

The Research of Socio-Economic Development in The European Union Countries With An Application of The Modified HDI Indicator

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ABSTRACT

The aim of this paper will be the presentation of an alternative, a deeper one compared to the popular measure of the standard of living, which is HDI, a measure of the socio-economic development of residents of the European Union. In this article the synthetic index of the socio-economic development of the European Union countries will be presented. It will be calculated through the use of the following determinants: 'Economy and Finance', 'Science and Technology', 'Health', 'Education' and 'Living Condition'. This index of the socio-economic development of residents of the European Union countries will be created as an arithmetic mean of indicators counted for particular determinants. The index, which will be created, is treated as a modified Human Development Index due to the fact that it will be completed with the added information.

KEYWORDS: *Socio-economic development, the European Union countries, HDI index, synthetic index, development index*

INTRODUCTION

When we inquire about the prosperity of a nation or a region of the world and about the quality of life of its inhabitants the problem still arises: How do we determine this? What information do we require? Which criteria are truly relevant to human 'thriving'? Most social scientists and economists would agree that GNP per capita is a crude and incomplete measure of quality of life. (Nussbaum, Sen 1993, Szirmai 2015). What in this case is important about human quality of life? The problem is actually more complex. It is not only the money people do or do not have, it is about how they are able to conduct their lives and what factors influence it.

The Human Development Index (HDI) was created by M. ul Haq in 1990 with the help and advice of A. K. Sen, who established the first assumptions of comprehensive measurement of socio-economic development (Anand, Sen 1994). The index operationalized the broad concept of human development by combining health, education and income into a composite index (Aguña, Kovacevic 2010). The indicator itself was systematically improved. The most significant change was made in 2010 and was a reflection of several assumptions made by M. ul Haq, inter alia: possibility of measuring the basic concept of human development to expand humans' choices; including only a limited number of variables (to keep it simply and manageable); to be constructed rather than using plethora of separate indices; covering both social and economic choices; with the use of quite flexible methodology and resistance to missing data (ul Haq 2003). HDI is a synthetic measure based on the average of indicators covering three basic spheres of life:

1. The sphere of health, which is assessed by the ratio of the average life expectancy.
2. The sphere of education, which is assessed on the basis of the rate of educational attainment, as measured by two indicators of educational designated for the adult population, ie.: literacy (the share of people who could read and write with understanding) and schooling (the average time of education, understood as the average number years of schooling).
3. The sphere of income, which is assessed on the basis of GNP (US \$) per capita, calculated according to purchasing power parity (PPP \$).

On this basis, the geometric mean of the indicators is calculated and, in result, the HDI ranks countries on a scale from 0 (the lowest level of human development) to 1 (the highest level).

The necessity of finding a new measurement of the quality of life of societies is emphasized by international organizations and especially scientists. That is why the author decided to modify the standard measure. Nowadays important factors are also science and technology and the standard of human living.

That is why, in this paper the following determinants of socio-economic development will be used:

1. Economy and Finance
2. Science and Technology

3. Health
4. Education
5. Living Conditions

MATERIALS AND METHODS

The construction of the synthetic measure of development requires the division of diagnostic variables set to stimulants and destimulants. Variables included in the set of stimulants have been marked with the sign (+), while the (-) granted destimulants. The transformation of destimulants to stimulants was made according to the following formula:

$$x_{ij}^{\{S\}} = \max_i x_{ij}^{\{D\}} - x_{ij}^{\{D\}} \quad (1)$$

where:

- x_{ij} – value of the j-th variable for the i-th country,
- S symbol indicates stimulant, while the symbol D destimulant.

Then, after the transformation of destimulants to stimulants, the normalization of variables was used according to the following formula:

$$u_{ij} = \frac{x_{ij}}{\max_i \{x_{ij}\}} \quad (i = 1, \dots, n; j = 1, \dots, m) \quad (2)$$

where:

- u_{ij} – normalized value of the j-th variable for the i-th country,
- n – number of countries,
- m – number of variables.

Synthetic measure of the socio-economic development was calculated by the following formula:

$$u_i = \frac{1}{r} \sum_{q=1}^r u_{iq}, \quad (i = 1, \dots, n; q = 1, \dots, r) \quad (3)$$

where:

- u_{iq} – synthetic variable value for the i-th country calculated on the basis of the variables belonging to the q-th determinant,
- r – number of determinants.

