How big are the economic inequalities of intra-metropolitan areas in the EU?

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Abstract. Objective*: Metropolitan regions represent densely populated and economically integrated urban areas, encompassing a central city and its surrounding suburbs, industries, and infrastructure. These regions, often transnational, serve as engines of economic growth, innovation, and job creation. They differ from administrative cities in terms of their degree of functionality and interconnectedness, being managed through collaborative governance. According to Eurostat, metropolitan areas are NUTS 3 regions (one or more) that may include a functional urban area of at least 250,000 inhabitants. They may be capital regions and/or second-tier regions (larger or smaller). At the level of the EU-27, 245 metropolitan areas have been identified, for which official statistical indicators are available and calculated. Their economic strength is significant, although there are also relatively high inequalities among these regions, driven by their potential and their importance at national or global level. In light of the above, this article explores the level of territorial inequalities across metropolitan areas in the European Union. The* ***methodology*** *involves quantitative analyses using regional statistical indicators, through which trends and the level of territorial inequalities are examined.* ***Results****: By assessing these disparities, the article identifies patterns of convergence or divergence among these regions.* ***Originality:*** *The article contributes to the existing literature by providing a comprehensive, data-driven analysis of the importance of metropolitan areas from the perspective of territorial inequalities. The originality of the study lies in its empirical approach, which highlights the fact that, even at the level of metropolitan areas within the EU, there are relatively large development differences that may affect cohesion and convergence at the Community level from the perspective of smart and sustainable development.*

Keywords: *metropolitan area, territorial inequalities, sustainable development, cohesion and regional policy, UE*
JEL Classification*: R10, R50, R51, R58, R59*

1. Introduction

Metropolitan areas are complex urban agglomerations consisting of a central city and its surrounding suburbs. These areas are characterized by a high degree of economic, social, and cultural integration. Metropolitan areas have several distinct characteristics that differentiate them from other urban areas. Key characteristics of these areas include: a large and diverse population, a strong economy based on diverse industries, a high level of economic integration with surrounding areas, a complex transportation system, including roads, public transportation, and airports, and a diverse range of

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cultural, educational, and recreational facilities. These characteristics are often interconnected and, together, create a vibrant and dynamic urban environment.

Recently, metropolitan areas have not been spared from crises and shocks, whose impacts have been uneven across cities, people, places, and firms located within them. For example, during the pandemic, low-income and marginalized social groups, living in precarious housing conditions, were more exposed to a higher risk of contagion.

Policies and actions aimed at promoting resilience must be adapted and differentiated according to local needs, taking into account the diverse assets, industries, and circumstances. Strengthening urban resilience requires proactive planning, investments in infrastructure, and the adoption of innovative solutions to mitigate risks and build sustainable urban environments capable of withstanding challenges. This will often require mechanisms to align national and local efforts and to ensure that decision-makers balance addressing immediate needs and efforts with tackling long-term structural vulnerabilities.

The present study aims to assess the structure and evolution of territorial disparities across metropolitan areas within the European Union, using a country-by-country analytical framework. In this context, the analysis is guided by the following research question: how do territorial disparities between metropolitan areas evolve within individual EU Member States over the period 2003–2021?

Based on these questions, the following hypotheses are formulated:

H1: Territorial disparities between metropolitan areas persist over time and are reflected in stable or increasing values of the coefficient of variation and amplitude.

H2: Higher values of the concentration coefficient (Gini) are associated with the stronger dominance of a leading metropolitan area, indicating a more uneven distribution of economic performance.

H3: Metropolitan systems within the European Union can be grouped into distinct structural typologies (e.g., balanced polycentric systems, dual metropolitan structures, and divergence patterns), as revealed by the combined interpretation of the three indicators.

H4: Countries characterized by divergence patterns exhibit simultaneously high values of the coefficient of variation, amplitude, and concentration coefficient, reflecting cumulative disparities rather than isolated differences.

H5: In dual metropolitan systems, the degree of balance between the two main metropolitan areas is directly reflected in the level of the concentration coefficient and amplitude.

Despite the fact that there exist multiple articles in the scientific literature addressing regional and urban inequalities in the European Union, existing studies tend to focus either on aggregated regional levels (e.g., NUTS classifications) or on single-country analyses. Moreover, most contributions rely on a limited set of indicators, typically emphasizing either the disparities or the convergence, without capturing the structural dimension of inequality.

This study contributes to the literature by providing a comprehensive and comparable analysis of territorial inequalities across all EU Member States at the metropolitan level, using a multi-indicator framework that combines the coefficient of variation, amplitude, and the Gini concentration coefficient (GC). By applying this approach consistently across countries, the paper identifies distinct structural typologies of metropolitan systems, offering a more nuanced understanding of how economic performance is distributed within national contexts.

In this sense, the originality of the study lies not only in the scale of the analysis, but also in the integrated methodological framework and the identification of recurring structural patterns across the European metropolitan landscape.

2. Literature review

The meaning attributed to the metropolitan region has widened over time, as urban development increasingly generates economic and functional linkages across larger territories. Whereas metropolitan areas are commonly delimited on the basis of morphological continuity around the main urban core, metropolitan regions encompass a substantially broader and multiscalar spatial entity that integrates urban, peri-urban, and semi-rural territories into a coherent functional system. Urban studies specialists consistently highlight four defining characteristics of metropolitan regions:

(i) their extensive economic influence over a broad hinterland;

(ii) their multi-nodal urban structure;
(iii) the presence of regional transport corridors, logistical clusters, and industrial networks;
(iv) their ability to connect peri-urban and rural territories with the wider metropolitan framework through labour-market relations, residential functions, and mobility flows (Gori Nocentini, 2025; Li et al., 2025, Xiao et al.; 2025).

The idea of the metropolitan region has important roots in the work of Patrick Geddes (1915). Through the concept of the city-region, Geddes proposed a way of looking at urban development that went beyond official administrative borders and focused instead on the wider territory connected to the city through economic activity, population movement, communication, and environmental relations. He viewed cities as parts of broader regional systems rather than as separate territorial units. This way of thinking anticipated later approaches to functional urban areas and influenced regional planning in countries such as the United Kingdom, the United States, and India. It also supported the view that metropolitan governance should take into account the close economic and environmental relations between the main urban centre and the surrounding territory.

Metropolitan regions are also considered an important framework for understanding the development and organization of infrastructure networks, especially in the field of transport. Transport corridors, including highways, commuter rail connections, and logistics routes, influence the spatial organization of wider territories by affecting residential patterns, employment opportunities, and access to public and private services (Villaruel et al., 2025). Research on the integration of air and rail transport highlights that airport-related metropolitan areas frequently involve several municipalities and economic centres, demonstrating that mobility networks extend beyond individual administrative units (Xiao et al., 2025). These findings highlight the importance of considering a metropolitan perspective in transport planning, as infrastructure development and accessibility assessment need to take into account functional connections across larger territories (Nadimi & Goto, 2025).

Governance perspectives provide an additional element for understanding metropolitan regions, highlighting the need for cooperation between different administrative levels and institutions (Khodabandeh & Shahabi Shahmiri, 2025). Effective metropolitan development involves the coordination of regional authorities, local governments, and specialized organizations, as many economic, social, and environmental processes extend beyond individual administrative boundaries. The complexity of economic activities, housing markets, and environmental systems requires coordinated approaches that cannot be addressed by single cities alone. In the absence of such cooperation, metropolitan regions may experience fragmented planning, territorial disparities, and difficulties in ensuring efficient public service provision (Sharma, 2025).

Thus, the most recent theoretical development related to metropolitan areas stems from the observation that classical models (from the 20th century) no longer fully explain the realities of contemporary urbanization (Saptono et al. 2025). In recent research and in the urban/regional planning literature, there is a reconceptualization of metropolitan areas as multi-scalar functional systems, more complex than mere urban agglomerations or administrative entities (Kemp at al., 2025).

The importance of the new metropolitan theory is highlighted by the following aspects:

1. It reflects the actual urbanization of the 2020–2025 period (cities expanding functionally beyond their physical boundaries).
2. It provides a better framework for public policies: planning infrastructure, mobility, environment, and housing at the regional scale (Tsekeris, 2026).
3. It is adopted in research and planning (appearing in EU and ESPON studies).

The scientific literature proves that on EU level the economic inequalities within and between metropolitan areas remain persistent despite efforts to counteract them. Although many of these areas concentrate significant advantages – such as population, capital, high value-added jobs, and higher education and R&D institutions – not all metropolitan areas benefit equally from these advantages (Official Journal of the EU, 2025).

The inequalities between metropolitan areas in the southeastern EU (Athens, Naples, Sofia, or Bucharest) and those in the north, center, and west are more pronounced, as a result of historical developments and the way policies and historical processes have shaped their evolution (Malheiros, et al., 2024).

The most inequalities are driven by the so-called "capital city effect." In many countries, the capital concentrates a very high GDP per capita (including investments and well-paid jobs), generating substantial internal disparities (Gómez-Tello et. al, 2025). These territorial disparities are evident in cases such as Bucharest, Budapest, Sofia, or Prague (Giannakis & Bruggeman, 2020). There can also be observed that the inequalities don't only exist between different metropolitan areas but also within them. Many European metropolises face pronounced socio-spatial polarization, resulting from the coexistence of highly prosperous neighborhoods with marginalized peripheral areas, social and ethnic segregation, and difficulties in accessing housing, particularly in cities with highly dynamic real estate markets aimed at regional development, infrastructure, green transition, and digitalization (Mikuła, 2024).

However, there is a risk that already strong metropolitan areas may utilize these resources more effectively, which could lead to the perpetuation or even deepening of disparities between metropolises. In conclusion, the overall picture of inequalities among metropolitan areas in the EU is characterized by high heterogeneity. Metropolises are central actors in economic growth and European integration, but they can also become sources of territorial polarization, both at the European and national levels. Managing these inequalities remains one of the major challenges for urban and regional policies in the EU, compounded by the ongoing management of multiple, increasingly intensified crises.

3. Methodology and data

This study employs a quantitative approach to analyze the territorial inequalities across metropolitan areas in the European Union. The research is based on data extracted from Eurostat, covering the period 2003-2021. The empirical analysis focuses on metropolitan areas from all 27 EU Member States, ensuring a comprehensive and comparable dataset at the European level.

The main economic indicator used is GDP per capita, expressed in euro per capita at purchasing power parity, which is widely recognized in the scientific literature as a relevant proxy for economic performance and living standards at the regional and urban level. This indicator allows for meaningful comparisons between metropolitan areas characterized by different economic structures and population sizes. In addition, population (number of inhabitants) is included to provide contextual support for interpreting the scale and concentration of economic activity.

In order to address the research questions and test the proposed hypotheses, the analysis relies on a set of three complementary statistical indicators, each capturing a distinct dimension of territorial inequality.

First, the coefficient of variation is calculated for the metropolitan areas within each Member State in order to measure the relative dispersion of GDP per capita values. This indicator enables a consistent and comparable assessment of internal economic disparities across countries, regardless of differences in absolute levels (H1).

Second, the range of variation (difference between maximum and minimum values) is used to highlight the amplitude of disparities between metropolitan areas and to identify the extent of economic gaps within national systems. This measure provides insight into the scale of economic gaps within national metropolitan systems and contributes to identifying divergence processes (H4).

Third, the Gini concentration coefficient is employed as a synthetic measure of inequality, capturing the degree of concentration in the distribution of GDP per capita across metropolitan areas. Unlike the coefficient of variation, which reflects relative dispersion, the concentration coefficient captures the extent to which economic performance is concentrated in one or a limited number of metropolitan areas, thereby directly addressing the role of leading metropolitan areas (H2, H5).

In this study, the Gini concentration coefficient is calculated using a normalized share-based approach. For each metropolitan area i, a relative weight $g_i$is computed as:

$$g_i = \frac{x_i}{\sum_{i=1}^{n} x_i} \quad (1)$$

where $x_i$represents the GDP per capita of metropolitan area i, and n is the total number of metropolitan areas within the country. Based on these shares, the concentration coefficient is determined as:

$$C_G = \sqrt{\sum_{i=1}^{n} g_i^2} \quad (2)$$

The analysis of territorial disparities is further supported by the examination of the annual dynamics of average, minimum, and maximum GDP per capita values. This approach allows for the identification of convergence or divergence trends over time and facilitates the interpretation of changes in the spatial distribution of economic performance.

The joint interpretation of these three indicators enables a multidimensional assessment of territorial inequalities, distinguishing between relative dispersion, absolute gaps, and structural concentration. This integrated approach forms the basis for identifying distinct metropolitan system configurations across the European Union (H3).

Rather than imposing predefined classifications, the study follows a country-by-country analytical framework. Each Member State is examined individually, using the same set of indicators, which ensures methodological consistency and comparability. This approach allows patterns of similarity and difference to emerge naturally from the data.

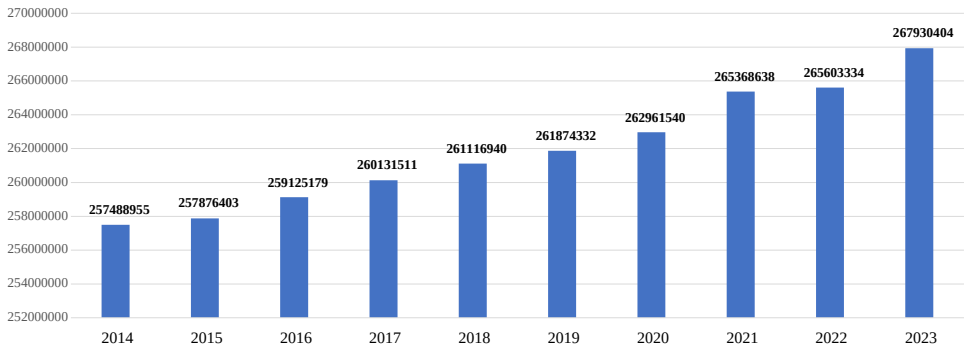
Special attention is given to countries with a limited number of metropolitan areas. In cases where only one metropolitan area is available, the concentration coefficient reaches its theoretical maximum and is not informative for internal comparisons. In such situations, the analysis focuses on the temporal evolution of GDP per capita.

Overall, the combined use of these indicators provides a robust analytical framework for assessing both the magnitude and the evolution of territorial inequalities across metropolitan areas in the European Union, offering a balanced perspective on structural disparities and growth dynamics.

4. Research results and comments

At EU level, in 2023, 267.93 million inhabitants live in metropolitan areas, with a positive trend of +4.6% (2014). Practically, the population of metropolitan areas increased by 10.441 million inhabitants (from 2.574 million), which means that there is an intense urbanization process at the level of the Member States. The total population of the EU-27 was, in 2023, 448.38 million people, and the metropolitan population represented 60% of the total (Figure 1).

Figure 1. The evolution of the population in the metropolitan area in EU-27, 2014-2021 (number of inhabitants)



Source: own computations based on Eurostat data, 2025.

The metropolitan area with the largest population in the EU is Paris, with 12.388 million inhabitants, followed by Madrid (6.87 million), Barcelona (5.797 million), and Berlin (5.481 million) (Table 1).

