



Human Resources Development in the Solution of Regional Disparities in Slovakia

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Abstract: *Different historical, geographical, socio-economic and social conditions have led to the situation that the regions in Slovakia are equipped with different start-up capital, different quality of human potential and various infrastructures and therefore they develop accordingly. Regional disparities are understood as differences in the degree of socio-economic development of regions, which is uneven. The problem of regional disparities cannot be seen only as economic differences between regions, as there are also significant intraregional differences within a region. In the regional context, education and training of youth and adults are directly linked to employment, social security, economic and social development. Insufficient education and training of individuals reduce their employment opportunities, limit their responsible approach to work and life, worsens living conditions, increases social risks, and may deteriorate their health. The level of educational attainment is also related to the level of innovation performance and the competitiveness of regions. A special area is represented by the preparation of capacities for the sector of research and development. The regional differences could be seen in the location of universities preparing graduates for research and development as well as the placement of research and development institutions. The main aim of the paper will be to point out how human resources could be deployed in the solution of regional disparities in Slovakia.*

1. INTRODUCTION

Since 2001, less developed regions in Eastern Europe have been catching up with the EU. However, many middle-income regions and less developed regions, especially in the south and south-west of the EU, are also suffering from economic stagnation or decline. Convergence between the Member States has accelerated, but internal regional disparities within fast-growing Member States have widened. Employment is growing, but regional disparities remain larger. The number of people at risk of poverty and social exclusion fell by 17 million between 2012 and 2019. Regional disparities as regards the innovation indicators have increased due to insufficient investment in research and development and weaknesses in the innovation ecosystems of the least developed regions.

The EU population is aging and the decline of the population is expected in the coming years. In 2020, as many as 34% of Europeans lived in a region with a declining population. It is assumed that in 2040 this share will reach up to 51%. Cohesion policy has a major impact on many regions and inhabitants in the EU. It helps to invest in more sustainable and balanced growth that has long-term benefits and impact. It supports physical and digital infrastructure, education and training, small and medium-sized enterprises and green deal transformation. More recently, cohesion policy has helped EU regions cope with the challenge of the coronavirus pandemic and its aftermath.

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Human potential is part of the socio-demographic potential of the territory. It is the basic carrier and the driving force of territorial development. Currently, regional development is marked by socio-economic instability, unemployment, the global economic crisis and the COVID-19 pandemic impact. The structure of the population is one of the basic demographic variables, which can be applied to predetermine demographic development and subsequent changes.

2. METHODOLOGY AND AIMS

The paper is focused on the human resources in the regions of the Slovak Republic, recent trends in birth rate, aging, numbers of graduates of primary and secondary education, upper secondary education training, numbers of students enrolled in universities and the impact of graduates to the employment in regions, especially in the sector of research and development (R&D).

The paper aims to point out how human resources could be deployed in the solution of regional disparities in Slovakia. Specific aims include the comparison of trends in the birth and aging of population in Slovakia over the last ten years. Trends are reflected in the numbers of pupils attending secondary grammar schools and secondary vocational schools, and the numbers of students enrolled in universities. The university graduates could generally contribute to the economic progress of the country and provide added value to the economic performance in regions. However, over years, there has been a huge phenomenon of brain drain.

The statistical data were analyzed and assessed accordingly and results proceeded. Based on the recent census, statistical figures provided by the Statistical Office of the Slovak Republic and the European Statistical Office, the analysis of trends and the comparison among eight regions in the Slovak Republic were elaborated. The results have confirmed the regional differences from the aspect of relevant indicators, such as attained education, employment rate and unemployment rate, average age of teachers, share of adult population in productive age in adult education and professional education, investments into research and development, migration to more attractive regions with well-paid jobs and the exodus abroad.

The results permitted us to outline some conclusions and recommendations aimed at the betterment of human resources development in the regions.

3. HUMAN RESOURCES IN THE REGIONS OF THE SLOVAK REPUBLIC

According to the census in 2021 in Slovakia, the ratio of men and women is relatively balanced. The state of the population as of 31.12.2020 is 5,459,781 inhabitants, out of which there were 2,793,295 women, which represents 51.16% of the total population, and 2,666,486 men, which represents 48.84% of the total population (Statistical Office of the SR. Population by Gender. 2022).

The number of inhabitants is inversely proportional to the area of NUTS 3 regions (Figure 1). Some regions, even if the largest in area, have a low number of inhabitants, which is best observed in the Banská Bystrica region. The uneven distribution of the population is largely related to demographic development but can be also ascribed to economic development.

Migration represents the movement of persons in geographical and societal space. The migration does not mean solely the movement of persons from one country to another, but also the movement and mobility of people between regions, which changes the number of inhabitants in regions.

In the Slovak Republic, internal migration represents the movement of the population from the eastern regions to the western regions, especially to the capital Bratislava. Based on this persistent trend, the number of inhabitants in individual regions has been changing (Table 2).