In contrast, measures of socio-economic development according to separate determinants was calculated using the following formula (Zelias 2004):

$$u_{iq} = \frac{1}{m} \sum_{j=1}^m u_{ij}, \quad (i = 1, \dots, n; j = 1, \dots, m) \quad (4)$$

A detailed list of indicators used for the construction of indicators for individual determinants of socio-economic development has been given below. Indicators have been selected based on the availability of Eurostat data.

I. Economy and Finance

1. Unemployment rate (-)
2. GDP per capita 1 (+)
3. Indicator of real expenditure per 1 inhabitant (+)
4. The number of poor people per 1000 inhabitants (-)

II. Science and Technology

1. Gross domestic expenditure on R&D (% of total expenses) (+)
2. Human resources in science and technology (% of the active population) (+)
3. The number of patent applications submitted to the European Patent Office per million inhabitants (+)
4. The number of researchers per 1000 inhabitants (+)

III. Health

1. Self-perceived long-standing limitations in usual activities due to health problem (-)
2. Self-reported unmet needs for medical care due to being too expensive (-)

3. Healthy life years (+)
4. Number of doctors per 1000 inhabitants (+)
5. Number of beds in hospitals per 100 000 inhabitants (+)

IV. Education

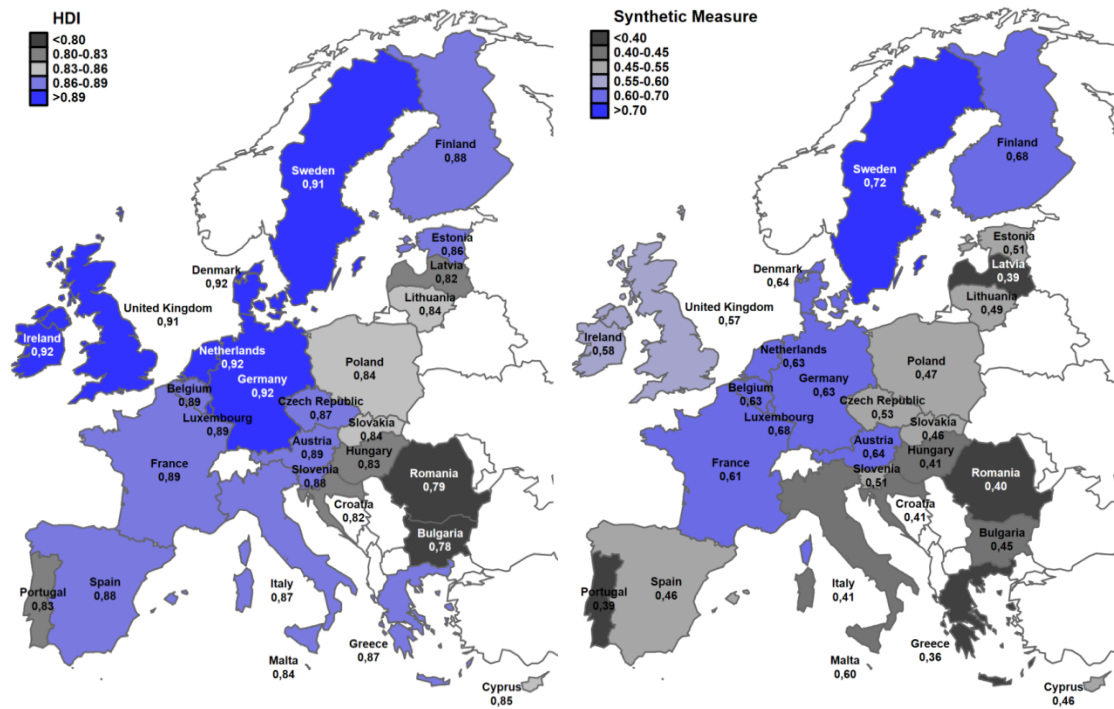
1. Participation rate in education and training (persons aged 25 to 64 years old) (+)
2. The percentage of people with at most lower secondary education and with no further education at the age of 18-24 years old (-)
3. The percentage of people obtaining a higher education between the age of 20 and 24 years old (+)
4. The percentage of people gaining or with higher education aged 15 to 64 (+)
5. The percentage of people with secondary education between the age of 15 to 64 (+)

