

## A Comparison of the Development of Selected Macroeconomic Indicators of the Regions of the V4 Countries

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Pavel Rezabek, Lubos Marek, Petr Doucek, Lea Nedomova

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### ABSTRACT

**Purpose:** The purpose of the article is to compare a degree of beta-convergence between V4 countries and EU28 at national and NUTS 2 level.

**Methodology/Approach:** We will make this comparison separately for each indicator (gross domestic product at current market prices, unemployment rate and disposable income of households.). To evaluate beta-convergence differences at national and regional level, we will compare the data for the V4 countries and for Germany and Austria. To show convergence, we approximated the GDP growth trend in individual countries, using a trend line for three different time periods.

**Findings:** Our results point to persistent disparities between regions. They have confirmed that the cohesion policy in the regions of the V4 countries should promote innovations and investments into less developed and predominantly agricultural regions, complete the necessary backbone infrastructure and develop a high-quality regional education. At regional level, the implementation of high value-added programs may be hampered by institutional factors and a lack of capacity to make the necessary infrastructure or human capital investments. Our analysis showed that differences in regional performance are also accompanied by significant differences in investigated indicators.

**Research Limitation/Implication:** Limitations of the paper are at first missing data for Poland to the year 2013. Second limit of the article are data from regions, because data are related to the place of residence of its branch.

**Originality/Value of paper:** Paper is full original,also a data analysis does not copy any other articles neither article in a journal nor paper on conference.

**Category:** Research paper

**Keywords:** V4 countries; NUTS 2 regions; cohesion policy

## 1 INTRODUCTION

The Visegrad Four (hereinafter as V4) (Czech Republic, Slovakia, Poland and Hungary) form a relatively homogeneous unity within Europe with many cultural-historical and economic similarities. They all began the process of economic transformation from a planned economy to a market economy in the early 1990s and became members of the European Union in 2004 once they completed this process.

During the switchover to a market economy, the V4 countries gradually converged, with different intensity over time, towards more advanced economies and their growth usually exceeded growth achieved in the old EU Member States because their initial growth was low, a so-called beta-convergence (Barro and Sala-i-Martin, 1992). Beta-convergence is a process in which countries considered less developed show a long-term higher value of a selected indicator than developed countries. In our article, we use it to compare the GDP of the analyzed countries.

However, the development of economies as a whole may not fully reflect the economic and social situation of all citizens or industries. It turns out that there may be significant differences across the regions of the V4 countries, which continue to deepen over time (see, for example Kuttar, 2009), thus reducing the overall economic growth potential. A comparison at country level may not reveal such development and may provide a distorted picture that may lead to exaggerated optimism in assessing the convergence and effectiveness of the economic policy. Deepening interregional differences may indicate that, despite the convergence of economies as a whole, there may not be a sigma-convergence at NUTS 2 level (Young, Matthew and Levy, 2008), signaling a gradual decrease in heterogeneity across regions in terms of income distribution and other macroeconomic indicators.

There may be several explanations for such development, but the main factors seem to be the previous high dependence of the regions on a single industry. In the era of a centrally planned economy, the necessary diversity was not promoted in the long term, administrative activities were concentrated in a single strong center and regional differences were part of the central plan (Dluhoš, Gajdoš and Hajduová, 2019). Many regions thus remained dependent almost exclusively on agriculture, mining and quarrying or on outdated heavy industry, which was not very competitive compared to developed countries after the switchover to a market economy. Its competitiveness continued to decline with the advancing convergence of employees' income, as it lagged behind in labor productivity growth and in the modernization of operations. Due to an insufficient transport and education infrastructure, low labor mobility and an underdeveloped tertiary sector, the regions concerned were not able to adapt as quickly as the regions close to the dynamically developing main centers. The identification of regional disparities and their detailed analysis is important for evaluating the effectiveness of the cohesion policy aimed at the development of economically weaker regions

in the EU. The EU has made the cohesion policy one of its main objectives and secures it through a series of interrelated funds (European Commission, 2015). Although some selected regions in the older EU Member States (southern Italy, selected regions of Spain and others) also receive money from these funds, the main recipients are naturally regions in the new EU Member States. The purpose of the cohesion policy is to reduce income inequality between regions, to increase social inclusion and to accelerate investments in selected regions in order to increase regional innovations and labor productivity (Widuto, 2019). The main areas that are the focus of this policy include transport infrastructure, business and competitiveness support, education, science and research and investments into energy supply and the environment (Kokocinska and Puziak, 2018).

