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### ИННОВАЦИОННЫЙ ПОТЕНЦИАЛ РЕГИОНОВ ВЫШЕГРАДСКОЙ ГРУППЫ

**Мариуш Чупич**

**Объект исследования.** Основная цель анализа – определить инновационный потенциал и уровень в регионах Вышеградской группы, через 25 лет после начала экономических преобразований. Контрольной точкой в анализе является Европейский союз и его средние значения с точки зрения выбранных показателей, характеризующих инновации.

**Методи, которые использовались в ходе исследования.** В анализе использовались два метода. В теоретической части используется метод исследования литературы. В эмпирической части – сравнительный метод, в рамках которого приведено сравнение отдельных показателей инновационного потенциала государств Вышеградской Группы со средними по Европейскому Союзу показателями.

**Результаты исследования.** Инновации и инновационность больше не связаны исключительно с экономической деятельностью. Они также соотносятся с государственным управлением и человеческими отношениями. Инновационность региона является составной частью инноваций всех единиц, действующих на данной территории, и определяет достижение конкурентных преимуществ.

Вышеградская Группа была сформирована в начале 1990-х годов. Он объединяет соседние страны Центральной и Восточной Европы, которые одновременно начали экономическую трансформацию.

Инновационный потенциал регионов Вышеградской Группы низкий в сравнении со средним по ЕС. Что еще хуже, в последние годы отставание по многим элементам этого потенциала усугубилось. В качестве примера можно привести такие показатели, как расходы предприятий на исследования и разработки, участие в обучении на протяжении всей жизни, или занятость в высокотехнологичном секторе. Одним из немногих потенциалов, которые могут определить экономическую конкурентоспособность группы V4 в будущем, являются человеческий капитал и высокий уровень образования в обществе. В результате анализа также выяснилось, что среди стран Вышеградской Группы инновационный потенциал наиболее сосредоточен в Чешском и Венгерском регионах. Это было также отражено в суммарном рейтинге инновационности. Что также важно, относительно высокий уровень инновационного потенциала характерен для столичных регионов, которые характеризуются высоким уровнем предпринимательства, более высоким уровнем образования и более активной научно-исследовательской деятельностью предприятий.

**Область применения результатов:** государственные агентства по поддержке инноваций, органы местного самоуправления, отвечающие за региональные инновации, предприниматели.

**Выводы.** Инновационность сегодня рассматривается как ключевой фактор конкурентоспособности стран и регионов. Низкий инновационный потенциал регионов Вышеградской группы влияет на их слабое экономическое положение в сравнении с более развитыми странами. Поэтому крайне важно, чтобы власти поддерживали отдельные элементы этого потенциала, особенно университетское образование.

**Ключевые слова:** инновации, инновационный потенциал, Вышеградская Группа, региональные инновации.

## ІННОВАЦІЙНИЙ ПОТЕНЦІАЛ РЕГІОНІВ ВИШЕГРАДСЬКОЇ ГРУПИ

Маріуш Чупіч

**Об'єкт дослідження.** Основна мета аналізу - визначити інноваційний потенціал і рівень в регіонах Вишеградської групи, через 25 років після початку економічних перетворень. Контрольною точкою в аналізі є Європейський союз і його середні значення з точки зору обраних показників, що характеризують інновації.

**Методи, які використовувалися в ході дослідження.** В аналізі використовувалися два методи. В теоретичній частині використовується метод дослідження літератури. В емпіричній частині - порівняльний метод, в рамках якого наведено порівняння окремих показників інноваційного потенціалу держав Вишеградської Групи з середніми по Європейському Союзу показниками.

**Результати дослідження.** Інновації та інноваційність більше не пов'язані виключно з економічною діяльністю. Вони також співвідносяться з державним управлінням і людськими відносинами. Інноваційність регіону є складовою частиною інновацій всіх одиниць, що діють на даній території, і визначає досягнення конкурентних переваг.

Вишеградська Група була сформована на початку 1990-х років. Він об'єднує сусідні країни Центральної і Східної Європи, які одночасно почали економічну трансформацию.

Інноваційний потенціал регіонів Вишеградської Групи низький в порівнянні із середнім по ЄС. Що ще гірше, в останні роки відставання з багатьох елементів цього потенціалу погіршилося. Як приклад можна привести такі показники, як витрати підприємств на дослідження і розробки, участь в навчанні протягом усього життя, або зайнятість у високотехнологічному секторі. Одним з небагатьох потенціалів, які можуть визначити економічну конкурентоспроможність групи V4 в майбутньому, є людський капітал і високий рівень освіти в суспільстві. В результаті аналізу також з'ясувалося, що серед країн Вишеградської Групи інноваційний потенціал найбільш зосереджений в Чеському і Угорському регіонах. Це було також відображено в сумарному рейтингу інноваційності. Що також важливо, відносно високий рівень інноваційного потенціалу характерний для столичних регіонів, які характеризуються високим рівнем підприємництва, більш високим рівнем освіти і більш активної науково-дослідницькою діяльністю підприємств.