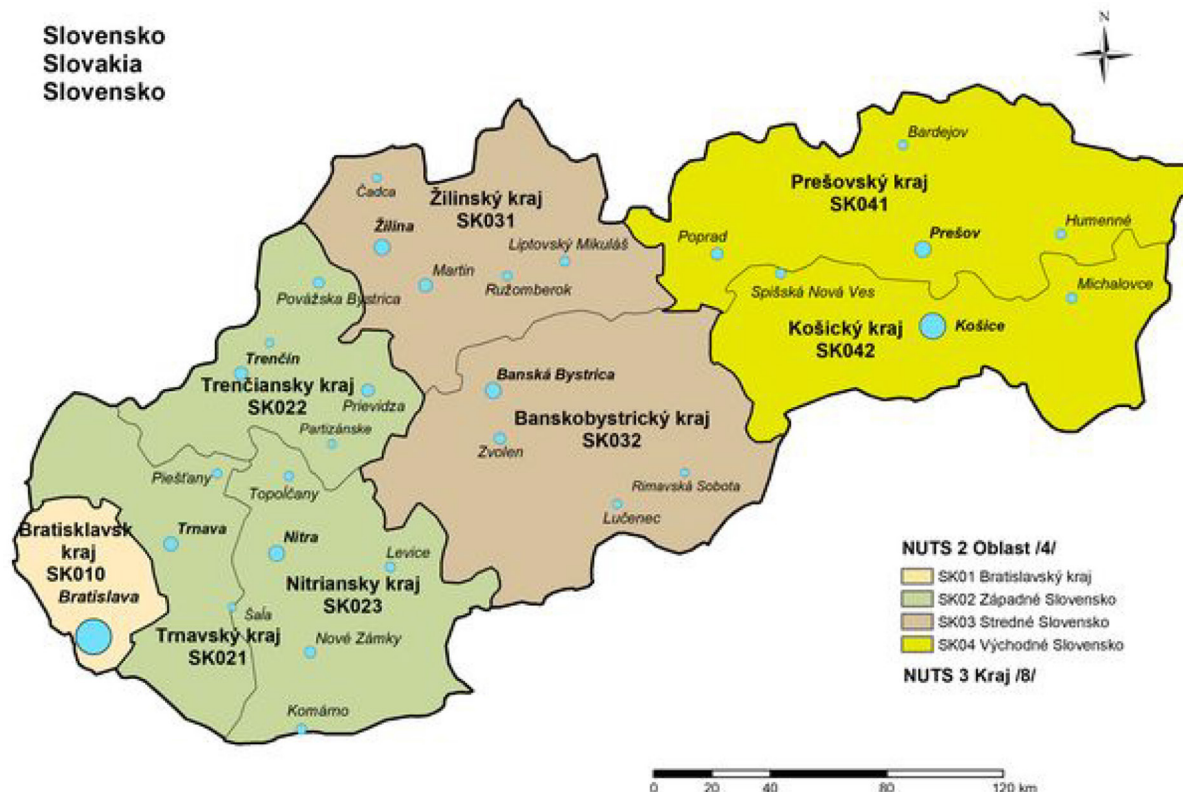


Figure 1. NUTS 2 regions in the Slovak Republic: Bratislava region, Western Slovakia, Central Slovakia and Eastern Slovakia

Source: <https://www.czso.cz/csu/czso/slovakia-nuts>

Table 1. Population in NUTS 3 regions in 2020

Region	Bratislava	Trnava	Nitra	Trenčín	Žilina	Banská Bystrica	Prešov	Košice	Slovak Republic
Population	677024	565324	582567	671508	691136	643102	827028	802092	5459781
Share in %	12,4	10,36	10,67	12,30	12,66	11,78	15,15	14,68	100
Area of the region in km ²	2052,6	4146,3	6343,7	4501,8	6808,5	9454	8972,8	6754,3	49034

Source: Statistical Office of the Slovak Republic. Statistical Yearbook of the Regions in the Slovak Republic. 2020. p. 664.

Table 2. Development of the number of inhabitants in NUTS 3 regions of the Slovak Republic

Region	2012	2013	2014	2015	2016	2017	2018	2019	2020	Increase/ Decrease
Bratislava	612682	618380	625167	633288	641892	650838	659598	669592	677024	64342
Trnava	556577	557608	558677	559697	561156	562372	563591	564917	565324	8747
Trenčín	593159	592394	591233	589935	588816	587364	585882	584569	582567	-10592
Nitra	688400	686662	684922	682527	680779	678692	676672	674306	671508	-16892
Žilina	690121	690420	690449	690434	690778	691023	691368	691509	691136	1015
Banská Bystrica	658490	656813	655359	653024	651509	649788	647874	645276	643102	-15388
Prešov	817382	818916	819977	820697	822310	823826	825022	826244	827028	9647
Košice	794025	794756	795565	796650	798103	799217	800414	801460	802092	8067
Slovak Republic	5410836	5415949	5421349	5426252	5435343	5443120	5450421	5457873	5459781	48946

Source: http://datacube.statistics.sk/#!/view/sk/VBD_DEM/om7011rr/v_om7011rr_00_00_00_sk.

A high increase in the number of inhabitants is observed in the Bratislava region and Western Slovakia (especially the Trnava region) and Eastern Slovakia (the regions of Prešov and Košice). The comparison of the number of inhabitants in 2012 and 2020 in the Bratislava region shows an increase of 64,342 inhabitants. In contrast, the population decline is observed in Central Slovakia (namely the Banská Bystrica region) and the eastern part of Western Slovakia (the Nitra region).

The declining trend of the population in the above regions can be attributed to the interregional migration of persons searching for a better quality of life and job opportunities. In recent years, population decline has been shown in most regions. It was caused especially by low birth rates, rapid population aging and interregional migration, as the economically active population moves to regions characterized by a better quality of life chances and abundant job opportunities.

