

Marta Vovk,

*Candidate of Economic Sciences, Associate Professor of International Economy Department,
Prydniprov's'ka State Academy of Civil Engineering and Architecture (Dnipro, Ukraine);*

Denys Braga,

*Master in International Economics, Fulltime PhD Student of the Department of International Economic
Relations and Economic Diplomacy, University of Economics in Bratislava (Bratislava, Slovak Republic)*

KNOWLEDGE ECONOMY OF THE EU: STRENGTHS AND WEAKNESSES¹

The aim of the article is to analyze strengths and weaknesses of knowledge economy of the EU. We have developed integral Knowledge Economy index (KE_i) for analysis of knowledge economy in the EU. There was identified three groups of the EU countries by the KE_i index. In view of the need to be in agreement with the postindustrial economy and Lisbon Strategy such disparities in the development of knowledge economy among the EU countries it was create unfavorable conditions for long-term growth as well as for fostering the region's competitiveness and its ability to counter economic shocks. There was concluded that one of the significant driver of the strengthen knowledge economy is the creation of strong institutional bodies. The other set of problems are problems of innovations commercialization.

Keywords: market of innovations, knowledge economy, EU, public policy, strength, weakness.

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Problem statement. Since the mid-twentieth century the third industrial revolution has arisen. A striking feature of the revolution was the transformation of science into industry of knowledge. Thus, since that time scientific and technical activity has become a branch of the economy. Much attention has been paid to education, its level and quality has increased, all the production has become automated, rocket building has been developed, the new materials have been used in construction, microbiology has been developed. Innovations have become a significant factor of economic growth.

Today innovation activity is a powerful tool to achieve sustainable economic growth in any country today, because new technology, development, production processes and saving natural resources can provide any country with a significant international competitive advantage. Today there is no country it is not aware of these realities.

To understand modern innovations, we should step aside from a purely scientific and technical focus. We also have to take into account the application and use of information technologies, evolution of new business models, and creation of new customer experience or service delivery approaches. In recent years, the world has witnessed increased competition. Companies achieve competitive advantages through innovation, which are manifested in the creation of a new product or a new design of already known product, a new marketing strategy in the new process of production, investment in human capital. The majority of industrial innovations are based on the accumulation of knowledge or improvement of existing processes, rather than on technological breakthrough. The slower competitors react, the greater the competitive advantages allow innovation to be achieved. After achieving the competitive advantages, the state can keep them only through continuous improvement of its goods.

Current state of the problem. The increasing linkage between knowledge and markets may be reasoned due to the symbolic of the present socialization of production forces. The general approach is extremely relevant nowadays, thanks to this socialization. There is the necessity is for perpetually updating goods, services and production strategies, and this will increase the value and risk of knowledge

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development and distribution [1, 3].

The general questions regarding creation of trade and its diversion in the European Common Market have been discussed in early 1967 by Balassa [2]. Author has presented some probationary assumption regarding the impact of the European Economic Community on trade flows during the six-year period that has elapsed since the Common Market's formation.

The research made by Laforet [18] focuses on the relationship between size, strategic and market orientation and innovation. The results show an interesting connection between a firm's innovativeness, its size, strategic (or competitive) and market orientation.

Curtis J Milhaupt [20] in his paper made a great attempt to analyze American and Japan markets for Innovations. The author has proved a significant role of venture capital in formation of markets for innovations. Also, author show that the market for innovation in Japan, is increasingly crucial for Japanese economic competitiveness and vitality [4]. The link between the EU product market reform and innovations has been analysed in the report developed by Rachel Griffith at al [15]. The report analyses the impact of product market reforms, in the form of the EU Single Market Programme [6,7], on the level of product market competition and the subsequent effects of competition on innovation activity and productivity growth. The report for the first time is summing-up the main ideas from the existing theoretical and empirical studies on the relationship between competition and innovation and uses findings to modify the subsequent empirical analysis [5].

Avadikyan and Cohendet [1] have focused their research on the central and difficult issue long-faced by the UK Ministry of Defense in implementing effective governance mechanisms rising from the continual trade-off between short-run market driven measures motivated by powerful arguments, and much long term and relative issues in terms of knowledge economics [8].

Unsolved issues as part of the problem. Lisbon strategy has become an expression of the desire of the EU government to implement the ambitious plans related to becoming "*the most competitive and dynamic knowledge-based economy in the world*" by 2010 [9].

