REGIONAL CONVERGENCE IN ECONOMIC AND INNOVATION PERFORMANCE: A COMPARATIVE ANALYSIS OF GERMANY AND THE CZECH REPUBLIC

Marta Nečadová

Abstract

This paper examines regional convergence in economic and innovation performance in Germany and Czechia, two neighbouring EU economies with distinct innovation capacities but strong economic ties. The first objective is to evaluate whether NUTS 2 regions in both countries display sigma convergence in economic performance, measured by GDP per capita (in PPS). The second objective is to assess the dynamics of national and regional innovation performance using the 11th edition of the Regional Innovation Scoreboard (RIS 2025). The methodological section discusses the construction of the RII (the Regional Innovation Index), outlining strengths such as comparability and consistency with the European Innovation Scoreboard, as well as limitations related to indicator availability. Germany, classified as a Strong Innovator, and Czechia, categorised as a Moderate Innovator, offer a contrasting context for analysing the evolution of regional disparities and the extent to which national innovation capacities translate into regional performance. Sigma convergence analysis is applied to the RII indicators for 2018–2025 to identify whether innovation performance across regions is becoming more homogeneous. A related aim is to determine whether differences in economic and innovation performance between the capital city and the other regions persist or decrease in Czechia.

Keywords: Regional convergence; Sigma convergence; GDP per capita (PPS); Regional Innovation Scoreboard (RIS); Innovation performance

JEL Code: O11, O18, O47

Introduction

A significant aspect of EU economic policy is the promotion of regional growth and the reduction of wealth disparities between EU regions. The degree of achievement of these goals can be observed in the evolution of the basic indicator of economic performance and living standards (GDP per capita). The Regional Innovation Scoreboard, which is a regional extension of the European Innovation Scoreboard, serves as the basic reference framework for the

empirical analysis of regional innovation systems in the EU. The methodological design of the RIS has been widely debated, particularly in the works of authors associated with its development (Hollanders, 2023; European Commission, 2025a; European Commission, 2025b).

Critical notes highlight the trade-off between comparability and the limited availability of data at the NUTS 2 regional level. A key limitation of the RIS is the lower number of indicators compared to the EIS and the need to impute missing values, which can lead to an underestimation of the dynamics of weaker regions and of informal innovations (Hollanders, 2023). A common criticism of the original methodology is the loss of information regarding various aspects of innovation performance due to the method of final aggregation—the arithmetic mean (e.g. Szopik-Depczyńska et al., 2020)

Using the concept of sigma convergence, we aim to assess whether national and regional differences in Czech and German regions are decreasing or persisting. The results of the Regional Innovation Index (RII), its pillars, and dimensions allow the identification of both convergence and persistence in differences in key aspects of regional innovation performance.

1 Literature review and the methods used

1.1 Some selected aspects of regional convergence in the EU - a brief literature review

The methodological framework of RIS has long been a subject of debate, particularly in the works of authors involved in its development (Hollanders, 2023), who highlight the trade-off between comparability and the limited availability of data at the NUTS 2 regional level. One of the most significant academic criticisms is the claim that regions' performance within the RIS may not reflect how effectively those regions convert inputs into outputs. Teirlinck & Spithoven (2023) argue that the RIS classification based on a point system may be insufficient for policymaking purposes because it does not distinguish whether a region's high score stems from strong inputs or from the efficient conversion of resources into outcomes. Based on RIS data, Teirlinck & Khoshnevis (2022) show that a region may converge in RIS rankings but diverge in efficiency (or vice versa). These authors found that the efficiency of innovation sales in small and medium-sized enterprises (i.e., the conversion of investments in research and innovation into innovation sales) was significantly lower in capital cities between 2006 and 2014. Authors interpret this finding as evidence of excessive investment in certain innovation inputs and a weaker conversion of these inputs into intellectual property outputs, thereby

challenging the assumption that capital cities are unequivocally "more efficient" in terms of welfare. (Teirlinck & Khoshnevis, 2022)

