Human Capital System Evaluation in the Context of the European Union Countries

Algimantas Sakalas, Zieduna Liepe

Kaunas University of Technology
K. Donelaicio st. 73, LT-44029, Kaunas, Lithuania
e-mail: algimantas.sakalas@ktu.lt, zieduna.liepe@ktu.lt

For economic science HC concept is known for at least the last fifty years in the works of Schultz (1964), Becker (1962), when such issues as productivity and effectiveness of individual were touched. Therefore, in the current economic theories it is also very important to recognize the role of human capital and its management necessity, to understand the HC formation and application as a manageable process, which you need knowing well both in micro and in macro level.

Evaluation of HC in macro level should include not only direct HC evaluation, but environmental evaluation as well. There must be evaluated not only the formal value of HC, but also the material, economical, social, environmental conditions, determining its appliance productivity and the need of systematic approach to HC.

HC system evaluation framework in country level consists of a number of social and economic indicators, which depending on their size and system performance are expressed in various sizes of absolute or relative indicators. The integration of these indicators into a single one, form an integrated index. For various phenomena to investigate and analyze in practice, the index method is used often, which helps to reveal the links and the structure between the researched phenomena (Human Development Index (Human development report 2011), the index of Genuine Wealth Assessment (Genuine Wealth Assessment (2012), and so on.).

Applying index calculation method, this article aims to reveal the indicators characterizing the formation principles of HC system, creating their evaluation methodology and on its base performing a comparative HC system-level analysis among the EU countries. The paper presents the main advantages of multi-factor indices method application, evaluating particular areas of social and economic activities; there is also proposed a seven stages process of HC system's integrated index formation and its practical adaptability comparing the selected EU countries and determining their level of HC development.

The results of accomplished comparative evaluation of HC system in the 27 European Union countries using five groups of indices (social, innovation, consumer value - income, costs, and economic development) allowed creating an information basis selecting the effective indices, making it possible to evaluate the formation level of HC system in individual EU countries.

Keywords: *Human capital (HC), integrated index, HC system, indicators, HC evaluation.*

.

Introduction

Human capacity development and acquisition of useful knowledge is a foundation for economic productivity and human welfare growth (Schultz, 1998). Acknowledging HC role and its management importance (Scholz, 2004; Huselid *et al.,* 2005; Kleynhans, 2006; Scholz, 2007; Sakalas & Liepe, 2010; Erosa *et al.,* 2010; Ployhart & Moliterno, 2011) it is necessary to have knowledge of HC system management at both micro and macro level.

Evaluating HC in macro level, it is important that the measurement instruments would describe not only the quality and quantity of HC and the factors determining them, but also would allow them to be compared internationally (Sakalas & Liepe, 2010).

The research object – the system-level evaluation of HC in the context of the EU countries.

The aim of the study – to create a comprehensive system of HC parameters characterizing the whole and its evaluation methodology, based on which to perform HC system-level comparable analysis among the EU countries.

HC system evaluation in macro-level functions to certain restrictions:

1. HC system evaluation must include not only the direct evaluation of HC, but also HC environmental assessment. This is a broader concept than HC evaluation in monetary units.

2. The objective of HC system evaluation is to form the necessary base of adjuvant indicators for HC assessment.

3. HC evaluation reliability is determined by the level of statistical system, talking of HC system research in the EU countries, its reliability depends on the data level published by Eurostat.

An accomplished comparative evaluation of HC system-level among the EU-27 countries, bringing together five partial indices into the integrated HC system index, allowed selecting the effective indices and assessing their impact on the formation of HC system in different countries.

The research methods - detailed review of scientific literature sources, comparative analysis and synthesis, data

browsing method using multi-factor indices analysis, principal components analysis, correlation analysis, reliability and validity analysis.

Advantages of multi-factor indices method application

HC system evaluation framework of individual country consists of a number of social and economic indicators, which depending on their size and system performance are expressed in various sizes of absolute or relative indicators that need to be brought together in a comparative framework. An accomplished analysis of mathematical and statistical (Bartoseviciene, 2010) methods applied for these objectives disclosed, that the best way to reach these goals is to apply a multi-factor indices method (Wolfram, 2011).

Every single social or economic indicator can be expressed by an individual index - an indicator, showing the level of this indicator in the analysis group. The index method has the advantage that there can be constructed the aggregate indices of several or more sub-indices, based on which one integrated index can be calculated.

Such complex indices as the Index of Sustainable Economic Welfare (ISEW), the Genuine Wealth Assessment (GWA), Measure of Domestic Progress (MDP), Measure of Economic Welfare (MEW) and so on are very widely used in the assessment of individual country level in a particular area. Big advantage of this method is, that economic and social indices can be combined together (Wen-jen Hsieh & Yu Hsing, 2002). Newman and Thomson (1989) stated that economic and social development correlate with each other framing the overall index. An example of such index is Physical Quality of Life Index (Thanawala, 2007), which is applied to assess the country's quality of life or well-being.

Typically there are three main groups of statistical indices: individual, group and general - complex indices (Bartoseviciene, 2010). Depending on the indices calculation method, in the literature there are distinguished general – aggregated and averages values, which are divided into the Geometric Mean Index, and Harmonic index (Wolfram, 2011).

Various economic and social phenomena and processes consist of many units that differ in various features, therefore the application of multi-factor indices method enables assessing functional relations among these analyzed phenomena and processes. According to Ciegis et al. (2009), there rarely exist the perfect indicators or indices and their formation involves particular methodological compromise between technical feasibility, public usability and systemic consistency. That's why

there has to be developed a systematic approach evaluating HC.