Literature is not fully conclusive on the real effectiveness of the cohesion policy. There are studies that find empirical support for its effectiveness (for example Venables and Gasiorek, 1999; Leonardi, 2006; Bradley and Untiedt, 2007; Di Cataldo and Monastiriotis, 2020), while the conclusions of other authors (Boldrin and Canova, 2001; Dall’Erba and Le Gallo, 2008) are rather skeptical or negative. Fratesi and Wishlade (2017) or Crescenzi, Fratesi and Monastiriotis (2017) point out that it is very difficult to evaluate effectiveness and suggest focusing mainly on the factors that can increase the effectiveness of the cohesion policy. Based on the performed analyses, they recommend making only specific investments in individual regions that correspond to several predetermined priorities. The outputs of our study may help to better target and streamline the above-mentioned tools of the cohesion policy in the regions of the V4 countries or to support the choice of their optimal mix. The right investments made as part of the cohesion policy can then help to increase the economic potential of the whole country and to accelerate convergence toward the advanced core of the EU.

## 2 METHODOLOGY

In this article, we empirically assess the extent to which heterogeneity across the regions actually persists and which V4 countries are the worst off in this regard. For these purposes, we compare the regions of the V4 countries at NUTS 2 level in terms of several different macroeconomic indicators. These are Gross Domestic Product at current market prices (in Purchasing Power Standard (PPS)) per capita (hereinafter as GDP), Unemployment Rate (in %, hereinafter as Unemployment rate) and Disposable Income of Households (in PPS) per capita (hereinafter as Disposable income) The goal is to find regions with similar economic characteristics and to group them, based on the cluster analysis, into homogeneous and economically interpretable groups. Since we have data in the form of time series, we are also interested in the dynamics of these quantities over time and in its impact on the increase or decrease of heterogeneity between the regions. We will make this comparison separately for each indicator, then we

will group similar regions into four clusters according to all analyzed indicators. To evaluate convergence differences at national and regional level, we will first compare the data for the V4 countries as a whole and then for the entire EU and for our closest neighbors – Germany and Austria.

## **2.1 Data Source and Processing**

The initial data for our analyses come from the Eurostat database. The entire analysis of all investigated quantities (GDP, Unemployment Rate and Disposable Income of Households) was performed in MS Excel and in Statgraphiscs Centurion 18. We used basic statistical functions and procedures to calculate the descriptive characteristics. The cluster analysis draws on hierarchical clustering with Ward's method (Johnson, 1967). It merges clusters with the minimum sum of squares. The method is based on the loss of information that occurs during clustering. The clustering criterion is the sum of squared deviations of each object from the centroid of the cluster to which it belongs. The distance of individual objects is measured based on squared Euclidean distance. The goal is not to optimize distances between clusters but to minimize cluster heterogeneity based on the criterion of minimum increment of the intragroup sum of squared deviations of objects from the centroid of clusters. In each step, the increment of the sum of squared deviations, created by their merger, is calculated for all pairs of deviations and then clusters corresponding to the minimum increment are merged.

The main output of the cluster analysis are dendrograms that we will display for the given data. We will try to divide the regions into 4 homogeneous clusters. These clusters should be easily identifiable from the dendrogram output. The cluster analysis should confirm the conclusions from the analysis and descriptive characteristics of data.

The data are compared for territorial units according to the NUTS 2 classification (CZSO, 2020; Eurostat, 2020a). All analyzed data come from the Eurostat database. However, there is a problem with data availability because all three analyzed indicators by region are not available for the same time period in all four countries. GDP per capita in USD at purchasing power parity is published by the V4 countries for the years 2000-2017, with the exception of Poland that only provides data for the years 2014-2017. All four countries publish the general unemployment rate at NUTS 2 level for the years 1999-2018. Poland publishes household income only for the years 2014-2016, other countries publish it for the years 2008-2016. This somewhat complicates the analysis of regional differences over time, but we always try to make comparisons over the longest possible time period. For the analysis of convergence at the level of the entire economy, there is generally no problem with data for Austria and Germany, but data for the entire EU or for some of its parts (Eurozone) are not always available. This will, of course, be reflected in some of the comparisons below – both in tables and figures.

To show convergence, we approximated the GDP growth trend in individual countries, using a trend line in the form  $y = ax + b$ , where  $a$  represents an estimated GDP growth trend. We approximated the trend line both for the entire analyzed period and for different time periods – the period of growth (2000-2007), the period of crisis (2008-2012) and the period of economic recovery after the crisis (2013-2017).

### 3 RESULTS

The results obtained from the analyses are divided into three areas, where we compare the impact of the following factors on regional heterogeneity:

- GDP at current market prices (in USD),
- Unemployment rate,
- Disposable income of households (in USD).

