# Metropolisation and regional inequalities in Central and Eastern Europe: The role of demographic change

## *Metropolizáció és regionális különbségek Kelet-Közép-Európában: A demográfiai változások szerepe*

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ABSTRACT: Metropolisation has become one of the defining features of regional development in Central and Eastern Europe. Since the beginning of the transition period, capital city regions have attracted an increasing concentration of economic activity, highly skilled labour and population, while many peripheral regions have experienced economic stagnation and demographic decline. Regional disparities are typically assessed using GDP per capita, which is generally interpreted as a measure of economic performance. However, because GDP per capita is an indicator combining both economic output and population size, demographic change may influence its dynamics and consequently the interpretation of regional convergence.

The paper examines the extent to which demographic processes modify the observed pattern of regional inequalities in eleven Central and Eastern European countries during the period 2000–2023. Rather than analysing demographic variables as determinants of economic growth, the study focuses on the arithmetic relationship between GDP, population, and GDP per capita. A simple decomposition framework is applied to separate the economic component of GDP per capita growth from the demographic component resulting from population change. The empirical analysis compares capital city NUTS3 regions, treated as proxies for metropolitan areas, with the remaining regions of each country. In addition, the study examines differences within peripheral regions by comparing areas characterised by the weakest economic performance with those experiencing the strongest population decline.

The results demonstrate that capital city regions consistently record faster GDP growth than the rest of their countries, confirming the continuing concentration of economic activity. However, this picture changes considerably when GDP per capita is analysed. Population growth in metropolitan regions mechanically reduces the observed rate of GDP per capita growth, whereas population decline in many non-capital regions inflates per capita indicators despite relatively weak economic performance. Consequently, part of the apparent convergence observed in GDP per capita does not reflect genuine convergence in economic activity but results from demographic adjustment. In several countries, including Poland, Slovakia and Estonia, demographic processes are sufficiently strong to reverse the interpretation of convergence when GDP per capita is compared with GDP measured in absolute terms.



The analysis also reveals considerable cross-country variation in the structure of demographic effects. In some countries, convergence is mainly influenced by rapid population concentration in capital city regions, whereas in others it is driven by depopulation of peripheral areas. Demographic processes contribute to reducing observed disparities within peripheral regions themselves, as areas with the weakest economic performance are not necessarily those experiencing the strongest population decline.

The findings suggest that GDP per capita should be interpreted as a hybrid indicator reflecting both economic performance and demographic dynamics. Consequently, analyses of regional convergence and evaluations of cohesion policy should explicitly account for demographic processes in order to avoid misleading conclusions concerning the scale and direction of regional development.

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*KULCSSZAVAK: regionális konvergencia; metropolizáció; demográfiai változások; regionális fejlődés; Kelet-Közép-Európa*

*ABSZTRAKT: A metropolizáció Közép- és Kelet-Európa regionális fejlődésének egyik meghatározó jellemzőjévé vált. A rendszerváltás kezdete óta a fővárosi térségek egyre nagyobb mértékben vonzzák a gazdasági tevékenységeket, a magasan képzett munkaerőt és a népességet, miközben számos perifériku régió gazdasági stagnálást és demográfiai hanyatlást él át. A regionális egyenlőtlenségeket jellemzően az egy főre jutó GDP adatával mérik, amit általában a gazdasági teljesítmény mutatójaként értelmeznek. Mivel azonban az egy főre jutó GDP a gazdasági kibocsátást és a népességszámot is magába foglalja, a demográfiai változások befolyásolhatják dinamikáját, és így a regionális konvergencia értelmezését.*

*A tanulmány azt vizsgálja, hogy a demográfiai folyamatok milyen mértékben módosítják a megfigyelt regionális egyenlőtlenségi mintázatot tizenegy közép- és kelet-európai országban a 2000–2023 közötti időszakban. A demográfiai változókat nem a gazdasági növekedés meghatározóiként elemzi, hanem a GDP, a népesség és az egy főre jutó GDP közötti aritmetikai összefüggésre összpontosít. Egyszerű dekompozíciós keretrendszer segítségével választja szét az egy főre jutó GDP növekedésének gazdasági komponensét a népességváltozásból eredő demográfiai összetevőtől. Az empirikus elemzés – a metropoliszrégiók közelítő megfelelőiként – a fővárosi NUTS3 régiókat hasonlítja össze az egyéb területi egységekkel. Emellett a perifériku régiók különbségeit is vizsgálja: összeveti a leggyengébb gazdasági teljesítményű és a legerősebb népességcsökkenést mutató területeket.*

*Az eredmények azt mutatják, hogy a fővárosi régiók gyorsabb GDP-növekedést mutatnak, mint az országok egyéb részei, ami megerősíti a gazdasági tevékenységek folyamatos koncentrációját. Ez a kép azonban megváltozik, amikor az egy főre jutó GDP dinamikáját elemezzük. A metropoliszrégiók népességnövekedése csökkenti az egy főre jutó GDP megfigyelt bővülési ütemét, míg számos nem fővárosi régióban – a viszonylag gyenge gazdasági teljesítmény ellenére – a népességcsökkenés felfelé torzítja az egy főre jutó mutatókat. Ennek következtében az egy főre jutó GDP esetében megfigyelt konvergencia részben nem a gazdasági teljesítmény valódi konvergenciáját tükrözi, hanem demográfiai kiigazítás eredménye. Több országban – köztük Lengyelországban, Szlovákiában és Észtországban – a demográfiai folyamatok kellően erősek ahhoz, hogy megfordítsák a konvergencia értelmezését, amikor az egy főre jutó GDP dinamikáját az abszolút értékben mért GDP változásával vetjük össze.*