**Область застосування результатів:** державні агентства з підтримки інновацій, органи місцевого самоврядування, які відповідають за регіональні інновації, підприємці.

**Висновки.** Інноваційність сьогодні розглядається як ключовий фактор конкурентоспроможності країн і регіонів. Низький інноваційний потенціал регіонів Вишеградської групи впливає на їх слабке економічне становище в порівнянні з більш розвиненими країнами. Тому вкрай важливо, щоб влада підтримувала окремі елементи цього потенціалу, особливо університетську освіту.

**Ключові слова:** інновації, інноваційний потенціал, Вишеградська Група, регіональні інновації.

## THE INNOVATIVE POTENTIAL OF THE VISEGRAD GROUP REGIONS

Mariusz Czupich

**Object of research.** The main aim of analysis is to determine the innovation potential and the level in the Visegrad Group regions, 25 years after the start of economic transformation. The reference point in the analysis is the European Union and its average values in terms of selected innovation indicators.

**Methods which were used in the course of the research.** Two methods were used in the analysis. The theoretical part uses a method of literature studies. In the empirical part - a comparative method, which used the comparison of the Visegrad Group states and the average for the entire EU, in the scope of selected indicators of innovation potential.

**Results of a research.** Innovation and innovativeness are no longer exclusively associated with economic activity. They also refer to public management and human attitudes. Innovativeness of the region is a component of innovation of all units operating in a given territory and determines the achievement of competitive advantage.

The Visegrad Group was formed in the early 1990s. It clusters neighboring countries of Central and Eastern Europe, which began economic transformation at the same time.

The innovative potential of the Visegrad Group regions is low, comparing to the EU average. What is worse, in recent years the distance in many elements of this potential has deepened. As an example are such indicators as: expenditures of enterprises on research and development, participation in lifelong learning, or employment in the high-tech sector. One of the few potentials that can determine the economics competitiveness of V4 group, in the future, is human capital and a high level of education in society. As a result of the analysis, it also turned out that among the Visegrad Group countries, the most innovative potential lies in the Czech and Hungarian regions. This was also reflected in the summary ranking of innovativeness. What is also important, relatively high level of innovation potential of the capital regions, which are characterized by high entrepreneurship, higher level of education and higher research and development activity of enterprises.

**Range of application of results:** government agencies supporting innovation, local government units responsible for regional innovation, entrepreneurs.

**Conclusions.** Innovativeness is considered today as a key determinant of the countries and regions competitiveness. The low innovation potential of the Visegrad Group regions affects their weak economic position in relation to more developed countries. Therefore, it is crucial that the authorities should support individual elements of this potential, especially university education.

**Key words:** innovation, innovative potential, Visegrad Group, regional innovation.

**Introduction.** The establishment of the so-called 'Visegrad Triangle' covering three Central European countries - Poland, Czechoslovakia and Hungary took place on February 15, 1991. After the dissolution of Czechoslovakia, on January 1, 1993 the Czech Republic and Slovakia became independent members of this group. At the same time, it changed its name to the Visegrad Group. The purpose of this group, referred to as 'V4', was advancing political and economic cooperation focused on the development of democracy and the free market. The group intended to transform and include its member states into the European Union and NATO. The first joint venture of the group was the establishment of the Central European Free Trade Agreement (CEFTA) in 1992. Within this organization, the principles of gradual liberalization of trade as well as the scope and stages of mutual integration ties were defined. Factors that were conducive to tightening this cooperation were the following [1, p.18]:

- territorial proximity;
- a network of transport and commercial links;
- convergence of the directions of system transformation - building a free market in place of a centrally planned economy;
- sharing similar macroeconomic problems;
- correlation of interests in the technical and economic sphere;
- the support of Western countries, which perceived this kind of regional cooperation as a valuable test of cooperation skills of former socialist states.

CEFTA was later joined by other countries from the Central and Eastern Europe region, such as, for instance, Albania, Macedonia, Moldova, Serbia and Kosovo, Montenegro. The V4 countries, after being included in the structures of the European Union, ceased to be members of CEFTA. The initiative of the integration agreement influenced positively the deepening of trade relations and the development of common mechanisms intended to coordinate activities.

At present the V4 Group is a platform for exchanging experience and economic cooperation. The significant elements of mutual relations include military and energy security, transport infrastructure, agriculture, regional development, culture, education, and sport.

Exemplary neighbourhood projects include taking a common stance on the EU climate and energy policy framework up to 2030 and the Region Security Support Program 2022 regarding the deepening of political-military and industrial relations with the Baltic States (Lithuania, Latvia, Estonia) and Romania and Bulgaria [2, p.7].