V. Living Conditions

1. The percentage of people who are unable to meet unexpected financial expenses (-)
2. The percentage of people who are not able/unable to make ‘ends meet’ (-)
3. The rate of people at risk of poverty (-)
4. Share of people living in under-occupied dwellings (+)

RESULTS AND DISCUSSION

The proposed construction of a synthetic measure of socio-economic development is based on five pillars. On the basis of the values of synthetic measures for each determinant of socio-economic development, the final synthetic measure was calculated (table 1 and figure 2). According to the low correlation between variables, the synthetic index was calculated on the basis of all of the analyzed indicators. On the 1. graph the values of HDI index for EU countries are presented. The distribution of HDI values in the EU countries is not very diverse (figure 1), if it is assumed that - hypothetically, this indicator may have values from 0 to 1. In addition, it is a substantive conclusion - HDI is characterized by very low sensitivity for changes in conditions life. Partial indicators included in the HDI: GDP, life expectancy and indicators related to the level of education show high stability over time. Therefore, HDI values, for example, the financial crisis of 2008, which afflicted a country such as Greece, Spain or Ireland, hardly shows, while living standards in the dynamically developing countries of the "new" Union are relatively low (Poland, the Czech Republic, Hungary, etc.).



1 figure. Values for HDI measure
(Source: author’s calculations)

2 figure. Values for ‘Synthetic measure’
(Source: author’s calculations)

Ranking of the EU countries according to the modified synthetic indicator of the socio-economic development was presented in the table 1. It can be seen that the highest values obtained Scandinavian countries – Sweden, Finland and then Luxembourg. The lowest values Portugal, Latvia and Greece, where the highest impact of financial crisis was observed.

Table 1. Positioning the EU countries according to the modified synthetic indicator of the socio-economic development

	Economy and Finance	Science and Technology	Health	Education	Living conditions	Synthetic measure
Sweden	4	2	17	1	1	1
Finland	6	1	16	3	3	2
Luxembourg	1	9	4	6	14	3
Denmark	3	3	6	2	17	4
Austria	5	7	5	9	6	5
Belgium	12	5	23	18	5	6
Germany	9	4	9	16	9	7
Netherlands	7	6	15	8	4	8
France	14	8	19	5	7	9
Irland	13	11	13	14	8	10
Malta	2	24	20	28	2	11
Great Britain	11	10	2	4	12	12
Czech Republic	16	13	24	11	13	13
Slovenia	15	12	3	10	21	14
Estonia	10	14	14	7	15	15
Lithuania	18	16	10	12	18	16
Poland	21	21	11	17	16	17
Spain	27	15	7	23	10	18
Slovakia	24	23	1	19	11	19
Hungary	19	18	12	21	28	20
Cyprus	8	25	18	13	25	21
Bulgaria	25	26	26	22	20	22
Croatia	26	27	22	20	19	23
Italy	22	20	27	25	23	24
Romania	20	28	8	26	22	25
Portugal	23	17	21	27	26	26
Latvia	17	19	28	15	27	27
Greece	28	22	25	24	24	28

(Source: author’s calculations)

Figures 3-7 present regression models for individual determinants of socio-economic development. Models of regression functions allowed to obtain estimated parameters for synthetic measure in terms of each of the determinants of socio-economic development.

