The association between human capital and overall productivity in the European Union countries

Dijana Oreški
Faculty of Organization and Informatics
University of Zagreb
Pavlinska 2, 42000 Varaždin, Croatia
dijana.oreski@foi.hr

Kristina Maršić
Faculty of Textile Technology
University of Zagreb
Prilaz baruna Filipovića 28a, 10000 Zagreb, Croatia
kristina.marsic@ttf.hr

Irena Kedmenec
Faculty of Organization and Informatics
University of Zagreb
Pavlinska 2, 42000 Varaždin, Croatia
irena.kedmenec@foi.hr

Abstract. *This study measures and compares the human capital of 26 European Union countries using the human capital index, which is calculated based on seven different human capital indicators. The overall human capital ranking lists Sweden at the top and Bulgaria at the bottom. This paper investigates what percentage of the variance in productivity measured by GDP per person employed could be explained by the human capital index. The results confirm the validity of human capital index because it explains more than 50% of the variance in productivity, whereas its individual subcomponents have less explanatory power. These research findings provide valuable information for policy makers when formulating effective strategies for strengthening their countries' human capital and, consequently, their productivity.*

Keywords: national intellectual capital, human capital, European Union, national wealth, productivity, economic growth, GDP per person employed.

1 Introduction

Knowledge has replaced the land, labour and physical capital as the most important factor of production and became the main driving force behind economic development in today´s world. With the development of knowledge society, a considerable shift occurred in favour of the knowledge production factor. In the knowledge economy, the value of countries, regions, organisations and individuals is directly related to their knowledge and intellectual capital [2]. The term intellectual capital is defined as "intellectual material – knowledge, information, intellectual property, experience – that can be put to use to create wealth" [13]. Intellectual capital represents the background of a nation's wealth creation process [3].

National intellectual capital refers to the national knowledge and capabilities involved in society's value creation processes [5]. National intellectual capital (NIC) is a specific category because it depends on different components, whose creation has a long-term temporal component. Over the past decade, intellectual capital has been attracting an increasing amount of attention, both from academics and practitioners. Different approaches were developed for measuring national intellectual capital. Based on a review of several NIC measurement models, this paper classifies NIC using Lin and Edvinsson's widely accepted methodology [6]. According to Lin and Edvinsson [6], NIC consists of five components: human capital, market capital, process capital, renewal capital and financial capital. Table 1 deconstructs the variables of each component.

In most countries, human capital accounts for more than 60% of the nation's wealth, which includes their natural resources, physical capital and human capital [15]. Thus, human capital, as an important component of NIC, is the focus of this paper. The human capital theory suggests that it is human capital – the knowledge and skills embodied in people – that is vital to a country's economic prosperity. According to Schultz [12], economists have long recognised that people are an important component of the wealth of nations. Human capital is a form of investment and it represents the sum of different kinds of knowledge, practical skills, behaviours, social characteristics and creative skills of people in the company, organization or community. [1] The initial investment in human capital increases costs in the present and benefits in the future [12]. The economic value of human capital is based on the creation of new knowledge and its implementation. The implementation of new knowledge leads to an increase in the output-input ratio, i.e., in productivity. Productivity can be measured in two ways: one is the quantitative method, which measures the amount of product that can be produced by employees in an hour of work [9].

Another is the monetary form of measuring productivity. The second approach is applied here and the productivity is measured by the GDP per person employed [4]. The economies with higher rates of human capital investments may achieve higher productivity.

This paper endeavours to address the following research questions:

1) What is the current state of human capital indices in the European Union countries?
2) What percentage of the variation in productivity in the European Union countries could be explained by the human capital index?
3) What are the implications for future development of human capital in the European Union?

The paper is organized as follows. In the next section, the data are explained and the human capital indices for European Union countries are measured. The 3rd section discusses the relationship between productivity and human capital components. Section 4 concludes the paper.