It is worth adding that due to the similar level of economic development, geographical location, common history and values, the V4 countries have convergent interests in terms of policies and decisions taken in the European Union [3, p.30]. This applies in particular to policies that involve redistribution of income, *i.e.* cohesion and agricultural policies, of which the Visegrad Group countries are beneficiaries. All this makes further cooperation on the forum of the European Union much sought after by the interested parties.

The Visegrad Group countries are an attractive place to locate foreign investments. It is related to low labour costs in comparison with Western Europe and a high level of qualifications of employees. Labour costs are 2-3 times lower than the EU average (see Table 1). An additional advantage of the countries in question is a large absorptive market of almost 64 million people, which is approximately 12.5% of the entire Community (2017).

**Table 1. Basic demographic and economic information on the Visegrad Group**

Country	Population, 2017, millions	Hourly labour costs*, euro	GDP per capita in PPS, EU 28 = 100, 2016	Unemployment rate, 2017	Services employment in % of total employment	R&D expenditure, all sectors, percentage of GDP, 2016
UE 28	511,52	26,8	100	7,6	73,1	2,03
Czech Republic	10,57	11,3	88	2,9	59,9	1,68
Hungary	9,79	9,1	67	4,2	65,8	1,21
Poland	37,97	9,4	68	4,9	58,3	0,97
Slovakia	5,43	11,1	77	8,1	65,6	0,79

\* Labour cost (compensation of employees plus taxes minus subsidies); Industry, construction and services (except public administration, defense, compulsory social security).

Source: author's elaboration on the basis of Eurostat [<http://ec.europa.eu/eurostat/data/database>].

Despite the fact that the V4 countries have not yet reached the EU average in terms of GDP per capita (the Czech Republic is closest to this level), their labour markets appear to be quite balanced. In 2017 the unemployment rate only in Slovakia was slightly higher than the EU average. The employment structure in the countries in question is still not characteristic of service-based economies, although the sector in Hungary and Slovakia offered employment to about 66% of all employees.

The level of innovativeness of the economies of the V4 countries, measured by expenditure on R&D, was lower than the average in the EU28. The Czech Republic and Hungary noted the best results in this respect.

Innovation is seen as a key factor of competitiveness. In the globalized world, the business offer should reflect the growing needs of customers. Therefore, it is necessary to take innovative risk in the form of work performed on the development of new products and services. The innovative process requires also many other elements, such as, for example, knowledge, competences, support of authorities, business support institutions, or financial expenditures. From this point of view, the innovative potential of the V4 Group becomes particularly interesting, especially in the regional cross-section, which allows local centres of innovation and peripheries to be identified.

The research objective of this article is to determine the innovative potential of the Visegrad Group countries at the regional level. The introduction of this article presents basic information about the establishment and objectives of the Visegrad Group. Next, the theoretical aspects of the region's innovativeness are presented. In the empirical part, the comparative method is used to diagnose the innovative potential of the regions. The selected indices derived from Eurostat resources were compiled with reference to the average level for the EU28, the EU15, and for the euro area. Specific data come from the years 2012-2016. In order to illustrate the changes that occurred at the level of individual indicators, their dynamics was calculated for the period starting from 2004, this is the year in which the countries discussed joined the European Union.

An additional element in this part of the article is a summary of the results of the Regional Innovation Scoreboard published in 2017 by the European Commission. The scoreboard ranks the European regions according to the synthetic index of innovation. The results obtained by the regions of the Visegrad Group countries were compared with the average EU level. The article ends with a summary containing the most important conclusions that were drawn from the analysis performed.

### **I. Theoretical aspects of the region's innovativeness**

Growing expectations of customers influence improvement of products and services, not only commercial, but also public, provided by local and regional authorities. Therefore, the concept of innovation and innovativeness gains in importance not only in the analysis of economic units but also spatial ones. Today, it is emphasized that innovations on socio-economic processes in a given territory is significant. In addition to innovation, attention is also paid to knowledge and networks as key elements conditioning the achievement of competitive advantage of the region. This is reflected in the theories of regional development created in recent years, such as: learning region [4] or regional innovation system [5].

Innovativeness of the region means a set of interrelated features shaping the ability of the regional socio-economic system to change, including reforms and innovative solutions that lead to improvement of the efficiency of the regional economy and raise the standard of living of the local population [6]. The innovation of the region is

determined by the innovativeness of units included in the regional system. Therefore, the determination of the level of innovation in the region is related to the innovativeness of enterprises located in the region, the level of social and human capital, entrepreneurship of public authorities in the region and the research and development potential. The complex nature of the region's innovation results from the fact that innovation is a process in which various institutions and organizations are involved (including technology parks, incubators, regional authorities, business environment institutions, banks and others). Innovation is the result of cooperation of all these units, therefore the region's innovation is defined as «the ability of the entire social, economic and institutional system to create, absorb and spread innovation» [7]

It is necessary to emphasize the important role of regional authorities. They should affect the majority of elements to increase in the level of innovativeness of the entire region. Therefore, the subject of their interest should be human resources in offices, enterprises, the quality of functioning of research, scientific and business-related institutions, including high-tech. Regional authorities should be the moderator of creating a knowledge-based economy. Impact instruments include: legal and tax regulations, spatial development plans, financial support instruments, including funds from the European Union, regional institutions supporting entrepreneurship and innovation, investor service offices, and infrastructure investments. Only active regional authorities can contribute to improving regional competitiveness and gaining advantage over other regions. This is the way to create the attractiveness of a given territory for residents, investors and tourists.