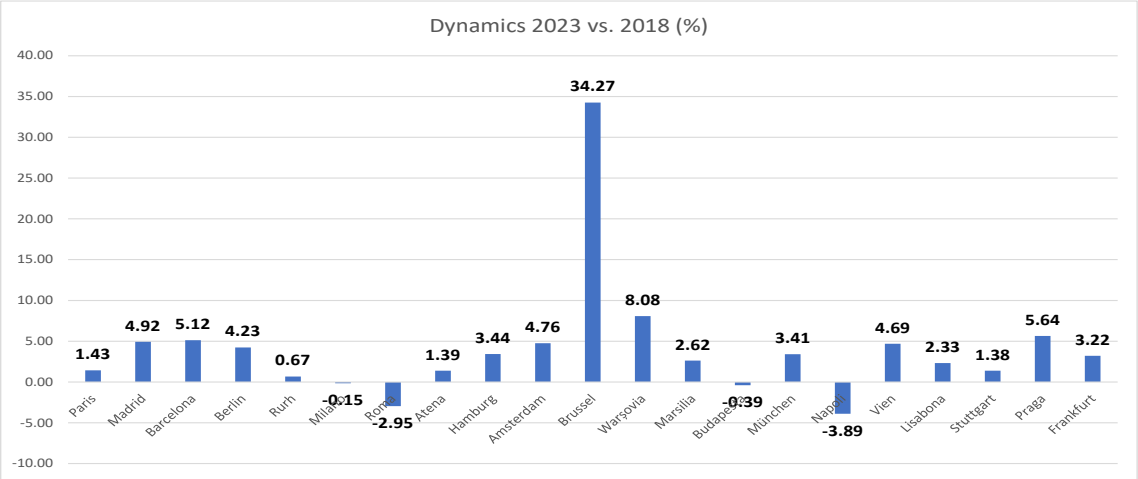
Table 1. Metropolitan areas with the largest population (number of inhabitants)

	2018	2019	2020	2021	2022	2023
Paris	12,213,447	12,252,917	12,291,557	12,348,605	12,329,432	12,388,388
Madrid	6,549,520	6,641,649	6,747,068	6,755,828	6,769,373	6,871,903
Barcelona	5,514,881	5,575,204	5,635,100	5,639,523	5,641,569	5,797,356
Berlin	5,259,363	5,303,846	5,342,887	5,351,765	5,376,272	5,481,613
Rurh	5,113,487	5,111,530	5,112,050	5,102,484	5,094,817	5,147,820
Milan	4,336,121	4,344,411	4,362,932	4,339,269	4,312,364	4,329,748
Rome	4,355,725	4,263,542	4,253,314	4,231,451	4,216,874	4,227,059
Athens	3,576,590	3,561,750	3,557,383	3,547,391	3,641,240	3,626,216
Hamburg	3,309,215	3,327,940	3,341,649	3,353,084	3,362,930	3,423,121
Amsterdam	3,242,852	3,269,905	3,302,548	3,316,712	3,344,598	3,397,323
Brussel	2,528,996	2,548,940	2,568,533	3,328,568	3,348,154	3,395,581

Source: own computations based on Eurostat data, 2025.

An analysis of population dynamics shows that most of the most populous metropolitan regions have increased their number of inhabitants, with the highest growth observed in Brussels (+34.27%). However, there are also three top regions that have seen a population decline: Naples (-3.89%), Rome (-2.95%), and Milan (-0.15%) (Figure 2).

Figure 2. Population dynamics in 2023 vs. 2018 (%)



Source: own computations based on Eurostat data, 2025.

In 2023, metropolitan areas in Romania had a population of 7.4 million inhabitants, representing a decrease of -2.48% compared to 2018. The largest metropolitan area in terms of population is the capital, Bucharest, with 2.290 million inhabitants, while the smallest is Galați, with 494,323 inhabitants (Table 3). In terms of dynamics, the largest population decline was recorded in Timișoara (-6.12%), followed by Craiova (-4.99%) and Ploiești (-4.74%). The capital also experienced a slight decrease (-0.53%). The only metropolitan area that recorded growth was Brașov (+0.29%).

In terms of density, the most densely populated metropolitan areas in the EU-27 are The Hague (2,786 inhabitants/km²), followed by Naples (2,539 inhabitants/km²), Wroclaw (2,347 inhabitants/km²), and Wuppertal (2,136 inhabitants/km²). The least densely populated are Tampere, Turku, and Uppsala, each with fewer than 50 inhabitants/km².

An important demographic indicator is the dependency ratio, a socio-demographic measure that assesses the proportion of the young population (0–14 years) and the elderly population (65 years and over) relative to the working-age population (15–64 years). It signals the social and economic pressure on the labor force. A high dependency ratio indicates an aging population, with a large number of individuals dependent on the younger generation, which can generate economic and social pressures.

At the metropolitan level, the male demographic dependency ratio in 2023 was 51.13%. Some metropolitan areas have a higher dependency ratio, which will affect the labor market and healthcare

systems. The most aged metropolitan areas are: Nice, Le Mans, Saint-Etienne, Les Abymes, Zwickau, Limoges, Fort-de-France, Nîmes, Görlitz, and Perpignan. At the opposite end, metropolitan areas with predominantly young populations include: Las Palmas, Oslo, Valletta, Luxembourg, Vienna, Graz, Innsbruck, and Madrid.

Belgium

In Belgium, six metropolitan areas are operational, whose GDP per capita has shown a general trend of steady growth, rising from an average of €24,350 per inhabitant in 2003 to €37,233 per inhabitant in 2021. This dynamic reflects solid urban economic progress, with a sustained capacity to adapt to socio-economic challenges, including during the global financial crisis (2008–2010) and the health crisis (2020–2021).

During the analyzed period, the Brussels metropolitan area stood out with the highest average GDP per capita (PPS) (€40,226 per inhabitant), reflecting its position as the European capital and an important administrative and financial center. Antwerpen and Gent follow in the ranking, with average values exceeding €34,000 per inhabitant, confirming the strong economic performance of the Flemish region, particularly in sectors such as logistics, the chemical industry, and specialized services. In contrast, the metropolitan areas of Charleroi, Liège, and Namur record significantly lower average levels, ranging between approximately €19,700 and €24,400. These differences highlight the persistence of territorial imbalances in Belgium, in the context of a slower and more challenging industrial reconversion process in the southern part of the country (Appendix 1).

Regarding the values of the concentration/diversification, we can mention:

a) *dispersion of values* - Gent exhibits the highest standard deviation, exceeding €5,190, and a coefficient of variation of nearly 15%, indicating volatile economic performance and heightened sensitivity to external or internal shocks; at the opposite end, Charleroi stands out with a coefficient of variation of approximately 9.4%, reflecting relative stability, albeit at a low level of economic performance. Brussels and Antwerpen show moderate variability, with coefficients around 10.5%, suggesting a balanced evolution of GDP per capita without major deviations during the analyzed period.
b) *the concentration coefficient* reveals a relatively stable distribution of GDP per capita across metropolitan areas over the period 2003–202 (Appendix 2). The values fluctuate within a narrow interval, between approximately 0.418 and 0.423, indicating a moderate and persistent level of territorial concentration.
c) Belgium exhibits a relatively *balanced spatial configuration*, where economic activity is not excessively concentrated in a single metropolitan area; the stability of the concentration coefficient is consistent with the results obtained using the coefficient of variation and the range of values, reinforcing the conclusion that territorial disparities in Belgium are moderate and structurally stable throughout the analyzed period.

The data highlighted a clear contrast among the four metropolitan areas of Belgium. These results emphasize the need for differentiated regional policies, tailored to local specificities, to reduce disparities and promote more balanced development at the national level.

Bulgaria

The statistical analysis of GDP per capita (PPS) values for the metropolitan regions of Sofia, Plovdiv, Varna, and Burgas highlights structural differences and distinct economic dynamics among these urban areas.

Between 2003 and 2021, GDP per capita experienced a significant increase, rising from an average of €7,725 per capita to €20,300 per capita. In 2021, the mean GDP per capita was €20,300, while the median stood at only €15,500, confirming the presence of exceptionally high values (in the case of Sofia) (Appendix 3).

Although GDP per capita has increased considerably in Bulgaria, this growth has not been evenly distributed among the four analyzed urban regions. The evolution of the coefficient of variation

suggests economic polarization in favor of the capital, highlighting the need for public policies aimed at reducing disparities and promoting balanced development in the secondary cities.

Sofia has by far the highest average GDP per capita (almost double that of the other regions). This confirms the capital's role as the main hub of economic growth and investment attraction in Bulgaria.

Regarding the values of the concentration/diversification, we can mention:

a) *the coefficient of variation* (28.88%) indicates the greatest volatility in economic performance, reflecting uneven development over time. This can be attributed to the accelerated urban development and external investments, as well as economic shocks that have affected the region differently compared to other areas. Plovdiv and Varna exhibit intermediate levels of GDP per capita and moderate volatility, reflecting steady economic development, though not matching the pace of the capital (Appendix 4).
b) *the concentration coefficient* calculated for Bulgaria indicates a relatively high and persistent level of territorial inequality across metropolitan areas over the period 2003–2021. The values range between approximately 0.545 and 0.558, remaining significantly above the theoretical minimum corresponding to perfect equality, which is 0.5 in this case. This pattern reflects a pronounced concentration of economic performance within the Bulgarian metropolitan system, driven primarily by the dominant role of Sofia. The capital consistently records substantially higher levels of GDP per capita compared to the other metropolitan areas, including Plovdiv, Varna, and Burgas, which remain at significantly lower levels throughout the analyzed period. From a dynamic perspective, the slight upward trend observed after 2015 suggests a gradual intensification of territorial disparities. This indicates that the gap between the leading metropolitan area and the secondary urban centers is not only persistent but also slowly widening over time.
c) although it reflects a steady process of economic development and convergence toward the EU average, the analysis revealed an increase in territorial inequalities. This dynamic signals a widening gap among the analyzed cities, with a more pronounced growth in Sofia, the country's capital, compared to the other three urban centers.

Czech Republic

The annual comparative analysis of GDP per capita (PPS) for the four metropolitan areas in the Czech Republic – Prague, Brno, Ostrava, and Plzeň – highlights a series of significant differences both in terms of levels and temporal variability. The average values for the entire analyzed period show that Prague stands out clearly from the other cities, with a mean level of €35,568, nearly double that of Brno (€21,425), Ostrava (€20,125), and Plzeň (€18,400). This difference undoubtedly reflects the capital's status as the main economic, administrative, and financial center of the country (Appendix 5).

Between 2003 and 2021, GDP per capita (PPS) in the four metropolitan areas of the Czech Republic – Prague, Brno, Ostrava, and Plzeň – followed a general upward trend, with the average rising from €16,725 in 2003 to €31,350 in 2021. This positive dynamic reflects a sustained process of national economic development, although it was not accompanied by a significant reduction in territorial disparities.

Regarding the values of the concentration/diversification, we can mention:

a) *the coefficient of variation* calculated among the metropolitan areas ranges between approximately 16.14% and 19.86%, highlighting moderate variability in economic performance and indicating that the differences between the analyzed metropolitan areas are significant, yet not extremely pronounced (Appendix 6). The stability of this indicator reflects the rigidity of the hierarchical structure of the Czech metropolitan system and the limited progress of territorial convergence processes. Overall, the evolution of the mean, the range between extreme values, and the consistently stable coefficient of variation outline a highly polarized model of metropolitan development, dominated by the Prague metropolitan area. This configuration suggests the existence of structural mechanisms that

favor the concentration of resources and investments in the capital, maintaining a significant gap relative to the other metropolitan areas over the long term (Appendix 6).

b) *the concentration coefficient indicates* a moderate and highly stable level of territorial inequality across metropolitan areas over the period 2003–2021. The values range between approximately 0.525 and 0.531, remaining above the theoretical minimum corresponding to perfect equality (0.5), but without indicating a strong concentration of economic activity. This pattern reflects the presence of a hierarchical metropolitan structure, with Prague consistently occupying the leading position in terms of GDP per capita. However, the differences between the capital and secondary metropolitan areas such as Brno, Ostrava, and Plzeň are less pronounced compared to more polarized systems, suggesting a more balanced distribution of economic performance.

In conclusion, there is a marked concentration of economic development around the Prague metropolitan area, followed at a distance by Brno, which exhibits more fluctuating but promising economic dynamics. The Ostrava and Plzeň metropolitan areas appear anchored in stable yet limited development, suggesting the need for more proactive economic policies and more effective investment attraction to reduce regional disparities and promote territorial cohesion within the Czech Republic.

Denmark

The evolution of GDP per capita in the four major metropolitan areas of Denmark – København, Århus, Odense, and Aalborg – reflects an economic trajectory marked by robust growth, alongside a gradual deepening of regional disparities. Statistical data for the Danish metropolitan areas highlight a clear differentiation in average GDP per capita levels, with higher values concentrated in the capital. The København metropolitan area records an average of approximately €40,711 per capita, significantly exceeding the averages of the other three areas. For example, in Århus, the average is €29,905, while in Odense and Aalborg it stands at €26,279 and €28,484, respectively (Appendix 7).

Regarding the values of the concentration/diversification, we can mention:

a) *the coefficient of variation* for København is 17.16%, suggesting a moderate level of fluctuations in GDP per capita. In contrast, the Odense and Aalborg metropolitan areas exhibit lower variability (12.36% and 12.56%, respectively), indicating a more balanced distribution of economic performance over the analyzed years. The statistical analysis of the four Danish metropolitan areas, København, Århus, Odense, and Aalborg, over the period 2003-2021 reveals an overall upward trend in GDP per capita, accompanied by a gradual increase in variability between the areas. The annual average GDP per capita ranges from €23,825 (2003) to €40,800 (2021), reflecting a notable economic advance over two decades. However, the dispersion of values between the four areas has become increasingly pronounced over time.

b) *the maximum value* reaches €56,400 (2021), while the minimum is €20,600 (2003), resulting in a total range of €27,800. This gap suggests an accelerated development trajectory, particularly for one of the areas (most likely the capital), compared with the other regions.

c) *the concentration coefficient* calculated for Denmark indicates a relatively low and stable level of territorial inequality across metropolitan areas over the period 2003-2021. The values range between approximately 0.511 and 0.525, remaining close to the theoretical minimum corresponding to perfect equality (0.5), which suggests a highly balanced distribution of GDP per capita (Appendix 8). This indicates that economic activity is not excessively concentrated in a single metropolitan center, reflecting a more evenly distributed urban system.

From a dynamic perspective, the concentration coefficient shows a slight upward trend, particularly after 2014, suggesting a modest increase in territorial disparities. However, the magnitude of this increase remains limited, and the overall structure of the metropolitan system continues to be characterized by stability and relative balance (Appendix 8).

Germany

The analysis of average GDP per capita (PPS, euro) highlights a picture of significant territorial disparities, with clear variations between the western and southern areas on one hand, and the eastern areas on the other. The metropolitan area of Munich ranks at the top, with an average GDP per capita of €53,846, reflecting a high level of economic development and a strong capacity to leverage local competitive advantages. Closely following is Frankfurt am Main, with an average of €53,108, confirming its major role in Germany's financial and economic system.

Within the category of highly competitive metropolitan areas are Stuttgart (average €46,036), Düsseldorf (€45,015), Nürnberg (€38,508), and Hamburg (€36,954), highlighting the concentration of high-performing economic activities in the western and southern parts of the country. Berlin records an average of €28,385, placing it in an intermediate position between the western economic hubs and the less-developed eastern regions. At the lower end of the spectrum are the eastern metropolitan areas, with Görlitz at the minimum of the distribution, averaging €21,631, followed by Neubrandenburg (€22,400), Magdeburg (€22,862), Schwerin (€23,154), and Halle an der Saale (€23,385), indicating the persistence of a significant structural gap (Appendix 9).

Overall, the difference between the highest-performing metropolitan area (München – €53,846) and the least-developed one (Görlitz – €21,631) is €32,215, reflecting a deep economic divide between western and eastern Germany, even more than three decades after reunification. This contrast highlights pronounced territorial disparities and the persistent difficulty of the eastern regions in bridging historical development gaps.

From a temporal perspective, the evolution of GDP per capita in the major German metropolitan areas shows a general upward trend, with the average increasing from €24,979 in 2003 to €38,754 in 2021, corresponding to an absolute growth of 13,775 euros over the analyzed period. However, the growth rate was not uniform, featuring episodes of acceleration as well as periods of relative stagnation.

Regarding the values of the concentration/diversification, we can mention that:

a) *the coefficient of variation* remains relatively stable, around 22–23%, indicating the persistence of a high level of territorial disparities (Appendix 10). The stability of this indicator suggests that, although all metropolitan areas have experienced economic progress, the territorial hierarchy and the degree of internal inequality have largely remained unchanged. In 2003, the difference between the highest-performing and the least-developed metropolitan area was €31,100, while in 2021 it reached €39,200, indicating a clear trend of increasing territorial polarization. This evolution shows that economic dynamics continue to favor already established centers, limiting convergence processes at the metropolitan level (Appendix 10).
b) *the concentration coefficient* remains exceptionally low throughout the period 2003-2021, decreasing slightly from approximately 0.125 in 2003 to around 0.122 in the most recent years. These values are very close to the theoretical minimum, indicating a near-uniform distribution of GDP per capita across a large number of metropolitan areas.

What differentiates Germany from other national systems is the combination of scale and balance. Despite the presence of economically strong metropolitan areas such as München, Frankfurt, Hamburg, and Stuttgart, no single center dominates the overall distribution. Instead, economic performance is spread across a wide network of metropolitan areas, resulting in a remarkably even structure.

