

**ECONOMICS** – THEMATIC STUDIES

# **Smart Cities, Smart Investment** in Central, Eastern and South-Eastern Europe



**European  
Investment  
Bank**





**Smart Cities, Smart Investment  
in Central, Eastern and South-Eastern Europe**

# **Smart Cities, Smart Investment in Central, Eastern and South-Eastern Europe**

**July 2018**

**A report by the EIB Economics Department**

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## **About the Economics Department of the EIB**

The mission of the EIB Economics Department is to provide economic analyses and studies to support the Bank in its operations and in its positioning, strategy and policy. The Department is a team of 40 economists and staff. It is headed by Debora Revoltella, Director of Economics.

## **Disclaimer**

The views expressed in this document are those of the authors and do not necessarily reflect the position of the EIB.

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## Introductory remarks

*“By far the greatest and most admirable form of wisdom is that needed to plan and beautify cities and human communities.”*

— Socrates

The European Investment Bank (EIB), or the “EU Bank” is celebrating the 60<sup>th</sup> anniversary this year. Its “original raison d’être” since its foundation has been convergence. Also for decades to come, the EU Bank’s mission is devoted to retain its utmost commitment to cohesion lending. Indeed, the future of convergence is in the modern and smart cohesion, including the smart and innovative investments into cities and regions. Smart cohesion financing will therefore keep on being the key pillar of the next Multiannual financial framework of the EU in the post 2020 era.

Convergence has already been robust across all European countries. There are, however, still regions struggling in their pursuit toward the European average as well as staying behind the most competitive areas of their own countries. To address these challenges and turn opportunities into reality will require good governance blended with appropriate financing for high impact investments. Such a combination is, in my view, the right way forward in our quest to increase the well-being and wealth of Europeans.

Nowadays, to be smart about the urban investments per se, is, already old-fashioned. To harvest the crops of smart urban investments, we need to look in broader perspective, behind the smart cities – we need to address smart regions, smart islands, smart villages and outskirts. What is our motivation here?

Many second-tier European cities struggle to keep up with the developmental pace observed in metropolitan hubs around the world. This combines with what we could call inability to benefit from their own competitive advantages – advantages carrying a major potential to accelerate Europe’s business, economic and energy evolution. All this in order to multiply benefits of the European project for all – European citizens and business too.

This locked potential, unfortunately, can be observed in many urban areas in Central, Eastern and South-Eastern Europe (CESEE). What we see in this region is a significant gap even with their domestic capitals. In this report, the Economics Department of the EIB lays out the case for smart investment in CESEE. It supports the EIB’s strategic positioning in the CESEE region at a time when the EU Bank is launching the “Smart cities and regions” initiative, built on the pillars of advising, blending and lending.

For the EIB, investment in smart cities and regions is a way to respond efficiently to its social and territorial cohesion mandate by supporting the upgrade of local economies in a quickly evolving digital world. Cities and regions are key partners for the EIB. The EU Bank supports projects to make cities more sustainable (energy transition, climate adaptation and efficient mobility), inclusive (housing, health care and integration of migrants) and more competitive (education, skills development and digital transition). Given the CESEE specifics with portfolio of variety of small-scaled projects, we are designing the investment platforms to address these investment needs at national level, with the intention to crowd-in private investors.

The EIB also wants to help cities with their investment planning and coordination, which, according to the EIB Investment Survey of municipalities, is a weak spot across the whole EU. With this in mind, the EIB, together with the European Commission, launched the Urban Investment Advisory Platform (URBIS): a one-stop shop for cities.

This study explains our motivation why we at the EIB have designed a new offering to advise, blend and finance the urban investments for smart cities and regions.

Vazil Hudak

Vice-President, European Investment Bank

## Preface

Through the EIB Investment Survey, the Economics Department shows significant evidence that CESEE cities lack behind their EU counterparts when it comes to basic infrastructure. Moreover, investments in transport and housing infrastructure in these cities have been below expectations in the past 5 years.

This paper utilises a multidimensional framework for defining smart cities and regions by introducing a Smart Region Index to identify and further examine the gaps in CESEE. The Smart Region Index focuses on aspects regarding economic dynamics and innovation, environmental sustainability, quality of administration, accessibility, human capital and quality of life. This approach has the benefit to allow the exploration of the underlining factors that cause the particular gaps to emerge. From the analysis, there is evidence that CESEE regions lack behind the EU in factors related to mobility, governance and quality of life. Furthermore, the paper provides a thorough discussion about the performance of capital and non-capital regions in CESEE and supports the consensus that intra-country regional disparities are relatively large.

Looking at the source of the problems, the EIBIS also allows the identification of obstacles when it comes to infrastructure project design and implementation. Evidence suggests that limited access to finance has a negative impact on municipalities' investment activities. Municipalities in CESEE are therefore dependent on European Structural and Investment Funds. As a result, EU funding reforms in the post-2020 Multi-Annual Financial Framework will be of the outmost significance for the financial situation of municipalities in the future. Regional coordination and prioritisation of projects is also an important aspect, which requires improvement.

As a result, smart city projects can help to address basic infrastructure needs and will make cities more attractive to people and businesses by encouraging innovation.

Debora Revoltella

Director, Economics Department, European Investment Bank

# Smart Cities, Smart Investment in Central, Eastern and South-Eastern Europe<sup>1</sup>

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*This paper makes the case for smart policies development in CESEE. It is split into five sections. Section 1 includes our motivation and gives an overview of the literature. Section 2 introduces the EIBIS 2017 results for CESEE cities by outlining their local infrastructure gaps. Moreover, by using a selection of indicators, we demonstrate the productivity and innovation gaps between CESEE and other EU cities. Furthermore, we discuss the ongoing and projected negative demographic trends in CESEE, and evaluate the capital and non-capital regional convergence in CESEE countries. Section 3 introduces a Smart Region Index, defining six main pillars of “smartness”, which allows us to identify gaps in CESEE regions compared with the EU. Section 4 uses the main results from the EIBIS and provides further conclusions when it comes to investment obstacles for CESEE municipalities. In addition, we assess the CESEE local fiscal health, and highlight the importance of the use of EU funds. Section 5 concludes and summarises the main results.*

## Key findings

- The EIB Investment Survey (EIBIS)<sup>2</sup> shows that 40% of CESEE<sup>3</sup> cities still register gaps in basic infrastructure. In addition, a large share of CESEE cities reported underinvestments over the last five years, specifically in transport and housing infrastructure, the areas where the quality of infrastructure is also considered to be the lowest.
- Regional economic data illustrates that most CESEE cities still lag behind the EU-28 average in productivity and innovation. Furthermore, they face several demographic challenges. Looking at individual CESEE countries, economic and societal gaps exist between capitals and other cities. Over the last fifteen years, CESEE capitals have done much to catch up in economic and social terms, growing more quickly than other regions in their countries. This allowed CESEE capitals to converge quickly to the EU income per capita average—some of them even emerged as European economic hubs.
- In this paper, a multidimensional framework is used to define smart cities and regions. The concept of “smart” is underpinned by six pillars: economic dynamics and innovation (Smart Economy), environmental sustainability (Smart Environment), quality of administration (Smart Governance), accessibility (Smart Mobility), human capital (Smart Society) and quality of life (Smart Living). This approach is in line with the UN urban agenda’s principles.<sup>4</sup> According to the latter, the smart city approach makes use of the opportunities from digitalization, clean energy and technologies, as well as innovative transport technologies, to allow inhabitants to

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<sup>1</sup> We are grateful to Lewis Dijkstra and Paola Annoni, Directorate General Regional and Urban Policy of the European Commission, for providing helpful advice and insights.

<sup>2</sup> European Investment Bank, “EIB Investment Survey 2017, municipal infrastructure”, 2017.

<sup>3</sup> In this paper the CESEE region covers (subject to data availability) the Czech Republic, Slovakia, Hungary, Poland, Slovenia, Croatia, Bulgaria, Romania, Latvia, Lithuania and Estonia.

<sup>4</sup> See Article 66 of the UN New Urban Agenda.

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make more environmentally friendly choices and boost sustainable economic growth while enabling cities to improve their service delivery.

- To help understand the underlying forces at work, we developed a Smart Region Index to gauge the urban potential in the light of technological challenges. This allows the identification of smartness gaps in CESEE regions, as well as the underlining factors and indicators that cause these gaps to emerge.
- Our analysis shows significant smartness gaps between CESEE regions and their EU counterparts, which are particularly evident in innovation, accessibility, quality of government and quality of life.
- Although on average CESEE capital regions perform better than non-capital regions when it comes to smartness indicators, they still lag the EU average. Significant gaps emerge when it comes to governance and living quality aspects. Nevertheless, within the CESEE countries, the capital regions perform significantly better than second-tier and other non-capital regions when it comes to societal factors, as well as firms' technological consumption and business sophistication. In addition, the CESEE intra-country regional disparities are much wider than those within other EU countries.
- Even though it is crucial, investment by itself is not enough to fill the existing gaps and promote intra-national and EU-wide convergence. The EIBIS allows us to identify the following major obstacles to filling gaps in infrastructure project design and implementation: budgetary limitations, the length of the approval process, political and regulatory instability and low technical capacity. Limited access to finance hinders municipalities' investment activities, given that more restrictive fiscal responsibility schemes have already recently been implemented in the region. CESEE municipalities are thus strongly dependent on European Structural and Investment Funds. Given this high dependence, EU funding reforms in the post-2020 Multi-Annual Financial Framework will be crucial for financing municipal investment. Furthermore, like their EU peers, CESEE municipalities perform poorly when it comes to the economic planning of infrastructure investment. They also perform worse than their EU counterparts in terms of regional coordination of their investments. This shows that there is room for improvement when it comes to prioritisation and coordination of projects, in order for municipalities to take advantage of the funds available for public investment.
- Smart city investments can therefore help to reduce capacity and efficiency gaps by meeting the basic infrastructure needs and by making cities more conducive to innovation and more attractive to people and businesses. This can be achieved by fostering coordination and prioritisation, by investing in capital cities and by developing second-tier cities with potential, giving them better links to the capitals.

## 1. Smart cities and regions in context

**In recent decades, the population and economies of European cities have been growing much more than in less urban areas.** We expect urbanisation and the economic success of cities to become increasingly prominent in the near future. OECD projections<sup>5</sup> indicate that 85% of the global population will live in cities by 2100 (up from 50% today). In addition, cities generate around 82% of the global gross domestic product (GDP) and are projected to account for 88% by 2025.<sup>6</sup> The combination of economic clustering with global trends, such as the emergence of a global middle class and the adoption of information technologies, puts cities at the centre of economic and societal change. This change is not limited to megacities: at a global level, and especially in rapidly urbanising countries, we expect second- and third-tier cities to experience the most radical population increase and economic transformation.<sup>7</sup>

**However, partly due to their attractiveness and economic structure, cities face difficult challenges, including social exclusion, migration and lower environmental quality.** The projected increase in urban population over the coming decades accentuates both opportunities and challenges, and calls for timely policy action. “Older” cities, particularly in North America and Europe, face the pressing need to replace ageing infrastructure, adapt local services to demographic changes and tackle social exclusion. In fact, many cities are in the paradoxical situation of being the most competitive and most unequal places in their countries.<sup>8</sup> Furthermore, as cities represent the economic engines of their countries, the process of upgrading their capacity for productivity, wealth and innovation immediately makes a country potentially more competitive.<sup>9</sup> Therefore, urban policies are the most important tool for overseeing the connection between competitiveness and inequality. Given their concentration and agglomeration, cities are also the areas where results for much of the population can be achieved with lower financial effort. However, there are no silver bullets to overcome all issues: policy and project design are often complex and require a consistent urban investment strategy and a strong local involvement to ensure impact.

**Overall, digitisation offers European cities many as yet unknown opportunities<sup>10</sup>** due to the way it is designed and financed. The upgrade and the inter-linking of infrastructures, new technologies and services in transport, buildings, energy and information and communications technology (ICT) improves cities’ competitiveness and improves both the quality of life of inhabitants and the cities’ environmental sustainability. On the other hand, promoting innovation requires not just the right policy mix, but also business models and financing solutions that decrease risk and ensure efficiency. Processes and governance are also crucial: as technology evolves, cities need to continue innovating to cope with rapid and disruptive changes.<sup>11</sup>

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<sup>5</sup> OECD, “The metropolitan century: understanding urbanisation and its consequences”, 2015.

<sup>6</sup> Climate Finance Leadership Alliance, “The state of city climate finance”, 2015.

<sup>7</sup> World Economic Forum, “Cities and urbanisation”.

<sup>8</sup> Boulant, J., Brezzi, M., and Veneri, P., “Income levels and inequality in metropolitan areas: a comparative approach in OECD countries”, OECD Regional Development Working Papers, 2016/06, OECD Publishing, Paris, 2016.

<sup>9</sup> European Commission, “The state of European cities”, 2016.

<sup>10</sup> Strategic Policy Forum on Digital Entrepreneurship, “Blueprint for cities and regions as launch pads for digital transformation”, 2016.

<sup>11</sup> National League of Cities, “Trends in smart city development”, 2016.

**There is a clear case for investment in second-tier<sup>12</sup> cities in Europe.**<sup>13</sup> These cities have not benefited as much from urbanisation and agglomeration economies as capital and large metropolitan cities. This is particularly evident for CESEE, where capitals have benefited disproportionately from economic growth, while other cities still have great untapped potential in terms of agglomeration economies and evident margin for reduction of agglomeration costs. We also consider the extent of the current lack of territorial and social cohesion to be a major issue from a political perspective, given the rise of social unrest in less developed areas.<sup>14</sup>

**Investing in CESEE capitals would support innovation, and evidence supports that investing in second-tier cities means that neighbouring regions will also benefit.**<sup>15</sup> **This would promote economic development of CESEE countries and support convergence in the EU.** As spatial proximity is crucial for growth,<sup>16</sup> promoting growth hubs beyond capitals would support national growth and support cohesion by reducing regional inequalities. In addition, investing in smaller cities would also ease pressures on capitals, by reducing real estate prices and other agglomeration costs such as congestion and pollution. Agglomeration economies are key drivers of economic growth as they arise due to economies of scale, increasing innovation and concentration of high-level services. Moreover, agglomeration produces both direct and indirect effects on growth due to greater interaction between firms and people. Second-tier cities can achieve many of the agglomeration effects of the capitals if they are enabled by the right infrastructure, facility and capacity.<sup>17</sup> Overall, national economies would benefit from a more diversified network of highly developed cities and a more connected urban hierarchy. This would also stop businesses and talented people being biased towards locating in the capital, increasing efficiency.<sup>18</sup>

**The concept of the smart city has recently been widely used as a trigger to upgrade urban economies through the increased efficiency gained by the widespread adoption of new technologies.** Many definitions of smart cities appear in the literature on urban development, mobility and the digital economy.<sup>19</sup> These stem from the different approaches by different sectors, particularly ICTs (“digital”, “wired” or “information” cities<sup>20</sup>), environment (“sustainable”, “green”, “eco” cities<sup>21</sup>), knowledge

<sup>12</sup> In line with the Eurostat definition, second-tier metro regions are the group of largest cities in the country, excluding the capital.

<sup>13</sup> European Commission, “The state of European cities report”, 2016.

<sup>14</sup> Rodriguez-Pose, A., “The revenge of the places that don’t matter (and what to do about it)”, London, Centre for Economic Policy Research, 2017.

<sup>15</sup> European Commission, “Seventh cohesion report”, 2017.

<sup>16</sup> Regions in the EU with high growth rates are predominantly surrounded by other high-growth regions, see Lavalle, C., Pontarollo, N., Batista, E., Silva, F., Baranzelli, C., Jacobs, C., Kavalov, B., Kompil, M., Perpiña Castillo, C., Vizcaino, M., Ribeiro Barranco, R., Vandecasteele, I., Pinto Nunes Nogueira Diogo, V., Aurambout, J., Serpieri, C., Marín Herrera, M., Rosina, K., Ronchi, S. and Auteri, D., “European territorial trends - facts and prospects for cities and regions”, European Commission, 2017.

<sup>17</sup> Parkinson, M., Meegan, R., Karecha, J., Evans, R., Jones, G., Sotara, M., Hall, P. “Second tier cities in Europe: in an age of austerity why invest beyond the capitals”. ESPON and Institute of Urban Affairs, Liverpool John Moores University, 2012.

<sup>18</sup> Parkinson, M., Meegan, R., Karecha, J., Evans, R., Jones, G., Sotara, M., Hall, P. “Second tier cities in Europe: in an age of austerity why invest beyond the capitals”. ESPON and Institute of Urban Affairs, Liverpool John Moores University, 2012.

<sup>19</sup> Cocchia, A., “Smart and digital city: a systematic literature review”, in *Smart city*, Springer International Publishing, 2014, pp. 13–43; Albino, V., Berardi, U., and Dangelico, R. M., “Smart cities: Definitions, dimensions, performance, and initiatives”. *Journal of Urban Technology*, No 22(1), 2015, pp. 3–21.