*Az elemzés jelentős országok közötti eltéréseket is feltár a demográfiai hatások szerkezetében. Egyes országokban a konvergenciát elsősorban a népesség fővárosi régiókban megfigyelhető gyors koncentrálódása befolyásolja, míg máshol a perifériku területek elnéptelenedése hajtja. A demográfiai folyamatok hozzájárulnak a perifériku régiókon belüli egyenlőtlenségek csökkenéséhez is, mivel a leggyengébb gazdasággal bíró és a legerősebb népességcsökkenést mutató területek nem feltétlenül azonosak.*

*Az eredmények arra utalnak, hogy az egy főre jutó GDP adatát hibrid mutatóként célszerű értelmezni, amely egyszerre tükrözi a gazdasági teljesítményt és a demográfiai dinamikát. Ebből következően a regionális konvergencia elemzéseinek és a kohéziós politika értékeléseinek figyelembe kell venniük a demográfiai folyamatokat annak érdekében, hogy elkerüljék a regionális fejlődés mértékére és irányára vonatkozó félrevezető következtetéseket.*

## Introduction

Metropolisation can be regarded as the most important territorial effect emerging with the rise of the global information economy. Globalisation, initiated alongside the development of information and communication technologies, has led to a shift from a territorial to a network-based organisation of space (Castells 1998; Jałowiecki 1999). Paradoxically, and contrary to some expectations (Friedmann 2005), the declining importance of distance in the new development paradigm has been accompanied by a strengthening of the role of nodes organising global flows, namely metropolitan areas (e.g. Castells 1998; Florida 2005; Scott 1999). The role of large cities has also increased due to the concentration of the most innovative activities within them, including high-technology industries and knowledge-based services (Krätke 2007). This has led to the emergence of so-called 'islands of innovation' (Hillpert 1992) and 'poles of creativity' (Kourtit et al. 2011), which offer agglomeration advantages based on the concentration of high-quality human capital within environments characterised by dense social interactions facilitating the flow of tacit knowledge (Camagni 1991).

Metropolisation contributed to the increase in regional disparities at the national level in most European Union countries during the 1990s (see e.g. ESPON 2005; Ezcurra, Rapún 2006; Geodecki 2006). This growing divergence was particularly problematic because the rapid development of metropolitan areas was typically accompanied by the offshoring of lower value-added activities to less developed countries. Although this process was regionally differentiated (Merino 2017), its effects were especially pronounced in non-metropolitan regions. This led to a significant social stratification within developed countries. On the one hand, a 'metropolitan class' emerged (Jałowiecki 1999), composed of highly educated individuals with advanced skills, whose importance stems from the growing role of human capital as a key factor in the information economy. On the other hand, many social groups either benefited only indirectly from globalisation or were adversely affected by the economic restructuring associated with it. This stratification also took distinct spatial form, reflected in the division between large cities and the remaining areas of the countries (Smętkowski, Gorzelak 2019), and has influenced territorial differences in political preferences (e.g. Rodríguez-Pose 2018), as illustrated by the outcome of the referendum on the United Kingdom's withdrawal from the European Union.

As a result of these processes, regional disparities – although not a new phenomenon, as evidenced by the origins of the European Regional Development Fund – have become, alongside social inequalities (e.g. Piketty 2014), one of the most important fields of research. The issue is also of considerable policy relevance, as many European and national policies are aimed at reducing disparities and promoting territorial cohesion. The present study does not seek to assess the effectiveness of regional policy, which is often subject to criticism (e.g. Gorzelak 2009), but rather to draw attention to the implications of the relationship between regional convergence and demographic change. It should be noted that in recent years a relatively high degree of inertia in the level of regional disparities has been observed in most European countries, despite clear evidence of ongoing metropolisation (Dijkstra, Garcilazo, Mcann 2013). The causes of this phenomenon are not fully understood and leave room for various interpretations. One such explanation is the Williamson hypothesis (1965). It assumes a gradual transition from spatial polarisation (associated with the process of modernisation under a new development paradigm) to the stabilisation of interregional disparities at higher levels of development (as confirmed by a number of empirical studies, e.g. Ezcurra, Rapún 2006; Nazarczuk 2015; Petrakos, Rodríguez-Pose, Rovolis 2005; Smętkowski 2015), and eventually to a decline in regional inequalities. However, there is no empirical evidence supporting this final phase, and doubts about its existence are linked to the possibility of successive waves of development. Typically, innovations first emerge in core regions, which may lead to a renewed increase in spatial disparities (Capello 2007). It is worth noting, however, that the observed stabilisation of regional disparities may not only result from the diffusion of development processes but may also be related to ongoing demographic changes (e.g. Batista e Silva 2016). These changes, particularly under conditions of low economic growth, may influence regional convergence, for instance through population flows from peripheral to core regions.

The aim of this paper is to demonstrate how demographic change affects the scale of regional disparities, using the example of Central and Eastern European countries. First, a simulation is presented to illustrate how population dynamics may influence convergence processes within a system composed of two regions: one more and one less developed. The empirical part then examines convergence between the main metropolitan area (typically the capital city) in each country and its surrounding regions. Particular attention is paid to the strengthening position of metropolitan areas within national settlement systems in terms of population size. In addition, an analysis of peripheral regions is conducted, focusing on the comparison between regions with the lowest GDP per capita growth and those experiencing the strongest population decline. This approach allows for a distinction between economic and demographic forms of peripherality and enables an assessment of the impact of population change on internal disparities within these areas. It should be noted that changes in population may result not

only from internal migration, but also from immigration, including international migration – particularly to metropolitan areas – as well as from regional differences in population ageing. The concluding section attempts to assess the implications of incorporating demographic processes into the analysis of regional convergence and outlines potential directions for future research.

