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The Catching up Processes of the Regions of the Visegrad Group Countries

Abstract

The majority of Central and Eastern European post-socialist countries acceded to the European Union in 2004. The integration of these economies to the Union had begun earlier, which was strengthened by grants from the Structural Funds after the accession. One of their aims is to facilitate the catching up processes of less developed regions and their convergence to the average of older member states. In our study[1], we examine the success of the catching up processes of the NUTS3 regions in the four Visegrad Group countries (V4), i.e., the Czech Republic, Hungary, Poland and Slovakia, between 2000 and 2014 to the average of the 15 initial member states of the European Union. Is there a process of catching up in each region, and if so, is it at a similar or a highly different rate? We analyze the development of GDP per capita at Purchasing Power Parity, and we examine disparities in the level of catching up using entropy-based Theil indexes. We provide a detailed analysis of two of the influencing factors of the catching up process of regions. Firstly, we look at whether the catching up process of the regions took place in a similar or very different way compared to the national average. Secondly, we examine how the size of the biggest city of the regions affected catching up, and whether the role of the biggest city of region can be shown.

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***Keywords**: economic catching up; Visegrad Group countries; NUTS3 regions; Theil index; breakpoint; agglomeration economies*

***JEL**: O18; O40; R11*

1. Introduction

One of the main objectives of the post-socialist countries joining the European Union in 2004 has been to catch up to the average of the existing member states (Artelaris et al. 2010; Farkas 2016; Gorzelak et al. 2010; Lux, Horvath 2017; Molendowski 2017; Norkus 2015). The economic catching up processes of less developed countries and regions can be assessed in various ways, and it is most common to measure it with GDP per capita, e.g., in the practice of the European Union. In the analysis of the catching up process of regions, a very important question is how independent the economic development of the regions can be of national processes, and whether territorial disparities increase or decrease (Smetkowski, Wojcik 2012; Próchniak, Witkowski 2014).

The literature on the economic catching up and/or growth of the regions emphasizes the importance of spatial concentrations and agglomeration economies (Donaghy 2009; McCann, van Oort 2009; Storper 2017). A great deal of scientific research has studied the role of big cities, especially capital and second-tier cities, in the economic growth of regions (Camagni, Capello 2015; Dijsktra et al. 2013; Parkinson et al. 2015). Capello et al. (2015) classify the potential agglomeration benefits of the regions according to settlement size and population density, thus isolating different catchment paths.

In the cohesion policy of the European Union, regional catching up is primarily considered at the NUTS2 territorial level. Today, an increasing number of analyses concerning the growth of regions are based on NUTS3 level, which refers roughly to a city and its agglomeration (Goecke, Hüther 2016; Neumann et al. 2014; Smetkowski 2015). The European Union typed the NUTS3 regions according to the size of the cities and the population density of the region[2]: predominantly urban regions, intermediate regions, and predominantly rural regions.

In our study, we examine the characteristics of the catching up processes of the *NUTS3 regions* in the four Visegrad Group countries (V4), the Czech Republic, Poland, Hungary and Slovakia, between 2000 and 2014. These neighbors in one block have a similar historical and cultural past and economic structure. We base our analysis of economic catching up on the data of GDP per capita at the

[2] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Urban-rural_typology

Purchasing Power Parity (PPP) of the NUTS3 regions, compared to the average of the 15 older member states of the European Union (EU15). Although it is possible to assess the success of catching up after several decades, we consider that the period of the past decade and a half is sufficient for the initial evaluation of the spatial processes.

The main research questions of our study are:

1. Did the economic catching up processes of the NUTS3 regions have a similar rate or were there substantial differences?
2. To what extent does the catching up of regions depend on the catching up process of the country or the size of the biggest city of the regions?

In our study, we first describe the database and the entropy-based Theil index we apply to study the disparities in the catching up processes of the NUTS3 regions. Then we review the characteristics and types of catching up processes in the Visegrad countries and their NUTS3 regions from 2000 to 2014. The process of catching up has several dimensions, beyond describing the processes; this paper elaborates on two background factors, namely the similarities within the countries and the potential effects of the biggest city of the regions.

2. Data and methodology

GDP is the core indicator considered in the measurement of catching up in the European Union. The methodology of the compilation of national accounts was changed starting from the autumn of 2014 to the ESA2010 (European System of Accounts) replacing the former ESA95 (EC 2013). *Purchasing Power Parity* (PPP) is commonly used for the international comparison of GDP, and *Purchasing Power Standard* (PPS) is the currency applied as the base of conversion. In our analysis, we use the data of GDP per capita at Purchasing Power Parity in the international dollar (USD), compiled based on the ESA2010. It is rare to find a *territorial price index* by region; thus we take the data from Eurostat database, knowing that the GDP of countries in PPS is converted to the GDP data at current prices into PPS for the regions within a country.

The time frame of our study was limited by the accessibility of the recalculated GDP data based on ESA2010, as the data related to the NUTS3 regions of the four countries have been available retroactively only since 2000. We collected the annual GDP (and population) data for the NUTS3 regions from 2000 to 2014 from the online database of the statistical office of each country.

The comparative regional studies of the EU or the target areas of the regional policy are usually based on the NUTS2 regions. In our opinion, the NUTS2 level is not only too heterogeneous, but it also has a different size in the four coun-

tries. For example, according to the national census of 2011, in Poland, the average population of the 16 NUTS2 regions (provinces) is 2,407,000 people, while in the other three countries it is considerably smaller: in the Czech Republic 1,315,000 people, in Hungary 1,429,000 people and in Slovakia 1,358,000 people. In the NUTS3 territorial units, there is generally only one important city and the average population of the regions is roughly similar: in the Czech Republic, it is 751,000 people, in Poland, 535,000 people, in Hungary 500,000 people and in Slovakia, 680,000 people.

