

The influence of knowledge on economy in Polish voivodships and in the regions of the United Kingdom as measured by the Knowledge Economy Index (KEI)

Benedykt Puczkowski

University of Warmia and Mazury in Olsztyn

Abstract

The Knowledge Economy Index (KEI) was used to determine the main sources of economic diversity (measured by GDP per capita) of Polish voivodships and United Kingdom regions. Knowledge Assessment Methodology (KAM) prepared by the World Bank Institute was adjusted to the conditions in Poland and in the United Kingdom. It has indicated that there are voivodships in Poland and regions in the UK whose educational system indices are high. This substantially influences the production and transfer of new knowledge into the economy. These areas are becoming more economically and socially friendly. However, there are also some areas where the situation is quite the opposite.

Key words: Knowledge Economy Index (KEI), educational and innovation systems, ICT.

Introduction

The Knowledge Economy Index (KEI) is an advanced assessment tool used to compare economies on the international level (including also the comparisons with other variables determining e.g. economic growth) and to evaluate if the economic environment is favourable for the effective use of knowledge in the development of economy. In this work, the KEI was used to compare the economic regions of Poland and the United Kingdom. The main pillars of the KEI affecting the level of knowledge exploitation in the regions were also explained. For this purpose, the model of the World Bank Institute - Knowledge Assessment Methodology (KAM 2008) was used. The main characteristics of the KEI include the assignment of particular groups of variables to the particular pillars of the knowledge-based economy model (according to the World Bank), the determination of the scope of notions, the normalisation of the subindices by the assignment of particular values (in the range of 0-10 - the higher the value, the higher the level of knowledge-based economy advancement),

the calculation of partial indices, their reweighing and the calculation of the final index.

Aim and methodology of research

The Knowledge Economy Index places our economy on the last position among the wealthiest countries of the world of the G7 group and is 1.4 points lower than in the United Kingdom (Tab. 1). The most substantial difference between the economies of Poland and the UK is observed in two pillars of knowledge-based economy: the innovation system and the information and knowledge system. The advantage of the United Kingdom over Poland in the application of innovations in economy is 2.27 points and in the use of ICT - 2.06 points. The indices measuring the financial and legal environment of enterprise are slightly more favourable, with the difference of 1.89. The Polish educational system is highly graded, as Poland, with the result of 8.82, comes before the UK, which has the result of 8.24.

Table 1. Selected areas of economy based on knowledge in Poland and in the United Kingdom (2008)

Country	Knowledge Economy Index (KEI)	Conditions for enterprise (legal and financial environment)	Innovation system	Education system	Information and communication system (ICT)
United Kingdom	8.92	9.28	9.18	8.24	9.01
Poland	7.52	7.39	6.91	8.82	6.95

Source: Author's own research based on http://info.worldbank.org/etools/kam2/KAM_page5.asp, 2008,

The aim of this work is to determine and present the main sources of economic diversity of the Polish and UK regions. A hypothesis has been stated that the standard of living, measured with GDP per capita, is strongly influenced by the educational system being adjusted to the new economy. The high level and appropriate structure of education in engineering and technical courses are the basis for the creation of new knowledge and its implementation into the new economy. As a consequence, the living standard is higher and the social and economic environment is more friendly.

The KEI was calculated according to a method developed by the World Bank Institute. The method consists in the determination of the arithmetic mean of the country's results measured according to three indices in the four pillars of knowledge

economy. The first pillar constitutes the regime of economic and institutional stimuli, the second one - the level of education and human resources, the third one - the level of innovation in economy (the innovation system), and the fourth one - computerization and the implementation of communication and information technologies. The values of each pillar are the arithmetic mean of previously normalized variables. The normalization procedure is necessary because of various scales and methods of measuring particular indices - it brings them all to one scale, making it possible to compare them. The normalized indices (U) have values from 0 (the lowest) to 10 (the highest). The normalization used in the KAM consists in the determination of absolute values of indices for the particular regions. Then, grades are assigned to the values - the best value is given grade 1, the second best is given grade 2 etc. Thus, for every region a number (N_h) of regions having a better value of the given index is determined. For the calculation of the normalized index (U), the following formula is used: $U = 10 * (1 - N_h/N_c)$, where U is the normalized index value, N_c is the number of all considered ratings. The formula renders results from 1 to 10. The normalized indices are considered in the calculation of the mean value for each pillar of knowledge economy.

The Knowledge Economy Index was calculated using the Knowledge Assessment Methodology of the World Bank Institute. Only the indices in the particular pillars of knowledge economy were changed in order to adjust the method to the Polish and UK conditions. For each pillar, the values of normalized indices were averaged (Tab. 2). Correlation coefficients of the tested variables were determined, with the significance coefficient of $p < 0.05$, using the Statistica software - for Poland $N = 16$, for the UK $N = 12$. In order to compare the situation of the voivodships in Poland and the regions of the United Kingdom, the KEI was calculated for the regions from the Eurostat NUTS 1 classification, as they are similar in area and population to Polish voivodships (from the NUTS 2 classification¹). During the calculation of KEI for the United Kingdom regions, the indices were selected in such a way as to make them most similar to the indices of voivodships.

¹ **NUTS** (fr. *Nomenclature des Unites Territoriales Statistique*, ang. *Nomenclature of Units for Territorial Statistics*) - the geocoding standard developed in the European Union in order to identify units for territorial statistics (Eurostat). Three levels of NUTS are distinguished, among which NUTS 2 and NUTS 3 are the most important.