In comparative terms, Germany can be considered a benchmark for metropolitan balance within the European Union. Its low concentration values contrast clearly with countries where economic activity is more unevenly distributed, while also highlighting the role of a diversified and polycentric urban system in sustaining territorial cohesion.

Estonia

Over the analyzed period, the average GDP per capita was 27,605 €, positioning Tallinn above the average of many other capitals in Central and Eastern Europe, reflecting a consistent economic performance within the Estonian context (Appendix 11).

The recorded values indicate noticeable economic growth, but also sensitivity to external events, especially during crisis periods. The minimum value was 16,200 €, while the maximum reached 37,100 € (a difference of 20,900 €, suggesting a significant range typical of a transitioning economy that experienced phases of accelerated development).

PIB per capita in Tallinn (2003 and 2021) reflects a stable evolution, with a steady growth rate and without extreme fluctuations. The Estonian economy, although small, has performed efficiently in the regional context, and Tallinn, as the capital, has directly benefited from processes of modernization, digitalization, and EU integration.

The calculation of the concentration coefficient is not applicable in the case of Estonia, as the national metropolitan system includes only a single metropolitan area (Tallinn). In such cases, the coefficient is 1, which does not provide meaningful information regarding territorial inequality.

Therefore, Estonia is excluded from the comparative analysis of metropolitan disparities, as the indicator requires the presence of multiple spatial units in order to capture the distribution of economic performance.

Ireland

The annual evolution of GDP per capita in the two metropolitan areas of Ireland between 2003 and 2021 reflects both periods of stability and phases of considerable fluctuation. From 2003 to 2007, values remained within a relatively narrow range, gradually increasing from €37,100 to €45,500, indicating a period of economic equilibrium before the crisis. The year 2008 marks the onset of pronounced instability, with the average falling to €39,200, reflecting the impact of the global financial crisis on the Irish economy (Appendix 12).

The differences between the analyzed metropolitan areas are significant. Dublin stands out with a high GDP per capita, averaging approximately €108,355 per inhabitant, reflecting a dynamic economy considerably more developed than the rest of the country. The standard deviation of €35,683 and a coefficient of variation of 25.9% indicate substantial temporal fluctuations in economic performance per inhabitant. Cork shows a much lower average, €39,665 per inhabitant, with a high degree of variability, evidenced by a coefficient of variation of 52.9%, signaling wide oscillations in GDP per inhabitant over time (Appendix 13). Thus, the comparative analysis highlights not only a structural discrepancy between the two areas but also a more pronounced instability in the Cork metropolitan area, which appears to have experienced more frequent periods of economic fluctuation.

The concentration coefficient calculated for Ireland indicates a transition from a relatively balanced to a more concentrated metropolitan structure over the period 2003-2021. In the early years of the analysis, the coefficient remained very close to the theoretical minimum corresponding to perfect equality (approximately 0.707), suggesting a relatively even distribution of GDP per capita between Dublin and Cork.

However, starting with the mid-2010s, the coefficient shows a gradual upward trend, reaching values of approximately 0.73 by 2021. This evolution reflects an increasing concentration of economic performance, driven primarily by the accelerated growth of Dublin compared to Cork.

From a structural perspective, the Irish metropolitan system is characterized by a dual configuration, where the relative balance between the two urban centers gradually shifts towards a more dominant role of the capital. The widening gap between Dublin and Cork is particularly evident in the later years of the analysis, indicating a process of growing territorial concentration.

Although the number of metropolitan areas is limited, which constrains the interpretation of the coefficient, the results clearly point to a divergence pattern, contrasting with more stable and balanced systems observed in other European countries.

Greece

In Greece, GDP per inhabitant in Athens and Thessaloniki shows notable differences both in average level and degree of variation. Athens records an average of approximately €27,311, significantly higher than Thessaloniki (€17,568), indicating a strong economic concentration in the capital. At the same time, the coefficient of variation in Athens is 7.63%, reflecting a more pronounced stability in living standards, compared to Thessaloniki, where variability is higher (10.42%) (Appendix 14). The difference between maximum and minimum values is also greater in the capital (€7,100 versus €5,900),

reflecting a more varied economic dynamic in Athens. Overall, the analysis suggests a pronounced regional polarization between the two major urban centers, with the capital benefiting from greater stability and a higher level of economic development.

Over the period 2003–2021, the average GDP per inhabitant for the metropolitan areas of Greece showed a fluctuating trend, reflecting the profound impact of successive economic crises. Between 2003 and 2008, there was a steady increase, reaching an average of €26,450 /inhabitant in 2008. The global financial crisis of 2008–2010 had a severe impact, evident in a sharp decline of the average to €23,150 /inhabitant in 2010, continuing to drop to €19,950 /inhabitant in 2012. The recovery was slow and fragmented, with average values remaining below the 2008 level until 2021, when a slight rebound to €23,050 /inhabitant was recorded.

This trend of high volatility, especially in the post-crisis period, highlights the structural vulnerability of Greek metropolitan areas, with significant implications for local economic resilience and the capacity to recover from external shocks.

The concentration coefficient calculated for Greece indicates a relatively balanced and stable distribution of GDP per capita between the two metropolitan areas over the period 2003–2021. The values remain close to the theoretical minimum corresponding to perfect equality (approximately 0.707), fluctuating within a narrow interval between 0.711 and 0.716.

This pattern suggests that, despite the consistently higher levels of GDP per capita recorded in Athina compared to Thessaloniki, the relative gap between the two metropolitan areas does not widen significantly over time. The stability of the coefficient indicates the absence of strong divergence or increasing concentration processes within the Greek metropolitan system (Appendix 14).

From a dynamic perspective, a slight increase in the coefficient can be observed during the years following 2010, reflecting the asymmetric impact of economic adjustments across metropolitan areas. However, this increase remains limited, and the overall structure continues to reflect a relatively balanced dual metropolitan system.

Spain

From the analysis of GDP per capita for the 23 metropolitan areas, Madrid stands out as the clear leader in economic performance, with an average of €33,500 per inhabitant and a standard deviation of approximately €3,152, indicating a balance between a high level of the indicator and moderate variability. Barcelona has an average of €29,000 per inhabitant with slightly lower dispersion, while Vitoria-Gasteiz, despite its smaller size, surprises with a very high average of over €37,000 per inhabitant, accompanied by somewhat greater variability.

Areas such as Valencia, Sevilla, Zaragoza, or Palma de Mallorca show average values between €20,000 and €27,000 per inhabitant, indicating relatively stable economic performance, yet significantly below that of Madrid and Barcelona. In southern cities like Málaga-Marbella, Córdoba, Granada, or Cádiz, average values are markedly lower, ranging from €17,000 to €19,000 per inhabitant, reflecting a persistent regional economic gap. Nevertheless, Málaga manages to maintain a low standard deviation, suggesting a relatively homogeneous distribution (Appendix 15).

The island metropolitan areas (Las Palmas, Palma de Mallorca, Santa Cruz de Tenerife) display a mixed economic profile: Palma de Mallorca records a higher average economic level compared to the other two, while Tenerife and Las Palmas remain at more modest, yet stable, average values. Zaragoza and Guipúzcoa show comparable mean levels, but Guipúzcoa stands out due to its higher volatility, which may indicate more pronounced regional inequalities.

The coefficient of variation provides additional insight: the most stable metropolitan areas, in terms of data homogeneity, are Santa Cruz de Tenerife, Murcia–Cartagena, and Las Palmas, all recording coefficients of variation below 6%. By contrast, areas such as Valladolid, A Coruña, and Vitoria/Gasteiz exceed 9%, suggesting the presence of considerable disparities among individual values within the sample.

Overall, two major categories clearly emerge:

1. metropolitan areas with high GDP per capita and moderate variation: Madrid, Barcelona, Vitoria/Gasteiz, Bilbao.
2. areas with modest economic performance and, in some cases, high variability: Córdoba, Granada, Cádiz, Elche/Alicante.

This disparity can be interpreted both as a consequence of structural differences within the economy and of regional policies or demographic characteristics.

The average GDP per capita values across the 23 metropolitan areas show a general upward trend between 2003 and 2008, with a remarkable acceleration during the 2005–2007 period, when the average increased from approximately €22,200 to over €25,300. This phase coincides with a favorable European economic context, prior to the global financial crisis. After 2008, a sharp decline can be observed, starting in 2009, when the average fell below €24,000, reaching a relative minimum in 2012, with an average value of approximately €22,943. This evolution reflects the impact of the economic crisis on Spanish metropolitan areas, followed by a period of stagnation between 2010 and 2014, marked by slight fluctuations but without a return to the pre-crisis growth pace.

After 2014, the average starts to increase again, reaching progressively higher values year by year, up to a peak of over €27,600 per inhabitant in 2019. The COVID-19 pandemic in 2020 leads to a visible decline in the average to around €24,147 per inhabitant, but a recovery can be observed in 2021, when the average rises again to €26,743 per inhabitant, indicating that economic resilience is beginning to take shape, at least at the aggregate level of the 23 metropolitan areas.

Evolution of the maximum and minimum values confirms these observations: between 2003 and 2008, the maximum values increased from 29,100 to 40,000, while the minimum values also rose but remained significantly below the maximum. After the crisis, the gap between the area with the lowest and the highest value reached a peak of over 22,000 during the period 2017–2019, suggesting that although GDP per capita increases on average, disparities are widening. The pandemic in 2020 leads to a reduction in both the maximum value (to 37,100) and the minimum value (to 17,100), but in 2021 the gap returns to a high level, with a maximum of 41,500 and a minimum of 19,300 (Appendix 15).

The concentration coefficient calculated for Spain indicates a very low and highly stable level of territorial inequality across metropolitan areas over the period 2003–2021. The values fluctuate within a narrow interval, between approximately 0.205 and 0.210, remaining extremely close to the theoretical minimum corresponding to perfect equality.

This result reflects a highly balanced distribution of GDP per capita across Spanish metropolitan areas, suggesting the absence of strong concentration processes. Although major urban centers such as Madrid and Barcelona consistently record higher levels of economic performance, their dominance does not translate into excessive territorial concentration.

From a structural perspective, the Spanish metropolitan system can be characterized as polycentric, with multiple urban areas contributing to overall economic performance. The stability of the concentration coefficient over time further indicates the absence of significant divergence or convergence processes, with the relative positions of metropolitan areas remaining largely unchanged.

In conclusion, the aggregated dynamics of the 23 metropolitan areas show sustained economic growth up to 2008, followed by a post-crisis contraction and a period of gradual recovery until 2019. The pandemic had a visible but temporary negative impact, and the resumption of growth in 2021 indicates an economic rebound, albeit an uneven one, with territorial disparities being maintained or even intensified. This statistical analysis highlights both the resilience of some areas and the persistent vulnerability of others, outlining a fragmented yet evolving economic landscape.

France

Paris clearly stands out with an exceptional economic level, recording an average GDP per capita of €559,230.64, by far the highest value in the sample. The extremely high standard deviation, exceeding €83,000, indicates wide variation across the years analyzed or among the components of the metropolitan area, reflecting both the dynamism and the economic inequalities characteristic of the French capital. At a considerable distance follows the Annecy–Geneva area, with an average of €80,440.12, which stands out as one of the most prosperous metropolitan areas, significantly influenced by its proximity to Switzerland.

In the next category fall Lyon and the Lille–Dunkerque–Valenciennes area, with averages of €66,765.00 and €64,688.91 respectively, confirming their role as major economic poles within France's territorial structure.

At a medium-to-high economic level are the metropolitan areas of Bordeaux and Toulouse, with similar average values of €42,574.07 and €42,028.05 per capita, respectively.

The group of metropolitan areas with values between €30,000 and €40,000 per capita includes Nantes, Rouen, Grenoble, Strasbourg, Marseille, and Nice. Nantes, with an average close to €38,000, is positioned toward the upper bound of this interval, while Strasbourg, Marseille, and Nice record relatively similar values, around €31,200.

Below this threshold, in the category of metropolitan areas with averages between €20,000 and €30,000, are Rennes, Montpellier, Le Mans, and Tours, followed by a larger group of urban centers with more modest economic performance, such as Orléans, Reims, Nancy, Saint-Étienne, Mulhouse, Clermont-Ferrand, Dijon, Poitiers, and Perpignan. Perpignan, with an average of only €9,092.08, alongside Poitiers (€10,076.71), is positioned at the lower end of the ranking.

The differences among these metropolitan areas are generally moderate to high, reflecting the existence of structural territorial disparities between major economic centers and peripheral metropolitan areas.

Regarding the *coefficient of variation*, marked differences can be observed among the metropolitan areas, indicating distinct levels of economic stability over time. Paris records a coefficient of variation of 14.91%, signaling the presence of notable fluctuations, while the Annecy–Genève area stands out with a high coefficient of variation of 28.86%, pointing to pronounced economic volatility. In contrast, Lyon shows a coefficient of variation of only 6.87%, highlighting a high degree of economic stability. Areas such as Marseille and Toulouse, with coefficients of variation of 18.57% and 11.63%, reflect a less predictable economy, while Strasbourg, Nice, and Nantes, with values between 10% and 15%, suggest relative balance. At the opposite end, in less developed areas such as Perpignan, the coefficient of variation exceeds 21%, indicating more pronounced instability and persistent structural fragility (Appendix 16).

The *concentration coefficient* calculated for France indicates a very low and highly stable level of territorial inequality across metropolitan areas over the period 2003–2021. The values fluctuate within a narrow interval, between approximately 0.167 and 0.173, remaining extremely close to the theoretical minimum corresponding to perfect equality.

This result reflects a highly balanced distribution of GDP per capita across French metropolitan areas, suggesting the absence of strong concentration processes. Although Paris consistently records the highest levels of economic performance, its dominance does not lead to excessive disparities across the metropolitan system.

From a structural perspective, the French metropolitan system can be characterized as polycentric, with multiple urban centers such as Lyon, Toulouse, and Bordeaux contributing significantly to national economic performance. The stability of the concentration coefficient over time indicates that the relative positions of metropolitan areas remain largely unchanged, with no significant divergence trends (Appendix 16).

Overall, the results highlight a metropolitan economy in expansion, yet deeply imbalanced, where a few areas concentrate growth and prosperity, while others remain stuck in slow development. From the perspective of cohesion and regional development policies, these findings call for targeted interventions, tailored to the specific characteristics of each metropolitan area, with an emphasis on balancing territorial development. At the same time, the analysis suggests that in the face of the recent health crisis, France's major urban agglomerations have demonstrated a higher degree of adaptability and resilience than during the global financial crisis, which constitutes a crucial starting point for a comparative assessment of the two shocks and their effects on the territory.

Croatia

The comparison of the two Croatian metropolitan areas, Zagreb and Split, reveals a substantial economic differentiation in terms of GDP per inhabitant. The average GDP per inhabitant in Zagreb is approximately €23,289, nearly double that recorded in Split (€12,958).

The difference highlights a stronger concentration of economic activity (and income) around the capital, where most institutions are located. The dispersion of values also differs between the two areas. In Zagreb, the standard deviation is about €4,829, while in Split it is approximately €2,376. This indicates greater variability in GDP per capita in Zagreb, which may reflect a more dynamic economic environment, with periods of significant growth as well as some pronounced fluctuations. *The coefficient of variation* supports this interpretation: in Zagreb it is 20.73%, while in Split it is 18.33%, suggesting

that although values in Split are lower, they are relatively more stable compared to the mean (Appendix 17).

The minimum GDP per capita in Zagreb was €15,000, while the maximum reached €33,500, resulting in a range of €18,500. In Split, the values are significantly lower, between €8,700 and €18,100, giving a range of €9,400. These differences in amplitude confirm Zagreb's dominant position in the Croatian economic landscape, not only through its higher average but also through the growth potential and economic diversity reflected in the extreme values.

Even though the number of observations is the same for both areas (19 years), the total sum of GDP per inhabitant is almost twice as high in Zagreb compared to Split. However, the relatively greater stability of values in Split may indicate a less complex economic base, yet one less exposed to major shocks. Over the analyzed period, GDP per inhabitant followed a sustained growth process. Annual average values increased from approximately €11,850 in 2003 to €25,800 in 2021. This growth rate confirms a gradual consolidation of the urban economy while also suggesting a potential widening of disparities between the two metropolitan areas.

The statistical analysis depicts a positive yet uneven evolution of GDP per capita in the two areas. Although both exhibit an upward trend, the magnitude and stability of growth vary, leaving room for interpretations regarding the differing pace of urban development and the capacity to adapt to economic shocks.

