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Article

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Forecast of the Development of Sectors of the National Economy in Slovakia

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Abstract

This paper aims to estimate the expected development of the share of employees in sectors of the national economy in selected regions of Slovakia (Bratislava, Košice, and Prešov Regions) and in the Slovak Republic as a whole up to 2025. It also predicts which sectors of the national economy (primary, secondary, tertiary or quaternary) will grow in Slovakia in 2020–2025 and which sectors will stagnate or decline. The results predict a steadily declining share of people employed in the primary and secondary sectors in Slovakia and in the self-governing regions investigated. In contrast, the share of the quaternary sector in total employment is likely to increase up to 2025 both in Slovakia and in the Bratislava and Košice Regions. The share of employees in the tertiary sector is expected to grow in Slovakia, but at the same time it is confirmed that in the Bratislava Region there is a gradual reallocation of employees working in the services sector and an increase in the share of employees working in the quaternary sector at the expense of the tertiary sector. This expected development of the shares of employees in the individual sectors and, in particular, the increase in the share of employees in the quaternary sector are in line with the reallocation of the shares of employees in the sectors of the national economies of the developed EU countries, especially the countries of Western and Northern Europe.

Keywords

Sectoral Division, Sectoral Change, Share of Employees, Quaternary Economy, Employment Trends, National Economy

JEL Classification

J21, O11, O14

Introduction

In the current period, sectors of the national economy in Slovakia and worldwide will take some time to recover from the effects of the receding COVID-19 pandemic. It is therefore essential to have an idea of how the different sectors of the national economy will develop and to try adapting the labour market or the rules of support for enterprises affected by the COVID-19 pandemic to these anticipated trends. At the same time, the current positive impact of the COVID-19 pandemic in implementing technological changes across sectors cannot be overlooked. Klimovský et al. (2021) correctly suggest that the pandemic is an accelerator of digital transformation in public service delivery in general. Agostino et al. (2021) point out the example of Italian state museums, which have been pushed for years to adopt more effective digital tools to increase participation and a more efficient user engagement. Also, as a result of the COVID-19 pandemic, digital technologies, and social media particularly, have become a powerful tool for public service delivery when an onsite service cannot be provided. The benefits of online service delivery are, for example, broader audiences and new ways of interacting with users. Bokolo (2020) states that medical centres responded to COVID-19 through rapid adoption of digital tools and technologies such as telemedicine and virtual care which refer to the delivery of healthcare services digital or at a distance using Information and Communication Technology (ICT) for treatment of patients. Horvat et al. (2021) analysed the digitalisation of public administration in relation to delivery, speed of procedure, usage of new technologies in V4 countries to determine whether public administration practices during the COVID-19 pandemic were more dynamic compared to the pre-pandemic period. In all examples, it was found that the COVID-19 pandemic became one of the key accelerators of digital transformation in the branches or countries examined. At the same time, it should be noted that this impact, given the duration of the pandemic, has not yet

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been sufficiently explored to draw definitive conclusions.

Since the beginning of the 21st century, the share of employees working in sectors of the Slovak national economy has changed quite substantially. Both the number and the share of employees working in the primary sector have been declining year by year. Similarly, the number and the share of employees working in the secondary sector have also been declining, and the rate of decline of employees in these two sectors is higher than the rate of the overall decline of employees in Slovakia. The number and the share of employees in the tertiary sector have been stagnating in the long term, with the highest percentage of employees (36.8%) working in the tertiary sector in Slovakia in 2008. In the Slovak Republic, as in many other countries of the European Union, the total number of employees is decreasing, mainly due to the demographic structure of the population. The only sector in which the number and the share of employees have been systematically increasing, especially since 2008, is the quaternary sector, which is a very positive fact given high labour productivity in this sector. At the same time, each country in Europe and in the world, as well as each region, has different prerequisites for establishing an optimum ratio of employees in sectors of the national economy, given its history, natural conditions, education system, the structure and quality of universities, the presence of raw material resources, the development of tourism in the country, and so on. Precisely because of the specific features of individual countries, the paper also includes a comparison of the structure of the Slovak Republic's national economy with other countries of the European Union, but the research and the forecasts produced are focused on the Slovak Republic and its selected regions.

Literature Review

According to Mihaescu et al. (2009), national economy is a set of resources, production activities, trade, service etc. at a country's level, between which are established reciprocal links which ensures the operation and economic development of society. The structure of the national economy reflects its component elements, nature and the characteristics of these components, the role played by each element's position within the whole and the ties and their mutual interaction.

In the past, the sectoral structure of the national economy, consisting of three sectors (primary, secondary, and tertiary), was defined by Fourastié (1951), who evaluated it according to the number of people employed in different sectors. Fourastié, at the time when he developed his theory, assumed that the growing problems with the unemployment rate in the secondary sector would be solved by the tertiary sector, which would be able to absorb all unemployed labour force. At that time, labour productivity of the tertiary sector was low, which was offset by the considerable interest in quantitatively increasing the quantity of labour force. The tertiary sector was described as having minimal, or even no, technical progress and hence very little growth in labour productivity. Fourastié did not foresee the enormous development in information technology, through the advent of which the activities included in the tertiary sector have become many times more efficient. Due to this fact, labour productivity in the tertiary sector has increased considerably, as a result of which the absorptive capacity for job vacancies in the tertiary sector as a whole has been reduced. However, at that time, it was true that the tertiary sector contributed significantly to the stabilisation of the labour market. A significant increase in the tertiary sector during the 20th century in the world as well as the tendency to put importance on knowledge, technology, and innovation has led to extending the traditional range of economic sectors through a quaternary sector. The quaternary sector and its share of the total sectoral structure of the economy requires a highly skilled and educated labour and ability of the economy to effectively use the human, social and intellectual capital. "For this reason, it is possible to assume its higher representation in highly developed countries and eventually its growing importance over time and towards the future. An integral property of the quaternary sector is that, directly or indirectly, intentionally or unintentionally, immediately or with delay it will certainly affect the existing sectoral structure and productivity in all spheres of economic activities" (Kenessey, 1987).

The division of the national economy into 4 sectors is currently the most widely used. The first and historically oldest one is the primary sector. This sector covers the main branches of agriculture, mining and quarrying. It includes the production of plant and animal products, the extraction of minerals, including activities that prepare minerals for processing and sale. Currently, a high proportion of employees working in the primary sector is typical of developing economies. The exploitation of natural resources can be a way for a national economy to earn export earnings. The sale of oil, gas and other natural resources has enriched many developing economies, enabling some countries to raise capital to invest in public services within the economy. One of the problems with relying on the primary sector is that the wealth generated is often unevenly distributed. For example, a small number of companies gain a dominant position over the production of raw materials and pay workers only a small proportion of the income earned. An example is some African countries where many have remained poor despite being rich in raw materials. A strong primary sector alone is not enough to lead to economic development. The problem may arise if raw materials are depleted or the industrial branch declines and the economy is not sufficiently diversified (Salami et al., 2010).