Empirical studies in recent years (Fanelli et al., 2026; Costa et al., 2024; Pina & Sicari, 2021) confirm an overall improvement in economic performance, but at the same time show that divergence between regions within the EU is persisting or even increasing. Using the RIS dataset, Fanelli et al. (2026) examine convergence among European regions (2016–2023) and note increasing dispersion in the post-COVID-19 period. Their findings suggest heightened polarisation: stronger regions are reinforcing their advantages through digital infrastructure and human capital, while many weaker regions face structural barriers. Their results regarding sigma convergence point to divergence (increasing dispersion) in the years 2020–2023 (highly innovative regions in Northern and Western Europe are strengthening their position, while many regions in Southern and Eastern Europe are stagnating). Similar conclusions are reached by Costa et al. (2024), who highlight the structural barriers to regional convergence and the limited ability of cohesion policies to balance differences in productivity and innovation.

Authors focusing on specific inputs into Innovation (e.g. Kijek et al., 2022) point to nonlinear convergence or convergence within "clubs" rather than a uniform convergence trajectory across the EU. Kijek et al. (2022) examine research and development expenditure in European regions using Eurostat and RIS datasets and find convergence within "clubs": regions fall into several convergence "clubs" with distinct trajectories, influenced by initial human capital, external knowledge (patents), and employment structures in the technology sector. From a policy perspective, this implies that a "one-size-fits-all" innovation policy within cohesion policy is unlikely to work; instead, tailored strategies aligned with club membership are needed.

Pina & Sicari (2021) show that progress in regional convergence in the EU has been uneven over the last two decades; at the same time, disparities between large cities and rural areas have widened in most countries. According to these and other authors, worldwide factors hindering convergence include globalisation, digitalisation, and global warming, but also the effects of the pandemic and energy crises. On the other hand, incomplete financial integration, less effective fiscal governance and insufficient innovation performance are usually considered Europe-specific factors hindering convergence. Alcidi (2019) demonstrates that the present distance between the richest and the poorest EU Member States is greater than when the euro was introduced, despite the high growth period before the crisis. Using the concept of beta-convergence, Alcidi´s analysis shows that Central and Eastern European (CEE) countries (with a lower-than-average initial relative GDP per capita) have experienced the largest growth rates

and the highest speed of convergence towards the EU average. By contrast, the position of most Southern EU Member States (with an initially higher-than-average GDP per capita) has deteriorated compared to the EU average. (Alcidi, 2019, p. 6)

1.2 Used methods -definitions of the sigma coefficient and the contribution to the final score

The first method (sigma coefficient) allows for the assessment of the degree of sigma convergence between regions. The second method (calculating the contribution of a pillar or dimension to the overall score) permits the evaluation of the actual significance of a pillar or dimension in the final composite indicator. The concept of sigma-convergence is used to assess the degree of real convergence across regions and over time. This convergence refers to a reduction in the dispersion, or variance, of economic indicators across regions or countries within the EU (Barro & Sala-i-Martin, 1992; Quah, 1996; Sala-i-Martin, 1996). It means a trend where regional economic disparities decrease over time. If the standard deviation (s.d.) between regions is diminishing, the degree of convergence is higher. The reference indicator for EU regional policy is GDP per capita in PPP.[1]. Our attitude to the measurement of sigma-convergence is traditional: the sigma coefficient = the standard deviation of regional GDP per capita in PPP (score in RIS or FRAMEWORK CONDITIONS, INVESTMENTS, INNOVATION ACTIVITIES, and INNOVATION IMPACTS pillars) relative to the country's average at the NUTS 2 level. The lower the resulting sigma coefficient, the higher the degree of convergence.