Integrated index construction methodology of countries HC system

The study involved the 27 EU countries that are different from both economic and social level, but they are united by unified political and economic objectives and mutual assistance in achieving these goals.

Constructing the index of HC system, indicators were selected based on the following criteria:
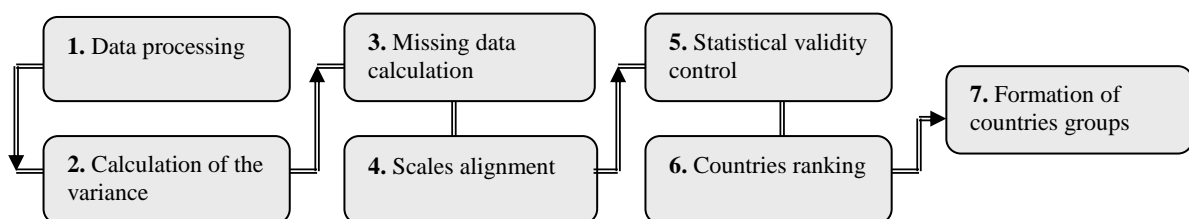• selected indicators should be collected in all the EU countries;
• in the study the indicators of the year 2010 were determined by Eurostat data delays;
• in exceptional cases, when there are accomplished specific studies in a certain year, their data can be used up to a 3-year limit;
• because of the missing data, for the formation of the following year indicators, there can be used the extrapolation methods (Lyman Ott & Longnecker, 2010).

Individual indicators selection was based on economic logic and thoroughly depends on the qualification of investigator and economic patterns knowledge. However, it should be noted that the reliability of the study can be significantly improved by the creation of skilled team of experts and selecting the proper method.

Selection of HC evaluation research method depends on the disposable type of data - quantitative or qualitative data. Since the research data base of our study includes the quantitative indicators, therefore there was applied the Data Mining method, using the exploratory multivariate factor - indexes analysis of descriptive statistics and correlative regression analysis.

Data mining method includes a process to extract the information from the data and is usually used for large-scale data analysis. According to Larose (2009), Data mining method may be divided into several stages - data search in databases; data consolidation; data selection; and creation of new model. In our case, the first step - data search in databases - or selection of the indicators was done considering the peculiarities of the analyzed research object, HC (for more details, see "Methodology principals of human capital evaluation in macro level" Liepe, 2012). The selection of the indicators applied in the formation of HC system's integrated index and its five constituent indices group was performed according to HC definitions highlighted in scientific literature, and the key factors distinguished in the concepts of HC.

The integrated index of HC system is formed following seven stages (see Figure 1).

Figure 1. Formation process stages of HC system's integrated index

In the **1st stage** the data base was formed, which consists of the European Union countries data published in the Eurostat, World Data Bank statistical data basis and the Human Development reports (Eurostat, 2010; Human development reports, 2011). In order to reduce the data size influence on the calculation of the results there was performed the normalization of indicators: instead of the absolute values there was used the growth coefficient / percentage or was calculated the value of absolute indicator per inhabitant / employee. The formed database was processed using SPSS package program support.

In the **2ⁿᵈ stage** the variance of the analyzed data was estimated, checking the data correlation with each other and identifying the affinities. If there are no such affinities then further factor analysis would be meaningless. Formed inter-correlation matrix of the analyzed indicators allowed reducing the scope of the database, eliminating the indicators weakly correlated with each other or logically related indicators strongly correlated with each other.

In the **3rd stage** there were determined the missing countries data using the S - mean procedure - which involves the calculation of missing rows data using the average method. This allowed maintaining certain variables for the calculation, without changing its position relative to others.

In the **4th stage**, using N-tile procedures there was carried out the data scale alignment. This allowed using the indicators in different measures in calculations, for example, fertility rate is measured in percentage, the population change - in units, life expectancy - in years, gross domestic product in thousands of Euro, etc. Using N-tile procedure, the variables were grouped into five segments (1 - the lowest value and 5 - the highest value).

In **5th stage** there was calculated the statistical validity[1] of HC system indices using the factor analysis and multicollinearity[2] was tested using reliability analysis. If validity demonstrates the compliance of the research with its stated objectives, reliability (or consistency) is a methodological characteristic, showing the degree of measurement accuracy (Garson, 2009). During the research, reliability analysis was accomplished using the internal consistency method, which is based on the correlation of individual variables that make up the overall group, using Cronbach's alpha model, which evaluates whether all the scales variables adequately reflect the size of exploration.

In the **6th stage** there was accomplished the country's ranking according to the estimates of HC index value ranges, taking into account their deviation from the average, using the standard normal distribution Z - scale for the conversions. Standardization converts the key data to a common scale of a normal distribution, when the mean is equal to - 0 and a standard deviation - 1 (Groh *et al.,* 2009). Thus, the variables with exceptional values have a great impact on other indicators.

In the **7ᵗʰ stage** there were distinguished groups of the EU countries. Purpose of this analysis – to group objects, so that the differences within the group would be minimal, while between the groups - the larger. Groups were formed by using the simplest and most commonly used in practice k - mean method. This method disaggregates data into k groups, in our case a number of the EU countries fall into one of the five groups, with estimates ranging from 1 to 5 points.