In three countries the NUTS3 territorial classification did not change significantly between 2000 and 2014; it was modified only in Poland, though several times. We considered the Polish territorial classification valid from 2015 as the basis, retroactively until 2000, which contains 72 NUTS3 units. In all four countries, capital cities form a separate unit, which we treat collectively with the NUTS3 regions forming their agglomeration as, from an economic perspective, they form a broadly contiguous region, and in Poland, we combined an additional seven cities and their neighboring regions representing their agglomeration (Lengyel 2016, 2017). This classification is very close to the new Eurostat classification of metropolitan regions[3]; however, we did not accept the different handling of the Slovakian capital region. The average population of the resulting *99 NUTS3 territorial units* is 650,000 people; the smallest has 190,000 people (Swiecki), while the largest has 3,340,000 people (Warsaw and its agglomeration). The population of 12 NUTS3 regions exceeds 1 million, 10 of them are merged metropolitan regions.

The studied NUTS3 territorial units by country, forming the mentioned metropolitan regions by merging, are the following:

- In the Czech Republic, 13 units (including Prague+: Prague and Středočeský),
- In Poland we formed 60 units from the original 72 regions (including Warsaw+: City of Warsaw, Warsawi-West and Warsaw-East; Łódź+: City of Łódź and Łódzki; Kraków+: City of Kraków and Krakowski; Katowicki+: Katowicki, Bytomski, Gliwicki, Sosnowiecki and Tyski; Poznań+: City of Poznań and Poznański; Szczecin+: City of Szczecin and Szczeciński; Wrocław+: City of Wrocław and Wrocławski; Gdański+: Gdański and Trójmiejski),
- In Hungary, 19 units (including Budapest+: Budapest and Pest),
- In Slovakia, 7 units (including Bratislava+: Bratislavský and Trnavský).

To examine the similarities and disparities in the catching up process, we selected the *Theil Index*, due to its decomposability on the one hand, and its applicability to relative indexes on the other. The Theil Index is a special case of the generalized entropy index; its formula in the case of n territorial units (Lengyel et al. 2017; Thissen et al. 2013) is

[3] http://ec.europa.eu/eurostat/web/metropolitan-regions/background

$$T = \frac{1}{n}\sum_{i=1}^{n}\left[\frac{y_i}{\overline{y}}\ln\left(\frac{y_i}{\overline{y}}\right)\right]$$

where $\overline{y}$ indicates the average. The range of the index based on the basic formula is the $[0;\ln n)$ interval, which can be normalized to $[0;1)$ interval dividing by $\ln n$. It takes value 0 if there are no disparities, and it takes its maximum if the examined phenomenon is concentrated in a single territorial unit. In the case of per capita measures, the index can be calculated by weighting based on population weights.

$$T = f_m \sum_{m=1}^{M}\left[\frac{\mu_m}{\overline{y}}\ln\left(\frac{\mu_m}{\overline{y}}\right)\right]$$

where $\overline{y}$ indicates the weighted average, μ_m is the income per capita in region *m*, and f_m is the fraction of the population in region *m* (Shorrocks 1980). The obtained index cannot be interpreted directly, but its higher value indicates higher disparities (Galbraith, Hale 2014).

The Theil Index – like entropy-type indices – is *decomposable*. The value of the index is equal to the sum of the weighted average of disparities within sub-populations and the disparities between sub-populations. The disparity in a country's income conditions can be decomposed to the sum of the disparities within each region and between the regions, or, in our example, the differences between the regions of the Visegrad countries can be decomposed to the sum of the disparities within the countries and between the countries. The rates obtained by decomposition can be interpreted in percentages. Dividing the population into *m* sub-populations and introducing $\overline{y}_i$ for the average of sub-populations, s_i for the share of i^{th} sub-population in the sum of values and T_{T_i} for the Theil Index of sub-populations looks as follows:

$$T = \sum_{i=1}^{m} s_i T_{T_i} + \sum_{i=1}^{m} s_i \ln\frac{\overline{y}_i}{\overline{y}}$$

The formula is basically comprised of a first term weighted from the Theil Indexes of the sub-populations and a second term indicating the Theil Index calculated from the average of the sub-populations. Its method of production shows that it can be decomposed to further levels (Thissen et al. 2013).

We used the *Chow Test* to *test the stability of the relationship between two variables* (Christopher 2007). The Chow Test is based on linear regressions and is used to determine whether the independent variables have different impacts on different subgroups. It tests the null hypothesis of the *lack of structural break,* and it is based on the comparison of the error terms of the regression on the total sample and the error terms of the regressions on the sample cut into two parts. The

test statistic is based on the sum of squares of the error terms, and follows *F distribution under the null hypothesis*.

In the subsequent parts of the study, first, we present the data on catching up at national and NUTS3 levels. Then we elaborate on the entropy-based decomposition of territorial disparities observed in the process of catching up, as well as the potential effect of the population and the biggest city of the region outlined in the catching up process of the region.

3. The catching up processes of the Visegrad countries and their NUTS3 regions

The catching up processes of the V4 countries in the period between 2000 and 2015 initially have similar characteristics, which can be attributed primarily to the pre-accession processes, the inflow of foreign capital and the accession in 2004 (Dorożyński, Kuna-Marszałek 2016; Farkas 2016). After the crisis of 2008, the catching up process of the Slovakian and Polish economies stayed continuous, while the Hungarian and Czech economies basically stagnated until 2012 and became more dynamic only from 2013, from which point all four countries converged with the EU15 average at a similar rate (Fig. 1). At the turn of the millennium, the difference between the most developed and least developed countries was 18 percentage points, which increased to 24 percentage points by 2006, and this gap gradually decreased to 12 percentage points from 2009, i.e., today some convergence can be detected between the four countries. In the case of the EU15, of course, it is a "fluctuating average", the weakening performance of certain older member states (Greece, Portugal, Spain, etc.) dragged down this average as a benchmark after the crisis of 2008.

