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IMPLEMENTING THE EU STRATEGY IN BALTIC STATES: A MULTI-OBJECTIVE EVALUATION

The European Union has been fostering creation of the common market since the treaty of Rome in 1958. This document was followed by many strategies aimed at economic cohesion and improvement of competitiveness both at national and the EU levels. Hence it is possible to evaluate specific country's situation and compare it with other countries by using various specific indices or applying statistical and mathematical methods. In this framework Baltic states in particular are considered. The aim of this article is to demonstrate how multi-objective evaluation methods can be applied when performing international comparisons, which is quintessential for strategic management and the open method of coordination.

Keywords: *multi-objective optimization; MULTIMOORA; structural indicators; Baltic states; European Union.*

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РЕАЛІЗАЦІЯ СТРАТЕГІЇ ЄС У КРАЇНАХ БАЛТІЇ: БАГАТОКРИТЕРІАЛЬНЕ ОЦІНЮВАННЯ

У статті показано, що Європейський союз сприяв створенню спільного ринку з моменту укладення Римського договору в 1958 році. За цим документом послідувало багато стратегій, спрямованих на досягнення економічної єдності і підвищення конкурентоспроможності на національному і європейському рівнях. Відтак можливо оцінити ситуацію конкретної країни і порівняти її з іншими країнами, використовуючи різні спеціальні індекси або застосувавши статистико-математичні методи. У цій статті, зокрема, розглядаються країни Балтії. Показано, як методи багатокритеріального оцінювання можуть бути застосовані при проведенні міжнародних порівнянь, що є типовим для стратегічного управління і відкритого методу координації.

Ключові слова: *багатокритеріальна оптимізація; MULTIMOORA; структурні показники; країни Балтії; Європейський Союз.*

Форм. 4. Табл. 3. Літ. 18.

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РЕАЛИЗАЦИЯ СТРАТЕГИИ ЕС В СТРАНАХ БАЛТИИ: МНОГОКРИТЕРИАЛЬНАЯ ОЦЕНКА

В статье показано, что Европейский союз содействовал созданию общего рынка с момента заключения Римского договора в 1958 году. За этим документом последовало множество стратегий, направленных на экономическое единство и повышение конкурентоспособности на национальном и европейском уровнях. Можно оценить ситуацию конкретной страны и сравнить ее с другими странами, используя различные специальные индексы или применив статистико-математические методы. В этой статье, в частности, рассматриваются страны Балтии. Продемонстрировано, как методы многокритериальной оценки могут быть применены при проведении международных сопоставлений, что является типичным для стратегического управления и открытого метода координации.

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Ключевые слова: *многокритериальная оптимизация; MULTIMOORA; структурные показатели; страны Балтии; Европейский Союз.*

1. Introduction. The European Union adopted the Lisbon Strategy in 2000. In this article we analyze some theoretical and practical aspects of the Lisbon Strategy. Goals as well as means to achieve them are identified by structural indicators.

Application of quantitative methods enables evaluation of states, regions or any other objects (Brauers et al., 2007; Brauers and Ginevicius, 2009). A more detailed analysis of Baltic states' position in the European Union will be presented.

In order to achieve this aim, the following tasks were raised: 1) to describe the Lisbon Strategy and its structural indicators; 2) to focus on the MULTIMOORA method; 3) to apply it when evaluating positions of the member states of the European Union; 4) to apply the dominance theory and thus obtain ranks of the EU member states.

2. The Lisbon Strategy and its implementation instruments. Main guidelines of the European Union development were drawn on March 23-24, 2000 in the spring meeting of the European Council held in Lisbon. Hence, these guidelines are called the Lisbon strategy. The strategy was necessary in order to compete with such countries as United States or China. The greatest attention was paid to the economy, social protection and environment.

However, it soon became clear that the Lisbon Strategy was struggling and high level group chaired by Wim Kok affirmed that the strategy needed to be reviewed (European Commission, 2004). Updated in 2005, it was called the Lisbon Strategy for Growth and Jobs. The renewed Lisbon Strategy had two headline targets to be reached by 2010: overall employment rate as close as possible to 70% and R&D spending to reach 3% of GDP.