The achievement of above-mentioned goal requires a number of measures directed to the development of innovative infrastructure that, in turn, is possible if the government establishes effective terms of innovative market performance and promotes the development of the European area of innovative research. R&D investments have become the main economic tool that can make considerable contribution to this goal, at the same time meeting the objective of the Barcelona European Council to increase R&D investment to 3 % of GDP by 2010[9].

The achievement of this point is considered as a powerful factor of long-term economic growth and increase in employment in Europe as it has been found that such increase of R&D investment would contribute to increase in GDP by 0.5 % and employment level by creating 400.000 additional jobs per year after 2010 [7].

Achievement the point of 3% was expected by increasing investments in research by 8 % annually (calculated as average between public and private expenditures, 6 % and 9 % accordingly). But until today these plans have not been implemented [7].

Originally anticipated that the growth of R&D investments will be coordinated by the EU Commission communication "More research for Europe – Towards 3 % of GDP", 2002 [10]. This tool was kindly supported by stakeholders and that resulted in the development of the Action Plan "Investing in research" that was reviewed by the Commission in 2003 [11]. The Action Plan was also supported by the Commission Staff Working Paper and numerous studies. It has provided a centered system of measures aimed at increasing investment in Europe.

Since 2003, all member states have triggered the innovative development measures according to the Action Plan. Almost all the EU countries have their own targets and areas of R&D investment.

The synergies of the overall research investments in the EU have resulted in increasing the share of

R&D investment in GDP to 2.6 % in 2010 [7]. Despite there has been achieved a considerable progress in R&D investment, in most member states public and private R&D investment stay insufficient for achieving national and the EU targets.

In 2005, the new Commission reviewed the Lisbon strategy and proposed the European Partnership for Growth and Jobs [12]. The European Council pointed out *"knowledge and innovation for growth"* as one of the three main pillars of the Partnership for Growth and Jobs. In the Framework of the Partnership the 3 % objective for R&D investment in Europe has been also confirmed [12].

It should be noted that R&D investment in Europe is promoted by Integrated Guidelines for Member States. Notably, Guideline 7 calls to *"increase and improve investment in R&D"* and outline focuses for R&D investment [13, p. 21]. Furthermore, Guideline 8 states that there is a need *"to facilitate all forms of innovation"* [13, p. 21].

Member States implemented these programmes according to "National reform Programmes" published in autumn 2005.

A number of actions for promoting R&D investment are implemented under Community Lisbon Programme, particularly in the Communication "More Research and Innovation – A Common Approach", adopted on the 12th of October [14]. This Communication outlines an integrated action plan that addresses the full research and innovation area and defines a number of new actions that are not in the framework of the Action Plan of 2003 [10].

Implementation of the measures defined in the latest Communication will allow Europe to develop its research and innovation potential. This is an important step towards the development of sustainable and innovative economy in the EU for meeting international challenges.

Aim of the article. The aim of the article is to analyze strengths and weaknesses of knowledge economy of the EU.

Main results of the research. Advantages of the EU to become a knowledge-based economy can be grouped into five points. Firstly, industry chain links between scientists & research institutions and industries, which build cooperation based on mutual benefit and collaboration between public and high innovative sectors. Secondly, the platform for policy development to provide a basis for exchange and cross-policy decisions in field on innovations and not only. Thirdly, a high technology innovations can accelerate the modernization and diversification of the regional economies. Fourthly, the governments are active players as stakeholders from innovative firm's activities that lead to legal status of such as a nonprofit organization, and help them to create the most favorable conditions for doing business at an early stage of growth. The last but not least, the support of economic growth, leading to a high level of employment.

It is impossible to create a new economy without a strong and well developed public policy. Features of the EU innovations policy can be defined in three main points. Firstly, focus on R&D and technological innovation flowing out from the results in knowledge transfer activities, starting from the idea of an innovative company to be turned into innovative products and innovative products for commercialization and technology transfer fade from country to country or from organizations. Secondly, long-term strategic economic development tool for the society, helping to diversify the economy and increase in tax revenues. Finally, the business climate in order to maintain the essential elements in the innovation process create the best conditions for the growth of start-ups.

Threats and weaknesses of the EU are the most difficult to investigate in some respects. This is due to the fact that innovation systems are potential tool in the strategy of the countries with different points of view and to combine all the elements of influence on the development and usage of innovations in such aspects as economic, social, political and organizational.

Furthermore, there is a difficulty in complex assessing knowledge potential of the EU countries as there are a lot of indicators in this field. We have analyzed the EU countries by some indicators for knowledge-based economy (table 1).

