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The Knowledge – Based Economy in the New Members States of the European Union: Methodological Aspects

Abstract

The concept of a knowledge–based economy as developed since the end of the 20th century is no subject to multiple theoretical approaches as well as varied methodological efforts. This has become a starting point for classifying sectors or even entire economies in terms of intensity of impact of knowledge as well as the developing of rankings defining the general position of a country assessed with respect to level of implementation of the knowledge–based economy model. The article presents an overview and classification of research methods in the realm of the knowledge–based economy—OECD, World Bank, and European Union—as well as the results of rankings using the Knowledge Economy Index (World Bank Institute) for the new member states of the European Union.

1. Introduction

The objective of this article is to present research methods in the realm of knowledge–based economy concepts in the new members states of the European Union. The evolution and classification of methodology as well as examples of evaluations of knowledge–based economy model development are presented on the basis of selected, very characteristic concepts of the OECD, World Bank, and European Union. The comparisons of knowledge–based economies in the new European Union member states were conducted applying the World Bank's "Knowledge Assessment Methodology" (KAM) and the World Bank ranking – "Knowledge Economy Index" (KEI)—as presented for the specified counties.

The knowledge–based economy as a model for a modern economy has its roots in the general transformations of the end of the 20th century. It was then that in addition to political changes, economic phenomena of worldwide character were observed, including market liberalization, increased national market openness coupled with a striving towards the creation of continental and global markets, universal application of information technology and the Internet for data processing, production organization, sales, and communications, and an unheard of to date growth on a worldwide scale in the value and dynamism of foreign direct investment.

Research into the knowledge–based economy in Poland as well as other countries involved in social and economic system transformation that also became new members of the European Union have been conducted as of the year 2000 (Piech 2004, pp. 1–54; Gospodarka oparta na wiedzy… 2003). It was at the same time that in its Lisbon Strategy, the European Union declared that by 2010 it will become the most competitive and dynamic knowledge–based economy in the world, capable of sustainable development, creating greater numbers of better jobs, and developing greater social cohesion. The knowledge–based economy is a contemporary megatrend (Szukalski 2005, p. 339), where the document approved by European Union member states in March of the year 2000 in the capital of Portugal defined a long–term effort and expectations of structural changes in a common European economy. A report ("Facing the Challenge…" 2005) was presented at the Council of Europe Summit in 2005 with an overview of mid–period implementation of the Strategy. There, priority actions in achieving the Lisbon targets were specified.

2. Defining the Concept of a Knowledge–Based Economy

According to the definition of the Organization for Economic Cooperation and Development (OECD), the knowledge–based economy model is an economy that is directly based on the production, distribution, and application of knowledge and innovation (OECD 1996, p. 14). According to the European Union, the knowledge–based economy defined in the Lisbon Strategy is based on an information society, research and innovation, and structural reforms fostering a growth in competitiveness and innovation (Lisbon session of the Council of Europe 2000). In describing the knowledge–based economy, the World Bank demonstrates that both knowledge and the ability to produce, acquire, and effectively utilize knowledge have been a tool of innovation, competitiveness, and economic success for a long time. "However, dramatic changes have taken place over recent years that have decidedly increased the

importance of knowledge and have provided great competitive advantage to entities capable of utilizing knowledge quickly and effectively. The growth in global trade and foreign direct investments observed over recent years, facilitated thanks to better information flow, has accelerated the effects of the described changes"[1]. Concrete methodological approaches are derived from the specified definitions, whose range of measurements encompass everything from isolated sectors of the economy termed "high–tech" all the way to multi–index approaches making possible the capturing of knowledge in each of its economic influences.

3. Measuring Knowledge–Based Economy Phenomena and Problems in Interpretation

Among the main reasons for creating the concept of a knowledge–based economy is the desire to describe the causes of economic growth within the framework of the endogenic theory (Zienkowski 2003, p. 15), where modeling leads to an increase in the complete and precise measuring of the outlay of production factors and depicting not only the quantity of outlays, but also their quality (Sztaudynger 2005, p. 23). In alternative production theories, the "knowledge" factor plays a decisive role in economic growth in parallel with a significant increase in its outlay, but without growth or with minimal growth in the outlay of the fixed asset factor. In spite of efforts aimed at the knowledge factor being taken into consideration in economic growth theory, there is the problem of measuring "knowledge." Certain researchers do not point to any dearth of data, but rather to gaps in theory (Piech, p. 266).

The described phenomena of a knowledge–based economy are based on *The Knowledge–Based Economy*, a pioneering work published by the OECD in 1996 that is regarded as a classic today. In spite of the fact that research into knowledge was started in the United States as early as the nineteen–sixties

[1] Final report of the Knowledge Economy Forum: "Wykorzystywanie wiedzy dla potrzeb rozwoju w krajach kandydujących do członkostwa w Unii Europejskiej", organized by the World Bank in conjunction with the European Commission of the Organization for Economic Cooperation and Development (OECD), The European Bank for Reconstruction and Development (EBRD), and the European Investment Bank (EIB), Paris, February 19–22, 2002. "Budowanie gospodarki opartej na wiedzy: Szanse i wyzwania stojące przed krajami kandydującymi do członkostwa w Unii Europejskiej", *Gospodarka oparta na wiedzy. Perspektywa Banku Światowego*, World Bank Scientific Research Committee, Rewasz Publishing House, 2003, pp. 13–14.

(Machlup 1962, as quoted by Piech 2004), it is the broad development of research at the end of the nineteen–nineties and the beginnings of the 21st century that should be particularly noted.[2]

In accepting Leszek Zienkowski's idea (Zienkowski 2003, pp. 15–19) that knowledge *per se* (outlay and state of knowledge) are becoming a more important factor determining the rate of development and level of development of the economy than outlay and the state and volume of fixed assets, it is necessary to identify concepts vital to conducting measurements and define their range:

- knowledge capital consists of accumulated scientific knowledge and educational capital,
- scientific knowledge is the cumulated result of scientific research, and
- educational capital is the level of education of society.

In the case of educational capital, it is postulated that its scope be limited to the working segment of society, where the officially achieved educational level should be decreased by the portion of functionally illiterate. Another postulate is that expenditures on research and development should be separated from those spent on education. As to outlay on education, expenditures on higher education should be identified.

As to scientific knowledge, the proposal is for it to be counted as research and development outlay on basic research. In spite of certain concerns, the premise that basic research has been and is a primary component of change—on the par with implementation—should be accepted. "Practical difficulties [including short time windows for research and development statistical data – the author] relating to estimates of the state of knowledge are why it is not the relation of the state of knowledge to level of development or the relation of states of knowledge to differences in development level that are analyzed, but the relation and dynamics of outlay on knowledge (outlay on research and

[2] Other methods for measuring a knowledge–based economy include: PPI 1999 – The New Economy Index: Understanding America's Economic Transformation; The World Bank, OECD, Korea, and the Knowledge–Based Economy: Making the Transition; Asia Pacific Economic Cooperation, 2000, Towards Knowledge–Based Economies in APEC; Harvard University, 2000, Readiness for the Network World; Australian Bureau of Statistics, 2002, Measuring a Knowledge–Based Economy and Society: An Austalian Framework; WBI 2002, Knowledge Assessment Matrix; more in (Piech 2004, pp. 20–22).

development and outlay on education) to the level and dynamics of economic development."[3]

Two positions on knowledge measurement methodology should be identified:

Position #1. A broad gamut of indicators is presented in order to describe the knowledge–based economy. The next move involves operations aimed at their normalization and a defining of weights. The set of indicators so grouped leads to the building of a single indicator. This approach is often and mainly used by economic analytical institutions of worldwide character, where a listing of approaches within the framework of this methodological group is depicted in Table No. 1.

Position #2. Shows the share of GDP generated by sectors of the knowledge–based economy or the share of labor generated by "knowledge workers" (Piech 2004, p. 16).

The greatest achievements in defining and measuring the knowledge–based economy are:

- "Knowledge–Based Economy," 1996 – Ogranization for Economic Cooperation and Development,
- "Knowledge Assessment Methodology" (KAM), 1998 – World Bank Institute,
- "Lisbon Strategy," 2000 – European Union.

[3] L. Zienkowski proposed changes to the System of National Accounts (SNA) by introducing a new category encompassing current levels of accumulation and outlay on science and education—outlay on future development. More in (Zienkowski 2003, pp. 17–18).

Table 1. Methodological Approaches to Measuring a Knowledge–Based Economy

Approach	Presentation of a Broad Range of Indicators		A Single Indicator			
			Based on Separate Knowledge Sectors		Based on a Selection of Indicator	
How is the knowledge–based economy measured?	"Raw" data	Normalized data	Arbitrary sector selection	Quantity–based selection criteria*	Indicators considered equally	Weighed indicators
Who performs the measuring?	OECD, World Bank, etc.	World Bank Institute (KAM)	Machlup, Porat	OECD	World Bank Institute (simplified KAM), PPI**	UNECE
Evaluation	Most frequently applied approach, but leading to a lack of lucid comparison of knowledge–based economy development		Criticism: The knowledge–based economy is present throughout the whole of the economy, not in isolated sectors or groups of industries or services		Too few applied indicators, equality of indicators	Arbitrary selection of applied weights

Comments:

* In this case, the intensity of research and development.