2 Measuring human capital

Karl-Erik Sveiby was the first to recognise the need to measure human capital [14]. Since then, many different measurements have been developed. According to Lin and Edvinsson [6], there are seven indicators of human capital: skilled labour, employee training, literacy rate, higher education (HE) enrolment, pupil-teacher ratio, internet subscribers and public expenditure on education. These indicators are grouped into two categories: the data with an absolute value, such as the literacy rate, HE enrolment, pupil-teacher ratio, internet subscribers, and public expenditure on education; and the data with a qualitative rating, based on a scale of 1-10, such as skilled labour and employee training. According to Lin and Edvinsson [6], although subjective, the qualitative rating of the degree of certain variable is unavoidable because "evaluating intangible assets cannot be fully represented by merely adding up absolute numbers" [6]. With the purpose of meaningful interpretation of quantitative scores and qualitative rankings, each quantitative indicator variable was divided by its corresponding highest score in the sample and multiplied by 10 in order to transform the number into a score of 1-10 [6]. This transformation was performed for all numerical indicators of human capital. Before this, the pupil-teacher ratio was transformed into teacher-pupil ratio. Finally, to obtain the human capital index, the average of all indicators was calculated. Thus, a human capital index can take a value in the range of 1 to 10.

The human capital index traces the size of public investment in education by incorporating the indicator of public expenditure. It also looks at the quality of education through the indicators related to pupil-teacher ratios. The development of talent is covered by the variables related to the implementation of apprenticeship and the priority given to employee training in companies.

Below, each of these human capital components are calculated and explained in detail. The data for most of these indicators was collected from the IMD World database [4] and OECD [8, 9, 10].

The indicator *skilled labour* determines if skilled labour is readily available. In terms of skilled labour (readily available), Ireland (8.08) is at the top of the list, followed by Denmark (7.81), Finland (7.51), and Greece (7.1). The country with the worst skilled labour indicator is Estonia (3.08), with Bulgaria (3.96) and Croatia (4.31) accompanying it closely at the bottom. Skilled labour indices for all countries are presented in Figure 1.

Employee training indicates if employee training is a high priority in companies. Denmark leads the way in employee training (7.79), while Germany (7.61) and Finland (7.46) hold the 2nd and the 3rd place on the list. The bottom three countries include Bulgaria (3.73), Poland (4.03) and Croatia (4.38). The scores of all countries are presented in Figure 2. *Literacy rate* is "the percentage of the population age 15 and above who can, with understanding, read and write a short, simple statement on their everyday life" [16]. The European Union countries in our research have very high and very similar literacy rates (see Figure 3). *Higher education enrolment* is the percentage of population that has attained at least tertiary education [6]. Higher education is of vital importance for a country, as it is a powerful tool for building knowledge-based societies of the 21st century. Lithuania scores highest in HE enrolment (48.8), followed by the United Kingdom (47.0), whereas the lowest scores of all the 27 countries belong to Austria and Italy, both with a score of 21 (Figure 4). *Pupil-teacher ratio* identifies a ratio of students to teaching staff in primary and secondary schools. Human capital includes looking at the quality of education through the indicators related to pupil-teacher ratios. The pupil-teacher ratio list is headed by Sweden (9.27) and Luxembourg (9.9). At the end of the list are the United Kingdom (19.9), the Czech Republic (18.82) and France (17.52). Figure 5 shows the pupil-teacher ratio of the EU countries. The highest number of *internet subscribers* (the number of fixed broadband internet users per 1000) belongs to the Netherlands (875), followed by Sweden (873). The list ends with Lithuania (472) and Austria (420). The scores of all countries are presented in Figure 6. *Public expenditure on education* is the total public education expenditure (current and capital) expressed as a percentage of total government expenditure for all sectors in a given financial year [16]. Figure 7 lists the scores of all countries. Denmark has the highest percentage of government expenditure for education (7.88), followed by Austria (7.22) and Sweden (6.82). Romania is at the bottom of the list (3.01), together with Bulgaria (3.52) and Slovakia (3.85).

Table 1. National intellectual capital indicators [6]

NATIONAL INTELLECTUAL CAPITAL				
HUMAN CAPITAL	*MARKET CAPITAL*	*PROCESS CAPITAL*	*RENEWAL CAPITAL*	*FINANCIAL CAPITAL*
Skilled labour	Corporate tax encouragement	Business competition environment	Business R&D spending	GDP per capita
Employee training	Cross-border venture	Government efficiency	Basic research	
Literacy rate	Openness to foreign culture	Intellectual property rights protection	R&D spending/GDP	
Higher education enrolment	Attitudes toward globalization	Capital availability	R&D researchers	
Pupil-teacher ratio	Transparency	Computers in use per capita	Cooperation between universities and enterprises	
Internet subscribers	Country image	Convenience of establishing new firms	Scientific articles	
Public expenditure on education	Exports of goods	Mobile phone subscribers	Patents per capita	