<sup>20</sup> Hollands, R. G., “Will the real smart city please stand up? Intelligent, progressive or entrepreneurial?”. *City*, No 12(3), 2018, pp. 303–320; Couclelis, H., “The construction of the digital city”, *Environment and Planning B: Planning and Design*, No 31(1), 2004, pp. 5–19; Cretu, L. G., “Smart cities design using event-driven paradigm and semantic web”, *Informatica Economica*, No 16(4), 2012, p. 57.

<sup>21</sup> Anthopoulos, L., and Fitsilis P., “Using classification and roadmapping techniques for smart city viability’s realization”, *Electronic Journal of e-Government*, 11(1), 2013, pp. 326–336; Batagan, L., “Smart cities and sustainability models”, *Revista de Informatica Economica*, No 15(3), 2011, pp. 80–87; OECD, “Green cities programme”, 2010.

(“learning” or “intelligent” cities<sup>22</sup>) and transport,<sup>23</sup> and result in more holistic views of cities as efficient and highly productive places hosting educated, innovative and collaborative communities.<sup>24</sup> In addition, some experts consider “smart” as an attribute of active and participatory governance,<sup>25</sup> since technology implies a policy shift in the way projects are defined and implemented. Several conceptual frameworks mix three main ingredients—technology, people and community (or institutions)—and emphasise the use of technology and data platforms as crucial elements in improving the management, the innovative capacity and the quality of life in cities, resulting in advancements for the local economy.<sup>26</sup>

**Post-crisis fiscal consolidation places a disproportionate cost on public investment, which particularly affects countries at the municipal level.** In some countries, national fiscal regulations limit the ability of cities to take on additional debt to fund new large-scale investment projects. Although the fiscal position of CESEE municipalities has broadly improved over the last few years, the investment by local governments remains subdued. A combination of political and economic choices and over-reliance on EU funds could be behind these trends. There are also a few reasons why this development is alarming. First, large investment gaps in urban investments exist, especially in second-tier cities. Second, local investment is deemed to have higher multiplier effects than central government investment, by having a greater impact on economic growth.<sup>27</sup> Third, by focusing on ICT infrastructure, capital stock might depreciate more quickly than in the past (and more investment is needed to replace degrading stock).

**At the municipal level, innovative financing does not necessarily have to increase local governments’ indebtedness.** Such financing can include:

- (i) projects where costs can be covered by user fees levied independently (i.e. the ASFiNAG model in Austria) in areas such as network services (energy, telecoms, digital infrastructure, roads, housing), where a clearly defined income stream is available;
  - (ii) lower cost maintenance projects rather than investment in new large projects;
  - (iii) congestion charging;
  - (iv) increased business property tax revenues generated by smart development (these projects are paid back by the increase in economic activity and land/property values in the area; this does not entail introducing new taxes, but uses existing taxes to generate extra revenues);
  - (v) leasing arrangements that would affect fiscal cash flow but not show up in the debt stock.
- Investment in smart city development has an additional benefit in the context of the current

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<sup>22</sup> Komninos, N., “The architecture of intelligent cities: integrating human, collective and artificial intelligence to enhance knowledge and innovation”, *IEEE 2nd IET International Conference on Intelligent Environments*, IEEE Xplore, 2006, pp. 13–20; OECD, “Learning cities: the new recipe in regional development”, *OECD Observer* No 217/218, Summer 1999.

<sup>23</sup> Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., and Williams, P., “Foundations for smarter cities”, *IBM Journal of Research and Development*, No 54(4), 2010, pp. 1–16; Hall, R. E., Bowerman, B., Braverman, J., Taylor, J., Todosow, H., and Von Wimmersperg, U., “The vision of a smart city”, No. BNL-67902; 04042, Brookhaven National Lab., Upton, NY (US), 2000.

<sup>24</sup> Lazaroiu, G. C., and Roscia, M., “Definition methodology for the smart cities model”, *Energy*, No. 47(1), 2012, pp. 326–332.

<sup>25</sup> Caragliu, A., Del Bo, C., and Nijkamp, P., “Smart cities in Europe”, *Journal of Urban Technology*, No 18(2), 2011, pp. 65–82.

<sup>26</sup> Nam, T., and Pardo, T. A., “Conceptualizing smart city with dimensions of technology, people, and institutions”, in *Proceedings of the 12th annual international digital government research conference: digital government innovation in challenging times*, 2011, pp. 282–291; Albino, V., Berardi, U., and Dangelico, R. M., “Smart cities: Definitions, dimensions, performance, and initiatives”, *Journal of Urban Technology*, No 22(1), 2015; Anthopoulos, L. G., “Understanding the smart city domain: a literature review”, in *Transforming city governments for successful smart cities*, Springer International Publishing, 2015, pp. 9–21.

<sup>27</sup> Anderson, D. et al. “Getting to know GIMF: the simulation properties of the global integrated monetary and fiscal model”, IMF Working Paper No 13/55, International Monetary Fund, 2013.

fiscal situation. As the intention is to crowd-in private investment, it has a relatively limited fiscal component and a large multiplier effect.<sup>28</sup>

**Smart city investment can address the basic infrastructure gaps and unlock innovative potential.**

Smart city projects could therefore incorporate a *capacity function*, satisfying the basic infrastructure needs, and an *efficiency function*, making cities more conducive to innovation and growth. The *efficiency function* is therefore rooted in the broader urban development strategy, which reacts to the challenges and opportunities cities face. With the projected acceleration in urbanisation, smart solutions will be needed to ease the pressures from the increasing size of urban areas while improving the quality of life of urban inhabitants. In CESEE cities, urban productivity can be boosted by increasing the quality of human capital, business environment quality, entrepreneurship, quality of institutions, market access and access to capital as well as research and innovation. Smart solutions in cities that create opportunities, unlock growth potential and allow businesses to thrive and employ younger generations have the potential to retain young talent in the cities where upgrades are performed.<sup>29</sup>

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<sup>28</sup> Bom, P., and Ligthart, J., “What have we learned from three decades of research on the productivity of public capital?”, *Journal of Economic Surveys*, 2014; Anderson, D. *et al.*, “Getting to know GIMF: the simulation properties of the global integrated monetary and fiscal model”, IMF Working Paper No 13/55, International Monetary Fund, 2013.

<sup>29</sup> Nevertheless, this particular challenge might be difficult to address purely with investment without wide-ranging structural shifts.

## 2. The state of CESEE cities: survey results and economic indicators

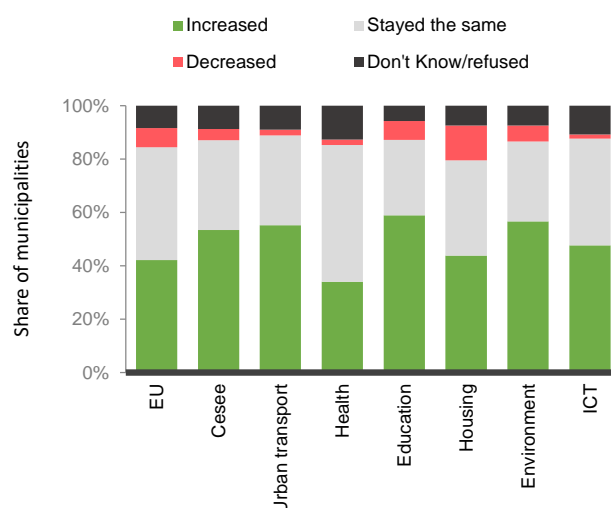
*In this section, we first document the local infrastructure gaps in CESEE municipalities revealed by the EIBIS. Next, we demonstrate with a selection of indicators the extent to which CESEE cities lag behind the EU in productivity and innovation. We show the ongoing and projected negative demographic trends in CESEE. Finally, we illustrate how economic convergence in the CESEE countries has mostly been driven by the capitals, creating a gap with the non-capital regions.*

### 2.1. Local investment gaps through the EIBIS lens

**In its 2017 Investment Survey, the EIB interviewed more than 550 municipalities across the EU to assess their investment activities, needs, constraints and financing.** In CESEE about 200 municipalities were interviewed. The survey provides a timely snapshot of municipality investment activities and provides a different angle on gauging the potential for smart city investment in CESEE.<sup>30</sup>

**Municipalities in the CESEE countries have increased their total infrastructure investment by more than the EU average over the last five years (Figure 1).** When asked about their investment activities over the last five years, CESEE municipalities saw no changes in health infrastructure, while most municipalities reported a decrease in housing infrastructure investment activity. Nevertheless, a particularly high investment activity was reported for urban transport, education and environment infrastructure.

**Figure 1 – Infrastructure investment activity by municipality over the last five years**



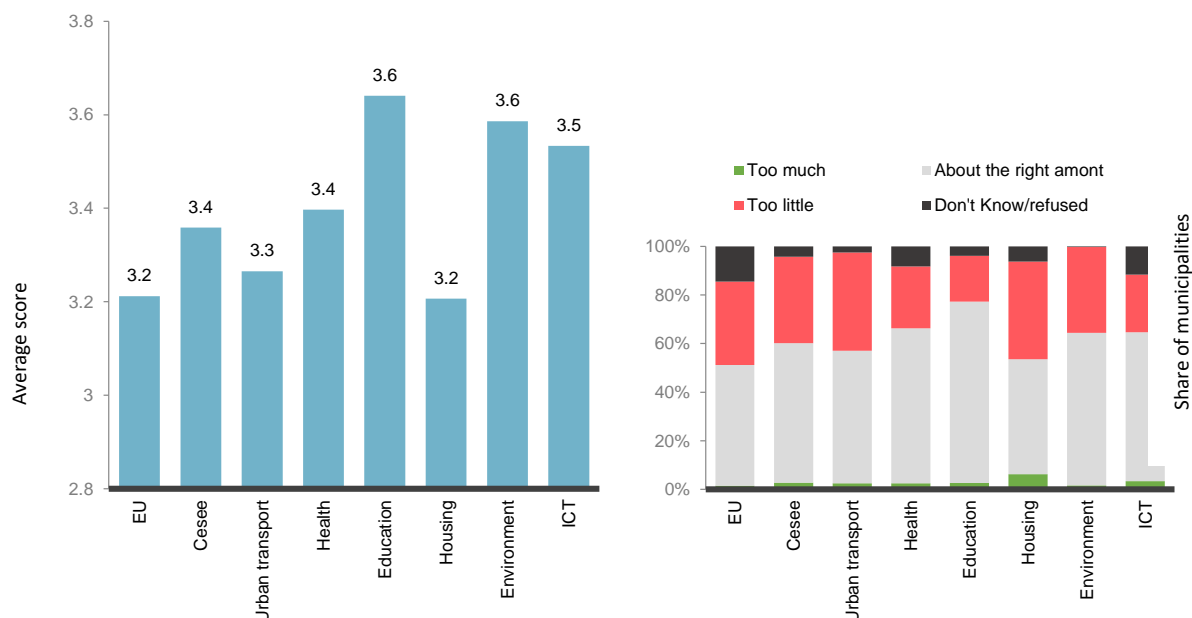
Q. If exclusively responsible for investment in this area: over the last five years has your investment spend in area increased, decreased or stayed around the same? If partially responsible: for each of the following areas, has the overall investment spend on infrastructure in your municipality increased, decreased or stayed around the same over the last five years?

**The overall quality of infrastructure in CESEE was assessed by the local municipalities to be slightly above the EU average (Figure 2).** The municipalities in the CESEE region see the largest bottlenecks in quality urban transport and housing infrastructure. These reported weaknesses in CESEE are commensurable with the EU average.

<sup>30</sup> European Investment Bank, "EIB Investment Survey 2017, Municipal Infrastructure", 2017.

**Almost half of CESEE municipalities report underinvestment over the last five years, similarly to the EU as a whole (Figure 2).** About 41% of municipalities in the CESEE region say that their past investment led to under provision of urban transport infrastructure, and 40% of municipalities say the same about housing infrastructure.

**Figure 2 – Reported infrastructure quality in municipality and perceived investment gap**



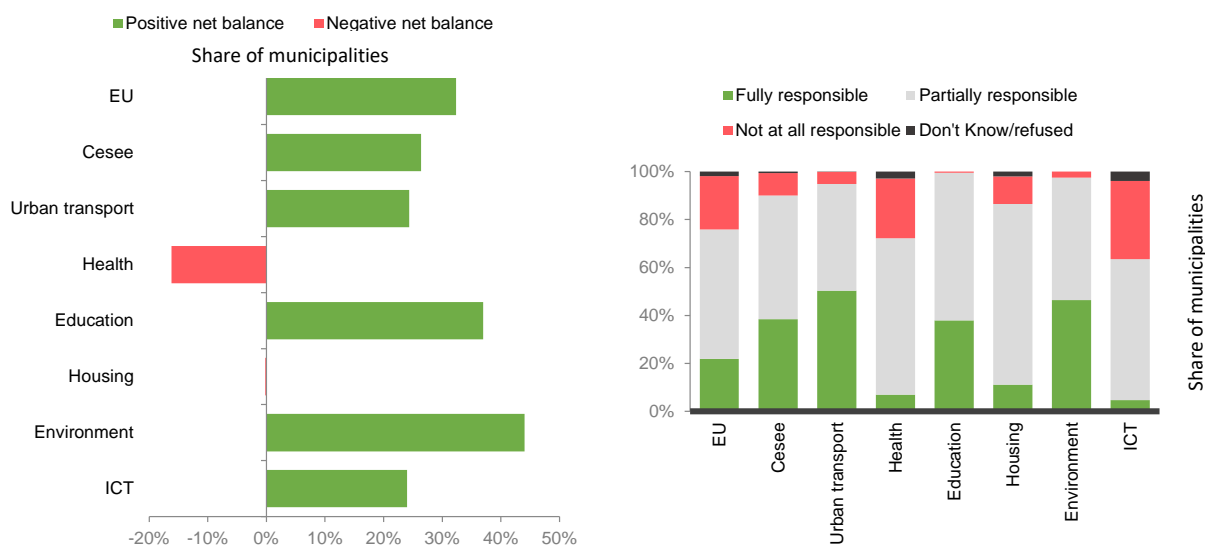
Q. How would you assess the quality of infrastructure each of these areas in your municipality on a scale of 1 to 5, where 1 means it is completely outdated and 5 means it is up to latest international standards?

Q. For each of the following, would you say that, overall, past investment in your municipality has ensured the right amount of infrastructure, or led to an under provision or over provision of infrastructure capacity?

**The municipalities in the CESEE countries are, on balance, not confident that the existing infrastructure gaps in health and housing will be closed over the next five years (Figure 3).** This is a striking difference to the EU as a whole, where, on balance, municipalities are confident that their current investment gaps will be closed in all areas.

**In comparison to the EU average, the CESEE region has a larger share of municipalities that are fully or partly responsible for overall infrastructure investment (Figure 3).** This largely mirrors the structure of their public finances. Zooming in, the CESEE municipalities lack full responsibility for health and housing infrastructure investment. As shown above, it is particularly for these two areas of infrastructure that the CESEE municipalities are not confident that the existing gaps will be closed over the next five years. In addition, housing is an area that in the CESEE region suffers from both a lower quality of infrastructure and underinvestment.

**Figure 3 – The gap can be closed within the next five years, and municipalities’ investment responsibilities**

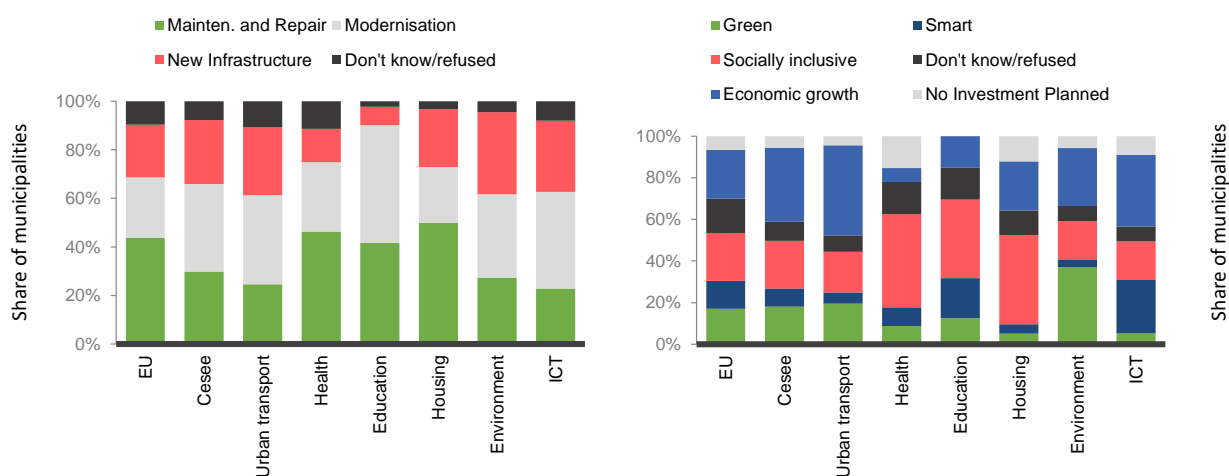


Q. How confident are you that the under provision/quality in area will be addressed in the next five years? (Net balance is the share of firms seeing a positive effect minus the share of firms seeing a negative effect.)