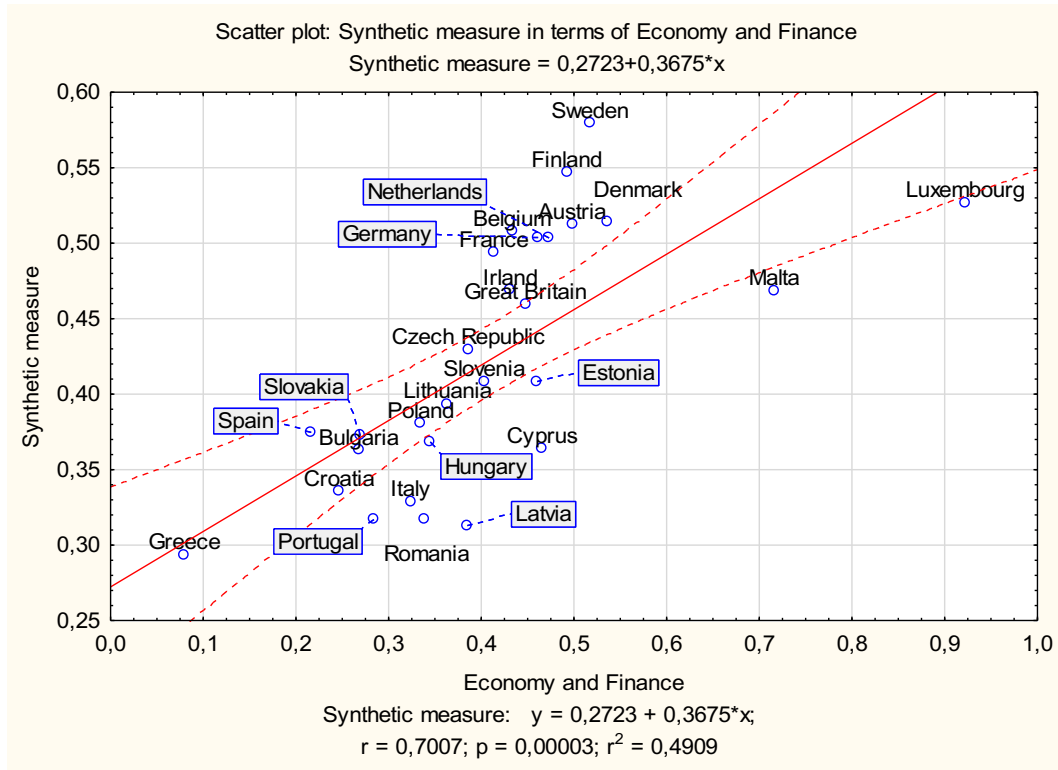


Figure 3. Regression function parameters – synthetic measure in terms of Economy and Finance
(Source: author’s calculations)

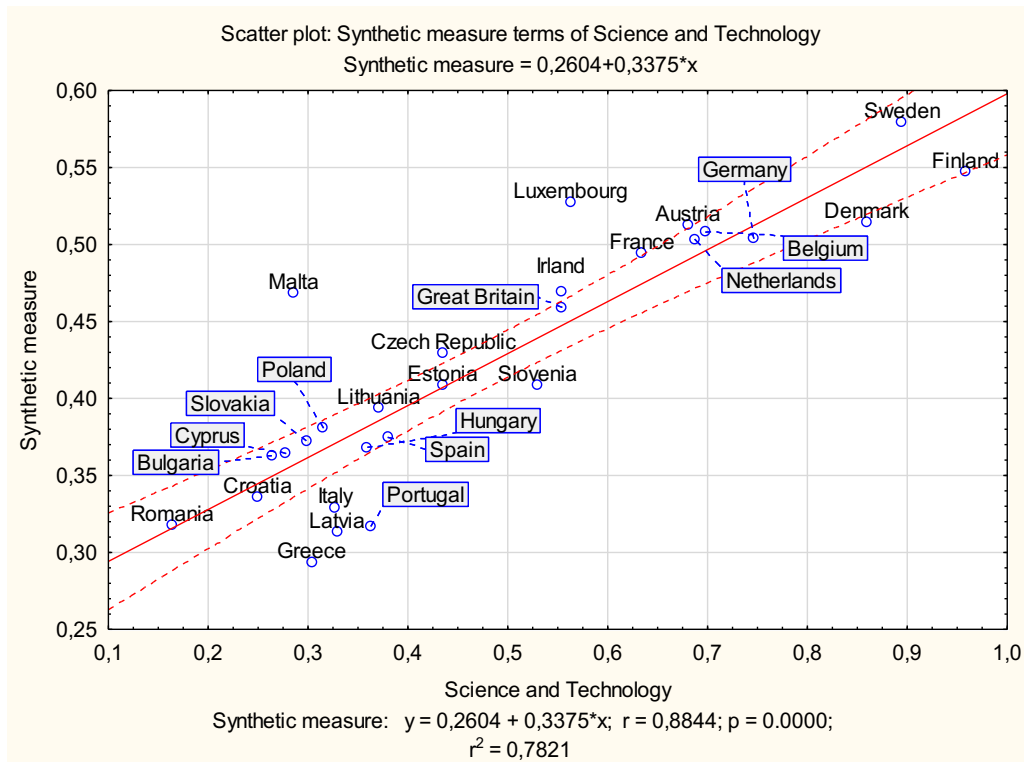


Figure 4. Regression function parameters – synthetic measure in terms of Science and Technology
(Source: author’s calculations)

