KNOWLEDGE ECONOMY: THE GLOBAL POSITION OF THE EUROPEAN UNION

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Abstract

The first part of the paper discusses the concept of knowledge economy, mainly from Fritz Machlup´s and Peter Drucker´s point of view. The second part of contribution shortly analyses selected summary innovation indices which are provided by European, American and international institutions and which characterise quantitative aspect of knowledge economy: Knowledge Index of World Bank Institute, Innovative-Based Competitiveness Index of the Information Technology and Innovation Foundation, Global Innovation Index of the Cornell University, INSEAD WIPO Innovation Union Scoreboard of the European Commission and the World Innovation Index which was created at the University of Economics, Prague. The third part of the contribution evaluates the position of European Union (in terms of knowledge economy) from the global perspective. The EU is compared with the BRICS countries (Brazil, Russia, India, China and South Africa), two East Asian leading countries (Japan and the Republic of Korea), two North American countries (Canada and USA) and Australia. All above mentioned indices were used for the assessment of European Union position.

Key words: knowledge economy, innovation index, European Union

JEL Code: O31, O47

Introduction: Knowledge Economy

The neoclassical theory of perfect competition presumes perfect information, particularly on prices. But many economists started to study different aspects of knowledge (or information) after the second world war period. Their analysis (Hayek, 1945 or Stigler, 1961, for example) was different from strict rationality included into prices of neoclassical orthodoxy.

But the concept of a knowledge economy comes from **Fritz Machlup** (1902 – 1983). He was born in Wiener-Neustadt, Austria, in 1902, and matriculated at the University of Vienna in 1920. Among his teachers were Friedrich von Wieser and Ludwig von Mises. Machlup

received his doctorate in 1923 and he immigrated to the USA in 1933. Machlup made significant contributions in several areas: the methodology of the social sciences, microeconomics, and education and research as factors of production. Machlup's writings on microeconomics address the theory of competition, of monopoly, and of intermediate forms. Much of his work on these topics is contained in two large volumes: The Political Economy of Monopoly (1952) and The Economics of Sellers' Competition (1952).

F. Machlup´s study The Production and Distribution of Knowledge in the United States (1962) grew out of five lectures he gave in 1959 and 1960.

The first part of his paper discusses the concept of knowledge. He identifies there four components of knowledge: education, research and development (R&D), communication and information (ICT). The second part analyses measurement of the knowledge economy based on a method of national accounting. F. Machlup estimated that, in 1958, the knowledge economy accounted 29% of GNP in the USA. The final part of the paper identifies policy issues associated with the knowledge economy.

As Godin (2008) stresses the Machlup´s synthesized ideas from different scientific disciplines and created new object of research, knowledge economy.

Peter Ferdinand Drucker (1909- 2005) developed and popularized the idea of the knowledge economy. He was born in Wien. In 1933, Drucker came in England and he became a naturalized citizen of the United States in 1943. He then had a distinguished career as a teacher, first as a professor of politics and philosophy at Bennington College from 1942 to 1949, then twenty-two years at New York University as a Professor of Management from 1950 to 1971. Peter Drucker is considered the founder of modern management. Drucker's books on management have been translated into more than 30 languages; the most important of these include: Concept of the Corporation (1946), The Practice of Management (1954), Managing for Results (1964), The Effective Executive (1966), Management: Tasks, Responsibilities, Practices (1974), Managing in Turbulent Times (1980), Innovation and Entrepreneurship (1985), The Frontiers of Management (1987), Managing the Non-profit Organization (1990), Managing for the Future (1992), Managing in a Time of Great Change (1995).

P. Drucker in his book The Age of Discontinuity: Guidelines to Our Changing Society (1992) discusses four major discontinuities: (1) the impact of the new technology on the industrial structure; (2) the shift from an "international economy," to a "world economy" which as yet lacks policy, theory, or institutions; (3) a new sociopolitical reality, embracing business, government, and other pluralistic institutions, which poses drastic political,

philosophical, and spiritual challenges; (4) the rising importance of knowledge and of formal education, with resulting implications for work, life, leisure, and leadership.

In twelfth chapter of this book with the title The Knowledge Economy, Drucker is focused on forces, which are changing present economy and creating the society of future (Drucker, 1992, pp. 263–268). Beside rapid development of technology, globalization and creation of new economy, appearance of new political and social challenges, which are changing society and present economy, Drucker emphasizes the need to put the knowledge and education and their implications on work, leadership and society in general, in the centre of a new economy.