Q. Is your municipality fully responsible, partly responsible or not at all responsible for each area?

**Looking ahead, the CESEE municipalities’ investment plans are more focused on infrastructure modernisation than the EU average (Figure 4).** Overall, the municipalities in the CESEE countries are expecting to increase investment across all the focus areas, which includes launching new infrastructure projects and modernisation and as well as maintenance. This has implications for the quality of investment projects under preparation as well as for identifying optimal financing options. In comparison to the EU average, CESEE municipalities prioritise economic growth over smart investing in their policies for the next five years (Figure 4). “Smart” investment priorities are particularly visible in education and ICT infrastructure investment.

**Figure 4 – Municipality investment and municipality policy priorities (for the next five years)**



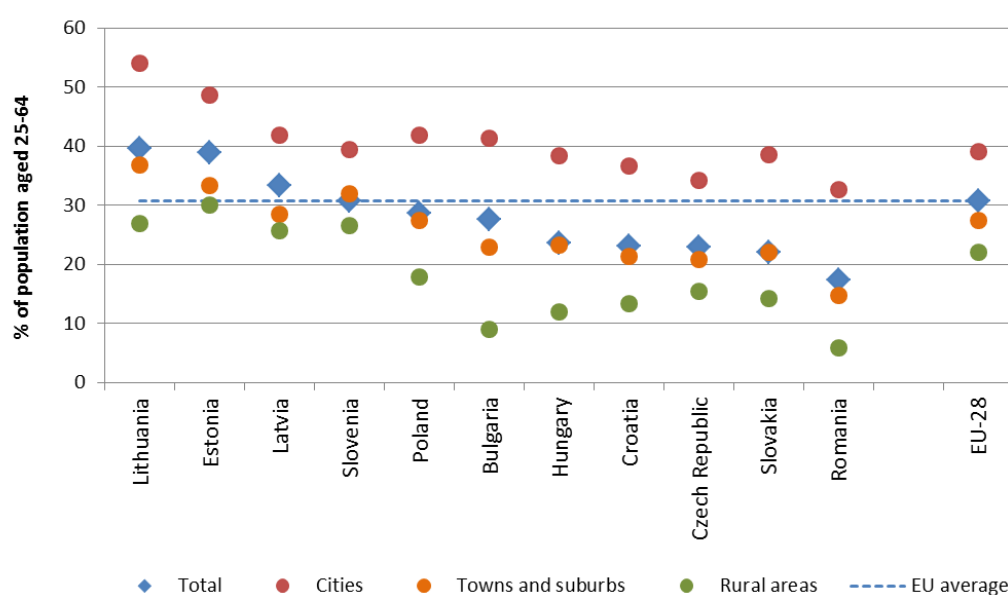
Q. Looking ahead to the next five years, will the largest share of your spend on infrastructure in each of these areas be for maintenance and repair, modernisation or the construction of new infrastructure?

Q. From the following, what would you say will be the main priority over the next five years?

## 2.2. Economic performance of CESEE versus EU cities

**Capitals are the main hubs of skilled labour and economic activity in CESEE.** In general, most advanced and high-value-added services and economic activities, as well as most tertiary education institutions, are based in cities. The supply of better paid jobs, and the availability of cultural amenities and services generates significant scale effects and explains why the quality of human capital in metropolitan cities is much higher than in other territories. Together with other urbanisation economies (larger market and population<sup>31</sup>) and agglomeration economies (e.g. better matching of labour supply and demand, specialisation and greater division of labour, sharing of inputs, amenities and suppliers, proximity and knowledge spillovers<sup>32</sup>) the human capital factor makes cities more competitive. In CESEE, the percentage of people with tertiary education living in cities is broadly aligned with the EU average. However, for both educational attainment (Figure 5) and productivity (Figure 6) our survey shows a huge gap between cities and rural areas. This is generally due to a concentration of economic activity in larger cities (mainly capitals) and a rather unbalanced urban hierarchy: most CESEE municipalities are much smaller than the OECD countries (30% of municipalities are above 20 000 inhabitants), especially in the Czech Republic (1%), Slovakia (2%) and Hungary (2%).<sup>33</sup>

**Figure 5 – Percentage of population aged 25–64 with tertiary education, 2016**



Source: Eurostat.

**Urban labour productivity is highly differentiated *within* the same country in the CESEE region.** As shown in Figures 6 and 7, CESEE capitals are the most productive metropolitan areas in their countries and host more high-growth firms, with significant gaps compared with smaller and second-tier cities, which are aligned to the country's average. On the one hand, this highlights the strong urban primacy in terms of localisation of higher value-added services and most productive firms, which typically is inter-linked with larger cities. It is also important to mention that part of the primacy of capital cities

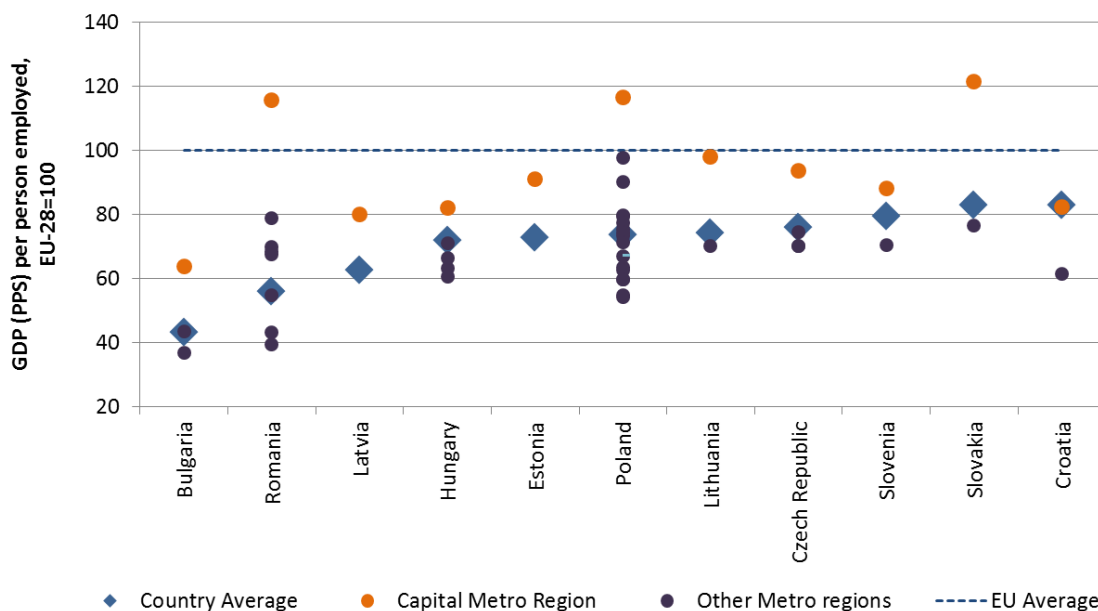
<sup>31</sup> According to OECD, by doubling the population in a city, productivity grows by 5%; see OECD, "Governing the city", 2015.

<sup>32</sup> Puga, D., "The magnitude and causes of agglomeration economies", *Journal of Regional Science* No 50(1), 2010, pp. 203–219.

<sup>33</sup> OECD, "Subnational governments in OECD countries, key data, 2016 edition", 2016.

might be driven by political-economic choices to concentrate public investment, favouring a larger accumulation of capital stock.<sup>34</sup>

Figure 6 – Productivity in CESEE metropolitan areas



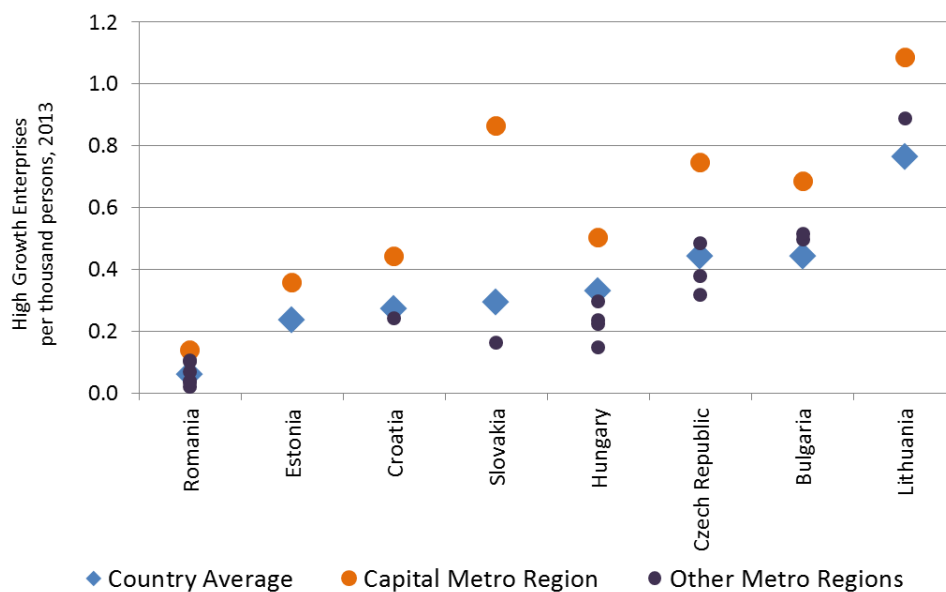
Source: European Commission.

**In CESEE, the per capita number of high-growth firms is much higher in capitals than in other metropolitan regions and in the country on average (Figure 7).** As also highlighted by the European Commission,<sup>35</sup> most CESEE capitals fare relatively well compared to their western EU peers in this indicator: the top three capitals in the EU are Vilnius, Bratislava and Prague, followed by Paris and Sofia. However, the gap between the capitals and other metropolitan regions is particularly large in CESEE, while the distribution is smoother in countries such as Germany, France and the Netherlands.

<sup>34</sup> Dijkstra, L., “Why investing more in the capital can lead to less growth”, *Cambridge Journal of Regions, Economy and Society*, No 6(2), 2013, pp. 251–268.

<sup>35</sup> European Commission, “The state of European cities 2016”.

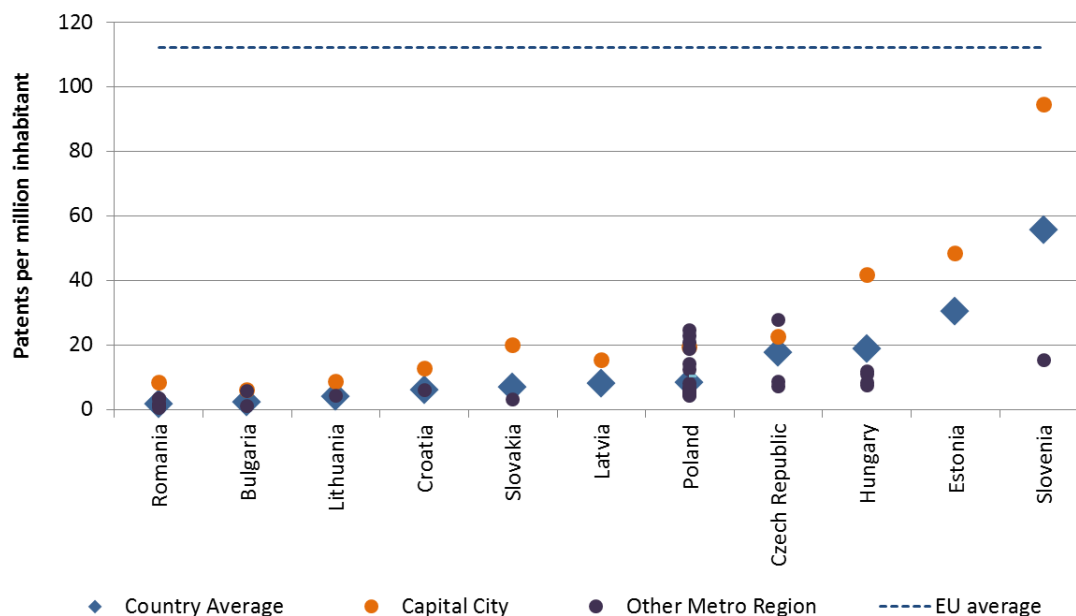
Figure 7 – High growth firms in CESEE cities



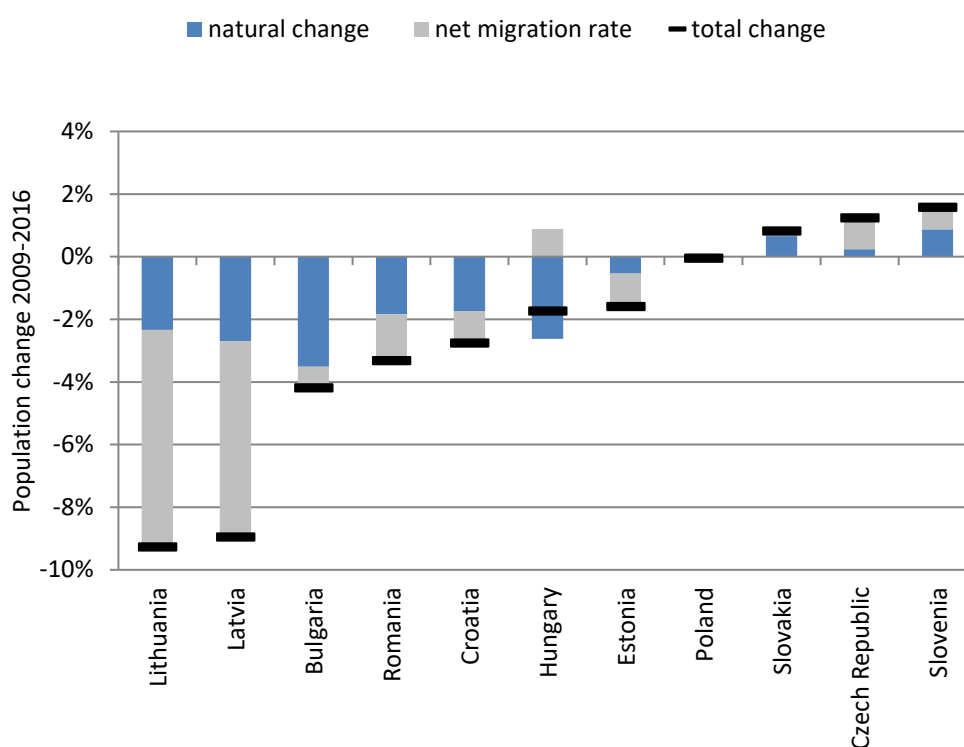
Source: Eurostat. No data for Poland, Latvia and Slovenia.

**CESEE capitals show a significant innovation gap with the EU average.** A very wide gap is observed when it comes to patents per capita between CESEE and the rest of the EU (Figure 8). As cities are ideal places for new ideas and the introduction of new products and processes, CESEE shows a large untapped innovation potential.

Figure 8 – Patents per capita in CESEE cities



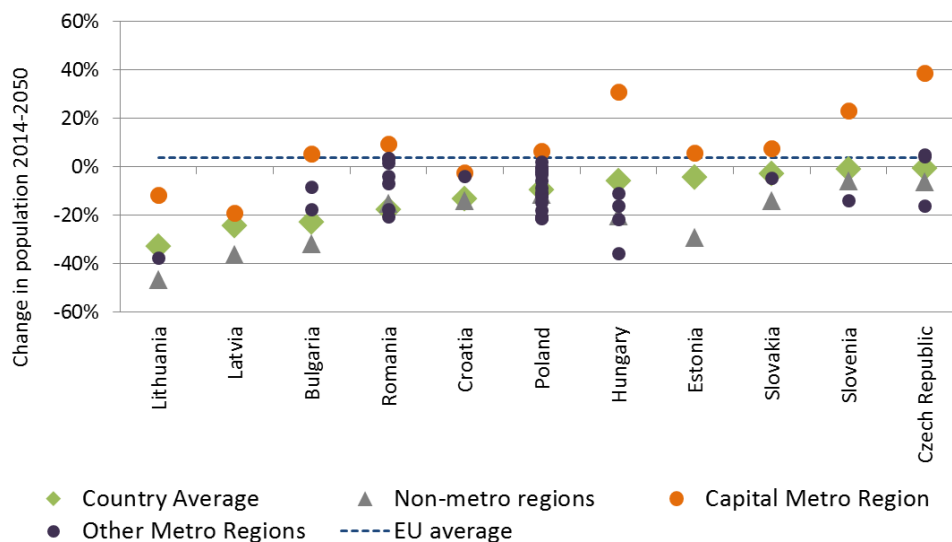
Source: Eurostat.