The balanced structure of the population can be ranked among the principal prerequisites for the development of the country. The overall development depends on the demographic structure of the population and the population aging. The phenomenon of aging is perceived globally, although the problem is more visible at the regional level. This aging affects the economic, societal and cultural aspects of social development. Each community tries to cope with the changes in the demographic composition of population policy. In 2013, the National Program of Active Aging for 2014 to 2020 was approved in Slovakia to help mitigate the negative consequences associated with demographic changes. The population policy should support, inter alia, the birth rate increase, middle age mortality decrease, and the integration of higher shares of immigrants. The general goal aims to create conditions for longevity in good health, strengthen the inclusion of elder persons in society and create conditions for a dignified life, enable the population to remain active in various areas (employment, volunteering), to take measures to eliminate discrimination based on age.

In Slovakia, in recent decades, significant demographic changes have been manifested, including population aging and the increase of older age population, with an impact on the whole society. While in 2011 the population aging index in Slovakia was 82.96%, in 2020 the index increased to 107.34%. Since the census in 2011, the share of the population over 65 years of age has grown significantly (Table 3).

Table 3. Population aging index in the Slovak Republic

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Index of aging (%)	82,96	85,51	88,34	91,17	94,22	96,96	99,43	101,90	104,80	107,34

Source: Statistical Office of the Slovak Republic, SODB 2021, Index of aging (Sauvy index) represents the number of persons in post-productive age (65+ years) per 100 persons in pre-productive age (0-14 years).

The share of the population in Slovakia in the pre-productive age from 0 to 14 years represents 15.90%, in the productive age from 15 to 64 years represents 67.03% and the share of the population in the post-productive age over 65 years represents 17.07%. While in 2011, the share of persons in pre-productive age (0-14 years) was higher than the share of persons in post-productive age (over 65 years), in 2021 the opposite is true (Table 4).

Table 4. Shares of the population due to the age composition in the Slovak Republic

	Year 2020 – Total
Share of persons in pre-productive age (in %)	15,90
Share of persons in productive age (in %)	67,03
Share of persons in the post-productive age (in %)	17,07

Source: Statistical Office of the SR, Census 2021

4. HUMAN POTENTIAL IN REGIONS

The basic priority in human resources development is the education of the young generation. Education is the most important component of human capital development. It can be considered the main factor affecting the overall development in regions. The education in secondary schools, the education and training in secondary vocational school and the study at universities are basic instruments for capacity building referring to the competitiveness of regions.

Table 5. Number of pupils at grammar schools in the regions of the Slovak Republic

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	Increase/ Decrease
Slovak Republic	80346	76711	74524	73757	72287	73880	72842	72755	70675	-9671
Bratislava region	13388	13275	13166	13430	13210	14009	14373	14430	14639	1251
Western Slovakia	21779	20558	19619	19549	19150	19395	19048	18660	18670	-3109
Trnava region	6713	6388	6222	6069	6025	6190	6039	5955	6044	-669
Trenčín region	6981	6636	6126	6415	6334	6369	6274	6142	6150	-831
Nitra region	8085	7534	7271	7065	6791	6836	6735	6563	6476	-1609
Central Slovakia	19929	18807	18193	17696	17355	17630	17152	18381	16491	-3438
Žilina region	11593	11061	10714	10438	10217	10353	10133	9802	9594	-1999
Banská Bystrica region	8336	7746	7479	7258	7138	7277	7019	8579	6897	-1439
Eastern Slovakia	25250	24071	23546	23082	22572	22846	22269	21304	20875	-4375
Prešov region	13045	12318	11902	11633	11329	11428	11151	10730	10447	-2598
Košice region	12205	11753	11644	11449	11243	11418	11118	10574	10428	-1777

Source: datacube.statistics.sk.

According to Table 5, there has been an increasing trend in the number of students at grammar schools in the Bratislava region, which is the most economically developed region with the most economically active population. In contrast, a decreasing trend in the number of pupils at grammar school is characteristic of other regions of Slovakia. The trend could be attributed to the lower birth rate in given age cohorts of pupils and the lower interest of pupils to attend secondary grammar schools as graduation from this type of secondary school presupposed enrolling in university study. There might also be some other reasons, especially the limited number of universities in NUTS 3 regions, except the Bratislava region, and the lower economic status of families.

Table 6. Number of pupils at secondary vocational schools in the regions

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	Increase/ Decrease
Bratislava region	13605	12708	12383	12132	12428	12442	12522	12856	13313	-292
Western Slovakia	55976	52402	49860	47608	45694	43821	42033	40471	40253	-15723
Trnava Region	17447	16537	15724	14416	13970	13437	12772	12355	12257	-5190
Trenčín region	17999	16447	15549	14763	13896	13118	12556	12005	11908	-6091
Nitra region	20530	19418	18587	18429	18728	17266	16705	16111	16088	-4442
Central Slovakia	41836	39765	37956	37003	35700	34534	33393	32126	32024	-9812
Žilina region	24099	22767	21719	20992	20090	19332	18609	17970	17939	-6160
Banská Bystrica region	17737	16998	16237	16011	15610	15202	14784	14156	14085	-3652
Eastern Slovakia	46539	43873	42600	41617	40332	38845	37127	36758	37066	-9473
Prešov region	25193	23466	22419	21482	20787	20299	19329	18724	18752	-6441
Košice region	21346	20407	20181	20135	19545	18546	17798	18034	18314	-3032