## II. Comparative analysis of innovative potential of the Visegrad Group regions

The study of innovative potential covered a total of 35 regions of the V4 Group countries: eight from the Czech Republic, seven from Hungary, sixteen from Poland, and four from Slovakia.

Innovation of regions is a derivative of multiple factors. Therefore, many proposals have been with regard to methods of analysis of this phenomenon. One of them is research and development activity determined by private expenditure on R&D in relation to gross domestic product. In 2015 this expenditure in the EU28 and the euro area on average amounted to over 1.3% of GDP (see Table 2). This level was exceeded in two Czech regions - *Střední Čechy* (1.6% of GDP) and *Jihovýchod* (1.53% of GDP) and in one Hungarian, including the capital city of the country (Budapest) - *Közép-Magyarország* (1.41% of GDP). It is worth distinguishing two further regions: the Czech *Severovýchod* and the Hungarian *Dél-Alföld*, where the expenditure of private enterprises reached over 1% of GDP. Out of Poland's regions, the poorly developed *podkarpackie* province belonging to the so-called 'eastern wall' of the country is noteworthy.

It recorded the highest rate among all of the Polish regions (0.96% of GDP). It is related to the functioning of the 'Aviation Valley' cluster in that area, which brings together about 160 enterprises involved in the production of helicopters and planes. These are highly innovative industries that require implementing new solutions.

The literature on the subject emphasizes that private R&D spending is much more effective than public spending. The willingness to take risks related to the work on inventions is not a strong side of the business environment in the V4 countries. It is enough to mention that in several Polish and Slovak regions the discussed expenditure was at an alarmingly low level oscillating around 0.1% of GDP. What is worse, in 2004-2015 only five Polish regions partially made up for this lagging behind the EU average. In other cases, the differences deepened even more. The changes in the level of spending in the Czech Republic and Hungary are slightly more optimistic. In the former country, as many as five out of eight regions noted improvement on a larger scale than the EU average (0.20 percentage point). In the latter, there were six such regions (out of the total of seven). This means that entrepreneurs from these countries focus their activities on new products and services to a greater extent than in the case of Poland and Slovakia. This demonstrates their greater propensity to take risks and build their competitiveness based on new technological solutions.

In the knowledge-based economy, the basic growth factor is human capital. It is identified with experience, knowledge, and competences that are characteristic of individual people. Thus, the level of human capital can be shaped within the education process. Therefore, when analysing regions' innovation, it is necessary to take into account the society's involvement in the process of acquiring new skills and knowledge.

Across the entire EU and the EU15 countries, the average share of the population with higher education was around 40% in 2016. It turns out that inhabitants of the Visegrad Group regions were characterized by a relatively high level of education. This applies especially to Polish regions where only four out of sixteen provinces (the *lubuskie*, *opolskie*, *kujawsko-pomorskie*, *warmińsko-mazurskie* provinces) recorded a slightly lower level than the aforementioned average. Noteworthy is the *mazowieckie* province, where over 57% of the population had higher education. In the other countries, these were primarily the regions with capital cities that exceeded significantly the EU average. Interesting conclusions can be drawn from the performed analysis of the dynamics of the level of education. In the years 2004-2016 in all V4 regions, the growth rate of people with higher education was higher than in the EU15. In some regions, such as, for instance, the Czech *Jihovýchod*, the Polish *mazowieckie* and *pomorskie* provinces, the increase was almost three times higher than in the aforementioned EU15. This means that in Central and Eastern Europe, much attention is paid to education and that in the last several years the educational gap separating them from Western Europe has been reduced significantly. However, the quality of education remains problematic. The number of university diplomas awarded is not tantamount to the level of knowledge and skills possessed. This could be proved even by low labour productivity in the CEE countries.

Table 2. Selected indicators of the innovation potential of the Visegrad Group regions

