any spending made by a person living alone or by a group of people living together in shared accommodation and with common domestic expenses (Eurostat). The strong impact of household expenditure on economic growth shows about its significance for economic development. Hence, policymakers should spare no effort to increase household disposable income (e.g. in recession it may be appropriate to cut income taxes, assuming that the resulting increases in disposable income will raise household spending, thereby reducing the severity of recession) (Johnson *et al.* 2005). It is clear that spending policies should be weighted against government ability to borrow, as well as overall health of public finances.

The impact of energy intensity is in the second place, being similar to that observed in Latvia, Estonia and Slovakia. Energy intensity shows the amount of energy needed to produce one unit of economic output. A lower coefficient value indicates higher energy efficiency. While differences in energy intensity levels can be attributed to such factors as geography, wealth, culture, natural endowment and economic structure, their movement over time reflects the combined effects of efficiency improvements, structural changes in the economy, changes in energy–using activities and types of fuel substitution (Joskow 2003).

Unemployment rate and labour productivity indicators relate to labour market. In Lithuania, the impact of unemployment is similar to that in Estonia, Poland, Czech Republic and Bulgaria. Unemployment rates represent unemployed people as a percentage of the labour force. The labour force is the total number of employed and unemployed people (Eurostat). Unemployment is the classical index of macro economy and the governments of many states take much effort to reduce this variable. The impact of labour productivity is very similar in all countries (except Poland). GDP has to grow based on labour productivity because it means the effective usage of resources. The ultimate goal of a well-functioning labour market is high and growing labour productivity, which, in turn, translates into higher wages and salaries for workers (Fraser Forum 2004). Therefore, the significance of labour market can be clearly seen and its monitoring is very important.

Gross inland energy consumption has a small negative impact in Lithuania similar to the situation in Estonia, Hungary and Slovakia. Gross inland energy consumption shows the usage of various energy sources (oil, gas, renewable, etc.). The growth of energy consumption is a result of rapid economic growth, creating larger demand which is caused by the increase in investment levels, population, and trade in energy. High energy consumption leads to environmental degradation (Chousa *et al.* 2008). Gross energy consumption is related to energy efficiency, and a positive impact of the latter can be an offsetting factor of lower total energy consumption. This shows a positive trend towards sustainable use of energy.

Household expenditure, energy intensity and labour productivity are economic indicators having the strongest impact in the whole sample. Two remaining indicators, i.e. unemployment and gross inland energy consumption, belong to social and environmental groups. Their effect is smaller in countries considered. The results are in good agreement with economic logic, proving that Central and Eastern European countries are developing in a similar way. As shown by the data, the Baltic states have nearly the same main determinants of economic growth and are on the same path of development. The economically logical results prove the validity of analysis. Hence, the areas considered should be monitored more closely in order to achieve higher economic growth.

5. Conclusions

The suggested hypothesis implies that, in a particular region, there might be a set of sustainable development indicators reflecting the factors strongly influencing GDP. Sustainable development indicators from Eurostat database for Central and Eastern Europe region were taken as a dimension for detailed consideration. Not every variable from the Eurostat sustainable development database satisfied the defined primary conditions (starting that Lithuanian data is available; the same data sets cover more than one country; the data gathered annually in the period from 1998 without intervals; the variables are statistically measured). To test the hypothesis, correlation and regression analyses were used. However, this approach has some drawbacks: the data cover only nine years but this period is statistically small, most of the variables analysed have the trend of the rapid growth, making the correlation results artificially high, while the data itself may be hard to measure. Nevertheless, the analysis performed can identify the trend of development.