**Figure 9 – Demographic changes (2009–16) in CESEE**

Source: Eurostat.

**Population projections in CESEE are not favourable.** Specifically, the demographic trend between 2009 and 2016 was unfavourable for most countries in the region (Figure 9). In fact, both natural change and migration are behind this trend. Population has declined by more than 8% in Lithuania and Latvia and by 4% in Bulgaria. Most importantly, under the main scenario of Eurostat’s demographic model,<sup>36</sup> no country in the region is expected to register an increase in its total population over the next few decades (Figure 10). Furthermore, Bulgaria and Romania are expected to witness a significant decrease in their population on the back of lower fertility, ageing and emigration.

<sup>36</sup> See Eurostat.

**Figure 10 – Demographic projections (2014–50) by metropolitan areas**

Source: Eurostat.

The projections for CESEE cities show that capitals are expected to register relatively positive dynamics, while second-tier cities are expected to decrease in population (Figure 10). This scenario has multiple policy implications:

- second-tier cities can play a crucial role in retaining and attracting population by offering alternatives to congested (and therefore less productive than the optimal) capitals for studying, working and doing business;
- urbanisation economies (dependent on the size of the cities) will not strongly support the convergence of second-tier cities. Consequently, higher productivity and more innovation and knowledge sharing are required to support the economic catch-up of second-tier cities.

European countries have been converging in terms of GDP per capita over the last four decades, with countries having lower GDP growing faster than the richer ones.<sup>37</sup> In particular, CESEE countries have registered a robust trend of convergence towards the EU average income level.<sup>38</sup> Sub-national variation, however, is often overlooked. Taking into account NUTS-2<sup>39</sup> regions, since the mid-1990s differences in both output per capita and employment have decreased, with less developed areas registering a better performance than the more developed ones. However, this convergence was halted by the 2008 financial crisis, which affected mainly middle- and lower-income southern European regions.<sup>40</sup>

In CESEE, domestic disparities kept on increasing, with capital regions growing much faster than the rest of the country. In other words, fast growing capital regions were the key contributors to their national economies' catching up with the rest of the EU. At the same time, these good performances widened national gaps, with many regional economies being unable to support this convergence process. This is shown in Figure 11:<sup>41</sup> the non-capital regions with the lowest GDP per capita in 2000

<sup>37</sup> In this section, the concept of convergence is related to Beta-convergence. This is directly related to Solow's neo-classical growth theory, where a key assumption is that factors of production, in particular capital, are subject to diminishing return. With diminishing returns, the growth rate of poorer economies should be higher and their income per head levels should catch up with those of richer economies (see Monfort, P., "Convergence of EU regions, measure and evolution", DG Regio Working Paper, 01/2008).

<sup>38</sup> European Commission, "Seventh cohesion report", 2017.

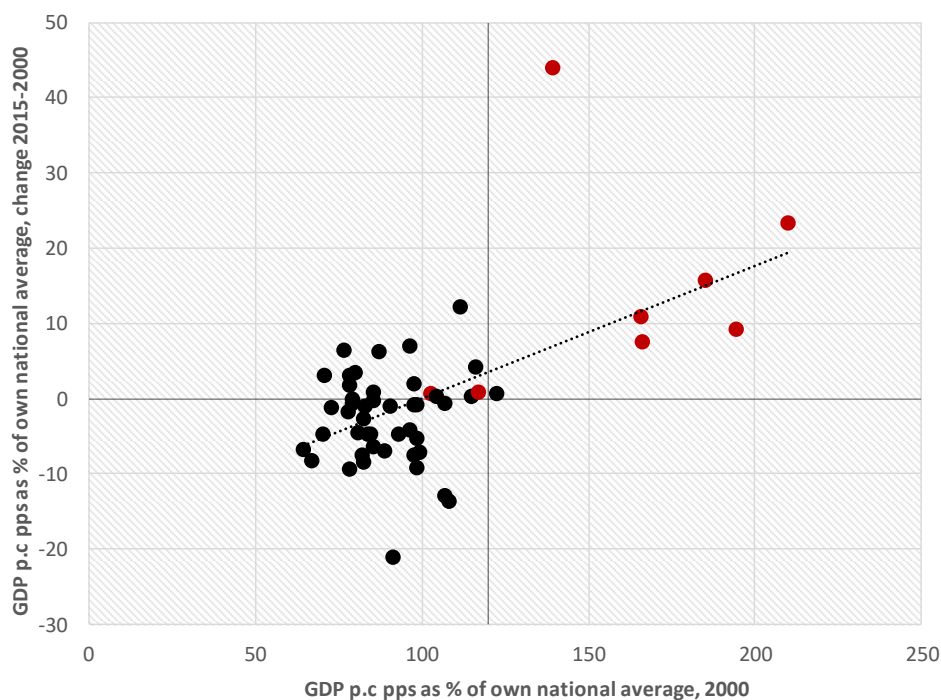
<sup>39</sup> Nomenclature of Territorial Units for Statistics

<sup>40</sup> European Commission, "Sixth report on economic, territorial and social cohesion", July 2014.

<sup>41</sup> Alcidi, C. et al., "Income convergence in the EU: within-country regional patterns", CEPS Commentary, February 2018.

in CESEE countries were those registering the lowest GDP growth over the period 2000–15. The capitals registered a significant growth gap with the rest of the country. Similar patterns are also observed by considering a more recent timeframe (e.g. after the full deployment of European Structural and Investment Funds following EU membership or after the global economic and financial crisis).

**Figure 11 – Beta convergence within countries: CESEE**



Source: Alcidi et al. (2018).

(Estonia, Lithuania, Latvia and are not in the graph because they are composed of only one NUTS-2 region).

Red dots: Capital region (NUTS-2). Blue dots: Other (NUTS-2) regions.

### 3. Smart Region Index: assessing the smartness of CESEE regions

*After looking at the gaps between the CESEE and EU cities from the perspective of the EIBIS for selected economic performance indicators, demographics and convergence, this section introduces a Smart Region Index that allows us to identify gaps between CESEE regions and the EU for our six main pillars of “smartness”.*

#### 3.1. Elements of smartness related to the wealth of cities

**Urban wealth is positively related to various elements of the “smartness” footprint in a city’s life and development.** The following scatter plots illustrate these relationships, without making any reference to causation. The figures below show the association between variables that approximate various elements of the “smart city” concept and the level of urban wealth as approximated by cities’ GDP per capita in purchasing power standards (PPS) terms.<sup>42</sup> These results also substantiate the view that the smart city is an overarching concept formed of an array of mutually reinforcing factors.

**A positive link between smart society and quality of living is crucial for urban wealth (Figures 12 and 13).** This supports the view that investing in smart forms of education (e.g. lifelong learning using new technologies) can lead to a more skilled labour force, better equipped to serve the evolving business needs of local companies. Creating a new university or strengthening an existing one is not enough: the presence of a leading research university in cities is not a necessary condition for innovation.<sup>43</sup> Other related factors that create an economic environment conducive to growth and innovation (a regional “knowledge-creation infrastructure”<sup>44</sup>), for example, the region’s ability to absorb a university’s spillover effects, are equally important. This is an encouraging finding for second-tier CESEE cities without a leading university. This result also touches not only on the concept of “creative class” in urban economics literature,<sup>45</sup> in which creative professions drive the innovation in cities, but also a related argument, that cultural amenities in cities (theatres, cinemas, etc.) attract creative minds.

**Business innovation and sophistication in cities is positively associated with urban wealth (Figures 14 and 15).** An approximation of the smart economy attributes of “smart cities” illustrates the view that support for innovative and entrepreneurial activity could be rewarded by higher economic growth and wealth. In addition, if a city can host and support the development of a few highly innovative firms, this can support further entrepreneurial generation in the region.<sup>46</sup>

**Smart mobility as approximated by local and long-distance accessibility has a positive impact on urban wealth (Figures 16 and 17).** The ease with which various activities in cities can be reached (work, school, entertainment), and more generally, better transportation capacity, is in line with the “new economic geography” literature<sup>47</sup> and conducive to economic growth and urban wealth.

<sup>42</sup> Caragliu, A. et al., “Smart cities in Europe”, *Journal of Urban Technology*, No 18, 2011.

<sup>43</sup> Mayer, H., *Entrepreneurship and innovation in second tier regions*, Edward Elgar, 2011.

<sup>44</sup> Mayer, H., *Entrepreneurship and innovation in second tier regions*, Edward Elgar, 2011.

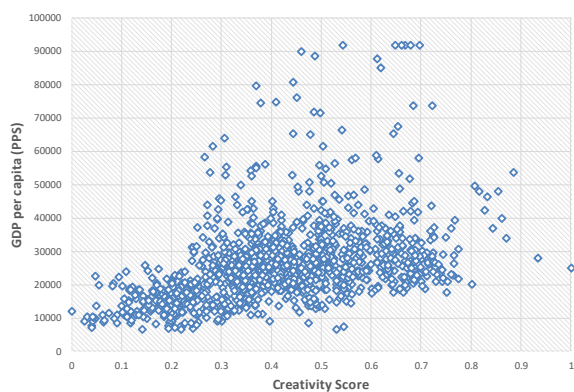
<sup>45</sup> Shapiro, J., “Smart cities: quality of life, productivity, and the growth effects of human capital”, NBER Working Paper 11645, September 2005.

<sup>46</sup> Mayer, H., “Firm building and entrepreneurship in second-tier high-tech regions”, *European Planning Studies*, 2013.

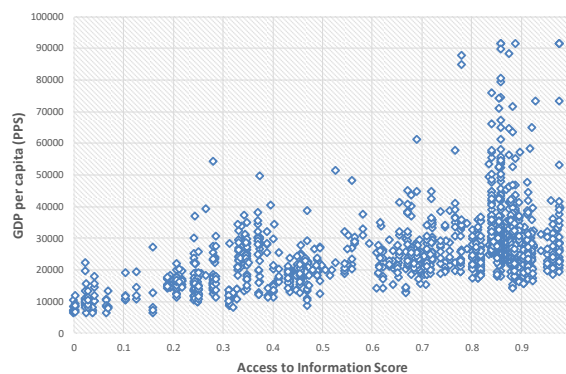
<sup>47</sup> Krugman, P. “The new economic geography, now middle-aged”, *Regional Studies*, 2011.

**Quality of environment and health and wellness variables are associated with greater urban wealth (Figures 18 and 19).** Quality of environment and quality of life are important elements of cities, making the case for investing in smart social infrastructure (e.g. health care), environmental amenities and energy efficiency.

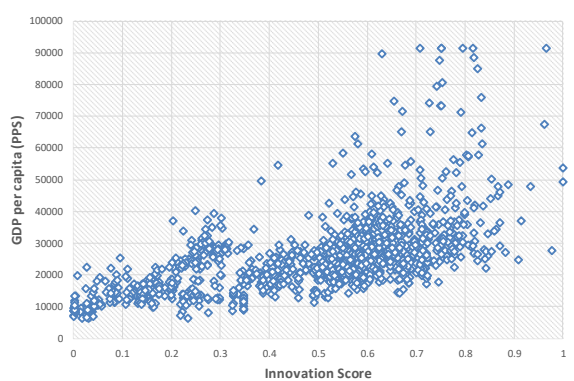
**Figure 12 – Creativity<sup>48</sup>**



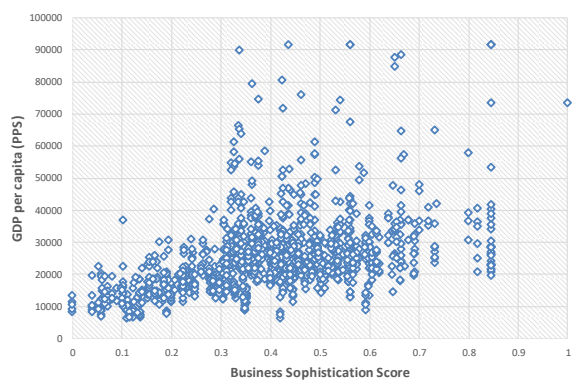
**Figure 13 – Access to information**



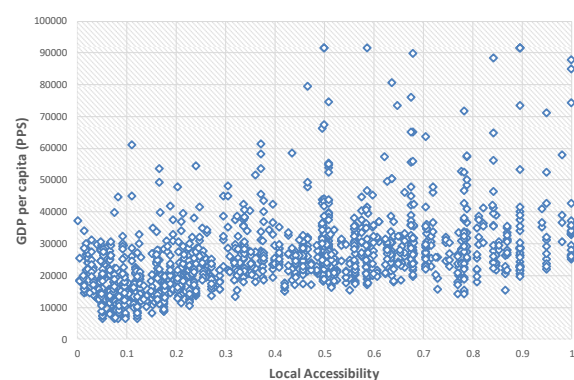
**Figure 14 – Innovation**



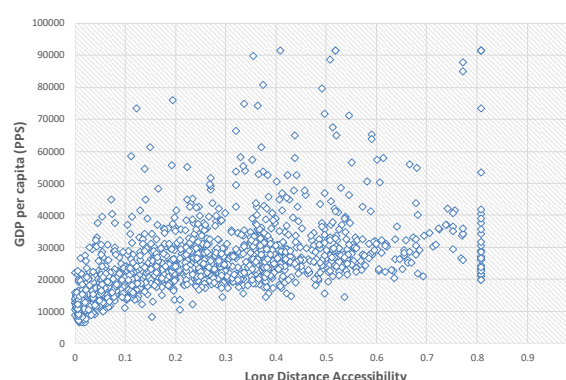
**Figure 15 – Business sophistication**



**Figure 16 – Local accessibility**



**Figure 17 – Long distance accessibility**



<sup>48</sup> These charts are based on the sub-pillars of the smartness indicator; see the next section and appendix for methodological details.

Figure 18 – Health and wellness

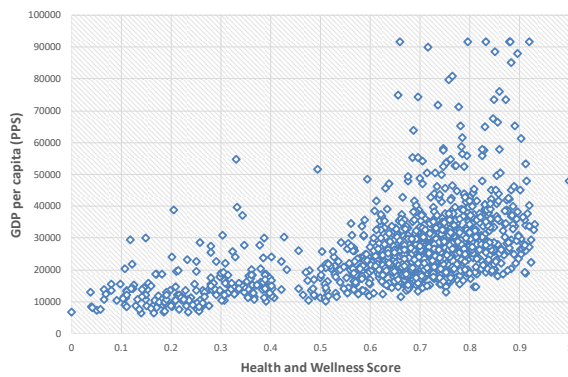
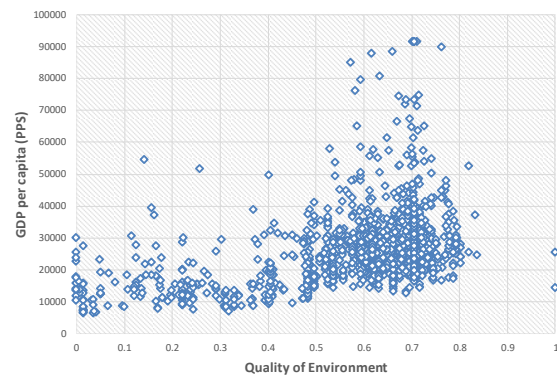


Figure 19 – Quality of environment



Source: Eurostat, authors' calculations.

### 3.2. Assessing smart regions: a framework to assess the regions' smartness

#### 3.2.1. Defining smart regions

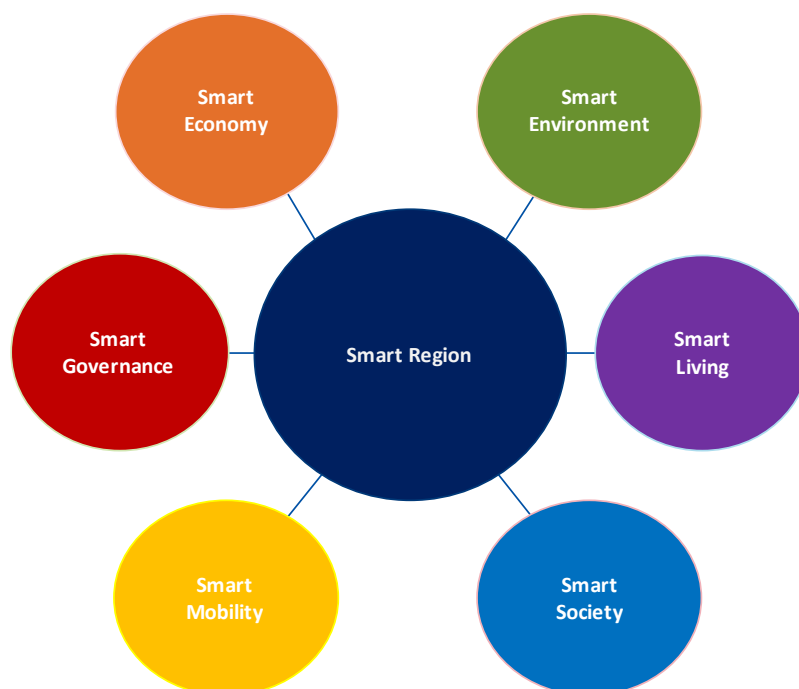
**One of the aims of this report is to assess the “smartness footprint” of European cities and territories consistently and transparently.** Due to the lack of complete coverage for the EU urban data, we focused on NUTS-3 regions as unit of analysis (where we managed to get full coverage for the EU) and we tried to capture smartness dynamics through indicators that reflect typical urban phenomena. This exercise should identify potential development gaps in several regions of interest, as well as the underlining factors and indicators that cause these gaps to emerge. Although the particular exercise was to concentrate on regions (238 in total) in CESEE countries, the procedure required the production of “smart” rankings for 1337 regions in 28 EU Member States.