The activities falling under the secondary sector are predominantly directly associated with the conversion of raw materials and semi-finished goods into finished products. In general, they cover the processes of manufacturing, processing, assembly and construction. They include industry, construction, water, electricity, gas, steam and air conditioning supply, including water collection and treatment, power generation, and water and power distribution. The secondary sector uses raw materials and converts them into finished products with higher added value, i.e. it deals with the use of raw materials from the primary sector and then these products are marketed primarily within the tertiary sector (Simandan, 2009). The activities of the secondary sector of the economy are no longer, as was the case in the primary sector, tied to the location of raw material resources and it is up to businesses to decide whether or not to move their production further away from a raw material source. Various factors enter this decision-making process, such as transport costs, availability of skilled labour, labour costs, legal, security and tax situation in the region, general attitude towards ecology and environmental protection, or the proximity of business partners or end customers. In addition to the advantages, this sector has some disadvantages, which are in some cases connected with pollution from manufacture or to dull and monotonous work in assembly workshops (Singer, 1987).

The tertiary sector of the economy includes all economic activities of an intangible nature, i.e., services intended for households, companies and the state to satisfy both individual and collective needs. It consists in providing services such as retail trade, wholesale trade, transportation, distribution, tourism and accommodation, catering, cultural, entertainment and recreational activities, public administration, and defence activities (Turečková and Martinát, 2015). Traditionally, countries with a strong tourism orientation have the highest share of employees working in the tertiary sector. Among the countries of the European Union, these are mostly touristic coastal countries.

The quaternary sector is historically the youngest and also began to appear in the works of authors around the world later than the other three sectors of the national economy. According to Kenessey (1987), it was the development of technology and the growing significance of the acquired knowledge and skills of human capital as well as the focus of companies on research and development that gave rise to the quaternary sector – the so-called knowledge sector. Mateides and Ďaďo (2002) point out that the science and public sector services have been moved from the tertiary sector to the quaternary sector. This includes health care, education, research and science, and activities that will have the largest growth rate in the future. The quaternary sector is a reflection of a knowledge-based economy. The share of the quaternary sector on the total sectoral structure of the economy requires a high-level skilled and educated labour and ability of the economies to use their human and intellectual capital effectively and correctly. That is why we can expect a higher share and a more dynamic development of the quaternary sector in advanced regions and countries in the following period of time. Economic activities and operations included in the fourth sector are like an engine of innovations, they create space for the emergence of new markets and branches and they are reflected in the original work and management, practices and methods. Therefore, the quaternary sector is important for current and future economic growth and qualitative development of the national economy and society at all (Turečková, 2014). Mallick (2015) agrees with this view of the paramount importance of the quaternary sector, stating that the development of the quaternary sector causes economic development. His study provides an important message that the quaternary sector, along with the tertiary sector, is crucial for economic growth and development. Hence, appropriate measures should be taken for the development of quaternary activities to achieve high economic growth and development.

Škrovánková (2017) states that the shares of people employed in different sectors of the national economy will change significantly in the coming years. It is already certain that in Europe (and also in Slovakia), due to demographic factors, the size of the productive population will decline, which will also cause a decline in the number of employees in most sectors of the national economy. In her opinion, the expected loss of a considerable number of employees in the primary sector may disrupt the country's economy, as Slovakia is classified as a rural country, characterised by the branches of the primary sector. The biggest changes in the number of people employed are likely to be in the secondary and tertiary sectors. This situation may lead to a partial threat to the national economy, as the largest employers are now active in the secondary sector. Positive changes can be expected in the quaternary sector, where the number of employees is expected to increase slightly.

The Slovak economy during 2007–2012 showed an example of the behaviour of sectors during rising unemployment levels in the economic crisis. Šiserová (2017) states that the secondary sector significantly responded to the adverse situation in the world during that period, and a significant drop in the number of employed people was reported in Slovakia as early as 2008–2009. It can be assumed that this was due to the global nature of the secondary sector, especially the industry in Slovakia, as the industry represents a truly vulnerable economic sector during the crisis. This was largely a decline in the number of employees in less sophisticated manufacturing, which is particularly sensitive to fluctuations in world markets. This was the main reason why Slovakia was the most affected country among the Visegrad Four countries during the 2008–2009 economic crisis. A strong focus on the automotive industry sidelined a more sophisticated manufacturing and made the Slovak economy more vulnerable.

Typology of Regions in Slovakia

The selected regions (self-governing regions in Slovakia) whose sectoral structure was investigated were chosen purposively. According to Isaksen (2001), policy-makers in a region should focus primarily on the local conditions and potential of the region. Each region has different prerequisites for successful development within individual sectors of the national economy. It is impossible to apply the same or even a similar approach to all regions on the basis of theoretical knowledge, regional innovation systems or education systems. Based on a specific approach, three types of regions have been defined (Tripl et al., 2014): 1). Peripheral regions - a typical peripheral region in Slovakia is the Prešov Region. Fáziková (2011) considers peripheral regions those which, due to their geographical remoteness, weakly developed economic base, sparse institutional network and a lower level of human and social capital, have problems with the creation of knowledge and its implementation in practice through innovation. Peripheral regions are characterised by low population density, fragmented settlement patterns, an economic base based on low value-added branches, and weakly developed technical and social infrastructure. The prolonged persistence of this situation consequently worsens the economic and social conditions in the peripheral regions. According to Tripl et al. (2014), the characteristic feature of peripheral regions is weakly developed, or even missing, innovation systems. A frequent feature is the lack of innovative firms, and a low level of subsidies for science and research. Peripheral regions are characterised by the dominance of SMEs in traditional sectors, partly focused also on agricultural activities. 2). Old industrial areas - a typical old industrial area in Slovakia is the Košice Region. The basic feature of this type of area is an over-specialisation in mature, mostly traditional sectors and often slightly out-dated technologies. The capacity to generate innovation is largely limited and supporting organisations tend to be strongly concentrated on traditional industries. 3). Metropolitan regions - there is no standard metropolitan region in Slovakia. The closest in type is certainly the Bratislava Region, which also meets some of the attributes of a metropolitan region. As a result of networking and constant exchange of knowledge, the metropolitan region is sometimes known for its fragmentation, manifested by insufficient levels of collective learning and systemic innovation activities. This type is found primarily in larger cities with too much diversity of sectors and innovation activities mainly in large firms, but often not meeting the high expectations of their owners and management. However, Rafaj and Rehák (2017) state that when it comes to local economic growth, much attention is currently focused on metropolitan regions because they play a key role in the economy, especially due to the high concentration of economic actors that locate in close proximity. They intensively interact with each other and carry out various economic activities. According to classical theories dealing with agglomeration advantages (Jacobs, 1970; Marshall, 2013), metropolitan regions are attractive to firms because they provide them with various advantages, such as a large labour supply, a wide choice of specialised suppliers and customers, and allow knowledge spillovers between them (the so-called spillover effects).