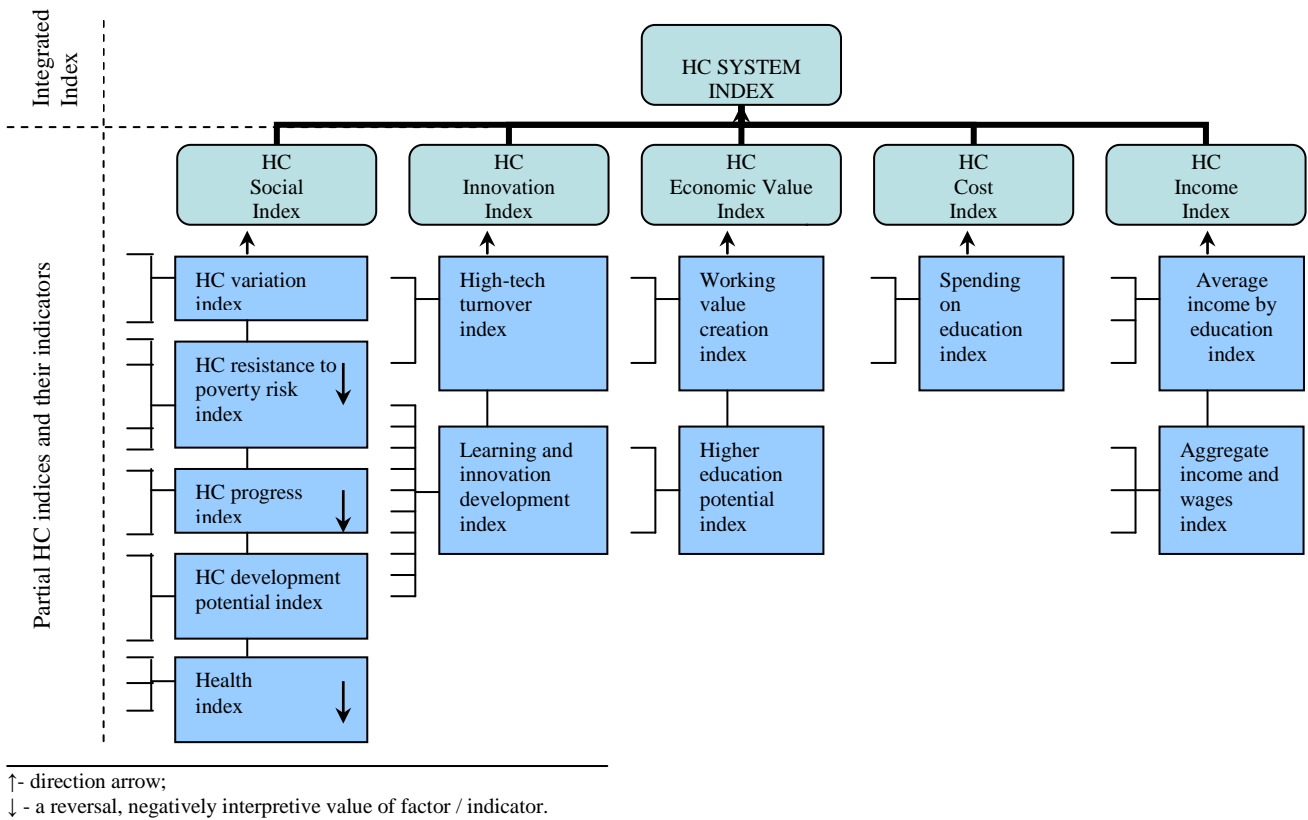## Index structure of HC system evaluation in EU countries

The primary database was analyzed based on correlation strength among the indicators. For empirical study there were selected indicators strongly correlated with HC value, they were combined with each other by organizing and integrating them into one integrated index. Figure 2 shows the calculation scheme of HC system integrated index.

Following the Data mining procedures of applied statistical methods (principal components analysis, factor analysis, correlation analysis, reliability analysis, etc.) there were merged, grouped and identified five major first-order groups of indices: HC social index - SI; HC innovation index - IN, HC consumer value - income index – II; HC cost index - CI, HC economic value (development) index - EI. In the Table 1 there are presented the estimates of the main factor and reliability analysis of individual and group indices.

To verify whether the survey sample was sufficient or not there was used the KMO - test (Kaiser-Meyer-Olking) analysis. According to it, the sample is sufficient if the KMO value is greater than or equal to 0,5. KMO estimates of factor analysis in presented survey are greater than identified value, and it shows that the operational sampling was sufficient and the data can be united into the components – factors: HC indices of economic value, innovation, cost, income are equal 0,500, a social index to - 0,613, an integrated HC system index reaches 0,814 (see Table 1).

Variation or percent of change (column %) shows an alteration level of each component - factor or a spread percentage relatively to the total alteration of all the variables. By grouping the indicators into separate factors they have been complied with the provisions that the variables with the factorial weight less than 0,4 will not be used for further survey. On this basis the scatter of factor scales range from 58,239 (HC Social Index) to 97,800 (HC Income Index).

The inner correlation level among distinguished factors and their constituent variables is described by: r_{mean} , which shows the average correlation between variables; r_{min} , which shows the minimum value of the correlation between variables; and r_{max} represent the maximum value of the correlation between variables. The higher the values, the more strongly variables are correlated with other variables assessing the same factor.

---

[1] *Validity* – the degree to which survey measures what it is supposed to measure and the relationship among variables based on the data are correct or 'reasonable' (Garson, 2009).

[2] *Multicollinearity* - a strong linear relationship among two or more independent variables (Garson, 2009).