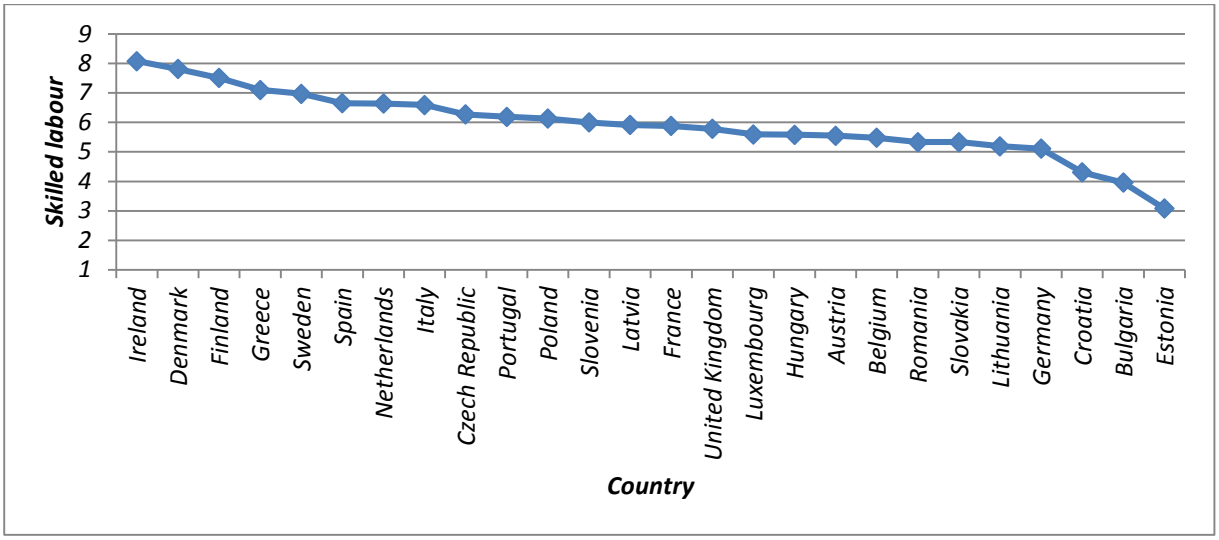

Figure 1. *Skilled labour* indicator scores

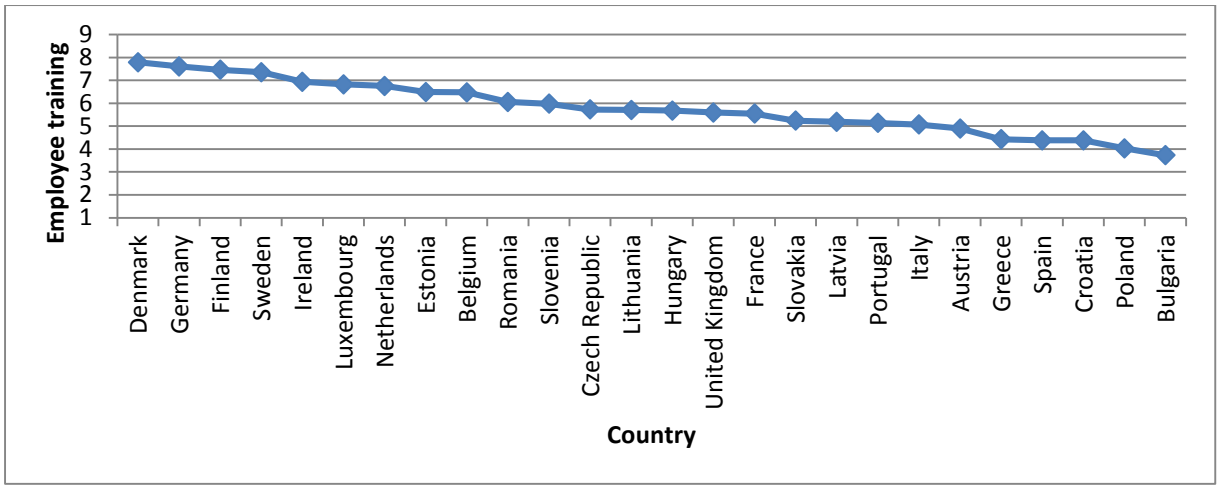

Figure 2. *Employee training* indicator scores

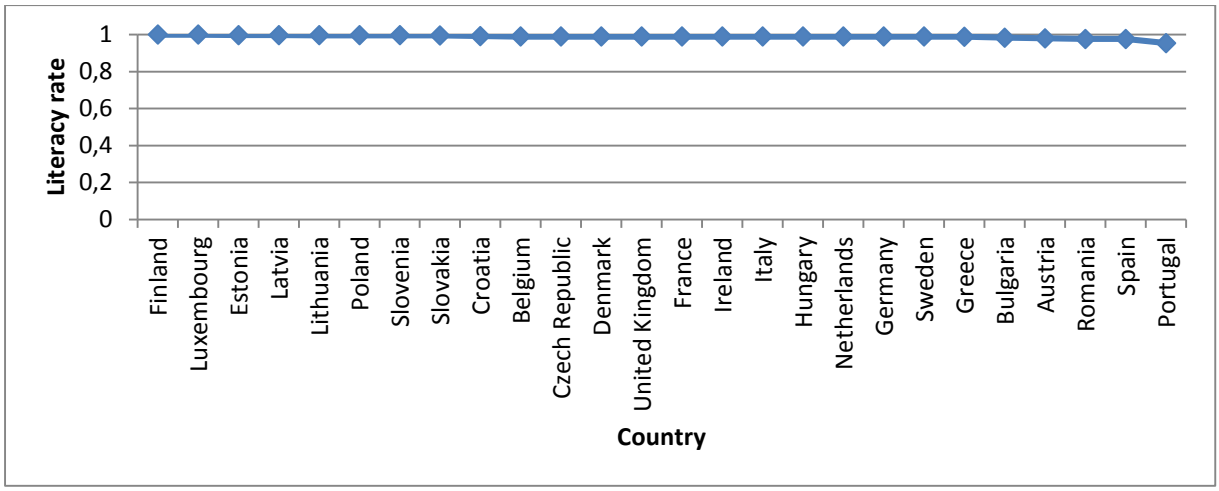