Methods and Creation of Baseline and Applied Models

In order to assess the impact of individual sectors on the unemployment rate during the period considered, the average number of people employed in these sectors was used as the indicator. It is important to note that during the period considered (2001–2019), the methodology for reporting the average number of people employed in individual sectors have changed slightly. Until 2009, only data of enterprises with more than 20 employees were taken into account in statistical reports. From 2010, data from all enterprises were considered. Also, employees of the Armed Forces were not part of the statistical surveys until 2006. In 2007, the Slovak Republic issued the Decree of the Statistical Office of the Slovak Republic of 18 June 2007 issuing the Statistical classification of economic activities, which entered into force on 1 January 2008. The Decree changed the Statistical branch classification of economic activities (OKEČ), in force until then, for the Statistical classification of economic activities (SK NACE Rev. 2), which is still in force in the European Union countries, including Slovakia (SLOV-LEX, 2007). The creation of “NACE Rev.2 – Statistical classification of economic activities in the European Community” was an important milestone for establishing a uniform classification of in the statistical collection and comparison of data in the European Union as well as in a wider geographical context (European Communities, 2008). The economic activities within OKEČ and NACE Rev.2 classifications are compared in Table 1 including a detailed analysis of economic activities, with a comparison of economic sectors in which they are classified (Burger and Šlampaiová, 2021).

To determine the forecast of the development of the share of sectors of the national economy – primary, secondary, tertiary, and quaternary – for the Slovak Republic and the Košice, Prešov, and Bratislava Regions, RStudio forecasts were chosen. In total, 16 separate modelling processes were created and for each of them reliable future values of the development of sectors of the national economy were obtained for each selected geographical region up to 2025.

Table 1. Comparison of OKEČ and NACE Rev.2 classifications.

OKEČ (2001-2007)			NACE Rev 2. (2008-2021)	
PRIMARY SECTOR				
Mode of production/ Extractive	Technology/ Craft	Methodology/ Trial and error	Time perspective/ Orientation to the past	Detailed theoretical classification/ Agriculture, Forestry, Fishing, Mining and quarrying
A Agriculture, hunting and forestry			A Agriculture, forestry and fishing	
B Fishing, fish farming			B Mining and quarrying	
C Mining and quarrying				
SECONDARY SECTOR				
Mode of production/ Fabrication	Technology/ Machine technology	Methodology/ Experimentation	Time perspective/ Ad hoc adaptiveness	Detailed theoretical classification/ Manufacturing, Processing of raw materials, Construction
D Manufacturing			C Manufacturing	
E Electricity, gas and water supply			D Electricity, gas, steam and air-conditioning supply	
			E Water supply; sewerage, waste management and remediation activities	
F Construction			F Construction	
TERTIARY SECTOR				
Mode of production/ Processing, recycling	Technology/ Intellectual technology	Methodology/ Simulations, models, decision theory	Time perspective/ Future orientation – forecasting and planning	Detailed theoretical classification/ All services, excluding services related to the creation and sharing of knowledge and information
G Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods			G Wholesale and retail trade; repair of motor vehicles and motorcycles	
H Hotels and restaurants			H Transportation and storage	
I Transportation, storage and telecommunications			I Accommodation and food service activities	
K Real estate, renting and business activities, research and development			L Real estate activities	
L Public administration and defence; compulsory social security			O Public administration and defence; compulsory social security	
O Other community, social and personal service activities			R Arts, entertainment and recreation	
P Private households with domestic staff			S Other services	
Q Extra-territorial organisations and bodies			T Activities of households as employers	
			U Activities of extraterritorial organisations and bodies	
QUATERNARY SECTOR				
Mode of production/ Processing, recycling	Technology/ Intellectual technology	Methodology/ Simulations, models, decision theory	Time perspective/ Future orientation – forecasting and planning	Detailed theoretical classification/ Services related to the creation and sharing of knowledge and information
J Financial intermediation			J Information and communication	
M Education			K Financial and insurance activities	
N Health and social work			M Professional, scientific and technical activities	
			N Administrative and support service activities	
			P Education	
			Q Human health and social work activities	

Source: Own elaboration based on Bell (1976); European Commission (2008); Turečková and Martinát (2015); Burger and Šlampaiková (2021).

One research question was set:

What is the expected development of the share of employees in individual sectors of the national economy up to 2025 in selected self-governing regions in Slovakia and in the Slovak Republic as a whole?

As part of the examination within the research question, other additional facts related to it were also investigated. It was investigated which of the sectors of the national economy, measured by the share of employees working in it, will grow most dynamically in Slovakia in 2020–2025 and which will stagnate or decline. In addition to the Slovak Republic as a whole, this fact was also examined in selected regions of the Slovak Republic, namely in the Bratislava, Košice, and Prešov Regions.

The data used for these variables were collected from the Statistical Office of the Slovak Republic and Eurostat for 2001-2019. The data on economic activities were classified into individual sectors based on the theoretical definition according to Bell (1976); European Commission (2008); Turečková and Martinát (2015); and Burger and Šlampaiková (2021).

An econometric model with six variables was chosen. The model consisted of the response, dependent variable “Average Registered Number of Employees” (in the number of persons), designated as “EMPL”. Five explanatory, independent variables were also selected. The first one is “Gross Value Added”, designated as “GVA”, in basic prices (in millions of €). The regional gross value added represents the individual quantification of GVA for branches, according to SK NACE Rev.2 classification in a selected region. The second independent variable is “Wages and Wage Compensation” (in thousands of €), designated as “WAGES”. The third independent variable is “Number of Enterprises” – “ENT” (in pieces). The fourth explanatory variable is “Average Number of Job Vacancies”, designated as “JV” (again in pieces). The last variable is “Gross Fixed Capital Formation” at current prices (in millions of €) – “FCF” and represents the acquisition of fixed assets, less disposals of fixed assets, i.e. the sales of these assets by producers during the year. Each of these variables is shown in combination with a numerical designation by sector as follows: 1 - primary sector, 2 - secondary sector, 3 - tertiary sector and 4 - quaternary sector.

Thus, the baseline model had the following form:

$$\text{EMPL} = \beta_0 + \beta_1 * \text{GVA} + \beta_2 * \text{WAGES} + \beta_3 * \text{ENT} + \beta_4 * \text{JV} + \beta_5 * \text{FCF} + u_t \quad (1)$$

The model was subjected to a t-test of coefficients, along with HAC correction, i.e. standard deviations without a burden to heteroskedasticity and autocorrelation. This means that if the HAC correction was not applied and there was a problem with the presence of autocorrelation or heteroskedasticity in the model, the standard deviations of β coefficient estimates could be biased, i.e., it could be assumed that the statistical significance of the variable is not correctly determined. In many cases, the results showed statistical insignificance for some variables that were determined using p-values. The p-values were compared with the specified significance level of $\alpha=0.05$, on the basis of the following hypotheses:

H0: The regression coefficient is not statistically significant, and

H1: The regression coefficient is statistically significant.

After estimating the regression coefficients, information was also obtained which β coefficients were positive – showing a positive dependence between the explanatory variable and the response variable EMPL, and which were negative – showing a negative dependence between the variables. Since the test of the coefficients in many cases showed statistically insignificant variables, we selected the model according to the AIC (Akaike Information Criterion) in a stepwise algorithm. Since this criterion is referred to as the so-called minimization criterion, the model that has the lowest value of these criteria is selected as the most correct one. The new model was again subjected to tests for correct model specification and significance. This completed the analysis and specification of the model, as the most appropriate model was found and then it was possible to move on to the forecasting application of the model.