Table 2. Indices of knowledge economy pillars in Poland and the United Kingdom

Specification	Poland	The United Kingdom
1. Regime of economic stimuli and institutions	GDP <i>per capita</i> (Euro)	GDP <i>per capita</i> (Euro)
	gross fixed capital formation <i>per capita</i> (Euro)	gross fixed capital formation <i>per capita</i> (Euro)
	average price of goods (electricity, fuel, salaries, food, water, heating) in each voivodship compared to the average price of these goods in Poland (in percentage terms, Poland = 100)	average prices of baskets of goods in particular regions compared to the average UK price (in percentage terms, UK=100)
	number of areas qualified to the NATURA 2000 programme (in percentage terms) - the ratio of the NATURA 2000 areas to the total voivodship area	number of protected areas (percentage ratio to the region area)
	promptness of handling cases in provincial administrative courts (average length in days) - cases such as complaints about deeds and other actions and about the inactivity of institutions	length of a case in a magistrates' court in days (criminal cases)
	real property tax - taxation of buildings and lands related to business activity (for 1 m ² , in Euro) motor vehicle tax - average tax value for lorries of allowable total weight from 3.5 to 5.5 t inclusive, from 5.5 to 9 t inclusive and from 9 and below 12 t (per item, in Euro)	average value of council tax (annually per item of real property, in Euro)
2. Education and human resources	percentage of students of technical and vocational schools in the voivodship in relation to the students of these schools in Poland	percentage of students of technical and vocational schools (level 3 – vocational education) in relation to the students of these schools in the UK
	percentage of students of technical and engineering university courses in the voivodship in relation to the students of these courses in Poland	percentage of students of technical university courses (medicine, biology, veterinary, agriculture, physics, mathematics, information science, engineering, architecture and construction) in relation to the students of these courses in the UK
	population with higher education degrees as a percentage of population in the age range of 15 - 64	population with higher education degrees as a percentage of population in the age range of 15 – 64

3. The innovation system	expenditures on research and development as % of GDP	expenditures on research and development as % of GDP
	number of people employed in research and development in 1000 professionally active people	number of people employed in research and development in 1000 professionally active people
	number of patents granted by the European Patent Organisation for one million inhabitants	number of patents granted by the European Patent Organisation for one million inhabitants
4. Information and Communication Technologies (ICT)	% of households with a stationary telephone	% of households with a stationary telephone
	% of households with a stationary computer	% of households with a stationary computer
	companies having an Internet access (percentage of all companies in the given voivodship)	% of companies having an Internet access (10 employees and more)

Research results

For the research on the conditions for enterprise as the regime of economic stimuli and institutions (according to KAM), the values of normalized indices were averaged. Table 3 shows that the highest GDP index per capita was noted in the Mazowieckie, Śląskie and Wielkopolskie voivodships, and the lowest in Lubelskie, Podkarpackie and Podlaskie. The highest GFCF was noted in Mazowieckie, Dolnośląskie and Wielkopolskie. Lubelskie, Kujawsko-Pomorskie and Podkarpackie voivodships showed the slowest development. The level of prices of goods and services is the highest in Mazowieckie voivodship - it is 23.7% higher than the average price level in Poland. The lowest price level is in Świętokrzyskie, with 86.1% of the price level in Poland. The percentage of areas qualified to the NATURA 2000 programme (measured as the ratio of the NATURA 2000 areas to the total voivodship area) indicates that the largest percentage of protected areas is located in Zachodniopomorskie voivodship, followed by Lubuskie and Podlaskie. The smallest percentage of protected areas is in Opolskie, Świętokrzyskie and Śląskie voivodships. The correlation coefficient of GDP per capita and the KEI is 0.67, which means that the correlation between these variables is strong. Similar results were achieved when the correlation between the KEI and investment expenditures was assessed ($r = 0.72$). The correlation between the price index and the KEI is also strong ($r = 0.72$, the higher the price index, the higher the KEI).

Table 3. Conditions for enterprise (legal and financial environment) in Polish voivodships (2007)

Voivodships	GDP per capita – in euro	Gross fixed capital formation per capita (in euro)	Price level (Poland = 100)	Percentage of areas qualified to NATURA 2000
Dolnośląskie	7 980	1 066	99.0	33.8
Kujawsko-pomorskie	6 737	699	88.8	11.7
Lubelskie	5 273	595	90.0	25.1
Lubuskie	6 967	863	87.1	68.5
Łódzkie	7 094	841	88.0	10.7
Małopolskie	6 591	880	93.9	22.8
Mazowieckie	12 235	1 605	123.7	24.4
Opolskie	6 399	720	91.1	4.6
Podkarpackie	5 332	713	86.7	52.1
Podlaskie	5 718	794	89.8	62.9
Pomorskie	7 586	934	99.8	36.0
Śląskie	8 331	927	103.0	9.1
Świętokrzyskie	5 778	778	86.1	9.1
Warmińsko-mazurskie	5 908	717	87.1	30.5
Wielkopolskie	8 259	1 109	93.0	38.6
Zachodniopomorskie	7 171	922	91.4	79.9

Source: Based on the Statistical Yearbook of Voivodships of 2007, the NATURA 2000 programme, Regional Data Bank of the Central Statistical Office of Poland of 2008, Eurostat of 2008.

The regime of economic stimuli and institutions measured in the regions of the United Kingdom is varied and shows much higher values than in Polish voivodships. The analysis of data included in Table 4 shows a considerable advantage of two economic centers, namely London and South East. Both the GDP per capita and GFCF are almost two times higher there than in Wales and North East. In London, the average prices of goods are 9.1 % higher than average prices in the whole country and 4.7 % higher than in the South East region. The lowest price level is noted in Wales and Scotland. The correlation coefficient of GDP per capita and the KEI is 0.61, which indicates a strong correlation between these variables. Similar results were achieved by testing the correlation between the KEI and GFCF ($r = 0.60$). The correlation between the prices of goods and services and the KEI is strong as well ($r = 0.75$, the higher the price level, the higher the KEI).