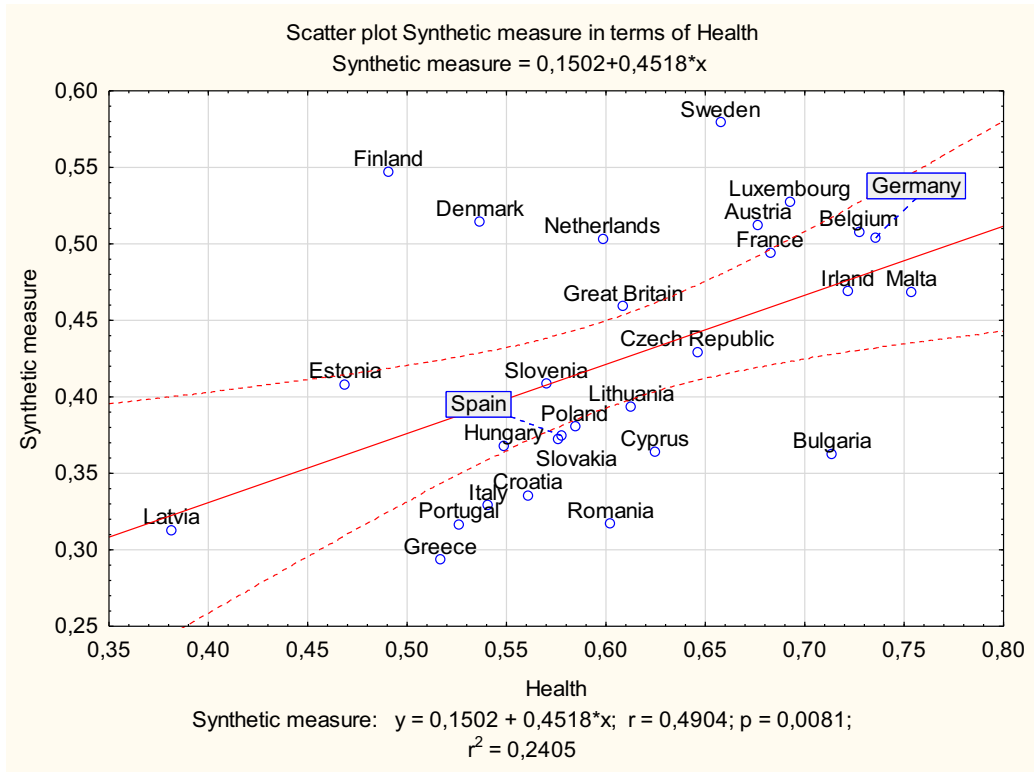


Figure 5. Regression function parameters – synthetic measure in terms of Health
(Source: author’s calculations)