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Table 1 – Knowledge economy indicators in the EU (developed by authors based on [15–17])

Country	Knowledge Economy Index (KEI), 2012				Percentage of total employment in knowledge-intensive activities, 2015, %	Patent applications, residents, millions, 2014
	Economic Incentive and Institutional Regime	Innovation	Education	Information and Communication Technology (ICT)		
Austria	9.26	8.87	7.33	8.97	36.4	2.092
Belgium	8.79	9.06	8.57	8.42	42.2	0.889
Bulgaria	7.35	6.94	6.25	6.66	28.3	0.218
Croatia	7.35	7.66	6.15	8.00	31.3	0.17
Cyprus	7.71	7.71	7.23	7.57	37.8	0.004
Czech Republic	8.53	7.90	8.15	7.96	30.5	0.91
Denmark	9.63	9.49	8.63	8.88	39.1	1.377
Estonia	8.81	7.75	8.60	8.44	34.1	0.044
Finland	9.65	9.66	8.77	9.22	38	1.419
France	7.76	8.66	8.26	8.16	39.5	14.5
Germany	9.10	9.11	8.20	9.17	36.9	48.154
Greece	6.80	7.83	8.96	6.43	34.9	0.651
Hungary	8.28	8.15	8.42	7.23	34.5	0.546
Ireland	9.26	9.11	8.87	8.21	41.9	0.263
Italy	7.76	8.01	7.58	8.21	32.9	8.601
Latvia	8.21	6.56	7.73	7.16	32.2	0.103
Lithuania	8.15	6.82	8.64	7.59	31.7	0.123
Luxembourg	9.45	8.94	5.61	9.47	51.6	0.128
Malta	8.94	7.94	6.86	7.80	43.8	0.005
Netherlands	8.79	9.46	8.75	9.45	38.1	2.294
Poland	8.01	7.16	7.76	6.70	29.4	3.941
Portugal	8.42	7.62	6.99	7.41	32.7	0.722
Romania	7.39	6.14	7.55	6.19	20.9	0.952
Slovak Republic	8.17	7.30	7.42	7.68	34.5	0.211
Slovenia	8.31	8.50	7.42	7.80	30.6	0.47
Spain	8.63	8.23	8.82	7.73	32.7	2.953
Sweden	9.58	9.74	8.92	9.49	44.4	1.984
United Kingdom	9.20	9.12	7.27	9.45	43.6	15.196

The analysis of knowledge economy in the EU countries we have conducted according to the following indices:

$$KE_{ij} = S_{ij}/S_j, \quad (1)$$

where KE_{ij} – index of knowledge economy i for by indicator j ; S_{ij} – the value of j indicator for a country i ; S_j – the average value of j indicator for all the EU countries.

$$KE_i = \sum_{j=1}^m KN_{ij}/m, \quad (2)$$

where KE_i – integral development index for knowledge economy in the EU countries; m – the number of indicators.

We have used Sturges index to number of classes to use in a histogram of the EU countries and identify the difference in their knowledge economy development [18]:

$$K = 1 + 3,322 \lg N, \quad (3)$$

where K – the number of groups; N – the number of objects for grouping.

There have been identified 3 groups of the EU countries (figure 1 and 2).

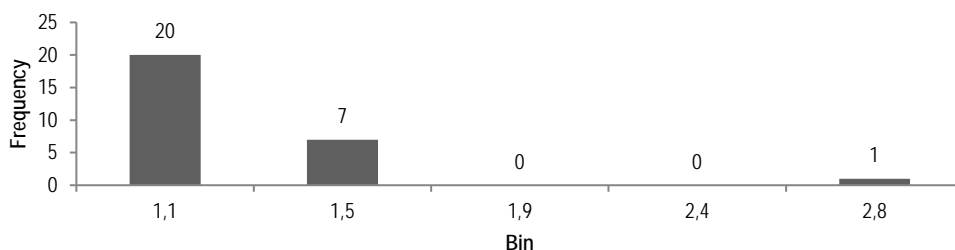


Figure 1– Frequency distribution histogram (calculated by authors)