## Literature background

Regional convergence has long been one of the central topics in regional science and economic geography. Since the seminal contributions of Solow (1956) and the extensive literature on β- (beta-) and σ- (sigma-) convergence, numerous studies have attempted to explain differences in regional growth trajectories by referring to capital accumulation, technological progress, human capital, institutional quality and spatial spillovers (Barro, Sala-i-Martin 1991; Capello 2007; Mankiw, Romer, Weil 1992; Petrakos, Rodríguez-Pose, Rovolis 2005). Within the conceptual framework of conditional convergence, demographic factors have also been recognised as important determinants of long-run growth. In particular, Mankiw, Romer and Weil (1992) demonstrated that economies converge towards different steady states once differences in saving, human capital accumulation and population growth are taken into account.

The literature on regional convergence has subsequently expanded in several directions, including spatial econometric approaches, club convergence and analyses of spatial spillovers (Dijkstra, Garcilazo, Mcann 2013; Ertur et al. 2006; Ezcurra, Rapún 2006). Increasing attention has also been devoted to the role of migration and demographic processes in shaping regional development trajectories. Population movements may contribute to regional convergence by reallocating labour from less productive to more productive regions, but they may also reinforce cumulative development processes through the concentration of human capital in prosperous regions. Consequently, migration has been analysed not only as an outcome of regional disparities but also as an important mechanism influencing regional growth and convergence (Kubis, Schneider 2016).

More recently, demographic change has become an increasingly important component of the regional development debate because many European regions simultaneously experience population ageing, depopulation and growing territorial imbalances (Batista e Silva et al. 2016). Several studies have demonstrated that demographic trends influence regional economic performance and cohesion. In particular, Kashnitsky, de Beer and van Wissen (2020) show that changes in regional age structures may affect the observed process of economic convergence and that the relationship between demographic and economic convergence is far from straightforward. Depending on the spatial distribution of demographic change, convergence in demographic structures may either reinforce or weaken convergence

in economic performance. Similar conclusions emerge from studies emphasising that demographic trends should be incorporated into analyses of long-term regional development and GDP dynamics (Curtale et al. 2026).

Although these studies considerably improve our understanding of the relationship between demographic processes and regional development, they generally treat demographic variables as determinants of economic growth or conditional convergence. In other words, demographic change is typically incorporated as one of the explanatory variables explaining differences in regional growth trajectories. Considerably less attention has been devoted to another aspect of this relationship, namely the implications of demographic change for the interpretation of GDP per capita itself as the principal indicator of regional disparities.

This distinction is important because GDP per capita is defined as the ratio between total economic output and population. Consequently, changes in population influence the observed dynamics of GDP per capita independently of changes in economic production. Population growth in economically successful metropolitan regions may therefore reduce the observed rate of increase in GDP per capita, whereas population decline in peripheral regions may improve per capita indicators despite relatively weak economic performance. As a result, part of the convergence observed in GDP per capita data, may reflect demographic adjustment rather than genuine convergence in economic activity.

This issue appears particularly relevant in Central and Eastern Europe. Following the post-socialist transformation and integration into the European Union, most countries in the region experienced rapid metropolitan concentration accompanied by demographic decline in many peripheral regions (Smętkowski, Gorzelak 2019). These parallel processes raise the question of whether the apparent stabilisation or reduction of regional disparities reflects genuine economic convergence or is primarily driven by population redistribution between metropolitan and non-metropolitan regions.

The present paper addresses this gap by proposing a simple decomposition of GDP per capita growth into an economic and a demographic component. Rather than analysing demographic change as a determinant of economic growth, the study focuses on its arithmetic contribution to GDP per capita dynamics and examines how this affects the interpretation of regional convergence between metropolitan and non-metropolitan regions in Central and Eastern Europe. This approach makes it possible to distinguish between convergence resulting from changes in economic performance and convergence reflecting demographic adjustment, thereby offering a complementary perspective on the assessment of regional disparities.

The importance of integrating demographic processes into analyses of regional economic development is further reflected in recent attempts to regionalise long-term GDP projections using demographic scenarios (Curtale et al. 2026). However, these studies focus on improving regional forecasts rather than on interpreting regional convergence measures.