**Although the conceptual framework of a smart territory (city or region) is often understood as a single quality, a more structured definition requires us to examine alternative characteristics.** This would allow us to understand the factors behind the ability of some regions to achieve high levels of “smartness”, and to provide potential policy conclusions. As a result, the concept of “smart” was divided into six pillars<sup>49</sup>: Smart Economy, Smart Governance, Smart Mobility, Smart Society, Smart Living and Smart Environment (Figure 20). Smart Economy comprises variables affecting competitiveness, for instance, innovation performance, degree of entrepreneurship, trademark applications and technological utilisation by firms. Smart Environment is defined by six variables explaining clean environmental procedures, the amount of pollution and environmental resource management. The Governance pillar includes indicators explaining the quality of services and the strength of regulations and administration procedures. Smart Living captures the fundamental aspects of quality of life such as Internet use, cultural factors, health conditions and the level of safety in a region. Additionally, when it comes to the variables that define Smart Mobility, both local and international accessibility factors were taken into consideration. Finally, the Society pillar includes

<sup>49</sup> A similar definition was given in “Smart cities: ranking of European medium sized cities”, Centre of Regional Science, Vienna University of Technology, October 2007.

variables explaining the citizens' level of education, creativity and the quality of employment in the region.

**Figure 20 – The conceptual framework of the Smart Region Index**



*Source: authors.*

**One important point is that each pillar captures multi-sectoral and complex phenomena.** To enhance the definition of each pillar, eleven sub-pillars were created, composed of diverse indicators and variables (Table 1). Furthermore, this step is important in reducing the bias within the pillars caused by not linking similar variables into sub-categories and therefore in producing consistent results. Specifically, the Economy pillar comprises the business sophistication and innovation sub-pillars. Smart Environment is also divided into two sub-pillars: efficiency of environmental management and the quality of the environment. The Governance pillar is defined by the sub-pillars for local institutions and for regulation and doing business. Smart Living involves three sub-pillars: health and wellness, access to information and personal safety. The Mobility pillar is characterised by the degree of local accessibility and long-distance accessibility. Finally, Smart Society is defined by three sub-pillars: quality of primary education, labour market efficiency and creativity.

**The variables used for the construction of the pillars and sub-pillars were identified as key drivers for the “smart” development of cities and regions in the existing literature.** Therefore, regions are defined as being smart if they perform well when it comes to the efficiency and innovation of their economy, quality of life, environmental performance and management, the quality of institutions and the governance framework, as well as their quality of transport, education and the labour market.<sup>50</sup>

<sup>50</sup> For the full list of variables included in the sub-pillars see Table 2.

**Table 1 – Characterising the smart pillars**

Sub-Pillars	Pillars
BUSINESS SOPHISTICATION INNOVATION	SMART ECONOMY
EFFICIENCY OF ENVIRONMENTAL MANAGEMENT QUALITY OF ENVIRONMENT	SMART ENVIRONMENT
LOCAL INSTITUTIONS REGULATION AND DOING BUSINESS	SMART GOVERNANCE
HEALTH AND WELLNESS ACCESS TO INFORMATION PERSONAL SAFETY	SMART LIVING
LOCAL ACCESSIBILITY LONG DISTANCE ACCESSIBILITY	SMART MOBILITY
QUALITY OF PRIMARY EDUCATION LABOUR MARKET EFFICIENCY CREATIVITY	SMART SOCIETY

### 3.2.2. Data sources and geographical coverage

**The final selection of indicators involved a total of 51 variables reflecting smartness dynamics in an urban context.** These indicators are all publicly available and based on regional (NUTS-3 and NUTS-2) and national data. The use of national data was needed to capture relevant information for urban and regional development. The data used was that most recently published from different sources, but because recent information for some variables was not available, older data was included. Therefore, the final selection ranges between 2011 and 2016. However, the structural nature of the oldest data in the sample provides sufficient confidence for its inclusion.

**Although the data considered in this exercise involves a sample of regions instead of cities, we emphasise that regional data is significantly richer than urban data.** One aspect of this data set involves the matching of variables having different geographical levels to avoid losing significant information. For instance, in cases where NUTS-3 information was missing, gaps were filled by the information at NUTS-2 level. Since all NUTS-3 regions are within a NUTS-2 region, by using the data of the upper layer (NUTS-2), we achieved full EU coverage, and no relevant information for a specific region was omitted. As a result, the data covers 1337 NUTS-3 regions in 28 EU Member States, out of which 238 regions are in the CESEE region.

The data sources include:<sup>51</sup> the Quality of Government Institute; World Bank Worldwide Governance and Doing Business indicators; the World Economic Forum; Eurostat; Spiekermann and Wegener (2016)<sup>52</sup>; the OECD Programme for International Student Assessment (PISA); Science-Metrix based on Scopus data; the UN E-Government Knowledge Database.

<sup>51</sup> See data table in the appendix.

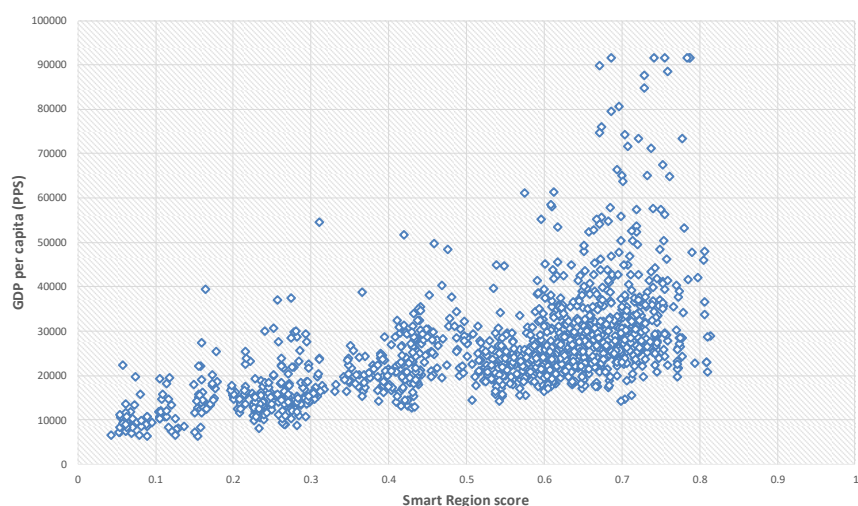
<sup>52</sup> Spiekermann, K., Wegener, M., "Spatial Scenarios for Europe 2050", *the ESPON Project ET2050*, 2016.

### 3.2.3. Variable selection and relation of the Smart Region Index with GDP

Certain criteria and statistical exercises were performed to filter the most important variables to be used and avoid any inter- and intra-dependencies between the variables, sub-pillars and pillars. In terms of their relevance, the variables were chosen based on current literature on regional development. To obtain the highest quality data, this was filtered according to coverage and time dimensions. Moreover, correlation matrices were constructed to verify the internal consistency within each sub-pillar and confirm the mathematical design of the exercise. Variables that were weakly correlated with the composite indicator were excluded from the framework.<sup>53</sup> The correlation between the final index and pillars was high and positive. Sub-pillars were positively correlated to each other, but only weakly. Also, variables included in each sub-pillar capture similar characteristics, an aspect confirmed by the high correlation between the variables within the same sub-pillars. The sign of the impact of each variable for each indicator was decided based on a prior expectation about the effect of the specific variable on the smartness of a region.

Figure 21 shows that smarter regions have a higher GDP per capita.<sup>54</sup> The Smart Region Index score has a strong and positive relationship with GDP per capita in PPS terms, although this indicator is not directly included in the index. It is important to note that a positive relationship was observed for all the pillars. Many regions show marginal improvement in their smartness levels given their GDP level, while others show that high smartness is not translated into economic output. Therefore, the Smart Region Index can be used to help regions assess which aspects of smartness are the strongest, and can thus be translated into development, and which ones need improvement.

Figure 21 – Smart region score and GDP per capita in PPS terms



Source: authors' calculations.

<sup>53</sup> Booyen, F., "An overview and evaluation of composite indices of development", *Social Indicators Research*, 2002.

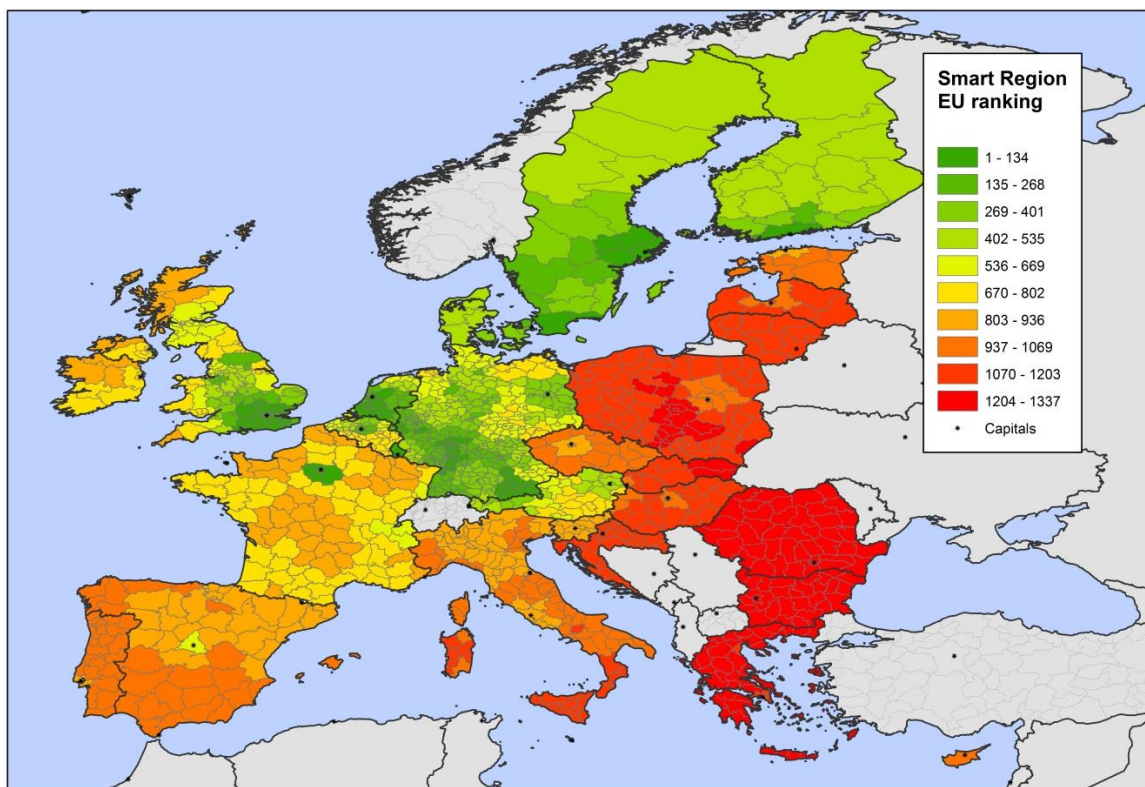
<sup>54</sup> GDP per capita was capped at the outlier value.

### 3.3. Assessment of territorial smartness in the EU and CESEE

The Smart Region Index shows a significant divide in the smartness footprint for Europe. The smartest regions are generally in the UK, Germany, the Netherlands and the Nordic countries. Southern European, Irish and French regions are mostly in the mid-range of the ranking. In many countries, not just in CESEE, the smartest region is the capital (e.g. Madrid, Paris-Île de France, London metropolitan area). Significant intra-national disparities are evident in Germany, the UK and Belgium. CESEE and Greek regions perform poorly overall: only a few regions in this group, mainly capitals (but in the case of Slovenia, also non-capital ones), rank above 900 out of 1337.

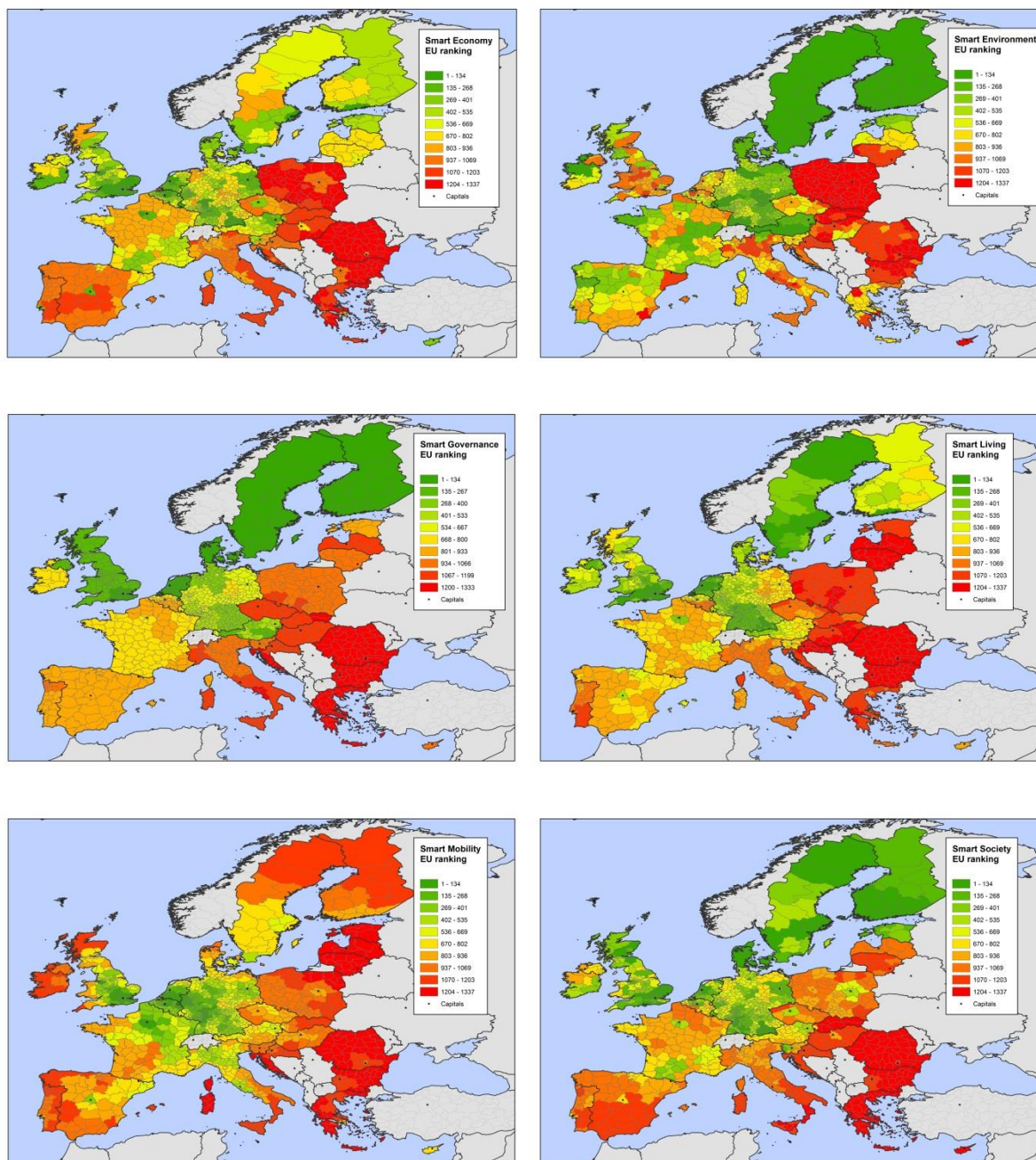
Regions in the UK dominate the top performing regions. Specifically, London and its commuting zone is ranked at the top of the final rankings, while Buckinghamshire and Oxfordshire also perform exceptionally in the overall smartness score. However, when looking at the individual pillars, most regions in the UK do not perform well when it comes to environmental aspects, particularly the efficiency of environmental management. The Dutch region of Utrecht is another top performer in the sample, but also faces environmental issues. On the other hand, the Stockholm region is one of the best performers in Smart Environment and overall one of the smartest regions, but it faces several challenges when it comes to Smart Mobility. The latter is also an area which requires improvement for the Helsinki region. Finally, German regions score relatively well overall but report average performance when it comes to environmental and governance. Paris and Luxembourg also achieve a good score overall. However, Paris shows weaknesses in the environmental and governance pillars, and Luxembourg in governance and mobility.

