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**Ph.D. Dissertation Thesis**

**ECONOMIC CHARACTERISTICS OF REGIONS IN THE VISEGRAD-4  
COUNTRIES**

by  
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## 1. INTRODUCTION

My research was aimed at comparing the regions of the Visegrád-4 countries – the Czech Republic, Hungary, Poland and Slovakia – according to their economic variables and characteristics. The relevance of the research topic lies in the fact that the Visegrád-4 countries are currently the most dynamically developing group of countries in the EU-28, which is expected to expand further with some Western Balkan countries in the future, leading to an increase in its role in the EU. The growth and expanding role of the economic recovery of the Visegrád-4 countries warrants a deeper detailed economic analysis of this group of countries, primarily in terms of population, employment, production and household income. It is advisable to assess the factors of economic recovery and to look for the long-term prospects of economic recovery. In the Czech Republic, Hungary, Poland, Slovakia, the analysis of the 39 regions shows many similarities and differences between the four countries examined.

The regional economic analysis of each region was based on the most important economic characteristics, which play a prominent role in the economic development of each region. Economic variables generally refer to the period 2010-2015, with a different period separately. For my scientific analyses, I used the Eurostat statistics for 2017.

In addition to economic growth, the region's regions have had to cope with a number of challenges, such as the low share of tertiary education in some regions, the relatively high economic importance of the mining and quarrying sector, the decline in higher value added production, rising unemployment, population and decline in agricultural employment. Addressing these economic difficulties requires effective economic cooperation between regions, a more efficient use of available financial resources, stimulating foreign capital investment, increasing the number of graduates and adapting training more flexibly to the labour market. The abbreviations of the economic variables and characteristics in the analysis are shown in brackets. An important aspect of regional demographic statistics is the analysis of differences and similarities between regions, in terms of population (Population1) and educational attainment (Skill2). In my research, population development plays a key role in

each region because it significantly influences the development of corporate competitiveness as a labour resource depending on the level of education. The evaluation of these two variables is a serious economic factor in the regional analysis of the Visegrád-4 countries under study.

The analyses cover the growth rate of GDP (GDPgrowth3) and regional gross value added (RGVA4). Changes in employment (Occupation5) and household income (FamilyIncome6) in our region are also part of the study. The comparative analysis of the regional level of scientific and technological development (R&D7) between regions includes the aggregation of R&D by economic sectors, as well as the sectoral R&D and human resources (R&D Person8), technology and knowledge intensive sectors (FoglTechn9), and the number of employees in education and training (HRSTPers10). The level of economic development of the regions concerned is well characterized by increasing funding for research, development and workforce training. Regions' GDP growth affects employment, household income levels and purchasing power, ie the region's ability to retain its population.

During my research I used the statistical analysis program called SPSS, which allows a wide overview of a large number of regions of several countries and allows them to be compared and analysed on a scientific basis. I also use SWOT analysis in my analysis.

The purpose of the research can be grouped as follows:

1. Prove that Population1 is highly correlated with Skill2, Mining11 and Unempl13.
  2. Demonstrate that the Skill2 variable is strongly correlated with GDPgrowth3, FamilyIncome6, Mining11, Unempl13, and inversely with FarmNumber12.
  3. Prove that the R&DPers8 variable also shows a strong correlation with the HRSTPers10 variable, and that the FoglTech9 variable also shows a strong correlation with the HRSTpers10 variable. And the economic variable Occupation5 has no significant correlation with other economic variables.
  4. Prove that Mining11 has a close correlation with Unempl13 and vice versa with FarmNumber12.
  5. Prove that the RGVA4 variable has a strong correlation with the FamilyIncome6 variable.
- The research focuses on the regional employment situation, with particular emphasis on the number of people employed in mining (Mining11) and agriculture (FarmNumber12),

influencing the overall employment situation. The industrial environment is the geographical environment, which provides the mineral resources, energy sources and other raw materials needed for production. The quantity and importance of natural resources have changed over history. The geographical location of companies is an important consideration in this regard. Developments in unemployment (Unempl13) and comparisons between regions highlight employment problems.