Since the arithmetic mean is used for the final aggregation, the nominal weights do not reflect the actual contribution of the pillar (dimension) to the overall score. The actual contribution of the pillar (dimension) to the final score (in %) is calculated as follows: $(weight_{pillar} \cdot pillar\ score) \cdot 100/RII\ score$. Nominal weights would correspond to the actual contribution only if all sub-indicators had identical scores. The contribution to the RII can help identify country (or region)-specific strengths and areas where the possibility for improvement

[1] As e.g. Babecký & Komárek (2020) emphasise, the use of GDP in PPP leads to some distortion of the results. A consequence of this methodological choice is an overvaluation of the results for newer EU member states (with generally lower price levels compared to the EU average) and undervaluation of the results for traditional EU countries. It is determined by the purchasing power parity (PPP) calculation mechanism, which takes into account, for example, the population's income and expenditure. The following factors affecting the standard of living are not actually reflected in the market exchange rate: the amount of subsidies provided, the extent of price regulation, differences in tax rates, and the level of social transfers. Conversely, an exchange rate based on purchasing power parity reflects neither the current demand for the currency in the foreign exchange market nor the global sentiment in these markets. (Babecký & Komárek, 2020)

exists. For the top-ranked regions, the four pillars contribute in a relatively balanced way to the final score.

2 RIS methodology and results of the Czech and German regions

2.1 The brief methodology of the RIS 2025 and the contributions of the pillars (dimensions) to the RII

The Regional Innovation Scoreboard (RIS) is the regional extension of the European Innovation Scoreboard (EIS), which evaluates countries‘ innovation performance at a national level. The RIS uses the EIS indicators or their proxies for which regional-level data is available and provides a comparative assessment of the performance of innovation systems across regions. The RIS 2025 follows the methodology of the EIS 2025 and uses data for 23 of the 32 indicators used in the EIS 2025.

For each year, the final CI (the RII) is calculated as the unweighted average of the rescaled scores for all indicators, where all indicators have the same nominal weight (1/23 if data are available for all 23 indicators). Table 1 outlines the structure of the RII composite indicator and briefly describes the methodology used to construct it.

Tab. 1: RIS pillars and dimensions and their contribution to the RIS

		Czechia				Germany			
RIS pillars (number of indicators/*nominal weight, %)*	RIS dimensions (number of indicators)	Contribution to RIS (CZ)		Contribution to RIS (Prague)		Contribution to RIS, % (GE)		Contribution to RIS, % (Berlin)	
		2018	2025	2018	2025	2018	2025	2018	2025
1. Framework conditions (5/***21.7***)	1.1 Human resources (2)	5.6	6.7	9.5	10.5	5.6	6.0	7.3	7.2
	1.2 Research systems (2)	4.0	6.3	9.8	11.4	4.0	4.4	6.1	7.0
	1.3 Digitalisation (1)	6.7	6.6	6.3	5.8	5.2	5.1	4.7	4.5
2. Investments (6/***26.1***)	2.1 Finance and support (1)	5.9	4.5	7.4	6.7	4.7	5.2	6.3	6.0
	2.2 Firm investments (3)	15.2	14.6	9.9	10.5	14.2	14.3	12.7	11.1
	2.3 Investments in info technologies (2)	10.3	9.5	11.5	10.8	8.0	8.2	9.8	9.3
3. Innovation activities (7/***30.4***)	3.1 Innovators (2)	9.2	9.5	8.1	7.7	8.6	9.1	8.2	9.6
	3.2 Linkages (2)	8.8	8.9	10.4	10.5	6.1	7.0	9.5	11.0
	3.3 Intellectual assets (3)	12.3	11.6	10.5	11.2	17.1	14.4	13.7	12.8

4. Impacts (5/***21.7***)	4.1 Sales and employment impacts (2)	8.5	7.2	6.7	6.2	8.5	7.7	7.8	7.3
	4.2. Trade impacts (1)	8.8	8.9	6.1	6.2	7.0	6.6	5.8	5.3
	4.3 Resource and labour productivity (2)	4.6	6.5	4.8	5.1	8.6	9.9	6.1	7.1
	1. Framework conditions	16.4	18.8	24.5	25.2	17.4	17.6	20.0	20.4
	2. Investments	31.4	28.6	28.8	27.9	26.8	27.7	28.9	26.5
	3. Innovation activities	30.3	30.0	29.0	29.4	31.7	30.5	31.4	33.5
	4. Impacts	21.9	22.6	17.6	17.5	24.0	24.2	19.7	19.7