Map 1 – Smart region ranking (EU-28 NUTS-3 regions)



Source: Authors' calculations.

Maps 2-7 – Smart regions pillars (EU ranking)



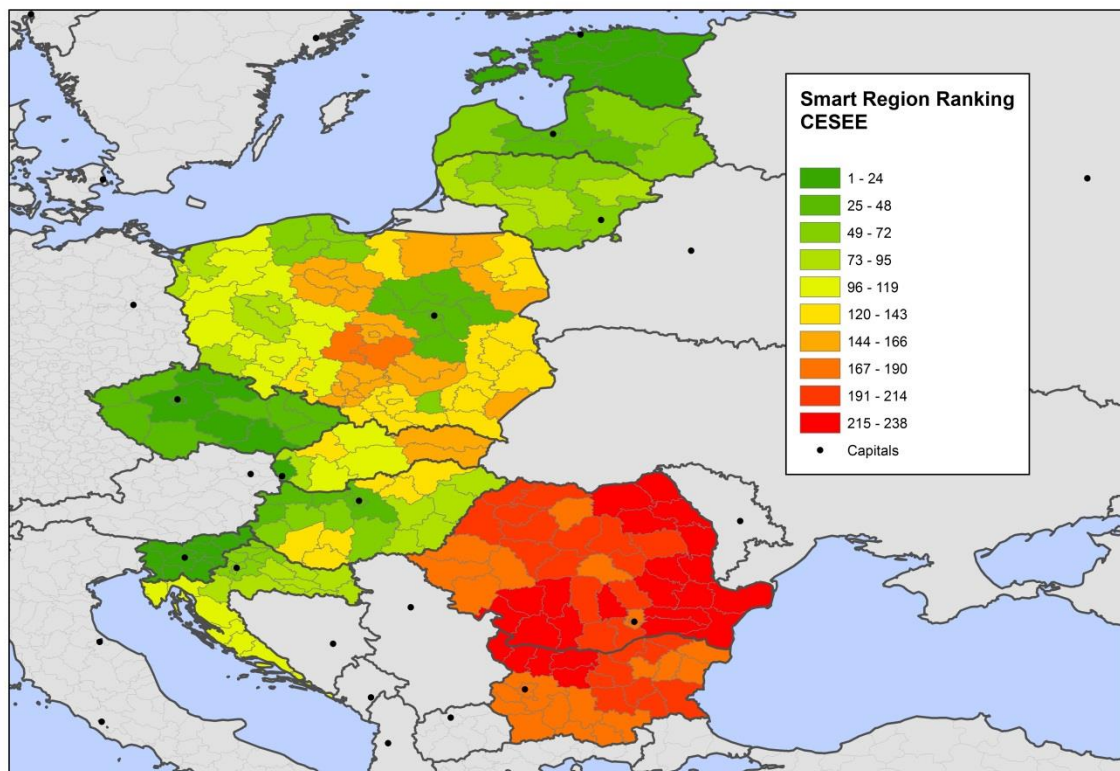
Source: Authors' calculations.

While the performance of CESEE cities overall is low, the picture is slightly different in each pillar. In the Economy and Society pillars, some CESEE capital regions perform better than most Western Europe regions. In Smart Mobility the performance of European regions seems to follow a strong centre–periphery pattern, with poor performance in the Nordic countries. However, a large gap is registered in governance and living pillars in CESEE.

In the CESEE region, as shown on Map 8, the regions registering the highest smart scores are in Slovenia, the Czech Republic and Estonia, while the capital regions of Slovakia and Hungary are in the top 30 of the smartest regions, significantly outperforming other regions in their respective countries. Regions of Bulgaria and Romania register a significantly lower performance: the bottom 70 CESEE

regions are all located in these two countries. Large differences in ranking are evident within Slovakia, Poland, Hungary and Croatia.

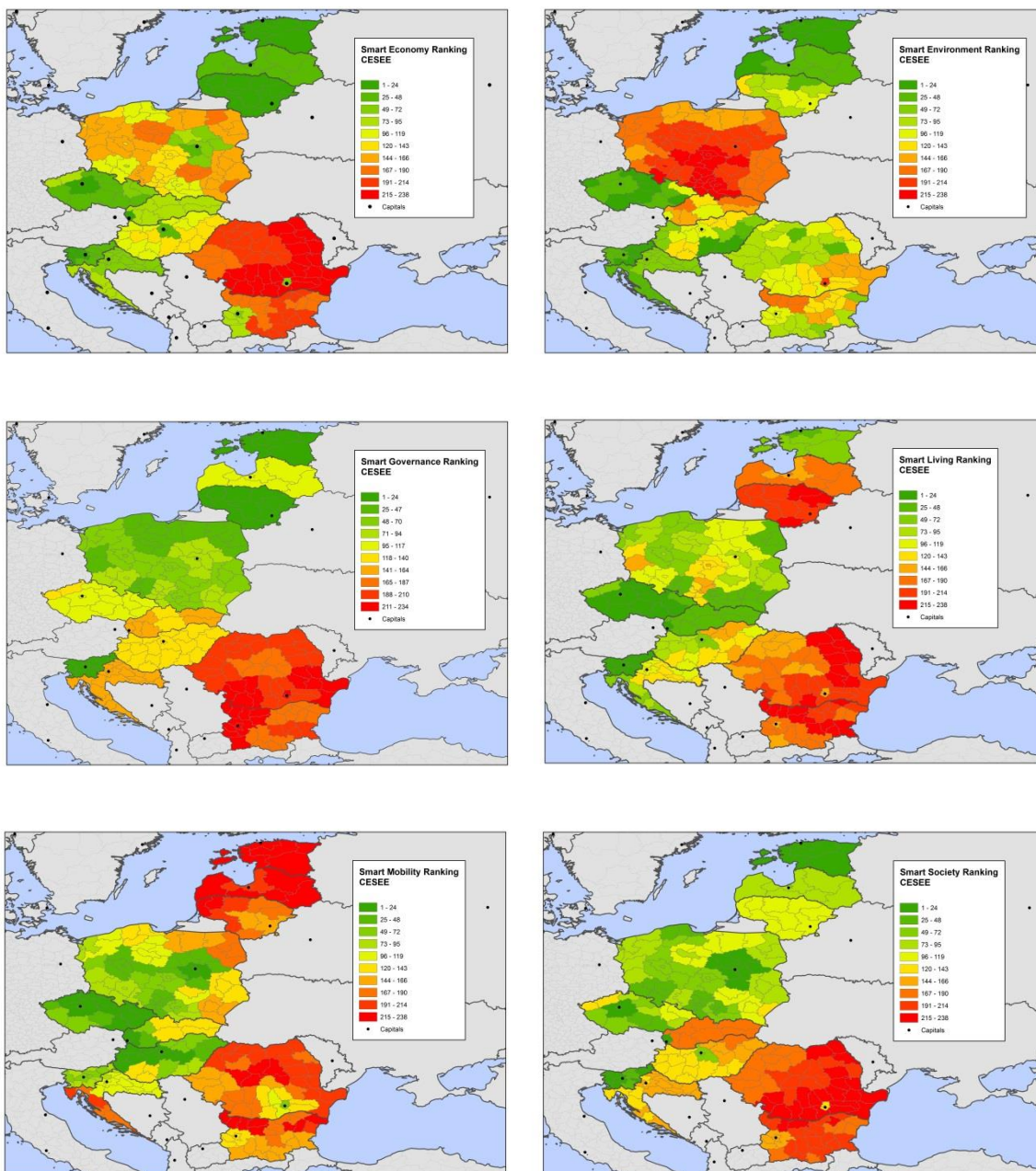
**Map 8 – Smart region ranking (CESEE, NUTS-3 regions, ranking within CESEE)**



Source: Authors' calculations.

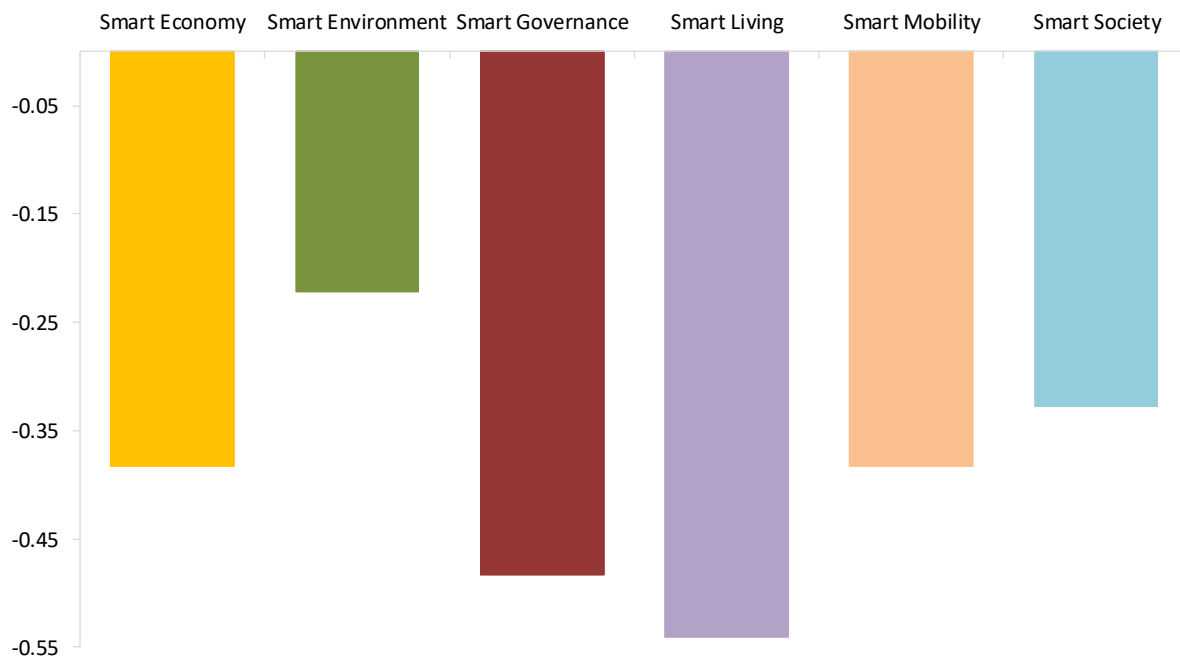
**Looking at the pillars underpinning the final CESEE ranking, it is evident that regional performance is highly diversified across the different countries.** In the Economy pillar, most of the CESEE capitals emerge as the best ranking regions in their countries, with a polarized pattern that mimics the concentration of economic activity in CESEE. In Smart Environment pillar, the performance of Polish regions is particularly low compared with the overall ranking. On the other hand, many Bulgarian and Romanian regions (except for Bucharest) perform relatively well. In the governance pillar, regions of the Czech Republic and Latvia score relatively poorly compared with their performance in other pillars. The opposite is true for Poland and Lithuania. In Smart Living, the best performing regions are in the Czech Republic, Slovenia and Slovakia. Poland registers a large internal divide, while Lithuania and Latvia score particularly poorly. The performance of the Baltic States is also low in Smart Mobility: this is the only pillar in which Slovenian regions are not among the best performers in CESEE. In Romania, the regions comprising the metropolitan area of the capital perform much better than the rest of the country. This is also the case in Poland, which again registers internal disparities. In the Society pillar, a strong capital bias is evident in most countries, while the best overall performing regions are in Estonia and Slovenia.

Maps 9–14 – Smart regions pillars (CESEE region)



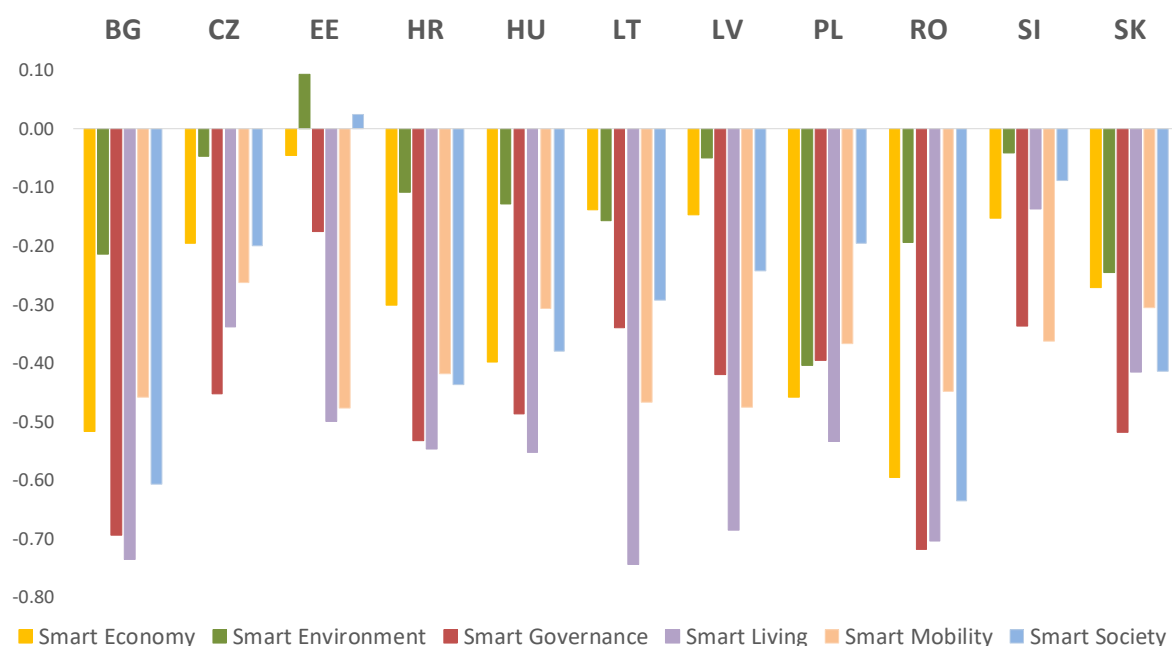
Source: Authors' calculations.

As mentioned earlier, CESEE countries show significant gaps with the rest of the EU in most pillars related to smartness. Aggregating the common strengths and weaknesses of the CESEE region, the figures below show the GDP-per-capita PPS-weighted smartness gap between the CESEE countries and the EU-28, for all six smartness pillars. The CESEE regions lag the rest of the EU in all areas. Nevertheless, the gaps are largest in Smart Living, Smart Governance, Smart Economy and Smart Mobility. This result, which is in line with the findings of the EIBIS, gives a clear indication of the policy prioritization for potential action in these areas.

**Figure 22 – CESEE overall smartness gap versus the EU (weighted by GDP per capita PPS)**

Source: Authors' calculations.

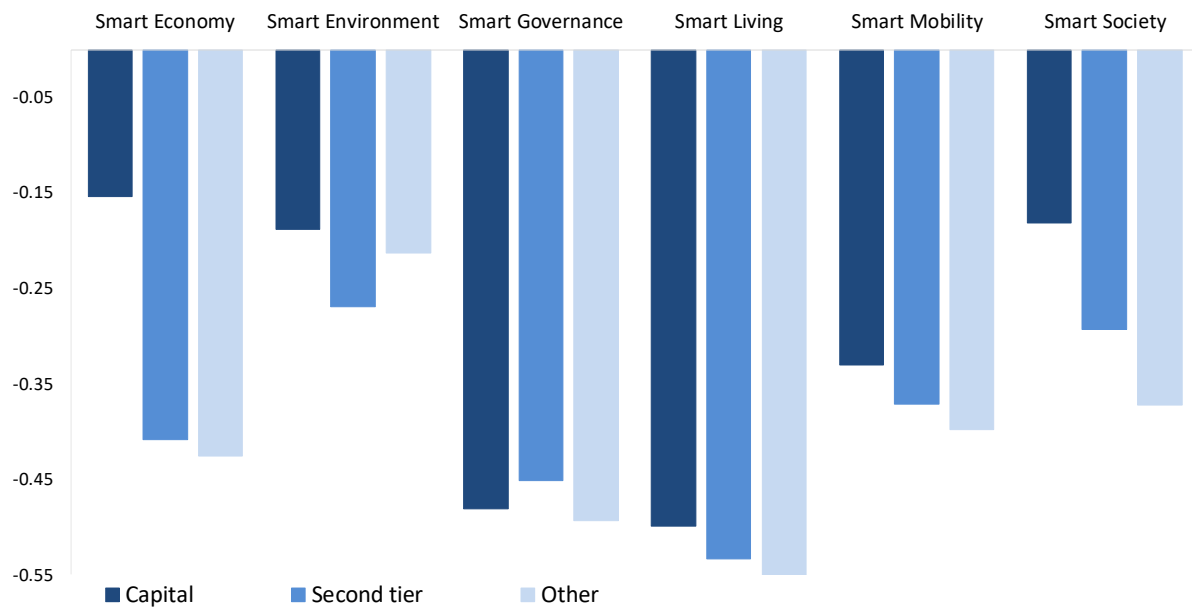
**Figure 23 shows the country decomposition of the CESEE smartness gaps versus those in the EU as a whole.** Not all CESEE countries register negative or substantially negative smartness gaps versus the EU. For example, Estonia performs better on average relative to the EU in the pillars of Smart Environment and Smart Society, while the gap in the pillar of Smart Economy is comparatively very small. Also, the Smart Economy gaps with the EU are relatively smaller in the Czech Republic, Slovenia, Latvia and Lithuania; the Smart Environment gaps are very small in Slovenia and Latvia; Smart Society gaps are small in the Czech Republic and Slovenia. On the other hand, Smart Governance, Smart Living and, to some extent, Smart Society are pillars with the largest gaps in most countries in CESEE. The largest smartness gaps versus the EU are recorded in Romania and Bulgaria across most of the smartness pillars.