Only five out of the analysed variables were found to be the most significant in the region of Central and Eastern Europe. They are energy intensity of the economy, household expenditure per inhabitant, growth rate of labour productivity per hour worked, unemployment rate and gross inland energy consumption. Household expenditure, energy intensity, labour productivity are indicators from the economic group, with their impact being the strongest in all the countries considered. It is compliance with economic logic stating that economic indicators are most significant at the transition stage of development. Two remaining indicators, i.e. unemployment and gross inland energy consumption, belong to social and environmental groups and their impact is less visible in the countries analysed. Only the increasing economic power allows the states to invest in social and environmental development. The results of the study show that Central and Eastern European countries are developing in a very similar way. It particularly applies to the Baltic states which have nearly the same significant determinants of economic growth and are on the same path of development. Despite the regions' similarities, every country has to establish its own competitiveness level and find its own opportunities to win its share in the global market. Only the country which is able to pursue sustainability policy and get the economic benefits from this can catch up with Western Europe much faster. For example, in stimulating household expenditure, the importance to spend rationally citizens' savings should be emphasized. The state policy of energy saving should be implemented by every economic agent. The effectiveness of using labour force should be sought by all enterprises, companies and institutions. However, sustainability philosophy obliges us to estimate every driving factor for long-term consequences.

References

Brundtland, G. 1987. *Our Common Future. The World Commission on Environment and Development*. Oxford: Oxford University Press. 416 p

Čekanavičius, V.; Murauskas, G. 2002. *Statistika ir jos taikymai II*. Vilnius: TEV.

Chousa, J. P.; Tamazian, A.; Chaitanya, K. V. 2008. *Rapid Economic Growth at the Cost of Environment Degradation? Panel Data Evidence from BRIC Economies*. William Davidson Institute Working Paper No. 908.

EUROSTAT. Available from Internet: <http://ep peurostat.ec.europa.eu/>.

Eviews 4 Users guide. 2000. Irvine CA: Quantitative Micro Software, LLC.

Fraser Forum. 2004. *Labour Market Performance*, 13–23.

Greenwald, D. 1994. *The McGraw-Hill Encyclopedia of Economics*. McGraw-Hill, Inc.

Grybaitė, V.; Tvaronavičienė, M. 2008. Estimation of sustainable development: germination on institutional level, *Journal of Business Economics and Management* 9(4): 327– 334. doi:10.3846/1611-1699.2008.9.327-334

Johnson, D.; Jonathan, A. P.; Souleles, N. S. 2005. *Household Expenditure and the Income Tax Rebates of 2001*. Bureau of Labor Statistics. Princeton University, Department of Economics and University of Pennsylvania, Finance Department.

Joskow, P. L. 2003. Energy policies and their consequences after 25 years, *Energy Journal* 24(4): 17–49.

Lucas, R. E. 2003. Macroeconomic priorities, *American Economic Review* 93(1): 1–14. doi:10.1257/000282803321455133

Martin, X.; Blanke, J.; Hanouz, M. D.; Geiger, T.; Mia, I.; Paua, F. 2008. *The Global Competitiveness Index: Prioritizing the Economic Policy Agenda*. Word Economic Forum, The global competitiveness report 2008–2009.

Mason, R. D.; Lind, D. A.; Marchal, W. G. 1999. *Statistical Techniques in Business and Economics*. Tenth edition. Irwin McGraw-Hill.

Podvezko, V. 2008. Sudėtingų dydžių kompleksinis vertinimas, *Verslas: teorija ir praktika* [Business: Theory and Practice] 9(3): 160–168.

Romer, P. M. 1994. The origins of endogenous growth, *Journal of Economic Perspectives* 8(1): 3–22.

Solow, R. M. 1988. Growth theory and after, *American Economic Review* 78(3): 307–317.

Tvaronavičienė, M.; Ginevičius, R.; Grybaitė, V. 2008. Baltijos šalių išsivystymo palyginimas: praktiniai kompleksinio požiūrio taikymo aspektai, *Verslas: teorija ir praktika* [Business: Theory and Practice] 9(1): 51–64.

Walsh, D. A. 2008. *Simple Rule of Thumb for Statistically Significant Correlation*. Available from Internet: <http://frank.mtsu.edu/~dwalsh/436/CORRSIG.pdf>.