Source: European Commission (2025b), author's processing
Note: In the EIS and RIS 2025 as part of a small-scale revision of the indicator framework, four indicators were updated (1.3.1 Broadband penetration -proxy for High-speed internet access in EIS, 2.3.1 Cloud computing in enterprises, 4.1.1 Sales of new-to-market and new-to-firm innovations is retained within the framework - now replaces Employment in knowledge-intensive activities, 4.2.1 Exports of medium and high technology products was added to the Trade impacts dimension, 4.3.3 Labour - higher scores reflect greater efficiency and innovation-driven growth). (European Commission, 2025b)

The 1st and 2nd column provides an overview of the four pillars and 12 dimensions of regional innovation performance (including the number of sub-indicators within the pillars and dimensions, and the nominal weights of the four pillars). The percentage contributions of the innovation performance dimensions to the final score are described in columns 3–10 of Table 1. Similar to the EIS, the RIS uses the arithmetic mean for the final aggregation. The contribution to the final score takes into account both the nominal weight of the pillars or dimensions (determined by the number of indicators) and the normalised score (i.e., the value reflecting innovation performance in a given area). This contribution to the overall assessment thus provides information on the importance of the pillar (dimension) in the final aggregation using the arithmetic mean, and, in combination with the normalised scores in Table 2, helps identify competitive advantages and disadvantages. Comparing contributions in the base year and the final year (the RII 2018 and the RII 2025) permits to track potential changes over time; a comparison between the contribution for the entire country (all NUTS 2 regions) and that for the capital region (see, for example, columns 3 and 5, or 4 and 6, for Czechia) highlights the specific position (competitive advantage) of the capital city region. If the contributions of a dimension differ (when comparing all regions with the capital city) and this difference persists over time, the cause of the slowdown in the convergence process between regions is identified in that dimension.

Tab. 2: RIS pillars and dimensions _normalised score for Czechia and Germany

RIS dimensions (number of indicators)	Czechia				Germany			
	CZ (all regions)		Prague		GE (all regions)		Berlin	
	2018	2025	2018	2025	2018	2025	2018	2025
1.1 Human resources (2)	0.28	0.35	0.64	0.75	0.36	0.40	0.58	0.59
1.2 Research systems (2)	0.19	0.33	0.66	0.81	0.26	0.29	0.48	0.58
1.3 Digitalisation (1)	0.66	0.69	0.85	0.83	0.68	0.68	0.74	0.74
2.1 Finance and support (1)	0.58	0.48	1.00	0.95	0.61	0.69	1.00	1.00
2.2 Firm investments (3)	0.50	0.51	0.44	0.50	0.62	0.63	0.67	0.61
2.3 Investments in info technologies (2)	0.50	0.50	0.77	0.77	0.52	0.54	0.77	0.77
3.1 Innovators (2)	0.45	0.50	0.55	0.55	0.56	0.60	0.65	0.80
3.2 Linkages (2)	0.43	0.47	0.70	0.75	0.40	0.47	0.75	0.91
3.3 Intellectual assets (3)	0.40	0.40	0.47	0.53	0.74	0.64	0.72	0.71
4.1 Sales and employment impacts (2)	0.42	0.38	0.45	0.44	0.55	0.51	0.62	0.60
4.2. Trade impacts (1)	0.86	0.93	0.82	0.89	0.91	0.88	0.92	0.88
4.3 Resource and labour productivity (2)	0.22	0.34	0.32	0.37	0.56	0.65	0.48	0.59
1. Framework conditions	0.32	0.39	0.66	0.72	0.46	0.46	0.63	0.67
2. Investments	0.51	0.50	0.65	0.66	0.58	0.61	0.76	0.73
3. Innovation activities	0.43	0.45	0.56	0.60	0.59	0.58	0.71	0.79
4. Impacts	0.43	0.47	0.47	0.50	0.63	0.64	0.62	0.65
Regional innovation index (RII)	***0.46***	***0.49***	***0.64***	***0.68***	***0.57***	***0.58***	***0.70***	***0.73***

Source: European Commission (2025b), author's processing
Note: The pink shading of cells in Table 2 indicates a competitive advantage in those dimensions, i.e., the highest normalised score. The light blue shading indicates the dimensions with the lowest scores.