Two kinds of development path can be observed. On the one hand, there is the Slovak and Polish path, and on the other hand, the Czech and Hungarian economies moved in line. Despite the similarity, there is also a significant difference between the performance of the Czech and Hungarian economies; until 2004 the difference was only 8 percentage points, but after that, it quickly increased to 15 percentage points in 2010, and then decreased to 13 percentage points from 2013. In addition, the crisis of 2008–2009 affected the four countries differently; while the catching up process of the Polish and Slovakian economies had a nearly sustained pace throughout, the Czech and Hungarian economies slowed down, and there was no convergence between 2008 and 2013. What is more, in Hungary, the same was true from as early as 2006.

Over the past decade and a half, the V4 countries increased their position from 46% of the EU15 average in 2000 to 67%, i.e., their total catching up was 21 percent-

age points. Slovakia was the most dynamic country (28 percentage points) and Hungary was the slowest (13 percentage points) (Table 1). In 2015, the Czech Republic was at 77%, Slovakia at 74%, Poland at 65% and Hungary at 64%. Over one and a half decades, the total GDP of the V4 (in PPS) increased from 7.9% to 10.7% compared to the GDP of the EU15; thus, despite catching up, the economic output of the V4 is still only a fraction, about a tenth, of the EU15. The predominance of the Polish economy affects the V4 average as nearly 60% of the population of the V4 countries lives in Poland.

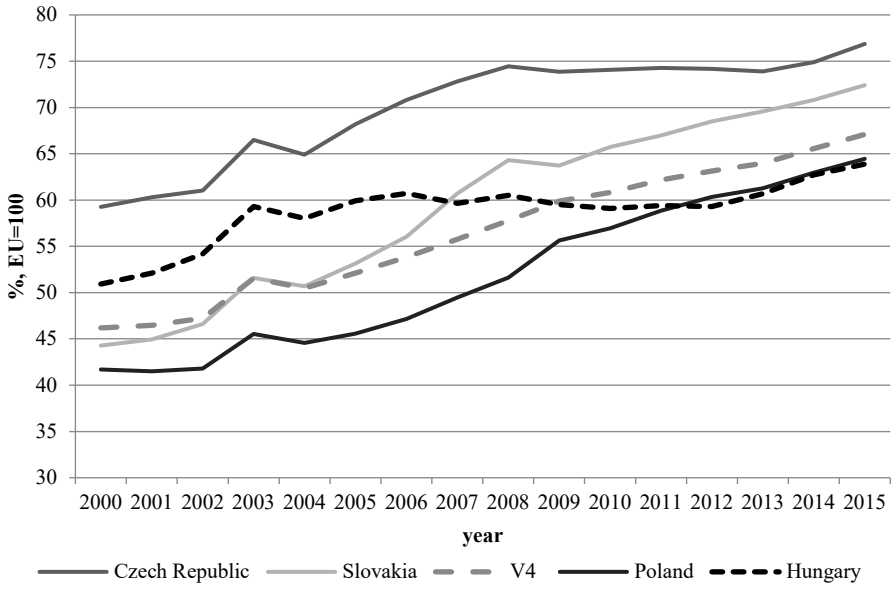

Figure 1. GDP per capita of V4 countries, PPS (USD), percent (EU15=100)

Source: World Bank.

Table 1. GDP per capita in PPS (USD)

	Per cent (EU15=100)				Change of percentage points		
	2000	**2007**	**2010**	**2015**	**2007–2000**	**2015–2010**	**2015–2000**
Czech Republic	59.3	72.8	74.1	76.9	13.6	2.8	17.6
Poland	41.7	49.5	56.9	64.5	7.8	7.5	22.7
Hungary	50.9	59.7	59.1	63.9	8.7	4.8	13.0
Slovakia	44.3	60.7	65.7	72.4	16.4	6.7	28.1
V4 total	46.2	55.8	60.8	67.1	9.6	6.3	20.9

Source: World Bank.

We note that between 2000 and 2015, the population of the EU15 increased from 376.4 million people to 401.6 million people, i.e., by 25.2 million people (by 6.7 %). Meanwhile, it decreased in the V4 countries from 64.3 million peo-

ple to 63.8 million people, so it did not change substantially. The population of the V4 countries decreased from 17.1% to 15.9% compared to the EU15; thus, the weight of the V4 within the EU is not significant in terms of either economy or population.

For the analysis of catching up in the 99 NUTS3 regions, we took the average of two years, 2000 and 2001, as a starting period due to the annual fluctuations, and the average of 2013 and 2014 as the closing period. In the starting period, the average of the regions was 46% compared to the EU15, while in the closing period it was 65%, evidently in line with the average of the V4 countries. The correlation between the data of the two periods is relatively strong (R^2=0.7829, linear correlation: 0.885); thus, the average catching up of less developed regions was not significantly faster than that of the already developed regions (Fig. 2).