## 2. RESEARCH METHODOLOGY

In my research I used the statistical analysis program called SPSS. This program allows you to review, scientifically substantiate and compare with each other a large number of regions in several countries. In the methods of analysis, I highlight the similarities and differences of the economic societies of different regions. This program is the most suitable for comparative analysis of the 39 regions of the Visegrád-4 countries – Czech Republic, Hungary, Poland and Slovakia – as it provides the grouping of 39 regions by economic characteristics. In order to compare different regions of the Visegrád-4 countries, it is necessary to determine the economic variables of each region by region. I summarized the grouping of the regions of the countries and the economic variables within the components. Component 1 consists of three variables and component three consists of four variables. In contrast, the fifth and sixth components have only one economic variable.

The KMO value indicates the extent to which economic variables are related to each other, that is, the strength of the correlation, which is highly moderate when above 50%. The table also shows the value of significant relationships between economic variables, 0.000 being the strongest significance value. The average of the numbers marked with "a" in the Anti-Image Matrices table gives the KMO value with near accuracy. If the value is 0.500 or greater, the value of the variable is medium, if it is below, then it is slightly medium, and if it is close to 0.900, the value of the variable is strong, and above 0.900 it is very strong. A value of 0.329 to 0.359 is considered slightly medium, while a value of 0.429 to 0.573 is considered to be moderate, while values of 0.620 and above are considered strong.

The magnitude of each variable represents the weight they appear in the research relative to the baseline value of 1.000. The lowest value of 0.711 is also significant based on the role and importance of the Population1 economic variable in the research. R&DPers8 and HRSTPers10 have the highest values of 0.905, which means that in these statistical research and analysis, these two economic variables have the highest weight relative to the baseline. It is clear from this statement that these two variables have become more important than the other variables as a result of higher education and research and development personnel. The third most important - but second in magnitude – 0.901 – is the most significant growth rate for FamilyIncome6. The growth rates of these three variables stand out from the others. The

first 6 components account for 83.358% of the research results and statistical analyses, so in the research and statistical analysis these six components and 13 economic variables are justified and expedient. The other components are not relevant for research and statistical analysis.

The SPSS method gives details of the magnitude of the relationships between each variable. If the correlation value approaches 0.500, then there is a moderate correlation between each variable, if it is above 0.500 then it is strong if it is closer to "1" or essentially "1", then the correlation is strongest for that variable over other variables. The middle row shows the significant value, which must be close to "0" or to "0" so that there is no or minimal difference between that variable and other variables. In the graphs related to the various factor analysis, the spatial proximity or distance of the regions in the coordinate system is obtained. Each variable represents the economic situation of a region and can be used to evaluate the similarity or difference, economic weakness or strength of that region compared to other regions.

In the case of regional demographic statistics, it is important to analyse the differences between the population (Population1) and educational attainment (Skill2) by region, as they have a significant impact on the development of corporate competitiveness. The economic development of each region is shown by changes in regional gross value added (RGVA4) and changes in household income (FamilyIncome6). The situation of regional employment is also influenced by the number of people employed in mining (Mining11).

### 3. SCIENTIFIC RESULTS

There are strong correlations among economic variances, which are as flows:

- between Population1 and Skill2, Mining11, Unempl13;
- Skill2 and GDPgrowth3, FamilyIncome6, Mining11, (Minus) FarmNumber12, Unempl13;
- GDP GDPNow3 and RGVA4, FamilyIncome6, R&D7, Mining11, (Minus) FarmNumber12, Unempl13;
- between RGVA4 and FamilyIncome6;
- between FamilyIncome6 and R&D7;
- between R&D7 and (Minus) FarmNumber12;
- between R&DPers8 and HRSTPers10;
- between FoglTech9 and HRSTPers10;
- between Mining11 and (Minus) FarmNumber12, Unempl13;
- between (Minus) FarmNumber12 and Unempl13.

Changes in the total number of employees (Employment5) has no correlation and no significant correlation with the other economic variables. This is explained by the fact that the total number of employees in the high-tech and knowledge-intensive sectors is essentially different (FoglTech9). HRSTPers10 differs from the FoglTech9 variable in that the latter refers to a smaller workforce because it only refers to the number of graduates and / or people employed in science and technology. However, the FoglTech9 variable represents twice the number of employees and the number of HRSTPers10 employees. Compared to HRSTPers10, the economic variable R&DPers8 is significantly smaller, as it only includes employees working in the field of research and development (R&D) and researchers. Thus, the decreasing number of employees in the order FoglTech9 > HRSTPers10 > R&DPers8.