Region/country	R&D expenditures in the business sector, % of GDP		Percentage population aged 30-34 having completed tertiary education		Percentage population aged 25-64 participating in lifelong learning		Employment in high tech manufacturing and knowledge-intensive high tech services, % of total employment		Scientists and engineers, % of total population		EPO patent applications per million inhabitants
	2015	Change in 2004-2015, in percentage points	2016	Change in 2004-2016, in percentage points	2016	Change in 2004-2016, in percentage points	2016	Change in 2004-2016, in percentage points	2016	Change in 2004-2016, in percentage points	Average form the years 2004-2012
European Union (28 countries)	1,31	0,20	39,1	12,2	10,8	1,7	4,0	-0,3	4,5	1,9	114,410
European Union (15 countries)	1,37	0,25	39,6	10,1	12,5	1,9	4,1	-0,5	4,7	1,8	141,893
<b>Czech Republic</b>	<b>1,05</b>	<b>0,33</b>	<b>32,8</b>	<b>20,1</b>	<b>8,8</b>	<b>3,0</b>	<b>4,7</b>	<b>0,3</b>	<b>4,1</b>	<b>2,1</b>	<b>17,098</b>
Praha	1	0,26	56,1	25,9	8,7	-2,5	9,7	1,4	8,4	3,9	30,940
Střední Čechy	1,6	-0,29	26,8	16,6	8,4	4,2	4,6	0,9	3,7	1,8	16,730
Jihozápad	0,98	0,60	24,3	15,3	9,0	4,5	3,9	-0,5	3,3	1,6	9,752
Severozápad	0,31	0,12	20,8	15,2	7,9	3,1	2,0	-1,1	2,0	0,6	6,322
Severovýchod	1,04	0,32	26,2	16,9	8,4	3,4	4,2	-0,7	3,4	1,8	20,666
Jihovýchod	1,53	0,95	40,5	26,7	9,6	3,2	5,0	0,5	4,7	2,6	19,597
Střední Morava	0,82	0,29	28,4	16,2	7,2	2,3	4,3	1,0	3,2	1,7	14,258
Moravskoslezsko	0,76	0,18	29,7	18,3	10,8	6,1	3,2	1,1	3,4	2,1	8,471
<b>Hungary</b>	<b>1</b>	<b>0,65</b>	<b>33,0</b>	<b>14,5</b>	<b>6,3</b>	<b>2,3</b>	<b>5,1</b>	<b>-0,5</b>	<b>5,2</b>	<b>1,1</b>	<b>18,112</b>
Közép-Magyarország	1,41	0,85	45,7	16,1	7,9	1,9	8,6	1,4	8,7	2,0	40,047
Közép-Dunántúl	0,73	0,50	25,0	11,5	7,5	3,7	3,5	-3,6	3,9	0,5	7,798
Nyugat-Dunántúl	0,45	0,25	26,6	11,5	4,6	1,5	4,2	-1,8	4,3	1,9	7,797
Dél-Dunántúl	0,16	0,09	28,7	14,8	4,8	1,2	2,8	-1,4	3,1	-0,6	7,013
Észak-Magyarország	0,41	0,31	26,3	14,9	4,2	0,8	4,9	-0,9	3,4	1,0	6,754
Észak-Alföld	0,8	0,50	24,8	12,8	6,3	3,5	3,6	-0,2	2,9	0,1	7,389
Dél-Alföld	1,24	1,10	26,6	10,1	5,9	3,0	2,0	-0,5	4,0	1,0	13,039
<b>Poland</b>	<b>0,47</b>	<b>0,31</b>	<b>44,6</b>	<b>24,2</b>	<b>3,7</b>	<b>-1,3</b>	<b>2,9</b>	<b>0,3</b>	<b>6,7</b>	<b>4,0</b>	<b>6,852</b>
Łódzkie	0,27	0,16	46,4	27,9	2,8	-2,3	2,9	0,8	5,7	3,4	9,638
Mazowieckie	0,75	0,43	57,0	28,0	5,8	0,1	5,4	0,4	8,0	3,7	11,666
Małopolskie	0,66	0,43	45,9	26,8	3,8	-0,5	3,6	1,2	7,5	4,8	11,586
Ślaskie	0,33	0,23	42,5	21,5	3,6	-1,5	2,3	-0,3	7,4	4,4	4,725
Lubelskie	0,26	0,16	41,3	16,2	4,2	-2,0	1,8	-0,7	6,3	4,1	4,245
Podkarpackie	0,96	0,75	41,3	25,7	2,0	-1,4	1,2	-0,4	6,0	3,7	4,360
Świętokrzyskie	0,27*	0,23	46,3	24,6	2,9	-1,2	1*	-0,3**	5,6	3,4	2,865
Podlaskie	0,23*	0,19	45,9	23,8	3,6	-1,5	1,3*	-0,3	5,8	2,9	1,495
Wielkopolskie	0,27	0,15	41,1	24,4	2,4	-2,1	1,9	-0,1	6,1	4,5	5,396
Zachodniopomorskie	0,13*	0,10	43,3	22,4	2,6	-2,8	1,6	-1,2	5,7	2,7	4,133
Lubuskie	0,14*	0,09	35,1	19,4	2,5	-2,4	1,5	0,0	5,2	3,6	9,670
Dolnośląskie	0,49	0,35	41,9	21,5	4,3	-1,8	4,4	2,3	7,8	4,7	7,380
Opolskie	0,14	0,10	36,1	21,6	2,6	-2,2	2,1	-0,7	4,9	3,1	4,270
Kujawsko-Pomorskie	0,3	0,13	36,5	20,6	3,3	-1,9	2,5	-0,3	5,3	3,4	3,746
Warmińsko-Mazurskie	0,06	0,05	34,4	18,2	2,4	-0,8	1,3	-0,3	5,1	2,1	1,259
Pomorskie	0,68	0,53	48,0	28,9	5,5	0,7	3,7	-0,3	7,1	4,8	5,413
<b>Slovakia</b>	<b>0,33</b>	<b>0,08</b>	<b>31,5</b>	<b>18,6</b>	<b>2,9</b>	<b>-1,4</b>	<b>4,1</b>	<b>0,2</b>	<b>3,2</b>	<b>0,9</b>	<b>7,076</b>
Bratislavský kraj	0,49	0,21	51,8	23,3	7,2	-5,1	8,9	2,5	6,7	1,1	21,818
Západné Slovensko	0,35	0,02	29,1	19,5	2,5	-0,5	3,6	0,3	2,6	0,8	5,689
Stredné Slovensko	0,3	0,09	26,5	13,2	2,7	-2,3	3,6	-0,4	2,5	0,4	2,385
Východné Slovensko	0,11	-0,01	29,1	18,6	1,8	-0,1	3,0	-0,2	3,1	1,3	5,091