Table 2 can be used to identify the competitive advantages of metropolitan regions during the period under review. Capital city regions achieve higher scores across all four pillars, improving the overall assessment of innovation performance in both countries. At the dimension level, Prague performs slightly below average in Trade Impacts and Firm investments, while Berlin lags behind in the Resource and labour productivity dimension. A more detailed look at the dimension level reveals the areas of innovation where metropolitan regions differ the most, i.e., identifies factors slowing regional convergence. The largest differences in scores in favour of metropolitan regions are in the dimensions Finance and support, Attractive research systems, Human resources, and Linkages.

The contributions of pillars and dimensions to the overall assessment (see Table 1) take into account both the normalised score and the number of indicators and reflect the importance of the pillar (dimension) for the final RII. The largest differences in favour of metropolitan regions in both countries are in the Framework Conditions pillar (for Czechia, this difference was 8.1 p.b. in the RII 2018; in the RII 2025, it was lower, 6.4 p.b.; the significance of this pillar for the Berlin metropolitan region was 2.6 p.b. higher in the RII 2018 and 2.8 p.b. higher in the RII 2025). The privileged position of metropolitan regions in this pillar (and the source of differences in innovation performance) is influenced primarily by the dimensions of Research systems and Human resources. At the dimension level, the innovation performance of both metropolitan areas is also driven by the dimensions of Finance and support and Linkages. Firm investments contribute more to regions' innovation performance in both countries than in Prague and Berlin (in Germany, the innovation dimension also contributes more to regions' final scores in the RII 2018). According to Teirlinck & Khoshnevis (2022), the cause may stem from lower efficiency of innovation sales in small and medium-sized enterprises in capital cities, i.e., the lower conversion of investments in research and innovation into innovation sales.

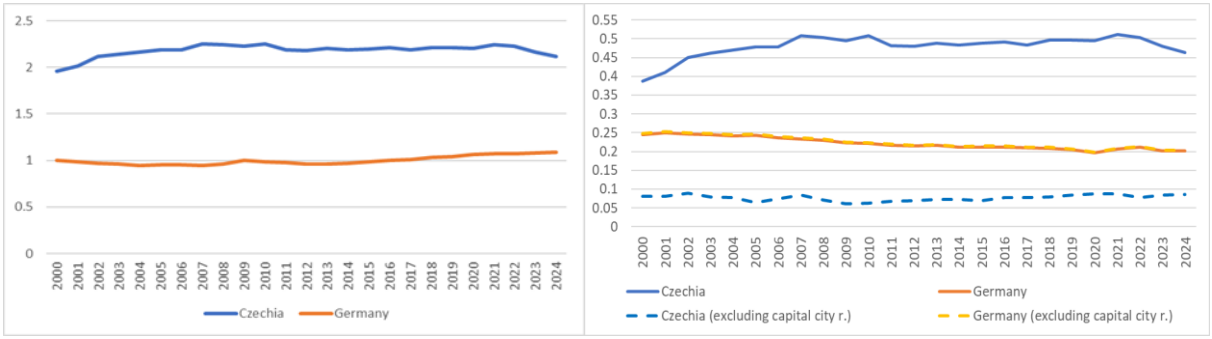
3 Results-measuring sigma-convergence

3.1 Convergence of real GDP per capita

The evolution of GDP per capita in purchasing power parity (PPP) for the NUTS 2 Czech and German regions reveals the following: during the observed period (the RII 2018–2025), Prague is more than twice as wealthy as other Czech regions (see Figure 1). Babecký and Komárek's (2020) analysis, conducted on a larger sample of EU countries, shows a clear relationship between country wealth and regional disparities (capital versus regions). Their findings are as follows: the poorer the country, the more visible the disparities between capital cities and regions. In contrast, for Germany, the disparities between the capital city and the other regions are negligible. The slight increase in Germany's ratio following the COVID-19 pandemic is due to faster growth in GDP per capita in Berlin compared to other German regions. The persistent differences between Prague and other regions are also evident in Figure 2. This figure indicates a slight narrowing of the gaps in living standards among German regions; the inclusion of the Berlin metropolitan region does not distort this trend.