#### **The most important relationships between economic variables**

1. As the population grows, the proportion of tertiary education graduates aged 25-64 will increase as the number of people employed in the mining industry increases or decreases to a lesser extent, while regional gross value added (in millions of euros). In addition, an increase

or a smaller decrease in these economic variables will also trigger an increase or a smaller decrease in family income in the respective regions. These processes are well understood in the SL01, CZ01, SL05, SL07, SL08, PL03 and PL16 regions.

2. With lower population growth, lower rates of tertiary education and employment in mining, the rate of falling unemployment is significant, as in the CZ08, CZ07, CZ06, CZ05 and, CZ04 regions.

3. It can be stated that the significant increase in the number of graduates (Skill2) has had an impact on the increase in the number of graduates and persons employed in science and technology (HRSTPers10), and their growth has had a significant impact on the as well as the growth of the research staff (R&DPers8). These factors have resulted in higher levels of regional processing, which have emerged at the corporate level. Increasing employment rates (FoglTech9) and higher skills levels of the workforce have contributed to the growth of household income. The best examples of this are the PL10, PL16, PL12, PL13, PL09, PL03, SL02, SL03, SL04 and PL08 regions.

4. Experience in the Czech Republic shows that in mining regions there has been an economic downturn as regional gross value added (RGVA4) and household incomes have risen or stagnated, or may have fallen. mining is a traditional industry.

5. The relatively small increase in population (Population1) and the decline in the share of tertiary education (Skill2) may have contributed significantly to the low increase in regional gross value added (RGVA4) and, in the case of the CZ04 region – may be higher for one region – and the growing weight of the mining sector (Mining11). The latter indicates that the main trend is not so much towards the growth of regional gross value added (RGVA4).

6. In some regions the population increased from 0.1% to 2%, in others it decreased from 0.1% to 3%, while the share of tertiary education graduates ranged from 14.2% to 29% and the number of people employed in mining was 6.7%. It increased from 10% to 10% but decreased from 5% to 21% for other regions. The standard deviation of household incomes is also significant, rising partly from 5.4% to 8.5%, and in other cases from 1% to 7%. This also shows that there are significant inconsistencies between regions in the evolution of their economic variables. While RGVA4, on the other hand, FamilyIncome6 decreased,

unemployment fell (CZ04, CZ08), while unemployment declined to a lesser extent (CZ01), but unemployment fell, such as CZ03, CZ05, CZ08, HU04, SL04 , CZ06, CZ07 and HU01 regions.

7. The downward trend in the production of regional gross value added (RGVA4), the decline in the share of graduates in higher education, the growing weight of the mining sector have naturally led to a decline in the economic competitiveness of each region and the resulting a minimal or decreasing increase or decrease in household income. It is also a fact that if there is no raw material production in a given country – agriculture and mining – then the processing industries will need to be imported, which in turn could significantly increase their unilateral foreign economic dependence. The processing industry capacity is increasingly being achieved by foreign direct investment in individual EU member states, including the Visegrád-4 countries.

8. In the SL01 region, GDP growth is also closely linked to population growth and a strong boom in mining, as well as a 76% reduction in the number of farmers in the Visegrád-4 region as a whole (FarmNumber12). Although the number of the unemployed decreased the least in Visegrád-4, by 6.8% (Unempl13). This, in turn, is offset by the boom in mining. The Bratislava region is a good example of the fact that growth in R&D has played a key role in economic recovery and GDP growth.

9. In Poland, population decline was felt across the country. In this PL08 region, population decline has been accompanied by a significant increase in per capita R&D support. In contrast, however, the 8.4% increase in household income is well below the Polish average.

10. PL14 Kuyavian-Pomeranian Voivodeship (Kujawsko-Pomorskie) In Bydgoszcz Torun region, unemployment, the number of farmers decreased, but the per capita R & D support increased, along with significant GDP growth. Production of regional processed products (RGVA4) increased by 13.4%, which is very similar to the Polish average. At the level of the PL14, the production of larger processed products contributed positively to a 9% increase in household incomes, compared to an average of 6.95% for the Visegrád-4 countries. The region achieved GDP growth of 46.2% over this period, exactly one percent lower than the average of the 39 regions in the four countries. This was not very prominent, but it was still significant in the Visegrád-4 countries, which was associated with a 1% decrease in the

population. With a 91% increase in per capita research and development support (R&D7), it outperformed the Visegrád-4 countries, with only a few Slovak regions (SL02, SL03, SL04, SL05 and SL06) achieving higher growth rates. beat.