** Progressive Policy Institute.

Source: K. Piech, "The Knowledge–Based Economy in Transition Countries: Assessing the Place of New Member States," K. Piech (Editor), *The Knowledge–Based Economy in Transition Countries: Selected Issues*, University College London, School of Slavonic and East Europe Studies, London 2004, p. 17.

4. OECD Methodology: Selection of Areas of Intense Knowledge Influence and Measurements

As early as the year 1996, the OECD called attention to problems linked with finding a univocal method for measuring knowledge resources. It cited four main reasons for which knowledge indicators cannot approach the systematic universality of traditional economic indicators. They are:

1. There is no fixed formula for explaining the influence of creating knowledge on the effects of created knowledge.

2. The impact of creating knowledge is difficult to depict due to the lack of knowledge "accounts" that might be equivalent to traditional national accounts.
3. Knowledge has no systematic appraisal structure that could serve as a basis for aggregating fragments—knowledge parts—that are in essence unique.
4. Newly created knowledge is not necessarily a pure addition to knowledge resources and the vitality of additional knowledge resource sections is not documented (OECD 1996, pp. 30–31).

Nevertheless, research undertaken into the knowledge–based economy has borne fruit in the development of methods for selecting areas of the strong impact of technology and the identification of sectors of industry and services (the most susceptible to the influence of knowledge) coupled with their isolation in terms of the intensity of this link.

The OECD has identified four industrial groups and specified their level of technological impact (Table 2). The assumption made for defining the "High–Tech" (HT) group involve investments in research and development in terms of added value that exceeded 15%, while in the case of "Medium–High–Technology" (MHT) investments ranged from 4% to 15% (average values for OECD countries over the years 1990–1999).

Table 2. Industrial Groups by Technology Impact – OECD

Group	Industry Sector	Detailed Sector Scope (Impact)
1.	High–Tech products (HT)	Pharmaceutical (2423), office equipment (30), radio, television, and communication equipment (32), medical, precision, and optical (33), aviation and space (353)
2.	Medium–High–Technology (MHT)	Chemical, excluding pharmaceutical (24), machine and equipment (29), electrical equipment and apparatus (31), automotive industry (34), transportation industry and road equipment (352+359)
3.	Medium–Low–Technology (MLT)	Coke, refined petroleum products, and nuclear fuel (23), rubber and plastic industry (25), other non–metallic products (26), base metals (27), metal structure products and furnishings (28), shipbuilding industry (351)
4.	Low–Technology (LT)	Food and beverages, and tobacco products (15–16), textiles, the textile, leather, and footwear industries (17–19), wood and paper industry, paper products, printing and publishing industry (20–22), other manufacturing industries, recycling (36–37)

Source: Own study based on *Measuring the Information Economy*, OECD, Paris, 2002.

In its "Knowledge–Based Industries" (KBIs) method, based on the four industrial groups identified by technological impact, the OECD proposes a set of five knowledge impact industrial and service groups (Table 3).

Table 3. High–Impact Knowledge Industries and Services – The "Knowledge–Based Industries"

Group	Industry / Service	Detailed Sector Scope (impact)
1.	High technological impact industry	Highly advanced technology industries (2423+30+32+353)
		Medium advanced technology industries (24+29+31+34+352+359)
2.	High knowledge impact service markets	Postal services (logistics) and communications (64)
		Financial and insurance services (65–67)
		Business services (71–74), i.e. equipment and furnishing rental services (71), computer services (72), research and development (73), other services (74), excluding real estate

Nota bene: Only two of the five groups of industries have been identified although all five continue to be termed by the OECD as being "knowledge–based industries" (as based on ISIC, Revision 3).

Source: Own study on the basis of K. Piech, "The Knowledge–Based Economy in Transition Countries: Assessing the Place of New Member States," K. Piech (Editor), *The Knowledge–Based Economy in Transition Countries: Selected Issues*, University College London, School of Slavonic and East Europe Studies, London, 2004, p. 26.

The OECD's "knowledge–based industries" method measures the impact and share of knowledge industries on the basis of their research and development share in the total added value of company sectors. Most ICT–advanced countries have a share of knowledge–based industries in total company sector added value in excess of one–quarter, where the share of the high knowledge impact service sector is greater than the sum of the HT and MHT industry shares. Moreover, worth noting is a certain regularity, whereby countries that are advanced in terms of the knowledge–based economy have a higher share of employed in the knowledge impact sectors and demonstrate greater growth dynamics in this employment group. However, there are criticisms raised against the OECD's method, because the influence of research and development is only one possible path to defining the creation of knowledge (knowledge creation is one characteristic form of knowledge) and knowledge is transferred through many branches and sectors of the economy, where industries with a low share of knowledge may use that knowledge in areas outside the studies. Nevertheless, the countries of the OECD are moving towards a knowledge–based economy and the rate of their progress in this field is a function of investment (Piech 2004, 28–29), where the realm of methodology

has its merits in the form of the introduction of the "knowledge investment" measure. As in the case of the OECD, it is assumed that the "knowledge investment" indicator encompasses expenditures on research and development, investment in software, and private and public expenditures on education (Tables 4a and 4b).

Table 4a. Investment in Knowledge in Selected Member States of the European Union, 2000

Country	Knowledge Investments as a percentage of GDP, 2000	Research and Development as a percentage of GDP, 2000	Software Outlay as a percentage of GDP, 2000	Higher Education Outlay as a percentage of GDP, 2000	Average Annual Growth
Poland	1.9	0.7	0.7	0.5	—
Slovakia	2.4	0.7	1.0	0.7	—
Hungary	3.1	0.8	1.4	0.9	3.4
Czech Republic	3.6	1.3	1.6	0.7	—
European Union	4.0	1.9	1.4	0.7	4.2

Nota bene: The European Union without Belgium, Denmark, and Greece.

Source: Own study on the basis of the OECD "Science, Technology, and Industry Scoreboard 2003," *Towards a Knowledge–Based Economy*, Paris, 2003, as quoted by K. Piech, "The Knowledge–Based Economy in Transition Countries: Assessing the Place of New Member States," K. Piech (Editor), *The Knowledge–Based Economy in Transition Countries: Selected Issues*, University College London, School of Slavonic and East Europe Studies, London, 2004, p. 30.

It should be noted that the measurement of outlay on research and development, higher education, and software as proposed by the OECD method is, in fact, the measurement of "knowledge production" (Malhotra 2003, p. 18). Apart from the share of added value in industrial sectors, it is possible to use the share of people employed in knowledge–based industries as a number presenting a value for the level of development of the knowledge–based economy (Piech 2004, p. 26).

Table 4b. Investment in Knowledge in Selected Member States of the European Union, 2005

Country	Total Research and Development Expenditure Share, OECD, 2005	Research and Development Expenditures in USD trillion (current PPP), 2005
Poland	0.4	3.0
Slovakia	0.1	0.4
Hungary	0.2	1.7
Czech Republic	0.4	3.0
European Union	29.6 $_{EU27}$	231.0 $_{EU27}$

Source: Own study based on the OECD "Science, Technology, and Industry Scoreboard 2007," *Innovation and Performance in the Global Economy*, Paris, 2007, p. 25.

The OECD "Science, Technology, and Industry Scoreboard 2007", *Innovation and Performance in the Global Economy* noted a slightly lower growth in expenditures on research and development than in the second half of the nineteen–nineties (data cross–sections for all OECD countries). As of the year 2001, these expenditures rose at the same rate as the GDP, staying at a level of approximately 2.25% of the GDP. The number of patent rights granted to universities has been growing in the countries of the OECD, while the number of publications prepared by international teams tripled over the years 1995–2005. The countries of the European Union are taking up cooperation with other countries of the European Union, in contrast to the global collaboration of the United States (OECD Science 2007, pp.2–7).

5. The World Bank Method: From the KAM Method to KEI Ranking

The Knowledge Assessment Methodology (KAM) of the World Bank Institute has developed a group of indexes – the Knowledge Economy Index (KEI) and the Knowledge Index (KI).

The economic indicator that is based on knowledge (KEI) is a successive advanced measure serving to compare economies on an international level, including the conducting of comparisons with other variables defining economic growth, for example, assessing the capacity for fostering an economic environment for the effective use of knowledge for economic development.[4] The main qualities of this indicator include the assigning of individual groups of

[4] A complete description of the method may be found in *How to Use the KAM?* www.worldbank.org/kam.

variables to defined pillars of the knowledge–based economy model as developed by the World Bank, defining the range of concepts, normalizing sub–indicators in assigning specified values (in a range of from 0 to 10, where the higher the value the greater the advancement of the knowledge–based economy) (Piech 2006,), calculating fragmentary indexes, their re–weighing, and the calculation of the final indicator (Table 5).