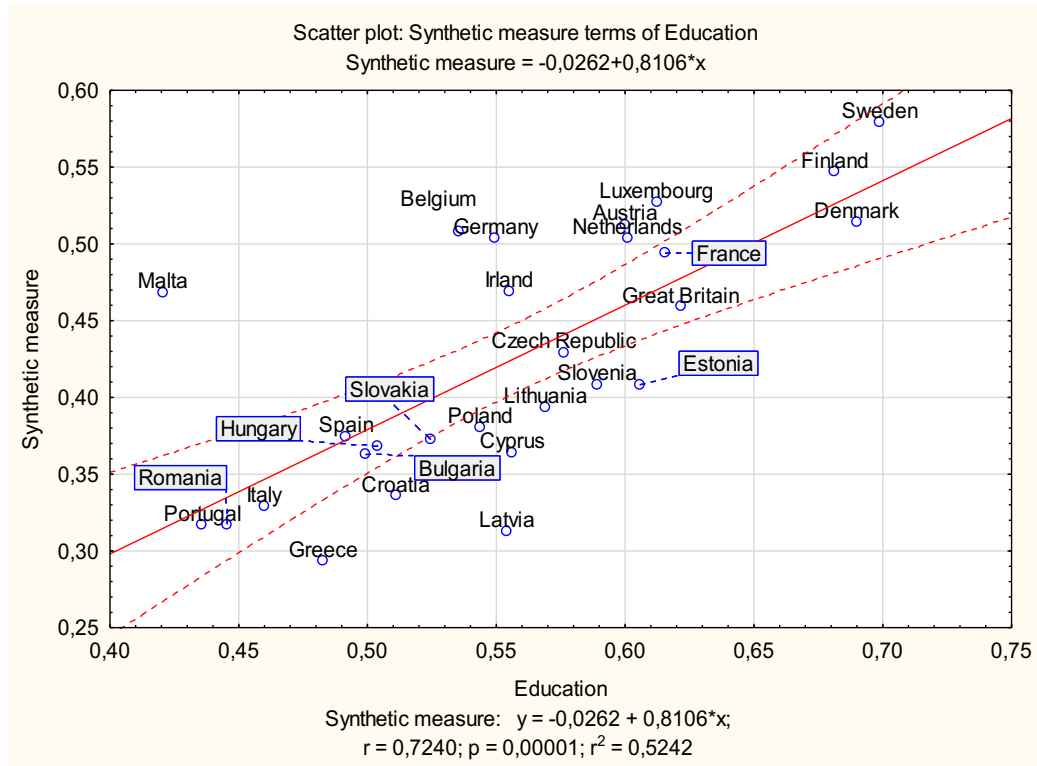


Figure 6. Regression function parameters – synthetic measure in terms of Education
(Source: author’s calculations)

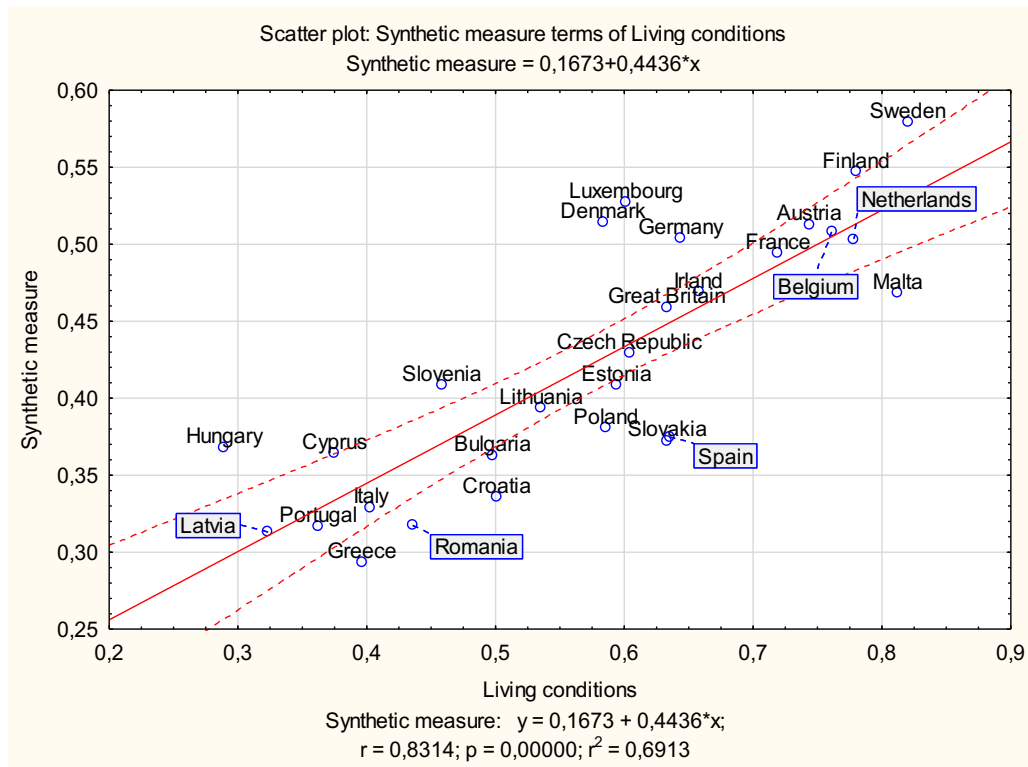


Figure 7. Regression function parameters – synthetic measure in terms of Living Conditions
(Source: author’s calculations)