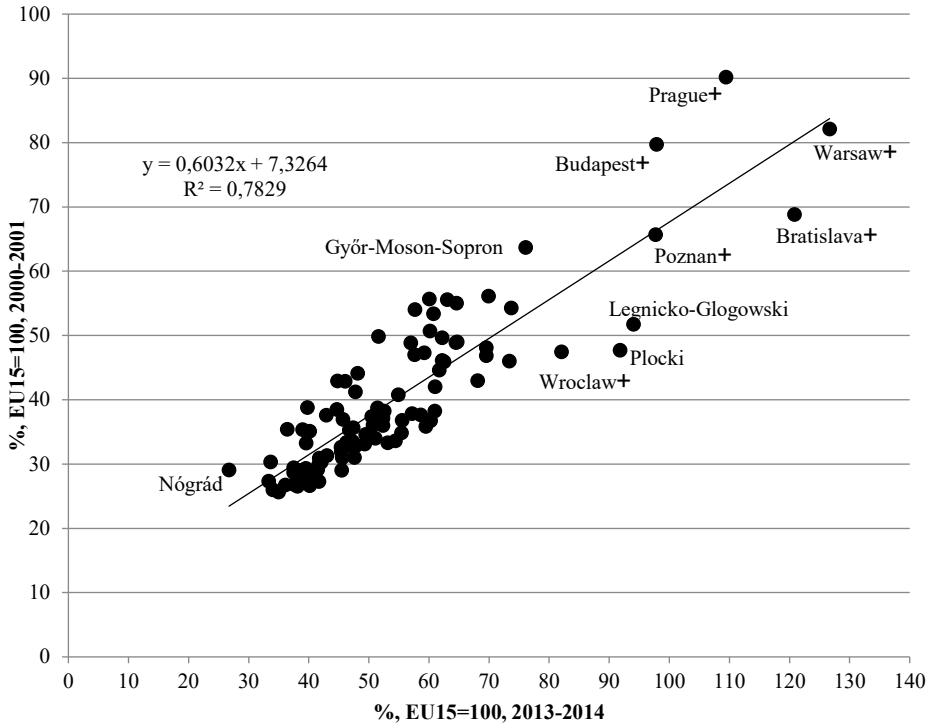

Figure 2. GDP per capita of NUTS3 regions, PPS (USD), percent (EU15=100) in 2000–2001 and 2013–2014

Source: authors' own elaboration.

While in 2000–2001 none of the regions reached the EU15 average, in 2013–2014, 3 metropolitan regions were already well above it (Appendix). Warsaw and its region reached 126.7% (improving by 44.5 percentage points), Bratislava and its region, 120.8% (improving by 52.0 percentage points), Prague and its region,

109.4% (improving by 19.2 percentage points), followed by Budapest and its agglomeration with 97.8% (improving by 18.1 percentage points). In the European Union, 9 regions exceeded 75%, considered to be a certain "development threshold" (we mentioned that we consider the average of the EU15 and not the EU28) in 2013–2014, besides the 4 capital regions; 4 Polish regions (Poznan and its region 97.7%, Legnicko-Glogowski 94.0%, Plocki 91.8%, and Wroclaw and its region 82.0%) and one Hungarian region, Győr-Moson-Sopron, with 76.1%, where the latter has mainly industrial regions (Lux and Horváth, 2017). It is evident from the data that the capital regions are in the lead in terms of both the rate of catching up and the level reached; apart from Budapest, the three other capitals have already "caught up"; they are above the EU15 average, and their competitiveness also stands out (Lengyel 2016).

Measuring the catching up between the two periods in percentage points shows that the regions of Bratislava and Warsaw are in leading positions, followed by 12 Polish and 2 Slovakian regions reaching at least 20 percentage points (*Appendix*). In terms of catching up among the 99 regions, 15 of the last 18 places are occupied by Hungarian regions (out of 20 Hungarian regions), and only 2 Czech and 1 Polish regions are included. The last 10 regions achieved an improvement of at most 4 percentage points, out of which 8 are Hungarian and 2 are Czech. The last place is occupied by the Hungarian Nógrád, the only region of the 99 where there was no catching up but actually a decline by 2.3 percentage points.

We categorized the regions according to the position they have compared to the *median of the 2013–2014 values* (50th place in the ranking has 50.7%; above it has a *high*, and below it has a *low position*) and compared it to the median of the catching up rate (12.8 percentage points; above it has *quick*, and below it has *slow catching up*) (Appendix). The 37 regions reaching higher values than the average and which are catching up quickly include 25 Polish, 5 Czech, 5 Slovakian and 2 Hungarian regions. The 13 regions reaching higher values than the average but which are catching up slowly include 8 Czech, 3 Hungarian and 2 Polish regions. The 12 regions below the average level but which are catching up quickly include 10 Polish and 2 Slovakian regions. The 37 regions below the average level and which are catching up slowly consist of 14 Hungarian and 23 Polish regions. Consequently, more than two-thirds of the Hungarian regions and about 40% of the Polish regions belong to the less developed and slowly catching up regions (the last 10 consists only of Hungarian regions), while none of the Czech and Slovakian regions fall into this category. Regarding two periods, between 2000 and 2008, and between 2009 and 2014, the annual rate of catching up in the case of quickly catching up regions is higher in both periods compared to the slowly developing regions.

In the case of the *spatial location of the four types of regions,* the role of geographical proximity and accessibility is prominent, and a core-periphery relationship is outlined (Fig. 3). The majority of the regions reaching a high value

(high-quick and high-slow) can be found within an arc with Prague as the center, probably due to the historical background and the geographical proximity of Bavaria and Lower Austria. The less developed regions (low-quick and low-slow) are placed on an external arc, which starts northwest from the Polish–German border and ends on the southwestern, Slovenian and Croatian border of Hungary. This core-periphery pattern is slightly modified by the Polish metropolitan regions (and Košice), and the Silesian regions. It can be established that proximity to the developed German and Austrian regions influences catching up. Furthermore, the settlement system and the spatial structure also have an impact on catching up, regarding which the metropolitan regions, playing a key role in the polycentric Polish settlement network, lead the way.