↑- direction arrow;

↓ - a reversal, negatively interpretive value of factor / indicator.

Figure 2. Structure of HC system integrated index

After the determination of KMO coefficient, the reliability of each scale was verified calculating the Cronbach's alpha (column - α) coefficient. This coefficient is a measure of internal consistency, which shows how closely a set of variables is associated with each other as a group. The values of Cronbach's alpha reliability coefficient typically range between 0 and 1. "High" alpha value is often used as evidence that the variables fully reflect and evaluate the basic construct and are inter-correlated. In Table 1, we see that the Cronbach's alpha of factors used in empirical survey is suitably high, ranging from 0,596 value (HC Innovation Index) up to 0,978 (HC income index).

Table 1

The research factor analysis and reliability estimates

FACTOR	α	r_{mean}	r_{min}	r_{max}	%	KMO
INTEGRATED INDEX OF HC SYSTEM	0,904	0,653	0,370	0,852	72,974	0,814
HC COST INDEX	0,876	0,780	0,780	0,780	89,000	0,500
HC SOCIAL INDEX	0,817	0,472	0,162	0,674	58,239	0,613
HC ECONOMIC VALUE INDEX	0,783	0,644	0,644	0,644	82,194	0,500
HC INNOVATION INDEX	0,596	0,424	0,424	0,424	71,216	0,500
HC CONSUMER VALUE – INCOME INDEX	0,978	0,956	0,956	0,956	97,800	0,500

The results of the survey factor and reliability analysis indicated that the selected research sample was sufficient, correlation among the indicators is reliable, consequently there can be carried out further HC system evaluation analysis in the context of the EU countries. The calculated individual, group indices and integrated one allows distinguishing groups - clusters approximate by the level of indicators. Scientific researches, analyzing different phenomena, distinguish the developed, advanced and developing countries (Pereira, 2011), but the classification of countries depends on the investigated problem (Lieser & Groh, 2010; Kearney, 2009).

The calculated integrated HC system evaluation index is presented in Table 2. All countries are divided into four separate groups according to the logical grouping principle (the first group - rating points to one value – does not involve any of analyzed countries).

In Figure 3 there is presented an overall average index for each group of countries (the 1st group index – 4,17, the 2nd – 3,56, the 3rd group index - 2,41, and the 4th group includes seven groups of countries, among which Lithuania is located, index - 1,55).

It should be noted that partial evaluation indices for individual country groups overlap; the values of separate indices may fall into a higher or lower valuation level of the group of countries (see Figure 4).

Table 2

HC system indices of EU countries

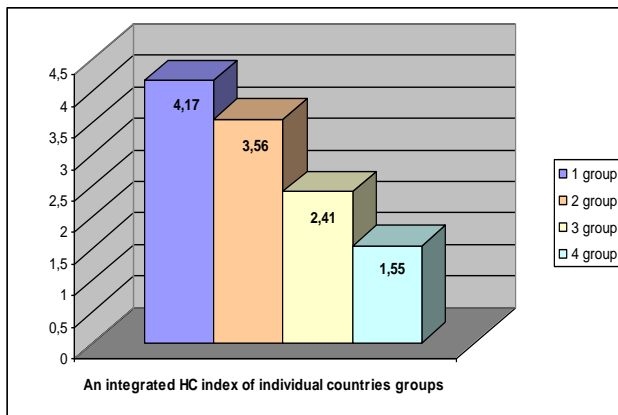| Gr.	Country	Individual Indices					Integrated Index
		SI	NI	II	CI	EI	
1	1.1. Netherlands	3,83	4,30	4,33	3,50	4,50	4,09
	1.2. Luxembourg	2,96	4,40	5,00	-	4,67	4,26
	1.3. Sweden	3,48	4,50	3,67	5,00	4,17	4,16
	1.4. Denmark	3,06	4,25	4,50	5,00	4,00	4,16
	Mean	3,49	4,36	4,38	4,50	4,33	4,17
2	2.1. Ireland	2,40	4,30	4,50	4,50	4,00	3,94
	2.2. Finland	2,80	3,85	4,67	4,50	3,50	3,86
	2.3. Belgium	2,82	3,20	4,17	4,50	4,17	3,77
	2.4. Austria	2.94	*3,80*	4,67	3,00	3,83	3,65
	2.5. United Kingdom	2,47	4,05	3,67	3,00	4,00	3,44
	2.6. Cyprus	1,92	2,33	3,50	5,00	3,83	3,32
	2.7. France	2,83	4,10	4,33	3,00	2,83	3,42
	2.8. Germany	2,29	3,85	3,50	2,00	3,67	3,06
	Mean	2,55	3,69	4,13	3,68	3,73	3,56
3	3.1. Slovenia	2.66	2,55	2,33	3,00	2,50	2,55
	3.2. Malta	2,81	3,50	2,83	3,00	2,17	2,86
	3.3. Spain	2,15	2,35	3,17	2,00	2,83	2,50
	3.4. Estonia	0,89	2,30	2,00	4,50	3,33	2,60
	3.5. Portugal	1,75	2,20	2,50	3,00	1,83	2,26
	3.6. Greece	1,24	1,58	3,17	-	2,33	2,08
	3.7. Italy	2,23	2,40	3,33	1,00	1,67	2,13
	3.8. Czech Republic	2,18	3,45	2,00	1,00	3,00	2,33
	Mean	2,00	2,54	2,67	2,50	2,46	2,41
4	4.1. Latvia	0,27	1,83	2,00	3,50	2,00	1,81
	4.2. Slovakia	1,48	1,85	2,00	1,00	2,50	1,77
	4.3. Poland	0,64	2,30	1,17	2,50	2,17	1,75
	4.4. Hungary	0,60	3,45	1,17	1,50	2,00	1,74
	4.5. Lithuania	0,21	1,55	1,17	3,50	2,00	1,60
	4.6. Bulgaria	0,21	1,10	1,00	1,50	2,33	1,14
	4.7. Romania	0,15	1,80	1,00	1,00	1,33	1,06
	Mean	0,51	1,98	1,36	2,07	2,05	1,55