To prepare the forecast of the development of the share of employees in the sectors of the national economy up to 2025 in Slovakia, ex-post and ex-ante forecasts were made. The ex-post forecast makes forecasts for values of the explanatory variable that are known but have not been used to estimate the model. In the ex-ante forecast, forecasts were made for values of the explanatory variable that are not yet known and therefore need to be found. The ex-post forecast makes predictions for values of the EMPL variable that have not been used to estimate the model. Therefore, the dataset was split into two samples – the training set (on which we estimate the model) and the test set (on which we use the estimated model to predict the response variable). The most commonly used ratio is 80:20, where 80% of the total data serve as the training set on which the model is estimated and 20% of the data constitute the test set. However, in this case, the predictive ability of the model was tested 1,000 times for maximum efficiency using a repetition cycle. This method was used to check whether the model equation works equally optimally when trained and tested on different samples of the data. A 1,000-fold cross-validation was made and the data were divided into 1,000 mutually exclusive samples, which in turn produced 1,000 linear models, where one of these samples was kept as a test sample and the remaining data

were used to train the model, for which MSE (Mean Squared Error) was calculated. Next, the model was estimated using the training sample and predictions were made using the test sample. The accuracy of the forecasts was verified through several metrics – correlation, MAE (Mean Absolute Error), MSE (Mean Squared Error), RMSE (Root Mean Square Error), and MAPE (Mean Absolute Percentage Error) were used. The results of these metrics should be as low as possible, which was the case in all 16 modelling runs. In all 16 cases, the model error was within 5%. When using cross-validation technique, it was also necessary to check that the accuracy of the predictions for such a large number of models (1,000) did not vary significantly, as well as that the slopes and levels of the linear lines of the models did not vary. After this check, the ability of the model to successfully predict values was demonstrated and ex-ante forecasts could be started. The final output was the forecast values for employment in each sector for individual regions for 2020–2025.

The baseline and applied models in all four sectors and in all four regions investigated are shown in Table 2.

Table 2. Baseline and applied models used in each sector.

Slovak Republic	
Primary sector: Baseline model	$EMPL1 = 69417 + -9.241 \cdot GVA1 + 0.192 \cdot WAGES1 + -11.501 \cdot ENT1 + -17.732 \cdot JV1 + -17.256 \cdot FCF1$
Primary sector: Applied model	$EMPL1 = -69644 + -70.967 \cdot GVA1 + 0.932 \cdot WAGES1 + -8.759 \cdot ENT1 + -6.572 \cdot FCF1 + 0.0157 \cdot I(GVA1^2) + -0.000000796 \cdot I(WAGES1^2)$
Secondary sector: Baseline model	$EMPL2 = 319650 + -3.742 \cdot GVA2 + 0.037 \cdot WAGES2 + -0.947 \cdot ENT2 + 16.166 \cdot JV2 + -1.211 \cdot FCF2$
Secondary sector: Applied model	$EMPL2 = 314960 + -3.484 \cdot GVA2 + 0.0302 \cdot WAGES2 + 16.095 \cdot JV2$
Tertiary sector: Baseline model	$EMPL3 = 308910 + -0.055 \cdot GVA3 + 0.036 \cdot WAGES3 + -1.182 \cdot ENT3 + 3.061 \cdot JV3 + 8.874 \cdot FCF3$
Tertiary sector: Applied model	$EMPL3 = 409770 + 0.037 \cdot WAGES3 + 1.453 \cdot ENT3$
Quaternary sector: Baseline model	$EMPL4 = 297460 + 2.189 \cdot GVA4 + 0.044 \cdot WAGES4 + -1.269 \cdot ENT4 + -37.83 \cdot JV4 + 9.588 \cdot FCF4$
Quaternary sector: Applied model	$EMPL4 = 337440 + 0.036 \cdot WAGES4 + -43.324 \cdot JV4$
Košice Region	
Primary sector: Baseline model	$EMPL1 = 4131.443 + -6.791 \cdot GVA1 + 0.239 \cdot WAGES1 + -9.147 \cdot ENT1 + 31.867 \cdot JV1 + -12.431 \cdot FCF1$
Primary sector: Applied model	$EMPL1 = 144600 + 0.109 \cdot WAGES1 + -0.738 \cdot ENT1 + 1.412 \cdot I(ENT1^2) + -0.0012 \cdot I(ENT1^3) + 0.00000037 \cdot I(ENT1^4)$
Secondary sector: Baseline model	$EMPL2 = 46068 + -5.311 \cdot GVA2 + -0.0038 \cdot WAGES2 + 2.785 \cdot ENT2 + 14.925 \cdot JV2 + 18.659 \cdot FCF2$
Secondary sector: Applied model	$EMPL2 = 45897.144 + -5.588 \cdot GVA2 + 2.941 \cdot ENT2 + 21.785 \cdot FCF2$
Tertiary sector: Baseline model	$EMPL3 = 58914 + -3.159 \cdot GVA3 + 0.047 \cdot WAGES3 + -1.662 \cdot ENT3 + -2.522 \cdot JV3 + -0.665 \cdot FCF3$
Tertiary sector: Applied model	$EMPL3 = 55182 + 0.0449 \cdot WAGES3 + -2.276 \cdot ENT3$
Quaternary sector: Baseline model	$EMPL4 = 20432 + 0.143 \cdot GVA4 + 0.033 \cdot WAGES4 + -1.459 \cdot ENT4 + 0.262 \cdot JV4 + 2.533 \cdot FCF4$
Quaternary sector: Applied model	$EMPL4 = 20470 + 11.95 \cdot GVA4 + 0.024 \cdot WAGES4 + 31.4 \cdot JV4$
Bratislava Region	
Primary sector: Baseline model	$EMPL1 = 2953.59 + -3.247 \cdot GVA1 + 0.042 \cdot WAGES1 + -0.513 \cdot ENT1 + 4.518 \cdot JV1 + -13.929 \cdot FCF1$
Primary sector: Applied model	$EMPL1 = 5054.932 + -32.457 \cdot GVA1 + 0.045 \cdot WAGES1 + 0.066 \cdot I(GVA1^2)$
Secondary sector: Baseline model	$EMPL2 = 32256 + -5.49 \cdot GVA2 + 0.047 \cdot WAGES2 + -1.7261 \cdot ENT2 + 3.8054 \cdot JV2 + 5.5814 \cdot FCF2$