Table 5. The Structure of the Knowledge Economy Index According to the World Bank

Group	KEI Indicator	KEI Variables
1.	Economic and institutional stimuli regimen	Tariff and non–tariff barriers
		Regulatory quality
		Rule of Law
2.	Education and human resources	Literacy rate among adults
		Share of people being educated on a secondary level among the total secondary school level age group population
		As above, but for only for higher education
3.	Innovation system	Research and development sector scientists
		Patent submissions granted by the United State Patent Office per million inhabitants
		Number of scientific articles in scientific and technical journals per million citizens
4.	Information technologies	Telephones per 1,000 persons
		Computers per 1,000 persons
		Internet users per 10,000 persons

Source: Own study based on *How to Use the KAM?* www.worldbank.org/kam.

The knowledge index (KI) is a measure defining the creation, use, and diffusion of knowledge – an encompassing of the entire knowledge potential of a given economy (Figure 1). "Methodologically, the knowledge index is a simple normalized average of national or regional results by the key parameters of the three pillars of a knowledge economy – education and human resources, innovation, and communication technology (ICT).[5]

[5] KI and KEI Indexes, www.worldbank.org/kam.

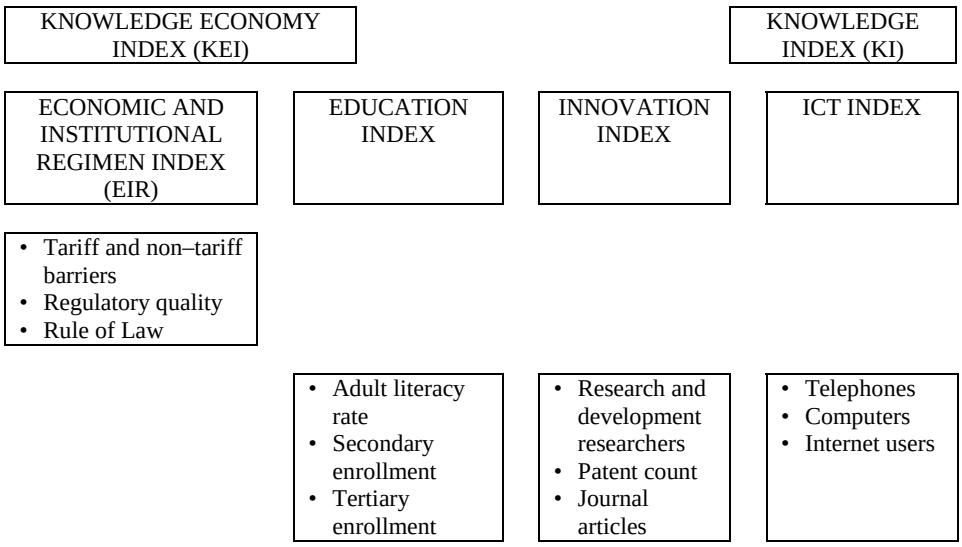

Figure 1. Knowledge Assessment Methodology Knowledge Indexes

Source: KI and KEI, www.worldbank.org/kam.

Knowledge assessment methodology (KAM) is a simple tool serving a quick defining of the position of the knowledge–based economy in the given country, both in comparison with other countries (data from 140 countries) or groups of countries or regions (G7, Western Europe, East Asia and the Pacific, South Asia, Europe and Central Asia, etc.), or the comparison of regions. It also includes the United Nations Human Development Index (HDI). Results derived make possible the identification of strong and weak "pillars" (Dahlman 1999 as quoted in Piech 2004) of the knowledge–based economy. The knowledge assessment methodology was developed within the framework of Knowledge for Development (K4D) by the World Bank Institute and has seen application in the Internet "Basic Scoreboard" version accessible at www.worldbank.org/kam.

It is on the basis of the knowledge assessment methodology (KAM) that the World Bank provides an annual ranking of countries in terms of advancement in building a knowledge–based economy. Since the launching of this publication, the Scandinavian countries have been occupying the highest positions. The greatest jump was achieved by China in 2007 (+29 positions), while the greatest fall involved countries of Africa and South America. Table 6 presents the positions of the new member states of the European Union. At this point it is worth noting the indication dating from the year 2002, where "the

creation of conditions for the blossoming of knowledge–based economies for European Union candidate countries is a difficult, but no less important a task."[6]

The structure and size of knowledge–based economies for individual new member states in line with the Knowledge Assessment Methodology (KAM) is presented in Appendixes No. 1, No. 2, and No. 3. In order to facilitate examination of the radar graphs, it should be stated that the greater the graph area the better the results achieved during analysis and the better the position of the country, region, or group of countries as compared with a defined group of countries (Europe and Central Asia, All Countries, High Human Development). The 2007 Knowledge Assessment Methodology (KAM) presents the current situation of the analyzed entities (the last graph for Poland is a comparison with the year 1995).

Table 6. World Bank Ranking on the Basis of the Knowledge Economy Index (KEI) in the Year 2007 – New European Union Member States

Country	2007 Position	KEI 2007 Position	1995 Position	Change since 1995
Slovenia	23	8.16	27	4
Estonia	25	8.07	25	0
Hungary	28	7.64	32	4
Czech Republic	29	7.64	29	0
Cypress	30	7.63	31	1
Lithuania	31	7.49	43	12
Latvia	33	7.37	52	19
Poland	35	7.24	38	3
Slovakia	36	7.22	33	-3
Bulgaria	41	6.18	47	6
Romania	48	5.86	56	8

Source: *Knowlegde Economy Index (KEI) 2007 Rankings*, The World Bank, Knowledge for Development Program, www.worldbank.org/kam.

[6] "Building Knowledge Economies: Opportunities and Challenges for EU Accession Countries," Final Report of the "Using Knowledge for Development in EU Accession Countries" Knowledge Economy Forum organized by the World Bank in cooperation with the European Commission, the Organization for Economic Cooperation and Development, the European Bank for Reconstruction and Development, and the European Investment Bank, Paris, February 19–22, 2002, May 2002, www.worldbank.org/eca/knowledgeeconomy.

6. The Lisbon Strategy: Program for the Transformation of the European Union Leading to a Knowledge–Based Economy

Approved at the Council of Europe summit in Lisbon, the Strategy is a long–term and comprehensive program for social and economic reform and change, where an important place is occupied by the model for achieving a knowledge–based economy in the member states of the European Union. A program for reaching a knowledge–based economy was also prepared for the then candidate, but currently new member states of the European Union. The Strategy has no rigid formula and is subject to adjustment during spring summits. Its implementation is dependent on the political will of individual governments, but mutual pressure fostering the implementation of mutual targets is no less important (The Lisbon Strategy… 2003, p. 61). Among problems linked with implementation of assumptions, the report of the High Level Group providing a mid–period overview of the Lisbon Strategy "includes an overloaded agenda, poor coordination on a community and national level, as well as incongruity in mutual objectives" (Facing the Challenge: The Lisbon Strategy… 2005) Ameliorating actions are proposed within the framework of the "Knowledge–Based Society" priorities.[7]

1. Elimination of administrative barriers in member states in terms of the mobility of scientific staff and researchers on a world level,
2. The creation of a European Research Council (ERC), which would be an institution financing and coordinating basic research on a European level with a long time horizon,
3. Implementation of the eEurope 2005 action plan in order to take advantage of ICT potential, and
4. Implementation of actions aimed at decreasing the complexity, time, and money tied with the protection of intellectual property in the area of Community Patents.

In discussing this method it must be remembered that in contrast to methods of measuring the knowledge–based economy presented earlier, this method:

[7] Discussion on the High Level Group report on the mid–period Lisbon Strategy overview, Office for the Committee for the Integration of Europe, Warsaw, 2005, pp. 3–4.

1. Is molded by an international entity that defines the framework for the economic policy of member states, instead of merely serving research or advisory functions as is the case with institutions developing knowledge–based economy methodologies,
2. At the same time, it is an economic program whose implementation is supported by funding (e.g. FP7 – 2007–2013 Framework Program involves outlay amounting to EUR 50,521 million, where FP6 provided EUR 16,270 million, which signified an increase by 221.8%) (Wierzbołowski 2007, p. 75),
3. Is supported by detailed programs (framework programs), and
4. Is a homogeneous method—i.e. due to a lack of any rigid formula for member states, each country is autonomous in terms of developing both detailed programs for implementing the Strategy and conducting measurements on "a national as well as regional and sector level" (The Polish Lisbon Strategy Forum… Part II 2003, p.25).

Below is a presentation of an overall introduction in terms of strategy, followed by measurement methods.

The Lisbon Strategy, in its part relating to the knowledge–based economy, is made up of two main legal and economic pillars—i.e. an information society, and research and innovation.