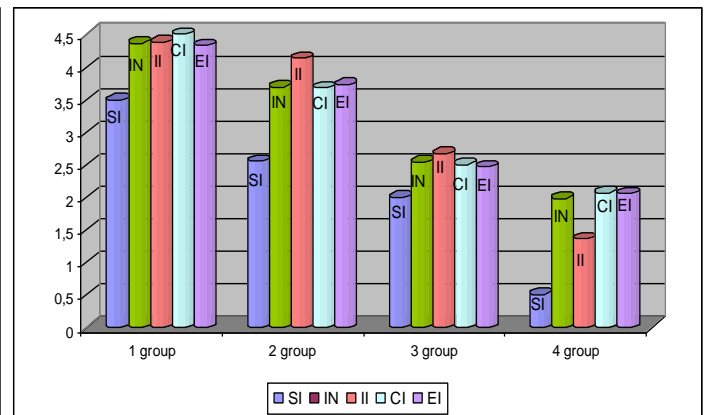**Figure 3.** Aggregate HC index of countries groups

Figure 4. Partial indices of distinguished countries groups

Between the first and the second group of the researched EU countries, HC social indices are lower than the integrated valuation indices. Accordingly, the evaluation index of Sweden is lower than supposed to be for the country, which is included to the top-level group. An analogous situation is in the fourth group, where Lithuania is located (see Figure 4). Evaluation of each index should be less than 1 and not greater than 2. However, HC social index rate is only 0,51, while HC cost index falls into the second group of evaluation scale.

It should be noted that, traditionally, although geographically neighboring Baltic countries have always stood with each other. Estonia with the aggregate integrated index 2,60 is ahead of Latvia (1,81) and Lithuania (1,60). In turn, the indices of Estonia are significantly higher both in the range of HC social and HC costs and HC economic value indices. An accomplished comparison of indices objectively confirms frequently met statement that Estonia has a much better handling system not only in economy but also in the field of HC.

Conclusions

1. Evaluating HC, bearing in mind that HC concept is broad and multifaceted, it is not enough to have individual characteristics, therefore the appropriate set of indicators,

reflecting the complexity of this concept must be selected. In consideration with this, in the article there were measured such social, economic and innovation indicators as poverty reduction, education, qualification and training improvement, health protection level, neonatal mortality, high-tech development and so on. These are the areas that must complement the evaluation conception of HC system in macro-level.

2. For the research data processing there was applied the method of Data Mining, using the exploratory multivariate factor -indexes analysis of descriptive statistics and correlative regression analysis.

3. An accomplished comparative evaluation of HC system in the 27 European Union countries using five groups of indices (social, innovation, consumer value - income, costs, and economic development) allowed selecting the effective indices, creation of information basis, based on which it is possible to assess the formation level of HC system and the impact of its determining factors in individual EU countries.

4. Based on the logical grouping principle there were distinguished four groups of countries according to the overall integrated index which has been calculated on the base of the five partial indices. Lithuania, together with other six countries (Latvia, Slovakia, Poland, Hungary, Bulgaria and Romania) fell into the fourth - the lowest level of HC development group. The reliability of mathematical calculations just proved already previously known statements about our countries retardation according to HC development, but not efficient usage of it. Attention is worthy of the neighboring country - Estonia's entry into the higher group.

5. Analysis of individual indices level allows clarifying both the backwardness and progress in the specific areas and predicting measures in order to reduce the retardation.

References

Baron, A., & Armstrong, M. (2007). *Human Capital Management: Achieving Added Value Through People*. London: Kogan Page Limited.

Bartoseviciene, V. (2010). *Ekonomines statistikos pagrindai*. Mokomoji knyga. Kaunas: Technologija, 97-104.

Becker, G. (1962). Investment in Human Capital: A Theoretical Analysis. *Journal of Political Economy,* 70, 9-49. http://dx.doi.org/10.1086/258724

Ciegis, R., Ramanauskiene, J., & Startiene, G. (2009). Theoretical Reasoning of the Use of Indicators and Indices for Sustainable Development Assessment. . *Inzinerine Ekonomika-Engineering Economics*(3), 33-40.

Erosa, A., Koreshkova, T., & Restuccia, D. (2010). How Important is Human Capital? A Quantitative Theory Assessment of World Income Inequality. *The Review of Economic Studies Limited.* 77, 1421-1449. http://dx.doi.org/10.1111/j.1467-937X.2010.00610.x

Eurostat (2010). Europos komisijos „Eurostat:" informacija. Available from internet: http://appsso.eurostat.ec.europa.eu /nui/show.do?dataset=mny_stk_mcp_a&lang=en

Garson, G. D. (2009). Factor Analysis. Is Statnotes: Topics in Multivariate Analysis. Available from internet: http://www2.chass.ncsu.edu/garson/pa765/statnote.htm

Genuine Wealth Assessment. (2012). The Economics of Happiness: Discovering Genuine Wealth. Available from internet: http://www.genuinewealth.net/resources.html.