\* 2005; \*\* 2005-2014

Source: author's elaboration on the basis of Eurostat (<http://ec.europa.eu/eurostat/data/database>).

Another indicator that affects significantly regional innovation is participation in lifelong learning<sup>1</sup>. The society's activity in acquiring new qualifications is related to entrepreneurial attitudes and openness to updating knowledge.

Unfortunately, the participation of people aged 25-64 in lifelong learning in the Visegrad Group countries was at a low level. Apart from the Czech *Moravskoslezsko*, none of them was equal to the average EU level, which amounted to 10.8% of the population in 2016. The Western European countries concentrated in the EU15 recorded a slightly higher average (12.5%). The best among the analysed regions were the Czech ones, where in 2016

<sup>1</sup> Continuing education is any type of education and training, including primary, secondary, and tertiary education, employee training, qualifications-enhancing training, distance learning, evening courses, self-learning. Continuing education also includes courses in foreign languages, IT, medical, as well as in culture and arts management. Persons participating in lifelong learning include those who during the four weeks preceding the survey participated in one of the aforementioned forms.

participation in lifelong learning was declared from 7.2 up to 10.8% of the population. Hungarian regions were on a slightly lower level oscillating between 4.2 and 7.9%. The lowest levels were noted in Poland and Slovakia, where on average 3.7% and 2.9% of the population declared their activity in acquiring new knowledge.

Negative conclusions can also be drawn from the analysis of changes from 2004-2016. Out of all 35 regions of the V4 Group, as many as 21 of them worsened their result in that period. These were mostly Polish and Slovak regions. The worst one in this respect was the Slovak *Bratislavský kraj*, in which the percentage of population aged 25-64 participating in courses and training fell by more than 5 percentage points. At the same time, the inhabitants of the Czech regions (apart from the *Praha* region) and the Hungarian regions increased their participation in training. The highest progress in this regard was noted in the previously mentioned *Moravskoslezsko*, where in 2016 the number of participants in lifelong learning in relation to the population was by more than six percentage points higher, if compared to 2004.

Another factor affecting the innovation of the region that was examined was employment in the high-tech industry<sup>2</sup> [8]. Across the European Union, this sector employed on average, about 4% of all employees in 2016. A similar level of employment was noted in the EU15. Out of the analysed regions, over one-third reported a higher level of employment than the EU average. Special consideration was given to the capital regions, where in the most technologically advanced sectors from 5.4 up to 9.7% of all workers found employment. Moreover, the European average was exceeded by most of the Czech and Hungarian regions. Out of the Polish provinces, apart from the *mazowieckie* province, also the *dolnośląskie* province offered a large number of jobs in its innovative sectors (4.4% of the employed). The worst situation in the entire population analysed occurred in the provinces located both in the eastern (the *podlaskie*, *warmińsko-mazurskie*, *świętokrzyskie* provinces) and western (the *lubuskie*, *zachodniopomorskie* provinces) parts of the country.

In the years 2004-2016, the share of high-tech employees in the EU28 and the EU15 decreased by 0.3 and 0.5 percentage points respectively. The declines also affected two-thirds of the analysed regions within the V4 countries. However, this trend did not affect most of the Czech regions, a half of Slovak ones, and individual regions from Poland and Hungary. From this group, it is worth distinguishing Poland's *dolnośląskie* province and Slovakian *Bratislavský kraj*, in which the share of employees in the high-tech sector increased by about 2.5 percentage points.