Machlup´s study gave rise to a whole literature on the knowledge economy, its measurement and economic policy recommendations. The first wave, starting in the 1970s, was connected with the so-called information economy.

The second wave of studies on the knowledge economy started in the 1990s and continues today. The number of publications devoted to the knowledge economy illustrates Table No. 1.

Tab. 1: Number of publications about the knowledge economy, 1970 - 2014

period	Google Scholar	Web of Science
1970 – 1974	23 300	0
1975 – 1979	37 600	1
1980 – 1984	55 300	0
1985 – 1989	94 000	0
1990 – 1994	126 000	1
1995 - 1999	484 000	67
2000 – 2004	863 000	305
2005 – 2009	855 000	927
2010 – 2014	569 000	1 114

Source: Google Scholar, Web of Science – retrieved 8.2.2015, own computation

The table shows the number of results that can be obtained by typing the concept "knowledge-economy" in two specialized databases. In the period 1970 – 2014 the Thompson Reuters´ Web of Science provides more than 2.420 results. Much broader Google Scholar database provides 2 690 000 results for the same category.

If we look at the corresponding five-year periods we see explosive growth in the number of articles and publications dealing with this issue up to 2004. Since 2005, Google Scholar database indicates that there is a gradual decline of interest in this issue. This is not possible to apply to "purely scientific" publications. According to the database Web of Knowledge, the number of these type publications continues to grow.

1. Quantitative aspect of Knowledge Economy

Starting with above mentioned F. Machlup´s article, the authors analyze both the qualitative and quantitative aspects of the knowledge economy. Now we focus on quantitative aspects of the knowledge economy.

A number of research and statistical institutions has created systems of indicators by which they try to characterise the level and dynamics of the knowledge economy reached in individual countries or regions in quantitative terms.

This part of the paper analyses briefly several systems which dealt with the quantitative aspect of knowledge economy. The World Bank Institute publishes two summarised indexes characterising the economies of individual countries - Knowledge Economy Index, KEI and **Knowledge Index**, KI. The structure of the Knowledge Index is shown in Figure 1.

Fig. 1: World Bank Knowledge Index

Knowledge Indexes			
Knowledge Economy Index			
	Knowledge Index		
Economic and Institution Regime Index	**Education Index**	**Innovation Index**	**ICT Index**
Tariff and Nontariff Barriers	Average years of schooling	Royalty Payments and receipts	Telephones
Regulatory Quality	Secondary enrolment	Patent count	Computers
Rule of Law	Tertiary enrolment	Journal articles	Internet users

Source: World Bank Institute. (2012)

The second system of indicators was created by the American Information Technology and Innovation Foundation, ITIF. The Foundation published its **Innovative-Based Competitiveness Index** in the report Atlantic Century, which assessed the global competitiveness based on innovations of the USA, EU and several further countries (Argentina, Chile, Indonesia, Malaysia, South Africa and Turkey) - see (ITIF, 2011). The first column of the Table 2 shows the index structure.

Tab. 2: The global Innovative-Based Competitiveness Index (IBCI) and the FBA World Innovation Index (WII)

IBCI	**WII**	
Indicators	**Indicators**	**Sources**
A. Human Capital		
Higher Education Attainments	Educational attainment of the population aged 25 years and older	OECD (2014)
Science and Technology Researchers	Total R&D personnel per thousand total employment, FTE	UNESCO (2015)
B. Innovation Capacity		
Corporate Investment in R&D	Research and development expenditure, % of GDP	World bank (2015)
Government Investment in R&D		
Scientific and Technical Publications	Publications: H-index	University of Granada (2015)

C. Entrepreneurship		
Venture Capital Investment	Venture capital availability	WEF (2013)
New Firms	Gross fixed capital formation (% of GDP)	World bank (2015)
D. Infrastruktura ICT		
E-Government	E-Government Development Index	United Nations (2014a)
Broadband Telecommunications	Percentage of households with Internet access at home	WEF. (2013)
Corporate Investment in Information Technology	Business-to-business Internet use	WEF. (2013)
E. Economic Policy		
Effective Corporate Tax Rates	Total tax rate (% profit)	World Bank Group. (2015)
Ease of Doing Business	Index of economic freedom	Heritage foundation. (2015)
F. Economic Performance		
Trade Balance	Current account balance (% of GDP)	World bank (2015)
Foreign Direct Investment Inflows	Foreign Direct Investment inflow as percent GDP	United Nations (2014b)
GDP per Working-Age Adult	GDP per capita, current USD	World bank (2015)
GDP per Hour Worked	High tech export, current USD	World bank (2015)

Note: 1) latest year available
Sources: Innovative Based Competitiveness Index - ITIF (2011), FBA World Innovation Index - own computation based on resources mentioned in the third column of the Table 3.