Source: datacube.statistics.sk

Table 6 referring to the numbers of pupils in secondary vocational schools in the regions presents a different trend than Table 5 (secondary grammar schools). In all regions, including the Bratislava region, the number of pupils in secondary vocational schools has been falling. The

decrease in the Bratislava region has been minimal, in comparison with the rest of the country. The decreasing trend is expected also in the coming years. The decreasing quantity should be replaced by increasing quality. The human capital development in the regions will thus depend on the creative and innovative activities of young people and their adequate adaptation to the requirements of labor markets in the regions. The graduates of secondary schools in general represent an age cohort where university applicants are concentrated.

The above observations correspond with the number of students at universities (table 7). Highly competitive regions are based on the knowledge and work capacity of persons who are able to adapt to changes in professions and life and are interested to develop and supplement their education in different ways and forms.

However, the number of students at universities in the Slovak Republic has been decreasing over the monitored years (2014-2020). It must be admitted that literacy, attained education and educational level representing the driving force of the population's economic activity has not been developing in accordance with the general requirement, trends, political expectations and regional requests. The quality of teachers is considered basic factor determining the quality of education and training. The results of the OECD international survey have shown that the average age of teachers in Slovakia is 44 years, with 82% of women. The share of teachers under the age of 30 is only 8.2%. The wish to work in the sector of education as a teacher has been diminishing as the graduates of teacher training universities prefer other professions. Therefore, there is no surprise that the age of teachers in Slovakia is increasing as there is limited renewal of teaching staff.

Another negative tendency is the exodus abroad of persons in productive age. Some 300.000 persons under 30 years of age have already left Slovakia by 2020, with the largest share of university graduates. The possible return would require specific measures, among other the availability of rental housing for young people and their families, as well as the availability of relevant jobs. Generally, young families would necessitate relevant allowances during parental leave (with the aim of economic stability) and subsequent professional growth and performance (Vision and Strategy of Development of Slovakia by 2030, 2019).

Table 7. Number of students at universities in the regions of Slovakia

Year	2014	2015	2016	2017	2018	2019	2020	Increase/ Decrease
Bratislava region	59254	52803	54470	34863	48270	47404	50277	-8977
Western Slovakia	41105	37821	34778	27828	27984	26713	28295	-12810
Trnava region	15876	14801	14260	10149	10138	9950	10869	-5007
Trenčín region	6043	5064	3736	2545	4047	3648	4413	-1630
Nitra region	19186	17956	16782	15134	13799	13115	13013	-6173
Central Slovakia	29320	26168	24611	18270	19729	25419	20301	-9019
Žilina region	15252	13445	13138	10055	10578	16763	11312	-3940
Banská Bystrica region	14068	12723	11473	8215	9151	8656	8989	-5079
Eastern Slovakia	30618	28248	28785	21322	22114	21583	23016	-7602
Prešov region	10346	9928	10173	7359	7486	7329	7682	-2664
Košice region	20272	18320	18612	13963	14628	14254	15334	-4938

Source: http://datacube.statistics.sk/#!/view/sk/VBD_DEM/om7011rr/v_om7011rr_00_00_00_sk.

The comparison of results in 2011 and 2020 concerning the education of the population aged 15 – 64 has shown the decreasing tendency in persons who completed lower than primary education,

primary education, secondary education and post-secondary non-university education. An increase was recorded solely in persons aged 15-64 who completed tertiary education (Table 8).

Table 8 includes the comparison between 2020 and 2011 from the aspect of other significant indicators of the education in Slovak population. The number of university graduates decreased significantly compared to 2011 and 2020. The share of the adult population aged 25-64 who participated in lifelong learning or professional education and training decreased in 2020 compared to 2011 as the share of men in 2011 was 3.5%, of women 4.6%; the share of men in 2020 decreased to 2.6% and of women to 3.0%.

Table 8. Education of the population in the Slovak Republic - comparison of 2011 & 2020

Indicator	2020		2011	
	women	men	women	men
Population (age 15-64) with completed lower than primary education, primary education or lower secondary education, in % (ISCED 2011, level 0-2)	14,9	12,5	19,7	14,6
Population (age 15-64) with completed upper secondary education and post-secondary non-university education, in % (ISCED 2011, level 3-4)	59,1	68,2	63,2	71,0
Population (age 15-64) with completed tertiary education, in % (ISCED 2011, level 5-8)	26,0	19,2	17,1	14,4
Adult population (age 25-64) with minimum upper secondary education, in %	92,0	93,3	89,3	93,3
Young population (age 20-24) with minimum upper secondary education, in %	89,2	90,1	94,0	92,6
Share of early school leavers from vocational education and training (age 18-24) in %	7,4	7,7	4,6	5,4
Graduates from I level and II level of university study	21 779	13 585	44 900	25 078
Graduates of III level of university study - doctoral study (post-graduate study)	662	639	847	825
Total share of university graduates in %	61,2	38,8	63,8	36,2
Share of adult population (age 25-64) who participated in long-life education or professional training in %	3,0	2,6	4,6	3,5

Source: Statistical Office of the Slovak Republic. Census 2021.