11. SL05 Žilinský kraj region achieved GDP growth of 77.8% over this period, similar to the performance of the SL06, SL07 and SL08 regions, which rank second in the Visegrád region after the SL01 region. against all regions of countries. This is a very outstanding performance for the whole Visegrád-4. This performance could also be significant because the population in this region increased only by a minimum of 0.1%. Only a few Slovak regions (SL02, SL03, SL04, and SL06) achieved higher growth rates than the 162.8% increase in per capita research and development support (even SLO1).

12. It can be stated that the population growth rate of the Visegrád-4 countries (Population1) is closely related to the increase of the population of the 39 regions and thus to the increase of higher education (Skill2). In the countries studied, where population growth accelerated, such as the SL01, CZ02, CZ01, PL16, HU01, PL02, and PL03 regions, between 1% and 4.4%, tertiary education is generally higher (21, Between 4% and 43.3%). The decrease or smaller increase in population is also directly proportional to the decreasing rates of Mining11 and Unempl13, such as CZ03, CZ04, CZ06, CZ08, HU02 (!), HU03, HU05, HU06, HU07, PL01, PL05, PL07, PL02, PL03, PL04, PL06, PL08, PL09, PL10. In the Visegrád-4 countries, the highest fall in unemployment was in the HU02 region. The reverse is true, that is, the Mining11 is also growing, but to a lesser extent, as the population grows, but the Unemployment 13 economic variables is definitely decreasing, but to a lesser extent compared to the former, for example, in the SL01, SL02, CZ01, CZ02, HU01 regions.

13. It can also be stated that the economic variable Skill2 is closely and unidirectionally related to the economic variables GDPgrowth3, FamilyIncome6, Mining11 and Unempl13, but inversely proportional to the FarmNumber12. The economic variable GDPgrow3 is closely and one-way correlated with the economic variables RGVA4, FamilyIncome6, R&D7, Mining11 and Unempl13, but inversely proportional to the economic variable FarmNumber12.

14. GDP growth in the 39 regions examined is strongly stimulated by the production of higher processed products (RGVA4) at the regional level and is also influenced to a large extent by

per capita R&D aid (R&D7). Naturally, in regions where the number of people employed in mining is increasing, this also has an impact on the regions' GDP growth, according to the results of the study. GDP growth, coupled with increased R&D subsidies, reduces the number of farms and thus the number of people employed in agriculture. Developments that stimulate GDP growth also reinforce the rising rate of unemployment. GDP growth undoubtedly has a positive effect on the growth of household incomes (FamilyIncome6), which is also the result of a reduction in the number of employees due to efficient production. These positive trends can be seen in the SL01, SL02, SL05, SL06, SL07, SL0, PL03, PL08, and PL12 regions, where GDP growth was between 58% and 86.3%, while per capita R&D the growth rate of subsidy was between 61% and 168.2%. It is important to note that the examples list regions where both GDP growth and per capita R&D aid are above the average of the V4 countries, 47.2% in the former and 58 in the latter case. 35%.

15. The decline in GDP is closely linked to a decrease or a minimal increase in the production of R&D7 and higher processed products (RGVA4). As a result, and in particular as a result of a modest increase in production technology, unemployment may fall as a result of rising employment rates. The number of farms will decrease to a lesser extent and agricultural employment may increase. These economic difficulties are contributing to the decline in income per household. This shows that the decline in GDP is due to a number of important causes and has serious negative effects. The average rates of decline and growth between 13% and 48.6% of GDP and the R&D7 minus 24.4% plus 44% are typical for some major regions, such as CZ01, CZ02, CZ03, CZ04, CZ05, CZ06, CZ07, CZ08, HU01, HU03, HU04, HU05, HU06 and PL15.

16. It can be stated that in case of the countries involved in the research, if the production of larger processed products (RGVA4) decreases at the regional level, the household income (FamilyIncome6) in the given regions decreases significantly during the period under review. This is true for the majority of regions. It is more common in these regions that at the level of the regions the production of larger processed products (RGVA4) has increased much more than in the respective regions, household incomes such as in the CZ02, HU02 and HU07 regions. In the HU05 region, household incomes declined despite strong growth in RGVA4. However, relative to the increase or decrease in the production of larger processed products (RGVA4) at the regional level, the rate of increase or decrease in household income is also slightly lower than in the SL02, SL07, SL08 and PL05 regions.