Table 4. Conditions for enterprise (legal and financial environment) in the UK regions

Regions	PKB/ Euro per capita, 2005.	Gross capital formation per capita (in euro), 2005.	Average price of a fixed basket of goods in the region in relation to the average price in the UK (UK=100, 2006)
East Midlands	2 7406	3 257	97.0
Eastern	2 8549	4 190	100.5
London	4 6524	6 653	109.1
North East	2 4227	3 619	93.0
North West	2 6176	3 603	95.9
Northern Ireland	2 4371	4 068	95.3
Scotland	2 8467	4 413	93.1
South East	3 2669	5 296	104.7
South West	2 8058	4 190	100.8
Wales	2 3155	3 242	92.1
West Midlands	2 6632	3 778	97.4
Yorkshire and The Humber	2 5846	3 484	93.5

Source: Eurostat 2008, *Relative regional consumer price levels in 2006* (www.statistics.gov.uk 2008)

The business conditions are influenced by, among other factors, the promptness of court services. The average duration of court cases such as complaints about deeds and other actions handled by the High Administrative Court was calculated in days. The most efficient court system was found in Kujawsko-Pomorskie (107 days), Warmińsko-Mazurskie (125 days) and Świętokrzyskie (114 days) - Table 5. The least favourable situation was noted in Małopolskie (549 days), Śląskie and Wielkopolskie (respectively 309 and 259 days). The research methodology considered three types of taxes affecting the business activity. As Table 5 shows, the highest tax on real property related to business activity was paid in Śląskie voivodship (5.58 Euro for m²), Podlaskie (5.45) and Podkarpackie (5.38), and the lowest in Łódzkie and Świętokrzyskie (4.94 in each) and Opolskie (4,95). The highest tax on lands related to business activity was in Śląskie (0.21 Euro for 1 m²), Pomorskie and Kujawsko-Pomorskie (0.20 in each). The lowest taxes were noted in Opolskie voivodship (0.18). The highest motor vehicle tax² was in Podkarpackie voivodship (295 euro), Świętokrzyskie (286) and Śląskie (285 Euro per vehicle). The correlation of variables between the KEI and the duration of court cases is quite strong ($r = 0.47$), and

² Average value of taxes on lorries of allowable total weight from 3.5 to 5.5 t inclusive, from 5.5 to 9 t inclusive and over 9 t. .

between the KEI and taxes it is weaker - $r = 0.26$ for the real property, 0.05 for lands and 0.46 for motor vehicles.

Table 5. The regime of economic stimuli and institutions in Poland (legal and financial environment) in 2007

Voivodships	Promptness of legal services (court cases) in days	Real property tax		Average motor vehicle tax (Euro)
		buildings related to business activity (Euro)	lands related to business activity (Euro)	
Dolnośląskie	207	5.31	0.192	248
Kujawsko-pomorskie	107	5.21	0.202	263
Lubelskie	128	5.06	0.179	254
Lubuskie	191	5.27	0.197	224
Łódzkie	217	4.94	0.198	242
Małopolskie	549	5.17	0.179	242
Mazowieckie	157	5.21	0.196	227
Opolskie	128	4.95	0.176	283
Podkarpackie	213	5.38	0.197	295
Podlaskie	130	5.45	0.197	266
Pomorskie	204	5.37	0.202	225
Śląskie	309	5.58	0.210	285
Świętokrzyskie	114	4.94	0.190	286
Warmińsko-mazurskie	125	5.21	0.186	251
Wielkopolskie	259	5.28	0.188	221
Zachodniopomorskie	219	5.12	0.192	217

Source: The Statistical Yearbook of Voivodships of 2007, www.bip.gov.pl, 2008, the High Administrative Court website (statistics of District Administrative Courts of 2007).

Entrepreneurs who take up and conduct business activity must remember about the environment protection laws. If the activity is conducted on areas subject to special environmental protection, the difficulties in the adjustment of technological processes to the production of goods are increased. The data in Table 6 indicate that in the United Kingdom, the largest percentage of protected areas is found in the South East region (0.55%) and the smallest in the East Midlands (0.14%). The analysis of the efficiency of the legal environment allows for an opinion that the system is the least efficient in Northern (186 days) and in East Midlands (169 days). Court case duration is the shortest in Yorkshire and The Humber (124 days). The highest real property taxes are found in the South East region (1613 euro a year per

item of real property) and in London, whereas in Northern Ireland these taxes are almost three times lower than in other regions. The correlation of the KEI variables with the duration of court cases is weak ($r = 0.29$), and the correlation of taxes with the KEI is very strong ($r = 0.83$).

Table 6. The regime of economic stimuli and institutions in the United Kingdom (legal and financial environment)

Regions	Protected areas in 2005 (%)	Duration of a court case in magistrates' courts in 2006 in days	Council tax – average for all real property per year (euro) in 2007
East Midlands	14	169	1345
Eastern	20	145	1523
London	23	152	1477
North East	36	129	1237
North West	48	152	1280
Northern Ireland	36	186	493
Scotland	22	141	1180
South East	55	148	1613
South West	41	147	1490
Wales	24	161	1021
West Midlands	32	140	1306
Yorkshire and The Humber	44	124	1231

Source: Based on *Regional trends 40* (www.statistics.gov.uk), *Judicial and court statistical report 2006* (www.justice.gov.uk), *Statistical Release: council tax levels by local authorities in England 2008-09* (www.local.odpm.gov.uk), *Northern Ireland Court Service Judicial Statistics 2007* (www.courtsni.gov.uk), www.scotland.gov.uk, www.4ni.co.uk. 2008.