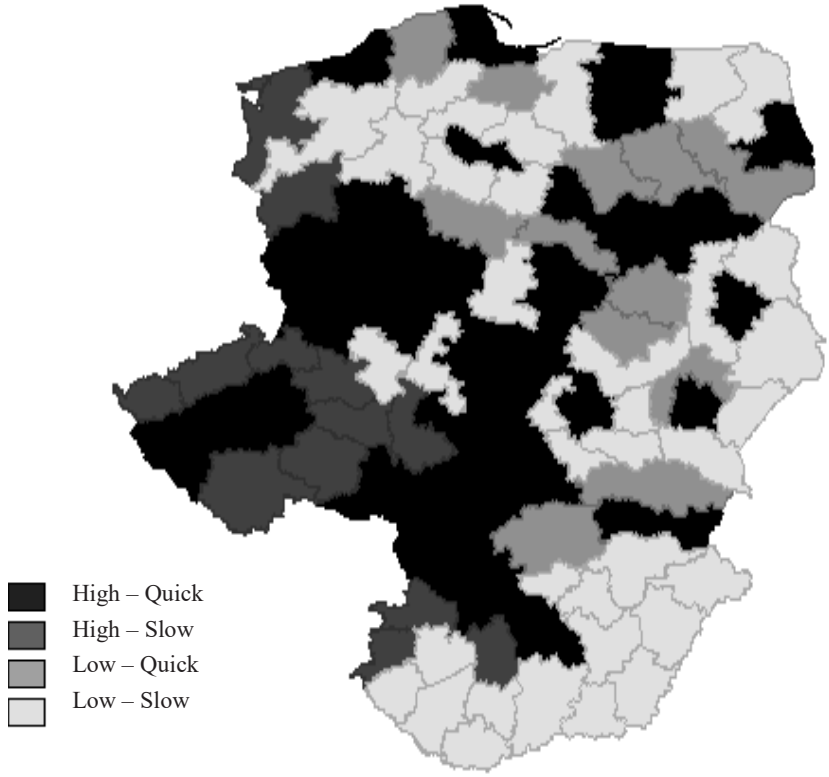

Figure 3. Types of NUTS 3 regions according to catching up characters

Source: authors' own elaboration.

Based on the data, there has been a process of catching up with the EU15 average in each V4 country, and the differences between the countries have also been reduced in the past decade and a half. Two developed paths are outlined for the countries; the Czech and the Hungarian, and the Polish and the Slovak countries

have a similar catch-up character. It is also indicated that in each country, more populated regions, particularly the capital cities and their regions, have a quick and outstanding catching up process. The basic question is whether a region can be independent of national trends and whether the disparities in catching up among the regions of the four countries have decreased. The other question is whether the catching up of metropolitan regions is automatic, i.e., whether the critical population number required for global competition is sufficient for strengthening agglomeration economies and thereby for more dynamic catching up.

4. The effect of the countries and the most populated cities of regions

Besides the historical and socioeconomic similarities of the Visegrad countries, there are also significant differences in the catching up process of their regions. They responded to the crisis of 2008–2009 differently, and the question is whether the regions could differ from their country's catching up processes. As we have mentioned, we use the entropy-based Theil Index to measure the disparities in the catching up processes of the regions, which also enables us to show the development of disparities between the countries and within each country.

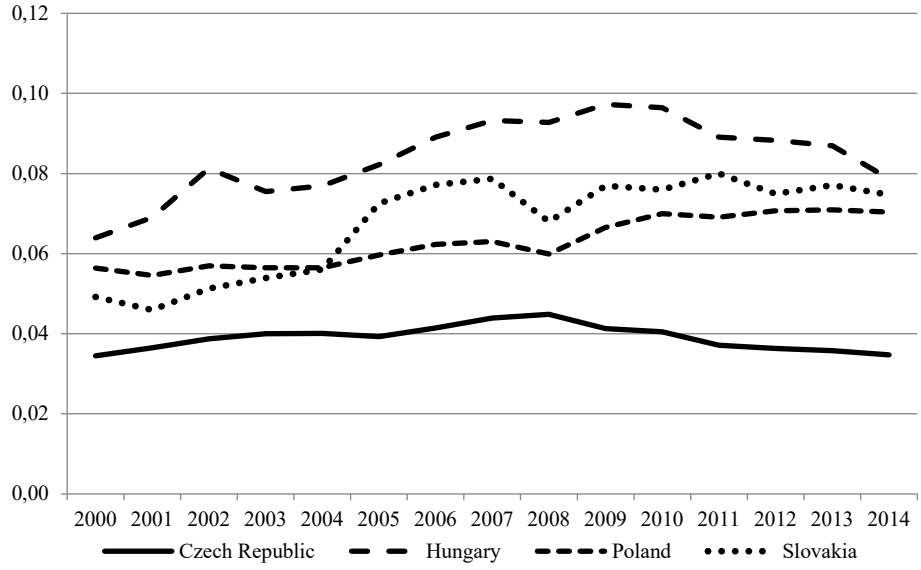

Figure 4. Theil Index in V4 countries

Source: authors' own calculations.

The total Theil Index indicates that, considering the 99 regions of the V4 countries collectively, the *differences in the rate of catching up* increased from 2000 to 2006, which was followed by a slow reduction (Fig. 4). The disparity was the biggest in Hungary throughout, while the lowest was in the Czech Republic. The peak was in 2008 in the Czech Republic and in 2009 in Hungary; from this point, the differences in the rate of catching up within the country continuously decreased. Disparities stagnated in Slovakia from 2007 and in Poland from 2009. In the Czech Republic, differences decreased to the level at the beginning of the 2000s by 2014, while in the other countries they remained at a considerably higher level compared to the year of 2000. The quick catching up preceding the crisis of 2008 was accompanied by the growth of territorial differences in each country, but the moderated development after the crisis slightly reduced territorial disparities.

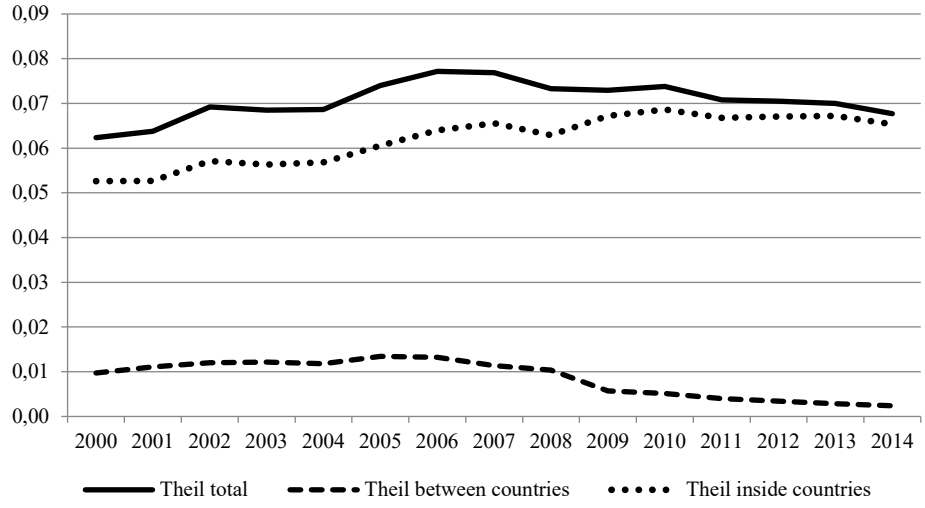

Figure 5. The Theil index and its decomposition

Source: authors' own calculations.