Achievement of the goals raised in the Lisbon strategy and other documents is evaluated by certain structural indicators. Expanded after Gothenburg Council, the list of structural indicators is divided into 6 groups (Hass et al., 2002: 48): 1) general economic background; 2) employment; 3) innovation and research; 4) economic reform; 5) social cohesion; 6) environment. Structural indicators statistics is dynamic. In 2000, European Commission prepared a list of 35 indicators, identifying progress in seeking Lisbon goals. In June 2001 Gothenburg European Council decided that sustainable development and environmental protection should also be considered as parts of the Lisbon strategy (Commission of the European Communities, 2001) and involved appropriate structural indicators into the annual reports. European Council of 2002 in Barcelona paid more attention to innovation and research activities and their importance to Lisbon strategy (Commission of the European Communities, 2002). High level group chaired by Wim Kok was established in 2004, which concluded that the Lisbon strategy would not be implemented by 2010 and proposed paying more attention to the labor market (European Commission, 2004: 39-44). In addition, European Commission began preparing annual reports on growth and jobs. Structural indicators are unified in the whole European Union, therefore it is possible to compare member states and to evaluate their progress. Thus, structural indicators help to identify and forecast implementation of the Lisbon strategy goals and to perform international comparison.

3. Multi-criteria evaluation methods and benchmarking of the European Union member states. Differences between the countries can be analyzed by mathematical-statistical methods. Such investigations can be based on econometric models, methods of factor analysis, correspondence analysis or multi-objective evaluation:

Multi-Objective Optimization by Ratio Analysis (MOORA) method was offered by Brauers and Zavadskas (2006) on the basis of previous research (Brauers, 2004). This method was further developed (Brauers and Zavadskas, 2010) and became MULTIMOORA (MOORA plus the full multiplicative form).

MOORA method enables non-subjective evaluation, because no weights should be necessarily given to objectives in analysis. MULTIMOORA embodies additive, reference points and multiplicative approaches of multi-objective optimization. Hence, MULTIMOORA method will be used in this article to evaluate Lithuania's position in the European Union as a case study. However, this method can be applied when analyzing situation of any country in-depth.

3.1. The MULTIMOORA method and international comparison. The fundaments of the MULTIMOORA method (ratio analysis, reference point theory, full multiplicative form, nominal group technique and Delphi) were laid by Brauers (2002, 2004). In order to cope with subjectivity problems arising from the usage of weights in previously known multi-objective methods (ELECTRE, PROMETHEE, AHP, TOPSIS etc.), Brauers and Zavadskas went rather to dimensionless measures in a ratio system which ratios were also used for a reference point method grouped together under the name of MOORA (Brauers, 2004, 293-328; Brauers and Zavadskas, 2006). Later on the full multiplicative form was added under the name of MULTIMOORA (Brauers and Zavadskas, 2010, 13-14). Thus, this section consists of 3 parts: 1) the ratio system; 2) the reference point approach and 3) the full multiplicative form. Nominal Group and Delphi techniques can also be used to reduce the remaining subjectivity (Brauers, 2004, 39-64).

The MOORA method begins with matrix X where its elements x_{ij} denote i-th alternative of j-th objective ($i = 1, 2, \ldots, n$ and $j = 1, 2, \ldots, m$).

The Ratio System of MOORA.

Ratio system defines data normalization (Brauers, 2007) by comparing an alternative of an objective to all the values of the objective:

$$x_{ij}^{*} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}}, \quad (1)$$

where x^{*}_{ij} denotes i-th alternative of j-th objective. Usually these numbers belong to the interval [-1; 1]. These indicators are added (if a desirable value of an indicator is maxima) or subtracted (if a desirable value is minima):

$$y_{i}^{*} = \sum_{j=1}^{g} x_{ij}^{*} - \sum_{j=g+1}^{n} x_{ij}^{*}, \quad (2)$$

where $g = 1, \ldots, m$ denotes number of objectives to be maximized. Then every ratio is given a rank: the higher the index, the higher the rank.

The Reference Point of MOORA.

Reference point approach is based on the ratio system ratios. The maximal objective reference point (vector) is found according to the ratios found in formula (2).

The *j*-th coordinate of the reference point can be described as $r_j = \max_i x_{ij}^*$ in case of maximization. Every coordinate of this vector represents maxima or minima of certain objective (structural indicator). Then every element of normalized responses matrix is recalculated and a final rank is given according to deviation from the reference point and the Min-Max Metric of Tchebycheff:

$$\min_i \left(\max_j \left| r_j - x_{ij}^* \right| \right) \quad (3)$$

The Full Multiplicative Form in MULTIMOORA.