#### 3.1 Gross Domestic Product at Current Market Prices

Due to different prices in the countries, we converted GDP per capita based on purchasing power parity. Let's first see what the comparison of individual countries looks like. We compared all countries, although data for Poland on the Eurostat website are available for 4 years only (2014-2017). Even so, Figure 1 provides an interesting comparison.

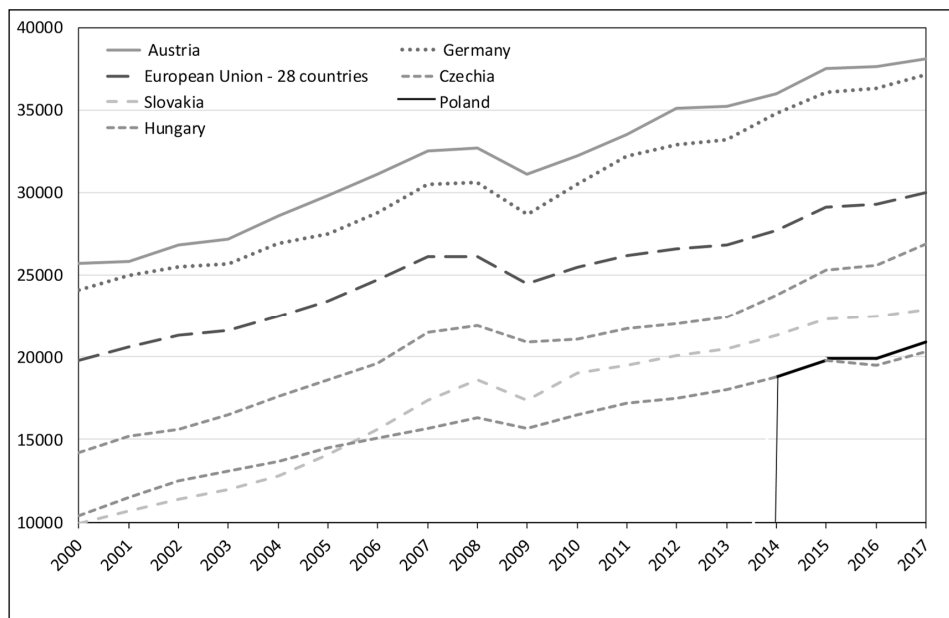


Figure 1 – GDP at Current Market Prices

At first glance, it is clear that the old EU Member States (Austria and Germany) continue to achieve significantly higher economic performance. Among the V4 countries, the Czechia shows the highest economic performance. It is followed by Slovakia and far behind Slovakia by Poland and Hungary. Overall, it is clear that convergence towards the EU's most developed countries is not fast enough to reach a similar economic level in the next decades. All V4 countries are at least converging toward the performance of less developed Western countries and the EU's economy as a whole. However, with respect to faster convergence toward the EU's economy, it is necessary to take into account the gradual enlargement of the EU for less developed countries. Table 1 shows that the speed of convergence towards more developed countries slowed down in the last years of the analyzed time period and indicates the need for stimulus measures to increase the growth potential of the V4 economies. We used linear regression to show the trends. In Table 1,  $a$  represents the slope of a line (trend) and  $R^2$  represents the coefficient of determination of the calculated trend estimate.

*Table 1 – Analysis of the GDP Trend in the V4 Countries and Selected Economies*

Country	The whole period		Boom 2000-2007		Crisis 2008-2012		Recovery 2013-2017	
	$a$	$R^2$	$a$	$R^2$	$a$	$R^2$	$a$	$R^2$
EU28	554.80	0.9431	854.76	0.9662	270.00	0.2732	800.00	0.9484
Czechia	674.51	0.9431	990.48	0.9755	100.00	0.1033	1,080.00	0.9627
Slovakia	801.24	0.9693	1022.60	0.9584	510.00	0.6270	600.00	0.9375
Hungary	534.47	0.9771	734.52	0.9833	390.00	0.7341	530.00	0.8702
Poland	No data	No data	No data	No data	No data	No data	690.00	0.8924
Germany	761.61	0.9692	845.24	0.9496	810.00	0.6104	930.00	0.9260
Austria	753.04	0.9677	1006.00	0.9629	720.00	0.5781	740.00	0.9145

Notes: Data for Poland's GDP are available in the Eurostat database starting from 2014 only. Therefore, the trend estimate is calculated only for the years 2013-2017.