Appendix 1. The correlation between GDP and sustainable development indices' changes in the Baltic states

	Lithuania	Estonia	Latvia
Labour productivity per person employed – GDP in Purchasing Power Standards (PPS) per person employed relative to EU-27 (EU-27 = 100)	0.44	–0.06	0.15
Total investment – % of GDP	**0.67**	**0.79**	**0.75**
Public investment – % of GDP	0.13	0.29	0.36
Business investment – % of GDP	**0.70**	**0.79**	**–0.09**
Dispersion of regional GDP per inhabitant – in % of the national GDP per inhabitant	–0.28	0.32	–0.52
Net national income – % of GDP	0.26	–0.25	0.33
Gross household saving – % of gross household disposable income	–0.26	0.05	–0.09
Labour productivity per hour worked – % change over previous year	0.25	na	na
Total R&D expenditure – % of GDP	0.36	–0.36	0.59
Energy intensity of the economy – kgoe per 1 000 euro	0.36	–0.31	–0.55
Total employment rate – %	**0.43**	**0.70**	**0.65**
Employment rate, by highest level of education attained – % of age group 25–64 years	**0.17**	**0.40**	**0.62**
Electricity consumption by households – 1 000 toe	0.05	–0.08	0.49
Electricity consumption by households – 1 000 toe	0.05	–0.08	0.49
Household expenditure per inhabitant, by category – Volume index (1995 = 100)	**0.69**	**0.91**	**0.85**
Total long-term unemployment rate – %	0.01	–0.48	–0.50
Lifelong learning – %	0.26	–0.23	na
Public expenditure on education – Percent of GDP	–0.16	–0.54	–0.16
Early school-leavers – %	–0.24	–0.42	na
Employment rate of older workers	0.12	0.56	0.32
Net migration, including corrections – persons	0.41	0.02	0.28
Incidence of salmonellosis – new cases per 100 000 persons	0.37	0.22	–0.19
Death rate due to chronic diseases – per 100 000 persons	0.00	0.48	0.55
Total greenhouse gas emissions – index base year = 100	**0.82**	**0.35**	**0.69**
Renewables in gross inland energy consumption – %	**–0.69**	**–0.05**	**–0.11**
Energy dependency – %	–0.10	–0.21	–0.06
Implicit tax rate on energy – Ratio of energy tax revenues to final energy consumption, deflated	–0.33	0.10	–0.21
Electricity generated from renewable sources – % of gross energy consumption	–0.06	0.09	0.07
Energy consumption of transport, by mode – 1 000 toe	**0.77**	**0.44**	**0.54**
Shares of environmental taxes in total tax revenues – %	–0.31	0.14	–0.28
Shares of labour taxes in total tax revenues – %	**–0.71**	**–0.82**	**–0.55**
Growth rate of labour productivity per hour worked – % change over previous year	0.40	0.29	0.38
Real effective exchange rate – index 1999 = 100	0.07	–0.05	0.52
Employment rate, by gender – %	**0.43**	**0.70**	**0.65**
Unemployment rate, by gender – %	**–0.41**	**–0.58**	**–0.70**
Municipal waste generated – kg per capita	**0.70**	**0.06**	**0.52**
Municipal waste treatment, by type of treatment method – kg per capita	0.90	–0.01	0.41
Emissions of acidifying substances, by source sector – 1 000 tonnes acid equivalents	0.45	0.23	0.48
Emissions of ozone precursors, by source sector – 1 000 tonnes ozone-forming potential	0.62	0.35	0.59