17. In some regions, the growth rate of household income was slightly higher than the production of larger processed products (RGVA4) at the regional level. Such regions include, for example, SL01, PL12, PL04, HU01, SL06, SL05 and SL04. Ultimately, at the regional level, the growth rate in the production of larger processed products (RGVA4) will allow for an increase in household income (FamilyIncome6). If the RGVA4 increases significantly, the FamilyIncome6 stagnates or to a lesser extent. With the growth of RGVA4, FamilyIncome6 is also growing noticeably.

18. It can be stated that the economic variable FamilyIncome6 is closely and unidirectionally related to the economic variables R&D7. If there is a significant increase in per capita R & D aid in the given regions, this will, although to a lesser extent, also lead to a slightly higher increase in household income. This correlation indicates that where support for research and development is stronger, it is expected that production technology developments will result in higher corporate and wage income growth, which will also contribute to the growth of household income. Per capita research and development subsidies (R&D7) increased most in regions SL02, SL03, SL04, SL05, SL06, PL08, PL05, PL14, HU07, PL07 and PL16, while household income increased.

19. It can be stated that the economic variable R&D7 is closely and inversely related to the economic variables FarmNumber12. In regions where per capita research and development subsidies have increased, there has been a marked decline in the number of farmers. In this case, there is an inverse relationship, because improvements in production technology have contributed to the concentration of agricultural production through support for research, and ultimately to a reduction in the number of farmers. The latter is found primarily in the Czech and Slovak regions such as CZ01, SL01, SL04, SL03, SL02, SL08, PL04, SL05, SL06, SL07, CZ06, CZ07 and HU05. In general, the number of farmers has decreased significantly in all regions due to the increasing efficiency of agricultural production.

20. It can be stated that the Mining11 economic variable is closely and unidirectionally related to the Unempl13 economic variables but is inversely proportional to the FarmNumber12 economic variable. This correlation is supported by the fact that the number of people employed in mining increased by an average of 5.4% in the 39 regions, while the unemployed decreased by 38.6%. As this decrease is smaller than the 45.1% decrease in the number of

farms, there is a one-way relationship between the first two, while in mining, the proportion of the decrease in the number of farms is inversely proportional.

This inverse proportionality exists between the Mining11 and the FarmNumber12 economic variables. In mining, the growth rate relative to the average of the 39 regions was mainly due to the 200% increase in the SL01 region, while the 6.8% drop in unemployment was the smallest with the 76% decrease in the number of farms (the second largest After CZ01 among the 39 regions). This means that mining has lost a significant amount of labour from agriculture, reducing unemployment to a very minimal extent. The number of farms in agriculture decreased, which may also have contributed to the decrease in the number of employed.

21. The HU02 region, together with a significant population decline, has seen a significant fall in unemployment and in the number of farmers. In addition, per capita R&D support has increased significantly in the V4 countries and even in the EU-28. The production of products with a higher degree of processing at regional level increased by 10.84%, which is above the level of 9.6% in the Visegrád-4 countries. At the level of the HU02 region, the production of products with a higher degree of processing has improved significantly but has resulted in an unfavourably low 2.7% increase in household income, which is 40% of the 6.95% average of the Visegrád-4 countries. did not even reach.

22. In the HU03 region, moderately strong GDP growth in the V4 countries could be achieved, with a relatively stagnant population growth, with much lower unemployment and agricultural employment, significantly lower per capita R&D support, which was higher than the V4 average. This region was able to achieve GDP growth through an increase in the production of products with a higher degree of processing, which undoubtedly played a role in the growth of household incomes reaching V4 average.

23. HU05 Northern Hungary, the region, achieved a GDP growth of 15.6% during this period, much lower than the 47.2% average for the Visegrád-4 countries. This was a significant difference related to the 4% decline in the population. At the same time, per capita research and development subsidies increased by only 2.9% (R&D7). Despite this small increase in the economic variable R&D7, far below the EU-28 and Visegrád-4 averages, a significant 14.8% growth rate was achieved in the HU05 region in the production of higher processed products

at regional level on the square. Household income decreased by 2.7%. With this decline, the HU05 region posted the fourth worst result after CZ04, CZ01 and CZ08 in terms of household income for V4s.