Figure 3. *Literacy rate* indicator scores

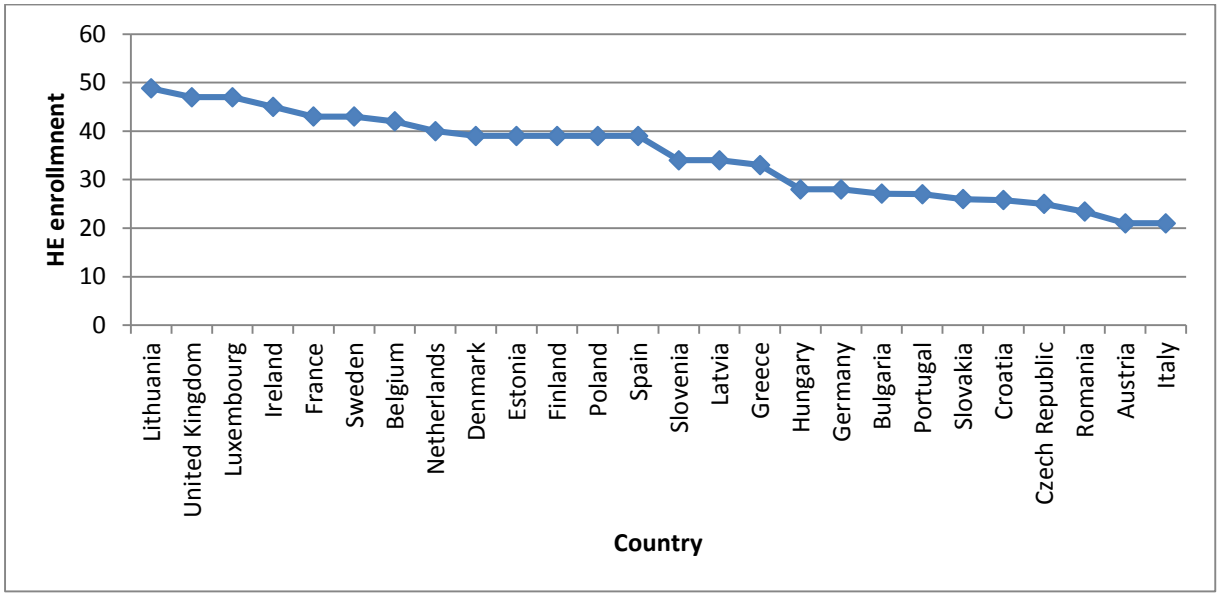

Figure 4. *HE enrolment* indicator scores

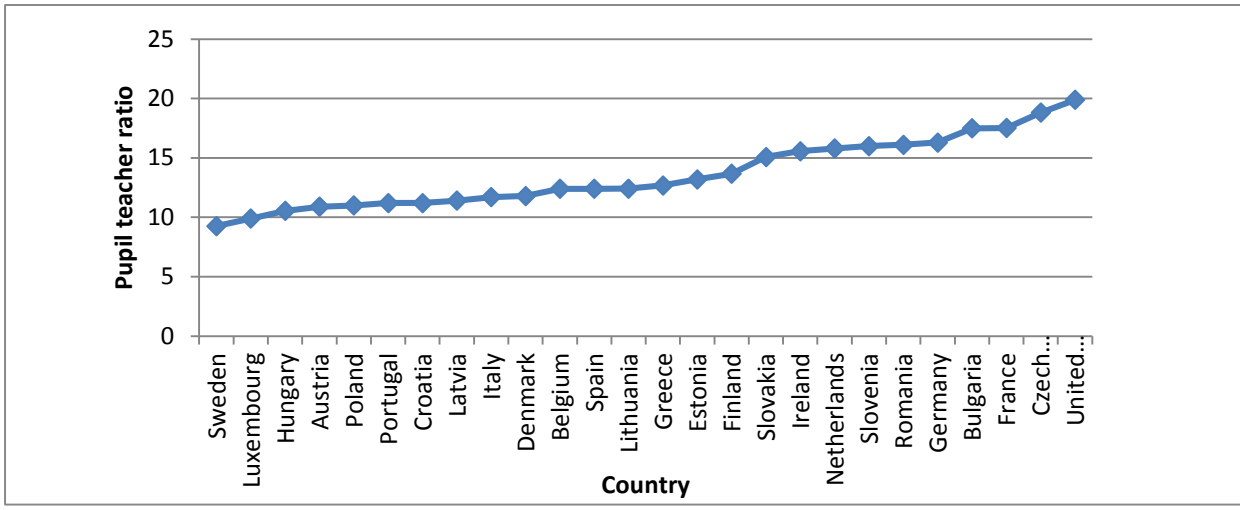

Figure 5. *Pupil-teacher ratio* indicator scores