The values of the *concentration coefficient* for Croatia, ranging between approximately 0.740 and 0.747 throughout the period 2003-2021, indicate a clear and persistent imbalance in the distribution of GDP per capita between the two metropolitan areas. These levels remain consistently above the theoretical minimum (0.707), reflecting a structurally uneven configuration (Appendix 17).

Zagreb's position as the dominant economic center is evident across all years, maintaining a substantial lead over Split. However, unlike cases where disparities increase over time, here the difference remains broadly constant, indicating that the system is not undergoing major reconfiguration, but rather reproducing an existing pattern.

In this sense, the Croatian metropolitan structure can be interpreted as one where economic differences are clearly defined and persistent, but not subject to significant acceleration. The lack of convergence between the two metropolitan areas highlights the limited capacity of the secondary center to close the gap, reinforcing the stability of the existing distribution.

Italy

The metropolitan areas of Milan and Rome stand out clearly with high average GDP per inhabitant, at 44,168 euro and 37,242 euro respectively, reflecting their role as national economic centers. Milan also shows the greatest data dispersion, with a range of 17,000 euro and a standard deviation exceeding 4,500 euro, indicating a high variability in economic performance over time. In contrast, southern cities such as Naples, Palermo, and Catania exhibit much lower average values, between 17,826 and 18,442 euro, accompanied by lower variability but comparable coefficients of variation (over 5-7%), suggesting persistent stagnation at low levels of GDP per inhabitant.

Metropolitan areas in central and northern Italy, such as Bologna, Padua, Genoa, Florence, and Verona, occupy an intermediate range, with averages between €31,000 and €36,800 per capita, but with considerable standard deviations (between €2,000 and €3,000), indicating significant fluctuations in income per inhabitant. Notably, areas such as Turin, Parma, and Reggio nell'Emilia have average values between €30,000 and €35,000 per capita and display moderate coefficients of variation (below 9%), reflecting relative economic stability over time (Appendix 18).

The descriptive statistical analysis shows that metropolitan areas in northern Italy enjoy a significantly higher and more volatile GDP per capita, reflecting strong economic dynamics, while the south remains characterized by lower values and relatively stable, but economically weaker, conditions. This regional duality is also evident in the statistical parameters of the distribution, confirming the structural economic disparities between northern and southern Italy. Between 2003 and 2021, the average GDP per capita across the 22 metropolitan areas showed an upward trend, starting from €25,481 in 2003 and reaching €32,913 in 2021. The evolution was not linear, with periods of stagnation or slight regression, such as between 2008 and 2010 or in 2012 and 2013 (Appendix 18).

The minimum GDP per capita was recorded in 2003 at €15,100, while the maximum, €53,900, was reached in 2021. The range between the extreme values increased over time, from €21,800 in 2003 to €34,300 in 2021. This trend reflects significant territorial disparities, with moderate economic growth that is unevenly distributed across Italy's metropolitan areas.

The *concentration coefficient* for Italy remains within a very narrow range, between approximately 0.210 and 0.214 over the period 2003-2021, values that are very close to the theoretical minimum. This pattern points to a relatively even distribution of GDP per capita across metropolitan areas, with no strong tendency toward concentration. The absence of significant fluctuations in the concentration coefficient suggests that the relative economic positioning of metropolitan areas has remained broadly unchanged. This indicates that, despite underlying structural differences, particularly between the northern and southern parts of the country, these disparities do not intensify in relative terms.

Overall, the Italian metropolitan system can be described as internally diverse yet structurally stable, with differences that are evident in absolute terms but remain relatively contained when assessed through the distribution of GDP per capita.

Cyprus

The analysis focused exclusively on the metropolitan area of Lefkosia (the only urban unit available in Eurostat). The average GDP per capita (2003-2021) was approximately €24,874, indicating a moderate economic level in the European context. This reflects a relatively stable evolution of economic performance at the urban level, without major fluctuations or significant deviations from the average trend.

The range between the extreme GDP per capita values is €10,700, with a minimum of €19,900 and a maximum of €30,600, indicating the presence of internal economic dynamics over time, even though comparisons between metropolitan areas are not possible.

In the case of Cyprus, *the concentration coefficient* takes the value of 1 throughout the entire period 2003-2021, reflecting the presence of a single metropolitan area (Lefkosia) in the dataset. This does not provide meaningful insight into territorial distribution, as the indicator requires multiple spatial units in order to capture differences in economic performance.

Rather than indicating a high level of concentration, this outcome simply reflects the structural limitation of the dataset. In the absence of additional metropolitan areas, the concept of distribution becomes inapplicable, and the coefficient loses its interpretative value in terms of territorial inequality.

For this reason, Cyprus should be treated separately within the analysis. Although the evolution of GDP per capita in Lefkosia remains relevant for understanding national economic dynamics, the country cannot be included in comparative assessments of metropolitan disparities based on the concentration coefficient.

In conclusion, the Lefkosia metropolitan area shows a stable economic trajectory over the analyzed period, with no significant variations in GDP per capita and a balanced distribution of this indicator over time.

Latvia

In Latvia, the only metropolitan area identified in the Eurostat database is Riga. The average GDP per capita (2003-2021) was approximately €21,716, reflecting a modest economic level compared to other European urban areas.

The difference between the minimum value (€12,600) and the maximum value (€30,400) is €17,800, reflecting a pronounced economic dynamic over the 19-year period analyzed. This significant range reinforces the conclusion regarding the uneven evolution of economic performance at the urban level.

Overall, the Riga metropolitan area experienced an economic evolution marked by notable variations in GDP per capita, without a clear trend toward stabilization during the period analyzed, yet with a relatively balanced distribution of values around the overall mean.

For Latvia, the concentration coefficient remains equal to 1 across the entire period 2003–2021, reflecting the fact that the metropolitan system is represented by a single urban area, Riga. In this

context, the coefficient does not capture any form of distribution, as there are no additional metropolitan units against which differences could be measured.

From an analytical perspective, this outcome does not indicate a high level of concentration in the conventional sense, but rather the absence of a metropolitan structure that would allow for internal comparison. As a result, the indicator cannot be used to assess territorial disparities within the country.

Consequently, Latvia is better interpreted through its temporal dynamics rather than through spatial distribution and would be excluded from cross-country comparisons based on the concentration coefficient.

Lithuania

In Lithuania, the two metropolitan areas – Vilnius and Kaunas – show significant economic differences in terms of GDP per capita (2003–2021). The Vilnius metropolitan area, as the national capital, has an average GDP per capita of €27,074, markedly higher than Kaunas, which has an average of €18,389. The difference of over €8,600 reflects a clear economic disparity between the political-administrative center and the secondary urban area.

The dispersion of values is more pronounced in Vilnius, with a standard deviation of €8,157 and a coefficient of variation of 30.1%, indicating considerable variability in living standards over time. Kaunas shows even higher volatility, with a coefficient of variation of 33%, signaling relatively greater economic instability. The differences between extreme values are significant: €28,900 in Vilnius and €20,300 in Kaunas, reflecting a broad but uneven development in both areas. However, the larger amplitude observed in the capital also highlights its capacity to reach higher levels of economic performance (Appendix 19).

According to the analyses, Vilnius stands out as the dominant economic pole of Lithuania, while Kaunas, although important from a regional point of view, records a more modest and volatile performance during the analyzed period.

The analysis of the evolution of GDP/capita during the period 2003-2021 reveals an upward trajectory, with an overall average that increased from €12,000 in 2003 to €36,600 in 2021. This dynamic reflects a sustained economic consolidation, even if the process was temporarily interrupted in 2009-2010, amid the global financial crisis. The 2003-2008 period is characterized by robust growth, with average annual jumps between €1,000 and €2,500, while the post-crisis period highlights a gradual and continuous recovery.

The annual difference between the extreme values – with a range increasing from €5,000 in 2003 to €13,600 in 2021 – indicates a trend of widening the gap between Vilnius and Kaunas, confirming the increasingly prominent role of the capital in the country's economic development.

The long-term analysis highlights both a process of economic convergence with European standards and a consolidation of the internal hierarchy between the two urban centers, with Vilnius being on a higher economic growth trend compared to Kaunas.

The *concentration coefficient* for Lithuania remains relatively high throughout the period 2003-2021, with values ranging from approximately 0.734 to 0.741, consistently above the theoretical minimum of 0.707. This indicates a clear and persistent difference in economic performance between the two metropolitan areas, Vilnius and Kaunas.

What is particularly noteworthy, however, is the gradual evolution of the coefficient over time. While the disparity between the two metropolitan areas remains evident, the concentration coefficient shows a slight downward tendency, decreasing from around 0.736-0.739 in the earlier years to approximately 0.734-0.735 in the later period. This suggests a modest reduction in the relative gap between Vilnius and Kaunas.

Overall, the Lithuanian metropolitan system can be characterized by a persistent but slightly narrowing disparity, where the leading position of the capital remains intact, yet the secondary metropolitan area demonstrates a gradual capacity to catch up, albeit at a moderate pace.

Luxembourg

In the context of a comparative analysis of European metropolitan areas, Luxembourg stands out clearly with an exceptionally high GDP per capita. With an average of approximately €70,589 over the period 200-2021, Luxembourg records the highest values in the entire analyzed sample.

The maximum value reached was €87,000, while the minimum was €49,400, resulting in a range of €37,600. This amplitude is explained by the economic dynamics of the city of Luxembourg, influenced by factors such as the performance of the financial sector, its international positioning, and integration into the economic flows of Western Europe. Despite global economic fluctuations, the Luxembourg metropolitan area maintains a high and consistent GDP per capita, serving as a clear example of sustainable metropolitan economic performance.

In Luxembourg, the *concentration coefficient* takes the value of 1 for the entire period 2003-2021, a direct consequence of the metropolitan structure being limited to a single urban area. In this setting, the indicator cannot reflect any internal differentiation, as there are no additional metropolitan units to establish a distribution pattern.

From an analytical perspective, Luxembourg stands out not through internal contrasts, but through its overall performance. The absence of a multi-metropolitan structure shifts the interpretation away from territorial comparisons and towards the role of the country as a high-performing economic benchmark within the European Union.

Hungary

In Hungary, the five metropolitan areas analyzed – Budapest, Miskolc, Pécs, Debrecen, and Székesfehérvár – show significant differences in GDP per capita, reflecting pronounced territorial disparities. Budapest, the capital and the country's main economic hub, stands out with an average GDP per capita of €28,095, a value considerably higher than the other metropolitan areas. The standard deviation of €4,589 and a coefficient of variation of 16.34% indicate moderate variability over time, characteristic of a dynamic yet relatively stable economy.

In contrast, Miskolc had a much lower average of €11,926, associated with a higher dispersion of values (standard deviation of €3,027) and a coefficient of variation of 25.38%, suggesting pronounced economic instability and greater vulnerability to cyclical fluctuations. Pécs shows a similar average value of €12,026, with lower variability (standard deviation of €2,130 and a coefficient of variation of 17.71%), indicating a more homogeneous evolution, but at a modest economic level.

Debrecen, the second-largest city in Hungary, occupies an intermediate position, with an average GDP per capita of €13,021 and relatively low variability (standard deviation of €2,151 and a coefficient of variation of 16.52%), reflecting a stable economic trajectory that nevertheless remains insufficient to narrow the gap with the capital. Székesfehérvár ranks higher in the national hierarchy, with an average of €17,411; however, the high variability (standard deviation of €4,036 and a coefficient of variation of 23.18%) indicates significant fluctuations in economic performance over time (Appendix 20).

Over the period 2003-2021, the annual average values of GDP per capita for the five metropolitan areas increased steadily, from approximately €11,900 in 2003 to €23,120 in 2021. This positive trajectory was nevertheless accompanied by the persistence of pronounced territorial disparities, reflected in the enduring gaps between minimum and maximum values. The annual ranges of variation widened progressively, from around €12,000 in 2003 to over €20,000 in 2021, suggesting a deepening of territorial inequalities within the Hungarian metropolitan system.

Across the Hungarian metropolitan system, differences in GDP per capita remain clearly visible throughout the period 2003-2021, as reflected by concentration coefficient values ranging from approximately 0.452 to 0.463. These levels lead to a structured distribution in which economic performance is not evenly shared among metropolitan areas.

A defining feature of this configuration is the strong position of Budapest, which consistently records substantially higher values than the rest of the metropolitan areas. This gap shapes the overall distribution, placing the capital in a distinct category compared to secondary urban centers. At the same time, cities such as Debrecen, Székesfehérvár, and Pécs display gradual improvements, contributing to a more nuanced internal structure.

Over time, the coefficient shows a mild downward trend, declining from around 0.463 in the early years to approximately 0.452 by 2021. This evolution suggests a slow adjustment in the relative distribution, driven by incremental gains in the secondary metropolitan areas rather than a reduction in the leading position of the capital.

In this context, Hungary can be understood as a metropolitan system characterized by a clear internal hierarchy, where differences persist but evolve at a measured pace, without abrupt shifts in the overall structure.

Overall, the analysis highlights a clear structural contrast between Budapest, as the dominant economic pole, and the other metropolitan areas, which are characterized by lower levels of GDP per capita and slower rates of convergence. These findings underscore the need for differentiated regional policies aimed at stimulating investment, strengthening human capital, and diversifying the productive base in lagging areas, in order to reduce territorial disparities and support a more balanced pattern of economic development.

Malta

In the case of Malta, the analysis of GDP per capita is limited by the existence of a single metropolitan area, Valletta, which makes it impossible to compute indicators of relative variation across regions, such as the coefficient of variation. In this context, the interpretation is based exclusively on the temporal dynamics of annual values and on the amplitude of variation.

In Malta, the Valletta metropolitan area records an average GDP per capita of approximately €24,763 over the period 2003-2021). Amplitude of €17,200, determined by a minimum of €17,700 and a maximum of €34,900, reflects a gradual and coherent evolution of GDP per capita over the analyzed period. This dynamic indicates a relatively balanced profile of economic growth, characterized by a steady upward trend and the absence of abrupt fluctuations or major deviations.

In Malta, the calculation of the *concentration coefficient* yields a constant value of 1 over the entire period 2003–2021, reflecting the fact that the dataset includes only one metropolitan area. Under these conditions, the indicator does not capture any form of distribution, as no internal comparison is possible.

In the absence of several metropolitan areas, the interpretation must be related exclusively to the trajectory of the indicator over time, which suggests a progressive consolidation of the level of economic development. The observed evolution is compatible with the general trends in island economies integrated within the European Union, where growth is sustained rather by successive accumulations than by cyclical leaps.

Netherlands

In the Netherlands, GDP per capita shows considerable variation across the 13 metropolitan areas, reflecting significant territorial disparities. The highest average values are recorded in Utrecht (€43,905), Groningen (€44,032), and Amsterdam (€42,737), while areas such as Enschede (€27,863), Leeuwarden (€25,095), and Tilburg (€29,695) are well below the national urban average.

Over time, the stability of GDP per capita values is notable in ’s Gravenhage, which records the lowest coefficient of variation (5.27%), followed by Leeuwarden (7.05%) and Zwolle (8.55%), indicating a relatively steady evolution. In contrast, Eindhoven (16.29%) and Enschede (12.80%) exhibit higher volatility. The amplitude of variation is narrowest in ’s Gravenhage (€8,600) and widest in Eindhoven (€23,600), highlighting clear differences in the pace of economic growth among the Dutch metropolitan areas (Appendix 21).

Between 2003 and 2021, the average value of GDP per capita recorded an upward trend, increasing from €28,161 to €41,676. The growth rate was relatively constant until 2008, followed by a decrease in 2009, when the average dropped to €33,761, after which a gradual recovery took place in the following years.

The highest annual average value was reached in 2021, at €41,676, while the minimum was recorded in 2003, at €28,161. The widest value range occurred in 2013 (€25,800), indicating pronounced territorial disparities among metropolitan areas. Moreover, the maximum gap remained consistently high in the years preceding the pandemic, hovering around €22,000-€24,000, which suggests the persistence of structural differences in development.

A clear pattern emerges in the Dutch metropolitan system when observing the evolution of the concentration coefficient, which gradually declines from approximately 0.279 in 2003 to around 0.269 in 2021. This steady movement suggests a progressive smoothing of differences in GDP per capita across metropolitan areas.