**Figure 23 – CESEE country-by-country smartness gap versus the EU (weighted by GDP per capita in PPS)**

Source: Authors' calculations.

**The CESEE capitals perform better overall than other territories in their own countries**, including the second-tier cities and other regions, mimicking the gap observed in the economic indicators shown in Section 2.2. This confirms the significant regional economic disparities within CESEE countries and the need to focus on both the capital cities and second-tier cities. Figure 24 shows clearly that most of the gaps in the Smart Economy and Smart Society in the overall CESEE region occur in second-tier cities and in cities other than the capital and those in the second tier. On the other hand, the gap in Smart Governance and Smart Living is equally large across all cities in CESEE countries, including the capitals. More precisely, in Smart Governance, the CESEE capitals score even worse than the second-tier cities. CESEE capitals also do not score highly compared with second-tier cities in areas reflecting quality of life, environment, low congestion and mobility. This once again reinforces the case for investment in second-tier cities to ease agglomeration costs and congestion in capitals.

**Figure 24 – CESEE smartness gap: capitals, second-tier cities and the rest (weighted by GDP per capita PPS)**



Source: Authors' calculations.

**While this appears to be a general trend, it is not the case for some Western European countries with smoother urban and regional hierarchy.** As gaps between capital and non-capital regions in some Western Europe are smaller, firms and people have a wide choice of potential and optimal location within the same country. If being situated in the capital is not a necessity, a firm can locate in a second-tier city that has the same quality and availability of services and quality of life for its employees, but also enjoy less congestion and lower costs. Firms and people do not need to move to capitals to enjoy access to technology, health care or a vibrant cultural life. Such a structure is not detrimental to growth, as it also decreases agglomeration costs for the capital and increases diversification in the economy.

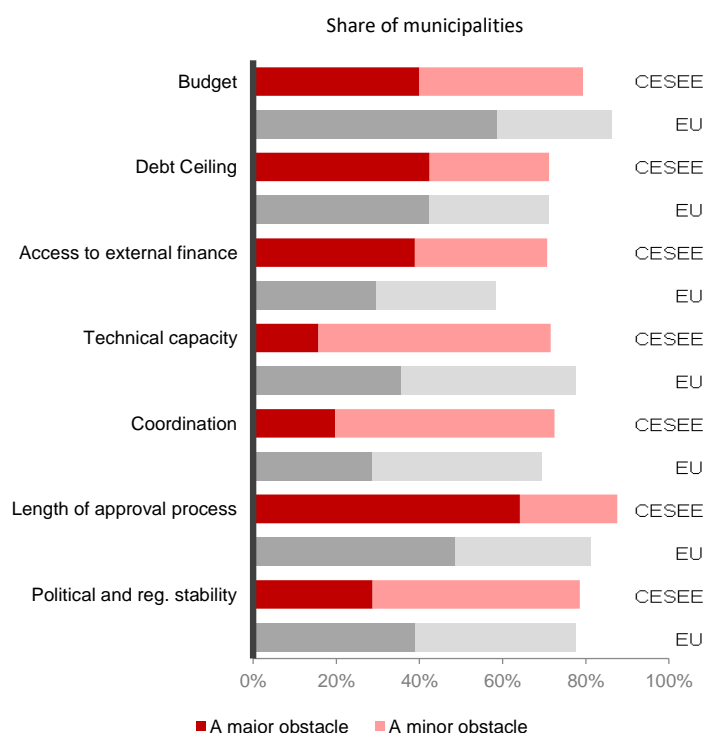
## 4. Obstacles and financing of municipal investment

Identifying and addressing the barriers to municipal investment and weaknesses in the municipal investment planning process needs to go hand in hand with identifying investment opportunities. This section uses the results of the EIBIS to show obstacles to CESEE municipalities' infrastructure investment, any planning and coordination bottlenecks as well as their sources of finance. Next, we assess the health of local fiscal balances in CESEE as well as the use of EU funds in financing regional development.

### 4.1. The EIBIS perspective on investment obstacles, planning and financing

A reduced budget and the length of the approval process are the main investment obstacles for about 80% of CESEE municipalities (Figure 25). This creates scope for improved and targeted advisory services in the region. There are more complaints about access to finance as an obstacle to investment by CESEE municipalities compared with the EU average. Technical capacity is also an investment obstacle for EU municipalities overall, and the CESEE region is no exception.

Figure 25 – Obstacles to infrastructure investment

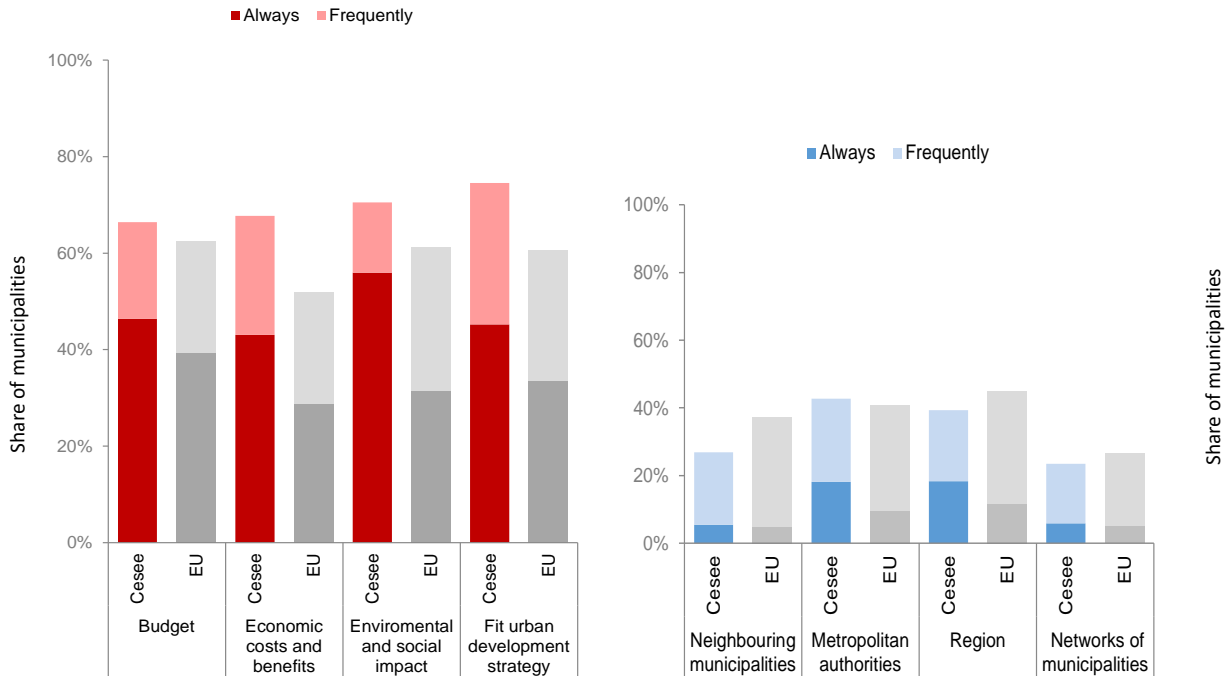


Q. To what extent is each of the following an obstacle to the implementation of your infrastructure investment activities?

Although their urban development strategy may not be perfect, more CESEE municipalities than the EU average stress its appropriateness when carrying out an assessment of a new infrastructure investment project (Figure 26). Almost twice as many CESEE municipalities than the EU average always consider environmental and social impacts in their investment project assessment. While this figure is still too low, more CESEE municipalities than the EU average also account for economic costs and benefits in their infrastructure investment project assessment.

**The share of municipalities coordinating with neighbouring municipalities, region and networks of municipalities is lower in CESEE than the EU average.** This could result in some planning and implementation inefficiencies (e.g. duplication, over or under capacity) in local infrastructure investment across the region (Figure 26).

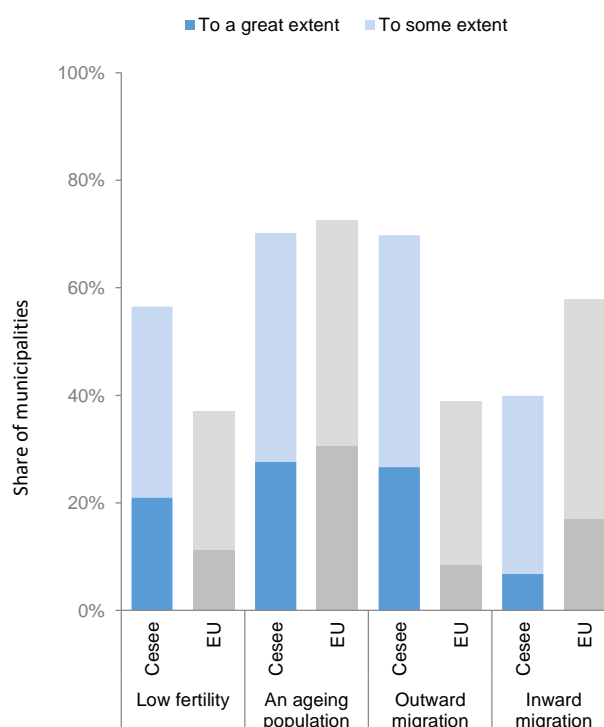
**Figure 26 – Municipality infrastructure planning and coordination in planning and implementation**



Q. Before going ahead with an infrastructure project, do you carry out an independent assessment of...? And: how important would you say are the results of the independent assessment(s) when deciding whether to go ahead with a project?  
 Q. How often does your municipality coordinate its investment projects with...?

**The availability of young skilled staff in the CESEE region could be further affected by negative demographic trends (Figure 27).** Outward migration and low fertility are, on balance, more critical drivers of demographics in CESEE than in the rest of the EU. In addition, ageing is perceived as the main negative demographic driver in municipalities across the whole EU, including CESEE.

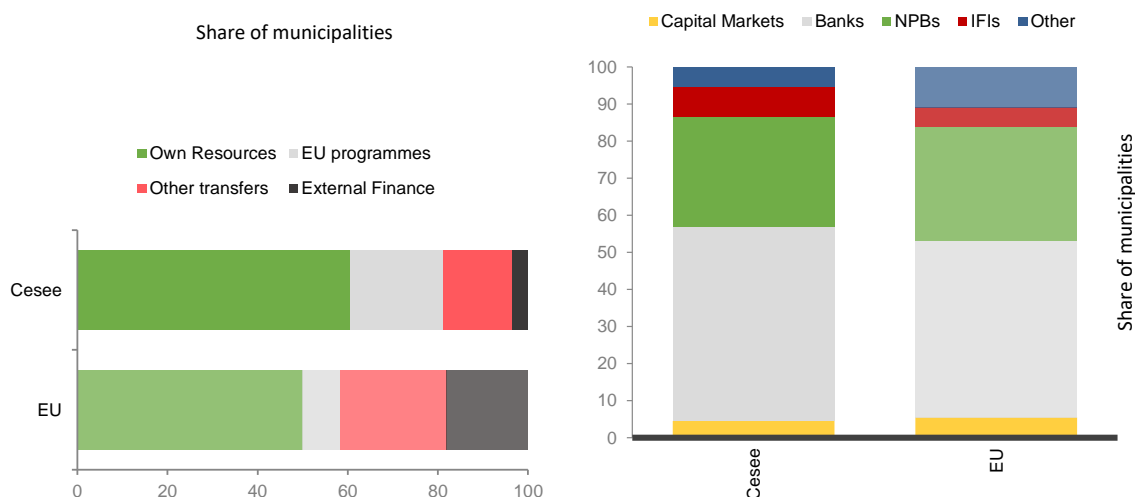
**Figure 27 – Drivers of demographics**



Q. To what extent do each of the following impact the demographic situation in your municipality?

**In comparison with the EU average, CESEE municipalities rely more on their own resources and EU funds to finance their infrastructure investments (Figure 28).** For CESEE municipalities, external finance is very marginal compared with the EU average. In terms of external finance, CESEE municipalities use more commercial bank funding and international finance institution funding, and slightly less capital markets funding, than the EU average (Figure 28).

**Figure 28 – Source of municipality investment finance and type of external finance used for the municipality’s investment activities**



Q. Approximately what proportion of your infrastructure investment activities was financed by each of the following?

Q. Approximately what proportion of your external finance does each of the following represent?

## 4.2. The contribution of European Structural and Investment Funds

**European Structural and Investment Funds (ESIFs) provide a major source of investment in CESEE.**<sup>55</sup>

Overall, the average annual EU funds absorption across the CESEE EU members was 1.5% of recipient countries' GDP in 2007–15, about a third of government investment in these countries. ESIFs are key financial sources for local authorities in CESEE, since at least 50% of the European Regional Development Fund is earmarked for urban areas, through central, regional and local actors. As shown by the EIB Investment Survey, ESIFs are also major sources of investment finance for direct municipal investments.

**One of the main changes to the 2014–20 programming period compared with previous ones is the introduction of integrated territorial development instruments.** In general, ESIFs are implemented at regional and/or national level, with the additional aim of investment in an urban context. In line with the location-based approach of the European Commission, a new regulatory requirement has been put in place to allocate resources for sustainable urban projects, to be implemented by local actors in 2014–20. This allocation is equal to at least 5% of European Regional Development Fund (ERDF) allocation,<sup>56</sup> out of a total of EUR 28 billion per year between 2014 and 2020. In other words, in the current programming period investment planning is specifically delegated to cities, which can select the projects, thereby taking responsibility for the implementation. Cities can implement their projects within regional and national programmes<sup>57</sup> or through an Integrated Territorial Investment (ITI) strategy.<sup>58</sup> The latter allows cities to draw funds from different ESIFs' operational programmes, to be used for integrated actions within a specific urban territory. The aim of this is to ensure greater flexibility in the use of different resources by focusing on local issues and projects. As shown in Figure 29, ITI had a large total allocation in Poland and the Czech Republic, and was also the favourite instrument for sustainable urban development in Slovakia, Croatia, Latvia, Lithuania and Slovenia. Conversely, Romania, Hungary, Bulgaria and Estonia decided to allocate this task and the related resources to specific priority axis within ESIFs' operational programmes.

**In Europe, the total allocation of ERDF funding to sustainable urban development for the programming period 2014–20 is EUR 15.5 billion (7.8% of ERDF funding, way above the minimum 5%), equal to EUR 2.2 billion per year.** As shown in Figure 29, which reports country-specific allocations, allocation is highly dependent on eligibility, and consequently to total allocation within structural funds. Poland, the largest recipient of ERDF, thus allocates the most resources to sustainable urban development. However, the CESEE countries allocating the highest percentage of their ERDF resources to urban development are Bulgaria (20%) and Romania (around 10%). The lowest percentage in CESEE is registered by Slovakia, which allocated the minimum required by the regulation (5% of total ERDF, equal to EUR 360 million). Overall, 70% of the total allocation for urban actions is applied in less developed regions, including in the CESEE countries, which have a substantially higher level of ESIF support. The main areas of allocation (around 75% of total funding) are:

- (i) energy efficiency, use of renewable energy in public buildings and housing;
- (ii) sustainable, multi-modal urban mobility (public transport, cycling, walking);

<sup>55</sup> European Commission, "Seventh cohesion report", 2017.

<sup>56</sup> Other funds, particularly the Cohesion Fund and the European Social Development Fund, can also allocate resources to integrated activities for sustainable urban development.