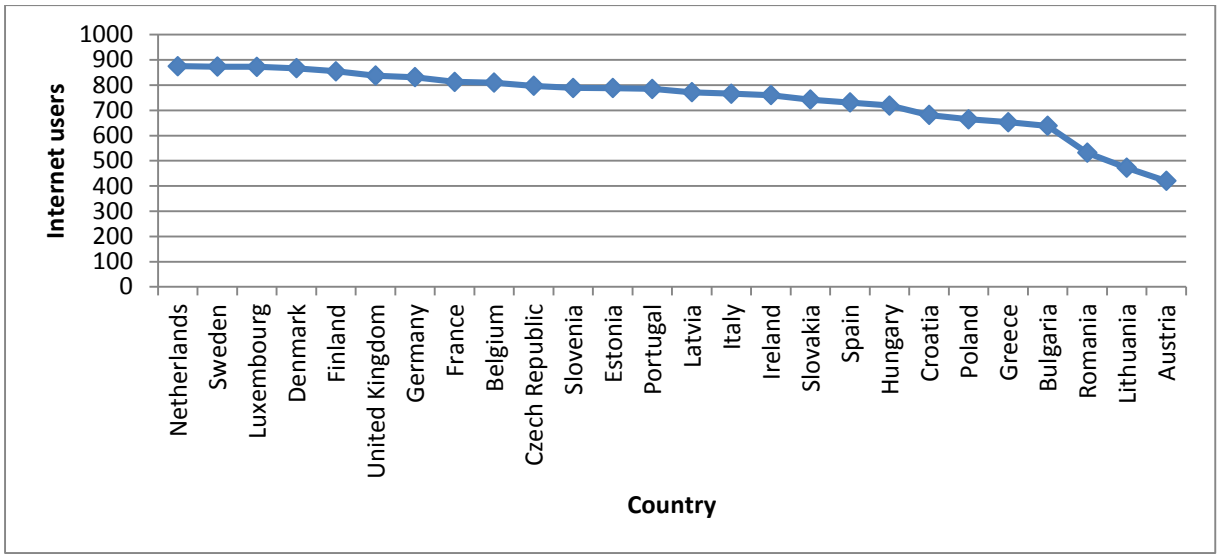

Figure 6. *Internet users* indicator scores

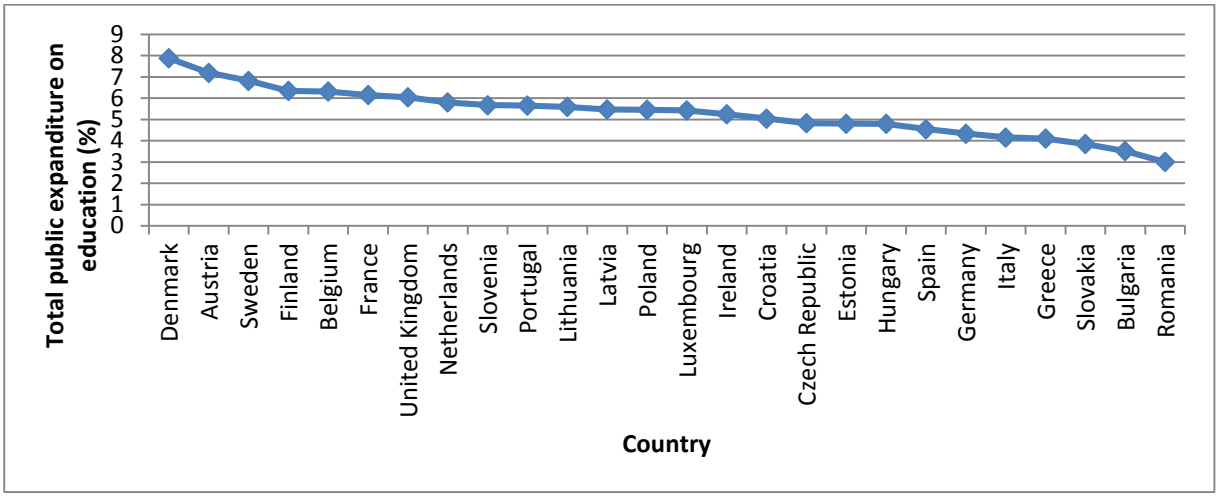

Figure 7. *Total public expenditure on education* indicator scores