Fig. 1: Ratio of real GDP p.c. in the capital city to the nationwide average

Fig. 2: sigma convergence of real GDP p.c. at the regional level



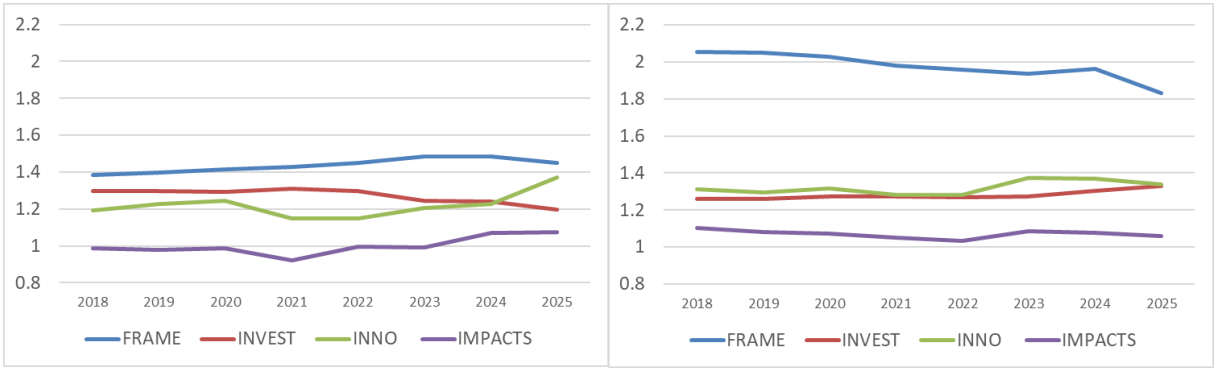
Source: Eurostat (10/02/2026), author's processing.

3.2 Convergence of RII pillars

The values and evolution of the ratio between capital city and nationwide average for the RII pillars (see Figures 3 and 4) and the values and evolution of the sigma coefficient for the RII pillars (see Figures 5-8) confirm the trends observed in the previous parts of this paper.

Fig. 3: RIS 2025_ GE_performance in RII pillars (ratio: capital city/nationwide average)

Fig. 4: RIS 2025_ CZ_performance in RII pillars (ratio: capital city/nationwide average)



Source: European Commission: Directorate-General for Research and Innovation (2025a), author's processing.

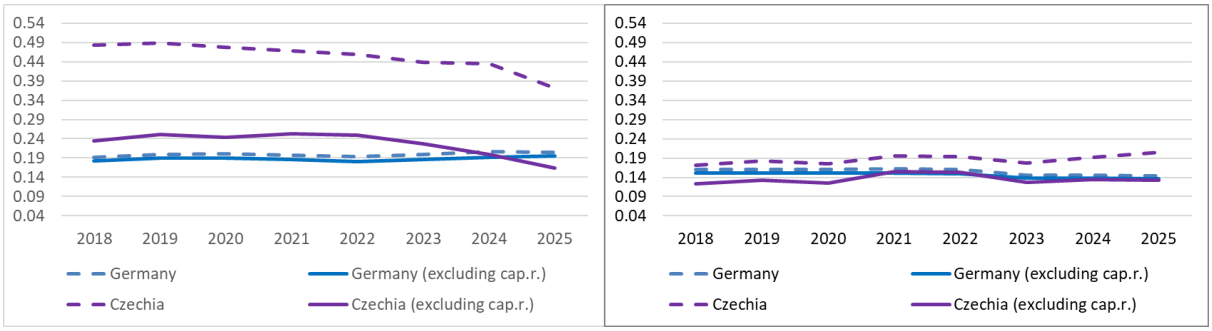
Figures 3 and 4 show the dominance of metropolitan regions across all innovation pillars in both countries. The largest and most persistent difference in favour of the Prague and Berlin regions is found in the Framework Conditions pillar. The dominant position of the Czech metropolitan region (according to RII 2025, Prague is a strong innovator, while other regions of Czechia are moderate innovators), particularly in the dimensions of Human Resources and Research Systems, is reflected in nearly double performance in Framework Conditions.