The analysis of the data from Table 1 shows that long-term beta-convergence between the V4 countries and the EU28 average concerns only Slovakia and the Czechia, where the trend line slope for the entire time period is higher than the trend of the EU28 average (first column in Table 1). These values also show greater dynamics of development in the Slovakia, both during the period of growth (2000-2007) and the period of crisis (2008-2012). During the crisis, Hungary showed dynamics similar to Slovakia's dynamics in terms of diminishing differences in the concept of beta-convergence. During the years 2013-2017 only the Czechia shows a faster development than the EU28. On the other hand, other V4 countries fell short, as Poland's growth rate lagged behind the EU28 by at least 14 percentage points.

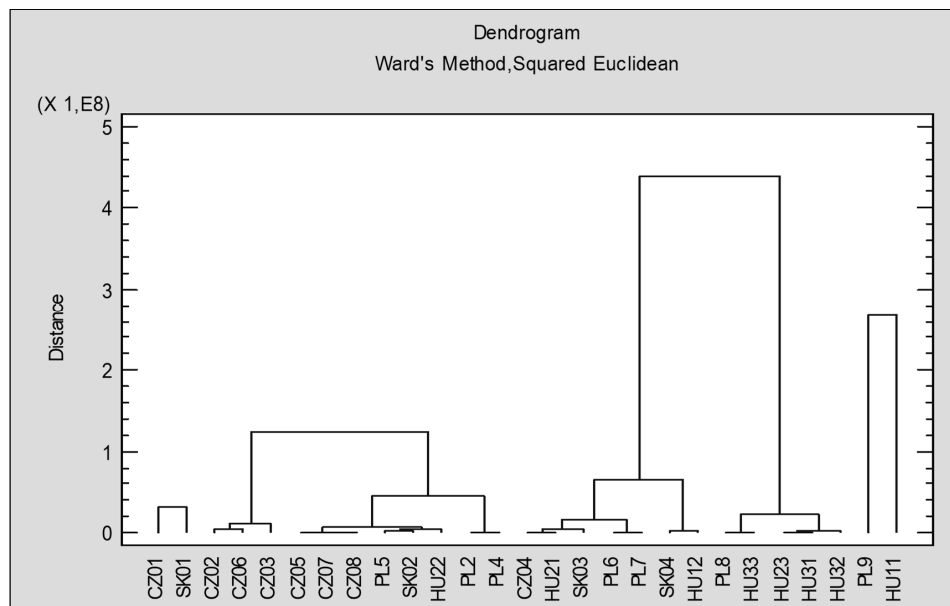
Just for the record, we can estimate, based on the current trends, when the V4 countries will reach the level of the EU28 (we made a comparison to estimate trends for the entire analyzed period). It will take Slovakia 42 years and the Czechia 48 years. Hungary will never reach it – the trend line has a lower steepness than that of the EU28. The reliability of the trend estimate during the crisis is very low, as the GDP of all countries first dropped in 2009 and then gradually went up. In this respect, the Czechia was affected by the crisis the most.

A closer look at the GDP trend at regional level (Eurostat, 2020b) suggests that one of the reasons for the low growth potential may be the lagging behind of poorer regions, whose performance is growing too slowly compared to administrative and economic centers.

The capital cities (as separate regions) with the highest GDP took the first three places, while the remaining regions lagged way behind. CZ01 Praha and SK01 Bratislava had a very similar GDP and swapped places during the last two years of the analyzed time period. They were followed by HU11 Budapest' at a considerable distance. PL09 Makroregion Województwo Mazowieckie, where Warsaw is located, was the last. The Hungarian region HU32 Észak-Alföld had the worst GDP during the last years of the analyzed time period, but alternated its worst place with its neighboring region HU31 Észak-Magyarország. It is obvious that in 2017 not only the CZ01 Praha region but also other regions in the Czechia performed very well in comparison. They took fifth to tenth place. Only the Czech region CZ04 Severozápad placed 16th. Hungarian regions placed the worst, taking five of the last six places.

### 3.1.1 Cluster Analysis

After obtaining the basic descriptive characteristics, we used the aforesaid data to perform the cluster analysis for the entire analyzed period. The clustering result is best displayed by the dendrogram in Figure 2.



*Figure 2 – Cluster Analysis for GDP at Current Market Prices by NUTS 2 Regions (V4)*

The results of the cluster analysis are consistent with the conclusions made before. The cluster analysis led to the creation of four homogeneous clusters. When reading the dendrogram from left to right, it is evident that the first cluster consists of CZ01 Praha and SK01 Bratislavský kraj. This cluster combines these two regions with the highest GDP. This only confirms the dominance of capital cities as economic leaders in their countries. The second cluster includes the majority of Czech regions; the third cluster includes the majority of Hungarian regions. The last cluster consists of 2 regions – PL09 Macroregion Województwo Mazowieckie and HU11 Budapest'. This cluster faithfully reflects the real economic power of the regions.