In 2020, 7.4% of women and 7.7% of men aged 18-24 made up the share of people with early termination of education and training which is a significant increase compared to 2011 (Table 9). In 2020, 7.6% of the population (both men and women) early left education and training, which is rather an increase compared to 2011, when it was 5.1%, out of which the share of working people in 2020 was 1.5% and the share in 2011 was 1.3%.

Table 9. Early school leavers from vocational education and training

Indicator	2020	2011
Population total (in %)	7,6	5,1
Working population (in %)	1,5	1,3
Unemployed population (in %)	6,1	3,8
Economically inactive persons who want to work (in %)	2,4	2,5
Economically inactive persons who do not want to work (in %)	3,7	1,3

Source: Statistical Office of the SR. Census 2021.

The share of the unemployed in 2011 was 3.8% and it increased significantly to 6.1% in 2020. The share of economically inactive persons who want to work reached 2.4% in 2020, which remained almost unchanged compared to 2.5% in 2011. The comparison between 2011 and 2020 in economically inactive persons who do not want to work increased significantly from 1.3% to 3.7%.

4.1. The Level of Attained Education

The share of the population aged 15 to 64 who attained pre-primary education, primary education and lower secondary education was 13.5% in 2020, the share of people aged 15 to 64 who

achieved upper secondary and post-secondary education was 62.5% and of persons aged 15 to 64 who attained tertiary education was 23.9%.

In 2020, more men than women attained higher secondary and post-secondary education in the Slovak Republic, and on the contrary, more women attained tertiary education. Pre-primary, primary and lower secondary education was approximately at the same level for men and women.

In 2020, a total of 2.8% of population aged 25 to 64 participated in adult education and professional training in the Slovak Republic, of which 2.6% were men and 3% were women. Compared to the European Union, where the level of adult education was 9.2%, the Slovak Republic lags behind significantly (Eurostat, 2021).

4.2. Unemployment in the Slovak Republic and the Unemployment Rate in the EU

The unemployment rate represents unemployed persons as a percentage of the labor force. As of December 31, 2021, there were 200.225 unemployed citizens in the Slovak Republic, which represents a 6.76% unemployment rate. In Slovakia, for a long time that was the lowest unemployment rate has been monitored in Western Slovakia, mainly due to the high number of job opportunities. The unemployment rate increases persistently in the east of Slovakia (Table 10). The most unemployed were in the Prešov region with a share of 10.75%, followed by the Košice region with a share of 9.98% and the lowest share was in the Trnava region with 4.16%.

Table 10. Unemployment in the Slovak Republic as of 31 December 2021 by regions

	Number of unemployed persons	Unemployment rate
Slovak Republic	200225	6,76%
Banská Bystrica region	32137	9,01%
Bratislava region	16027	4,38%
Košice region	40788	9,98%
Nitra region	18436	4,80%
Prešov region	45574	10,75%
Trenčín region	14009	4,28%
Trnava region	13061	4,16%
Žilina region	20193	5,32%

Source: Statistical Office of the Slovak Republic. 2022.

More job opportunities and a higher educational level of the population are confirmed in Western Slovakia, as the highest proportion of residents with higher education live in the Bratislava region. On the other hand, Bratislava Region has the lowest share of residents with attained primary education. The situation in the Bratislava region confirms that the development of human resources in terms of competitiveness should focus on adult education and further vocational and professional education and training, as progress should be triggered and accompanied by capacity building in regions.

At the end of 2021, the unemployment rate decreased both in the Eurozone and the European Union as a whole, as the demand for labor force started to increase again. According to data from Eurostat, in 2020 there were 15,808,000 unemployed persons in the European Union, in 2021 the number of unemployed people fell to 13,612,000.

According to the Eurostat data, the unemployment rate in the euro area decreased to 7% in December 2021 compared to 8.2% in December 2020. The unemployment rate across the EU

decreased to 6.4% in December 2021 compared to 7.5 % in December 2020. In December 2021, 13.612 million men and women were unemployed in the EU, of which 11.481 million were in the Eurozone.

As regards the persons under the age of 25, as many as 2.748 million persons were unemployed in the EU, out of which 2.222 million lived in the euro area. In December 2021, the unemployment rate of people under the age of 25 reached 14.9% in the EU and the Eurozone. This means a decrease from 15.3 % in November 2021 in the EU and 15.4% in the Eurozone.

4.3. Science, Research and Innovation in Slovakia

The prerequisites for a high-quality level of science and research are two factors - a qualified and educated team of researchers and a sufficient volume of invested funds. Both factors can be considered the initial impulses supporting the innovativeness of the country. These factors influence each other, because without sufficient funding it will not be able to retain high-quality researchers, and without high-quality human capital, there will be no willingness to invest in research and development.

The connection between research, development and innovation on one side and a prosperous economy on the other side can be observed on a global level. On a global scale, there is competition between the US, the European Union and China in terms of investment in research and innovation in relation to GDP. Every year, China pours investments into research and development, trying to become a global leader.

In 2020, Belgium became the leading country within the European Union, sharing first place with Sweden. Both Belgium and Sweden invested 3.5% of their GDP in research and development (R&D). Slovakia and the other five new EU Member States (Bulgaria, Cyprus, Latvia, Malta, and Romania) found themselves at the opposite end of the ranking. Table 11 shows the values of Slovakia in terms of the percentage of GDP.