Groh, A. P., Liechtenstein, H. V., & Lieser, K. (2009). *The European Venture Capital and Private Equity Country Attractiveness Index(es)*. IESE Business School – University of Navarra, 1-15;

Human Development Report. (2011). Zmogaus issivystymo indekso ataskaitos informacija. Available from internet: http://hdr.undp.org/en/media/HDR_2010_EN_TechNotes_reprint.pdf.

Huselid, M. A., Becker, B. E., & Beatty, R. W. (2005). The Workforce Scorecard: Managing Human Capital to Execute Strategy. *Harvard Business Press*, *Mar 1. Business & Economics*, 278.

Lyman Ott, R., Longnecker, M. (2010). *An Introduction to Statistical Methods and Data Analysis*. Brooks/Cole. Cengage Learning.

Kearney, A. T. (2009). Global Retail Development Index. *Windows of hope for global retailers*, 1-5.

Kleynhans, E. P. J. (2006). The Role of Human Capital in the Competitive Platform of South African Industries. *SA Journal of Human Resource Management,* 4, 55-62. http://dx.doi.org/10.4102/sajhrm.v4i3.100

Larose, D. T. (2006). *Data Mining Methods and Models*. John Wiley and Sons, Inc.

Liepe, Z. (2012). Methodology principles of human capital evaluation in macro-level//*Economics and management = Ekonomika ir vadyba* [elektroninis isteklius]/Kaunas University of Technology. Kaunas: KTU. ISSN 1822-6515., 17(2), p. 753-759. [Business Source Complete; Current Abstracts; TOC Premier; Central & Eastern European Academic Source].

Lieser, K., & Groh, A. P. (2010). The Attractiveness of 66 Countries for Institutional Real Estate Investments: A Composite Index Approach. *IESE Business School – University of Navarra*, 63, 2-10.

Newman, B. A., & Thomson, R. J. (1989). Economics Growth and Social Development: a Longitudinal Analysis of Causal Priority. *World development*, 17(4), 71–100. http://dx.doi.org/10.1016/0305-750X(89)90255-6

Pereira, E. (2011). Developing Countries Will Lead Global Growth in 2011. World bank. Is *Forbes*. Available from internet: http://www.google.lt/imgres?imgurl=http://blogs-images.forbes.com/evapereira/files/ 2011/01/ Developed_ and_developing_countries3.png&imgrefurl=http://blogs.forbes.com/evapereira/2011/01/12/.

Ployhart, R. E., & Moliterno, T. P. (2011). Emergence of the Human Capital Resource: a Multilevel Model. *Academy of Management Review,* Vol. 36, No. 1, 127-150. http://dx.doi.org/10.5465/AMR.2011.55662569

Sakalas, A., & Liepe, Z. (2010). Human Capital and it's Measurement Insight Attitudes. *Economics and Management.* Kaunas University of Technology. Kaunas: Technologija, 15, 726-732.

Scholz, Ch. (2007). Human Capital Management – More than just a Phrase. *German Journal of Human Resource Research*, 21(3).

Schultz, T. W. (1964). *Investment in Human Capital*. Economic Growth – an American Problem, Englewood Clifts.

Schultz, T. W. (1998). *Investavimas i zmones. Gyventoju kokybes ekonomika*. Vilnius: Eugrimas.

Thanawala, K. (2007). Economic Development and All That. *International Journal of Social Economics*, 17(12), 18.

Wen-jen Hsieh; & Yu Hsing. (2002). Economic Growth and Social Indicators: the Case of Taiwan. *International Journal of Social Economics*, 29(7), 519.

Wolfram Mathworld. (2011). Tinklapio „Wolfram Mathworld" informacija. Available from internet: http://mathworld.wolfram.com/.

World bank. (2011). Pasaulinio banko „The world bank" informacija. Available from internet: http://data.worldbank.org/ indicator/FP.CPI.TOTL.ZG

Algimantas Sakalas, Žiedūna Liepė

Žmogiškojo kapitalo sistemos vertinimas Europos Sąjungos šalių kontekste

Santrauka

Žmogaus gebėjimų plėtra ir naudingų žinių kaupimas yra ekonomikos produktyvumo ir žmonių gerovės augimo pagrindas (Schultz, 1998). Žmogiškojo kapitalo koncepcija ekonomikos mokslui yra žinoma mažiausiai jau penkiasdešimt metų (Schultz, 1964; Becker, 1962), kai buvo pradėta kalbėti apie tokias problemas kaip individo produktyvumas. Dabartinių laikų ekonomikos teorijose ir mokslinėje literatūroje, plačiai pripažįstamas žmogiškojo kapitalo vaidmuo ir jo valdymo būtinumas (Scholz ir kt., 2004; Huselid ir kt., 2005; Kleynhans, 2006; Scholz, 2007; Sakalas, Liepe, 2010; Erosa ir kt., 2010; Ployhart, Moliterno, 2011). Todėl yra ypač svarbu išnagrinėti žmogiškojo kapitalo formavimą ir panaudojimą kaip valdomą procesą, kurį reikia gerai pažinti tiek mikro-, tiek ir makrolygiu.

Vertinant žmogiškąjį kapitalą makrolygmeniu, svarbu, kad matavimo priemonės apibūdintų ne tik jo kiekį ir kokybę, juos lemiančius veiksnius, bet leistų juos palyginti tarptautiniu mastu (Sakalas, Liepe, 2010).