### 3.2 A Comparison Based on Unemployment Rate

Registered unemployment rate is another macroeconomic indicator, based on which we will compare these regions. In this case, we can compare data for a longer time period because an unemployment rate time series is available for all countries for the years 1999-2018 except the EU28. Data for the V4 countries and their comparison with selected advanced economies are shown in Figure 3.



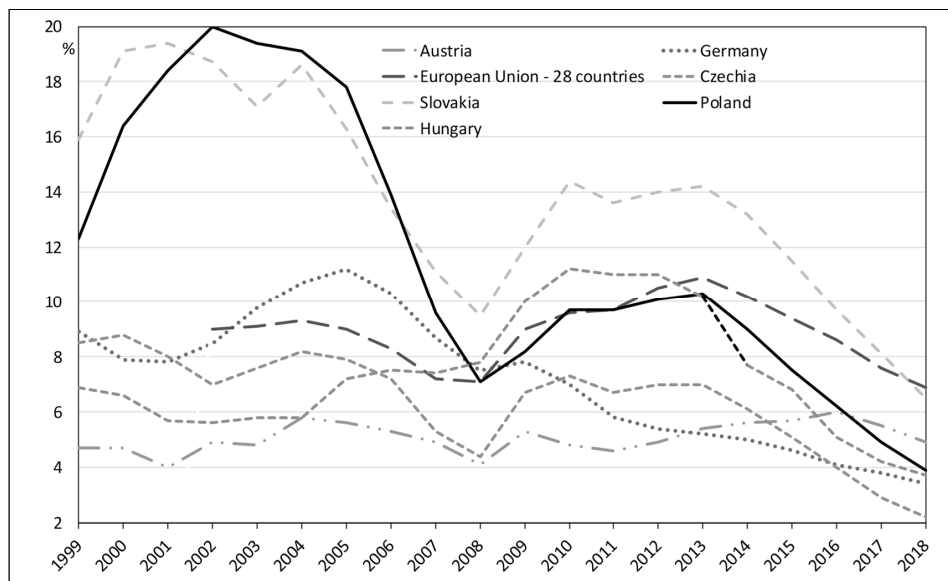


Figure 3 – Unemployment Rate (%) in V4 Countries and Selected Economies

In general, the unemployment rate in all V4 countries went down but varied in the countries due to the persistence of structural factors. These include the size of the tertiary sector, an uneven distribution of skilled labor and a strong focus of many regions on a single industry (see also Table 2). The situation in Slovakia was the worst; its unemployment rate, unlike that in the other countries, was still – despite a significant drop during the last years of the analyzed time period – above the unemployment rate in developed EU Member States. Slovakia as well as Poland also showed the highest employment sensitivity to a worsened economic situation and a significant cyclical increase in unemployment rate in the downturn phase of the economic cycle. The Czechia was again in the best position; unlike in the other three V4 countries, its unemployment rate did not exceed 10% and was below the unemployment rate in advanced economies during the last years of the analyzed time period. The trend in unemployment rate in Poland and Hungary did not differ much after 2008; Hungary's unemployment situation was a little bit better during the last post-crisis years.

The Czech regions did very well in 2018; five of them placed among the top six regions. Slovakia's unemployment rate was high in comparison; the lowest unemployment rate was in SK01 Bratislava, which placed 11th, and the Slovak regions with the highest unemployment rate took the last two places. Hungary showed big differences between regions; some ranked fifth, seventh and eighth, while others were the third and fifth from last. Polish regions also showed big differences, ranking from 10th to 24th place.

Table 2 – Unemployment Rate (Eurostat, 2020c)

	2000	2016	2018
EU – 28 countries	9.0*	8.6	6.9
EU – 15 countries (1995-2004)	8.4	9.1	7.5
Euro area (19 countries)	9.4	10.0	8.2
Germany	7.9	4.1	3.4
Austria	4.7	6.0	4.9
Czechia	8.8	4.0	2.2
Slovakia	19.1	9.7	6.5
Hungary	6.6	5.1	3.7
Poland	16.4	6.2	3.9

Notes: Data 9.0 \* is from 2001, data for 2000 are not available.

### 3.2.1 Cluster Analysis

The situation described in Figure 4 is far from as clear-cut as it was in the case of GDP. From the graphical display, we would expect the cluster analysis to cluster regions with high unemployment. Again, we set the clustering criteria to create four separate clusters. Let's see what the dendrogram for the given data looks like for the whole analyzed period.