The slight decrease of the total Theil Index after the growth until 2007 is primarily due to the *reduction of the differences between countries* (Fig. 5). While in 2000, 16% of the disparities can be traced back to the disparity between countries, in 2014 this decreased to 3.5%. The disparities within countries are on an increasing trend on the whole, which can be attributed primarily to the increase in Polish and Slovakian territorial disparities. Both countries' catching up is quick and consistent, but it also entails an increase in territorial differences; the economic growth of metropolitan regions is stronger, and the catching up process of peripheral, mainly rural regions is significantly slower.

In the Visegrad countries, the institutional and business sectors are also concentrated in the *largest settlement of the regions*. Each region with a city with

at least half a million inhabitants improved its position by a minimum of 18 percentage points, and the regions with a city with at least 300 thousand inhabitants improved by at least 15 percentage points (except for Szczecin in Poland, considered an outlier) (Fig. 6). There was significant variation in the catching up of regions with smaller cities, also including some outliers (Poland's Plock and Legnica), but the vast majority improved their position by 5–18 percentage points (Salgótarján in the Nógrád region of Hungary is a negative outlier). It seems that the engines of the regions' catching up are the cities as the "gateway cities" reaching a critical mass in the global competition.

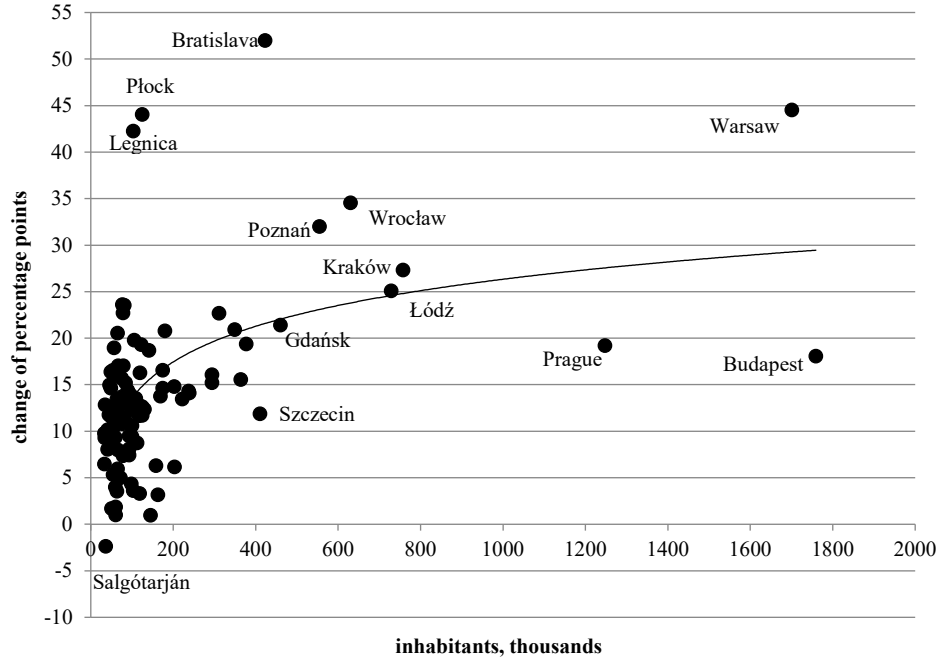

Figure 6. Change of GDP per capita of NUTS3 regions between 2013–2014 and 2000–2001 (PPS, USD, EU15=100), percentage point and the population of the biggest city of regions

Source: authors' own calculations.

The nonlinear relationship between the population of the region's biggest city and the region's catching up can be analyzed from the aspect of *breakpoint*. The Chow test assumes the knowledge of the breakpoint and thus *we conducted the test for every potential breakpoint* (the size of a city in our example) and hereafter we considered as a breakpoint the observation (1) where there was a significant break, (2) at the lowest empirical significance level.

The Chow tests, based on linear regressions, considering every potential settlement size showed that a breakpoint is outlined the most clearly in the case of a city size of 93,000 people. For a small size city, a larger population is accompanied

by a higher catching up rate (by 0.14 percentage points per 1000 people, p-value = 0.001), while above 93,000 people, there is no evident significant correlation (0.01 percentage points per 1000 people, p-value = 0.896).