Regions and metropolitan areas show nearly identical performance in the Impacts pillar; this may be due to lower efficiency in converting innovation inputs into innovation outputs in

metropolitan regions (see, e.g., Teirlinck & Khoshnevis (2022). In Czechia, a slight divergence can be observed in the Investments pillar starting in 2023, in Germany in the Innovation Activities pillar.

Fig. 5: RIS 2025_sigma convergence of the 1st pillar (Framework conditions)

Fig. 6: RIS 2025_sigma convergence of the 2nd pillar (Investments)



Source: European Commission: Directorate-General for Research and Innovation (2025a), author's processing.

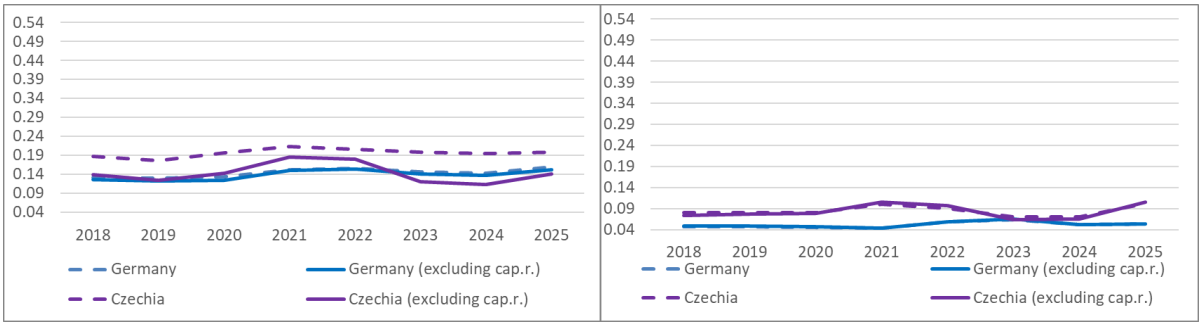
The sigma coefficient values for "Framework conditions" (see Figure 5) are the highest for both countries and indicate the greatest differences between the metropolitan region and other regions in this pillar of regional innovation performance. The double sigma coefficient (with the Prague region) captures the Prague region's exclusive position in the dimensions of Human Resources, Attractive Research Systems, and Digitalisation. A narrowing of the gaps between other regions and Prague has been evident since the RII 2022. In Germany, a slight difference with a tendency toward divergence between Berlin and other regions has persisted since RII 2023. In Czechia, weak convergence has been evident since RII 2024.

Figure 6 shows relatively small but persistent differences in the Investments pillar, with a tendency to divergence between Prague and other regions of Czechia since RII 2023. This divergence can be explained by increased variability in dimensions 2.1 (Finance and Support) and 2.3 (Investments in information technologies). Regional differences in Germany remain virtually unchanged over time and are not caused by the unique position of the Berlin region.

The values of the sigma coefficient in the Innovation Activities pillar for Czechia are similar to those in the Investments pillar (see Fig. 7), reflecting the continuing disparities between the metropolitan region and other regions. A slight increase in regional disparities (excluding Prague) in the RII 2021 and 2022 (under pandemic conditions) is explained by increased variability in dimension 3.1 (Innovators) and a decline in performance in dimension 3.3 (Intellectual assets).

Fig. 7: RIS 2025_sigma convergence of the 3rd pillar (Innovation activities)

Fig. 8: RIS 2025_sigma convergence of the 4th pillar (Impacts)



Source: European Commission: Directorate-General for Research and Innovation (2025a), author's processing.

The sigma coefficient values in Impacts indicate the smallest differences between metropolitan and other regions in both countries. In this pillar as well, the impact of the COVID-19 crisis is divergent due to a decline in innovation performance in dimension 4.3 (Resource and labour productivity). The reason for the increase in differences between Prague and the Czech regions since the RII 2024 is a decline in innovation performance in dimensions 4.1 (Sales and employment impacts) and 4.3, as well as an increase in variability in dimension 4.3. Germany's innovation performance in this pillar shows persistent, but slight differences between Berlin and other regions.