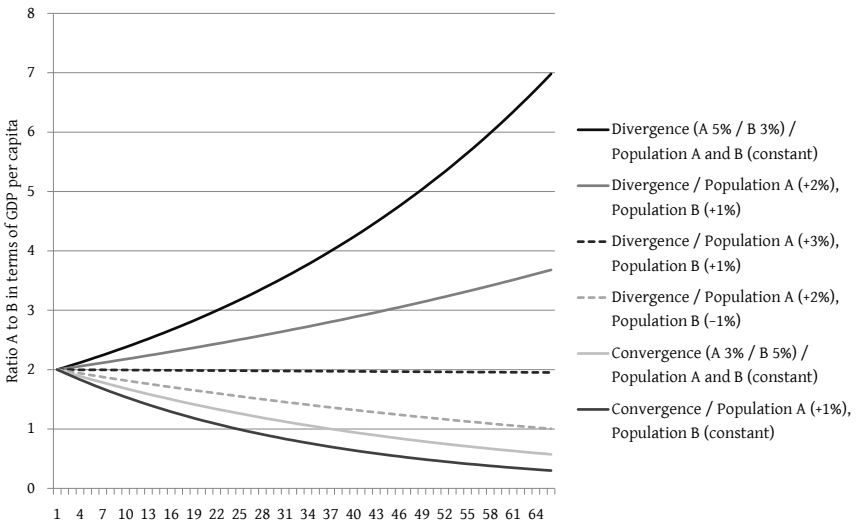
## Data and methods

### *Simulation of regional convergence influenced by demographic change*

It should be noted that regional convergence, understood as changes in differences in the level of prosperity measured by GDP per capita, may be influenced not only by the growth rate of goods and services produced, but also by changes in the population of the compared regions.[1] In particular, this may be consistent with the neoclassical theory of migration (e.g. Todaro 1976), which assumes population flows from less developed to more developed regions. Moreover, metropolitan regions are typically frequent destinations for international migration. At the same time, it should be recognised that such outflows may be offset by higher natural population growth, which is often characteristic of less developed, frequently rural regions.

The following section presents a hypothetical trajectory of σ-convergence between two regions with different levels of prosperity, depending on real GDP growth rates (in situations of β-convergence and divergence), under different scenarios of population change (Figure 1).

Figure 1: Simulation of regional convergence under alternative scenarios*
*A regionális konvergencia szimulációja alternatív forgatókönyvek mellett*




** GDP per capita in region A (more developed) / GDP per capita in region B (less developed).*
*Source: author's elaboration*

The simulation is based on an example of two regions with identical population and an initial difference in GDP per capita of 2:1. For this setting, two basic development scenarios and several variants of demographic change are considered. In the first scenario, a higher GDP growth rate of 5% is assumed for the more developed region (A), and a lower rate of 3% for the less developed region (B), which should lead to regional divergence. Assuming constant population in both regions over the considered time horizon (66 years), GDP per capita in the more developed region would become seven times higher than in the less developed one. According to World Bank data, this corresponds to the difference in the level of development (at exchange rates) between France (USD 38,500) and Albania (USD 4,800).

However, if the model incorporates population growth – abstracting from its causes – of 2% annually in region A and 1% in region B, the increase in disparity would be significantly smaller, reaching a ratio of 3.68:1. Increasing the population growth rate in region A by an additional percentage point to 3% annually would result in little change in the development gap despite differences in GDP growth rates. This implies that divergence in economic growth would be fully offset by faster population growth in region A. It should be noted, however, that in this variant region A would have four times the population of region B after 66 years.

Alternatively, replacing the relatively unrealistic assumption of population growth in region B with a population decline of 2% annually, combined with a modest population increase of 1% annually in region A, would lead to an equalisation of development levels between the regions. This would be accompanied, however, by a 3.6-fold increase in the population of region A and a halving of the population of region B, which would ultimately account for only one-eighth of the total population of such a bipolar system.

The second scenario assumes regional convergence resulting from faster economic growth in region B (5% annually) and slower growth in region A (3% annually). Under the assumption of constant population, this would lead to equalisation of development levels after 37 years. However, introducing a demographic variant in which population grows by 1% annually in region A while remaining constant in region B would result in convergence in GDP per capita after 25 years. Of course, larger differences in population growth rates between the regions could further shorten this period.

It should be emphasised that the above simulation is purely hypothetical. It is difficult to assume the stability of parameters such as economic growth rates and population dynamics over such a long time horizon, due to business cycles, potential shifts in development paradigms, and demographic transitions. The purpose of the simulation is solely to illustrate the potential impact of demographic processes – associated with natural increase and migration – on regional convergence. It should also be noted that this effect may be particularly pronounced in situations where differences in GDP growth rates between regions are relatively small.

### *Decomposition of GDP per capita growth*

The analysis is based on a decomposition of GDP per capita growth into an economic and a demographic component, which allows changes resulting from economic growth to be separated from those driven by population dynamics. This approach enables the identification of the impact of demographic processes on the interpretation of regional disparities, particularly in the context of assessing convergence between capital city regions and the rest of the national territory. In contrast to standard approaches based solely on per capita indicators, the applied procedure makes it possible to determine the extent to which observed changes are real and to what extent they result from changes in population. The formula below follows directly from the definition of GDP per capita after taking logarithms and expressing the relationship in terms of changes:

$$\Delta \ln (GDP_{pc}) = \Delta \ln (GDP) - \Delta \ln (Pop)$$

This allows for a clear separation between changes resulting from economic growth and those stemming from population dynamics. The first element reflects the economic dimension, while the second captures the demographic processes. It should be emphasised that this decomposition is an accounting identity rather than a causal model. It isolates the arithmetic contribution of population change to GDP per capita growth for a given rate of GDP growth.

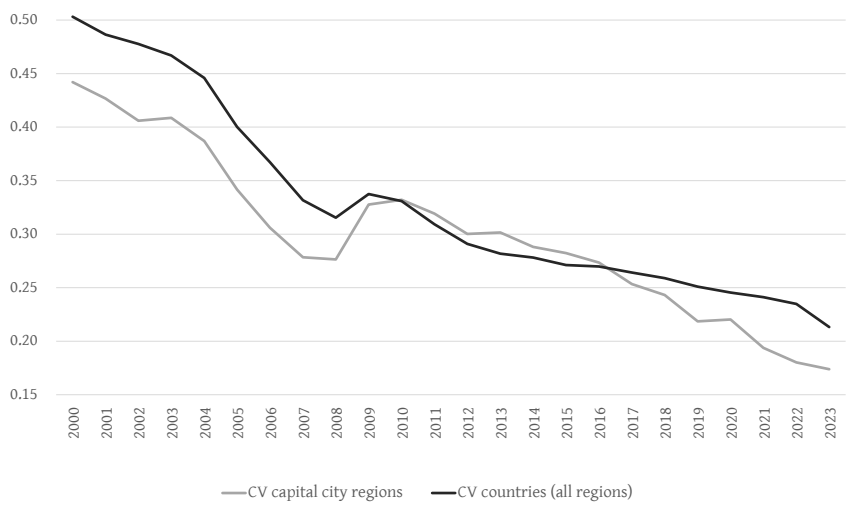
The paper distinguishes two levels at which demographic processes operate. First, the direct impact of population change on GDP per capita growth is analysed separately for capital city regions and for the remaining (non-capital) regions of each country. Second, the influence of demographic change on the assessment of regional convergence, defined as the difference between GDP growth and GDP per capita growth, is examined in the capital city regions versus other regions. The demographic effect grasped in this way makes it possible to assess the extent to which population processes modify the observed scale of divergence or convergence.