Brauers and Zavadskas (2010: 13-14) proposed MOORA to be updated by the full multiplicative form method embodying maximization as well as minimization of a purely multiplicative utility function. Overall utility of the *i*-th alternative can be expressed as a dimensionless number:

$$U_i' = \frac{A_i}{B_i}, \quad (4)$$

where $A_i = \prod_{j=1}^{g} x_{ij}$, $i = 1, 2, \ldots, m$ denotes the product of objectives of the *i*-th alternative to be maximized with $g = 1, 2, \ldots, m$ being the number of objectives (structural indicators) to be maximized and
where $B_i = \prod_{j=g+1}^{n} x_{ij}$ denotes the product of objectives of the *i*-th alternative to be minimized with $m - g$ being the number of objectives (structural indicators) to be minimized.

3.2. Evaluation of Baltic States' position in the European Union according to MULTIMOORA method. Sets of certain indicators are needed to perform international comparisons. The analysis of this article is performed using Eurostat database of structural indicators. Various authors (Tarantola et al., 2004: 13; Munda and Nardo, 2005) argue that the shortlist of structural indicators correctly represents all structural indicators. Two indices for every country were calculated: one based on shortlist indicators and other on full list of indicators. By testing hypothesis of their equality, F-test showed that trend line of scatter plot between these two indices did not differ from 45 degree line significantly. Thus structural indicators belonging to the shortlist (Table 1) and covering the period of 2000-2009 (latest available at March 2011) are used for analysis. The data cover 27 member states of the European Union. Therefore it can be concluded that application of MULTIMOORA methods in general satisfies all the conditions of robustness given by Brauers and Zavadskas (2009: 354-356).

The indicators are measured in different dimensions. The volume index of GDP per capita in purchasing power standards (PPS) is expressed in relation to the European Union (EU-27) average set to equal 100. If the index number of a country is higher than 100, this country's level of GDP per capita is higher than the EU average and vice versa. Labor productivity per capita employed is measured as GDP in PPS per capita employed relative to EU-27 average (EU-27=100). The employment rate is calculated by dividing the number of employed persons aged 15 to 64 by the total population of the same age group. The employment rate of older workers is calculated by dividing the number of employed persons aged 55 to 64 by the total population of the same age group. The indicator "Youth education" attainment level is defined as % of young people aged 20-24 having attained at least upper secondary

education level. Gross domestic expenditure on R&D is expressed as % to GDP. Business investment, namely for private sector, represents total gross fixed capital formation as a percentage of GDP. Comparative price levels are the ratio between purchasing power parities and market exchange rate for each country shown in relation to the EU average (EU-27=100). The share of persons with a disposable income below the risk-of-poverty threshold, which is set at 60% of the national median disposable income (after social transfers) is resembled by At-risk-of-poverty rate indicator. Long-term unemployment rate is the number of persons that have been unemployed for more than 12 months expressed as of total labor force. Greenhouse gas emissions indicator presents annual total emissions (CO2 equivalents) in relation to "Kyoto base year". In general the base year is 1990 for the non-fluorinated gases and 1995 for the fluorinated gases. Gross inland consumption of energy divided by GDP (kg of oil equivalent per 1000 euros) results in the "Energy intensity of the economy" indicator. The index of inland freight transport volume is defined as the ratio between ton-kilometers (inland modes) and GDP (chain-linked volumes, at 2000 exchange rates) and indexed on 2000. However, the application of MULTIMOORA method enables summarizing all these indicators expressed in different dimensions.

Table 1. **Structural indicators used in evaluation of Lithuania's position in the EU**

	Structural indicator	Desirable value
	I. General economic background	
1.	GDP per capita in PPS (EU-27 = 100)	Max
2.	Labour productivity per person employed	Max
	II. Employment	
3.	Employment rate	Max
4.	Employment rate of older workers	Max
	III. Innovation and research	
5.	Youth education attainment level	Max
6.	Gross domestic expenditure on R&D	Max
	IV. Economic reform	
7.	Business investment	Max
8.	Comparative price levels	Min
	V. Social cohesion	
9.	At-risk-of-poverty rate	Min
10.	Long-term unemployment rate	Min
	VI. Environment	
11.	Greenhouse gas emissions	Min
12.	Energy intensity of the economy	Min
13.	Index of inland freight transport volume	Min