The third analysed system was created by INSEAD and the World Intellectual Property Organization (Cornell University, INSEAD and WIPO, 2014). Information about the overall structure of the **Global Innovation Index** is provided by Table 3.

Tab. 3: Global Innovation Index

Global Innovation Index (average)						
Innovation Efficiency Ratio (ratio)						
Innovation Input Sub-Index					**Innovation Output Sub-Index**	
Institutions	Human capital and research	Infrastructure	Market sophisticatio n	Business sophisticatio n	Knowledge and technology outputs	Creative outputs
Political environment, Regulatory environment, Business environment	Education, Tertiary education, Research and development	ICTs, General infrastructure, Ecological sustainability	Credit Investment, Trade and competition	Knowledge workers, Innovation linkages, Knowledge absorption	Knowledge creation, Knowledge impact, Knowledge diffusion	Creative intangibles, Creative goods and services, Online creativity

Source: Cornell University, INSEAD and WIPO (2014)

All these indexes examine the situation from a global point of view. The European Commission publishes the **Innovation Union Scoreboard (IUS)**. An overview of the structure of this European innovation index of 2014 is offered in Figure 2.

The contribution which compares the knowledge economy in several selected states was drawn up also at the Faculty of Business Administration of the University of Economics in Prague as a specific feedback to the conclusions of the Innovation Union Scoreboard. The second column of the Table 2 shows the WII structure. It is evident from this table that WII structure was inspired directly by the Innovative-Based Competitiveness Index of the American Information Technology and Innovation Foundation. Both indices are very similar but not exactly the same.

Fig. 2: Innovation Union Scoreboard (IUS)

<table>
<tr><td colspan="8">Summary Innovation Index</td></tr>
<tr><td colspan="3">Enablers</td><td colspan="3">Firm Activities</td><td colspan="2">Outputs</td></tr>
<tr><td>Human Resources</td><td>Open, excellent research systems</td><td>Finance and support</td><td>Firm investments</td><td>Linkages and entrepreneurship</td><td>Intellectual assets</td><td>Innovators</td><td>Economic effects</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>New doctorate graduates</td><td>International scientific co-publications</td><td>R&D expenditure in the public sector</td><td>R&D expenditure in the business sector</td><td>SMEs innovating in-house</td><td>PCT patent application</td><td>SMEs with product or process innovations</td><td>Employment in knowledge intensive activities</td></tr>
<tr><td>Population aged 30-34 with tertiary education</td><td>Top 10% most cited scientific publications</td><td>Venture capital investments</td><td>Non-R&D innovation expenditure</td><td>Innovative SMEs collaborating with others</td><td>PCT patent application in societal challenges</td><td>SMEs with marketing or organisational innovations</td><td>Medium/high products contribution to trade balance</td></tr>
<tr><td>Youth with at least upper secondary education</td><td>Non-EU doctorate students</td><td></td><td></td><td>Public – private co-publications</td><td>Community trademarks</td><td>Employment fast-growing firms of innovative sectors</td><td>Knowledge intensive services imports</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>Community design</td><td></td><td>Sales of new to market and new to firm innovations</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>License and patent revenues from abroad</td></tr>
</table>

Source: UNU-MERIT. (2014)

2. EU global position

The above described systems will be applied to assess the global position of the EU. In terms of time the most recent scoreboards will be applied. Apart from the rating of the BRICS countries (Brazil, Russia, India, China and South Africa) Table 4 contains a further two East

Asian leading countries (Japan and the Republic of Korea), two North American countries (Canada and USA) and Australia.

All the knowledge economic indices with the exception of the Innovation Union Scoreboard (IUS), rate a relatively large number of countries. Therefore "Rank 1" is stated in the column of each index which shows the position of a specific country on the scoreboard. The "Rank 2" column contains the sequence reduced only to selected countries. "Rank 2" may contain only number 1 to 11, because only 10 countries are compared and the EU as the eleventh. Only "Rank 1" is stated in the case of the IUS because the study (UNU-MERIT, 2014) examines only 11 in the table of stated countries.