The empirical analysis covers 11 Central and Eastern European countries over the period 2000–2023. Capital regions are defined as NUTS3 regions encompassing the capital city (together with their surrounding areas if they are separate NUTS3 units – proxy of Functional Urban Areas). All remaining regions are represented by an aggregate of other NUTS3 units. This implies that the results are intentionally simplified, as the group of remaining regions – especially in countries with a polycentric settlement structure such as Poland and Romania – includes regions with large cities that often follow a metropolitan development path. The data are sourced from Eurostat and include GDP in current prices (EUR) and population number.

## Results

A key contextual feature of the analysis is the strong convergence in development levels measured in EUR at both the national and metropolitan levels across the countries studied (Figure 2). Similarity is greater between capital city regions than between countries, with the exception of a short period following the 2008 economic crisis, during which some capital city regions experienced more pronounced declines (e.g. in the Baltic states). At present, differences are relatively small, reflecting the rapid catching-up of less developed countries and their capital city regions with more advanced countries and their capital cities during the analysed period.

Figure 2: Disparities in GDP per capita in CEE countries, 2000–2023 (coefficient of variation)
*Az egy főre jutó GDP egyenlőtlenségei a közép- és kelet-európai országokban, 2000–2023 (relatív szórás)*




*Source: author's elaboration based on EUROSTAT data*

To complement the analysis, an additional examination of disparities within non-capital city regions was conducted. This involved identifying, in each country, regions with the lowest GDP per capita growth and regions experiencing the largest population decline. This approach allows for a partial distinction between economic peripherality and demographic peripherality.

The results of the decomposition of average annual GDP per capita growth indicate a clear advantage of capital city regions over the rest of the country in terms of GDP measured in absolute values (Table 1). In all analysed countries, GDP growth in capital city regions exceeds that in the rest of the countries. It is illustrated, for example, by differences exceeding 3 percentage points in Bulgaria

(10.20% vs. 6.99%) and over 1.5 percentage points in Romania (10.23% vs. 8.62%), as well as a clear advantage in countries with more moderate growth dynamics, such as Czechia (7.38% vs. 6.37%) and Poland (6.76% vs. 5.87%). These results point to an ongoing concentration of economic activity in capital city regions.

At the same time, when measured in terms of GDP per capita, the picture is much more differentiated. Although in some countries capital city regions still exhibit higher growth rates (e.g. Czechia: 6.49% vs. 6.30%; Hungary: 6.30% vs. 5.75%), in others the growth rates are similar or even higher in the non-capital regions. This weakens the process of divergence and, in some cases, results in convergence between capital city regions and other areas (e.g. Poland: 5.93% vs. 6.04%; Slovakia: 6.83% vs. 7.43%; Estonia: 7.47% vs. 8.24%).

These differences are directly related to asymmetric demographic processes, which systematically affect per capita indicators. In most of the analysed countries – such as Poland, Czechia, Slovakia, Slovenia and Estonia – capital city regions record clear population growth, which mechanically lowers the growth rate of GDP per capita compared to the GDP growth (a negative demographic effect) (Figure 3). At the same time, in non-capital regions in many countries, particularly in Romania, Bulgaria, Lithuania and Latvia, as well as to some extent in Hungary and Croatia, population decline is observed, which inflates GDP per capita growth (a positive demographic effect). As a result, demographic processes flatten observed development disparities by reducing growth rates in core regions and increasing them in other regions.

The scale of this phenomenon is synthesised in Table 2, which presents the role of the demographic effect in convergence processes, defined as the difference between GDP growth (%) and GDP per capita growth (%). In all analysed countries, this effect takes positive values, indicating that accounting for demographic processes reduces the observed divergence between capital city regions and other regions. Moreover, in some cases the effect is strong enough to reverse conclusions regarding the direction of change. For example, in Poland, Slovakia and Estonia, convergence in terms of GDP per capita turns out to be only apparent and results from demographic processes, while in terms of GDP a clear divergence is observed.