As Table 2 suggests, generally positive changes in seeking the Lisbon goals throughout 2000-2009 were observed in 3 Baltic states, namely Estonia, Latvia, and Lithuania, despite the ongoing economic crisis. The increasing values of one of the main economic indicators – GDP per capita in PPS compared to EU-27 average – prove the promising changes in economies of Baltic states. However, the growth of GDP per capita somehow decreased around 2009. Baltic states, nevertheless, exhibited relative growth of economic well-being if compared to 27 EU member states: the index of GDP per capita in PPS rose from 45% in 2000 to 63% in 2009 for Estonia,

from 37% to 49% for Latvia, and from 39% to 53% for Lithuania. It can be concluded, that even if these countries did not experience growth of GDP per capita in absolute terms, they managed to increase their relative economic well-being whereas those countries with higher than EU average values of GDP per capita, e. g. Belgium, Denmark, France, Italy, Austria, Finland, had decreases in the values of GDP per capita. Moreover, Estonia demonstrated both the highest increase as well as the highest value of the indicator. The similar patterns can be identified when analyzing labor productivity per person employed indicator. All Baltic states experienced growth in labor productivity, whereas Estonia performed the best.

As for employment rate indicators, one can observe effects of economic downturn. The employment levels have dropped in 2009 in Latvia and Lithuania, whereas it increased by 0.5% in Estonia. Employment rate of older workers, however, did not shrunk in either of Baltic states.

The dynamics of innovation and research indicators suggests some ambiguous conclusions. On the one hand, Baltic states are peculiar with higher level of youth education attainment if compared with EU average (78.6% in EU-27, as of 2009). On the other hand, these states raise relatively lower amounts of research and development funds. For instance, the EU-27 average was 2.01% of GDP in 2009, whereas the same figure for Estonia was some 1.42% of GDP. Moreover, even lower values were observed for Latvia and Lithuania: 0.46 and 0.84% of GDP, respectively. To conclude, Baltic states' education systems tend to be underfunded and generating output with rather arbitrary abilities to improve the economic and social situation in respective states. For having achieved high rates of youth education attainment GDP per capita in Baltic states still remains below the EU average.

Business investments shrunk in Baltic states as of 2009. Latvia, meanwhile, is the country where the largest part of GDP is invested – 17.1%, whereas the same figure is 16.5 in Estonia and 13.2 in Lithuania. On the contrary, comparative price levels kept steadily growing in 3 Baltic states.

Table 2. **The absolute values of structural indicators for Baltic states, 2000-2009**

Structural indicators	Year	Estonia	Latvia	Lithuania
1. GDP per capita in PPS, index	2000	45	37	39
	2004	57	46	50
	2009	63	49	53
2. Labour productivity per person employed, index	2000	46.9	40.2	42.7
	2004	57.4	45.7	53.3
	2009	64.5	50	55.5
3. Employment rate, %	2000	60.4	57.5	59.1
	2004	63	62.3	61.2
	2009	63.5	60.9	60.1
4. Employment rate of older workers, %	2000	46.3	36	40.4
	2004	52.4	47.9	47.1
	2009	60.4	53.2	51.6
5. Youth education attainment level, %	2000	79	76.5	78.9
	2004	80.3	79.5	85
	2009	82.3	80.5	86.9

The End of *Table 2*

Structural indicators	Year	Estonia	Latvia	Lithuania
6. Gross domestic expenditure on R&D (GERD),%	2000	0.6	0.44	0.59
	2004	0.85	0.42	0.75
	2009	1.42	0.46	0.84
7. Business investment, %	2000	22	22.9	16.4
	2004	27.1	24.4	18.8
	2009	16.5	17.1	13.2
8. Comparative price levels, index	2000	57.2	58.8	52.6
	2004	63	56.1	53.5
	2009	75.1	74.8	67.8
9. At-risk-of-poverty rate after social transfers, %	2000	18	16	17
	2004	20.2	19.2	20.7
	2009	19.7	25.7	20.6
10. Long-term unemployment rate, %	2000	6.3	7.9	8
	2004	5	4.6	5.8
	2009	3.8	4.6	3.2
11. Greenhouse gas emissions, index	2000	44.5	38.1	39
	2004	49.3	41.1	44.2
	2008	49.6	44.4	48.9
12. Energy intensity of the economy, kg OE per 1000 EUR	2000	812.71	441	571.22
	2004	687.52	387.02	547.4
	2008	570.51	308.74	417.54
13. Volume of freight transport relative to GDP, index	2000	100	100	100
	2004	90.1	107.2	106.2
	2009	61.1	103.6	117.9