Secondary sector: Applied model	$EMPL2 = 32256 + -5.49 * GVA2 + 0.047 * WAGES2 + -1.7261 * ENT2 + 3.8054 * JV2 + 5.5814 * FCF2$
Tertiary sector: Baseline model	$EMPL3 = 71717 + 0.0165 * GVA3 + 0.034 * WAGES3 + -0.417 * ENT3 + 1.204 * JV3 + 0.107 * FCF3$
Tertiary sector: Applied model	$EMPL3 = 78380 + 0.036 * WAGES3 + -0.495 * ENT3$
Quaternary sector: Baseline model	$EMPL4 = 4.229 + 6.199 * GVA4 + 0.019 * WAGES4 + 0.085 * ENT4 + 13.814 * JV4 + 3.699 * FCF4$
Quaternary sector: Applied model	$EMPL4 = 37040 + 4.226 * GVA4 + 0.022 * WAGES4$

Prešov Region

Primary sector: Baseline model	$EMPL1 = 13500 + -3.939 * GVA1 + 0.175 * WAGES1 + -10.69 * ENT1 + -24.03 * JV1 + -25.66 * FCF1$
Primary sector: Applied model	$EMPL1 = 1610500 + 0.06372 * WAGES1 + -6920 * ENT1 + 11.899 * I(ENT1^2) + -0.0102 * I(ENT1^3) + 0.00000435 * I(ENT1^4) + -0.00000000741 * I(ENT1^5)$
Secondary sector: Baseline model	$EMPL2 = 27799 + -6.601 * GVA2 + 0.086 * WAGES2 + -2.934 * ENT2 + 26.14 * JV2 + 3.046 * FCF2$
Secondary sector: Applied model	$EMPL2 = 28603 + -5.873 * GVA2 + 0.091 * WAGES2 + -3.759 * ENT2 + 25.915 * JV2$
Tertiary sector: Baseline model	$EMPL3 = 33844 + -5.068 * GVA3 + 0.0535 * WAGES3 + 0.282 * ENT3 + 1.071 * JV3 + 0.826 * FCF3$
Tertiary sector: Applied model	$EMPL3 = 34454 + 3.903 * GVA3 + 0.0533 * WAGES3$
Quaternary sector: Baseline model	$EMPL4 = 33075 + -3.288 * GVA4 + 0.06 * WAGES4 + -2.162 * ENT4 + 6.852 * JV4 + -7.41 * FCF4$
Quaternary sector: Applied model	$EMPL4 = 32290 + 0.073 * WAGES4 + -4.531 * ENT4$

Source: Own elaboration.

Results

Before looking at the results of the forecasts for sectors of the national economy in Slovakia and in the regions investigated up to 2025, it is important to look at the shares of sectors of the national economy in the EU countries. There are a number of countries in the European Union with a much higher level of competitiveness as well as innovation performance than in Slovakia. The shares of individual sectors measured by the number of employees in these countries can also be a guide for Slovakia and its regions which the path to follow in supporting specific sectors. At the same time, it is also necessary to point out the limitations of this comparison. Each country has a large number of differences (history, raw material resources, business environment, education level and system, human capital level), so it is impossible to transfer and copy identically the system of the position of individual sectors from any country. But it is certainly possible to look at the most economically advanced EU countries and see how they have set the share of employees in each sector and try learning something from that comparison, or try adapting it to the conditions of the Slovak Republic and its regions.

Analysis of the Number of People Employed in Individual Sectors in the European Union Countries

When analysing the shares of employees working in individual sectors in Slovakia and in selected Slovak regions, a comparison with the situation in the EU countries appears useful. The share of people employed in individual sectors in percentage is shown in Table 3.

When analysing the sectors by number of people employed in them in 2017 in European Union countries, it can be seen that countries with a high share of people employed in the primary sector – Romania (24.2%) and Bulgaria (19.5%) – are the countries that are less innovative and developed within the EU countries. As regards the share of people employed in the secondary sector, only three countries have this share above or equal to 30% – the Czech Republic (36%), Slovakia (31.2%), and Poland (30%). At the same time, these three countries with a strong secondary sector were below the EU average in terms of performance measured as GDP per capita in 2017. A very high number of people employed in the tertiary sector was predominantly in countries with significant profits from tourism (Cyprus 50.3%, Greece 49.4%, Spain 47.8%, Italy 42.3%), but their GDP per capita is below the EU average. Conversely, countries with the highest number of people employed in the quaternary sector, such as the Netherlands (48.4%), Luxembourg (46.8%), Belgium (46.4%) Sweden (45.6%), the United Kingdom (44.6% – in 2017, the United Kingdom was part of the European Union), Denmark, and

France (42.5), also had GDP per capita well above the EU average. In Slovakia, the secondary sector is more dominant and the quaternary sector is partially subdued when compared to the EU average. Also, GDP per capita in Slovakia is significantly lower than the EU average.

Table 3. Share of people employed in individual sectors in % and GDP at market prices per capita in € in 2017.

Countries	Share of people employed in the primary sector in % (2017)	Share of people employed in the secondary sector in % (2017)	Share of people employed in the tertiary sector in % (2017)	Share of people employed in the quaternary sector in % (2017)	Gross domestic product at market prices per capita in € (2017)
European Union – 28 countries	4.7	21.4	38.1	35.8	27,780
Belgium	1.3	17.4	34.9	46.4	35,330
Bulgaria	19.5	24.4	35.1	21.0	6,310
Czech Republic	3.6	36.0	34.9	25.5	17,200
Denmark	2.5	16.9	38.0	42.5	47,360
Germany	1.5	24.0	36.4	38.1	35,420
Estonia	4.2	27.9	38.3	29.6	14,440
Ireland	5.5	17.7	38.9	37.9	54,240
Greece	11.4	14.0	49.4	25.2	17,410
Spain	4.2	17.2	47.8	30.8	24,410
France	2.8	16.5	38.2	42.5	32,370
Croatia	7.3	26.0	40.1	26.7	11,500
Italy	3.8	22.8	42.3	31.1	26,500
Cyprus	3.8	16.6	50.3	29.3	23,120
Latvia	7.6	22.8	40.5	29.1	11,560
Lithuania	7.9	24.9	38.7	28.4	12,720
Luxembourg	0.9	18.7	33.6	46.8	82,550
Hungary	4.4	27.5	39.4	28.7	11,930
Malta	1.5	17.4	40.8	40.3	20,850
Netherlands	2.3	14.2	35.2	48.4	40,730
Austria	4.0	22.3	38.7	35.0	37,090
Poland	11.4	30.0	33.5	25.0	11,820
Portugal	9.2	22.7	38.1	30.0	17,650
Romania	24.2	29.1	30.0	16.7	8,320
Slovenia	7.7	29.0	31.1	32.2	19,430
Slovakia	2.7	32.4	34.7	30.2	14,970
Finland	3.8	22.2	33.0	40.9	36,270
Sweden	2.2	19.8	32.4	45.6	43,350
United Kingdom*	1.5	16.1	37.8	44.6	32,460

* **Note:** Throughout the preparation of the paper, including the processing of statistical data, the United Kingdom was part of the European Union. **Source:** Eurostat (2019a), (2019b); own calculation.