In the times of the new economy, the success depends mostly on the personnel with technical and engineering qualifications. Considering this, averaged values of normalized education and human resource indices were used in the research method. The percentage of vocational and technical high school students in particular voivodships in relation to the students of these schools was included in the calculations. Table 7 shows that the largest percentage of students of these school is found in Śląskie voivodship (12.4%) followed by Wielkopolskie (10.6%) and Małopolskie (9.9%). Almost four times lower percentage was noted in Opolskie and Lubuskie. The highest percentage of students of engineering and technical college courses compared to the students of these courses in the whole Poland is in Małopolskie and Mazowieckie (respectively 14.8 and 14.7%). The situation in Opolskie (with the index value of 1.1), Opolskie (1.4) and Warmińsko-Mazurskie (2.2) is unfavourable. The largest number of people with higher education degrees

(compared to the total number of population in the age range from 15 to 64) is in the following voivodships: Mazowieckie (17.1%), Pomorskie (13.1%) and Małopolskie (12.4%), and the smallest in Opolskie and Lubuskie (9.8% in each). A very strong correlation of the KEI and the number of vocational school students was noted ($r = 0.64$). The strongest correlation (of all the tested variables) of the KEI was noted with the number of students of engineering and technical college courses – $r = 0.83$, and the correlation of the KEI and the population with higher education degrees was 0.73.

Table 7. Education and human resources in Poland (%)

Voivodships	Students of technical and vocational high schools	Students of engineering and technical college courses	Population with higher education degrees as % of the population in the age range from 15 to 64 in the voivodship in 2002
Dolnośląskie	6.0	12.0	12.1
Kujawsko-pomorskie	6.2	3.4	10.1
Lubelskie	5.5	4.6	11.7
Lubuskie	2.8	1.1	9.8
Łódzkie	5.4	4.7	11.5
Małopolskie	9.9	14.8	12.4
Mazowieckie	9.8	14.7	17.1
Opolskie	2.8	1.4	9.8
Podkarpackie	7.2	3.6	10.4
Podlaskie	3.2	2.5	11.5
Pomorskie	5.9	7.6	13.1
Śląskie	12.4	9.9	10.8
Świętokrzyskie	3.8	2.9	11.4
Warmińsko-mazurskie	4.3	2.2	10.1
Wielkopolskie	10.6	8.1	11.2
Zachodniopomorskie	4.2	6.5	12.0

Source: Based on the Regional Data Bank of the Central Statistical Office of Poland (National Census of 2002, Population) and Small Statistic Yearbook of the Republic of Poland of 2008.

In Poland, the index of education and human resources is 0.58 points higher than in the United Kingdom (Tab. 1). The analysis of the percentage of technical and vocational high school students presented in Table 8 shows that the most favourable situation is in the London region (14.3% of the total number of students in the United Kingdom) and the North West region (13.8%). The lowest indices were found in Northern Ireland and Wales (respectively 2.8 and 4.3%). The percentage of students of engineering and technical college courses in relation to the total number of students is similar - the highest in London (17%) and North West (11.8%), and the lowest in Northern Ireland (2.7%) and Wales (5.2%). The highest percentage of

population with higher education degrees was noted in London (36.8%) and the lowest in North East (22.8%). The analysis of correlations showed a strong dependency of the KEI on the number of technical and vocational high schools ($r = 0.72$) and of technical college students ($r = 0.63$). The correlation index of the KEI with the number of population with higher education degrees was 0.62.

Table 8. Education and human resources in the United Kingdom (%)

Regions	Students of technical and vocational high schools (level 3) in 2006	Students of technical colleges in relation to the total number of students in 2000/2001	Population with tertiary education level in relation to the total population of the region in 2007
East Midlands	6.4	6.8	25.2
Eastern	7.1	6.3	26.2
London	14.3	17.0	36.8
North East	5.0	5.2	22.8
North West	13.8	11.8	25.9
Northern Ireland	2.8	2.7	24.8
Scotland	7.2	10.3	31.9
South East	12.0	10.6	30.2
South West	7.7	6.6	28.6
Wales	4.3	5.2	24.9
West Midlands	10.8	8.3	25.5
Yorkshire and The Humber	8.6	9.0	23.3

Source: Based on Eurostat 2008 and the following reports *Students in Higher Education Institutions 2000/2001* (www.hesa.ac.uk 2008) and *Regional Trends 40* (www.statistics.gov.uk 2008).

The values of normalised indices pertaining to the expenditures on research and development as a percentage of GDP were averaged in the analysis of the innovation system. Table 9 shows that Mazowieckie (1.1) and Małopolskie (1.2) voivodships are in the lead. The lowest indices were noted in Świętokrzyskie (0.08), Opolskie (0.12) and Lubuskie (0.15). For the calculation of the innovation system index, also the scale of employment in research and development for 1000 professionally active people was used. In this respect, the most favourable situation is in Mazowieckie voivodship (9.8). A much worse situation is seen in Świętokrzyskie (1.2), Lubuskie (1.6) and Podkarpackie (1.7). The largest number of patents for 1 million inhabitants was granted in Wielkopolskie voivodship (4.46), followed by Mazowieckie (3.48) and Pomorskie (2.09). A strong correlation of industry innovation expenditures with the KEI ($r = 0.82$) and of the employment in research and

development with the KEI ($r = 0.82$) was noted. The correlation of the KEI with the number of patents granted by EPO is on average level ($r = 0.67$).