6.1 The Information Society

The strategy formulating action aimed at the information society defined it in concrete programs. The primary program for spreading Internet communications was the eEurope 2002 Action Plan. Successive areas coupled with the information society were 3G (UMTS) cellular telephony and digital television. The aim of the eEurope 2005 Plan is the creation of a favorable investment climate, growth in production, and the modernization of public sector services as well as that every citizen of the European Union becomes a full–fledged citizen of the global information society. Detailed objectives involve e–government, e–health, e–business, e–education, broadband network development and utilization, tele–information network and data transmission security, and the implementation of the IPv6 transmission protocol. The plan mainly concentrates on providing users with tools supporting social integration, but it also refers to targets that are strictly related to knowledge–based economy objectives.

Programs for achieving a knowledge–based economy were developed for candidate countries that are currently European Union member states. eEurope+

was just such a program with respect to the information society pillar. With accession on May 1, 2004, the new member states became full–fledged (bearing in mind transition periods) participants in the Lisbon Strategy program.

6.2. Research and Development

The creation of a European Research and Innovation Space (European Research Area) as well as an increase in expenditures on research and development, with related changes in structure, are fields in the main circles of interest (The Polish Lisbon Strategy Forum… Part I 2003, p. 22).

European Research Area signifies:

- Development of appropriate mechanisms for the creation of improvement networks as well as the drafting of related maps.
- Analysis and monitoring of the results of the research and development sector with respect to incurred outlay.
- Improvement of the environment for growth in private expenditures on research and development (the partnership of research and development institutions and technology companies launching innovative efforts, tax policy motivation, and support on the part of venture capital and the European Investment Bank).
- Application of benchmarking in the system of national studies as well as the use of the appropriate instruments in state policy, identification (plan of the year 2000) basic indicators serving an evaluation of research results in various specialty fields, and the selection of indicators for assessing and measuring the development of human resources, and the development of a European Specialty Level Charter.
- Guarantying technical conditions for the creation of a high–speed trans–European electronic communication network among universities, scientific libraries, and scientific research centers, as well as schools, gradually,
- Fighting the disdain of scientists for mobility as well as a quest for the best talent and caring for it.
- Minimizing the costs of patenting inventions in the European Union, achieving the best and best protected European patent (The Polish Lisbon Strategy Forum… Part II 2003, p. 14).

Presently, the most important instruments applied in the European Union for implementing research and development are the framework programs as well as special, supplementary programs incorporated in the European Research Area structure. The FP6 concentrated on several strategic priorities including studies

in information (Info), biology and medicine (Bio), materials and material technology (Techno), and education (Edu) (The Polish Lisbon Strategy Forum… Part II 2003, p. 46). FP7 worked to make the ERA concept concrete and was also a new approach to European Union scientific policy, where through its ties to industrial policy is served an increase in the competitiveness of European Union industry on an international scale. That program laid stress on the following priorities: (Wierzbołowski 2007, p. 93) ICT, ideas, health, people, transportation, nanotechnology, materials and new manufacturing technologies, energy, food, agriculture and fisheries as well as biotechnology, extraterrestrial space, security, and scientific research infrastructure. Moreover, what links FP5, FP6, and FP7 is the "defined way of thinking about the role of science in the European Union, which is passing into a state of an information society and a knowledge–based economy. […] the dominant feature of FP5 involved questions of the information society as a reaction to the Maastricht Treaty and the Amsterdam Treaty. […] Support for creating ERA dominated FP6, which tied this program to the Lisbon Strategy. While dominant in FP7 was adapting the European Union […] to a new competitive model" (Wierzbołowski 2007, pp. 79–80).

Pursuant to the main document of the Strategy, the framework programs, and the scientific discourse, the chief assumptions in measuring knowledge *sensu largo* as depicted in the Lisbon Strategy qualify the method into Position #2 (see item 2. Measuring Knowledge–Based Economy Phenomena and Problems in Interpretation, above) as they demonstrate the share of GDP input by the sectors of the knowledge–based economy.

"An assessment of the performance of research and development tasks is mainly conducted through measures of outlay as well as the scientific and technological results of such outlay, mainly in the form of patent and supplementary indexes" (The Polish Lisbon Strategy Forum… Part II 2003, p. 14). A successive measure is the ratio of outlay (as a percentage of the GDP) financed by the private sector and by the public sector, the share of expenditures on research and development per researcher (in thousand USD PPP), the gross scholarization indicator (the share of people studying at a given educational level to the population number of the relevant age group, mainly with respect to the higher education level), and the number of college students per 10,000 population.

The following indexes may be identified in the realm of the information society: the Internet access index for both households and businesses, the pupils per computer index, the share of public services performed through the Internet, and access to broadband Internet (Table 7).

Table 7. Knowledge–Based Economy Pillars as Defined by the Lisbon Strategy and Detailed Indexes

Knowledge–Based Economy Pillars	Indicators
Information Society (IS)	• Household Internet access index • Business Internet access index • Pupils per computer index • Share of public services (cases) performed over the Internet • Access to broadband Internet
Research and Development (R&D)	• Ratio of R&D outlay as a GDP percentage • Number of patents • Outlay ration (as a GDP percentage) financed by the private and public sectors • Share of R&D expenditures per researcher (in thousand USD PPP) • Scholarization index • Number of college students per 10,000 population • Outlay on higher education as a GDP percentage

Source: Own studies on the basis of www.eurostat.eu.

In spite of encouragement, such as that found in the "Recommendations"[8] it is still true that the European Union designated approximately 2% of its GDP on research and development, which is not much more than its starting point. Only 55% of these expenditures are business expenditures. The number of scientists, especially those involved in technology and engineering, also remains unsatisfactory. Nevertheless, the Commission ("Czas wrzucić wyższy bieg…" 2006) postulates an increase in the portion of European Union structural funds for research, development, innovation, information and telecommunication technologies (broadband connections), increased investment in higher education (2010 target – 2% GDP), and the establishing of the European Institute of Technology ("Poprawa transferu wiedzy między instytucjami…" 2007, p. 8).

Detailed data regarding indicators for the knowledge–based economy in line with the Lisbon Strategy are presented in Tables 8, 9, and 10.

[8] "Council Recommendation of July 12, 2005 on the Broad Guidelines for the Economic Policies of the Member States and the Community (2005 to 2008)," 2005/601/EC, Official Journal of the European Union, 2005.

Table 8. Research and Development Intensity as a Percentage of the GDP, Annual Growth Rate, Private Outlay, and Scientists in the New Member States of the European Union and the European Union "27"

Country	R&D Intensity and R&D Outlay as a percentage of GDP			Average Annual Growth Rate [%]	R&D Outlay Financed by the Private Sector as a Percentage of the Whole	Scientists and Engineers as a Percentage of the Work Force
	2000	2005	2006	2001–2005	2004	2006
EU "27"	1.86	1.84	1.84	1.5	54.9	4.8
Bulgaria	0.47	0.51	0.50	6.8	28.2	3.0
Czech Republic	1.21	1.41	1.54	8.3	52.8	3.3
Estonia	0.61	0.93	1.14	16.5	36.5	4.0
Cypress	0.24	0.40	0.42	15.2	18.9	4.2
Latvia	0.44	0.56	0.69	17.6	46.3	3.4
Lithuania	0.59	0.76	0.80	11.4	19.9	4.1
Hungary	0.78	0.94	1.00	5.0	37.1	4.2
Malta	—	0.54	0.55	—	18.6 (2002)	3.9
Poland	0.64	0.57	0.56	1.1	26.9	5.2
Romania	0.37	0.41	0.46	—	44.0	4.0
Slovenia	1.41	1.46	1.59	—	58.6	5.5
Slovakia	0.65	0.51	0.49	-0.6	38.3	3.0

Source: Own study on the basis of Eurostat, News Release 34/2008, "Science, Technology and Innovation in Europe: EU27 R&D Spending Stable at 1.84% of GDP in 2006," Eurostat, News Release 6/2007, "Reaserch & Development in the EU: Preliminary Results, in Relation to GDP, EU27 R&D Expenditure Stable at 1.84% in 2005".

During the 2001–2006 period of implementation of the Lisbon Strategy, the knowledge–based economy development indicators for the new European Union member states demonstrated significant differentiation in specific countries. Slovenia (1.59), the Czech Republic (1.54), Estonia (1.14), and Hungary (1.00) came close to European Union "27" average values for outlay on research and development (as a percentage of GDP). Most countries were in the 0.42 (Malta) to 0.80 (Lithuania) range. The highest average annual growth rate (as a percentage of annual growth) in research and development outlay over the years 2001–2005 as compared with the low European Union "27" value (1.5)

was achieved by the Baltic countries (from 11.4 to 17.6) as well as Cypress (15.2), with the Czech Republic, Hungary, and Bulgaria, and the lowest position occupied by Poland (1.1) and Slovakia (-0.6). The share of private outlay in research and development outlay amounted to 54.9 for the European Union "27," where only Slovenia (58.6) and the Czech Republic (54.9) came close to the Lisbon target, while the remaining countries are still on the road to achieving it, where they did achieve high values, however—Latvia (46.3), Romania (44.0), Slovakia (38.3), Hungary (37.1), and Estonia (36.5). In terms of the indicator of the share of scientists among all employed (as a percentage of the labor force), the European Union "27" level (4.8) was clearly exceeded by Slovenia (5.5) and Poland (5.2).