Table 11. Investments in research and development in Slovakia as a % of GDP

Year	2014	2015	2016	2017	2018	2019	2020
Investment in R&D as % of GDP	0,88	1,16	0,79	0,89	0,84	0,83	0,92

Source: EUROSTAT

The Slovak Republic had set a goal to invest 1.8% of GDP in research by 2020. Table 11 includes investments in research and development in relation to GDP, showing that the Slovak Republic failed to meet this target. The investments increased only by 0.13% of GDP from 2016 to 2020. In 2015, investments rose above 1% of GDP, but this was a consequence of the EU structural funds intended for the Slovak Republic.

From the point of multi-source financing of research and development in the monitored period, the biggest share of financing originates from business and state sources.

It is obvious that Slovakia has obvious shortcomings from the aspect of multi-source financing of research and development. The average share of investments from state resources in the European Union is around 29%, while the share of this type of investment in Slovakia represents around 40%. In the new member states, the EU structural and investment funds may be one of

the reasons for the low share of private resources. In some countries, these funds are insufficiently implemented, which also is the case in Slovakia, where in 2020 these funds represented 14.28%.

The Bratislava region is the smallest region within the NUTS 2 regions in Slovakia, but it spends the highest share of funds on research and development. For the year 2020, the value of invested financial resources in Bratislava region is more than doubled when compared to Western Slovakia, the second in the ranking. Compared to Eastern Slovakia, the difference is more than threefold. For the year 2020, the financial support for research and development in the Bratislava region reached 393.853.000 euros, thus surpassing the highest value of investments in 2015. The leadership of the Bratislava region can be attributed to several factors, among others, that Bratislava is the capital and largest city of Slovakia with the concentration of most researchers and most research institutions in Slovakia.

It is paradoxical, that in Eastern Slovakia with the second largest city Košice the rate of funding of research and development is at the lowest level when comparing all eight NUTS 3 regions are compared. This is also reflected by the departure of a number of young qualified people from Eastern Slovakia to Western Slovakia, especially to the Bratislava region or abroad. The region of Eastern Slovakia has long been considered unattractive for domestic and foreign investors, who prefer other EU countries or regions in Western Slovakia when expanding their business. The reason may consist of insufficient infrastructure or inappropriate conditions for retaining and developing talents. In this regard, the Slovak government must help balance regional differences in research and development.

According to the data of the Slovak Statistical Office, Western Slovakia is the region with the largest number of enterprises. The majority of small and medium-sized enterprises are located here, and the business sector is the largest source of funding for research and development in this region. On the contrary, the least funds flow from private non-profit organizations, which have the lowest representation in the other regions as well. The governmental sector provides this region the lowest contribution compared to other Slovak regions.

The Bratislava region was the most supported region from governmental resources in 2020 when governmental finances made up almost half of the total resources. The Bratislava region is the region with the second highest number of small and medium-sized enterprises and the highest number of large enterprises; however, the funding support for research and development by this sector is the lowest among the Slovak regions, at the level of 30.97%. A significant share of funds comes from foreign sources. Foreign investors have been considering the Bratislava region the most attractive within Slovakia, therefore they have concentrated in this region.

In Central Slovakia, the ratio of finance from business and governmental resources is relatively balanced. Financial resources spent in these sectors are around 41%. A relatively high percentage of resources came from universities.

There are seven universities in Central Slovakia, but there are eleven universities in the Bratislava Region. If funding is compared, Central Slovakia spends three times more funds compared to the Bratislava Region. In the Bratislava Region, private non-profit organizations participate in the support of R&D to the highest extent among the regions.

Eastern Slovakia invests the least funds in R&D. The structure of funding in Eastern Slovakia mainly comes from business and governmental sources. A relatively high share, almost 17%, comes from foreign sources, which is only 1% less than in the Bratislava region.

In the territory of Slovakia, the field of technical sciences received the largest share of the total funds provided. The main content of technical sciences is research in the field of technical systems, their analysis and prediction of the development of new processes and objects. This group includes a whole range of industries, such as construction, engineering, information and communication technologies, and electrical engineering. These sectors are the most represented in Slovakia, therefore this area is financed to the greatest extent. The largest amount of funds invested in technical sciences was identified in Western Slovakia. The second most supported scientific field in Western Slovakia is agriculture, with a key impact on the quality of life.

The natural sciences include sciences such as mathematics, physics, chemistry, biology, and many other sciences that deal with the functioning of the Earth. In 2020, this scientific area was the most funded in the Bratislava region, which has nine faculties focusing on natural sciences, which is the most among the monitored regions. A significant volume of funds was allocated to technical sciences. Medical sciences, together with social sciences and humanities are significantly more represented in comparison with other regions. The least supported scientific area in the Bratislava region were agricultural sciences.

As in the majority of the monitored regions, also in Central Slovakia, the field of technical sciences is financed the most. Compared to other scientific areas in this region, technical sciences exceed them by ten times on average. Humanities in Central Slovakia received the lowest financial support. The presence of the Faculty of Medicine in Martin may be the reason that the medical sciences with priorities such as human health, diagnosis and treatment of diseases, were the second most funded area.

In Eastern Slovakia, the least financially subsidized region, technical sciences attracted attention with the share of financial support. In the area of natural sciences, the funding was of the second highest amount preceded by the Bratislava region. Other scientific fields were funded at approximately the same level.