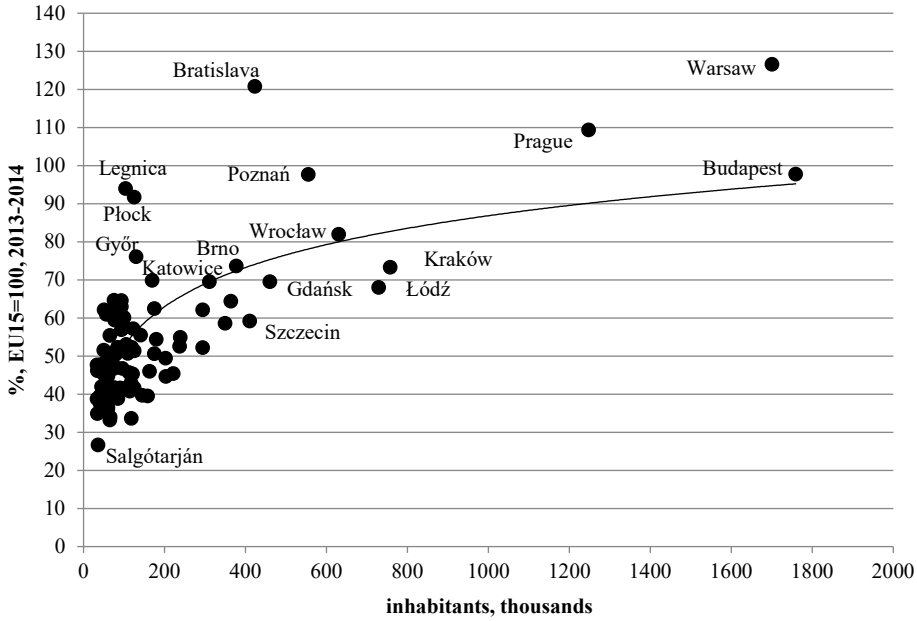

Figure 7. GDP per capita of NUTS3 regions in 2013–2014 (PPS, USD), percent (EU15=100) and the population of the biggest city of regions

Source: author's own edition.

The regions with cities take the lead not only in the rate of catching up, but also in terms of the level and *position* compared to the EU15 average in 2013–2014 (Fig. 7). Each region with a city with at least half a million inhabitants is at minimum 70%, while the regions with a city with at least 300,000 inhabitants are at minimum 60%. The regions with a smaller urban population have high variation between 35–65%, and there are some outliers (Legnica, Plock, Győr, and again, Salgótarján).

The nonlinear relationship between the population of the biggest city and the GDP per capita position of the region compared to the EU15 in 2013–2014 was also analyzed using Chow tests in terms of breakpoint. The breakpoint here was outlined at 100,000 people. In the case of cities with fewer than 100,000 people, a greater population involves a higher relative development level (by 0.26 percentage points per 1000 people, p-value = 0.000), while above 100,000 people there is no significant correlation (0.04 percentage points per 1000 people, p-value = 0.634). In terms of catching up and the position reached in 2013–2014, the Hungarian Nógrád region and its center, Salgótarján, had the worst position among the 99 regions.

The above-described results collectively indicate that the size of the biggest city in the region is equally important in terms of catching up and the level of development reached by the end of the examined period. In the case of the cities below about 100,000 people, the catching up rate and development level of the region strongly correlates with the city size. However, in the case of the biggest city above 100,000 people, the size of the city does not have an additional positive effect; there is high variation, and other factors are important, e.g., urban development exploiting urbanization agglomeration economies. The capital cities stand out in all four countries, but only Poland has further cities that can perform dynamic catching up as a regional growth pole.

5. Conclusions

In our study, we examined the catching up processes of the NUTS3 regions of the Visegrad countries compared to the EU15 member state average between 2000 and 2014 on the basis of the GDP per capita based on Purchasing Power Parity. The data indicate a catching up process in all 4 countries, although along two different paths: the Czech and Hungarian economies slowed down between 2006 and 2008, while the Slovak and Polish economies developed relatively steadily throughout. Catching up is evident in the case of 98 regions out of the 99, only the position of the Hungarian Nógrád region deteriorated.

The development of the regions had a different tendency, but based on the Theil Index, the role of national economic policies and institutions is significant, and we consider the efficiency of territorial policy and territorial development to be a major factor. Observing the 99 regions of the four countries collectively, the differences in the rate of catching up increased between 2000 and 2006, and decreased after the crisis. The differences within the countries were continuously reduced in the Czech Republic and Hungary after 2009, while they stagnated in Slovakia and Poland. The performance of the capital regions reaching a dynamic and high level was outstanding; Warsaw, Bratislava and Prague have already caught up with the EU15 average, while Budapest and its region has been moving along with it, keeping a distance for some time.

The population of the regions, especially the number of inhabitants of the biggest city, has a strong correlation with the quickness of the catching up process and the achieved position. Each metropolitan region reached a high level, but they have high variation in terms of the rate of their catching up. In the case of regions with smaller cities, both the reached level and the catching up rate correlate with the size of their biggest city. The role of the settlement network is evident in the success of catching up, especially in the case of the Polish polycentric settlement system, while in Hungary and Slovakia, with the exception of the capital cities, the cities are too small to provide a base for globally competing companies.

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Appendix

Population and GDP per capita of NUTS 3 regions in 2013–2014 (high, low), per cent (PPS, EU15=100) and change from 2000–2001 to 2013–2014 (quick, slow), percentage points

Name	Population 2011	Population of the biggest city	High	Quick
Bratislava+	1206	423	120.8	52.0
Warsaw+	3272	1701	126.7	44.5
Plocki	335	125	91.8	44.1
Legnicko-Glogowski	455	103	94.0	42.3
Wroclaw+	1197	630	82.0	34.6
Poznan+	1156	555	97.7	32.0
Kraków+	1457	758	73.4	27.3
Łódź+	1109	729	68.1	25.1
Piotrkowski	598	76	59.5	23.6
Zilinský	689	81	60.3	23.5
Katowicki+	2795	311	69.5	22.7
Nitriansky	690	78	61.0	22.7