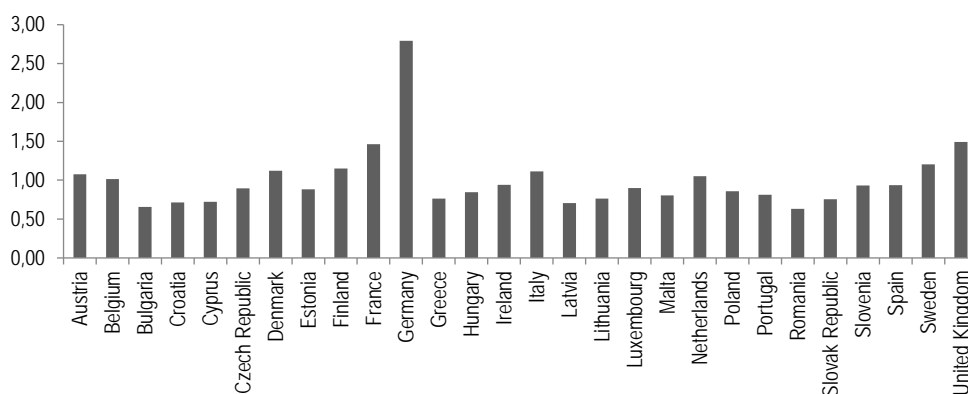


Figure2– Evaluation of the development of knowledge economy in the EU byKE_i index (calculated by authors)

There have been identified three groups of the EU countries by the KE_i index. The first group [the value of KE_i index 0,63 – 1,06]: Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Ireland, Hungary, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain. The second group [the value of KE_i index 1,06 – 1,49]: Austria, Denmark, Finland, France, Italy, Sweden, United Kingdom. Into the third group fell only Germany with the value of KE_i index 2,79.

The analysis has shown that the EU countries are mostly differed by percentage of total employment in knowledge-intensive activities and the number patent applications by residents.

It should be noted that in view of the need to be in agreement with the postindustrial economy and Lisbon Strategy such disparities in the development of knowledge economy among the EU countries create unfavorable conditions for long-term growth as well as for fostering the region's competitiveness and its ability to counter economic shocks. Furthermore, the values of Knowledge Economy Index in 1995 for many countries of the EU were higher than in 2012 [15]. Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Sweden and United Kingdom have lost their positions since 1995. At the same time positive trends can be observed in transition countries. Such countries as Estonia, Czech Republic, Latvia, Lithuania, Slovak Republic, Poland, Hungary, Romania and Bulgaria have enhanced their positions but they as before lag far behind developed countries of the EU.

One of the significant driver of the strengthen knowledge economy is the creation of strong institutional

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bodies. According to the data of Global Innovation Index 2015 [19] United Kingdom (87,32), Sweden (90), Netherlands (91,88), Finland (95,84), Ireland (87,22), Luxembourg (83,54) and Denmark (93,13) stand at the ten top economies including through the "institutions" indicator. In the transition countries the values of the same indicator are mostly below: Latvia – 77, 7; Lithuania – 73, 6; Estonia – 80,8; Czech Republic – 76, 4; Poland – 75,3; Hungary – 73, 4; Romania – 69,7; Bulgaria – 69,7; Slovakia – 75, 1. Thus, for many countries the lack of the development of institutional bodies prevents to enhance knowledge economy competitive positions.

The other set of problems are problems of innovations commercialization. Today commercial capacity of innovation is crucial for all innovation process. Not only innovators are interested in successful commercialization but also investors that aim at investing resources in promising projects. Previous investigation has shown that in the EU countries effectiveness of commercialization depends on many factors such as quality of human capital, legal and institutional environment, interactions between parties of innovation process, including international relations, information and communication technologies.

According to the EU countries experience in commercialization of innovations, great attention should be paid to incentives. Such incentives include mainly two types: by nature of resource fund and by object of stimulation.

Moreover, the future success of commercialization depends also on goals of business, form of intellectual property, budget of economic resources, system of risks, related to the specificity of the product, privacy questions, business reputation.

A great contribution to the overall process of commercialization makes a proper understanding and awareness of steps that facilitate promotions of innovations to the market. In particular, they can be generally divided into technology-oriented decisions and business-oriented decisions. The first group includes involvement by industrial groups in innovation project activities, technology transfer, capacity study, testing or demonstration activities, prototyping, pilot project development. The second group consists of development of business plan, market study, startup launch, capital investment, investment from public authorities. Thus, before introducing innovation to the market and considering its commercial potential, it is important to be aware of a number of barriers to commercialization of innovations. In light of this problem the results of the project Flash Eurobarometer 394 «The role of public support in the commercialization of innovations» are very useful[20]. The project has been conducted at the request of the Directorate-General for Enterprise and Industry in the 28 EU Member States as well as in Switzerland and the United States. It was planned to benchmark innovation activities in a variety of areas, and investigate barriers to commercialization, as well as the role of public funding in innovation (Figure 3).



Figure 3 – Barriers to commercialization of innovation [14]

In view of the above, all actors of innovation process should take into account many factors that impact final financial success of commercialization. Thus, only after considering above-mentioned factors and barriers of commercialization process one should make a conclusion about commercialization capacity of innovation and its financial effectiveness.