Tyrimo objektas – žmogiškojo kapitalo sistemos lygio vertinimas ES šalių kontekste.

Žmogiškojo kapitalo (toliau – ŽK) sistemų vertinimas makrolygmeniu turi tam tikrų apribojimų:

1. ŽK sistemos vertinimas turi apimti ne tik tiesioginį ŽK vertinimą, bet ir ŽK aplinkos vertinimą. Tai platesnė samprata nei ŽK vertinimas piniginiais vienetais.

2. ŽK sistemos vertinimo tikslas yra suformuoti reikalingą pagalbinių rodiklių bazę žmogiškajam kapitalui vertinti.

3. ŽK vertinimo patikimumą statistinės sistemos lygiu. Kalbant apie ES šalių žmogiškojo kapitalo sistemos tyrimą, jo patikimumas priklauso nuo *Eurostate* skelbiamų duomenų lygio.

Straipsnio tikslas – sukurti ŽK sistemą, kompleksiškai apibūdinančią rodiklių visumą ir jų įvertinimo metodiką, jos pagrindu atlikti ŽK sistemų lygio palyginamąją analizę tarp ES šalių.

Tyrimo metodai – mokslinių literatūros šaltinių išsami apžvalga, palyginamoji analizė ir sintezė, duomenų naršymo metodo daugiafaktorių indeksų analizė.

Pritaikant daugiafaktorių indeksų skaičiavimo metodą, šiame straipsnyje siekiama atskleisti ŽK sistemą kompleksiškai apibūdinančių rodiklių formavimo principus, sukurti jų įvertinimo metodiką ir jos pagrindu atlikti ŽK sistemų lygio palyginamąją analizę tarp ES šalių. Šiam tikslui pasiekti buvo išnagrinėti pagrindiniai daugiafaktorinio indeksų metodo taikymo privalumai, buvo suformuota ES šalių ŽK sistemos vertinimo indekso struktūra, pagal kurią buvo atliktas palyginamasis šalių grupių vertinimas.

Daugiafaktorinio indeksų metodo taikymo privalumai. Vertinant ŽK, reikia žinoti, jog ŽK sąvoka yra plati ir daugialypė (Liepe, 2012; Baron, Armstrong, 2007; Scholz, Stein, Bechtel, 2004), todėl nepakanka pavienių rodiklių, o turi būti parinktas tam tikras rodiklių rinkinys, atspindintis šios sąvokos kompleksiškumą. Turi būti vertinami tokie socialiniai, ekonominiai ir inovaciniai rodikliai, kaip skurdo mažinimas, švietimas, žmonių kvalifikacijos kėlimas, sveikatos apsaugos lygis, naujagimių mirtingumas, technologijų plėtra ir kt. – tai sritys, kurios turi papildyti ŽK vertinimo makrolygmeniu koncepciją.

Kiekvienas kitoks socialinis ar ekonominis rodiklis gali būti išreiškiamas individualiu indeksu – indikatoriumi, parodančiu šio rodiklio lygį analizuojamoje grupėje. Indeksų metodo privalumas, kad gali būti apskaičiuotas kelių ar net keliolikos dalinių indeksų suvestiniai indeksai, kurių pagrindu gali būti apskaičiuojamas vienas kompleksinis indeksas. Tokie kompleksiniai indeksai, kaip *Tvarios ekonominės gerovės* indeksas, *Tikrosios gerovės* vertinimas, *Tikrosios pažangos* rodiklis, *Ekonominės gerovės matas*, *Vidaus pažangos matas* ir kt. (Genuine Wealth Assessment, 2012) labai plačiai naudojami vertinant atskirų šalių lygį tam tikroje srityje. Didelis šio metodo privalumas, kad ekonominius ir socialinius indeksus galima sujungti (Wen-jen Hsieh; Yu Hsing, 2002). Anot Čiegio ir kt. (2009) retai egzistuoja tobuli indikatoriai, jų kūrimas apima tam tikrą metodologinį kompromisą tarp techninio galimumo, visuomeninio tinkamumo naudoti ir sisteminio neprieštaringumo.

Šalių ŽK sistemos kompleksinio indekso konstravimo metodika. Tyrimas apėmė – 27 ES šalis, kurios yra skirtingos tiek ekonominiu, tiek socialiniu lygiu, tačiau jas vienija bendrų politinių ir ekonominių tikslų siekimas ir savitarpio pagalba siekiant šių tikslų. Analizuojamų šalių ŽK sistemos vertinimo bazę sudaro daugybė socialinių ir ekonominių rodiklių, kurie priklausomai nuo šalies dydžio, sistemos efektyvumo išreiškiami įvairaus dydžio absoliutiniais ar santykiniais rodikliais. Atskirų rodiklių parinkimas buvo grindžiamas ekonomine logika, tai yra priklauso nuo ekonominių dėsningumų žinojimo ir tyrėjo kvalifikacijos. Todėl konstruojant ŽK sistemos indeksą, rodikliai buvo atrenkami remiantis šiais kriterijais: atrinkti rodikliai turi būti renkami visose tirtose ES šalyse; 2010 metų rodiklių naudojimą tyrime nulėmė *Eurostat* duomenų vėlavimas; išimtinais atvejais, kai buvo tam tikrais metais atlikti specialūs tyrimai, jų duomenys gali būti panaudoti neviršijant 3-jų metų ribos; trūkstant duomenų, kitų metų rodikliams suformuoti gali būti pasinaudota ekstrapoliacijos metodais (Lyman Ott, Longnecker, 2010).