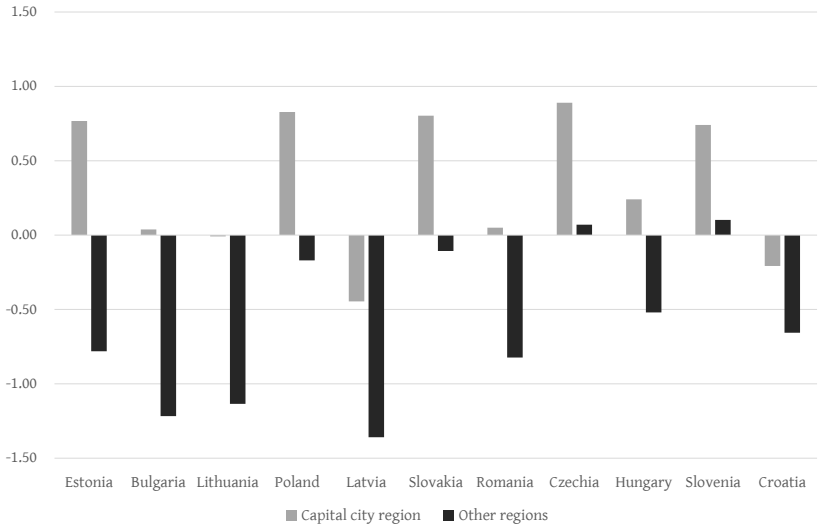
The analysis of the structure of the demographic effect makes it possible to distinguish between three main types of countries. In the first group (Poland, Czechia, Slovakia and Slovenia), the capital city component dominates, meaning that the demographic effect is primarily driven by population concentration in capital city regions, which reduces GDP per capita growth in the core. In the second group (Romania, Bulgaria, Lithuania, Latvia and Croatia), the peripheral component plays a key role, associated with strong depopulation of other regions, which leads to an inflation of their per capita indicators. The third group (Estonia and Hungary) consists of countries with a mixed pattern, in which both mechanisms – capital city concentration and other regions depopulation – occur simultaneously and at a similar scale.

Table 1: Average annual growth rates of GDP per capita and its components, including the demographic effect, in CEE countries, 2000–2023 (%)
*Az egy főre jutó GDP és összetevőinek – köztük a demográfiai hatásnak – az átlagos éves növekedési üteme a közép- és kelet-európai országokban, 2000–2023 (%)*

| *Country* | *GDP per capita (EUR)* | | *GDP (EUR)* | | *Population* | | *Demographic effect (%)* | |
|---|---|---|---|---|---|---|---|---|
| | *Capital city region* | *Other regions* | *Capital city region* | *Other regions* | *Capital city region* | *Other regions* | *Capital city region* | *Other regions* |
| Slovenia | 4.68 | 4.18 | 5.42 | 4.28 | 0.74 | 0.10 | -0.16 | -0.02 |
| Poland | 5.93 | 6.04 | 6.76 | 5.87 | 0.83 | -0.17 | -0.14 | 0.03 |
| Czechia | 6.49 | 6.30 | 7.38 | 6.37 | 0.89 | 0.07 | -0.14 | -0.01 |
| Slovakia | 6.83 | 7.43 | 7.63 | 7.33 | 0.80 | -0.11 | -0.12 | 0.01 |
| Estonia | 7.47 | 8.24 | 8.24 | 7.46 | 0.77 | -0.78 | -0.10 | 0.09 |
| Hungary | 6.30 | 5.75 | 6.54 | 5.23 | 0.24 | -0.52 | -0.04 | 0.09 |
| Romania | 10.18 | 9.44 | 10.23 | 8.62 | 0.05 | -0.82 | 0.00 | 0.09 |
| Bulgaria | 10.16 | 8.20 | 10.20 | 6.99 | 0.04 | -1.22 | 0.00 | 0.15 |
| Lithuania | 9.03 | 8.00 | 9.02 | 6.87 | -0.01 | -1.13 | 0.00 | 0.14 |
| Croatia | 5.93 | 5.54 | 5.72 | 4.88 | -0.21 | -0.66 | 0.03 | 0.12 |
| Latvia | 7.33 | 7.51 | 6.89 | 6.15 | -0.45 | -1.36 | 0.06 | 0.18 |

*Source: author's elaboration based on Eurostat data*

Figure 3: Average annual population change in CEE countries, 2000–2023 (%)
*Átlagos éves népességszámváltozás a közép- és kelet-európai országokban, 2000–2023 (%)*




*Source: author's elaboration based on Eurostat data*

The results indicate that demographic changes not only affect the observed development disparities but may fundamentally alter their interpretation. GDP per capita, as a measure of regional convergence, turns out to be a hybrid indicator in which the demographic component may lead to a systematic underestimation of actual economic divergence. At the same time, the nature of this distortion is spatially differentiated and depends on whether the dominant mechanism is population concentration in capital city regions or depopulation of other regions.

In order to deepen the interpretation of the results, an additional analysis of disparities within non-capital regions was conducted, focusing on two extreme types of regions: (1) those with the lowest GDP per capita growth in the given country, and (2) those experiencing the strongest population decline at the national level. This approach makes it possible, to some extent, to distinguish between economic peripherality and demographic peripherality.

As a result, it can be observed that in some of the analysed countries, accounting for demographic processes leads to a significant blurring of differences between peripheral regions. Regions with the lowest GDP per capita growth rates and those experiencing the strongest depopulation exhibit similar GDP growth dynamics, which is particularly evident in countries such as Hungary, Poland and Romania. This suggests that observed differences in GDP per capita growth largely stem from divergent demographic trajectories rather than from fundamental differences in economic performance (Table 3).