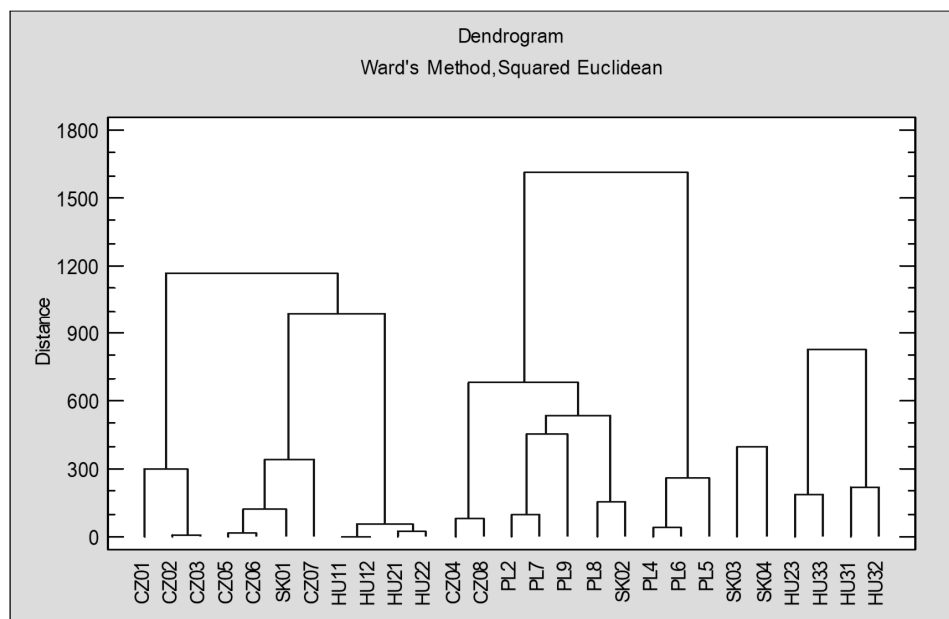


Figure 4 – Cluster Analysis for Unemployment Rates by NUTS 2 Regions (%)

The Czech regions did very well as compared to other regions. Most of them are in the first cluster. Polish regions prevail in the second cluster. The third cluster contains two Slovak regions that – in previous comparisons – did not do well. This was also confirmed by the fact that they form a separate cluster. The fourth cluster consists exclusively of Hungarian regions where the unemployment rate is rather higher.

### 3.3 A Comparison by Disposable Income of Private Households

Figure 5 shows the trend in disposable household income in individual countries; disposable household income for Poland was available only for the years 2014–2016. Again, we added Austria and Germany to the V4 countries.

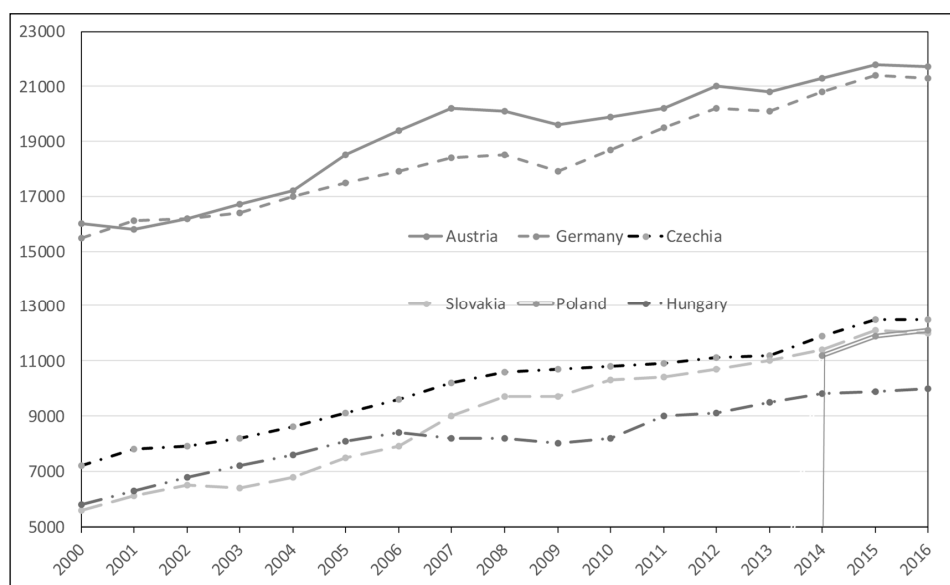


Figure 5 – Disposable Household Income – V4 Countries

The situation in terms of disposable income is similar to that of GDP; there is still a big difference between income in the most developed EU countries and income in the V4 countries. This is not surprising since income represents a relatively stable percentage of GDP. Nevertheless, we can still see certain differences as compared to GDP. At first glance, it is clear that the V4 countries (with the exception of Hungary) are more alike in terms of disposable income than in terms of GDP. It is because income represents a relatively low percentage of GDP in the Czechia, which means a relatively low participation of Czech households in generated wealth. The higher growth rate of disposable income in Slovakia and Poland enabled these countries to get significantly closer to the Czechia in spite of a higher GDP growth rate in the Czechia during the post-crisis period (Figure 5). Nevertheless, disposable household income was the highest in the Czechia during the entire analyzed period. There was not much