24. As the GDP growth in the HU05 region was below the average of V4, the region also lagged behind the average growth of the V4 tertiary education level. The level of education in the field of higher education (Skill2) increased by 17.2%, below the average of the Visegrád-4 countries (25.42%). Not only the decline in population, but also the 17.2% increase in tertiary education and the 5% increase in the mining sector contributed to the 58% decrease in the unemployed and 37% in the agricultural workforce. GDP growth can be an incentive for higher tertiary education levels, but it is also reciprocal, since higher tertiary education levels also have an impact on GDP.

25. Region HU01 also includes the capital Budapest. The growth of the research staff was 14.9%, compared to 35.5% in the higher education. In this case, the task is not only to supply the labour force of this region, but also to other domestic regions. The situation is similar in the PL02 region, to which Warsaw belongs, where the increase in research staff was only 26%, compared to 38.4% for tertiary graduates. In the SL01 region, together with the capital city of Bratislava, the research population has even decreased by 15%, compared to a 39% increase in tertiary education. In the SL01 region, this decline is justified by the fact that the growth of research staff has been concentrated in other regions by the creation of jobs of this kind in the capital. These regions, for example, have an increase in research staff of 18.4% in the SL02, SL03 and SL04 regions, approaching a 19.7% growth rate in tertiary education.

26. In the economic variable HRSTPers10, there are not only graduates but also other employees in the science and technology sectors who do not necessarily need a university degree. On the other hand, in the case of the economic variable R&DPers8, tertiary education is essential to fill the job. Therefore, it would be important to approximate the growth rates of the two economic variables R&DPers8 and Skills2, so that the demand and supply of labour in this area could be better balanced, which in this case represents a significant structural difference. The SPSS method also reveals that there is no significant correlation and significance between the two economic variables. This is generally the case in the V4 countries, which poses serious social difficulties in the context of higher education institutions.

#### **4. NEW SCIENTIFIC RESULTS**

The population growth rate of the Visegrád-4 countries is closely related to the increase in the level of higher education in the 39 regions. As the population grows, the rate of growth of tertiary skilled labour is generally higher. Declining population growth, or to a lesser extent, is also directly related to the decreasing role of mining and unemployment. In the Visegrád-4 countries, the highest fall in unemployment was in the HU02 region. The reverse is also true, with the role of mining increasing, albeit in direct proportion to population growth, while unemployment is declining. With lower population growth, tertiary education and a lower rate of employment in mining, the decline in unemployment is more significant.

The significant increase in the share of graduates in higher education has an impact on the growth of tertiary education and science and technology jobs, and has a significant impact on the growth rate of high technology and knowledge intensive sectors and on the growth of research staff. These factors have led to an increase in the level of regional processing. Rising employment rates and higher skills levels of the workforce have contributed to the growth of household income.

I concluded that, based on Czech experience, mining regions are expected to experience declining economic growth as regional gross value added and household incomes are barely rising, stagnating or declining. If the production of higher processed products decreases, so does the household income.

The declining trend in regional gross value-added production, the decline in the share of graduates in higher education, the growing weight of the mining sector are leading to declining economic competitiveness, with a decline in corporate profitability and household income growth.

## 5. CONCLUSIONS

Visegrád-4, the most dynamically developing group in the EU-28, has achieved significant economic performance. These economic results have come from increasing levels of employment, increasing R&D subsidies, increased research staff and steady decline in unemployment, increased production of higher value-added products, intensified agricultural production and, in some regions, mining. development. The economic boom has led to GDP growth and, in parallel, household income may have increased. GDP growth undoubtedly had a positive impact on the growth of household incomes (FamilyIncome6), which was also due to the decline in the number of employees due to efficient production. These positive trends can be seen in the SL01, SL02, SL05, SL06, SL07, SL0, PL03, PL08, and PL12 regions, where GDP growth ranged from 58% to 86.3%, while per capita R&D the growth rate of aid varied between 61% and 168.2%. Regions with both GDP growth and per capita R&D support above the V4 average are also listed.