The funding of research and development is directly related to the human resources employed in R & D. According to the Eurostat database, the number of researchers in the European Union has been increasing. The total number of researchers in Slovak regions has been increasing annually. In 2020, the number represented 22,404.6 FTE equivalent. Both sexes were represented among the researchers, but male representation prevails, at approximately 61%.

In 2020, 45.6% of researchers in Slovakia were concentrated in the higher education sector. The second most represented sector was the business sector (35.9%). The governmental sector has employed 4,127 researchers (18.4%). The least represented was the non-profit sector, with as little as 0.05% of the total number of researchers. The total of employees in all R&D branches in Slovakia represented 0.81% of the total workforce. The average of the European Union is at the level of 1.44%. Slovakia thus placed itself below the EU average, while at the same time showing the worst results in the V4 grouping. The Czech Republic, as the only V4 country with a share of 1.54% of the total labor force in R&D, exceeded the European average.

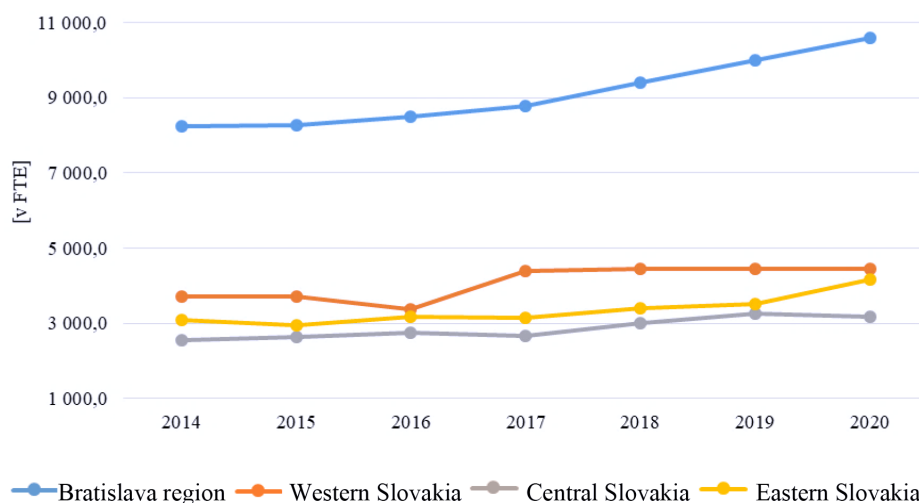


Figure 2. Development of the number of employees in R&D in the NUTS 2 regions in 2014-2020 [in FTE- full-time equivalent in person-years]

Source: Yearbook of science and technology of the Slovak Republic

The Bratislava region has been making significant progress compared to other NUTS 2 regions. For the monitored period 2014 – 2020, the number of R&D employees in FTE equivalent was growing continuously, while the highest number of employees (10,588.8) was located in the Bratislava region in 2020. The second place with the highest number of employees was taken by Western Slovakia. At the turn of 2016-2017, after a slight decline growth occurred, and 4,396 employees worked in R&D. Subsequently, a stagnation started, and from 2016 to 2020 only 56 workers had been added.

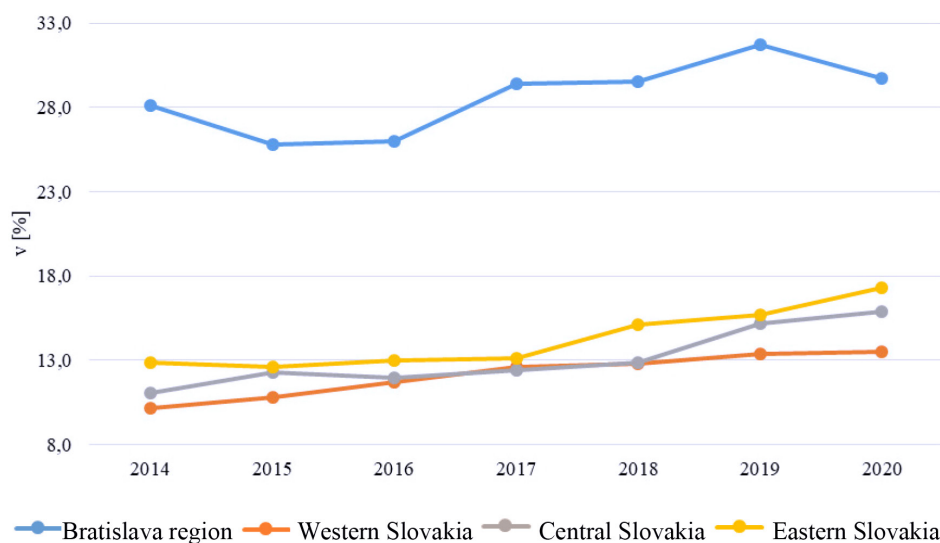


Figure 3. Human resources in science and technology (HRST) in NUTS 2 regions 2014 – 2020 [in %]

Source: Eurostat

In Eastern Slovakia, the number of employees in R&D did not vary significantly during the monitored period. In 2017, a visible slight increase in the number of R&D employees began, and in 2020 it crossed the threshold of four thousand employees for the first time, bringing it closer to the level of Western Slovakia.