Continued next page

	Lithuania	Estonia	Latvia
Emissions of particulate matter by source sector – 1 000 tonnes particulate-forming potential	0.58	0.04	0.51
Final energy consumption, by sector – 1 000 toe	**0.80**	**0.62**	**0.62**
Persons with low educational attainment, by age group – %	–0.06	0.31	0.20
Employment rate of older workers – %	0.12	0.56	0.32
Life expectancy at age 65, by gender – years	–0.25	–0.10	na
Total fertility rate – number of children per woman	0.17	–0.06	–0.07
General government debt – General government consolidated gross debt as a percentage of GDP	**–0.83**	**–0.50**	**–0.56**
Suicide death rate, by age group – Total – crude death rate per 100 000 persons	**–0.60**	**–0.69**	**0.19**
Greenhouse gas emissions – index base year = 100	**0.82**	**0.35**	**0.69**
Greenhouse gas emissions by sector – million tonnes CO^2 equivalent	**0.84**	**0.35**	**0.68**
Greenhouse gas emissions intensity of energy consumption – index 2000 = 100	0.19	–0.03	0.12
Gross inland energy consumption, by fuel – 1 000 tonnes of oil equivalent	**0.64**	**0.26**	**0.57**
Implicit tax rate on energy – Euros per tonne of oil equivalent	0.33	0.10	–0.21
Modal split of freight transport – % in total inland freight tonne-km	0.51	–0.09	–0.45
Volume of freight transport – Index 2000 = 100	–0.36	–0.53	–0.13
Greenhouse gas emissions from transport – 1 000 tonnes of CO_2 equivalent	**0.77**	**0.62**	**0.50**
People killed in road accidents – Number of killed people	0.61	0.47	–0.57
Emissions of ozone precursors from transport – 1 000 tonnes of ozone-forming potential	0.60	0.29	–0.51
Emissions of particulate matter from transport – 1 000 tonnes	**0.65**	**0.60**	**0.41**
Forest trees damaged by defoliation – %	**0.76**	**–0.04**	**0.10**
Shares of environmental and labour taxes in total tax revenues – %	–0.31	0.14	–0.28
Indicators chosen for regression analysis are printed in bold *na-data not available			

Indicators chosen for regression analysis are printed in bold
**na-data not available*

Appendix 2. The correlation between GDP and main sustainable development indices' changes in the Baltic states

Indicator	Lithuania	Latvia	Estonia
Total investment – % of GDP	0.67	0.79	0.75
Business investment – % of GDP	0.70	0.79	–0.09
Total employment rate – %	0.43	0.70	0.65
Employment rate, by highest level of education attained – % of age group 25–64 years	0.17	0.40	0.62
Unemployment rate	–0.41	–0.58	–0.70
Growth rate of labour productivity per hour worked – % change over previous year	0.40	0.29	0.38
Real effective exchange rate – index 1999 = 100	0.07	–0.05	0.52
Energy intensity of the economy – kgoe per 1 000 euro	0.36	–0.31	–0.55
Municipal waste generated – kg per capita	0.70	0.06	0.52
Final energy consumption – 1 000 toe	0.80	0.62	0.62
Household expenditure per inhabitant – Volume index (1995 = 100)	0.69	0.91	0.85
Shares of labour taxes in total tax revenues – %	–0.71	–0.82	–0.55
General government debt – General government consolidated gross debt as a percentage of GDP	–0.83	–0.50	–0.56

Continued next page

End of Appendix

Indicator	Lithuania	Latvia	Estonia
Suicide death rate, by age group – Total – crude death rate per 100 000 persons	–0.60	–0.69	0.19
Greenhouse gas emissions – index base year = 100	0.82	0.35	0.69
Gross inland energy consumption – 1 000 tonnes of oil equivalent	0.64	0.26	0.57
Forest trees damaged by defoliation – %	0.76	–0.04	0.10
Energy consumption of transport – 1 000 toe	0.77	0.44	0.54
Greenhouse gas emissions from transport – 1 000 tonnes of CO**2** equivalent	0.77	0.62	0.50
Emissions of particulate matter from transport – 1 000 tonnes	0.65	0.60	0.41
Renewables in gross inland energy consumption – %	–0.69	–0.05	–0.11

Giedrė LAPINSKIENĖ. Master of Management and Business Administration, Vilnius Gediminas Technical University. Research interests: sustainable development, indicators of sustainable development, economic growth.

Manuela TVARONAVIČIENĖ. Doctor, Professor, Department of Enterprise Economics and Management, Vilnius Gediminas Technical University. Research interests: economic development, foreign direct investment, business environment.