difference between Slovakia and Poland; disposable household income in Hungary was significantly lower.

These conclusions are also confirmed by the ratio of disposable income in the V4 countries and Germany and Austria (data for the entire EU were not available). Here, too, we can see income convergence, which, however, is slow and insufficient. With the exception of the Czech Republic, income ratios are similar or only slightly lower than in the case of GDP. In the Czechia, this ratio is significantly lower and indicates the above-mentioned low participation of households in growing wealth and room for income growth in the longer term.

Table 3 – Ratio of the V4 Countries to Other Countries

	2000		2016	
	Germany	Austria	Germany	Austria
Czechia	0.46	0.45	0.59	0.58
Slovakia	0.36	0.35	0.56	0.55
Hungary	0.37	0.36	0.47	0.46
Poland	n/a	n/a	0.57	0.56

Notes: Let's look at the results of the cluster analysis.

### 3.3.1 Cluster Analysis

We applied the principle of cluster analysis with the same parameters, as in the previous cases, to the data for the entire analyzed period. We obtained four clusters and the results were as expected.

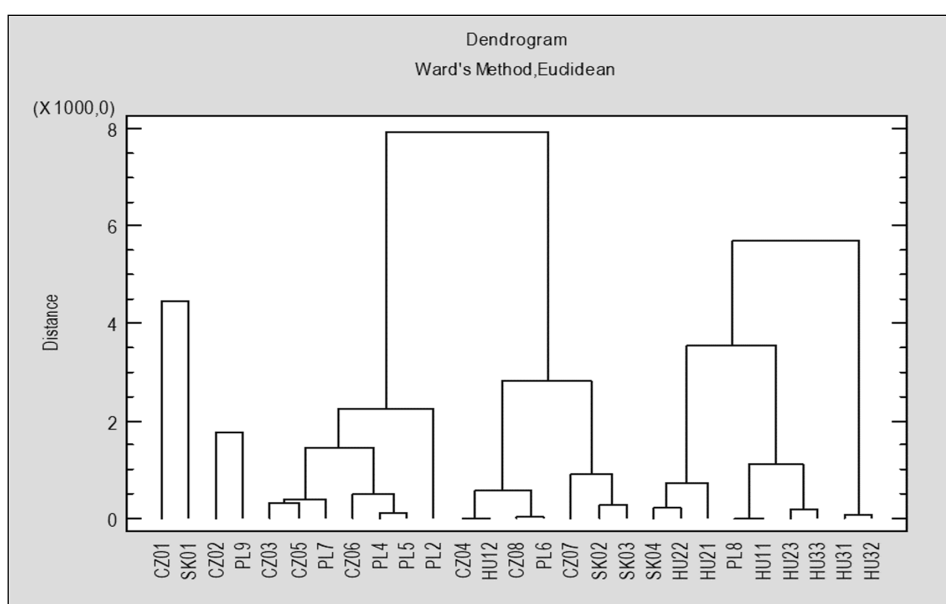


Figure 6 – Cluster Analysis for Disposable Household Income – V4 Countries

Consistent with the previous results, the two strongest regions are included in one cluster. The second cluster consists of the next two strongest regions (i.e. the third and fourth region). The third cluster consists of a large number of regions within similar disposable household income. The fourth cluster mainly represents Hungarian regions, which was expected.

#### **4 DISCUSSION**

The goal of the article was to compare a degree of convergence of V4 countries at national and NUTS 2 level. We first made this comparison using basic statistical characteristics and then verified our conclusions based on the cluster analysis. We grouped the regions into four clusters and examined the representation of individual regions in these clusters.