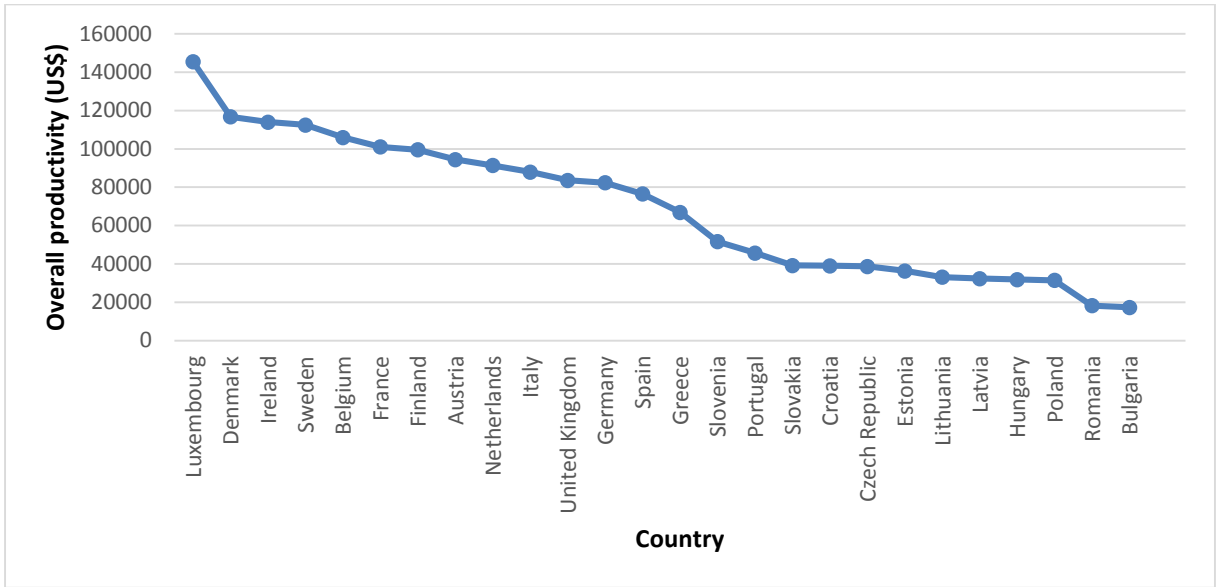

Figure 8. Productivity of EU countries

Based on the seven input indicators, human capital indices were calculated. The results are presented in Table 2.