Forecasts of the Number of Employees in Individual Sectors in Slovakia and its Self-governing Regions

The forecasts of the share of people employed in the primary sector are in line with expectations. The low share of employees working in the primary sector currently is typical for a number European countries (see Table 3). As a higher share of employees working in the primary sector is more typical for peripheral regions, the estimated significant decline in the share of employees working in the primary sector in the Prešov Region is somewhat surprising. The decline in the share of employees in the primary sector in the Košice Region, in whose territory the Eastern Slovak Lowland and the Tokaj Wine Region are located, which offer interesting opportunities for the development of the Košice Region's economy within the primary sector, is also partly surprising.

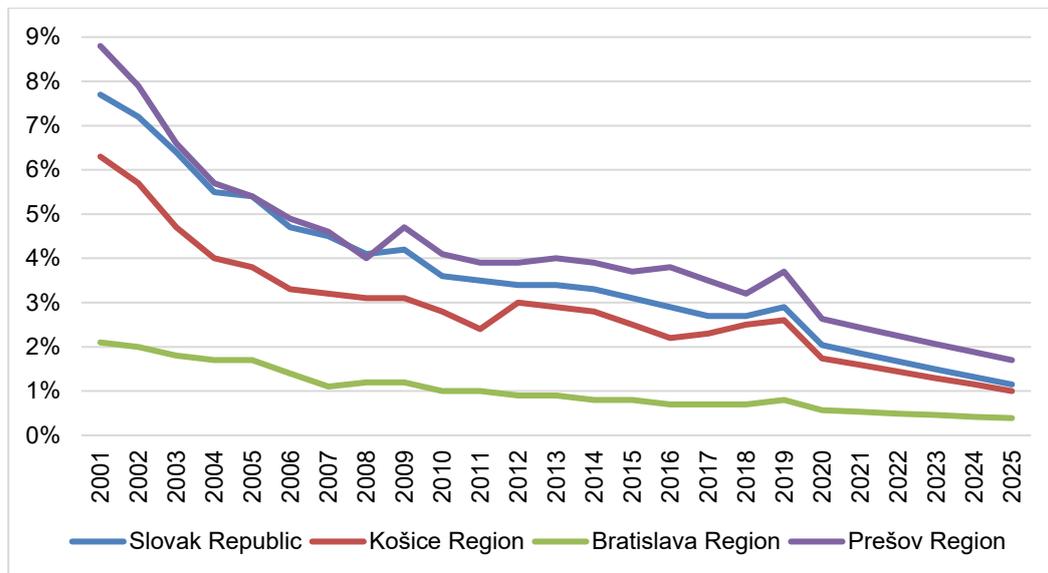


Fig. 1. Share of people employed in the primary sector in %.

The share of employees in the secondary sector in Slovakia is among the highest in the European Union. According to the forecast, this share will slightly decline up to 2025, nevertheless, the secondary sector will remain a relatively stable pillar of the Slovak economy. When comparing the Slovak Republic and its individual regions, it is evident that the share of employees employed in the secondary sector is considerably lower in the Bratislava Region than in the other compared regions in Slovakia. Conversely, in the Bratislava Region, the services sectors – i.e., the tertiary sector and especially the quaternary sector – dominate more than in the other regions and in the Slovak Republic as a whole.

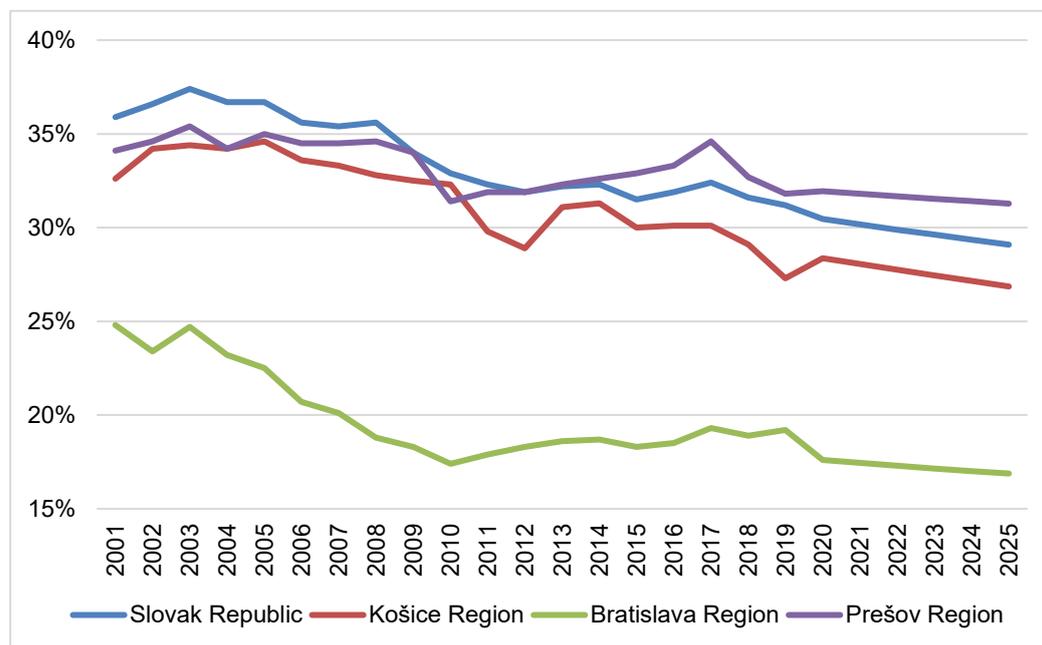


Fig. 2. Share of people employed in the secondary sector in %.

The share of employees in the tertiary sector in Slovakia is the highest in the long term, but it is expected to increase only slightly in 2020–2025. In the Bratislava Region, the share of employees in the tertiary sector is even expected to decline, and to gradually shift to the quaternary sector. In other regions, especially in the Prešov Region, on the other hand, a relatively massive increase in the number of jobs in the tertiary sector is expected. The Prešov Region has a high long-term potential of growth, especially in tourism (the presence of the highest mountains in Slovakia – the High Tatras, the Pieniny National Park, and the Poloniny National Park), and of further job creation in the tertiary sector.

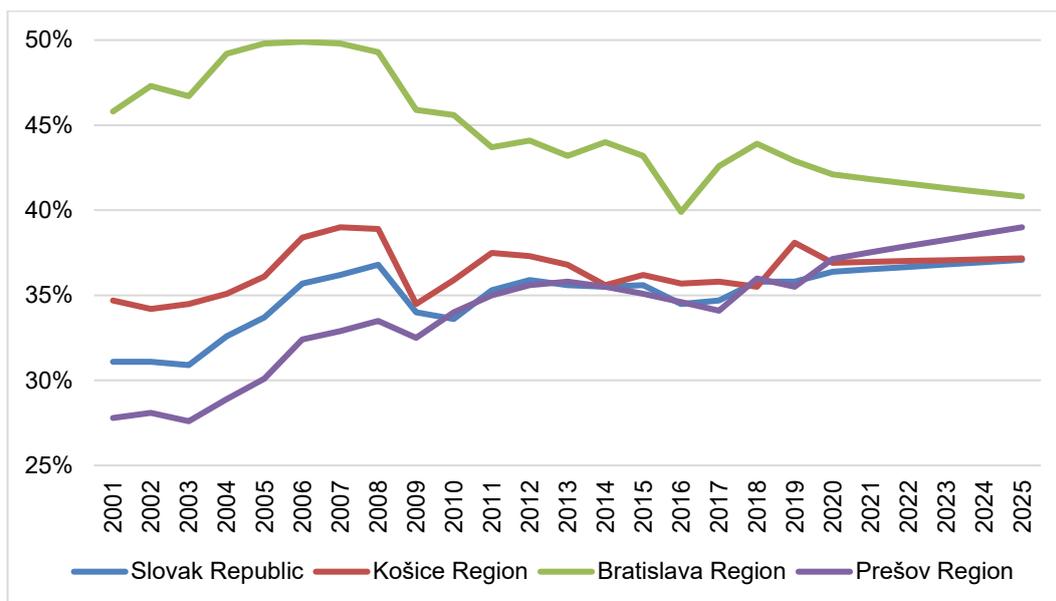


Fig. 3. Share of people employed in the tertiary sector in %.