I find that the Mining11 economic variable is closely and one-way correlated with the Unempl13 economic variables, but inversely proportional to the FarmNumber12 economic variable. This correlation is supported by the fact that the number of people employed in mining increased by an average of 5.4% in the 39 regions, while the unemployed decreased by 38.6%. As this decrease is smaller than the decrease in the number of farms (45.1%), there is a one-way relationship between the first two, while in mining, the proportion of the decrease in the number of farms is inversely proportional. The growth rate in mining was mainly due to the 200% increase over the average of the 39 regions in the SL01 region, while the 6.8% decrease in unemployment was the smallest here, but the decrease of the number of farms was the second largest. was after CZ01 among the 39 regions. This means that mining has lost a significant amount of labour from agriculture, minimizing unemployment. The number of farms in agriculture decreased, which also affected the decrease in the number of employed. It is more common in the regions under study that the production of larger processed products (RGVA4) at the regional level has increased much more than the growth rate of household incomes in these regions, for example in the CZ02, HU02 and HU07 regions. However, it has also happened that the growth or decrease of household incomes is

slightly lower than in the regions of SL02, SL07, SL08 and PL05, as compared to the increase or decrease in the production of larger processed products (RGVA4) at regional level.

Based on the SWOT analysis of the general economic situation of the Visegrád-4 countries, it can be stated that according to its internal characteristics the economic development of the region is outstanding in comparison to the EU-28 countries. This required a sufficient level of labour supply in each country and region and the transformation of their economic structure to produce products with higher levels of processing. In addition to labour supply, higher incomes of employees are becoming increasingly characteristic, which also contributes to the increase of purchasing power in the internal market. One of the weaknesses of the region is the need to improve the level of innovation in order to achieve the appropriate internationally recognized competitiveness. This makes the products exported by the regions more marketable on the international markets. Removing this, both better and to a greater extent, also requires tackling a serious capital shortage.

The external environment for Visegrád-4 countries is favourable membership of the EU and compliance with the production technology quality requirements set by the EU. Imposing quality requirements on the Visegrád countries can be an internationally favourable condition, because it is precisely this that will encourage further innovative economic development. The adverse external conditions for the Visegrád-4 countries are that the economic rivalry between the individual member states impairs the strengthening of broader and more effective foreign economic relations. In addition, the EU has been at a competitive disadvantage in a number of areas, such as agriculture with its fragmented land use and increasing energy dependency.

The further development of the Visegrád-4 region requires the development of innovation and the further strengthening of the knowledge-based society. Closely related to this is the skill level of the workforce, which does not stop at the level of higher education. Continuing education, life-long training and scientific research for the development of production technology must continue to play an important role. All this can ensure the international competitiveness of the region. Further expansion of foreign direct investment will make it possible to increase R&D and employment levels.

## 6. SUMMARY

My research focused on the comparisons of the economic variables of the Visegrád-4 regions of the countries, according to their characteristics. The four countries – Czech Republic, Hungary, Poland and Slovakia – list with their respective regions together with their identification numbers in Eurostat. In the case of Poland, the Voivodships are being analysed in the main regions within my research, as the size of the Voivodships corresponds to the other regions of the Visegrád-4 countries and the NUTS-2 statistical classification method used in the EU. In the case of the Czech Republic and Slovakia, the names of smaller areas within the region are also classified in brackets, which can also be traced back to Eurostat's statistical records. The importance and relevance of the research topic is that the EU is now the most dynamically developing country group in the Visegrád-4 countries.

During my research, I used the statistical analysis method *SPSS (Statistical Program for Social Sciences)*. This statistical analysis method provides an overview of a large number of regions in a wide variety of countries and a well-founded analysis and comparison. In analytical methods, I highlight the economic and social similarities and different characteristics of each region. The SPSS analysis method provides several different methods for analysis, partly through dimension reduction, factor analysis, descriptive statistics, rotation, regression, standard deviation. Additionally, hierarchical cluster analysis, dendrogram and ward's method give the 39 regions a classification of economic characteristics.

The main goals of my research were to analyse the close correlation of *Population1* variable with *Skill2*, *Mining11*, and *Unempl13* with these other economic variables; and the relationship between the level of education and training, GDP growth, the share of those employed in industry and agriculture, the evolution of family income and the situation of unemployment. I pondered the results of the interaction of these variables. Cross-regional comparative analysis of regional levels of scientific and technological development (*R&D7*) can be easily reached by aggregating R&D by economic ages, by sector R&D personnel and researchers (*R&DPers8*), by employing technology and knowledge intensive sectors (*FoglTechn9*), and in the field of education and training (*HRSTPers10*).

## LIST OF PUBLICATION

**Gál Zsolt, PhD Student**

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