Table 2: Demographic effect on GDP convergence processes in CEE countries, 2000–2023
*A GDP-konvergencia folyamataira gyakorolt demográfiai hatás a közép- és kelet-európai országokban, 2000–2023*

| *Country* | *Difference in growth dynamics: capital city region vs. the rest of the regions* | | *Demographic effect on the process of differentiation* | | | *Significance (%)* | |
|---|---|---|---|---|---|---|---|
| | *GDP per capita (EUR)* | *GDP (EUR)* | *Total* | *Capital city component* | *Other regions component* | *Capital city component* | *Other regions component* |
| Estonia | -0.77 | 0.78 | 1.55 | 0.77 | 0.78 | 49.5 | 50.5 |
| Slovakia | -0.61 | 0.30 | 0.91 | 0.80 | 0.11 | 88.2 | 11.8 |
| Latvia | -0.17 | 0.74 | 0.91 | -0.45 | 1.36 | 24.7 | 75.3 |
| Poland | -0.11 | 0.89 | 1.00 | 0.83 | 0.17 | 83.0 | 17.0 |
| Czechia | 0.19 | 1.01 | 0.82 | 0.89 | -0.07 | 92.7 | 7.3 |
| Croatia | 0.39 | 0.84 | 0.45 | -0.21 | 0.66 | 24.0 | 76.0 |
| Slovenia | 0.50 | 1.14 | 0.64 | 0.74 | -0.10 | 87.9 | 12.1 |
| Hungary | 0.55 | 1.31 | 0.76 | 0.24 | 0.52 | 31.6 | 68.4 |
| Romania | 0.74 | 1.61 | 0.87 | 0.05 | 0.82 | 5.7 | 94.3 |
| Lithuania | 1.03 | 2.15 | 1.13 | -0.01 | 1.13 | 0.7 | 99.3 |
| Bulgaria | 1.96 | 3.21 | 1.25 | 0.04 | 1.22 | 3.0 | 97.0 |

*Source: author's elaboration based on Eurostat data.*

Table 3: GDP growth rates and population change in peripheral regions of CEE countries, 2000–2023 (%)
*GDP növekedési ütemek és népességszámváltozás a közép- és kelet-európai országok periférikus régióiban, 2000–2023 (%)*

| *Country* | *Country* | | | *NUTS-3 regions with the lowest GDP per capita growth* | | | *NUTS-3 regions with the largest population decline* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *GDP* | *GDP percapita* | *Population* | *GDP* | *GDP per capita* | *Population* | *GDP* | *GDP per capita* | *Population* |
| Czechia | 6.74 | 6.47 | 0.27 | 4.84 | 5.00 | -0.16 | 6.24 | 6.53 | -0.29 |
| Croatia | 5.19 | 5.73 | -0.54 | 3.14 | 4.28 | -1.14 | 4.58 | 5.86 | -1.28 |
| Latvia | 6.73 | 7.67 | -0.94 | 5.59 | 6.85 | -1.26 | 6.40 | 8.31 | -1.91 |
| Lithuania | 7.72 | 8.55 | -0.83 | 4.83 | 6.62 | -1.79 | 6.89 | 8.70 | -1.81 |
| Hungary | 5.84 | 6.13 | -0.29 | 4.29 | 4.67 | -0.38 | 4.24 | 5.30 | -1.06 |
| Poland | 6.04 | 6.12 | -0.08 | 4.82 | 4.96 | -0.14 | 4.80 | 5.65 | -0.85 |
| Romania | 9.04 | 9.76 | -0.73 | 7.18 | 7.83 | -0.65 | 7.31 | 9.11 | -1.80 |
| Slovenia | 4.69 | 4.43 | 0.26 | 2.86 | 3.09 | -0.23 | 3.84 | 4.24 | -0.40 |
| Slovakia | 7.41 | 7.40 | 0.01 | 6.67 | 6.95 | -0.29 | 6.83 | 7.12 | -0.29 |
| Bulgaria | 8.18 | 9.13 | -0.95 | 4.77 | 6.83 | -2.06 | 5.19 | 8.08 | -2.89 |
| Estonia | 7.92 | 8.05 | -0.12 | 6.78 | 7.27 | -0.49 | 7.02 | 8.50 | -1.49 |

** In each country, the first region is the one with the slowest GDP per capita growth, while the second is the one with the largest population decline: Czechia (Karlovarský kraj, Moravskoslezský kraj); Croatia (Požeško-slavonska županija, Vukovarsko-srijemska županija); Latvia (Kurzeme, Latgale); Lithuania (Utenos, Tauragės); Hungary (Vas, Bekes); Poland (Szczecinecko-pyrzycki, Chełmsko-zamojski); Romania (Covasna, Hunedoara); Slovenia (Zasavska, Pomurska); Slovakia (Trenčiansky kraj, Banskobystrický kraj); Bulgaria (Kyustendil, Vidin); Estonia (Lääne-Eesti, Kirde-Eesti).*
*Source: author's elaboration based on Eurostat data*

A more detailed examination reveals that, in many cases, regions with the lowest GDP per capita growth are not the same as those experiencing the most pronounced population decline. This points to a partial decoupling of economic and demographic processes, and thus to their distinct spatial determinants. Depopulation tends to be concentrated in regions facing structural demographic challenges (such as ageing and out-migration), which do not necessarily coincide with areas characterised by the lowest levels of economic growth.

In countries with strong peripheral depopulation (e.g. Bulgaria, Lithuania, and Latvia), this effect becomes particularly pronounced. Population decline leads to an overestimation of GDP per capita growth, which may mask the underlying development challenges of these areas. As a result, peripheral regions may appear relatively dynamic when assessed using per capita indicators, even though their economic potential, measured in absolute terms, remains limited.

By contrast, in countries with more even demographic processes (e.g. Czechia and Slovenia), differences between the two types of regions remain more clearly visible, suggesting that the impact of demography on the assessment of development processes is weaker. In such cases, GDP per capita growth more closely reflects underlying economic dynamics.

Overall, the results indicate that the demographic effect acts not only as a factor modifying the assessment of convergence between capital city regions and other regions, but also as a mechanism leading to the compression of internal disparities within peripheral areas. In other words, demographic processes may reduce the observed scale of regional inequalities not through genuine convergence in development levels, but through changes in the number of the population, which constitutes the denominator of per capita indicators.