According to the forecast, the quaternary sector in Slovakia is expected to have a relatively significant growth in the share of employees working in it in 2020–2025. Especially in the Bratislava Region, the quaternary sector could become dominant in the course of 2020–2025 in terms of the total share of jobs in the national economy as well as in terms of the number of newly created jobs. Moreover, this growth is stable and is not only part of the 2020–2025 forecast, but in the Bratislava Region, the Košice Region as well as in Slovakia it also reflects changes in the sectoral structure of the economy since as early as 2008. Major employers in the quaternary sector in the Bratislava Region already include many scientific research and educational institutions (institutes of the Slovak Academy of Sciences, a number of universities and R&D centres – some of them fall under the public sector and some under the private sector). Similarly, the vast majority of financial, banking and insurance institutions operating in Slovakia are headquartered in Bratislava. Another advantage of the Bratislava Region over the other regions in Slovakia is its formal and informal ties supported by physical proximity to the Austrian capital Vienna.

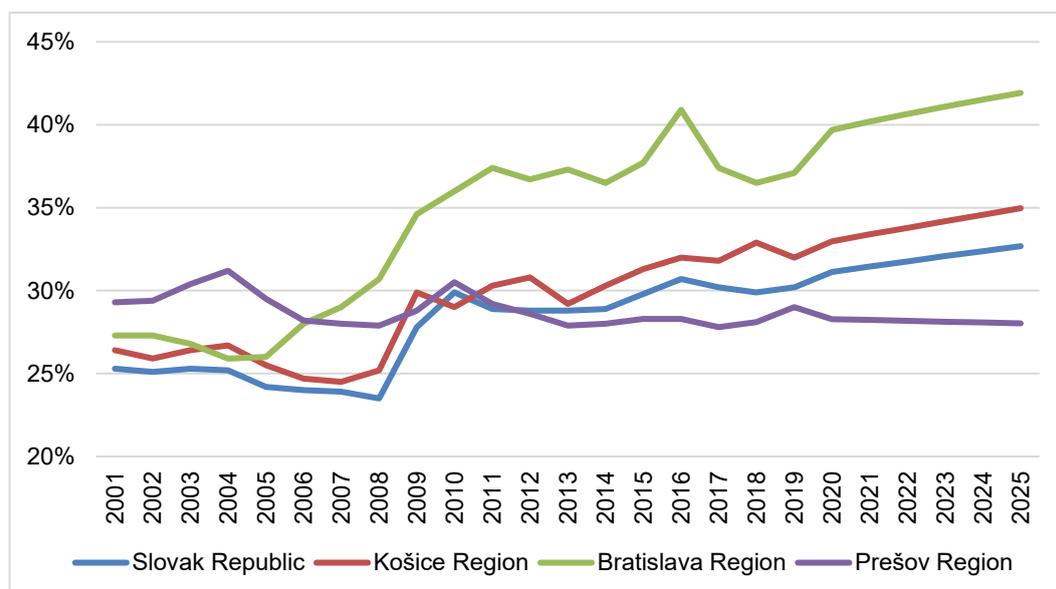


Fig. 4. Share of people employed in the quaternary sector in %.

Discussion and Evaluation of the Research Question

Part of the methodology of the paper was to determine the research question. The question was “What is the expected development of the share of employees in individual sectors of the national economy up to 2025 in selected self-governing regions in Slovakia and in the Slovak Republic as a whole?” The same research also investigated which of the sectors of the national economy, measured by the share of employees working in it, would grow most dynamically in 2020–2025 in Slovakia and in the selected self-governing regions and which, in contrast, would stagnate or decline.

When evaluating the research question, the estimated decline in the shares of sectors in total employment in 2020–2025 can be seen in the primary and secondary sectors. This decline in the shares can be seen both in the Slovak Republic as a whole as and in the regions investigated. The share of employment in the primary sector is estimated to decline in all regions investigated and in Slovakia up to 2025. While in 2001 this share was low in only the Bratislava Region, in 2025 this share is likely to be very low (less than 2.5%) in each self-governing region in Slovakia. In the secondary sector, the estimated values of the shares up to 2025 in Slovakia and also in the Košice and Prešov Regions differ significantly from the values of the share of the secondary sector in the Bratislava Region. In the Bratislava Region, the total share of employees working in the secondary sector has been much lower in the long term than in Slovakia and in other self-governing regions, and this situation will definitely persist in 2020–2025. The reason for this is Bratislava's position as a metropolitan region and this is supported by its proximity to the major European metropolis – the city of Vienna, which predisposes Bratislava and the Bratislava Region to focus on intensive-knowledge services much more than any other city in Slovakia. The share of employees in the tertiary sector is expected to increase slightly in the Slovak Republic and in the Prešov Region in 2020–2025, while in the Košice Region it is likely to rather stagnate and in the Bratislava Region even to decline up to 2025. In contrast, the share of employees in the quaternary sector is strongly expected to grow up to 2025, both in the Slovak Republic and in the Bratislava and Košice Regions. A slight decline within this sector is expected only in the Prešov Region. The estimated development can be assessed positively. The Slovak Republic as well as the self-governing regions within Slovakia lag significantly behind the developed countries and regions – especially in Western and Northern Europe – in the share of employees of the national economy working in the quaternary sector.

Conclusion

The role and importance of sectors to the national economy has changed over the last twenty years. The number of people employed in individual sectors and branches has also changed. Burger and Šlampačková (2021) find that the share of people employed in the primary sector has dramatically decreased in Slovakia over the past 70 years. While in 1948, 62% of all employees in Slovakia worked in the primary sector, in 2019 it was only 2.9%. The paper also points out that this share will continue to decrease up to 2025, both in the Slovak Republic and in all the self-governing regions investigated (Bratislava, Košice, and Prešov).

In 2017, the share of people employed in the secondary sector in Slovakia (32.4%) was the second highest among the European Union countries, after the Czech Republic. This high share of the secondary sector is expected to decline in 2020–2025, which is positive information given the fact that the secondary sector is more volatile than other sectors in times of economic and other crises. At the same time, even after this decline, the dependence of the Slovak Republic and regions in Slovakia (partly except for Bratislava) on the success, performance and competitiveness of the secondary sector will be relatively high.