7. Conclusions

The presented methods for measuring the level of development of the knowledge–based economy are derived from the character of approach represented by the institutions creating the given measure. In this case, an important role is played by the range of research (e.g. 140 countries within the framework of Knowledge Assessment Methodology), continuity of research into methodology (e.g. as of 1996 in the case of the OECD), and the character of the institutions (e.g. the World Bank, an advisory institution).

The Knowledge–Based Economy method of the Organization for Economic Cooperation and Development and the Knowledge Assessment Methodology (KAM) of the World Bank Institute confirm through their approach that they can be classified as belonging to Position #1, where the broad spectrum of indicators creates a single indicator. The Lisbon Strategy method of the European Union tends towards Position #2, where the objective is to demonstrate the share of GDP input by the knowledge–based economy sector or the share of the labor force provided by knowledge workers.

By using the application on the Internet page, only the Knowledge Assessment Methodology (KAM) of the World Bank Institute enables a comparison of states of development of the knowledge–based economy. Published for many years now, the Knowledge Economy Index (KEI), based on the Knowledge Assessment Methodology (KAM), makes it possible to analyze progress in specific countries on the road to reach a knowledge–based economy.

In line with measuring tools applied, the effects of a measurement of the state of development of the knowledge–based economy in the new member

states of the European Union allows the identification of the following regularities:

- The Baltic states (Lithuania, Latvia, and Estonia) have achieved the highest rate in achieving the targets of the knowledge–based economy,
- The Vyshehrad group of states (the Czech republic, Slovakia, Hungary, and Poland) form a successive, though less compact group of countries that achieve average results in the knowledge–based economy field, where the clear leaders are the Czech Republic and Hungary,
- In all studies, Slovenia shows the achievement of significant progress in achieving a knowledge–based economy—including the highest position (23) in the World Bank Ranking of the examined group of countries,
- Cypress and Malta, though sometimes outside of the classification, achieve average scores in the area of implementation of knowledge–based economy targets, and
- Bulgaria and Romania, although countries with the shortest period of membership in the European Union, have simultaneously achieved a high rate of change in selected knowledge indicators, overall remain in the group of countries whose road to implementing the knowledge–based economy model seems to be the longest, which is confirmed by the World Bank Ranking where they achieved a knowledge economy index (KEI) of 41 and 48, respectively.

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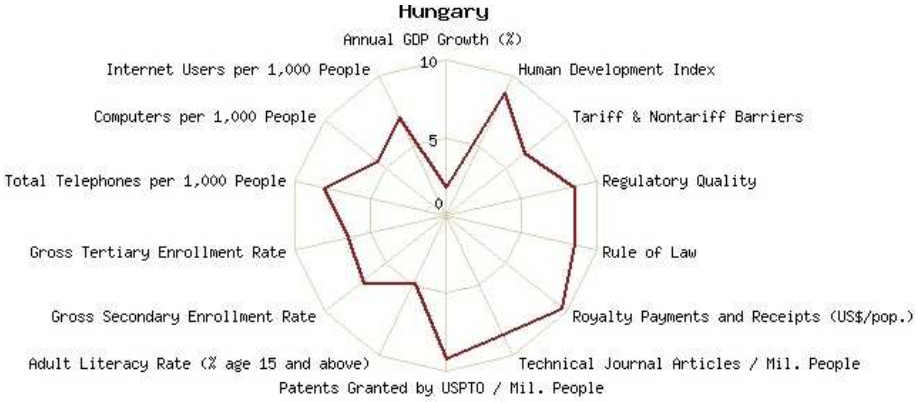
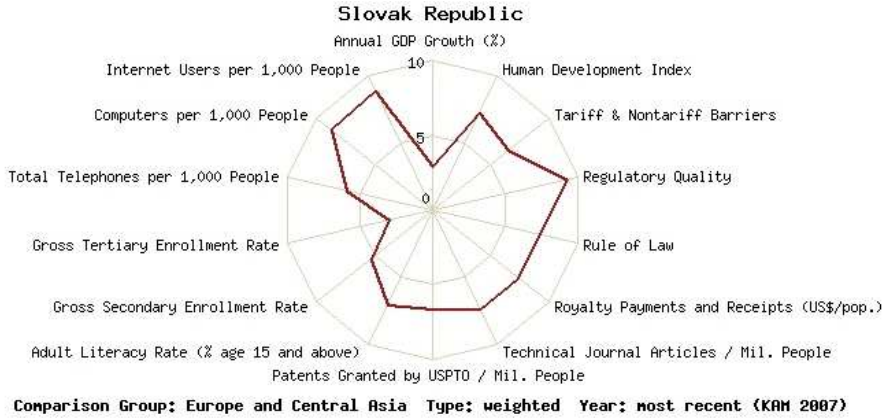
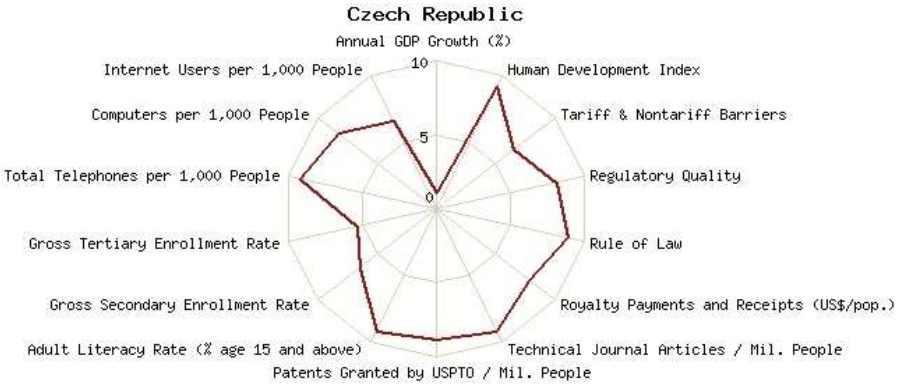
Appendix No. 1.

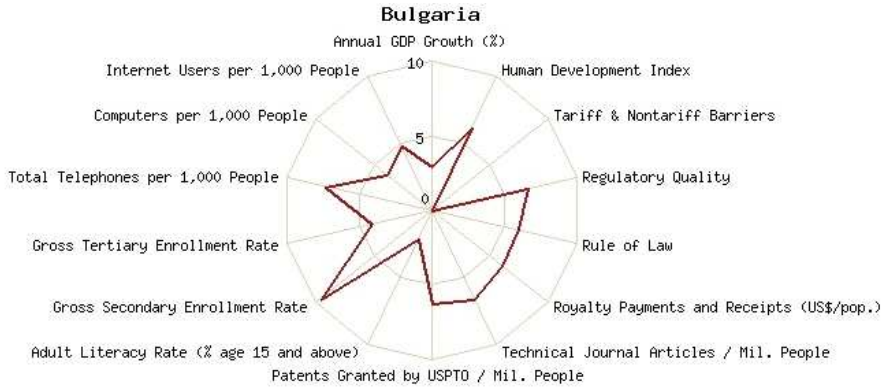
Knowledge–Based Economy Graphs using the KAM Method of the World Bank Institute for New Member States of the European Union







Comparison Group: Europe and Central Asia Type: weighted Year: most recent (KAM 2007)



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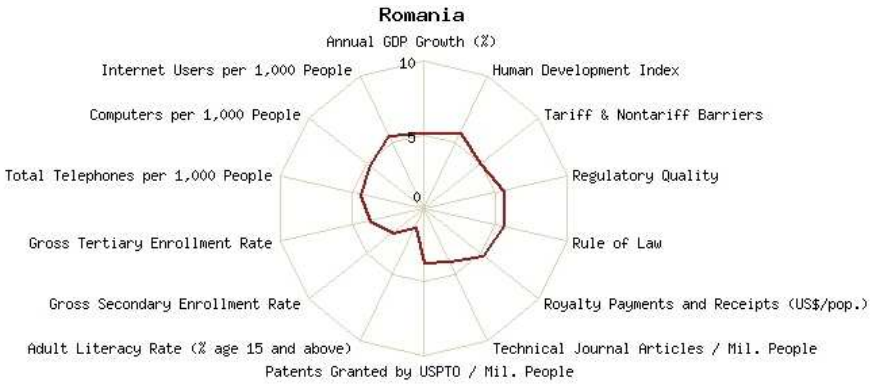

Comparison Group: Europe and Central Asia Type: weighted Year: most recent (KAM 2007)