Rather than being shaped by a single dominant center, the distribution reflects the presence of several strong urban economies operating at relatively comparable levels. Cities such as Amsterdam, Utrecht, and Eindhoven stand out, yet their advantage does not significantly distort the overall balance. Instead, economic performance appears to be distributed across a network of metropolitan areas that evolve in a broadly synchronized manner.

An interesting aspect in the case of the Netherlands is the absence of abrupt shifts. Even during periods of fluctuation, the coefficient remains within a narrow corridor, indicating that relative positions between metropolitan areas are largely preserved. This stability points to a system where adjustments occur incrementally, without major disruptions in the internal structure.

The dynamics of GDP per capita in metropolitan areas reflect a relatively balanced process of economic growth, marked by episodes of divergence during periods of crisis and a general tendency toward a slow reduction of territorial disparities.

Austria

In the case of Austria, the average values of GDP per capita over the analyzed period range between €34,500 in Graz and €43,236 in Salzburg, suggesting the existence of moderate territorial disparities among the main urban centers. The highest average value is recorded in Salzburg, followed by Vienna (€37,495) and Linz (€37,184), while Innsbruck is positioned slightly below the national urban average, at €36,326.

Although absolute differences are visible, the relative dispersion is lower than in the case of other analyzed countries, with the coefficient of variation ranging between 8.4% in Wien and 13% in Salzburg, indicating a relatively uniform distribution of the level of economic development among Austrian metropolitan areas (Appendix 22).

The standard deviation is highest in Salzburg (5,626 euros), reflecting a higher variability of GDP per capita values over time, while Graz shows a relatively moderate dispersion compared to its average level, with a coefficient of variation of 11.5%. The range of variation is highest in Salzburg (19,900 euros), followed by Linz (16,100 euros), while Graz records the smallest range (14,000 euros). These results suggest the existence of persistent differences in the pace of economic growth, but without generating pronounced territorial disparities, with Austria maintaining relatively high inter-urban stability throughout the period analyzed.

The annual average values of GDP per capita for the five metropolitan areas show a general upward trend over the period 2003-2021, rising from approximately €30,000 to €44,740. The evolution was relatively steady, with moderate year-to-year variations, reflecting a stable and sustained economic dynamic at the urban level.

The standard deviation gradually increased, from approximately €2,055 in 2003 to over €4,600 in 2021, a trend explained by the overall rise in average values. The range between the maximum and minimum values expanded progressively, from €5,300 in 2003 to €11,200 in 2021, indicating a gradual widening of the GDP per capita spectrum among the five metropolitan areas. Nevertheless, this increase was proportional to the general growth of the average level, suggesting the maintenance of relative balances and the presence of moderate and stable territorial disparities among Austria's major urban centers.

Looking across Austrian metropolitan areas, the differences in GDP per capita appear relatively contained, a pattern reflected in concentration coefficient values that gradually decrease from about 0.447 in 2003 to roughly 0.434 in 2021. This evolution points to a slow alignment among metropolitan economies rather than the persistence of pronounced gaps.

Although Wien remains the most prominent metropolitan area, its lead is not sharply separated from other cities such as Salzburg, Linz, or Graz. Instead, these urban centers operate within a relatively narrow range of economic performance, which contributes to a more even overall distribution.

What makes the Austrian case distinctive is the closeness of its metropolitan profiles. The data suggest that multiple cities follow comparable development paths, with incremental improvements occurring across the system. This reduces the likelihood of strong imbalances and supports a more cohesive metropolitan structure.

Over time, the slight downward movement of the coefficient signals that these similarities have become even more pronounced. Rather than reshaping the hierarchy, the system evolves through gradual convergence in relative terms, reinforcing a balanced configuration among its metropolitan areas.

Poland

For Poland's metropolitan areas, pronounced territorial disparities can be observed, reflected in significant differences in GDP per capita. Warsaw records the highest average value, at approximately €36,779, well above the average of the other metropolitan areas. Zones such as Łódź, Kraków, and Wrocław follow, with values ranging between €18,689 and €27,089, indicating a substantial economic gap relative to the capital. In contrast, smaller urban centers such as Tarnów and Bielsko-Biała display much lower levels, of around €11,110 and €17,215 respectively, highlighting important differences between the central metropolitan core and peripheral areas.

The relatively high standard deviations in most metropolitan areas indicate a considerable variability of GDP per capita values over time, especially in the case of Warszawa, where the standard deviation reaches 9,642. In contrast, in areas such as Łódź and Białystok, lower values of this indicator suggest more stable dynamics. The coefficient of variation calculated between metropolitan areas reveals a relatively high dispersion of values, more pronounced in the case of areas with low average levels of GDP per capita, which confirms the existence of significant territorial disparities within Poland (Appendix 23).

Overall, the spatial structure of economic development highlights a clear concentration of economic performance in the capital area, alongside the persistence of significant gaps relative to secondary metropolitan centers and smaller urban areas, shaping a strongly polarized territorial profile.

The analysis of GDP per capita dynamics during the period 2003-2021 indicates a general upward trend, with an increase from €10,984 in 2003 to €27,274 in 2021. This evolution reflects a sustained process of economic development, characterized by an average annual growth rate of approximately 1,000 euros, with moderate variations from one year to the next.

The Polish metropolitan landscape reveals a clear economic gradient, shaped by the consistently higher performance of Warszawa and a broad spectrum of secondary metropolitan areas positioned at varying distances from this leading center. This structure is reflected in concentration coefficient values declining gradually from approximately 0.300 in 2003 to around 0.287 in 2021 (Appendix 23).

Rather than forming a sharply divided system, the data suggests a layered configuration. Cities such as Wrocław, Poznań, and Kraków occupy an intermediate tier, bridging the gap between the capital and less developed metropolitan areas. Further down this spectrum, a larger group of cities follows similar growth trajectories at lower levels of GDP per capita.

Over time, the narrowing of the coefficient points to a slow smoothing of this gradient. The relative positions of metropolitan areas remain broadly intact, yet the distances between them become less pronounced. This reflects the steady advancement of secondary and peripheral metropolitan areas, which progressively reduces the gap without fundamentally altering the hierarchy.

In this sense, Poland's metropolitan system is best understood as a continuum of economic levels rather than a binary structure, where differentiation persists but becomes more gradual and less steep over time.

Overall, Poland's economic dynamics are characterized by a sustained increase in the average level of GDP per capita, while maintaining significant territorial disparities between the main metropolitan areas, especially between the capital and secondary urban centers.

Portugal

The analysis of GDP per capita for the metropolitan areas of Lisbon, Porto and Coimbra highlights the existence of clear territorial disparities, reflecting the economic structure and different degree of development of each urban center. Lisbon records the highest average value, of 28,547 euros, significantly above Porto (€19,732) and Coimbra (€18,942). This hierarchy confirms the dominant role of the capital in the national economy and its positioning as the main pole of economic development.

The coefficient of variation calculated between metropolitan areas confirms these differences, highlighting a low volatility in Lisbon (6.46%) and higher values in Porto (11.23%) and Coimbra

(10.83%), reflecting a wider dispersion of the level of economic development in these two urban centers (Appendix 24).

The analysis of the minimum and maximum values reinforces the picture of territorial disparities. Lisbon presents a variation range between €24,600 and €32,000, corresponding to a difference of €7,400, while Porto records values between €16,200 and €23,700, and Coimbra between €15,500 and €22,500. Although the amplitude of the ranges is relatively close, their higher absolute level in the case of Lisbon confirms the superior position of the capital in the urban economic hierarchy.

Overall, the territorial structure of GDP per capita in Portugal highlights a strong concentration of economic performance in the Lisbon area, while maintaining persistent gaps with the secondary metropolitan centers, Porto and Coimbra.

In the period 2003–2021, the average values of GDP per capita indicate a long-term growth trend, from €18,766 in 2003 to €24,266 in 2021, with a maximum of €26,000 euros reached in 2018. This evolution suggests a sustained economic development process, characterized by a gradual improvement in the standard of living in all the metropolitan areas analyzed.

The range between the minimum and maximum values at the annual level remained high throughout the period, and the dynamic suggests that, although the average level of GDP per capita has increased, the relative differences between the main metropolitan centres have been maintained.

Within the Portuguese metropolitan system, Lisbon clearly occupies the central position, while Porto and Coimbra form a closely aligned secondary group. This internal configuration is reflected in concentration coefficient values declining from approximately 0.584 in 2003 to around 0.574 in 2021, indicating a gradual adjustment in the distribution of GDP per capita.

What defines this structure is not fragmentation, but cohesion within the secondary tier. Porto and Coimbra follow similar trajectories, forming a compact group that evolves alongside the capital, albeit at a lower level. This reduces internal dispersion and contributes to a more balanced overall configuration.

Overall, the analysis highlights a development model characterized by generalized economic growth, while maintaining structural territorial disparities between Lisbon and other major metropolitan areas, which outlines an uneven spatial distribution of economic performance.

Romania

Data on GDP per capita for the nine metropolitan areas in Romania highlight pronounced territorial disparities, with Bucharest clearly standing out as the country's main economic growth pole. The average value for this area is approximately €33,405, significantly higher than in the other urban centers, reflecting a strong concentration of economic activity and income in the capital. At the opposite end of the spectrum, the lowest average values are recorded in Galați (€9,968) and Craiova (€11,089), underscoring the existence of substantial structural gaps between the administrative core and the metropolitan areas in the south-eastern and south-western parts of the country.

The coefficient of variation calculated among the metropolitan areas within the same country confirms the magnitude of these territorial disparities. The highest values are observed in Cluj-Napoca (41.01%) and Iași (39.86%), indicating a pronounced heterogeneity of GDP per capita levels and a more uneven growth pattern. In contrast, metropolitan areas such as Galați (31.80%) and Timișoara (32.38%) display a relatively higher degree of homogeneity, albeit at considerably lower average levels compared to Bucharest (Appendix 25).

The difference between the maximum and minimum values of GDP per capita further highlights the scale of territorial disparities. Bucharest records the largest amplitude, at approximately €42,900, while Galați shows the smallest difference, of about €11,800. These results lead to deeply divergent development trajectories and confirm the persistence of unbalanced economic structures among the metropolitan areas.

Overall, the distribution of GDP per capita in Romania reveals a pronounced concentration in favor of Bucharest, which clearly stands out as the country's main economic engine. The other metropolitan areas follow differentiated growth trajectories, some marked by high volatility, others by a more stable evolution, but at significantly lower economic levels. This configuration reflects the persistence of deep-rooted structural territorial disparities.

During the period 2003-2021, the annual average GDP per capita across the nine metropolitan areas recorded a substantial increase, rising from €7,188 in 2003 to €28,233 in 2021, which corresponds to an almost fourfold multiplication in nominal terms. This upward trend is supported by the continuous growth of the maximum values, which increased from €12,900 in 2003 to €55,800 in 2021, reflecting the consolidation of urban poles with very high economic performance.

In parallel, the minimum values increased from approximately €4,700 to over €16,600, but at a slower pace, which led to a widening of the variation range from €8,200 in 2003 to €39,200 in 2021. This dynamic indicates that, although the overall level of GDP per capita rose substantially, territorial disparities among metropolitan areas did not diminish; on the contrary, they intensified over the period under review.

The Romanian metropolitan system is shaped by a rapid expansion of economic activity, accompanied by a visible widening of differences in GDP per capita. This trajectory is captured by the steady increase of the concentration coefficient, from approximately 0.382 in 2003 to around 0.433 in 2021, signalling a strengthening differentiation among metropolitan areas.

Bucharest clearly defines the upper end of the distribution, advancing at a markedly faster pace than the rest of the system. Its growth not only elevates the overall level but also stretches the distance separating it from other metropolitan areas. This dynamic becomes particularly evident after the mid-2000s, when the gap begins to expand more visibly.

At the same time, several metropolitan areas, notably Cluj-Napoca, Timișoara, and, to a lesser extent, Brașov, demonstrate a consistent capacity to improve their relative position. These cities form a secondary tier that partially narrows the distance within the middle of the distribution, even as the leading position of the capital becomes more pronounced.

The lower segment of the metropolitan system follows a similar upward trajectory, yet at a slower pace, which contributes to the overall stretching of the distribution. As a result, the system evolves not through uniform convergence, but through a combination of strong growth and uneven gains across metropolitan areas.

This configuration highlights a development pattern where expansion and differentiation occur simultaneously, producing a more complex internal structure in which progress is widespread, but not evenly shared.

Slovenia

During the period 2003-2021, the metropolitan areas of Ljubljana and Maribor recorded significantly different levels of GDP per capita, reflecting persistent territorial disparities in economic development. The average GDP per capita in Ljubljana was approximately €32,689, while in Maribor it stood at only €18,689, indicating a substantial gap of over €14,000. This discrepancy confirms the dominant role of the capital in the national economy and the concentration of economic activities around the country's main administrative and financial center.

Relative variability, expressed through the coefficient of variation calculated for the two metropolitan areas, is very similar: 13.37% in Ljubljana and 13.45% in Maribor. This result suggests that relative to the average level of each area, the annual fluctuations in GDP per capita were proportionally comparable. Nevertheless, the absolute differences remain substantial, as confirmed by the range of variation, which is significantly higher in Ljubljana (€17,800) than in Maribor (€9,900). This situation indicates a greater capacity for economic adaptation and expansion in the capital metropolitan area.

Overall, the analysis highlights a clear concentration of economic potential in Ljubljana, where both the average level of GDP per capita and the magnitude of its variations reflect superior economic dynamism. Maribor occupies a secondary position, with a more stable economic profile but a considerably more modest scale, which highlights the persistence of structural territorial disparities.

In the period 2003-2021, the average annual values of GDP per capita for the two metropolitan areas indicate a generally upward trend, increasing from approximately €19,750 in 2003 to €33,600 in 2021. Until 2008, a steady growth can be observed, with the average reaching €26,200, followed by a temporary correction in 2009, when the value declined to €23,900. During 2010-2014 the dynamics remained relatively moderate, with values hovering around €24,500. After 2015, the growth rate intensified again, culminating in a level exceeding €33,000 in 2021.

The difference between the maximum and minimum values of GDP per capita increased considerably over time, from €11,100 in 2003 to €19,000 in 2021. This evolution shows that, although the overall level of GDP per capita rose significantly, territorial disparities between the two metropolitan areas did not diminish but progressively intensified. In 2021, the extreme values ranged between approximately €24,100 in Maribor and €43,100 in Ljubljana, confirming the consolidation of the capital's dominant position within the national economic structure.

Slovenia's metropolitan configuration unfolds as a two-speed system, where Ljubljana and Maribor follow distinct yet consistently separated development paths. This structure is reflected in concentration coefficient values that remain high throughout the period, fluctuating slightly around 0.636-0.643.

The relationship between the two metropolitan areas is defined less by abrupt changes and more by stability in their relative positioning. Ljubljana maintains a clear lead across all years, while Maribor advances at a slower but steady pace. The distance between them does not expand significantly, yet neither does it contract in a substantial way.

What stands out is the persistence of this gap over time. Even as both metropolitan areas experience overall growth, their trajectories remain broadly parallel, preserving the existing structure rather than reshaping it. This results in a configuration where differences are neither intensifying nor disappearing but rather becoming a stable feature of the system.

Toward the end of the period, the slight decrease in the coefficient suggests a marginal softening of the disparity, though without altering the underlying pattern. Slovenia therefore illustrates a metropolitan system characterized by continuity, where development occurs simultaneously in both areas, but at distinct and enduring speeds.

In conclusion, the analysis highlights a pattern of overall economic growth, accompanied, however, by the persistence and even the intensification of territorial disparities. Ljubljana steadily consolidates its role as Slovenia's main economic engine, while Maribor remains in a secondary position, with a slower pace of development, which raises important challenges for cohesion policies and balanced territorial development.

Slovakia

In Slovakia, GDP per capita in euros for the two metropolitan areas – Bratislava and Košice – shows clear and persistent territorial disparities in economic development. The Bratislava metropolitan area stands out with a significantly higher GDP per capita, averaging around €45,074, compared to only €15,279 in Košice. This substantial difference confirms the dominant role of the capital in the national economy and the concentration of the main economic activities around the country's administrative and financial center.

The extreme values further emphasize this contrast. In Bratislava, GDP per capita ranges from €26,800 to €53,200, while in Košice it lies between €10,300 and €20,300. The difference between the maximum and minimum values, i.e., the range, is therefore considerably larger in the capital, indicating a higher growth potential and a superior capacity for economic adaptation.