Table 2. Human capital index

Country	HC index
Sweden	8.81
Denmark	8.75
Luxembourg	8.32
Finland	8.22
Ireland	7.92
Belgium	7.89
Netherlands	7.82
United Kingdom	7.55
France	7.50
Latvia	7.42
Poland	7.30
Slovenia	7.28
Lithuania	7.26
Portugal	7.26
Spain	7.20
Hungary	7.14
Estonia	7.10
Germany	7.01
Greece	6.88
Italy	6.83
Czech Republic	6.74
Austria	6.71
Croatia	6.62
Slovakia	6.48
Romania	5.94
Bulgaria	5.73

Sweden has the highest human capital index (8.81), followed by Denmark (8.75) and Luxembourg (8.32). Slovakia (6.48), Romania (5.94) and Bulgaria (5.73) have the lowest human capital index.

3 Productivity

Theoretical models of human capital and growth are built around the hypothesis that the knowledge and skills embodied in humans directly raise productivity and increase an economy's ability to develop and to adopt new technologies. Human capital has a direct impact on increasing the productivity of individuals and therefore their personal income throughout working life [1, 7, 12].

Productivity is a measure that shows the amount of products and services that an employee can produce for each hour of work. The increase in human capital results in a double effect of increasing profits and people's satisfaction. The overall productivity of 26 European Union countries is presented in Figure 8. The greatest overall productivity is recorded in Luxembourg, Denmark and Ireland, while the lowest overall productivity is found in Poland, Romania and Bulgaria.

Hereinafter, we empirically investigate the relationship between human capital and productivity by applying regression analysis. Since the analysis of different human capital components showed that different countries were at the top and at the bottom of the list, depending on the analysed indicator, we wanted to investigate which human capital components showed the greatest impact on the country's productivity. Thus, the first regression model aimed to explain the variable of productivity using seven explanatory variables, i.e., the subcomponents of the human capital index. However, this model had serious problems with multicollinearity, especially because of the correlation coefficient of 0.550 between the variables *employee training* and *internet subscribers*. Due to the small sample size, it was not possible to perform factor analysis. Thus, it was decided to model two regression equations, one having qualitative rankings as explanatory variables, and the other having quantitative scores as explanatory variables.

In the first model productivity is the explained variable, while *skilled labour* and *employee training* are the explanatory variables. The model is statistically significant, F(2, 23) = 10.463 (Sig.=0.001), adj. R2 = 0.431. Standardized regression coefficients can be found in Table 3. Both explanatory variables are statistically significant (Sig.<0.05). Their standardized beta coefficients amount to 0.393 for *skilled labour* and 0.455 for *employee training*.

Table 3. Impact of qualitative rankings on productivity

Model	**Standardized Coefficients**	**t**	**Sig.**
	Beta		
(Constant)		-2.532	.019
Skilled labour	.393	2.463	.022
Employee training	.455	2.853	.009

In the second model productivity is the explained variable, while the explanatory variables include *literacy rate*, *higher education*, *pupil-teacher ratio*, *internet subscribers* and *public expenditure on education*. Since the variables *higher education* and *public expenditure on education* are correlated, with the corresponding correlation coefficient of 0.457, the variable *higher education* was excluded from the further analysis. Finally, the model is statistically significant, F(4, 21) = 4.608 (Sig.=0.008), adj. R2 = 0.366. Standardized regression coefficients can be

found in Table 4. Two variables are statistically significant (Sig.<0.05): *internet subscribers* and *public expenditure on education*, with their standardized beta coefficients amounting to 0.375 and 0.459, respectively.

Table 4. Impact of quantitative scores on productivity

Model	Standardized Coefficients	t	Sig.
	Beta		
(Constant)		-.212	.834
Literacy rate	0.006	.038	.970
Pupil-teacher ratio	0.074	.435	.668
Internet subscribers	0.375	2.200	.039
Public expenditure on education	0.459	2.595	.017

In the third regression model, the variance in productivity is explained by *human capital index*, which is basically the average of seven human capital subcomponents. The model is statistically significant, F(1, 24) = 30.881 (Sig.=0.000), adj. R2 = 0.544. Standardized regression coefficients can be found in Table 5. *Human capital index* is statistically significant (Sig.<0.05), with its standardized beta coefficient amounting to 0.750.