Table 9. The innovation system - average values of normalized indices for Polish voivodships

Voivodships	Expenditures on research and development in % of GDP	(%) of people employed in research and development (for 1000 professionally active people)	Number of patents granted by EPO for 1 million inhabitants
Dolnośląskie	0.45	3.8	2.85
Kujawsko-pomorskie	0.25	3.4	0.62
Lubelskie	0.48	3.3	1.33
Lubuskie	0.15	1.6	2.13
Łódzkie	0.52	3.4	1.18
Małopolskie	1.02	5.4	1.85
Mazowieckie	1.1	9.8	3.48
Opolskie	0.12	2.4	2.75
Podkarpackie	0.3	1.7	0.82
Podlaskie	0.27	2.8	1.78
Pomorskie	0.52	5.4	2.09
Śląskie	0.34	3.5	1.14
Świętokrzyskie	0.08	1.2	1.66
Warmińsko-mazurskie	0.24	2.0	0.75
Wielkopolskie	0.47	3.5	4.46
Zachodniopomorskie	0.17	3.4	0.63

Source: Statistical Yearbook of Voivodships of 2007 and www.eurostat.eu, 2008.

On the basis of the KAM, three pillars presented in Table 10 were used to calculate the Knowledge Economy Index. The largest expenditures on research and development in % of GDP were noted in the following regions: Eastern (2.77%) and South East (1.51%). It is reflected in the percentage of employment in research and development units (9.5% in Eastern and 8.3% in South East). The increased expenditures on research and development result also in the largest number of patents for 1 million inhabitants - in Eastern 103.65 and in South East 115.24. In the regions of Scotland and Wales, where the lowest percentage of population is employed in research and development units and the lowest expenditures are assigned for research and development, only 0.07 (Scotland) and 11.09 (Wales) patents for 1 million inhabitants were registered. The index of correlation between KEI and the research and development expenditures is 0.57. The correlation of KEI

with the employment in research and development units ($r = 0.65$) and the number of patents ($r = 0.70$) is even stronger.

Table 10. The innovation system in the United Kingdom

Regions	Expenditures on research and development in % of GDP	(%) of people employed in research and development (for 1000 professionally active people)	Patents (EPO) for 1 million inhabitants
The United Kingdom	0.98	4.9	59.54
East Midlands	1.02	5.0	54.0
Eastern	2.77	9.5	103.65
London	0.35	2.6	73.12
North East	0.58	2.5	52.86
North West	1.12	4.6	43.45
Northern Ireland	0.42	3.8	9.92
Scotland	0.49	2.7	0.07
South East	1.51	8.3	115.24
South West	1.14	5.5	38.55
Wales	0.40	2.2	11.09
West Midlands	0.81	5.0	65.97
Yorkshire and The Humber	0.36	2.4	51.25

Źródło: Based on Eurostat 2008 and the report entitled *Research & Development in UK Business 2006* (www.statistics.gov.uk 2008).

The averaged values of normalised indices were also assumed in order to check the level of ICT in particular voivodships. Considering this pillar, the percentage of households with a stationary telephone was calculated. The highest values were found in Opolskie (79.5%) and Podlaskie (78%), the lowest in Kujawsko-Pomorskie (59.3%). The percentage of households equipped with a computer was assumed as an indicator of information technologies. The highest value was in Podlaskie (96), and the lowest in Warmińsko-Mazurskie (83). The largest number of businesses with an Internet access (percentage of all businesses in the given voivodship) was noted in Podlaskie (96) and Kujawsko-Pomorskie (92), and the smallest in Warmińsko-Mazurskie (83). The research has shown an average correlation of the KEI with the number of telephone lines ($r = 0.42$) and the correlation of the KEI with the number of businesses with an Internet access was about two times lower ($r = 0.29$). A much stronger correlation was observed when the number of employees using computers in companies was considered in relation to the KEI ($r = 0.56$).

Table 11. Information and communication technologies (ICT) in Poland in 2006 (%)

Voivodships	Households with a stationary telephone	Households with a computer	Businesses with an Internet access
Dolnośląskie	77.7	48.6	87
Kujawsko-pomorskie	59.3	45.1	92
Lubelskie	70.1	41.5	89
Lubuskie	67.5	54.7	86
Łódzkie	67.2	51.9	86
Małopolskie	74.7	50.5	88
Mazowieckie	74.0	51.3	90
Opolskie	79.5	50.3	91
Podkarpackie	75.7	54.6	85
Podlaskie	78.0	49.5	96
Pomorskie	75.5	56.9	91
Śląskie	69.3	52.5	88
Świętokrzyskie	68.1	40.8	90
Warmińsko-mazurskie	67.6	41.3	83
Wielkopolskie	69.6	58.6	91
Zachodnio-pomorskie	66.5	39.8	88

Source: Based on *Information Society in Poland 2004-2006*, by the Central Statistical Office of Poland, 2008 and the report entitled *Social Diagnosis 2007* (<http://www.diagnoza.com/files/diagnoza2007/diagnoza2007-html.html>).

The statistical data show that in the United Kingdom only 7% of households are devoid of a stationary telephone. The data from Table 12 indicate that in this respect the regions of East Midlands, Eastern and South East are in the lead (95% households are equipped with telephones). In the London (64%) and South East (63%) areas, there is a largest number of computers in households. Scotland leads in the number of companies with an Internet access (80% companies). The correlation of KEI with the number of households with a telephone is 0.67, and with the number of households with a computer is 0.92. The dependence of KEI on the number of enterprises with an Internet access is average ($r = 0.55$).

