BANKU AUGSTSKOLA

Rakstu krājums

Vadībzinātne • Ekonomika

II

BIZNESA UN FINANŠU
PĒTNIECĪBAS CENTRS

2011

QUALITY OF HUMAN CAPITAL: MULTIDIMENSIONAL ANALYSIS FOR EUROPEAN UNION COUNTRIES[1]

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Summary

Overall quality of human capital of a country is currently considered as one of the most important determinant of competitive position of economy. As a result the differences in that factor influence economic potential of a country. In order to form effective public policies and propose some strategies for improving this factor one needs to point some leaders in the field to learn from them and to know the countries whose mistakes should be avoided. Thus the subject of the article is to assess the differences in quality of human capital in European Union countries. Due to the fact that the quality of human capital is considered as ambiguous and multi-definable phenomena, some tools of statistical multivariate analysis were applied in the research. In this case, zero unitarization method was used. The statistical material needed to complete the study was obtained from a Eurostat database.

Key words: quality of human capital, knowledge based economy, multivariate analysis.

Introduction

Human capital is currently considered as one of the most important factors influencing competitiveness and innovativeness of economy. Economists and policy makers understand that creation and utilization of knowledge is going to have the dominant role in the process of growth in XXI century (Balcerzak 2009, pp. 54-70; Bassanini et all 2000). Hence, the differences in abilities to utilize knowledge on the national level will determine international economic position and future of every society. These abilities are mostly influenced by overall quality of human capital of a country. This means that all societies wanting to participate in the globalized knowledge based economy have to form effective public policies and propose strategies for constant improving quality of their human capital. In that context there is a need for international comparisons of different approaches to forming policies improving quality of human capital and its results. That kind of comparisons can be helpful in pointing some leaders in the field to learn from them and to know the countries whose mistakes should be avoided.

Thus, the subject of the article is to assess the differences in quality of human capital in European Union countries in the years 2002-2008. That period is mostly determined by availability of data for a panel of all EU member states. Due to the fact that the quality of human capital is considered as ambiguous and multi-definable phenomena, some tools of statistical multivariate analysis were applied in the research. That approach has currently quite strong theoretical background (Kunasz 2009, pp. 35-47; Balcerzak, Rogalska 2009, pp. 22-33). In this case, zero unitarization method was used. The statistical material needed to complete the study was obtained from a Eurostat database.

The method of taxonomic analysis

The most common feature of all researches concerning that complex problem is treating quality of human capital of a country as a multidimensional phenomenon. It means that its analysis should be based on some tool of multivariate statistical analysis. It is especially necessary in case of analysis in international dimension. In this paper, a taxonomic method of synthetic measure of development was

1 Publishing of this publication was funded by Nicolaus Copernicus University in Toruń from NCU grant 392-E.

used. The method enables to measure quality of human capital of a country that is based on a vector of indicators in international perspective.

In order to assess the quality of human capital in European Union countries data gathered by Eurostat for the year 2002-2008 for twenty seven countries of the European Union was used (Eurostat 2009). It should be stressed that due to the methodology based on changeable pattern of development this analysis cannot be treated as a dynamic research. However, it can still provide some patterns and directions of changes in the analyzed phenomenon.

The first stage of the analysis was building the set of potential diagnostic variables. In the beginning five sub-sets containing altogether thirty five variables that can represent factors connected to quality of human capital treated from the macroeconomic perspective. Tables from 1 to 5 contain the variables and descriptions of the type of variables. In case of stimulant for every two variables x_{ij}, x_{kj} that refer to objects A_i, A_k the relation $x_{ij} \rangle x_{kj} \Rightarrow A_i \, f \, A_k$ is fulfilled, where f means that object A_i is preferred to A_k. In that case a maximum value of a variable is preferred. In case of disstimulant for every two variables x_{ij}, x_{kj} that refer to objects A_i, A_k the relation $x_{ij} \rangle x_{kj} \Rightarrow A_i \, p \, A_k$ is fulfilled, where p means that object A_k is preferred to A_i object A_i. In that case minimum value of a variable is preferred (Walesiak 2002, pp. 16-19).

Table 1

General economic effectiveness of labour: conventional measure of labour quality

Variable	Type of variable: values preferred
x_1 – labour productivity per person employed	stimulant: max
x_2 – labour productivity per hour employed	stimulant: max

Source: own work.