Poland
Annual GDP Growth (%)
Human Development Index
Tariff & Nontariff Barriers
Regulatory Quality
Rule of Law
Royalty Payments and Receipts (US$/pop.)
Technical Journal Articles / Mil. People
Patents Granted by USPTO / Mil. People
Adult Literacy Rate (% age 15 and above)
Gross Secondary Enrollment Rate
Gross Tertiary Enrollment Rate
Total Telephones per 1,000 People
Computers per 1,000 People
Internet Users per 1,000 People
10
5
0
Comparison Group: Europe and Central Asia Type: weighted Year: most recent (KAM 2007)


Estonia
Annual GDP Growth (%)
Human Development Index
Tariff & Nontariff Barriers
Regulatory Quality
Rule of Law
Royalty Payments and Receipts (US$/pop.)
Technical Journal Articles / Mil. People
Patents Granted by USPTO / Mil. People
Adult Literacy Rate (% age 15 and above)
Gross Secondary Enrollment Rate
Gross Tertiary Enrollment Rate
Total Telephones per 1,000 People
Computers per 1,000 People
Internet Users per 1,000 People
10
5
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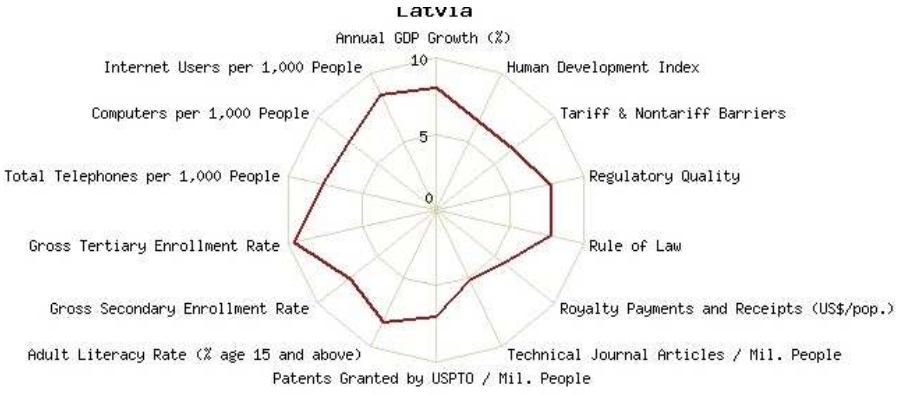
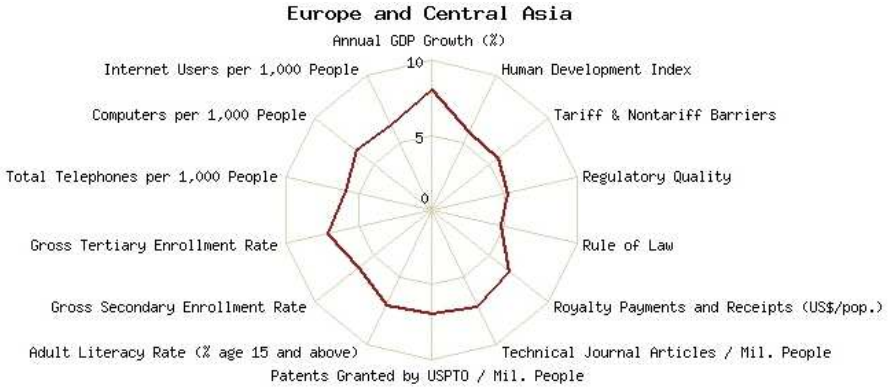
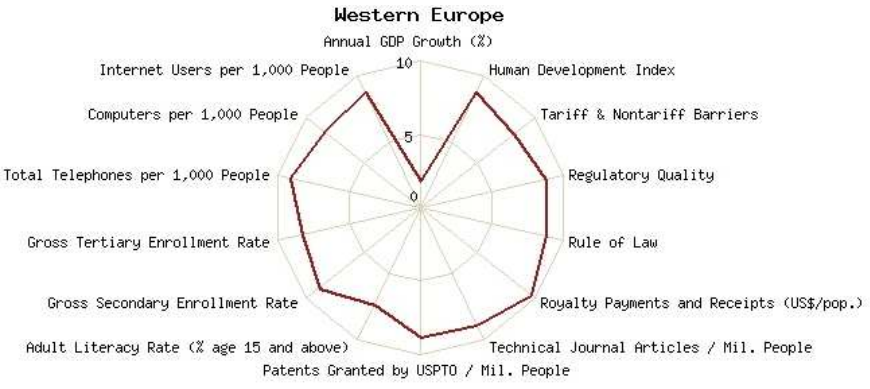
Comparison Group: Europe and Central Asia Type: weighted Year: most recent (KAM 2007)


Latvia
Annual GDP Growth (%)
Human Development Index
Tariff & Nontariff Barriers
Regulatory Quality
Rule of Law
Royalty Payments and Receipts (US$/pop.)
Technical Journal Articles / Mil. People
Patents Granted by USPTO / Mil. People
Adult Literacy Rate (% age 15 and above)
Gross Secondary Enrollment Rate
Gross Tertiary Enrollment Rate
Total Telephones per 1,000 People
Computers per 1,000 People
Internet Users per 1,000 People
10
5
0
Comparison Group: Europe and Central Asia Type: weighted Year: most recent (KAM 2007)

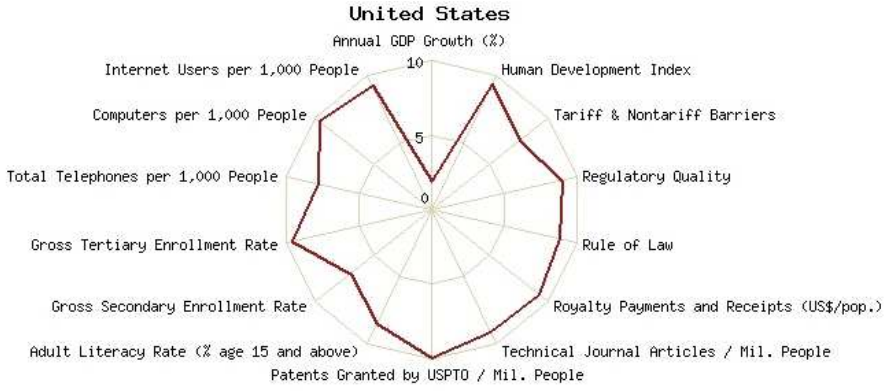
Comparison Group: Europe and Central Asia Type: weighted Year: most recent (KAM 2007)



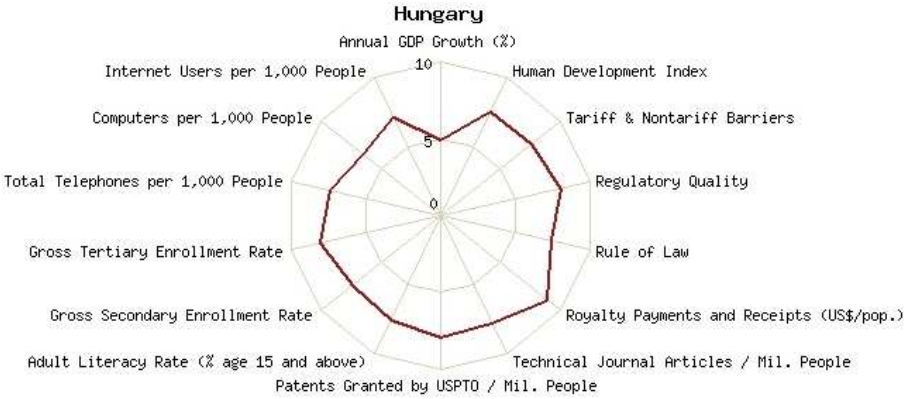
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)



Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)



Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)



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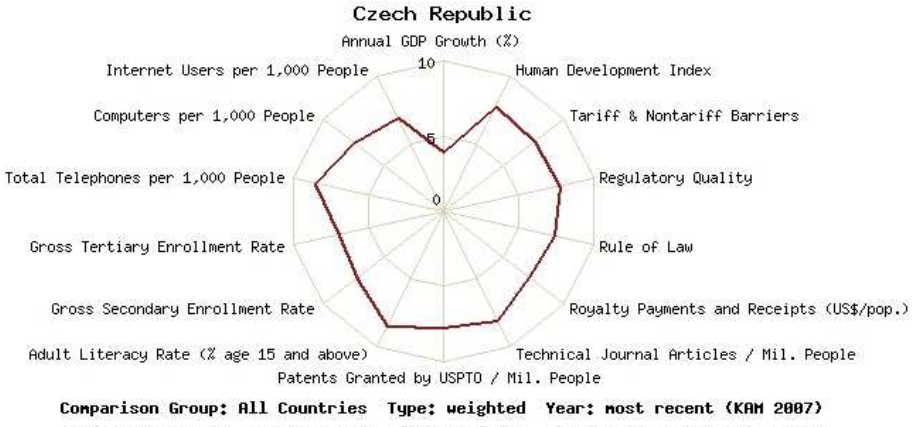
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)