The coefficient of variation calculated for each metropolitan area shows similar values: 18.34% in Bratislava and 17.34% in Košice. This similarity suggests that relative to the specific average of each area, the annual fluctuations in GDP per capita were relatively comparable proportionally. However, the absolute differences remain very high, reflecting a structural territorial imbalance.

The annual dynamics analysis indicates a steady increase in the average GDP per capita for the two metropolitan areas, from approximately €18,550 in 2003 to €35,350 in 2021. This positive trend confirms Slovakia's overall economic development. However, the gap between the two areas has not narrowed; on the contrary, it has widened. In 2003, the difference between Bratislava and Košice was around €16,500, and by 2021 it had grown to over €30,100, indicating increasingly pronounced territorial disparities.

Slovakia's metropolitan structure is defined by a pronounced and enduring imbalance between Bratislava and Košice, reflected in concentration coefficient values that remain consistently high, ranging from approximately 0.705 to 0.720. These levels signal a strong differentiation that shapes the overall economic profile of the country.

Bratislava maintains a dominant trajectory throughout the entire period, advancing at a pace that places it well above the national metropolitan landscape. In contrast, Košice follows a more moderate growth path, which, although positive, does not significantly alter the distance between the two metropolitan areas.

The pattern illustrates a configuration where economic expansion does not translate into internal balancing. Instead, growth reinforces an already uneven structure, resulting in a stable yet clearly differentiated metropolitan system.

Finland

Between 2003 and 2021, GDP per capita confirmed the dominant status of the Helsinki metropolitan area within the Finnish economy. The average GDP per capita in Helsinki was approximately €40,021, over €11,000 higher than the average levels recorded in the other two metropolitan areas, Tampere (€28,763) and Turku (€28,684). These differences indicate significant territorial disparities within Finland's urban system, reflecting the concentration of economic and institutional resources around the capital.

Against this background, the variability of GDP per capita is higher in Helsinki, as evidenced by the higher values of the standard deviation and the coefficient of variation. This characteristic suggests a greater exposure of the capital to economic fluctuations and a greater capacity to adjust in dynamic economic contexts. In contrast, Tampere and Turku show a lower dispersion of values, which indicates a more stable evolution, but at a lower level of economic performance.

The analysis of the annual evolution of average GDP per capita values highlights a general upward trend between 2003 and 2021 across the three metropolitan areas. From an average level of approximately €26,400 in 2003, it reached nearly €38,000 in 2021, indicating a gradual consolidation of urban economic performance. However, the pace of this growth was not uniform, being marked by annual variations reflected in changes in average values and dispersion indicators.

The relatively low values of the coefficient of variation for each metropolitan area – 9.37% in Helsinki, 8.76% in Tampere, and 8.86% in Turku – indicate high temporal stability of GDP per capita, suggesting relatively constant and well-established growth trajectories. The differences between maximum and minimum values increase gradually, from approximately €8,000 in 2003 to over €13,000 in 2021, highlighting the progressive consolidation of internal territorial disparities. In 2021, the maximum value was €46,500, and the minimum €33,400, reflecting a clearly hierarchical urban structure.

The analysis confirms the existence of a clear hierarchical territorial model, in which Helsinki functions as the main hub of economic growth, while Tampere and Turku occupy secondary positions, characterized by stability and positive dynamics, but at a structurally lower level. Although the differences do not reach extreme levels, their long-term persistence highlights the need for regional policies aimed at strengthening the development capacity of secondary urban centers and promoting a more balanced process of territorial convergence.

The Finnish metropolitan system exhibits a pattern of controlled differentiation, where disparities in GDP per capita are clearly present but remain within stable and predictable bounds. This is reflected in concentration coefficient values fluctuating narrowly around 0.586-0.591 throughout the period 2003-2021. This results in a metropolitan system where differences are neither negligible nor escalating, but rather embedded within a stable framework. Economic development progresses across all areas, while the internal structure remains coherent and well-contained.

Sweden

Between 2003 and 2021, metropolitan GDP per capita exhibited varied values, reflecting a polycentric structure of economic development. Stockholm stands out with an average of €46,131, surpassing the other three metropolitan cities and confirming the capital's role as the main economic, financial, and technological hub of the country. Göteborg, with a GDP per capita of €32,831, remains Sweden's second-largest urban center, known for its maritime and technological industries as well as its port infrastructure. Malmö and Uppsala show comparable average values, €29,053 and €31,300 respectively, both benefiting from proximity to other urban centers and strong higher education institutions that contribute to knowledge development and innovation.

The coefficient of variation calculated for each metropolitan area indicates a high degree of stability in the evolution of GDP per capita. Values range from 9.76% in Malmö to 11.35% in Göteborg, with similar levels observed in Stockholm and Uppsala, reflecting relatively steady trajectories without large fluctuations. This highlights the structural robustness of the Swedish urban economy and its capacity to maintain a sustained growth path.

Although Stockholm records the highest average, it also exhibits the largest standard deviation in absolute terms, exceeding €4,800, indicating a wider range of annual variations, possibly influenced by external factors. Overall, the analysis highlights a stable urban economy with notable regional differences, particularly between the capital and other metropolitan areas. These contrasts reflect the functional specialization of cities and their capacity to attract investments, both in human capital and technology. Between 2003 and 2021, there is a steady upward trend: the annual average rose from €27,650 in 2003 to €41,475 in 2021, and the difference between maximum and minimum increased from €12,400 in 2003 to €20,400 in 2021, indicating a strengthening of territorial inequalities. A more pronounced diversification process among the metropolitan areas is also observed, reflected in the increase of the standard deviation from about €5,600 to over €9,100.

The overall structure is marked by continuity rather than transformation. Relative positions remain largely unchanged, and differences neither intensify nor diminish significantly. This stability indicates that economic growth is distributed in a way that preserves the existing hierarchy without amplifying internal imbalances.

In this setting, the metropolitan system combines differentiation with cohesion: a clear ranking exists, yet it is accompanied by a degree of proximity between levels that prevent the emergence of strong disparities.

Although absolute differences between regions have increased, their proportion relative to the overall average has remained fairly stable. The distribution of values is slightly skewed and concentrated, suggesting an economic system with relatively balanced performance, yet showing a subtle tendency toward polarization among the regions analyzed.

5. Discussions and conclusions

The comparative assessment of metropolitan areas across the EU *reveals a heterogeneous landscape, shaped by distinct structural patterns in the distribution of GDP per capita*. Rather than converging toward a single model, European metropolitan systems display multiple configurations, reflecting differences in economic structure, institutional context, and development trajectories. These differences are consistently captured through the combined interpretation of the coefficient of variation (CV), the amplitude, and the Gini concentration coefficient (CG), which together allow for a comprehensive evaluation of both the scale and the distribution of economic performance (Table 2).

Table 2. The statistical profile of the key metropolitan areas of EU-27 Member States

Category	Country	Statistical profile
Balanced polycentric systems	Netherlands	Low CV, low amplitude, moderate Gini
Balanced polycentric systems	Germany	Moderate CV, moderate amplitude, stable Gini
Balanced polycentric systems	Austria	Low CV, low amplitude, stable Gini
Balanced polycentric systems	Sweden	Moderate CV, moderate amplitude, stable Gini
Balanced polycentric systems	France	Moderate CV, moderate amplitude, stable Gini
Balanced polycentric systems	Belgium	Moderate CV, moderate amplitude, stable Gini
Controlled differentiation	Finland	Moderate CV, limited amplitude, stable Gini
Controlled differentiation	Portugal	Moderate CV, moderate amplitude, stable Gini
Controlled differentiation	Denmark	Moderate CV, moderate amplitude, stable Gini

Category	Country	Statistical profile
Development gradient	Poland	Moderate CV, high amplitude, moderate Gini
Development gradient	Spain	Moderate CV, high amplitude, moderate Gini
Development gradient	Italy	Moderate to high CV, high amplitude, moderate Gini
Dual metropolitan structure (balanced)	Slovenia	Stable CV, moderate amplitude, stable Gini
Dual metropolitan structure (balanced)	Croatia	Moderate CV, moderate amplitude, stable Gini
Dual metropolitan structure (moderately unbalanced)	Lithuania	Moderate to high CV, moderate amplitude, relatively high but slightly decreasing Gini
Dual metropolitan structure (unbalanced)	Slovakia	Higher CV, high amplitude, high Gini
Dual metropolitan structure (unbalanced)	Greece	Moderate to high CV, high amplitude, relatively high Gini
Dual metropolitan structure (unbalanced)	Ireland	Moderate CV, high amplitude, moderate to high Gini
Divergence pattern	Romania	Increasing CV, high amplitude, high Gini
Divergence pattern	Bulgaria	Moderate-high CV, high amplitude, high Gini
Divergence pattern	Hungary	Increasing CV, high amplitude, high Gini
Divergence pattern	Czech Republic	Moderate to high CV, high amplitude, relatively high Gini
Single metropolitan system	Estonia, Latvia, Cyprus, Malta, Luxembourg	Not applicable (single unit)

Source: own characterization based on the computations made with the data obtained from Eurostat, 2026.

Synthetically, we can say that there are five categories of metropolitan area in EU:

1. The first category is represented by countries where metropolitan development follows a relatively balanced and polycentric pattern reflected in relatively low values of the coefficient of variation and limited amplitude, indicating a narrow range between minimum and maximum values. At the same time, the concentration coefficient remains at moderate and stable levels, confirming that economic performance is distributed across multiple metropolitan areas rather than concentrated in a single core.
2. A second configuration can be identified in systems characterized by controlled differentiation. The concentration coefficient further supports this interpretation, showing only minor fluctuations, which indicates that the distribution of economic performance remains structurally unchanged. The concentration coefficient reinforces this finding, remaining within a relatively narrow range, which indicates that the relative weight of each metropolitan area within the national system is preserved.
3. A third category corresponds to metropolitan systems organized along a development gradient (Poland illustrates this pattern through a clear stratification, with Warszawa at the top, followed by a strong intermediate group including Wrocław, Poznań, and Kraków, and a broader set of metropolitan areas such as Lublin, Białystok, and Kielce at lower levels). The coefficient of variation indicates a moderate level of dispersion, while the amplitude reflects a wide range of values. The concentration coefficient complements this perspective by indicating that, although Warszawa has a leading role, economic performance is distributed across multiple metropolitan areas, preventing excessive concentration.
4. Another pattern is associated with processes of divergence. Romania provides a clear example, where Bucharest advances at a significantly faster pace than other metropolitan areas such as Cluj-Napoca, Timișoara, and Brașov. This dynamic is reflected in increasing amplitude values and, in certain periods, rising coefficients of variation. The concentration coefficient confirms

this tendency, indicating a growing share of economic performance associated with the capital metropolitan area. A similar, though less pronounced, pattern can be observed in Bulgaria.

5. A separate category includes countries represented by a single metropolitan area. In these cases, the concentration coefficient reaches its maximum value by construction, reflecting the absence of internal metropolitan differentiation rather than the distribution of economic performance. As such, the interpretation focuses on the temporal evolution of GDP per capita rather than spatial comparisons.

A distinct configuration emerges in countries with a dual metropolitan structure. In Slovenia, Ljubljana and Maribor evolve along parallel trajectories, maintaining a relatively constant difference. This stability is reflected in all three indicators: the coefficient of variation remains steady, the amplitude shows limited fluctuation, and the concentration coefficient confirms a stable distribution between the two metropolitan areas. Also, in contrast, Slovakia exhibits a more pronounced imbalance. Bratislava consistently outperforms Košice, and the difference between the two remains substantial. This is reflected in higher values of the amplitude and the coefficient of variation. The concentration coefficient further indicates that a significant share of economic performance is associated with the leading metropolitan area, and this structure remains largely unchanged over time.

At the same time, the analysis shows that a high level of economic development does not automatically ensure a uniform internal distribution. In countries such as Italy, significant differences persist between metropolitan areas such as Milano and Napoli or Palermo. Similarly, in Finland, Helsinki maintains a consistent advantage over Tampere and Turku, although disparities remain stable. These examples highlight the role of structural factors, including economic specialization and institutional capacity, in shaping metropolitan dynamics.

Taken together, the results confirm that the territorial inequalities across metropolitan areas in the European Union are shaped by a combination of structural, historical, and institutional factors. The joint interpretation of the coefficient of variation, the amplitude, and the concentration coefficient provides a consistent and robust framework for understanding these differences.

These findings are broadly consistent with the scientific literature on urban and regional inequalities, which emphasizes the role of agglomeration economies, institutional capacity, and historical development paths in shaping spatial economic outcomes. At the same time, the results extend the existing research by providing a unified comparative framework applied systematically across all EU Member States, allowing for the identification of recurring structural patterns at the metropolitan level.

In conclusion, the results confirm that disparities are not random but follow identifiable spatial configurations that can be consistently captured through the combined use of the coefficient of variation, amplitude, and the concentration coefficient (Appendix 26).

The results also highlight the importance of the capital city effect as a key driver of internal disparities. In a significant number of cases, including Bucharest, Budapest, Sofia, and Bratislava, the capital metropolitan area records substantially higher GDP per capita levels compared to secondary metropolitan areas, contributing to increased concentration and dispersion simultaneously. This pattern is consistently reflected in higher Gini values and larger amplitude ranges, confirming the central role of capital regions in shaping national metropolitan hierarchies.

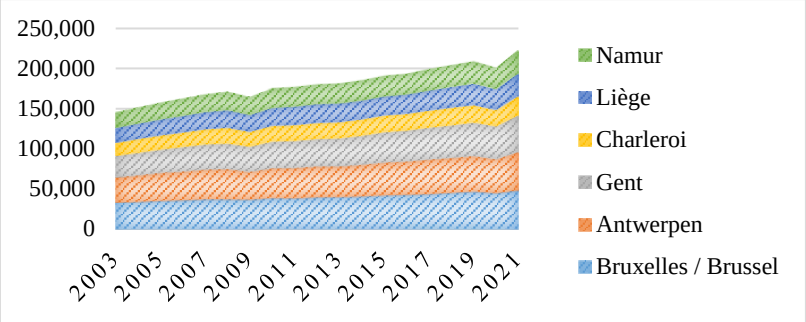
Regarding the policy implications, the findings suggest that a uniform approach to metropolitan development is unlikely to be effective. In polycentric systems, policy efforts may focus on strengthening functional linkages and complementarities between metropolitan areas. In contrast, in countries characterized by divergence patterns or unbalanced dual structures, targeted interventions aimed at supporting secondary metropolitan areas become essential in order to reduce internal disparities. Without such measures, there is a risk that existing differences may persist or intensify over time.

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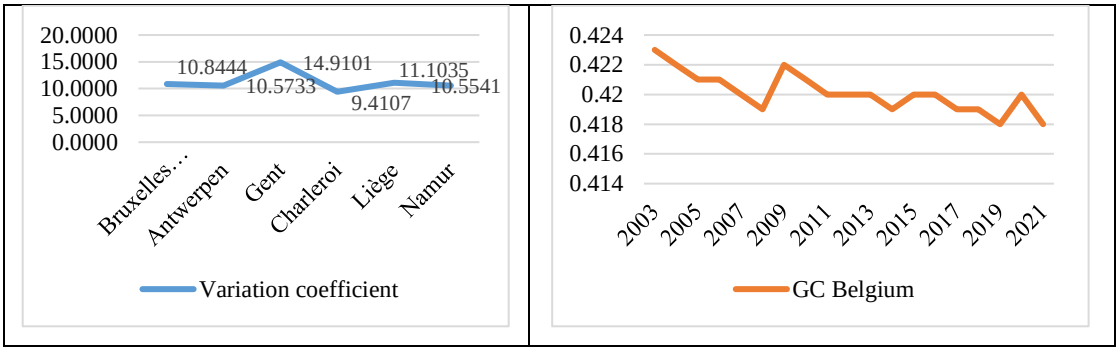
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Appendix 1. Evolution of GDP per capita (€/inhabitant) in 2003–2021, Belgium



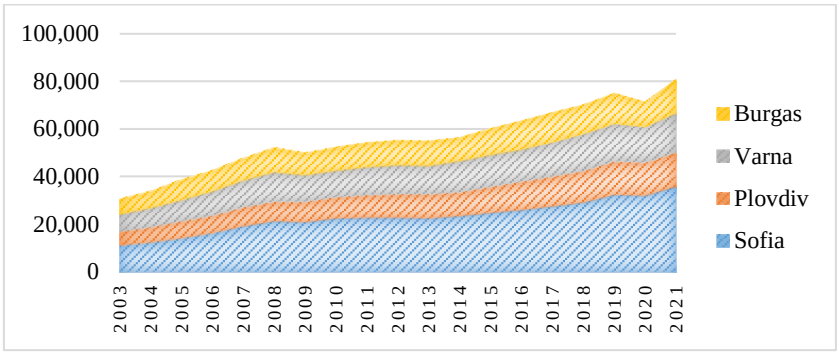
Source: own computations based on Eurostat data, 2026.