Table 5. Impact of human capital index on productivity

Model	Standardized Coefficients	t	Sig.
	Beta		
(Constant)		-4.083	.000
Human capital index	0.750	5.557	.000

The variables *total public expenditure on education* and *employee training* have the highest impact on the overall productivity, followed by *skilled labour* and *internet subscribers*. Due to the very similar literacy rates in the analysed countries, *literacy rate* was not a significant predictor of overall productivity. Also, *pupil-teacher ratio* was not significant in the model. The interesting finding is that the third model, with *human capital index* as the explanatory variable, had the greatest explanatory power. Thus, this result confirms the validity of human capital index as a multidimensional concept that takes into consideration relevant human capital indicators and could therefore be a better predictor of the overall productivity in comparison with its components used separately.

4 Conclusion

This research is the first attempt to measure and compare the human capital of the European Union countries, which represents the first valuable contribution of this paper. Further on, the research confirms that the accumulation of human capital positively influences the overall productivity. However, which components of human capital are most important? Literacy rate is very high in all the European Union members, which means that its further improvement will not have a substantial impact on the overall productivity. The pupil-teacher ratio in schools varies substantially between the analyzed countries. However, it seems that all the countries have satisfactory scores and that any further decrease of this ratio would not contribute to the overall productivity of their economies. Of all the individual human capital indicators, the employee training and total public expenditure on education have the highest impact on the overall productivity, and these are the components that offer room for improvement. If a government wants to achieve an increase in productivity by investing in its human capital, it should create an environment in which the private sector has incentives to invest in employee training.

Future research should investigate other components of national intellectual capital in relation to the overall productivity. Since there is also a possibility of increased productivity influencing investments in human capital, future research should focus on the panel data analysis. This would enable a better understanding of the interesting relationship between human capital and productivity through time.

References

[1] Becker, G.S. Human capital: A theoretical and empirical analysis, with special reference to education. (2nd ed.). National Bureau of Economic, Research. New York, NY: Columbia University Press, 1975.

[2] Edvinsson, L.; Bounfour, A. Assessing national and regional value creation, *Measuring Business Excellence*, 8 (1): 55-61, 2004.

[3] Edvinsson, L.; Malone, M. Intellectual Capital: Realising your company's true value by defining it`s hidden brainpower. New York: Harper Business, 1997.

[4] IMD World Competitiveness Center, IMD World Talent Report, http://www.imd.org/uupload/imd.website/wcc/Ne

wTalentReport/IMD_World_Talent_Report_2014bis.pdf, downloaded: February 08th 2015.

[5] Kozak, M. Intellectual Capital as a Key Factor of Socio-Economic Development of Regions and Countries, *Procedia Economics and Finance*, 6: 288-295, 2013.

[6] Lin, C.Y.Y.; Edvinsson, L. National intellectual capital: A comparison of 40 countries, Springer, New York, 2011.

[7] Mincer, J. Schooling, Experience and Earnings. New York: Columbia University Press, 1974.

[8] OECD. Classifying Educational Programmes. Manual for ISCED-97 Implementation in OECD Countries, OECD, Paris, 1999.

[9] OECD.International science and technology co-operation: Towards sustainable development. Proceedings of the OECD Seoul conference. Paris: OECD, 2000.

[10] OECD 2014 TALIS 2013 Results - An International Perspective on Teaching and Learning http://www.oecd-ilibrary.org/education/talis-2013-results_9789264196261-en, downloaded: April 3rd 2015.

[11] Petz, B. Osnove statističke metode za nematematičare, Naklada Slap, Zagreb, 2004.

[12] Schultz, T. Investment in Human Capital, *American Economic Review*, 51: 1-17, 1961.

[13] Stewart, T.A. Intellectual capital: The new wealth of organizations, New York: Nicholas Brealey, 1997.

[14] Sveiby, K.E. The New Organizational Wealth: Managing & Measuring Knowledge Based Assets, Berrett-Koehler, 1997.

[15] World Bank, Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development, *Environmentally Sustainable Development Studies and Monographs* Series No. 17, Washington, D.C., 1997.

[16] World Bank, http://data.worldbank.org/indicator/SE.ADT.LITR.ZS, downloaded: February15th 2015