## Discussion: demographic mechanisms and regional convergence

The results obtained are consistent with the literature on metropolisation and regional inequalities (Krätke, 2007; Rodríguez-Pose 2018), confirming the increasing concentration of economic activity in capital metropolitan regions (Henning, Westlund, Enflo 2022). In all analysed countries, higher economic growth is observed in capital city regions than in other regions, indicating a persistent process of divergence in absolute terms (GDP).

At the same time, the results point to an insufficiently recognised demographic mechanism that may lead to a systematic distortion in the assessment of regional convergence. In contrast to conventional approaches based solely on GDP per capita, the decomposition analysis shows that the observed stability or convergence of inequalities may result from two opposing processes: the concentration of economic activity in capital city region and the depopulation of other regions. As a result, GDP per capita emerges as a hybrid indicator,

reflecting both economic and demographic changes. A particularly important finding is the variation in the structure of the demographic effect across countries. In some cases, population concentration in capital city regions plays the dominant role, while in others the key mechanism is the depopulation of other regions. This suggests that the process of metropolisation in Central and Eastern Europe is not uniform, but rather takes the form of different spatial configurations combining varying relationships between economic growth and population change.

The analysis of peripheral areas indicates that economic and demographic processes are not fully aligned spatially. Regions with the lowest economic growth do not always coincide with those experiencing the strongest population decline, and in some cases accounting for demographic processes leads to a blurring of differences between them. This suggests that population dynamics not only modify the relationship between capital city regions and the rest regions in the countries, but also contributes to the compression of internal disparities within peripheral areas. Consequently, GDP per capita data may partially mask underlying development differences.

The findings are partly consistent with studies for highly developed countries, which demonstrate long-term population concentration and its association with regional divergence (Henning, Westlund, Enflo 2022). At the same time, in contrast to the case of Sweden – where a "double divergence" (in both population and GDP per capita) has been observed – the results for Central and Eastern Europe point to the importance of a compensatory mechanism, in which depopulation of peripheral regions inflates per capita indicators.

These results have important implications for the research on regional convergence. In particular, they suggest that interpretations based solely on per capita indicators may lead to incomplete conclusions regarding both the scale and direction of change. In the case of Central and Eastern European countries, observed convergence may be partly statistical in nature, resulting from population change rather than from genuine equalisation of development levels.

At the same time, the results should be interpreted with caution. The applied approach is decompositional and does not allow for the identification of causal relationships between demographic change and economic development. Moreover, the use of aggregated data at the NUTS3 level may simplify complex processes occurring at lower spatial scales. Despite these limitations, the analysis makes it possible to capture an important and so far insufficiently explored mechanism through which demographic processes influence the interpretation of development dynamics.

## Conclusion

In summary, the results indicate that the process of metropolisation in Central and Eastern European countries leads to both an increasing concentration of economic activity in metropolitan areas (illustrated by the capital city regions) and to demographic changes that jointly shape observed processes of regional convergence. In particular, the findings suggest that part of the convergence observed in terms of GDP per capita results from a mechanism of demographic adjustment. In capital city regions, dynamic economic growth is distributed across a growing population so that, for a given rate of GDP growth, the observed growth of GDP per capita is mechanically lower because GDP is divided among a larger population. At the same time, in other non-capital – especially peripheral – regions population decline may lead to a relative improvement in these indicators despite weaker economic performance. Consequently, convergence observed at the level of per capita income does not necessarily reflect a genuine equalisation of economic potential, but may be partly statistical in nature, which comes from the differences in population change between capital city regions and other regions.

From a research perspective, this implies the need for a more consistent separation of economic and demographic components in analyses of regional development, as well as the use of decomposition approaches as a complement to standard measures. From the perspective of regional policy, the results suggest the need for a cautious interpretation of per capita indicators when assessing the effects of cohesion policy, particularly in regions affected by depopulation, where improvements in such indicators may not reflect real increases in productivity. In this context, measures based on absolute values as well as analyses of demographic change are justified to be considered, in order to provide a more comprehensive assessment of development processes and their spatial consequences.

The results point to several important directions for further research on metropolisation and its implications for social and territorial cohesion. First, there is a need to deepen the analysis of demographic mechanisms by disentangling their main components, such as internal and international migration, natural population change, and age structure. This would allow for a better understanding of the extent to which observed changes in per capita indicators result from selective population flows as opposed to structural processes. Second, it would be valuable to move towards more spatially disaggregated analyses, which would make it possible to capture the internal differentiation of peripheral areas. In particular, it would be important to examine the extent to which demographic processes lead to a compression of development disparities within regions, and what their implications are for access to public services and quality of life. Third, the findings suggest the need for further development of methodological approaches that allow for the simultaneous consideration of economic and

demographic components in analyses of regional convergence. It would be worthwhile to compare the results using alternative measures of development, including indicators based on absolute values, household incomes or labour productivity, which could help to reduce the influence of statistical effects related to population change. Finally, an important direction for future research is a more in-depth analysis of the role of secondary urban centres as potential growth poles in peripheral regions. In the context of the observed diversity of metropolisation mechanisms, it is worth examining the extent to which such centres can mitigate the negative effects of depopulation and support more balanced territorial development. This, however, requires research integrating economic, demographic and institutional processes at both national and local scales.

## Notes

1 Regional GDP per capita estimates at the NUTS3 level are derived within the framework of the European System of Accounts and should be interpreted as statistical estimates rather than direct observations. Nevertheless, they constitute the standard measure of regional economic performance used by Eurostat and in the literature on regional development and convergence.

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