The innovative activity depends on the quality of human capital. However, the subject of frequent analyses in the literature on the subject is also the quantitative aspect of human resources. This particularly applies to resources involved in highly innovative sectors. This group comprises mainly scientists and engineers. In the EU28 and the EU15 such persons constituted about 4.5% of the population in 2016. Within the Visegrad Group countries, in turn, the largest number of scientists and engineers could be found in the capital regions, where their share in the population ranged from 6.7% in *Bratislavský kraj* up to 8.7% in *Közép-Magyarország*. Interestingly, the EU average was exceeded in all Polish regions. A high share of qualified human resources is related to the educational boom and a relatively high level of education of the society. In the years 2004-2016, the increase in the share of this group in the population was higher than the average for the entire EU and ranged from 2.1 percentage points in the *warmińsko-mazurskie* province up to 4.8 percentage points in the *pomorskie* and *małopolskie* provinces.

A significant criterion for assessing the innovation of countries and regions is the patent activity. The indicator built on the number of new patents can be used as a reliable measure of technological activity. Unfortunately, the high level of education in the society of the Visegrad Group did not translate into the results of innovative activities. When analysing the number of patent applications submitted to the European Patent Office per one million of inhabitants, one can see a huge disproportion between all of the V4 countries and the average for the EU28 and the euro area. In the time period 2004 and 2012 the capital regions, being the best ones in this regard, yearly worked out on average from 11 up to 40 (the *mazowieckie* province) patent applications per one million inhabitants, while in the entire EU it was 114 and in the euro area 141. Even larger differences could be found in other regions. Particularly low patent activity was noted in the Polish and Slovak regions. It can be concluded that there was no correlation between the level of education and the involvement in the commercialization of inventions. Maybe it was so since entrepreneurs from the V4 regions did not seek patent protection internationally as their inventions and products had a local reach only. Another reason for this state of affairs could be the high cost of obtaining patent protection.

In order to deepen the analysis of the V4 group regions, it is worth quoting the latest Regional Innovation Scoreboard 2017 (RIS) published by the European Commission, which ranks 220 European regions into four groups (leader, strong, moderate, and modest innovators) following the synthetic innovation indicator. Moreover, the region, which is close to being promoted to the higher level group, is marked with a plus sign, while if it is close to falling to a lower level group - with a minus sign. The synthetic index is calculated on the basis of a set of 18 variables, such as, for example, innovative SMEs collaborating with others as percentage of SMEs, R&D expenditures in the public sector as percentage of GDP, trademark applications per billion regional GDP.

<sup>2</sup> High-tech manufacturing sectors include Chemicals, Machinery, Office equipment, Electrical equipment, Telecommunications and related equipment, Precision instruments, Automobiles and Aerospace and other transport. Number of employed persons in the knowledge-intensive services sectors include Water transport, Air transport, Post and telecommunications, Financial intermediation, Insurance and pension funding, Activities auxiliary to financial intermediation, Real estate activities, Renting of machinery and equipment, Computer and related activities, Research and development, and Other business activities (Regional Innovation Scoreboard 2017 – Methodology Report, p. 11 [<http://ec.europa.eu/docsroom/documents/23986>]).

The capital cities of the Czech Republic and Slovakia (*Praha* and *Bratislavský kraj*) ranked the best in the V4 group and were included in the group of strong innovators. Figure 1 shows the RIS results of individual V4 regions in relation to the average for the EU28.

The average result for the EU28 was exceeded slightly by the first of these regions, while the second almost equalled it. For comparison, it should be added that the leader of the entire ranking (Stockholm) reached 165% of the EU average. The strengths of *Praha* and *Bratislavský kraj* included public education, international scientific publications, public spending on R&D, employment in the high-tech sector, and export of high-tech products. The remaining capital regions from Hungary and Poland did not score well in the ranking because they reached approximately 78% and 64% of the EU average, respectively. In terms of countries, the Czech and Slovak regions were also found to be the most innovative. In the moderate + group, there were as many as six Czech regions and one Slovakian, while in the moderate innovators group - one from each country. The lowest level of innovation among the V4 group was found in the Polish provinces, in the vast majority of which achieved a result below half of the EU average, and nine provinces were included in the group of modest innovators. The biggest weaknesses of the Polish regions included a low level of R&D activity among enterprises, lack of high-tech industries as well as low public involvement in acquiring new skills and competences.