Models of regression functions (presented in Figures 3-7) allowed to obtain estimated parameters for each of the determinants of socio-economic development. Their interpretation will allow to state if the synthetic measure increases, if each determinant increases by 1. This will allow to estimate which determinant has the greatest impact on the socio-economic development of EU countries. From the estimated results, it was obtained that Science and Technology ($r = 0.88$) and Living Conditions ($r = 0.83$) have the greatest impact on socio-economic development. By interpreting the parameters of the models, we will obtain that if we increase the expenditure on Economy and Finance by 1, then an increase in the synthetic measure by 0.37 will be obtained. In the case of Science and Technology, if we increase the expenditure on this determinant by 1, then we will obtain an increase in the synthetic measure by 0.34, in Health by 0.45, in Education by 0.81 and in Living conditions by 0.44.

CONCLUSION

The aim of this paper was the presentation of an alternative, a deeper one compared to the popular measure of the standard of living, which is HDI, a measure of the socio-economic development of residents of the European Union. It was calculated through the use of the following determinants: ‘Economy and Finance’, ‘Science and Technology’, ‘Health’, ‘Education’ and ‘Living Condition’. The index, which was created, is treated as a modified Human Development Index due to the fact that it was completed with the added information.

Another issue is the fact that the universally used HDI does not show the property of presenting the sensitivity of the processes taking place in individual countries. In a dynamically changing reality, there is the need for creating indicators of the conditions of social life that will be sensitive to the processes taking place in individual countries. The traditional HDI index does not show this property.

REFERENCES

- Aguña, C.G., Kovacevic, M. (2010). *Uncertainty and Sensitivity Analysis of the Human Development Index*, “Human Development Research Paper” vol. 47.
- Allardt E., *Having, Loving, Being: An Alternative to the Swedish Model of Welfare Research* [w:] Nussbaum M., Sen A. (red.), *The Quality of Life*, Oxford, Clarendon Press 1993
- Anand, S. Sen, A. K. (1994). *Human Development Index: Methodology and Measurement*, Human Development Report Office Occasional Papers, vol. 12.
- Andersen E.B., *The Statistical Analysis of Categorical Data*, Springer-Verlag, Berlin 1991
- Andrews F.M. (red.), *Research on the Quality of Life*, Survey Research Center, The University of Michigan 1986
- Andrews F.M., Withey S.B., *Social Indicators of Well-being*, Plenum, New York 1976