Table 12. Information and communication technologies (ICT) in the United Kingdom (in %)

Regions	Households with a telephone	Households with a computer	Businesses with an Internet access
East Midlands	95	59	65
Eastern	95	61	72
London	93	64	74
North East	92	52	58
North West	91	58	64
Northern Ireland	91	46	67
Scotland	92	55	80
South East	95	63	69
South West	94	61	76
Wales	91	51	64
West Midlands	91	58	64
Yorkshire and The Humber	92	55	70

Source: *Regional Trends 39, Use of ICT by UK business* (www.statistics.gov.uk 2008).

The calculated indices were normalised just like in the KAM method, then averaged and presented in Table 13. The Mazowieckie voivodship is on the first position with the KEI of 7.96. This index is 0.44 points higher than the one presented for Poland in Table 1 and also 1.96 points higher than the world index. This result is mostly influenced by the considerable advantage of the innovation system (2.88 points in comparison with the total result for Poland), and of the educational system (0.23 pt higher than the KEI given by the World Bank for Poland). The Mazowieckie voivodship has worse conditions for business than the average value for Poland (the index is 0.98 lower than for Poland). The lowest KEI is found in Warmińsko-Mazurskie voivodship (KEI = 3.17 pt). In spite of the relatively high business conditions index (6.02), other pillars affecting the final grade of knowledge economy in this voivodship are very low, particularly the application of innovation systems and the education and human resource index (4.41 points lower than the world level). The state of ICT application is also unfavourable (the index is 5.28 points lower than the one for the whole world). Świętokrzyskie and Lubuskie voivodships with their KEI values of 3.74 and 3.54 are underdeveloped as far the application of innovation systems (1.67 and 3.54, respectively) and information technologies (3.96 and 4.58, respectively) is concerned. These voivodships also show a low index of education and human resources (in Świętokrzyskie, it is 3.54, and in Lubuskie, 0.83). The research has indicated that the correlation of the KEI with the innovation system is

the strongest ($r = 0.97$), then the correlation with the educational system follows ($r = 0.82$) and the next in order is the application of ICT ($r = 0.62$). The correlation coefficient of the KEI and the conditions for enterprise is $r = 0.09$, which proves that these conditions have little influence on the Knowledge Economy Index.

Table 13. Knowledge Economy Index (KEI) in Polish voivodships together with other indices necessary for the calculation of the KEI

Voivodships	Knowledge Economy Index (KEI)	Conditions for enterprise (legal and financial environment)	Innovation system	Education system	Information and communication system (ICT)
Mazowieckie	7.96	6.41	9.79	9.17	6.46
Wielkopolskie	7.39	6.64	7.92	7.08	7.92
Pomorskie	7.34	5.63	7.92	7.29	8.54
Małopolskie	7.12	5.16	8.33	9.17	5.83
Dolnośląskie	6.60	5.78	7.71	7.71	5.21
Śląskie	5.42	3.36	5.42	7.29	5.63
Łódzkie	5.25	5.78	6.04	5.42	3.75
Lubelskie	5.18	5.08	5.42	5.63	4.58
Podlaskie	5.17	4.84	4.58	3.33	7.92
Podkarpackie	4.51	4.06	3.13	5.00	5.83
Opolskie	4.43	5.23	4.17	0.42	7.92
Zachodniopomorskie	4.39	6.95	2.92	5.63	2.08
Kujawsko-pomorskie	4.24	5.08	3.33	4.38	4.17
Lubuskie	3.92	6.72	3.54	0.83	4.58
Świętokrzyskie	3.74	5.78	1.67	3.54	3.96
Warmińsko-mazurskie	3.17	6.02	2.50	2.50	1.67