Table 2

Conditions of labour markets

Variable	Type of variable: values preferred
x_3 – unemployment rate in the group of females	disstimulant: min
x_4 – unemployment rate in the group of males	disstimulant: min
x_5 – employment rate in the group of females	stimulant: max
x_6 – employment rate in the group of males	stimulant: max
x_7 – employment growth in case of females	stimulant: max
x_8 – employment growth in case of males	stimulant: max

Source: own work.

Table 3

Education adjustment to knowledge based economy requirements

Variable	Type of variable: values preferred
x_9 – life-long learning in case of females – percentage of the adult female population aged 25 to 64 participating in education and training	stimulant: max
x_{10} – life-long learning in case of males – percentage of the adult male population aged 25 to 64 participating in education and training	stimulant: max

x_{11} – youth education attainment – females as percentage of the population aged 20 to 24 having completed at least upper secondary education	stimulant: max
x_{12} – youth education attainment – males as percentage of the population aged 20 to 24 having completed at least upper secondary education	stimulant: max
x_{13} – spending on human resources measured as total public expenditure on education as a percentage of GDP	stimulant: max
x_{14} – science and technology graduates – females (graduates in mathematics, science and technology per 1 000 of population aged 20-29, tertiary graduates in science and technology per 1 000 of population aged 20-29 years	stimulant: max

Source: own work.

Table 4

Social Cohesion

Variable	Type of variable: values preferred
x_{15} – dispersion of regional employment rates - the dispersion of regional (NUTS level 2) employment rates of the age group 15-64 shows the regional differences in employment within countries and groups of countries	disstimulant: min
x_{16} – inequality of income distribution	disstimulant: min
x_{17} – at-risk-of-poverty rate before social transfers females	disstimulant: min
x_{18} – at-risk-of-poverty rate before social transfers males	disstimulant: min
x_{19} – at-risk-of-poverty rate after social transfers females	disstimulant: min
x_{20} – at-risk-of-poverty rate after social transfers males	disstimulant: min
x_{21} – at-persistent-risk-of-poverty rate females	disstimulant: min
x_{22} – at-persistent-risk-of-poverty rate males	disstimulant: min
x_{23} – early school leavers – females	disstimulant: min
x_{24} – early school leavers – males	disstimulant: min
x_{25} – long-term unemployment rate females – Long-term unemployed (12 months and more) as a percentage of the total active population	disstimulant: min
x_{26} – long-term unemployment rate males – Long-term unemployed (12 months and more) as a percentage of the total active population	disstimulant: min

Source: own work.

Table 5

Utilization of modern information and knowledge based economy infrastructure

Variable	Type of variable: values preferred
x_{27} – level of Internet access – households	stimulant: max
x_{28} – broadband penetration rate	stimulant: max
x_{29} – ICT expenditure by type of product	stimulant: max
x_{30} – e-Commerce via Internet	stimulant: max
x_{31} – e-government on-line availability	stimulant: max
x_{32} – e-government usage by individuals	stimulant: max
x_{33} – e-government usage by enterprises	stimulant: max
x_{34} – high-tech exports measured as exports of high technology products as a share of total exports	stimulant: max
x_{35} – gross domestic expenditure on R&D as a percentage of GDP	stimulant: max

Source: own work.

These potential diagnostic variables were verified with regard to availability of data for the panel of countries in the years 2002 to 2008. As a result, the following variables were eliminated from the set of potential diagnostic variables: from x_{13} to x_{22} and from x_{27} to x_{34}.

In the next stage of the analysis the remaining diagnostic variables were assessed with regard to criteria of information importance. The diagnostic variables should be characterized by high space variation, information importance and relatively low correlation.

High space variation means that diagnostic variables should not bear a strong resemblance to themselves in the sense of information about objects. In order to assess space variation a variation coefficient is used. When a variable has a lower value than accepted $V = \varepsilon$, it was eliminated from the set of diagnostic variables. In the study, the accepted value was $V = 10\%$. Only the variable x_6 was not fulfilling this criterion. As a result it was eliminated from the set of potential diagnostic variables.

Formal criteria of information importance also often include criterion of information significance. The variable fulfills this criterion when for stimulants it obtains low values of a variable. In order to assess the importance skewness coefficient is used which in case of stimulants for an important variable has positive values. When the distribution of a variable characterizes with left asymmetry it means that the variable weakly differentiates the analyzed objects as most of them obtain high values of a given feature. However, in this research this formal criterion could not be used. As a result of multidimensional process of convergence between EU countries in many aspects it is very difficult to find variables that strongly differentiate the countries. Thus, fulfilling this formal criterion would lead to unacceptable losses of important information.