ŽK vertinimo tyrimo metodo parinkimas priklauso nuo disponuojamųjų duomenų tipo – kiekybiniai ar kokybiniai duomenys. Kadangi tyrimo duomenų bazę sudaro kiekybiniai duomenys, todėl matematiniams duomenims apdoroti buvo taikomas duomenų naršymo metodas, panaudojant aprašomosios statistikos tiriamąją daugiamatę faktorinę indeksinę analizę ir koreliacinę regresinę analizę.

Algimantas Sakalas, Zieduna Liepe. *Human Capital System Evaluation in the Context of the European Union Countries*

Duomenų naršymo metodas (plg angl. *Data mining*) – apima procesą, skirtą ištraukti informacijai iš duomenų ir paprastai naudojamas didelės apimties duomenims analizuoti. Anot Larose (2009), duomenų naršymo metodo procesą galima suskirstyti į kelis etapus – duomenų ieškojimas duomenų bazėse; duomenų susiejimas; duomenų atrinkimas ir naujo modelio sukūrimas. Pirmasis žingsnis – duomenų ieškojimas duomenų bazėse – buvo atliekamas, atsižvelgiant į analizuojamo tyrimo objekto, t. y. ŽK ypatumus (daugiau informacijos ieškoti „Methodology principals of human capital evaluation in macro level" Liepė, 2012).

ŽK sistemos kompleksinis indeksas buvo formuojamas pagal septynis etapus: duomenų apdorojimas; dispersijos apskaičiavimas; trūkstamų duomenų apskaičiavimas; atliktas skalių suvienodinimas; statistinis validumo tikrinimas; šalių reitingavimas; šalių grupių išskyrimas.

ES šalių ŽK sistemos vertinimo indekso struktūra. Pirminė duomenų bazė buvo sudaryta remiantis Europos Sąjungos šalių duomenimis, skelbiamais *Eurostat*, *World Data Bank*, *Žmogaus socialinės raidos* pranešimų statistinėse duomenų bazėse ir ištirta pagal rodiklių tarpusavio ryšių stiprumo požymius. Empiriniam tyrimui atlikti buvo atrinkti stipriai su ŽK vertės rodikliais koreliuojantys rodikliai, kurie buvo sujungti, tarpusavyje juos grupuojant ir sujungiant į vieną kompleksinį indeksą. Patikrinti ar tyrimo imtis buvo pakankama ar ne, buvo panaudota KMO-test (plg. angl. *Kaiser-Meyer-Olking*) analizė, nustačius KMO koeficientą, kiekvienos skalės reliabilumas (arba patikimumas) buvo tikrinamas apskaičiuojant *Cronbach's alfa* koeficientą, kuris parodo, kaip glaudžiai kintamųjų rinkinys yra susijęs tarpusavyje kaip grupė. Taip pat buvo atlikta analizuojamų duomenų faktorinė analizė, kuria buvo siekiama įvertinti šalies ŽK sistemos indeksą sąlygojančių veiksnių grupių ir juos apibūdinančių rodiklių matavimo skalių tinkamumą ir patikimumą, vertinant atskirų ES šalių grupių ŽK.

 Remiantis šia analize buvo suformuota kompleksinio ŽK sistemos indekso skaičiavimo struktūra. Apskaičiuoti individualūs, grupiniai ir kompleksiniai indeksai leido išskirti artimas pagal rodiklių lygį šalių grupes – klasterius. Moksliniuose tyrimuose, analizuojant skirtingus reiškinius, yra išskiriamos išsivysčiusios, pažengusios ir besivystančios šalys (Pereira, 2011), tačiau šalių klasifikacija priklauso nuo nagrinėjamos problemos (Lieser, Groh, 2010; Kearney, 2009).

Išvados. Atliktas 27 Europos Sąjungos šalių ŽK sistemos palyginamasis vertinimas, panaudojant penkias indeksų grupes (socialinis, inovatyvumo, vartojamosios vertės – pajamų, kaštų ir ekonominės plėtros), leido atrinkti veiksmingus indeksus, suformuoti informacinę bazę, pagal kurią galima įvertinti ŽK sistemos formavimo lygį ir jį lemiančių veiksnių įtaką atskirose ES šalyse.

Remiantis loginiu grupavimo principu ir apskaičiuotais daliniais ir kompleksiniais indeksais, pagal rodiklių lygį buvo išskirtos artimos keturios šalių grupės. Lietuva, kartu su kitomis šešiomis valstybėmis (Latvija, Slovakija, Lenkija, Vengrija, Bulgarija ir Rumunija) papuolė į ketvirtąją – žemiausio ŽK išsivystymo lygio grupę. Reikia paminėti, kad daliniai vertinimo indeksai atskirų šalių grupėse persidengia, tai yra atskirų indeksų reikšmės gali patekti į aukštesnį ar žemesnį šalių grupės vertinimo lygį.

Matematinis skaičiavimų patikimumas tik patvirtino jau anksčiau žinomus teiginius apie mūsų šalių atsilikimą, pagal ŽK išsivystymą, tai pat jo ne efektyvų panaudojimą. Dėmesio yra vertas kaimyninės šalies – Estijos patekimas į aukštesnę grupę.

Individualių indeksų lygio analizė sudaro galimybes išaiškinti tiek atsilikimą, tiek pažangą atskirose srityse ir numatyti priemones atsilikimui mažinti.