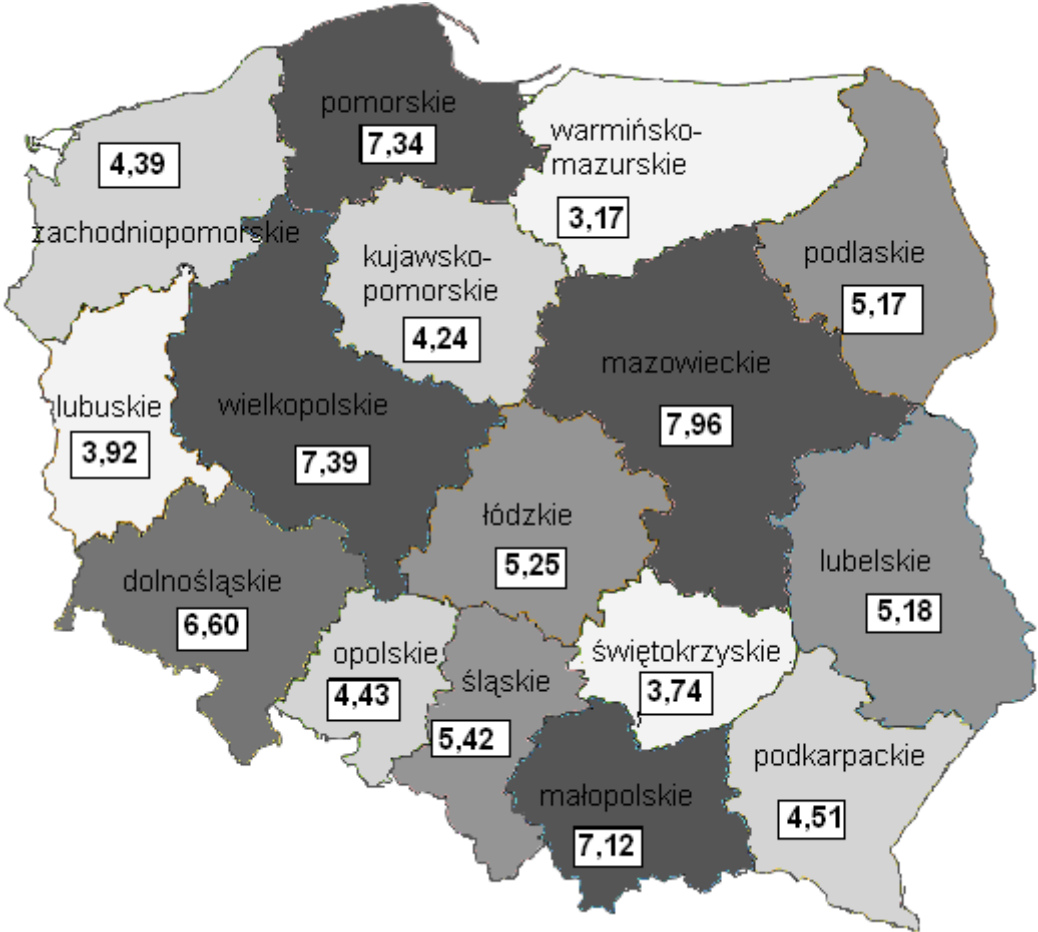
The United Kingdom is placed on the third position in the G7 group of the wealthiest countries in the world as far as the Knowledge Economy Index is concerned. The analysis of the KEI in particular regions of this country shows the highest indices in three regions concentrated around the city of London: South East – KEI = 7.99, Eastern – KEI = 6.98 and London – KEI = 6.84 (tab. 14). This result was influenced by the four pillars considered in the calculation method: conditions for business - which were not the highest noted in these regions; the innovation system - a considerable advantage of two regions over the others; the educational system - the highest rated in the London region; in these regions, the information and communication technologies are also most widely used. The regions which occupy

three lowest positions in the presented analysis (Wales – KEI = 2.81, Northern Ireland – KEI = 3.06 and North East – KEI = 3.68) have similar conditions for enterprise (regime of economical stimuli). The North East region, with its index of 6.11, has better conditions than nine other regions. Its low position is a result of the level of education being significantly lower than in other regions, as well as a very low implementation of IC technologies. The correlation of the KEI with the educational system is the strongest ($r = 0.88$), followed by the correlation with the ICT system ($r = 0.83$) and the implementation of innovative solutions ($r = 0.70$). The correlation index of KEI with the conditions for enterprise is 0.13, which shows that the influence of the regime of economic and institutional stimuli on the Knowledge Economy Index is slight.

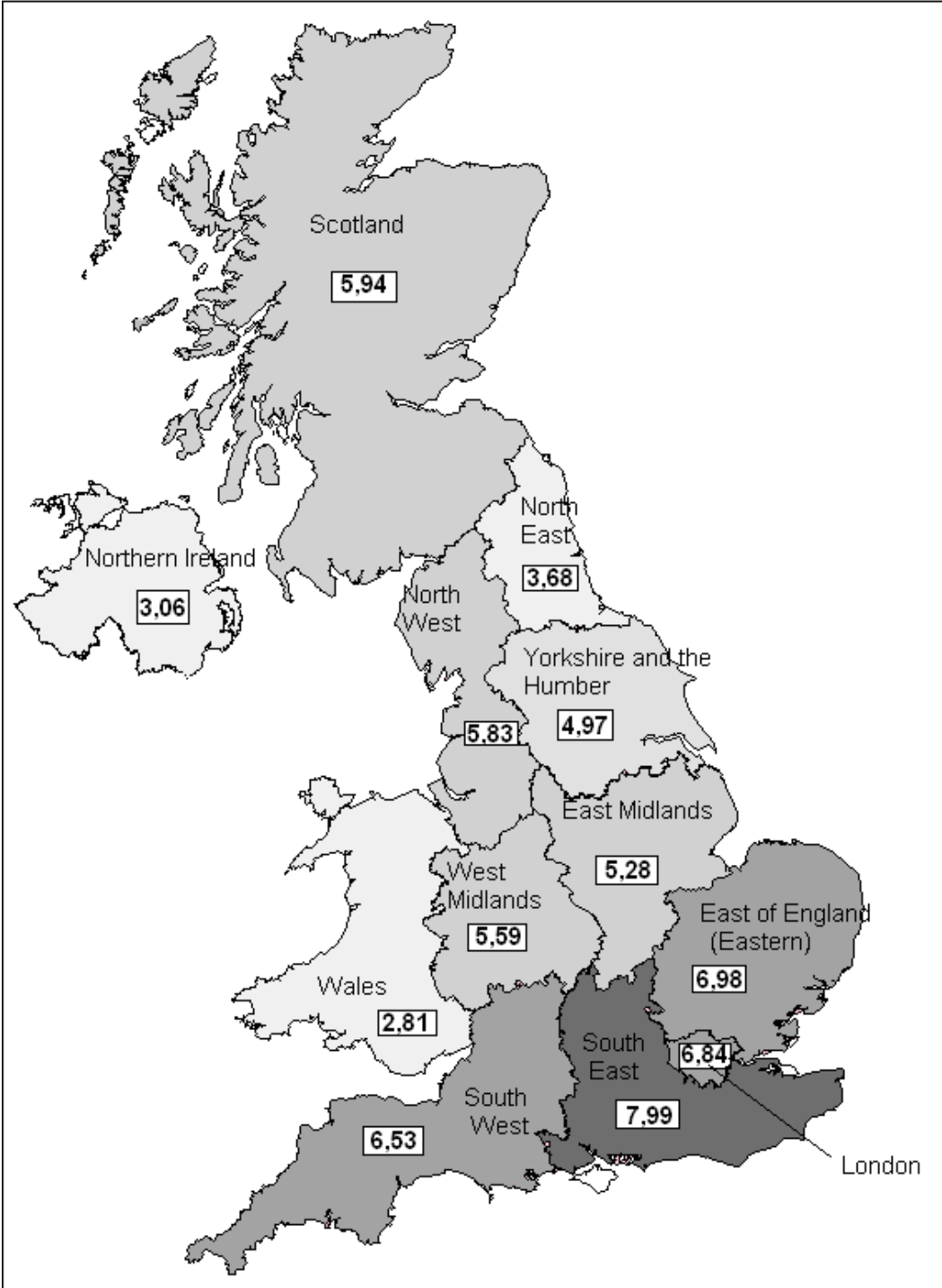
Table 14. Knowledge Economy Index (KEI) in the United Kingdom with other indices necessary for the calculation of the KEI