The last formal criterion of information importance is based on the demand for low correlation between final diagnostic variables. When there is a high correlation between the variables it can lead to duplication of information. In case of high correlation between the variables some representative variables are selected with an accepted frontier value of correlation coefficient $r = r^*$. In this analysis $r^* = 0{,}8$ was set as the frontier value (Ostasiewicz 1998, pp. 115-117, 120-121; Zeliaś 2000, pp. 40-45). Table 6 presents the chosen representative variables in every year.

Table 6

Representative variables after correlation analysis for information importance in the years 2002-2008.

2002	2003	2004	2005	2006	2007	2008
x_1	x_1	x_1	x_1	x_1	x_1	x_1
x_3	x_3	x_3	x_3	x_3	x_3	x_3
			x_4	x_4	x_4	x_4
x_5	x_5	x_5	x_5	x_5	x_5	x_5
x_7	x_7	x_7	x_7	x_7	x_7	x_7
x_8	x_8	x_8	x_8	x_8	x_8	x_8
x_9	x_9	x_9	x_9	x_9	x_9	x_9
x_{10}						
x_{11}	x_{11}	x_{11}	x_{11}	x_{11}		x_{11}
					x_{12}	
	x_{25}					x_{25}
		x_{26}				x_{26}
x_{35}	x_{35}	x_{35}	x_{35}	x_{35}	x_{35}	x_{35}

Source: own study.

On the basis the two criteria of information importance that were implemented final set of diagnostic variables was selected. It included x_1, x_3, x_4, x_5, x_7, x_8, x_9, x_{11}, x_{35}.

The next stage of the analysis was the process of normalization of diagnostic variables. Zero unitarization method was used here. The literature on multivariate statistical analysis provides a great variety of normalization methods which quite often influence the results obtained. Zero unitarization method was used as it fulfills all postulates of effective normalization procedure and this normalization procedure results in normalized variables that are always positive and belong to the equal intervals (0. 1) (Kukuła 2000, p. 81). The transformation formulae were as follows:

1. In case of variables that were classified as stimulants:

$$z_{ij} = \frac{x_{ij} - \min\limits_i \{x_{ij}\}}{\max\limits_i \{x_{ij}\} - \min\limits_i \{x_{ij}\}} \quad (i = 1, 2... n); (j = 1, 2... m); z_{ij} \in [0,1]$$

2. In case of variables that were classified as disstimulant:

$$z_{ij} = \frac{\max\limits_i \{x_{ij}\} - x_{ij}}{\max\limits_i \{x_{ij}\} - \min\limits_i \{x_{ij}\}} \quad (i = 1, 2... n); (j = 1, 2... m); z_{ij} \in [0,1]$$

Finally the synthetic measure of development was constructed as follows:

$$SMD_i = \frac{1}{m} \sum_{j=1}^{m} \quad (i = 1, 2... n); (j = 1, 2... m); \; SMD_i \in [0,1]; \; z_{ij} \in [0,1]$$

Quite often some defined by experts or technically estimated weight factors are included in the process of constructing final synthetic measure. In this research weight factors were not used, as in the case of expert defined weight factors there is a wide space for arbitrary decisions influencing final results. On the other hand, technical methods of weight factors technical estimation are highly imperfect (Kukuła 2000).

The final results of the analysis are presented in table 7.

Table 7

Results of taxonometric analysis of quality of human capital in European Union countries in the years 2002 - 2008