Appendix 2. Coefficient of variation and Gini coefficient of the metropolitan areas of Belgium



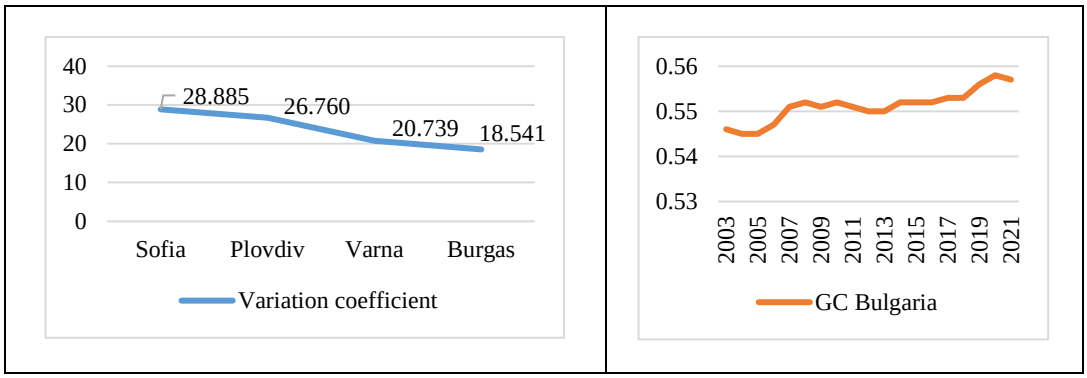
Source: own computations based on Eurostat data, 2026.

Appendix 3. Evolution of GDP per capita (€/inhabitant) in 2003–2021, Bulgaria



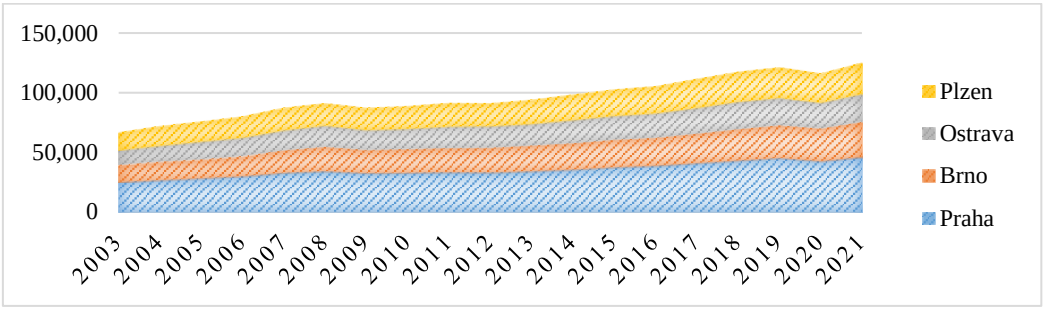
Source: own computations based on Eurostat data, 2026.

Appendix 4. Coefficient of variation and Gini coefficient of the metropolitan areas of Bulgaria



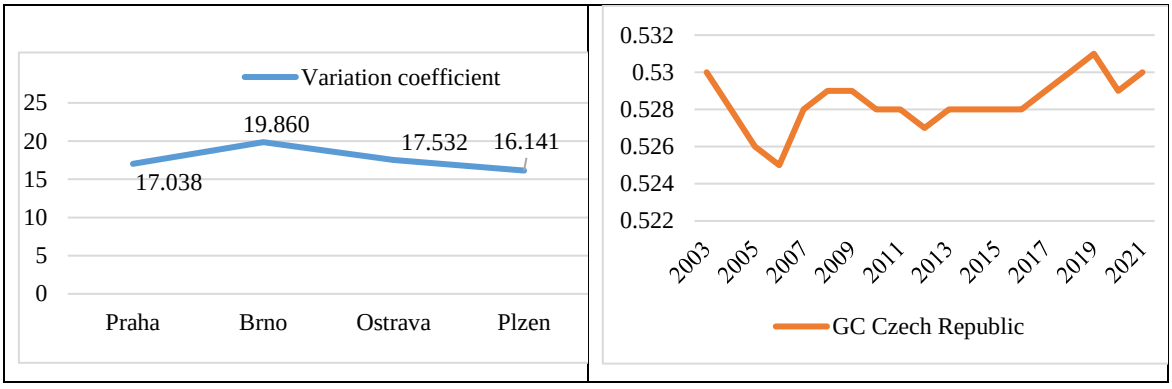
Source: own computations based on Eurostat data, 2026.

Appendix 5. Evolution of GDP per capita (€/inhabitant) in 2003–2021, Czech Republic



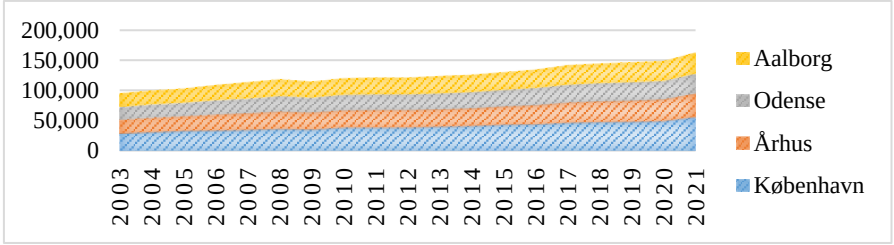
Source: own computations based on Eurostat data, 2026.

Appendix 6. Coefficient of variation and Gini coefficient of the metropolitan areas of the Czech Republic



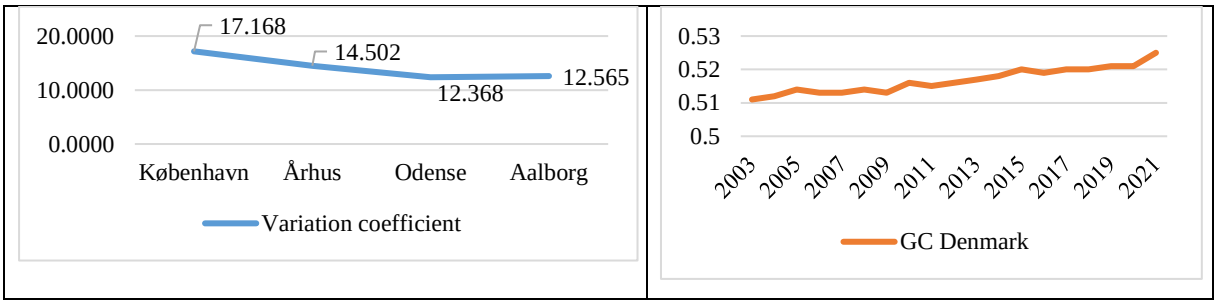
Source: own computations based on Eurostat data, 2026.

Appendix 7. Evolution of GDP per capita (€/inhabitant) in 2003–2021, Denmark



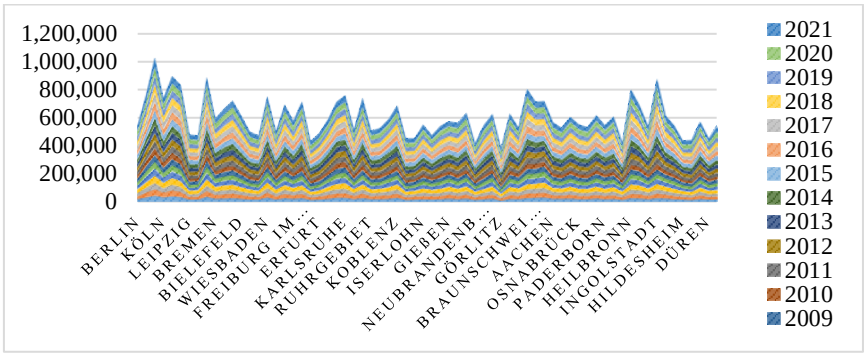
Source: own computations based on Eurostat data, 2026.

Appendix 8. Coefficient of variation and Gini coefficient of the metropolitan areas of Denmark



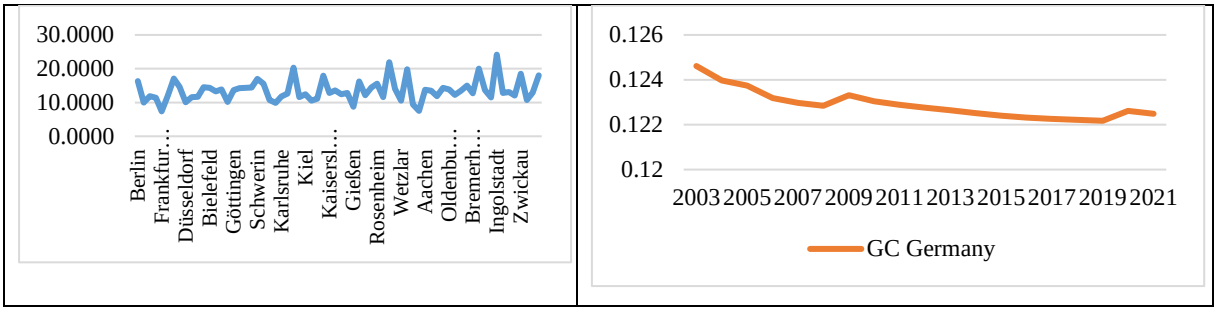
Source: own computations based on Eurostat data, 2026.

Appendix 9. Evolution of GDP per capita (€/inhabitant) in 2003–2021, for the 68 metropolitan areas of Germany



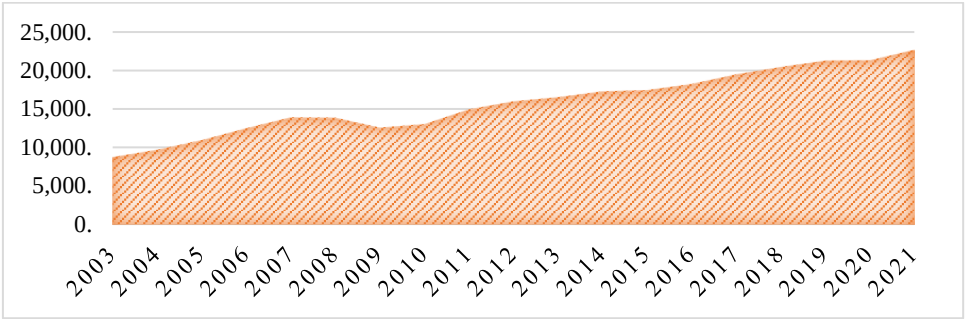
Source: own computations based on Eurostat data, 2026.

Appendix 10. Coefficient of variation and Gini coefficient of Germany's metropolitan areas



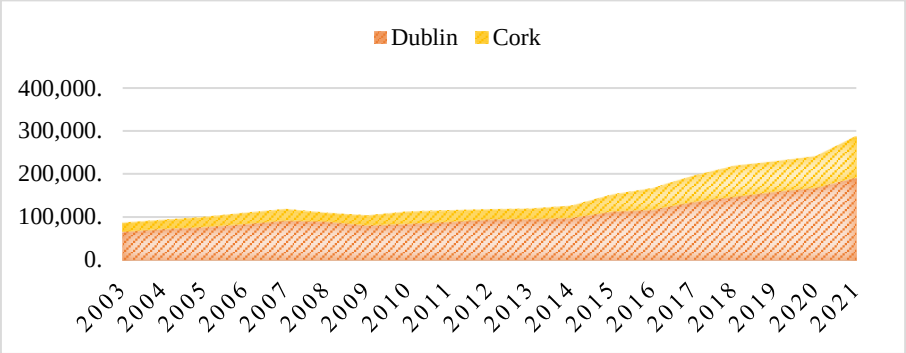
Source: own computations based on Eurostat data, 2026.

Appendix 11. Evolution of GDP per inhabitant (€/inhabitant) in 2003–2021, Estonia



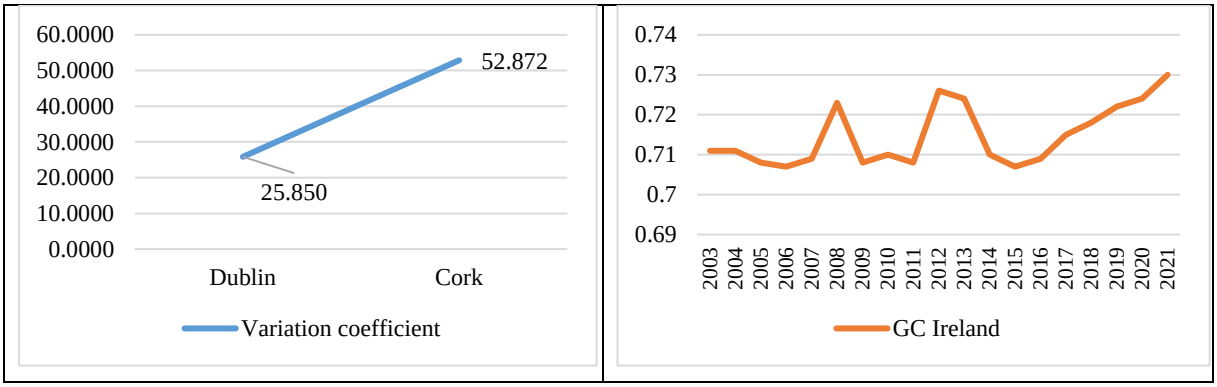
Source: own computations based on Eurostat data, 2026.

Appendix 12. Evolution of GDP per capita (€/inhabitant) in 2003–2021, Ireland



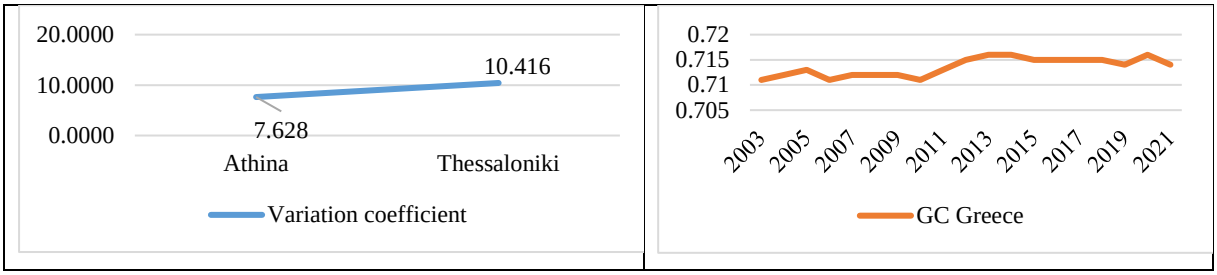
Source: own computations based on Eurostat data, 2025.

Appendix 13.Coefficient of variation and Gini coefficient of the metropolitan areas of Ireland



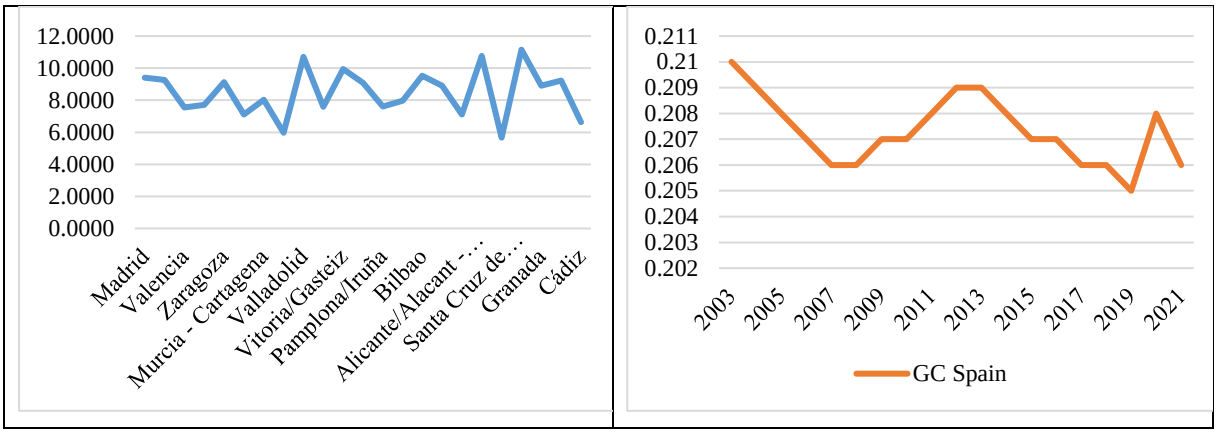
Source: own computations based on Eurostat data, 2026.