- Backhaus K., Erichson B., Plinke W., Schuchard-Fischer Chr., Weiber R., *Multivariate Analysenmethoden*, Berlin, Springer-Verlag 1989
- Bartholomew D.J., *The Statistical Approach to Social Measurement*, Academic Press, London 1996
- Bullinger M., *Ensuring International Equivalence of Quality of Life Measures: Problems and Approaches to Solutions* [w:] Orley J., Kuyken J. (red.), *Quality of Life Assessment: International Perspectives*, Berlin - New York - Tokyo, Springer 1993
- Busato, F., Maccari, N. (2016). *The Environmental Human Development Index*, “Rivista di Studi Sulla Sostenibilita”, vol. 14, pp 31-44.
- Diener E., Biswas-Diener R., *Will Money Increase Subjective Well-Being?* [w:] Michalos A.C. (red.), *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement*, Springer 2002
- Diener E., Suh E., *Measuring Quality of Life: Economic, Social, and Subjective Indicators* [w:] Michalos A.C. (red.), *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement*, Springer 1997
- Estes R. J. (red.), *Advancing Quality of Life in a Turbulent World*, Vol. 29, Springer 2006
- Frei B.S., Stutzer A., *Happiness and Economics*, Princeton University Press 2002
- Ghislandi S., Sanderson W.C., Scherbov S., *A Simple Measure of Human Development: The Human Life Indicator*, Wiley 2018
- Gillingham R., Reece W.S., *Analytical Problems in Measurement of the Quality of Life*, Social Indicators Research, 1980, Vol. 1-4
- Glatzer W., *Quality of Life in the European Union and the United States of America: Evidence from Comprehensive Indices*, Applied Research in Quality of Life, 2006, nr 1
- Grabiński, T. (2003). *Analiza taksonometryczna krajów Europy w ujęciu regionów*, Akademia Ekonomiczna w Krakowie, Kraków, Poland.
- Haller M., Hadler M., *How Social Relations and Structures can Produce Happiness and Unhappiness: An International Comparative Analysis* [w:] Michalos A.C. (red.), *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement*, Springer 2006
- ul Haq, M. (2003). *The Birth of the Human Development Index*, in “Readings in Human Development”, ed. S. Fukuda-Parr and A. K. Shiva Kuma, Oxford, United Kingdom, pp 127-137.
- Hassan, H.M, Ibrahim, O. A. (2010). *A Revised Human Development Index (RHDI) for Sudan: An Empirical Study*, Working Paper available at SSRN. (<http://dx.doi.org/10.2139/ssrn.1530405>).
- Henderson H., Lickerman J., Flynn P., (ed.), *Quality of Life Indicators, A new tool for assessing national trends*, Calvert-Henderson, 1999
- Jobson J.D., *Applied Multivariate Data Analysis. Vol. II, Categorical and Multivariate Methods*, Springer-Verlag, New York 1992
- Kai-Tai F., Yao-Ting Z., *Generalized Multivariate Analysis*, Springer-Verlag, Berlin 1990
- Kelley, Allen C., *The Human Development Index: Handle with care*, Population and Development Review 17(2), 1991
- Kovacevic, M., *Review of HDI Critiques and Potential Improvements*, Human Development Research Paper 2010/33, New York: United Nations Development Programme, http://hdr.undp.org/sites/default/files/hdrp_2010_33.pdf.
- Maccari, N. (2014). *Environmental sustainability and Human Development: a greening of Human Development*, Working Paper available at SSRN. (<http://dx.doi.org/10.2139/ssrn.2426073>).
- Malina A., Zeliaś A., *On Building Taxonomic Measures on Living Conditions*, Statistics in Transitions, vol. 3, nr 3, 1998
- Michalos A.C., *Combining social, economic and environmental indicators to measure sustainable human well-being*, Volume 40, Issue 1–2, Springer 1997
- Michalos A.C. (red.), *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement*, Journal no. 11205, Springer Netherlands 2006
- Phillips D., *Quality of life – concept, policy and practice*, Routledge, New York 2006
- Prescott-Allen R., *The Wellbeing of Nations: A Country-by-Country Index of Quality of Life and the Environment*, Island Press, Waszyngton-Covelo-Londyn, 2001
- Sagar, Ambuj D. and Adil Najam, *The Human Development Index: A critical review*, Ecological Economics 25(3), 1998, 249–264. [https://doi.org/10.1016/S0921-8009\(97\)00168-7](https://doi.org/10.1016/S0921-8009(97)00168-7)
- Sirgy, M.J., Rahtz D., Swain D. (red.), *Community Quality-of-Life Indicators, Best Cases II*, Vol. 28, Springer 2006
- Slottje D., Scully G., Hirschberg J., Hayes K., *Measuring the Quality of Life across Countries*, Westview Press, San Francisco 1991
- Szirmai A. (2012). *The Dynamics of Socio-Economic Development*, Cambridge University Press.
- Szirmai A. (2015). *Socio-Economic Development*, Universiteit Maastricht, Netherlands.

- Theofilou P., *Quality of Life: Definition and Measurement*, „Europe’s Journal of Psychology”, Vol. 9 (1), 2013
- Whelan C.T., Layte R., Maitre B., Nolan B., *Income, deprivation and economic strain in European Social Review*, Vol. 17, No. 4, 2001
- Wilson L., *Developing a Model for the Measurement of Social Inclusion and Social Capital in Regional Australia* [w:] Michalos A.C. (red.), *Social Indicators Research: An International and Interdisciplinary Journal for Quality-of-Life Measurement*, Springer 2006
- Wolff H., Chong H., Auffhammer M., *Classification, detection and consequences of data error: Evidence from the Human Development Index*, *The Economic Journal* 121(553): 843–870, 2011
- Zeliaś A. (Eds.) (2004). *Poziom życia w Polsce i krajach Unii Europejskiej*, PWE, Warszawa.
- http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/USA.pdf
- Human Development Report 2016 http://hdr.undp.org/sites/default/files/2016_human_development_report.pdf.