Tab. 4: Performance of the European Union innovation system in the global context

	IUS	WII	KI		ITIF		GII	
Country	**Rank 1**	**Rank 1**	**Rank 1**	**Rank 2**	**Rank 1**	**Rank 2**	**Rank 1**	**Rank 2**
South Korea	1	1	15	4	5	2	16	3
USA	2	2	9	2	4	1	6	1
Japan	3	3	18	5	11	4	21	5
EU	4	NA	NA	NA	19	6	NA	NA
Canada	5	5	12	3	7	3	12	2
Australia	6	4	7	1	12	5	17	4
China	7	6	86	9	34	8	29	6
India	8	10	111	10	43	11	76	10
Russia	9	7	43	6	29	7	49	7
Brazil	10	8	55	7	38	9	61	9
South Africa	11	9	70	8	41	10	53	8

Sources: Innovation Union Scoreboard (IUS) - UNU-MERIT. (2014), Knowledge index (KI) - World Bank Institute. (2012), The Global Innovative-Based Competitiveness Index (ITIF) – ITIF (2011), Global Innovation Index (GII) - INSEAD, & WIPO. (2014), FBA World Innovation Index 2015 (WII) – own computation.

In terms of the IUS, which was commissioned by the European Commission, the performance of the EU innovation system is the fourth best in the world. The performance of the Korean system and US system has improved by 17% and the performance of the Japanese innovation system by 13% compared with the European.

Korea, USA and Japan are ahead of the EU in areas such as expenditure in the business sector on science and research, common professional publications of the private and public sector, in the number of patents or in the share of the population with tertiary education.

According to the Innovation Union Scoreboard 2013 (UNU-MERIT, 2013), the performance of the Australian innovation system comes only to 62% and performance of the Canadian system to 79% of the performance of the European Union. The IUS draws attention

to the fact that the difference in performance is greater if the European Union and the BRICS countries are compared against a comparison of the EU with the other already mentioned countries.

Besides the current situation, the dynamics of the innovation systems need to be monitored. The Innovation Union Scoreboard signals that the difference between the EU on the one hand and the USA and Japan on the other is narrowing. However the difference is widening of the difference in the performance of the European and Korean system. The difference between the EU and the BRICS countries remains the same or is even greater. An exception here is the Chinese economy. China now achieves 44% of the current innovation performance of the EU, but the gap is narrowing gradually.

In terms of the American Innovative-Based Competitiveness Index, the European position is worse. On the scoreboard the EU-25 is moving to sixth place, Canada and Australia are still ahead of it apart from the earlier stated three countries.

The scoreboards of the Knowledge Index (KI) of the World Bank Institute and Global Innovation Index (GII) of France's INSEAD do not explicitly present the EU as a whole, only individual EU member countries can be found in the indices. The average of the sequence of 27 EU member countries will be applied as a reference and simplified criterion. Both indices (KI and GII) rank the EU-27 in sixth position and confirm the view of the ITIF of the innovation performance of the EU.

Similarly, the FBA World Innovation Index 2015 does not provide information about the EU-28. It evaluates only the performance of three EU countries: Germany, France and United Kingdom. But these three countries are biggest economies of the European Union. They represent together 41,5% of total EU-28 population but due to the efficiency of their economies they create 51,7% of the total GDP produced in the European Union in 2013.

If we regard the average score of these three biggest European economies in the WII index we find their common position is behind the Canada but in front of China. We have to emphasize the efficiency of these three economies is higher than the average of the EU-28 is. So, if we compute the score for all 28 EU member states the result will be worse. But the hypothesis is – not verified yet – the EU-28 efficiency would be still better than in the case of China in the global context.

So our computation confirms the results of all above mentioned indices (with the exception of the Innovation Union Scoreboard).

Conclusions

All analysed knowledge economic indices - with the exception of the Innovation Union Scoreboard (IUS) – rank the EU-27 in sixth position behind South Korea, USA, Japan, Canada and Australia.

Also our computation confirms the results of all above mentioned indices (with the exception of the Innovation Union Scoreboard). It seems the European Innovation Union Scoreboard overestimates the position of European economies and it is too optimistic for European countries.

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