Appendix 14. Coefficient of variation and Gini coefficient of the metropolitan areas of Greece



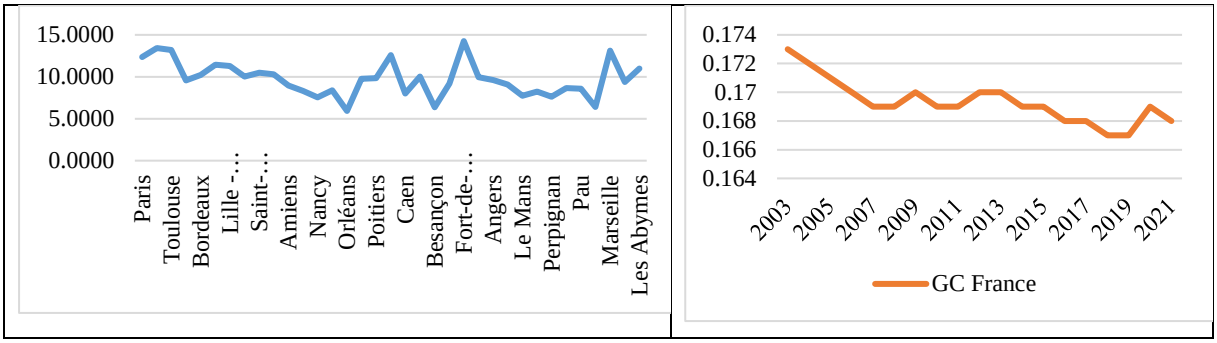
Source: own computations based on Eurostat data, 2026.

Appendix 15. Coefficient of variation and Gini coefficient of the metropolitan areas of Spain



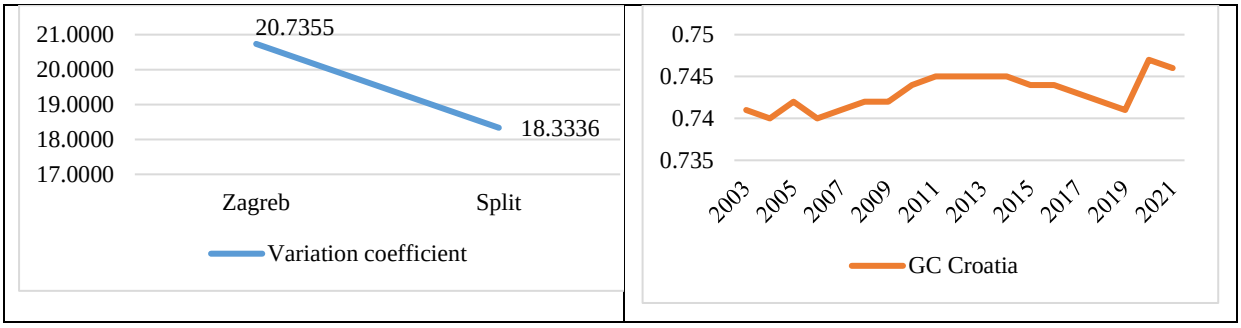
Source: own computations based on Eurostat data, 2026.

Appendix 16. Coefficient of variation and Gini coefficient of the metropolitan areas of France



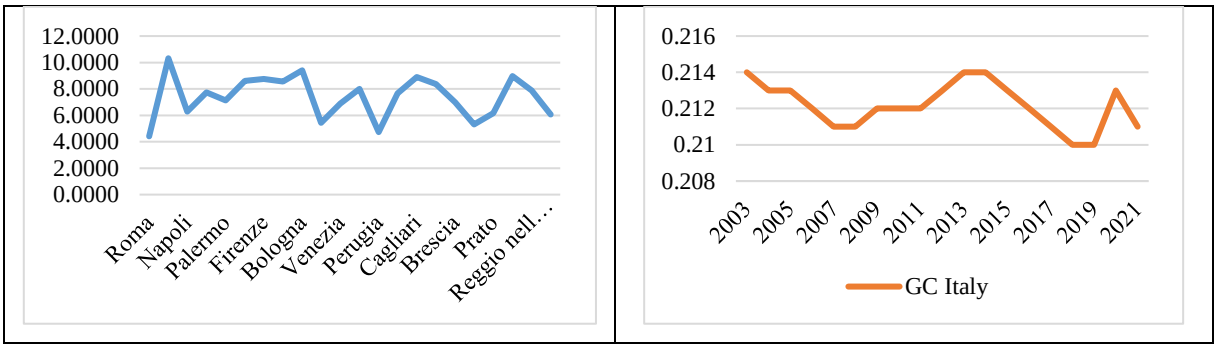
Source: own computations based on Eurostat data, 2026.

Appendix 17. Coefficient of variation and Gini coefficient of the metropolitan areas of Croatia



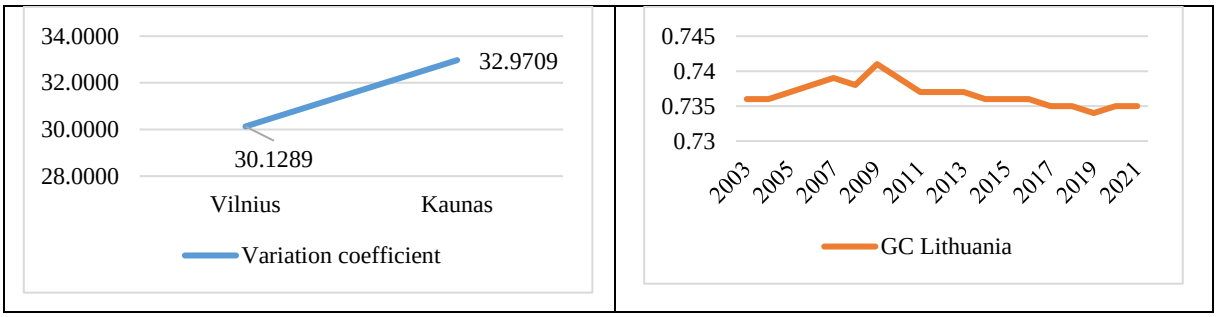
Source: own computations based on Eurostat data, 2026.

Appendix 18. Coefficient of variation and Gini coefficient of the metropolitan areas of Italy



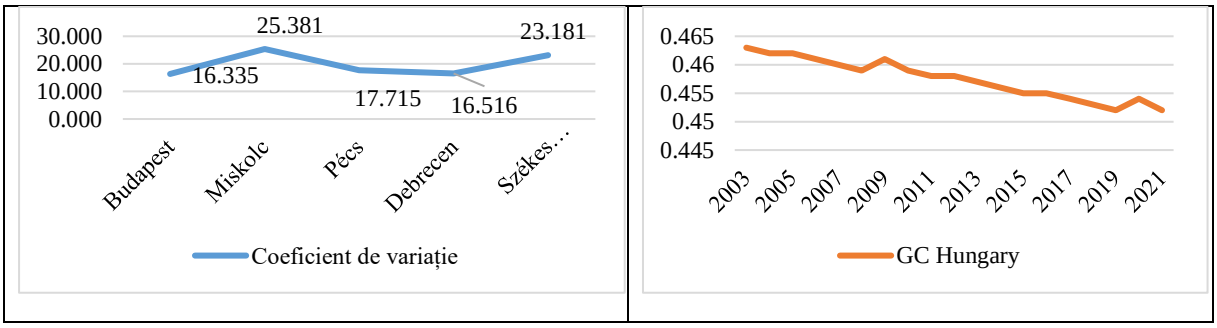
Source: own computations based on Eurostat data, 2026.

Appendix 19. Coefficient of variation and Gini coefficient of the metropolitan areas of Lithuania



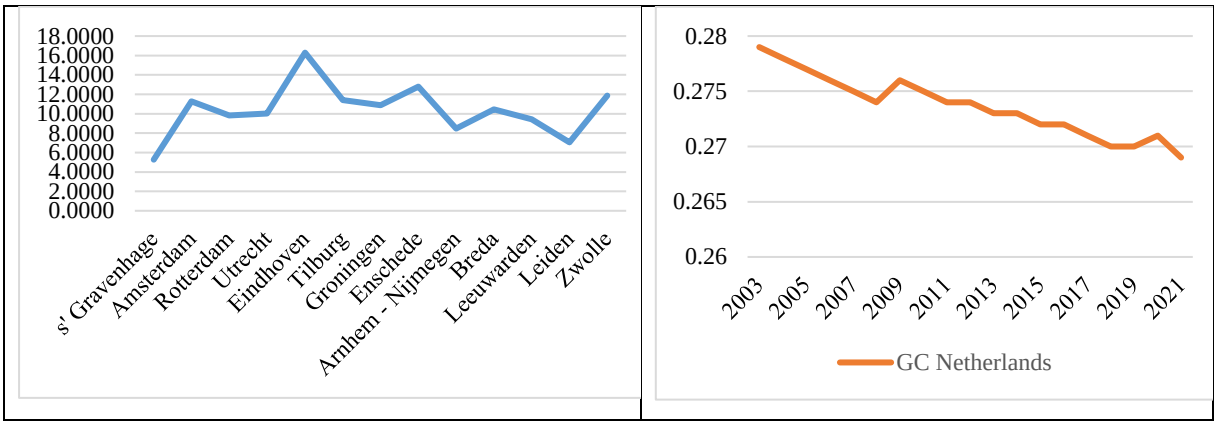
Source: own computations based on Eurostat data, 2026.

Appendix 20. Coefficient of variation and Gini coefficinet of the metropolitan areas of Hungary



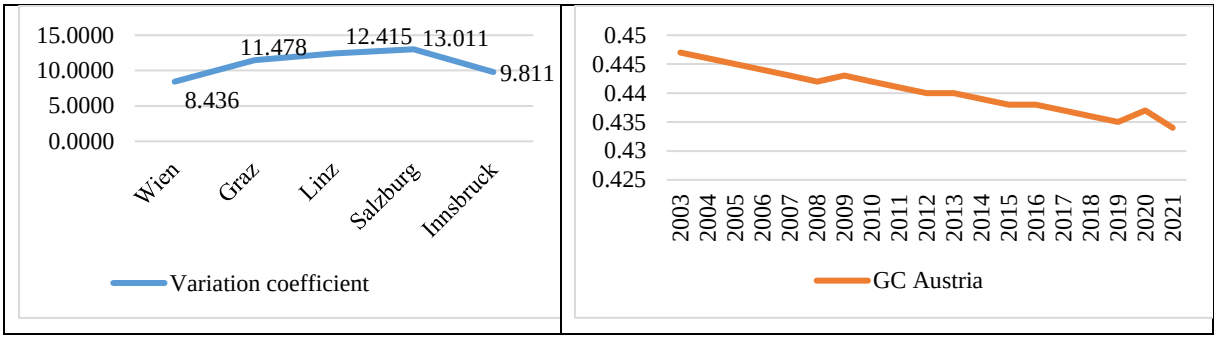
Source: own computations based on Eurostat data, 2026.

Appendix 21. Coefficient of variation and Gini coefficient of the metropolitan areas of Netherlands



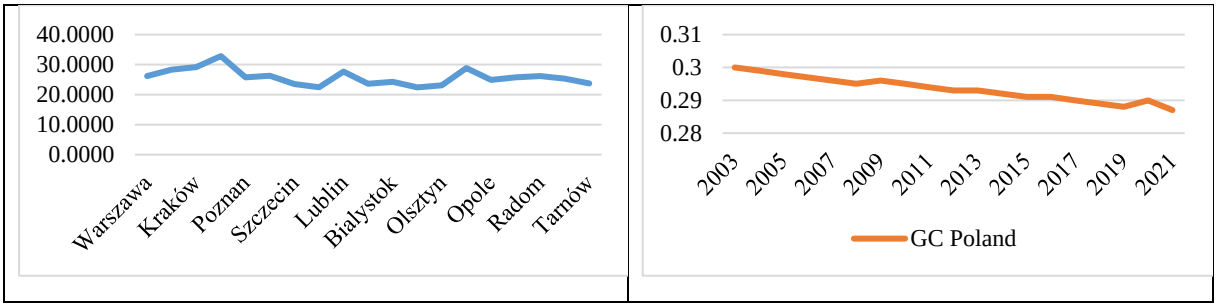
Source: own computations based on Eurostat data, 2026.

Appendix 22. Coefficient of variation and Gini coefficient of metropolitan areas of Austria



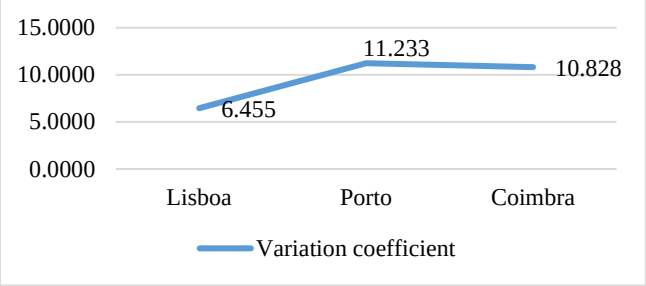
Source: own computations based on Eurostat data, 2026.

Appendix 23. Coefficient of variation and Gini coefficient of metropolitan areas of Poland



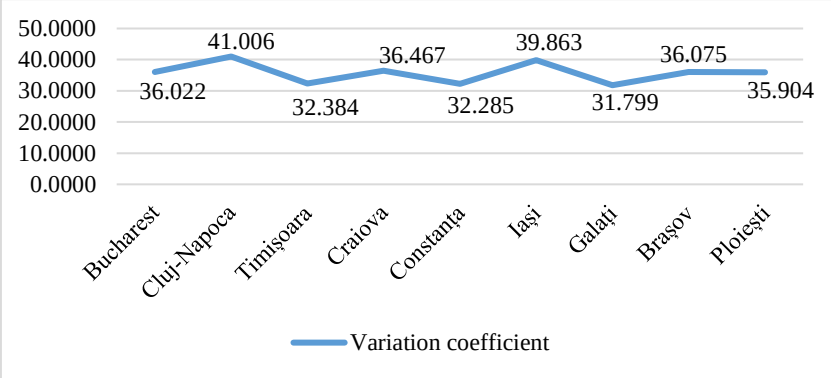
Source: own computations based on Eurostat data, 2026.

Appendix 24. Coefficient of variation of metropolitan areas of Portugal



Source: own computations based on Eurostat data, 2026.

Appendix 25. Coefficient of variation of metropolitan areas of Romania



Source: own computations based on Eurostat data, 2026.

Appendix 26. Hierarchy of EU metropolitan areas from the perspective of the average value of GDP per capita (€/inhabitant)

Development level	Metropolitan areas	GDP/capita (average)
High	Paris, Milan, Rome, Hamburg, Frankfurt, Munich, Amsterdam, Brussels, Luxembourg, Copenhagen, Dublin, Madrid, Barcelona, Lisbon, Vienna, Helsinki, Stockholm, Warsaw, Prague, Bratislava, Budapest, Ljubljana, Bucharest-Ilfov, Sofia	over 30,000
Medium	Lyon, Turin, Marseille, Lille, Ghent, Strasbourg, Bologna, Cork, Athens, Valencia, Seville, Zaragoza, Porto, Braga, Graz, Linz, Gothenburg, Malmö, Kraków, Gdańsk, Brno, Ostrava, Vilnius, Riga, Tallinn, Nicosia, Valletta, Cluj-Napoca, Iași, Timișoara, Plovdiv, Varna, Zagreb	23,000 – 30,000
Low	Naples, Palermo, Bari, Liège, Charleroi, Orléans, Thessaloniki, Málaga, Vigo, Turku, Tampere, Lublin, Białystok, Košice, Prešov, Debrecen, Pécs, Maribor, Kaunas, Tartu, Daugavpils, Brașov, Constanța, Craiova, Galați, Ploiești, Burgas, Ruse, Split, Rijeka, Osijek	under 23,000

Source: own computations based on Eurostat data, 2025.