Conclusions and directions of further researches. The analysis of strengths and weaknesses of knowledge economy of the EU has shown that the countries in the region differ in the level of the development of knowledge economy. There has been developed integral Knowledge Economy index (KE_i) for analysis of knowledge economy in the EU. The index is based on the following knowledge economy indicators: three sub-indices of Knowledge Economy Index (KEI): Economic Incentive and Institutional Regime, Innovation, Education, Information and Communication Technology (ICT) and two separate indicators: Percentage of total employment in knowledge-intensive activities and Patent applications. According to KE_i index the EU countries fell into following groups. The first group [the value of KE_i index 0,63 – 1,06]: Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Ireland, Hungary, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain. The second group [the value of KE_i index 1,06 – 1,49]: Austria, Denmark, Finland, France, Italy, Sweden, United Kingdom. Into the third group fell only Germany with the value of KE_i index 2,79. The analysis has shown that the EU countries are mostly differed by percentage of total employment in knowledge-intensive activities and the number patent applications by residents.

The significant driver of the strengthen knowledge economy is the creation of strong institutional bodies and effective commercialization of innovations. According to the data of Global Innovation Index 2015 for many of the EU countries the lack of the development of institutional bodies prevents to enhance knowledge economy competitive positions. The results of Flash Eurobarometer 394 have shown that the most significant barriers to commercialization of innovations in the EU countries are lack of financial resources, market dominated by established competitors and cost of complexity of meeting regulations or standards. Among other barriers is low demand for innovative goods or services, lack of marketing expertise, weak distribution channels, lack of market standards or regulations, difficulties in maintaining intellectual property rights. Thus, taking into account Lisbon strategy priorities measures are needed to support knowledge creation and business innovation in the EU countries for meeting international challenges.

Further research should be devoted to, mainly, two following questions which are remained unanswered: what kind of instruments should be developed for the EU's innovation policy to be consistent with the objective of guarantee relevant, low-cost and accessible innovations? And, will the laws and regulations regarding innovation policy in the EU research programmes satisfy the Innovation Union's open approach to innovation, innovation brokering and patent pools?

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М.С. Вовк, канд. екон. наук, доцент кафедри міжнародної економіки, Придніпровська державна академія будівництва та архітектури (м. Дніпро, Україна);

Д.О. Брага, магістр з міжнародної економіки, аспірант кафедри міжнародних економічних відносин та економічної дипломатії, Економічний Університет в Братиславі (м. Братислава, Словаччина)

Економіка знань в ЄС: сильні та слабкі сторони

Мета статті – проаналізувати сильні та слабкі сторони економіки знань ЄС. Розроблено інтегральний індекс Економіки Знань (КЕІ) для аналізу економіки знань в ЄС. Визначено три групи країн ЄС за індексом КЕІ. Зважаючи на необхідність узгодження з постіндустріальною економікою та Лісабонською стратегією, такі розбіжності у розвитку економіки знань у країнах ЄС створюють несприятливі умови для довгострокового зростання, а також для сприяння конкурентоспроможності регіону та його спроможності протистояти всесвітнім викликам. Зроблено висновок, що одним з важливих факторів зміцнення економіки знань є створення сильних інституційних органів. Ряд інших проблем пов'язаний з процесом комерціалізації інновацій.

Ключові слова: ринок інновацій, економіка знань, ЄС, державна політика, сильна сторона, слабка сторона.

М.С. Вовк, канд. екон. наук, доцент кафедри міжнародної економіки, Придніпровская государственная академия строительства и архитектуры (г. Днепр, Украина).

Д.А. Брага, магистр международной экономики, аспирант кафедры международных экономических отношений и экономической дипломатии, Экономический Университет в Братиславе (г. Братислава, Словакия)

Экономика знаний в ЕС: сильные и слабые стороны

Цель статьи – проанализировать сильные и слабые стороны экономики знаний ЕС. Разработан интегральный индекс Экономики Знаний (КЕИ) для анализа экономики знаний в ЕС. Учитывая необходимость согласования с постиндустриальной экономикой и Лиссабонской стратегией, такие различия в развитии экономики знаний в странах ЕС создают неблагоприятные условия для долгосрочного роста, а также для содействия развитию конкурентоспособности региона и его способности противостоять глобальным вызовам. Сделан вывод, что одним из важных факторов укрепления экономики знаний является создание сильных институциональных органов. Ряд других проблем связан с процессом коммерциализации инноваций.

Ключевые слова: рынок инноваций, экономика знаний, ЕС, государственная политика, сильная сторона, слабая сторона.

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