Country	2002		2003		2004		2005		2006		2007		2008	
	SMD	No	SMD	No	SMD	No	SMD	No	SMD	No	SMD	No	SMD	No
Belgium	0,5987	11	0,5130	12	0,5473	11	0,5413	11	0,4435	16	0,4540	15	0,4886	11
Bulgaria	0,2955	25	0,3584	24	0,3664	23	0,3888	22	0,3540	21	0,3901	21	0,4264	17
Czech Republic	0,5542	14	0,4324	20	0,4802	14	0,4959	16	0,4544	14	0,5355	11	0,5023	10
Denmark	0,7542	2	0,6336	4	0,6540	6	0,6988	3	0,6934	1	0,7253	1	0,6967	1
Germany	0,5715	13	0,4630	13	0,5047	13	0,4380	18	0,3844	19	0,4315	17	0,4793	12
Estonia	0,5005	17	0,4582	14	0,4327	18	0,5009	15	0,6092	6	0,4875	14	0,4628	13
Ireland	0,6544	8	0,6162	6	0,6714	3	0,7327	1	0,6470	3	0,6364	6	0,4539	14
Greece	0,4704	22	0,4193	21	0,4411	17	0,3988	21	0,3566	20	0,3227	23	0,3304	23
Spain	0,4709	21	0,4430	17	0,4722	15	0,5188	12	0,4520	15	0,3956	20	0,2414	27
France	0,5920	12	0,5167	11	0,5236	12	0,5149	14	0,4308	17	0,4339	16	0,4486	15
Italy	0,5106	16	0,4527	16	0,4671	16	0,4303	19	0,4186	18	0,3973	19	0,3722	21
Cyprus	0,6088	10	0,6175	5	0,6019	8	0,5987	8	0,4939	12	0,5731	9	0,5525	8
Latvia	0,4904	19	0,4415	18	0,4323	19	0,4598	17	0,5316	10	0,5024	13	0,3825	19
Lithuania	0,4710	20	0,4365	19	0,3990	22	0,5159	13	0,4627	13	0,5487	10	0,4000	18
Luxembourg	0,6853	6	0,6126	7	0,6317	7	0,6442	7	0,6221	4	0,6542	3	0,6148	6
Hungary	0,5179	15	0,4564	15	0,4142	20	0,4089	20	0,3451	22	0,2940	24	0,2810	26
Malta	0,3822	24	0,3097	26	0,2616	27	0,3391	23	0,2321	27	0,3284	22	0,3427	22
Netherlands	0,7139	5	0,5960	9	0,5872	9	0,5972	9	0,5890	7	0,6504	5	0,6299	5
Austria	0,6677	7	0,5985	8	0,6549	5	0,6522	6	0,5880	8	0,6153	8	0,6344	4
Poland	0,2873	26	0,2200	27	0,2933	25	0,3230	26	0,2917	25	0,4176	18	0,4478	16
Portugal	0,4954	18	0,3770	22	0,3995	21	0,3371	24	0,2963	23	0,2444	27	0,3180	24
Romania	0,2757	27	0,3657	23	0,3082	24	0,2956	27	0,2922	24	0,2853	26	0,3028	25
Slovenia	0,6265	9	0,5302	10	0,5821	10	0,5416	10	0,5215	11	0,6222	7	0,6146	7
Slovakia	0,3940	23	0,3355	25	0,2739	26	0,3342	25	0,2773	26	0,2931	25	0,3731	20
Finland	0,7332	3	0,6468	3	0,6674	4	0,6753	4	0,6165	5	0,6520	4	0,6461	3
Sweden	0,7949	1	0,7199	1	0,7073	1	0,7178	2	0,6840	2	0,7240	2	0,6863	2
United Kingdom	0,7278	4	0,6721	2	0,6796	2	0,6643	5	0,5623	9	0,5254	12	0,5204	9

Source: based on own calculation and data: Europe in figures, Eurostat Yearbook 2009, Office for Official Publications of the European Communities, Luksemburg 2009.

Conclusions

The results obtained in the research are consistent with many other international rankings on international competitiveness that show very strong positions of Scandinavian countries (World Economic Forum 2010a; 2010b). Sweden, Finland and Denmark are almost in all years ranked among the best five European Union countries. This means that the policies supporting development of human capital implemented by these countries should be the subject of special interest of all European policy makers.

From the perspective of the whole European Union and its potential in the global world, mostly influenced by the biggest and the most developed economies such as France, Germany, Italy, the results of the research are not very optimistic. Germany as the most important economy of continental Europe was obtaining positions from 12th to even 19th, in the case of France it was from 12th to 17th. However, the worst situation is found in the case of Italy that was classified in positions from 16th to 21st. That can mean that the most important economies of the European Union are facing serious challenges of reforming their policies responsible for human capital development. If these countries do not reform their policies, the international competitive potential of the whole European Union will probably deteriorate in the future.

Moving to the so called new member states, good results can be found in the case of Slovenia and Czech Republic. The first one has almost always been ranked among the best 10 countries and Czech Republic, in spite of the probable influence of global financial crises in the last two years of the analysis, seriously improved its position and was ranked 10th in the year 2008.

Even though the year 2008 is considered as the beginning of the crisis in Europe, its negative influence, especially through labour market channel, can be seen in the case of Latvia and Lithuania. In the year 2002-2007 both these economies seriously improved their position, but in the year 2008 there was a serious deterioration in that field. However, this cannot be said about Estonia that comparing to the year 2007 in the year 2008 managed to improve its position. But on the other hand, this country was not able to keep its great results from the year 2006.

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