Social cohesion indicators also show some backwardness caused by the economic downturn. The at-risk-of-poverty rates have increased in Latvia (from 19.2% in 2004 to 25.7% in 2009). However, they have declined in Estonia (from 20.2% to 19.7%) and Lithuania (20.7 to 20.6%). Noteworthy, these rates had been growing before the accession to the EU in all 3 Baltic states. Indeed, the poverty rate was higher in 2009 than in 2000 in all of them, with the highest value of 25.7% in Latvia. Long-term unemployment levels have been decreasing in 3 Baltic states since 2000. As of data of 2009, the lowest level of long-term unemployment was observed in Lithuania (3.2%).

The trends of environmental indicators are generally positive, with exception of those of greenhouse gas emissions. These emissions have increased in all Baltic states, with Estonia having the largest index of 49.6%. Accordingly, Estonia also has the highest energy intensity (570.51 kg OE per 1000 EUR GDP). Nevertheless, the energy intensity was reduced throughout the period of 2000-2009 in the economies of all Baltic states. The most energy-efficient state is Latvia with 308.74 kg OE per 1000 EUR GDP (as of 2009). Meanwhile, Estonia managed to reduce its ratio between volume of freight transport and GDP by almost 40% from 2000 to 2009. Latvia and Lithuania, however, remained the linking hubs between East and West, thus having the ratio increased by 3.6 and 17.9% respectively.

Although many of the discussed structural indicators are expressed in %, one cannot simply add them up and thus compare the states. For GDP % are not the same as % of labor force used in employment indicators etc. The application of multi-objective optimization method therefore becomes necessary. Consequently, we will

apply the MULTIMOORA method for international comparison of all 27 member states of the EU.

According to the above mentioned indicators, response matrix was created. Elements of the matrix were converted by employing formula (1). Summarizing index for each state was calculated by applying formula (2). Each state was attributed with appropriate rank: the higher the index, the higher the rank. According to the ratio system approach, Estonia was attributed with the rank of 22 during 2000, that of 19 during 2004, and that of 16 during 2009. Accordingly, Latvia was attributed with ranks of 20, 18, and 24 for the same periods, Lithuania received ranks of 24, 21, and 21.

Consequently, the ranking of the states was performed according to the reference point approach. First, the maximum objective reference point r_j was found. Secondly, the response matrix was rearranged by calculating deviations of each element from the reference point. These deviations show state's position in certain area (for example, null value of the first indicator means that respective state has maximal GDP per capita among EU countries). Final ranks were given according to formula (3).

In addition, analysis of Baltic states' position in the European Union in 2008 was performed using the full multiplicative form method. Matrix of responses was used to estimate the utility of each alternative (i. e., development performance of each European Union member state) by applying formula (4). This utility function is n-power form (Brauers and Zavadskas, 2010). The results are given in Table 9 (Annex A) while detailed data can be obtained by contacting the corresponding author.

The relative performance of 3 Baltic states can be analyzed in-depth by using the data from the reference point. Larger deviation means that the value of respective indicator is relatively further from maximum in the European Union. Indeed, 3 Baltic states can be considered as quite a homogenous region for we can observe virtually the same pattern of deviations from maximal values.

The dynamics of greenhouse gas emissions indicator (the 11th indicator) is the most promising, it exhibits relatively low gap between Baltic states and the forerunner of the EU. Latvia was peculiar here due to the lowest values in the EU of that index in 2004 and 2009.

The values of youth education attainment indicator (the 5th indicator) are also among the highest in the EU. More specifically, Lithuania precedes other Baltic states according to this indicator.

The most problematic indicator for Baltic states was that of GDP per capita (the 1st indicator). Moreover, the difference between the maximum in the EU and the respective values for each Baltic state increased during the period of 2000-2009. Another serious problem for Baltic states is their relative backwardness in labor productivity (the 2nd indicator). Even though the labor productivity in all these states approached nearer to the maximum of the EU, we can observe an increasing differentiation among Baltic states in 2009; i. e., Latvia is peculiar with relatively lower labor productivity whereas Estonia is the forerunner among Baltic states.

Gross domestic expenditure on R&D activities (the 6th indicator) also remained far behind the maximum in the EU. However, the increasing differences between Baltic states can be observed in this area. Estonia was constantly increasing those expenditures thus reducing the gap between its national expenditures and maximum in the EU. Lithuania was following Estonia in increasing R&D expenditures, howev-

er, the economic crisis resulted in the increased gap between these two states in 2009. In addition, Lithuania has the largest gap of business investments (the 7th indicator).