Although the V4 countries form a relatively homogeneous unit, their starting positions before the convergence process began were not entirely identical and these differences persist to some extent. In terms of monitored indicators, the Czechia maintains its best position in the long run, while Hungary performed relatively worst in the convergence process. This may reflect, among other things, the effectiveness of economic policies in individual countries and, in the first phase of transformation, the ability to attract foreign investors through investment incentives. On the other hand, economic development in the period of transformation also has a number of common features. In particular, it appears that the pace of convergence has slowed significantly in recent years and that it will take a very long time or even unrealistic to reach the economic level of the EU's most developed countries. One of the reasons for the slowing convergence may be the phenomenon of the so-called "middle-income trap", when V4 countries have focused too much on the comparative advantage of cheap and educated labor force as the main engine of growth (Eichengreen, Park and Shin, 2013; Ehl, 2016). To re-accelerate the convergence process, it would be necessary to improve overall efficiency and focus on higher value-added production.

Our analysis has shown that countries also have some common features in regional development. Based on all used indicators, we have shown that the regions with capital cities have a completely privileged position and that the other regions lag far behind economically. Inclusion in individual clusters was largely determined by the economic situation in each region. The same regions usually appeared in individual clusters, regardless of whether they were clustered by GDP, unemployment rate or disposable household income. The situation remains stable over time and the regions stay in the same clusters over time.

These results point to persistent disparities between regions and suggest the need for more effective cohesion policy measures to increase the economic performance of lagging regions. The higher growth potential and faster convergence of capital cities can be explained by several factors (Kuttor, 2009).

These are regions with a highly-developed infrastructure, where the majority of economically important companies is based. Thanks to the concentration of universities, these regions have a high percentage of the skilled workforce needed to achieve higher labor productivity and a high-value-added services sector that significantly contributes to the economic output. In this regard, our results have confirmed that the cohesion policy in the regions of the V4 countries should promote innovations and investments into less developed and predominantly agricultural regions, complete the necessary backbone infrastructure and develop a high-quality regional education (European Commission, 2017), which further recommends focusing on a carefully selected specialization with a high-added-value and innovative potential in selected regions.

In this context, it is worth noting that the effectiveness of cohesion policy at EU level cannot lie solely in the effective redistribution of money between countries, resp. relevant regions, but also requires well-prepared programs and good management of individual projects at the local level (see also Wostner, 2008). At regional level, the implementation of high value-added programs may be hampered by institutional factors and a lack of capacity to make the necessary infrastructure or human capital investments. Only the efficient use of allocated funds can help to transform strongly agricultural regions or regions relying on heavy industry into dynamically developing areas.

Our analysis also showed that differences in regional performance are also accompanied by significant differences in employment rates and, consequently, disposable income. Traditionally, agricultural regions and then especially regions with a concentration of mining industry, whose production is already non-promising from today's point of view and has been gradually subdued, are doing poorly in this area (see, for example, the Central Slovakia region). As high unemployment and low income levels are accompanied by social problems and low education, it is necessary to ensure wider inclusion of the population in the work process and to maintain a sufficient supply of work in order to support the regions. This is again related to the emphasis on effective retraining programs and the growth of education.

It would certainly be interesting to include other macroeconomic indicators in our comparison. However, their availability at NUTS 2 level is relatively limited; even the website of Eurostat and national statistical offices lack a lot of indicators broken down by region. However, the authors of this article will continue with their work and will compare the V4 regions with some developed regions in Europe in their future research.

## **ACKNOWLEDGEMENTS**

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## ABOUT AUTHORS

**Pavel Rezabek**<sup>0000-0003-1944-8772</sup> (P.R.) – Assoc. Prof., Prague University of Economy and Business, Faculty of Economics, Prague, Czech Republic; former member of the of the Bank Board of Czech National Bank, e-mail: pavel.rezabek@vse.cz.

**Lubos Marek**<sup>0000-0003-4761-1936</sup> (L.M.) – Full Prof., Prague University of Economy and Business, Faculty of Informatics and Statistics, Prague, Czech Republic, e-mail: marek@vse.cz.

**Petr Doucek**<sup>0000-0002-5647-661X</sup> (P.D.) – Full Prof., Prague University of Economy and Business, Faculty of Informatics and Statistics, Prague, Czech Republic, e-mail: doucek@vse.cz.

**Lea Nedomova**<sup>0000-0002-8499-959X</sup> (L.N.) – Assist. Prof., Prague University of Economy and Business, Faculty of Informatics and Statistics, Prague, Czech Republic, e-mail: nedomova@vse.cz.

## AUTHOR CONTRIBUTIONS

Conceptualization, P.R., L.M. and P.D.; Methodology, P.R.; Validation, P.R.; Formal analysis, P.D., L.M. Resources, L.N.; Original draft preparation, P.D., L.N.; Review and editing, P.D.; Visualization, L.N.; Supervision, P.D.; Funding acquisition, P.D.

## CONFLICTS OF INTEREST

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.



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