Czech Republic
Annual GDP Growth (%)
Human Development Index
Tariff & Nontariff Barriers
Regulatory Quality
Rule of Law
Royalty Payments and Receipts (US$/pop.)
Technical Journal Articles / Mil. People
Patents Granted by USPTO / Mil. People
Adult Literacy Rate (% age 15 and above)
Gross Secondary Enrollment Rate
Gross Tertiary Enrollment Rate
Total Telephones per 1,000 People
Computers per 1,000 People
Internet Users per 1,000 People
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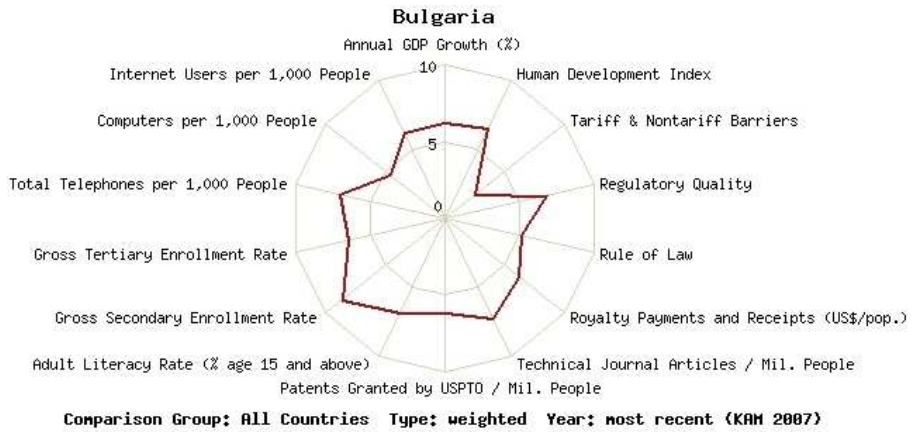
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)


Bulgaria
Annual GDP Growth (%)
Human Development Index
Tariff & Nontariff Barriers
Regulatory Quality
Rule of Law
Royalty Payments and Receipts (US$/pop.)
Technical Journal Articles / Mil. People
Patents Granted by USPTO / Mil. People
Adult Literacy Rate (% age 15 and above)
Gross Secondary Enrollment Rate
Gross Tertiary Enrollment Rate
Total Telephones per 1,000 People
Computers per 1,000 People
Internet Users per 1,000 People
10
5
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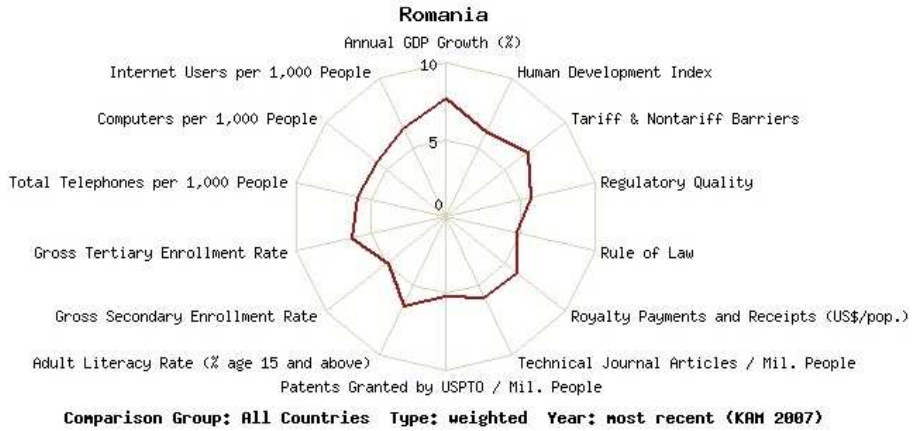
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)


Romania
Annual GDP Growth (%)
Human Development Index
Tariff & Nontariff Barriers
Regulatory Quality
Rule of Law
Royalty Payments and Receipts (US$/pop.)
Technical Journal Articles / Mil. People
Patents Granted by USPTO / Mil. People
Adult Literacy Rate (% age 15 and above)
Gross Secondary Enrollment Rate
Gross Tertiary Enrollment Rate
Total Telephones per 1,000 People
Computers per 1,000 People
Internet Users per 1,000 People
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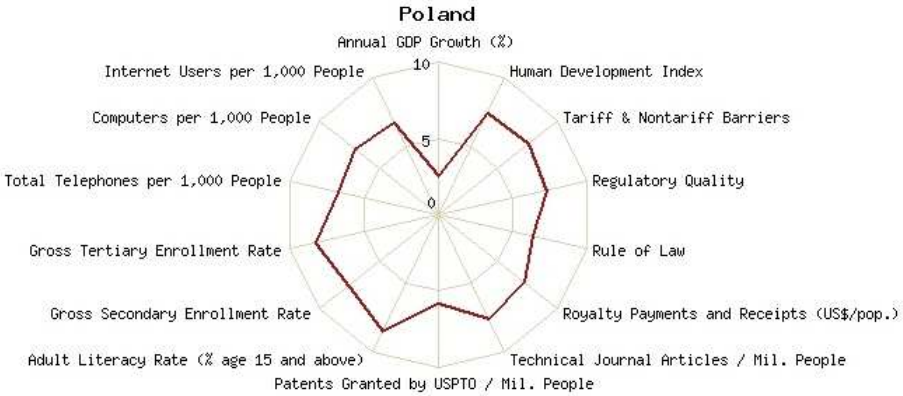
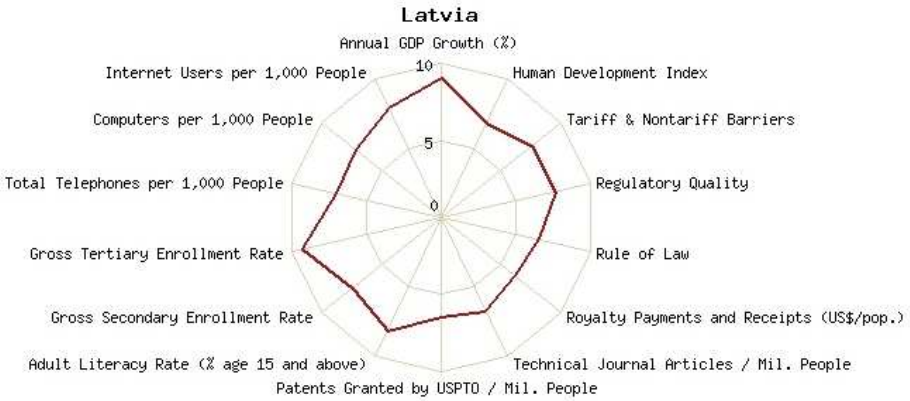
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)

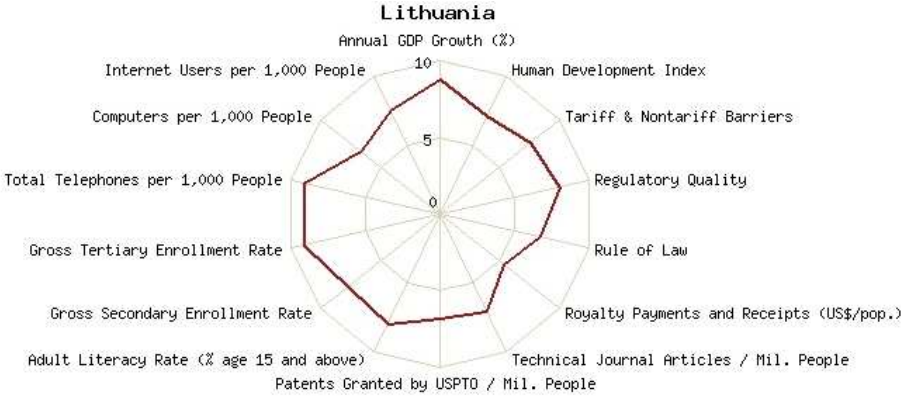


Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)

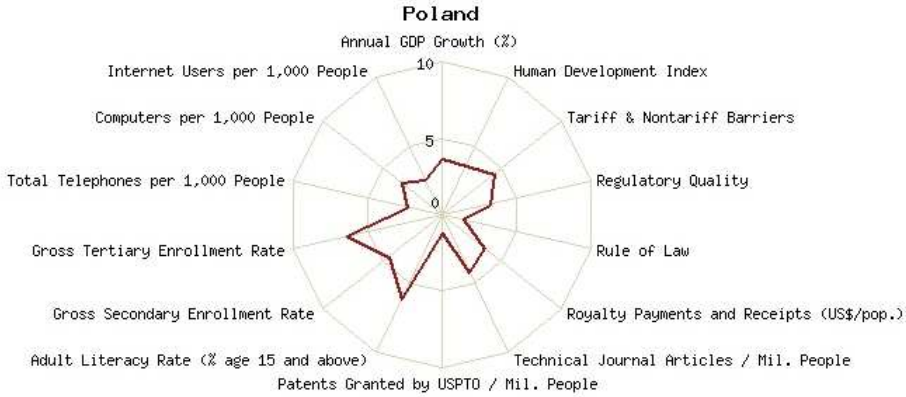
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)