Another relatively backward indicator for all Baltic states is the level of long-term unemployment (the 10th indicator). This indicator, however, improved over the investigated period: the gap between the observed minimum level of long-term unemployment in the EU and the respective values in Baltic states has somehow decreased since 2000. Nevertheless, we can observe a worsened situation in Latvia and Lithuania if compared with that in Estonia given the data of 2009. The ongoing economic crisis has also impacted the growing poverty rate in Baltic states (the 9th indicator). This problem is especially important for Latvia.

The energy efficiency indicator (the 12th indicator) has exhibited improvement in 3 Baltic states. However, economies of these states remained relatively inefficient if compared to those of the best performing EU countries.

The 1st, 2nd and 6th structural indicators in Lithuania are those deviated from maxima to the highest extent. This means that GDP per capita, labor productivity and gross expenditure on R&D are relatively low in Lithuania. Low values of the first two indicators can be explained by assumption that Lithuania has not found its place in world economic (labor division) system yet. Hence its industry is oriented on production of low demand goods and services using obsolete technologies. Low employment level in R&D indicates that Lithuania is not prepared to cope with challenges of knowledge economics. Estonia copes best with this issue among Baltic states. Inevitable demographic changes should lead to increasing proportion of older people in labor force and in the whole population. Thus Lithuania's economy is not fully developed.

The 3rd, 5th, 8th and 11th indicators in Lithuania are close to maximum values. Thus Lithuania is among leaders in the European Union by employment level, youth education attainment level, comparative price levels and greenhouse gas emissions. Low comparative price levels mean that Lithuanian production can be competitive at the European Union market due to lower costs. There are fewer companies of heavy industry in Lithuania, which pollute environment, thus greenhouse gas emissions are low.

The best situation is in innovation and research area if focusing on Baltic states. Indeed, much more attention to R&D financing and business investments is needed. Lithuania has progressed in the spheres of employment, social cohesion and environment, but employment of older people should be increased and intensity of energy consumption should be lowered (by encouraging modern energetic technologies). Indicators of general economic background are among the lowest in the European Union, thus structural reforms for Lithuanian economy are needed. Furthermore, it can be concluded that Baltic region is quite homogenous in innovation and research as well as in economic reform areas (indicators 5 to 8), thus it can become attractive for investors.

Estonia has the lowest value of the index of inland freight transport volume, which means that Estonia does not relate its economic development with growing intensity of inland transport. On the one hand, Latvia has the lowest value of greenhouse gas emissions index; on the other hand, the same state has the lowest greenhouse gas emission index value in the EU. It can be concluded that Latvia has advanced in producing environment-friendly energy. Latvia has highest deviation among Baltic states of the 9th indicator – at-risk-of-poverty rate – which indicates serious social problems.

Nevertheless, straightforward comparisons between 2002, 2004 and 2009 have to be avoided. Each of these years shows a trend break compared to the two other ones. Indeed, in 2002 Baltic states were outside the European Union, whereas since May 2004 they are full members of the Union. Finally, 2009 was the middle of the recession which characterized the high income countries of the world.

Appropriate policy of administration of the European Union financial support can help to accelerate innovations as well as R&D. European Union regional policy is directed on reduction of social and economic differences between regions, cohesion and development of the entire European Union. 4 structural funds as well as a cohesion fund were instituted to support development. Priorities and tasks for allotting European Union financial support are defined in Lithuanian Single Programming Document. More attention should be paid for mentioned problematic areas in this and other strategic documents.

Ranking by MULTIMOORA method was performed by combining the results from MOORA and the full multiplicative form. Each EU member state was attributed with 3 ranks for each year. The dominance theory was applied to summarize these 3 ranks into a single one resembling relative performance of certain state during the investigated period. Hence, the dominance theory will be introduced in the next section.

4. Cardinal and Ordinal Scales in MULTIMOORA. MULTIMOORA has to totalize ranks from the ratio system, reference point and the full multiplicative form. Indeed, adding up ranks, ranks mean an ordinal scale (1^{st}, 2^{nd}, 3^{rd} etc.) signifies a return to a cardinal operation (1 + 2 + 3 + ...) as maintained by Kendall and his theory of correlation of ranks (1948). Is this allowed?