Conclusion

The evolution of the sigma coefficient in both parts of our analysis (GDP per capita in Germany and Czechia in the period 2000 – 2024; regional innovation performance results based on the RII dataset 2018 - 2025) confirms the privileged position of the capital city regions in the assessment of regional innovation performance for Czechia and persistent, but slight differences between Berlin and other regions for Germany. Germany tends to have a smaller gap between its capital city region and its other regions compared to Czechia. Our conclusions regarding sigma convergence at the level of the RII pillars and dimensions are consistent with the findings of the authors cited above and highlight the dominance of the Prague metropolitan region, particularly in the Framework Conditions pillar. The COVID-19 pandemic has widened disparities between regions—particularly in the new EU member states. The Prague region has strengthened its performance relative to other regions in the dimensions of Human resources, Research systems, and Finance and support. The data also suggest lower efficiency in converting innovation inputs into outputs in the Prague region (see the comparison of Prague's innovation performance with that of all Czech regions in the dimensions of Finance support and

Trade impacts). Although the RIS is widely used, it has also been the subject of criticism: aggregate assessments based on the arithmetic mean of innovation performance indicators may oversimplify the evaluation of regional innovation performance. Appropriate economic policy should therefore take into account the structural characteristics of individual regions.

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References

Alcidi, C. (2019). Economic Integration and Income Convergence in the EU. *Intereconomics*, *54*(1), 5–11. https://doi.org/10.1007/s10272-019-0783-6

Babecký, J. & Komárek, L. (2020). Regional disparities in selected EU countries. Global Economic Outlook 2/2020, Czech National Bank. https://www.cnb.cz/export/sites/cnb/en/monetary-policy/.galleries/geo/geo_2020/gev_2020_02_en.pdf

Barro, R. J., & Sala-i-Martin, X. (1992). Convergence. *Journal of Political Economy*, *100*(2), 223-251.

Costa, À., Galletto, V., Garcia, J., Raymond, J. L., & Sánchez-Serra, D. (2024). Evolution of the convergence in European regions: 2000–2019. *Annals of Regional Science, 73*, 1625–1648. https://doi.org/10.1007/s00168-024-01308-8

European Commission. Directorate General for Research and Innovation. (2025a). Regional Innovation Scoreboard 2025. Publications Office. https://doi.org/10.2777/2313906

European Commission. Directorate General for Research and Innovation. (2025b). *Regional Innovation Scoreboard 2025. Methodology Report – Independent expert report.* Publications Office. https://doi.org/10.2777/2313906

Fanelli, R. M., Cipollina, M., & Scrocco, A. (2026). Innovation index convergence in Europe: How did COVID-19 reshape regional dynamics? *Sustainability, 18*(3), 1337. https://doi.org/10.3390/su18031337

Hollanders, H. (2023). A critical assessment of the European Innovation Scoreboard. In F. Gault, A. Arundel, & E. Kraemer-Mbula (Ed.), *Handbook of Innovation Indicators and Measurement* (pp. 391–412). Edward Elgar Publishing. https://doi.org/10.4337/9781800883024.00032

Kijek, T., Kijek, A., & Matras-Bolibok, A. (2022). Club convergence in R&D expenditure across European regions. *Sustainability, 14*(2), 832. https://doi.org/10.3390/su14020832

Quah, D. T. (1996). Convergence empirics across economies with (some) capital mobility. *Journal of Economic Growth*, *1*, 95-124.

Sala-i-Martin, X. X. (1996). Regional cohesion: evidence and theories of regional growth and convergence. *European economic review*, *40*(6), 1325-1352.

Szopik-Depczyńska, K., Cheba, K., Bąk, I., Kędzierska-Szczepaniak, A., Szczepaniak, K., & Ioppolo, G. (2020). Innovation level and local development of EU regions. A new assessment approach. *Land Use Policy*, *99*, 104837. https://doi.org/10.1016/j.landusepol.2020.104837

Contact

Marta Nečadová

Department of Managerial Economics

Faculty of Business Administration

Prague University of Economics and Business

W. Churchill Sq. 1938/4, 13067 Prague 3, Czech Republic

necadova@vse.cz