During the monitored period, Central Slovakia has been the region with the lowest share of R&D employees. The highest number in the region was recorded in 2019 (3,255.3). In 2020, there was a decrease in the number of employees (3,187.4).

Human resources in science and technology (HRST) consist of persons who successfully graduated from III level of university education or persons who have been working in science and technology in spite they did not graduate from the III level of university education.

Figure 3 demonstrates the percentage of the human resources employed in science and technology from the total workforce in the NUTS 2 regions. The leading region is the Bratislava region, mainly due to the high concentration of HRST in this region. The second highest percentage of human resources in science and technology is located in Eastern Slovakia.

Most probably the technical universities located in Bratislava and Košice have been an attractor for HRST. In 2017, Western Slovakia, Central Slovakia and the Eastern Slovakia regions achieved almost the same level of employment of HRST. The Bratislava region was ranked above the EU average, however from an overall aspect, Slovakia was placed on the lowest ranks and the percentage of HRST in the total workforce is at the level of 17.3%.

When Slovakia would like to maintain and promote a high-quality workforce in R&D, it is necessary to set up more suitable conditions for future employees even during their university studies. The lack of researchers in Slovakia has been caused by the neglect of education funding in recent years. This resulted in a situation where a large number of smart students had decided to depart abroad for a better life and work conditions. Unfortunately, they do not utilize the acquired knowledge and skill in favor of the R&D in the home country.

5. FUTURE TRENDS IN RESEARCH

Future trends in research should focus on aspects linked to the deployment of human resources in regions. The deployment of secondary school leavers and university graduates qualified for the requirements of regional labor markets is not fully utilized as a relatively high percentage of them migrate to regions with better quality of life levels and well-paid job opportunities, some of them leaving the country and search jobs abroad. The employment rate differs between regions and within the regions. The essential factors such as the necessity to innovate educational processes and the preparation of the R&D sector staff should be highlighted.

The necessity to innovate educational processes in Slovakia is also visible on the example of other EU Member States. The EU countries, following the path of education upheaval and transformation, have been producing a large number of experts, spending incomparably more funds on R&D, and are thus generating suitable conditions and environments in order to retain university graduates. Countries investing huge amounts of funding in innovation, research and development have started to strengthen a more prosperous and competitive economy.

The further development of vocational education of employees at productive age is mainly influenced by the requirements of employers in the labor market. The criterion of success and effectiveness of adult education is assessed and measured in terms of “become a successful applicant in the labor market.” It should be probably changed to the criterion of “be employed as a successful applicant with knowledge and skills that could be transposed to related professions”.

Another problem that Slovakia has been facing, and which cannot remain unnoticed in the future, is a certain imbalance between the demand from companies and the supply of graduates. In terms of innovative activities, the Slovak labor market is still not sufficiently prepared for industrial revolution 4.0.

The problem of regional disparities cannot be seen only as economic differences between regions, as there are also significant intraregional differences within a region. Regional differentiation in Slovakia has been increasing over the last 30 years and has reached a level known as regional polarization or regional disparities. Neither the funding from EU structural and investment funds could have reduced the economic and social differences since 2004. The research should focus on the assessment of the benefits of EU funds in relation to the development of human capital regions.

6. CONCLUSION

Trends are reflected in the numbers of pupils attending secondary grammar schools and secondary vocational schools, and the numbers of students enrolled in universities. The university graduates could generally contribute to the economic progress of the country and provide added value to the economic performance in regions. However, over years, there has been a huge phenomenon of brain drain.

We consider the human potential in regions the most important factor in the sustainable growth of regions in Slovakia. Employees of productive age deserve special attention from their employer, especially the vocational training, and acquisition of necessary knowledge and skills, including digital skills.

However, vocational adult education is mainly influenced by the requirements of employers in the labor market. The criterion of success and effectiveness of adult education is assessed and measured in terms of “become a successful applicant in the labor market.” A special problem in Slovakia is represented by the digital skills of adults and the ability to solve problems in the IT environment. The digitization index (DESI index) in the human capital component contains an indicator for the rate of basic skills in the population aged 16-74, where Slovakia reaches a level below the EU average. The acquisition of basic digital skills are essential for further education (e.g. online courses), effective involvement of citizens in the functioning of the state (e-government, e-health) and self-governing regions and prevention of further marginalization of vulnerable groups.

These disparities are also caused by the fact that graduates do not meet a certain level of expertise and skills, required by an employer. As a result, employers consider graduates unattractive and start headhunting persons demonstrating high-level quality expertise and skills. This causes inequality in the labor market, which results in the unemployment of graduates. With the onset of the 4.0 industrial revolution, the problem will refer to the expertise and skills of graduates as well as to digital skills which will be considered “a cornerstone” of digitization.

Industry 4.0 requires radical changes in education and industry. Technological knowledge and skills are important factors in the industrial revolution 4.0. With this in mind, different qualification requirements will be demanded from graduates. Above all, it is necessary to emphasize mathematics, informatics, analytical and critical thinking. This is the reason why in the near future the education ought to be changed in Slovakia and students should be developed in the above knowledge and skill, promoting the graduates to become attractive on the labor market, showing

the adaptability to requirements of newly arisen professions and jobs. Greater emphasis on the innovativeness of teaching should be put in the foreground of the governmental policy of education. New challenges have been demonstrated by new professions in the era of industry 4.0.

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