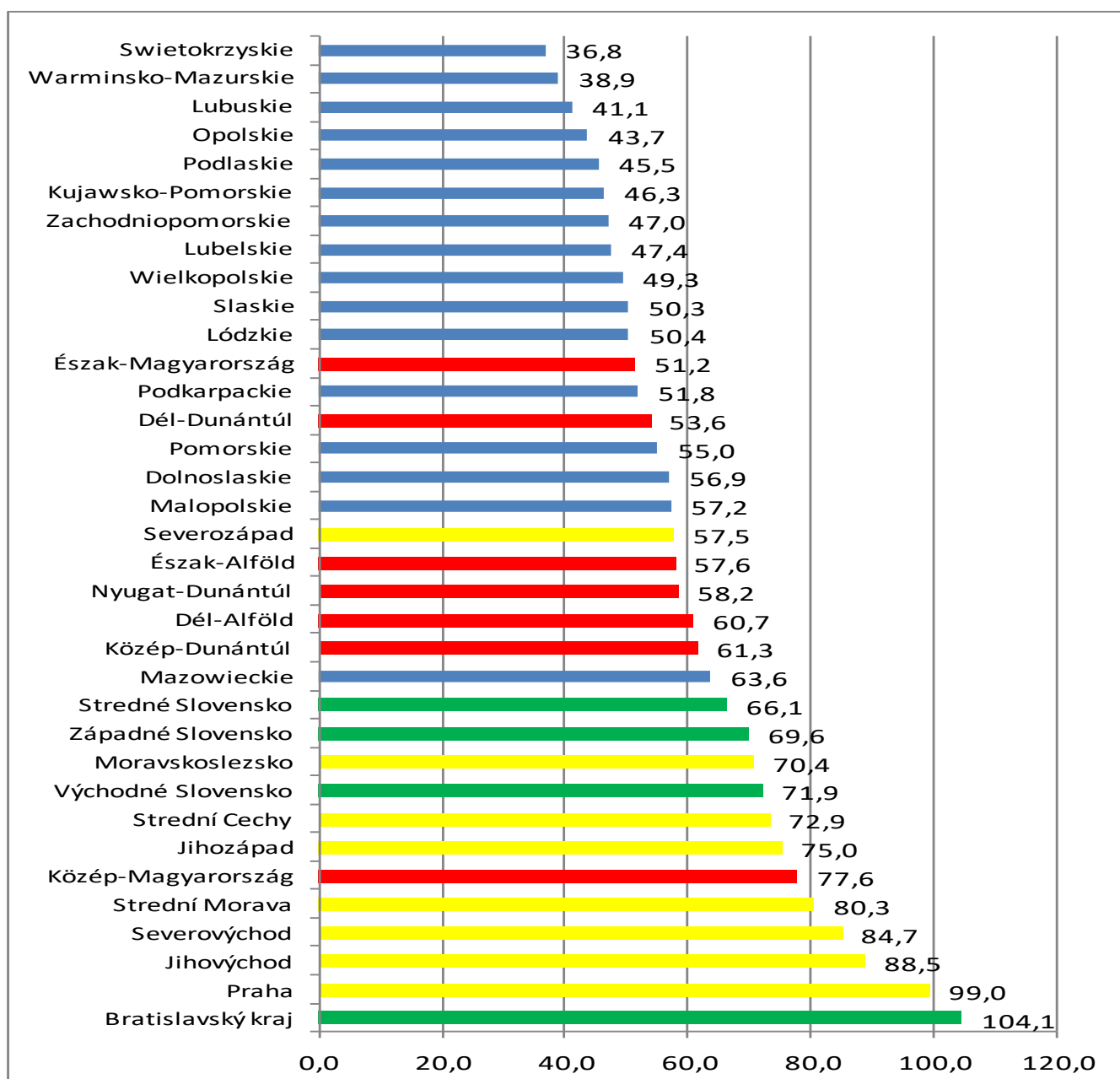


Figure 1. Regional Innovation Scoreboard 2017 – Regions of the Visegrad Group in relation to the average for the EU28

Source: author's elaboration on the basis of European Commission [[https://ec.europa.eu/growth/industry/innovation/facts-figures/regional\\_en](https://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en)].



### Summary

Innovation is one of the basic factors of the region's competitiveness. The involvement of the authorities and the economic environment in the process of creating new products and services is necessary but also insufficient for building the attractiveness of a specific region. The attitudes of the society are also important, especially in the area of raising the level of human capital and the use of new competences and knowledge in research and business institutions.

The innovative potential of the Visegrad Group countries' regions is still found to be low, when compared to the average EU level. This was confirmed by both partial indicators and a summary ranking of innovativeness. The capital regions were distinguished positively, which is related to a higher level of entrepreneurship, the presence of higher education institutions, research institutions, and foreign investments. It is also worth noting that among the V4 countries, the highest rates of innovation potential were achieved by the Czech and Hungarian regions. This concerned, among others, private spending on R&D, lifelong learning, employment in the high-tech sector, and the patent activity.

Nevertheless, it should be emphasized that in many regions of the V4 Group the distance to the average EU level in terms of particular elements of the innovation potential in recent years has increased significantly. The expenditures of enterprises on research and development, participation in lifelong learning, or employment in the high-tech sector can serve as examples. This means a deterioration in the competitiveness of the economies of the countries considered. However, there is certain potential that, when properly used, can reverse the negative tendencies. The strength of the Visegrad Group is human resources and a high level of education of the society. Therefore, it seems that the right direction of improving the innovation policy of the countries discussed should be striving to increase the quality of education, especially in the areas related to science and technology. Taking efforts to improve the quality of human capital may translate into an increase in the efficiency of enterprises and improvement of their technological advancement.

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