The answer is "no" following the Noble prize Winner K.I. Arrow:

4.1. The Theorem of Arrow. "Obviously, a cardinal utility implies an ordinal preference but not vice versa" (Arrow, 1974).

1. A deduction of an ordinal scale, a ranking, from cardinal data is always possible.

2. An ordinal scale can never produce a series of cardinal numbers.

3. An ordinal scale of a certain kind, a ranking, can be translated in an ordinal scale of another kind.

In application of axiom 3 we shall translate the rankings of 3 methods of MULTIMOORA into an other ordinal scale based on dominance.

4.2. Dominance, Being Dominated, Transitiveness and Equability. Brauers and Zavadskas launched the following dominance theory in 2011.

Stakeholders or their representatives like experts may give various importance to objectives in a multi-objective problem, but this is not the case with 3 methods of MULTIMOORA. These methods represent all possible methods with dimensionless measures in multi-objective optimization and one can not argue that one method is better or is of more importance than the others.

Dominance. Absolute dominance means that an alternative, solution or project is dominating in ranking all other alternatives, solutions or projects which are all being dominated. This absolute dominance shows as rankings for MULTIMOORA: (1-1-1).

General dominance in 2 of 3 methods with a P b P c Pd (P preferred to) is for instance of the form:

(d-a-a) is generally dominating (c-b-b).

(a-d-a) is generally dominating (b-c-b).

(a-a-d) is generally dominating (b-b-c).

and further on transitiveness plays fully.

Transitiveness

If *a* dominates *b* and *b* dominates *c*, than also *a* will dominate *c*.

Overall dominance of one alternative on another.

For instance (a-a-a) is overall dominating (b-b-b) which is overall being dominated by (a-a-a).

Equability

Absolute equability has the form: for instance (e-e-e) for 2 alternatives.

Partial equability of 2 on 3 exists, e. g. (5-e-7) and (6-e-3).

Circular Reasoning

Despite all distinctions in classification some contradictions remain possible in a kind of circular reasoning.

We can cite the case of:

Object A (11-20-14) dominates generally object B (14-16-15).

Object B (14-16-15) dominates generally Object C (15-19-12).

but Object C (15-19-12) dominates generally Object A (11-20-14).

In such a case the same ranking is given to 3 objects.

The same rules apply for the 3 methods of MULTIMOORA with no significance coefficients proposed.

5. Application of the dominance theory. This section describes the final results of the international comparison based on MULTIMOORA method and the dominance theory. The synthesis of the two latter methods enabled to rank all the EU member states according to their performance in implementing the Lisbon Strategy during certain periods of time, namely 2000, 2004, and 2009 (Table 3). The detailed description on calculus is given in Section 3.

Table 3. **The ranks of the EU member states provided by MULTIMOORA**

Member State	2000				2004				2009			
	RS	RP	MF	**Final**	RS	RP	MF	**Final**	RS	RP	MF	**Final**
Sweden	1	3	3	**2**	1	4	2	**1**	1	5	2	**1**
Luxembourg	2	10	1	**3**	2	6	3	**3**	2	1	5	**2**
Denmark	3	1	2	**1**	3	4	1	**2**	3	6	1	**3**
Austria	5	2	4	**4**	6	2	5	**5**	5	4	3	**4**
Netherlands	6	5	5	**5**	7	1	7	**7**	6	2	4	**5**
Finland	4	8	7	**7**	4	8	6	**6**	4	10	6	**6**
United Kingdom	8	6	6	**6**	5	5	4	**4**	7	7	7	**7**
Germany	7	7	8	**8**	10	9	9	**9**	8	8	8	**8**
France	11	9	10	**11**	9	10	10	**10**	9	11	9	**9**
Ireland	10	12	9	**10**	8	11	8	**8**	11	3	10	**10**
Belgium	9	4	11	**9**	11	7	11	**11**	10	9	11	**11**
Czech Republic	12	14	12	**12**	13	15	13	**13**	12	15	13	**12**
Cyprus	18	26	17	**18**	16	24	16	**17**	13	19	12	**13**
Slovenia	13	11	13	**13**	12	14	12	**12**	14	14	14	**14**
Italy	16	13	15	**15**	14	12	14	**14**	15	13	15	**15**
Estonia	22	19	20	**20**	19	18	18	**18**	16	21	16	**16**
Spain	15	15	16	**16**	17	13	15	**15**	17	12	17	**17**