Regions	Knowledge Economy Index (KEI)	Conditions for enterprise (legal and financial environment)	Innovation system	Educational system	Information and Communication Technology system (ICT)
South East	7.99	5.83	9.44	8.33	8.33
Eastern	6.98	4.86	9.72	4.72	8.61
London	6.84	5.14	3.89	10.00	8.33
South West	6.53	5.28	6.67	5.83	8.33
Scotland	5.94	7.08	2.78	7.22	6.67
North West	5.83	5.28	5.83	8.06	4.17
West Midlands	5.59	5.42	6.67	6.11	4.17
East Midlands	5.28	3.06	6.94	4.17	6.94
Yorkshire and The Humber	4.97	6.53	2.78	5.00	5.56
North East	3.68	6.11	4.44	1.39	2.78
Northern Ireland	3.06	5.28	3.33	0.83	2.78
Wales	2.81	4.31	1.67	2.50	2.78

Picture 1. KEI in Polish voivodships



Picture 2. KEI in the United Kingdom



Summary

The research has indicated that there are some voivodships in Poland where the index of innovation systems is particularly low (for instance, Warmińsko-Mazurskie - 2.50, Świętokrzyskie - 1.67 and Lubuskie - 3.54). In the United Kingdom, similar characteristics apply to Wales -1.67, Northern Ireland - 3.33, North East - 4.44. The analysis of the correlation between the Knowledge Economy Index and the innovation systems indicates that in Poland this is the strongest correlation, with the value of 0.97, whereas in the United Kingdom its value is 0.7. The assessment of the influence of education and human resources on the KEI in Poland has shown that the correlation of these variables is also very strong ($r = 0.82$). The strongest correlation of the KEI in the UK was the one with the educational system ($r = 0.88$). The research shows a low level of education in the engineering and technical university courses in the following voivodships: Lubuskie (0.83), Świętokrzyskie (3.54), Warmińsko-Mazurskie (2.5). The development of human resources in the regions of the UK which occupy three lowest positions in the KEI rating is also strongly correlated with the Knowledge Economy Index. It is confirmed by the results of the educational system analyses: Wales - 2.50, Northern Ireland - 0.83, North East - 1.39. The research has also shown a considerable variation of the ICT index in particular voivodships: the difference between Mazowieckie and Warmińsko-Mazurskie is 7.71 points. Three UK regions which occupy the last positions in the rating showed almost three times lower ICT indices than the regions classified as the highest. The stated research hypothesis has been verified positively. The educational system, adjusted to the needs of the modern job market, influences the living standard measured by GDP per capita. The high level of education in engineering and technical university courses as well as its appropriate structure are the basis for the creation and implementation of new knowledge into the new economy (which is confirmed by the correlation coefficient of the KEI and the educational systems - in the United Kingdom 0.88, in Poland 0.82). The high education level brings tangible results - the higher standard of living of the population and the more friendly social and economic environment.

Conclusions

Poland substantially differs from the United Kingdom in its level of knowledge economy. In Poland, the difference between the highest rated Mazowieckie voivodship and the lowest rated Warmińsko-Mazurskie is 4.79 points. In the United Kingdom, there is a difference of 5.18 points between South East and Wales. GDP per capita of Mazowieckie voivodship is 2.04 times higher than in Warmińsko-Mazurskie. A similar difference is noticeable between the regions of London and Wales - GDP per capita is 2.01 times higher. The research methodology and results indicate that knowledge implementation is definitely too low in the Polish and UK regions placed on the lowest positions in the KEI rating. It is possible to improve this situation (according to the research results), providing that expenditures on human resource development and on research and development are increased. The dependency of the price of goods and services on the KEI may be interesting for managers. The correlation is strong: $r = 0.72$ in Poland and 0.75 in the UK, i.e. the higher the level of price index, the higher the KEI. This means that the more knowledge the produced goods require, the higher their price is. The important correlation between conditions for enterprise (the influence of property and motor vehicle taxes, the efficiency of the judiciary, price level, GFCF and GDP per capita was tested) and the KEI was not confirmed. On the basis of the used research methodology and research results it can be assumed that the common managers' opinion of tax charges being too restrictive in Polish voivodships and the regions of the UK has not been confirmed.

The paper have published at: Puczkowski B. The influence of knowledge on economy in Polish voivodships and in the regions of the United Kingdom as measured by the Knowledge Economy Index (KEI), International Studies, University of Lodz.