Name	Population 2011	Population of the biggest city	High	Quick
Gdanski+	1289	460	69.5	21.4
Lubelskie	717	349	58.6	20.9
Rzeszowski	622	179	54.4	20.8
Leszczynski	551	65	55.4	20.6
Kaliski	673	105	53.1	19.8
Jihomoravský	1165	377	73.7	19.4
Opolski	630	123	57.2	19.3
Prague+	2511	1247	109.4	19.2
Trenciansky	594	56	61.0	19.0
Rybnicki	640	141	55.5	18.7
Budapest+	2941	1759	97.8	18.1
Siedlecki	316	79	51.1	17.1
Komárom-Esztergom	304	66	61.7	17.0
Bielski	662	175	62.5	16.5
Zielonogórski	636	119	52.3	16.3
Moravskoslezský	1233	294	62.2	16.1
Zlínský	590	75	64.7	15.7
Bydgosko-Torunski	774	364	64.5	15.6
Jeleniogórski	582	84	52.4	15.2
Bialostocki	510	294	52.2	15.2
Czestochowski	529	237	52.6	14.3
Kosický	792	239	54.9	14.1
Plzeňský	571	169	69.9	13.8
Koszalinski	362	109	50.7	13.5
			High	**Slow**
Gorzowski	387	125	51.4	12.7
Vysočina	512	51	62.2	12.5
Győr-Moson-Sopron	445	130	76.1	12.4
Szczecin+	921	410	59.2	11.9
Olomoucký	639	100	57.6	10.6
Královéhradecký	554	93	64.6	9.5
Pardubický	516	100	60.1	9.5
Ústecký	829	93	57.0	8.1
Jihočeský	636	93	63.0	7.4
Vas	256	78	60.8	7.4
Fejér	422	98	60.0	4.3
Liberecký	438	103	57.6	3.6
Karlovarský	304	50	51.6	1.7
			Low	**Quick**
Ostrołęcko-siedlecki	391	54	47.6	16.6
Skierniewicki	372	49	45.5	16.4
Starogardzki	434	61	49.3	16.2
Ciechanowsko-płocki	347	45	47.9	15.0

Name	Population 2011	Population of the biggest city	High	Quick
Kielecki	781	202	49.5	14.8
Olsztynski	624	175	50.7	14.6
Tarnobrzeski	622	49	45.6	14.6
Presovský	815	90	41.7	14.4
Slupski	337	96	46.8	14.0
Koninski	661	77	47.3	13.7
Radomski	625	221	45.4	13.5
Lomzynski	413	63	40.1	13.5
Banskobystrický	660	79	50.5	13.1
			Low	**Low**
Swiecki	190	34	46.2	12.8
Walbrzyski	682	121	45.3	12.7
Tarnowski	464	114	40.8	12.5
Grudziadzki	395	99	41.5	12.3
Sieradzki	455	44	42.0	11.8
Suwalski	279	69	39.3	11.8
Oswiecimski	556	51	47.4	11.7
Wloclawski	370	117	43.0	11.7
Elblaski	537	125	41.7	11.7
Pulawski	496	50	38.1	11.5
Pilski	414	75	46.8	11.4
Nowosadecki	530	84	38.9	11.1
Inowroclawski	370	76	41.7	10.8
Bialski	310	58	37.6	10.8
Nyski	384	59	38.8	10.6
Chojnicki	224	40	39.5	10.2
Sandomiersko-jedrzejowski	497	33	38.8	9.8
Elcki	291	59	36.1	9.4
Nowotarski	340	34	35.0	9.3
Bács-Kiskun	522	112	45.7	8.8
Krosnienski	487	47	37.5	8.8
Szczecinecko-pyrzycki	440	41	37.5	8.1
Chelmsko-zamojski	649	66	34.0	8.0
Tolna	232	33	47.7	6.5
Borsod-Abaúj-Zemplén	689	158	39.6	6.3
Hajdú-Bihar	543	203	44.7	6.2
Przemyski	398	65	33.3	6.0
Heves	309	54	42.9	5.3
Jász-Nagykun-Szolnok	390	72	40.1	5.0
Zala	283	59	48.1	4.0
Somogy	319	63	39.0	3.6
Szabolcs-Szatmár-Bereg	565	118	33.6	3.3
Csongrád	412	163	46.1	3.2

Name	Population 2011	Population of the biggest city	High	Quick
Veszprém	354	60	44.8	1.9
Baranya	381	145	39.8	1.0
Békés	363	60	36.4	1.0
Nógrád	203	36	26.7	–2.3

Source: author's own elaboration.

Streszczenie

PROCESY NADRABIANIA ZALEGŁOŚCI W REGIONACH KRAJÓW GRUPY WYSZEHRADZKIEJ

Większość krajów postsocjalistycznych w Europie Środkowej i Wschodniej przystąpiła do Unii Europejskiej w 2004 roku. Integracja tych gospodarek z Unią rozpoczęła się wcześniej i została wzmocniona po akcesji dzięki dotacjom z funduszy strukturalnych. Jednym z ich celów jest ułatwienie procesu nadrabiania zaległości przez mniej rozwinięte regiony i ich konwergencji do średniej dla starszych państw członkowskich. W niniejszym badaniu poddano analizie sukces procesu nadrabiania zaległości w regionach NUTS3 w czterech krajach Grupy Wyszehradzkiej (V4), tj. w Czechach, na Węgrzech, w Polsce i na Słowacji, w latach 2000–2014, w stosunku do średniego poziomu dla 15 najstarszych państw członkowskich Unii Europejskiej. Czy proces nadrabiania zaległości występuje w każdym regionie, a jeśli tak to czy proces ten przebiega w podobnym tempie, czy też różni się ono istotnie w zależności od regionu? Analizie poddano zmiany PKB per capita według parytetu siły nabywczej, i zbadano dysproporcje w tempie nadrabiania zaległości za pomocą indeksów Thiela bazujących na entropii. Dokonano szczegółowej analizy dwóch czynników wpływających na proces nadrabiania zaległości w regionach. Po pierwsze, sprawdzono, czy proces nadrabiania zaległości w regionach odbywał się w podobny lub bardzo odmienny sposób w porównaniu z przeciętnym dla danego państwa. Po drugie, zbadano, w jaki sposób wielkość największego miasta w regionie wpłynęła na proces nadrabiania zaległości i czy można pokazać rolę największego miasta regionu.

***Słowa kluczowe**: nadrabiania zaległości w obszarze gospodarki; kraje Grupy Wyszehradzkiej; regiony NUTS3; Indeks Theila bazujący na entropii; wartość graniczna; korzyści skali*