The End of *Table 3*

Member State	2000				2004				2009			
	RS	RP	MF	**Final**	RS	RP	MF	**Final**	RS	RP	MF	**Final**
Portugal	14	16	14	**14**	22	16	20	**20**	19	16	18	**18**
Greece	19	20	19	**19**	20	19	19	**19**	18	17	19	**19**
Hungary	17	17	18	**17**	15	17	17	**16**	21	22	20	**20**
Poland	23	18	23	**23**	26	23	25	**25**	20	23	22	**21**
Lithuania	24	21	21	**23**	21	21	22	**22**	22	24	21	**22**
Slovakia	26	22	24	**24**	24	26	24	**24**	23	20	23	**23**
Latvia	20	23	22	**23**	18	22	21	**21**	24	25	24	**24**
Romania	25	24	26	**26**	25	25	26	**26**	25	26	25	**25**
Malta	21	25	25	**25**	23	20	23	**23**	26	18	26	**26**
Bulgaria	27	27	27	**27**	27	27	27	**27**	27	27	27	**27**

With respect to the dominance theory the EU member states were classified in the following way. There were 3 groups of states defined, namely group 1, encompassing states with ranks from 1 to 9, group 2, encompassing those with ranks of 10-18, and finally group 3 for the remaining countries. These 3 groups will be henceforth called core, semiperiphery, and periphery states respectively. There was a case of circular reasoning observed in 2000: Poland (23-18-23) dominated Lithuania (24-21-21), which, in turn, dominated Latvia (20-23-22). However, Latvia also dominated Poland in 2 of 3 methods. All these states, hence, were given ranks 21-23[4].

As we can see, Sweden dominated Luxembourg and the remaining EU states in 2009 according to the structural indicators identifying the goals of the Lisbon Strategy. Hence, the core group consists of Sweden, Luxembourg, Denmark, Austria, the Netherlands, Finland, the United Kingdom, Germany, and France. Generally, all these states belonged to the same group in 2000 as well as in 2004. However, France improved its relative position, whereas Belgium formerly belonging to the core group can be considered belonging to the semiperiphery in 2009.

The semiperiphery group encompassed Ireland, Belgium, Czech Republic, Cyprus, Slovenia, Italy, Estonia, Spain, and Portugal (as of 2009). Indeed, much more dynamics can be observed among relative positions of these member states. For example, Cyprus has been constantly improving its relative position (18 in 2000 and 13 in 2009). The same applies for Estonia (ranks 20 and 16 respectively). At the other end of spectrum, Portugal was not so successful in seeking the Lisbon goals: it had the rank of 18 in 2009 instead of that of 14 in 2000.

The periphery group consists of the least advanced EU member states, namely Greece, Hungary, Poland, Lithuania, Slovakia, Latvia, Romania, Malta, and Bulgaria. These states have also changed their relative positions. More specifically, Poland managed to ameliorate it, whereas Hungary and Latvia faced decline. Hence, it is obvious that economic crisis affected the implementation of the Lisbon goals in the number of the EU member states.

As for Baltic states, it can be concluded that Estonia remained the forerunner and Lithuania with Latvia lagged behind. Moreover, Estonia managed to improve its relative achievements rising through the 20th, 18th, and 16th positions in 2000, 2004, and 2009 respectively. Norkus (2007) analyzed the Estonian phenomenon in-depth.

[4] All calculations are available from the authors on demand.

Lithuania remained more or less in a stable position, whereas Latvia experienced relative ascent and later was dropped down, possibly due to the world economic problems. However, 3 Baltic states were not member states of the EU up to 2004, hence the impact of EU policy was limited in these states prior to their accession.

6. Conclusion. In this study 27 EU member states were compared on the basis of 13 structural indicators describing certain aspects of Lisbon Strategy's implementation and with application of the MULTIMOORA method. The most of attention was paid to 3 Baltic states, namely Estonia, Latvia, and Lithuania.

The EU member states were ranked according to the system of structural indicators. Consequently, there were 3 groups of states defined, namely core (group 1) encompassing states with ranks of 1 to 9, semiperiphery states (group 2) with ranks of 10-18, and finally periphery states (group 3) for the remaining countries. Estonia belongs to the semiperiphery group since its entrance in the EU in 2004, whereas Lithuania and Latvia rank in the periphery group consisting also of the least advanced EU member states: Greece, Hungary, Poland, Slovakia, Romania, Malta, and Bulgaria.

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Стаття надійшла до редакції 20.12.2011.