The tertiary sector and the share of employment in it has been severely affected by the COVID-19 pandemic. Several sectors, for example, in tourism, such as Accommodation and food service activities and Arts, entertainment and recreation, are barely recovering from the receding COVID-19 pandemic, and yet the performance of the tertiary sector is very important for several regions (for example, the Prešov Region). It is therefore positive that the share of the tertiary sector is expected to slightly increase in Slovakia, and in some regions, such as the Prešov Region, this sector could again become a pillar of growing competitiveness.

In overall, the share of employees working in the tertiary sector is expected to grow most dynamically in Slovakia in 2020–2025. This is a positive fact, since in most advanced economies the core of economic activities included in the quaternary sector is like an engine of innovation and competitiveness growth. The advantage of the quaternary sector, and a number of branches associated with it, is that it brings knowledge- and creativity-driven growth and to a much lesser extent brings negative externalities, typical especially for the primary and secondary sectors, such as raw material depletion or environmental pollution. Also, the impact of the expansion of this sector on climate change is lower than in the case of the other sectors. At the same time, it is important to note that the quaternary sector and its growing share in the overall sectoral structure of the economy increasingly requires a highly skilled and educated labour force. The high share of the quaternary sector in the world's most developed countries is an important trend for the future. The ever-growing need for a highly skilled and educated labour force as a key objective should also be taken into account when formulating effective measures for policy makers in the search for optimal state aid settings, for example in the programming period 2021–2027 when implementing the Cohesion Policy, but also when drawing funds from the Recovery and Resilience Plan of the Slovak Republic. The Recovery and Resilience Facility, which was created by the European Parliament and the Council of the European Union (2021), was originally intended to be a dedicated instrument designed to tackle the adverse effects and consequences of the COVID-19 crisis in the European Union. However, in the case of the Slovak Republic, its implementation to some extent replaces part of the unrealised investments that should have been made in the previous programming period through the European Structural and Investment Funds.

It is now clear that support for education, skills and human capital formation, which is aimed at the development of the quaternary sector, has the potential to ensure the sustainable and dynamic economic development of the

country in the long term. At the same time, it is important to bear in mind that the development of the quaternary sector, especially technologies such as artificial intelligence, automate certain job tasks and consequently reduce the number of jobs needed. This is already and will continue to be one of the reasons for the possible decline in the number of jobs, particularly in the primary and secondary sectors.

The overall optimisation of the number and structure of employees in the national economy not only until 2025, but also in the following years, should be guided by the expected technological development in individual sectors of the national economy in Slovakia. According to the Recovery and Resilience Plan of the Slovak Republic, which was created by the Ministry of Finance of the Slovak Republic (2021), the most significant technological changes affecting society concern digitalisation, automation, artificial intelligence and robotics, and cybersecurity. Digitalisation is bringing new business models in all sectors of the economy. As a result, the need for IT workers is growing rapidly and the impact of the quaternary sector is steadily increasing. Production processes in both industry and services are being significantly affected by advancing automation. Consequently, many jobs will have to be transformed and some of them are likely to disappear. However, automation and the arrival of artificial intelligence are also an opportunity to increase labour productivity and wage levels in Slovakia. At the same time, with the arrival of technological changes, cybersecurity and the jobs involved are growing in importance.

Another important current trend having an impact on the structure of jobs within sectors is the preference for the so-called green economy in several European Union countries, which is gradually followed by the Slovak Republic. The development of renewable sources in power engineering, the increase in energy efficiency through the renovation of buildings, investments in the electrification of railways, the purchase of railway vehicles with alternative drives, the rapid emergence of electromobility and the development of related infrastructure contribute to reducing the share of fossil fuels in the energy mix and increase Slovakia's resilience in the field of energy security. Another factor affecting the labour market, which is closely related to the promotion of the green economy, is the presence of climate change, which results in more frequent extreme weather events. Slovakia needs to invest a lot of resources in measures related to the green economy and the response to climate change. Decarbonisation is key in this effort, which also directly affects the competitiveness of economies and the number and structure of jobs across sectors. Related investments in environmentally friendly technologies can reduce the production cost for companies, including environmental charges. However, decarbonisation targets, while clearly necessary, often result in changes in the structure of the economy, including negative impacts on the labour market.

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Annex 1: Estimated Values of the Number and Share of Employees in Individual Sectors in 2020-2025

Year	Primary sector		Secondary sector		Tertiary sector		Quaternary sector	
	Number of employees	%	Number of employees	%	Number of employees	%	Number of employees	%
Slovak Republic								
2020	31,206	2.04%	465,655	30.46%	556,092	36.38%	475,728	31.12%
2021	28,684	1.85%	466,813	30.17%	565,087	36.53%	486,495	31.45%
2022	26,162	1.67%	467,971	29.89%	574,082	36.67%	497,262	31.76%
2023	23,640	1.49%	469,129	29.62%	583,078	36.81%	508,028	32.08%
2024	21,119	1.32%	470,287	29.35%	592,073	36.95%	518,795	32.38%
2025	18,597	1.15%	471,445	29.09%	601,068	37.09%	529,562	32.68%
Košice Region								
2020	3,113	1.74%	50,863	28.36%	66,203	36.92%	59,140	32.98%
2021	2,859	1.59%	50,570	28.06%	66,635	36.97%	60,176	33.39%
2022	2,604	1.44%	50,277	27.75%	67,067	37.02%	61,213	33.79%
2023	2,350	1.29%	49,984	27.45%	67,499	37.07%	62,250	34.19%
2024	2,096	1.15%	49,691	27.15%	67,931	37.12%	63,286	34.58%
2025	1,842	1.00%	49,398	26.86%	68,364	37.17%	64,323	34.97%
Bratislava Region								
2020	2,112	0.57%	65,006	17.61%	155,428	42.11%	146,536	39.70%
2021	2,014	0.53%	66,021	17.45%	158,236	41.83%	152,040	40.19%
2022	1,916	0.49%	67,036	17.30%	161,044	41.56%	157,544	40.65%
2023	1,818	0.46%	68,050	17.15%	163,852	41.30%	163,048	41.09%
2024	1,720	0.42%	69,065	17.01%	166,660	41.05%	168,552	41.52%
2025	1,622	0.39%	70,080	16.88%	169,468	40.81%	174,056	41.92%
Prešov Region								
2020	4,149	2.63%	50,424	31.94%	58,632	37.14%	44,644	28.28%
2021	3,877	2.44%	50,616	31.81%	59,720	37.53%	44,924	28.23%
2022	3,605	2.25%	50,808	31.67%	60,808	37.90%	45,203	28.18%
2023	3,334	2.06%	51,000	31.54%	61,895	38.27%	45,483	28.13%
2024	3,062	1.88%	51,192	31.41%	62,983	38.64%	45,763	28.08%
2025	2,790	1.70%	51,384	31.28%	64,070	39.00%	46,042	28.03%

Source: Own elaboration.