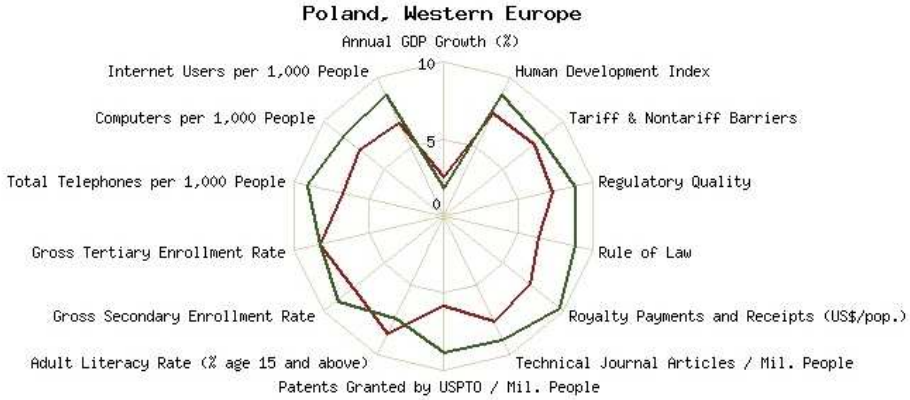
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)



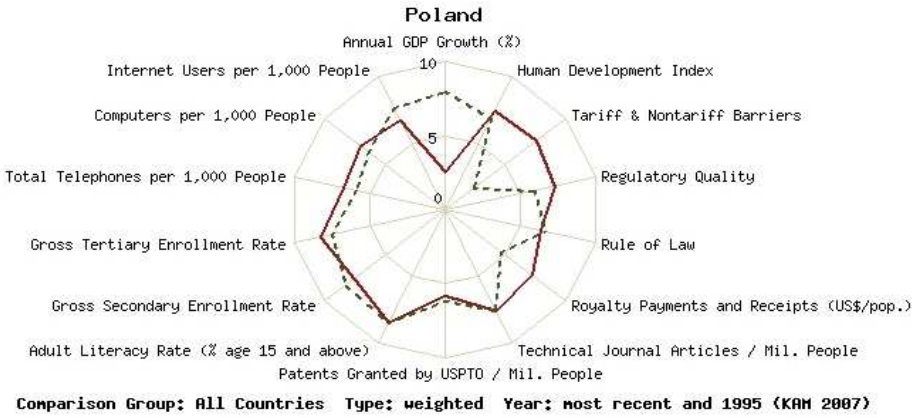
Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)



Comparison Group: High Human Development Type: weighted Year: most recent (KAM 2007)



Comparison Group: All Countries Type: weighted Year: most recent (KAM 2007)



Source: www.worldbank.org/KAM

Appendix No. 2.

The Knowledge–Based Economy using the KAM Method of the World Bank Institute: Specification of Indicators for the Studied New Member States of the European Union

Country	KEI		Economic Incentive and Institutional Regime		Innovation		Education		ICT	
	recent	1995	recent	1995	recent	1995	recent	1995	recent	1995
Slovenia	8.16	7.65	7.57	6.71	8.18	7.79	8.54	7.75	8.34	8.33
Estonia	8.07	7.76	8.07	8.20	7.42	6.59	8.29	8.07	8.49	8.18
Hungary	7.64	6.99	7.64	5.73	8.18	7.57	7.68	7.47	7.08	7.18
Czech Republic	7.64	7.53	7.59	8.23	7.67	7.01	7.59	7.32	7.69	7.57
Cyprus	7.63	7.11	8.04	7.46	7.64	7.33	6.61	5.96	8.22	7.69
Lithuania	7.49	5.89	7.45	5.21	6.43	5.25	8.30	7.26	7.79	5.83
Latvia	7.37	5.55	7.26	6.21	6.44	2.28	8.35	7.32	7.45	6.39
Poland	7.24	6.48	7.07	5.02	6.89	6.14	8.11	8.09	6.87	6.64
Slovak Republic	7.22	6.95	7.38	6.84	6.95	6.96	6.92	6.97	7.63	7.04
Europe and Central Asia	6.30	6.01	5.19	4.19	6.93	6.84	6.81	6.53	6.28	6.46
Bulgaria	6.18	5.81	4.84	5.11	6.56	4.66	7.34	7.12	5.99	6.36
Romania	5.86	5.33	5.77	5.25	5.69	4.89	5.91	6.01	6.09	5.17

Country	KEI		Economic Incentive and Institutional Regime		Innovation		Education		ICT	
	recent	1995	recent	1995	recent	1995	recent	1995	recent	1995
Western Europe	8.70	8.79	8.61	8.45	9.16	9.07	8.20	8.50	8.81	9.15
Slovenia	8.16	7.65	7.57	6.71	8.18	7.79	8.54	7.75	8.34	8.33
Estonia	8.07	7.76	8.07	8.20	7.42	6.59	8.29	8.07	8.49	8.18
Hungary	7.64	6.99	7.64	5.73	8.18	7.57	7.68	7.47	7.08	7.18
Czech Republic	7.64	7.53	7.59	8.23	7.67	7.01	7.59	7.32	7.69	7.57
Cyprus	7.63	7.11	8.04	7.46	7.64	7.33	6.61	5.96	8.22	7.69
Lithuania	7.49	5.89	7.45	5.21	6.43	5.25	8.30	7.26	7.79	5.83
Latvia	7.37	5.55	7.26	6.21	6.44	2.28	8.35	7.32	7.45	6.39
Poland	7.24	6.48	7.07	5.02	6.89	6.14	8.11	8.09	6.87	6.64
Slovak Republic	7.22	6.95	7.38	6.84	6.95	6.96	6.92	6.97	7.63	7.04
Europe and Central Asia	6.30	6.01	5.19	4.19	6.93	6.84	6.81	6.53	6.28	6.46
Bulgaria	6.18	5.81	4.84	5.11	6.56	4.66	7.34	7.12	5.99	6.36
World	5.93	6.41	5.11	5.42	8.00	8.11	4.21	4.78	6.38	7.32
Romania	5.86	5.33	5.77	5.25	5.69	4.89	5.91	6.01	6.09	5.17

Source:www.worldbank.org/KAM

Appendix No. 3.

The Knowledge–Based Economy using the KAM Method of the World Bank Institute: Ranking of the Studied New Member States of the European Union by Indictors (KEI, KI)

Rank	Country	Missing Data	KEI	KI	Economic Incentive Regime	Innovation	Education	ICT
1	Estonia		7.76	7.61	8.20	6.59	8.07	8.18
2	Slovenia	X	7.65	7.96	6.71	7.79	7.75	8.33
3	Czech Republic		7.53	7.30	8.23	7.01	7.32	7.57
4	Hungary		6.99	7.40	5.73	7.57	7.47	7.18
5	Slovak Republic		6.95	6.99	6.84	6.96	6.97	7.04
6	Poland		6.48	6.96	5.02	6.14	8.09	6.64
7	Croatia	X	6.06	7.00	3.25	7.34	6.84	6.82
8	Lithuania	X	5.89	6.11	5.21	5.25	7.26	5.83
9	Bulgaria		5.81	6.05	5.11	4.66	7.12	6.36
10	Latvia	X	5.55	5.33	6.21	2.28	7.32	6.39
11	Russian Federation		5.36	6.53	1.85	5.73	7.91	5.96
12	Romania		5.33	5.36	5.25	4.89	6.01	5.17
13	Ukraine	X	5.24	6.29	2.09	6.02	7.98	4.86
14	Turkey		5.06	4.44	6.94	3.18	4.31	5.83
15	Serbia and Montenegro	X	4.99	6.50	0.46	8.46	5.03	6.01
16	Belarus	X	4.64	5.61	1.72	5.47	8.08	3.29
17	Armenia	X	4.61	5.40	2.25	5.63	5.98	4.58
18	Georgia	X	4.50	5.58	1.25	5.38	7.17	4.19
19	Kazakhstan	X	4.41	5.13	2.25	3.94	7.34	4.11
20	Macedonia, FYR	X	4.15	4.58	2.86	3.38	4.87	5.50
21	Moldova		3.93	4.22	3.07	3.36	6.79	2.51
22	Kyrgyz Rep.	X	3.76	4.22	2.39	3.91	5.61	3.13
23	Azerbaijan	X	3.46	4.32	0.89	4.84	5.75	2.36
24	Uzbekistan	X	3.39	4.31	0.61	4.09	6.75	2.11
25	Albania	X	2.78	2.50	3.62	1.83	3.29	2.38
26	Tajikistan	X	2.57	3.39	0.11	1.80	6.58	1.79
27	Bosnia and Herzegovina	X	n/a	n/a	2.32	0.79	n/a	3.57

Source: www.worldbank.org/kam