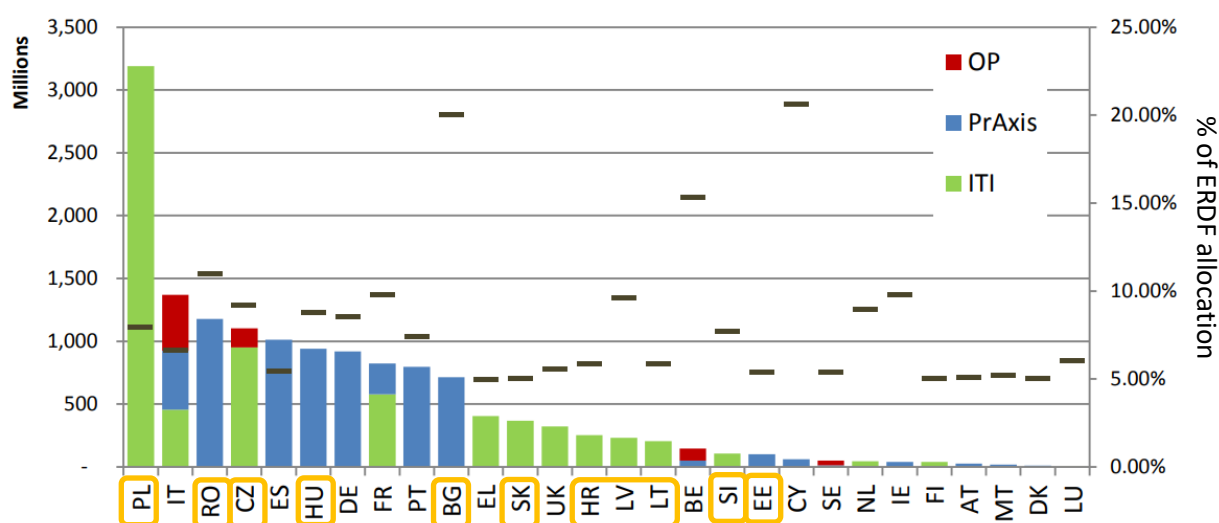
<sup>57</sup> Under the umbrella of a regional or national operational programme (OP), or as a priority axis within an operational programme.

<sup>58</sup> Using a part of the allocation of one or more priority axes of one or more operational programmes.

- (iii) improvement of the urban environment (brownfields, heritage, water, waste, air quality, noise);
- (iv) social inclusion and poverty reduction (access to health care and social care, de-institutionalisation)<sup>59</sup>.

As shown by a study carried out by the European Policies Research Centre, the strategies implemented under the territorial instruments are multi-sectoral, multi-partner and often multi-fund (by drawing resources from other funds beyond ERDF). Consequently, they encourage vertical and horizontal cooperation, territorial integration and knowledge sharing.<sup>60</sup>

**Figure 29 – ERDF budget allocated to sustainable urban development, 2014–20 by member state and delivery mode**



Source: Matkó (2016).

Notes – OP: operational programmes; PrAxis: programming axis within operational programmes; ITI: integrated territorial investment. Markers and right-hand scale: % of total ERDF allocation.

**However, the EU funds have exhibited considerable cyclical dynamics.** EU funds absorption is inherently linked to the EU budget cycle, as shown during previous multi-annual financial frameworks. It is therefore largely influenced by exogenous factors related to project implementation, as well as by changes in EU-wide policies. Moreover, as also reported in this section, technical and administrative capacity need to be in place in cities to make use of the available resources and to coordinate between cities efficiently. Recent analysis shows that integrated territorial instruments have supported multi-level governance and generated new governance arrangements and institutions for advancing technical capacity and enhancing coordination between and within municipalities.<sup>61</sup>

**The debate on the post-2020 Multiannual Financial Framework of the EU is dominated by the motto “doing more with less”.** In a post-Brexit Europe, funding for cohesion policy may be reduced.<sup>62</sup> This could lead to a greater need for financial instruments, a higher thematic concentration on key

<sup>59</sup> Matkó, M., “Sustainable urban development in cohesion policy programmes 2014–2020, a brief overview”, paper presented at Urban Development Network Meeting, 18.2.2016.

<sup>60</sup> Var der Zwet, A., Bachtler, J., Ferry, M., McMaster, I., and Miller S., “Integrated territorial and urban strategies: how are ESIF adding value in 2014–2020?”, 2016.

<sup>61</sup> Var der Zwet, A., Bachtler, J., Ferry, M., McMaster, I., and Miller S., “Integrated territorial and urban strategies: how are ESIF adding value in 2014–2020?”, 2016.

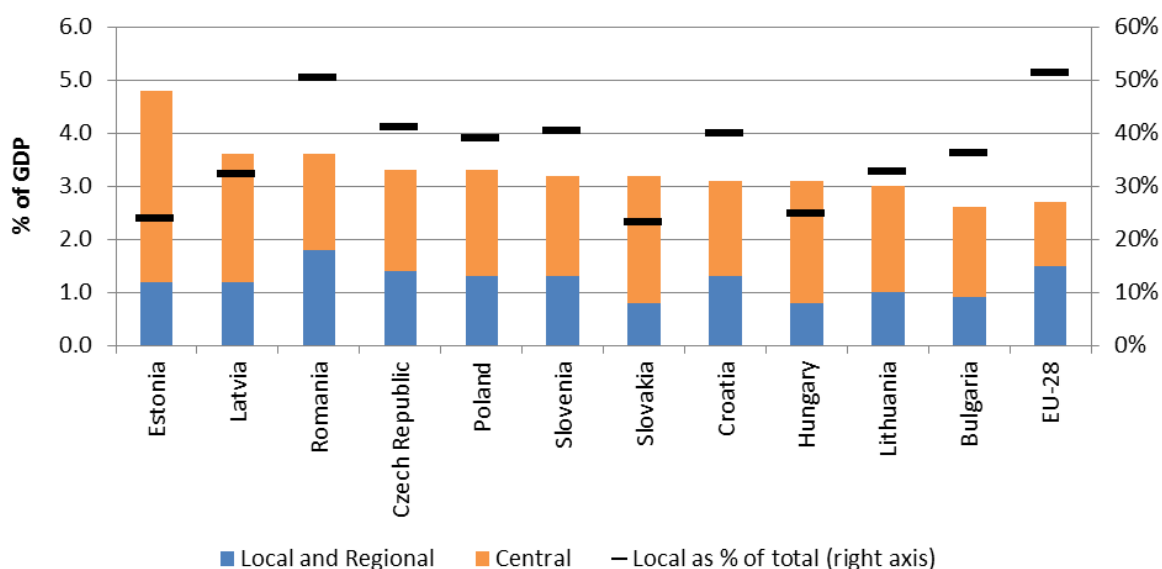
<sup>62</sup> Var der Zwet, A., Bachtler, J., Ferry, M., McMaster, I., and Miller S., “Integrated territorial and urban strategies: how are ESIF adding value in 2014–2020?”, 2016.

priorities, with prioritisation of key projects, and more selective grant spending. For this reason, the technical capacity, governance and coordination issues highlighted by the EIB Investment Survey are crucial for deciding the efficient use of these (potentially scarce) resources.

### 4.3. Fiscal trends for local authorities in CESEE

**Local authorities are the leading institutions in public investment projects. On average, sub-national authorities are responsible for some 51% of the gross fixed capital formation of the general government.** In CESEE, this share is generally lower, particularly in Estonia, Hungary and Slovakia (Figure 29). In Europe as a whole, local authorities' spending represents around one-third of public sector expenditures and, although there are country-specific peculiarities in terms of responsibilities and autonomy, regions and cities are the providers of key public services such as transport, sanitation, health, education and childcare.

**Figure 30 – Public investment by level of government, 2016**

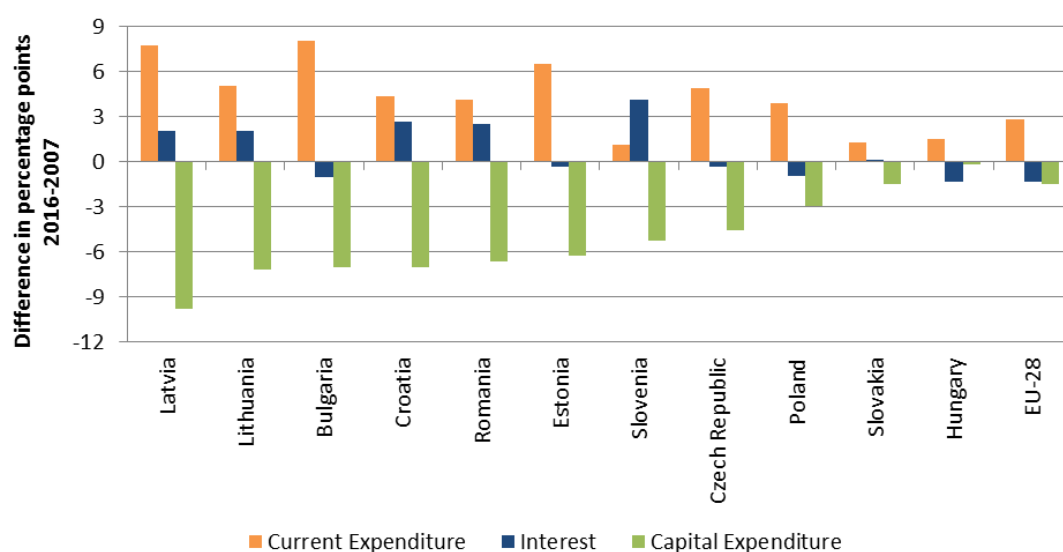


Source: Eurostat.

**Since 2007, fiscal adjustment in EU countries has fallen disproportionately on local authorities, and particularly on public investment.** Over the last decade, changes in investment activities by regional and local authorities explain as much as 75% of the overall fall in total public investment.<sup>63</sup> This trend is particularly relevant for the different trajectories observed within European countries. As shown in Figure 31, which reports expenditure composition, these changed significantly in the local governments in the region. These shifts are larger than those of central governments.<sup>64</sup> In areas hit most badly by the financial crisis, local authorities reduced public investment more significantly in response to budgetary constraints (on both the expenditure side and the revenue side), with a potential significant impact on social cohesion and on the financial recovery capacity of weaker regions.

<sup>63</sup> For details on the impact of Stability and Growth Pact (SGP) on investment of local/regional authorities, see Council of European Municipalities and Regions, "Reviving local public investments: flexibility is needed in the existing rules of the stability and growth pact", 2015.

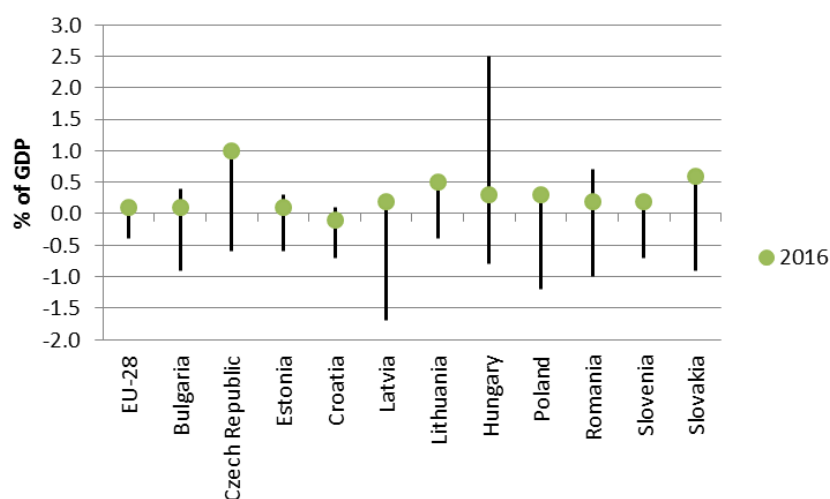
<sup>64</sup> See EIB, "EIB Investment Report 2017/2018: from recovery to sustainable growth", 2017; Ahrend, R., Curto-Grau, M., and Vammalle, C., "Passing the buck? Central and sub-national governments in times of fiscal stress", OECD Regional Development Working Papers, No 2013/05, OECD, 2013.

**Figure 31 – Change of expenditure composition of local governments (in share of their total expenditure), 2007–16**


Source: Eurostat.

#### 4.4. Focus on structure of local finances and debt

In recent years, sub-national governments have seen a significant improvement in the fiscal balance. This is in line with the EU average. As shown in Figure 32, which reports local governments' balance in 2016, local governments of all countries in the EU registered a surplus in 2016. The only exception is Croatia, where local authorities registered a limited deficit in 2016 (–0.1% of GDP). In most countries, this result was the largest or nearly the largest surplus in a decade.

**Figure 32 – Local governments' balance, 2016 and 2007–16 range**


Source: Eurostat.

Note: lines indicate the range of values registered in 2007–16; green dots indicate the 2016 balance.

**This trend is not incidental, as most countries implemented reforms to improve the fiscal responsibility of local authorities,**<sup>65</sup> by imposing balanced budgets and limiting the debt capacity of municipalities. In Slovakia,<sup>66</sup> Czech Republic,<sup>67</sup> Poland,<sup>68</sup> Romania and Bulgaria,<sup>69</sup> sub-national governments are subject to a balanced budget rule, while in other countries fiscal rules have become stricter over the last few years.<sup>70</sup> In Estonia, Croatia, Slovakia, Latvia and Slovenia, regional governments and municipalities have the right to borrow to finance certain types of investment projects (golden rule). However, this capacity is often limited by being subject to central government control and approval or to legal limitations. In recent years, the most radical sub-national fiscal reform has been implemented in Hungary, where the 2012 Constitutional reform and the 2011 Local Government Act (LGA, in effect from 2013) have reduced the scope, functions and financing resources of sub-national governments.<sup>71</sup>

**Overall sub-national debt in CESEE is limited, amounting to only a marginal share of total government debt.** The only exceptions are Latvia and Estonia, where sub-national debt is significant when compared with total debt but limited as a share of GDP. As shown in Table 2, sub-national debt declined in relative terms from 2013 to 2016 in most countries, with a few exceptions. In fact, marginal increases were registered in Bulgaria (as a percentage of GDP) and in Slovakia and Estonia (as a share of total debt). Most of the debt is in loans, with securities representing a relatively significant share of debt only in Poland, the Czech Republic and Estonia. The maturity profile (Table 3) is highly diversified across the region, with Hungarian local authorities facing short-term maturities, while most of the debt of local authorities in Slovakia (and to some extent in Bulgaria, Latvia and Romania) has a much longer maturity profile.

<sup>65</sup> This section and the following are based on OECD, "Subnational governments around the world, structure and finance", 2016.

<sup>66</sup> Fiscal rules became stricter with the Fiscal Responsibility Constitutional Act of 2011 and the Law on Budgetary Responsibility of 1 March 2013, which came into effect in 2015.

<sup>67</sup> In Czech Republic, following the new Constitutional Act (October 2012), a new fiscal framework is under preparation regulating local government indebtedness.

<sup>68</sup> In Poland, the 2011 Public Finance Act stipulated to balance local current budgets and strengthened debt limitations requiring that the sum of loan instalments and interest payments must not exceed 15% of total debt.

<sup>69</sup> Only for municipalities, following the regulatory requirements of Public Finances Act, in force since 2014, strengthening fiscal rules.

<sup>70</sup> In Lithuania, in 2015, amendments to municipal borrowing regulations were drafted to reinforce municipal fiscal discipline. In Croatia, the Fiscal Responsibility Act (2010) limited the spending of local authorities and imposed controls on borrowing. In Slovenia, amendments introduced in 2008 strengthened existing restrictions on debt service and debt outstanding.

<sup>71</sup> In particular, new central government offices at the local level took over many functions previously exercised by municipalities and are also in charge of sub-national legal and financial supervision.

**Table 2 – Sub-national debt in CESEE**

	% of GDP			% of general government debt		
	2013	2016	change	2013	2016	change
<b>Bulgaria</b>	1.1	1.2	0.1	6.6	4.2	-2.4
<b>Czech Republic</b>	2.8	1.9	-0.9	6.3	5.1	-1.2
<b>Estonia</b>	3.6	3.4	-0.2	35.3	35.6	0.3
<b>Croatia</b>	1.6	1.4	-0.2	1.9	1.7	-0.2
<b>Latvia</b>	6.0	5.8	-0.2	15.3	14.3	-1.1
<b>Lithuania</b>	2.0	1.6	-0.4	5.1	4.1	-1.1
<b>Hungary</b>	1.5	0.2	-1.3	2.0	0.3	-1.7
<b>Poland</b>	4.3	3.9	-0.4	7.7	7.3	-0.4
<b>Romania</b>	2.5	2.2	-0.3	6.8	5.9	-0.9
<b>Slovenia</b>	2.0	1.9	-0.1	2.9	2.4	-0.5
<b>Slovakia</b>	2.2	2.2	0.0	4.0	4.2	0.2

Source: Eurostat.

**Table 3 – Structure and maturity of sub-national debt in CESEE**

	Loans	Debt Securities	< 1 year	1–5 years	5–7 years	7–10 years	10–15 years	15–30 years	> 30 years
<b>Bulgaria</b>	89%	11%	1.8%	6.5%	5.7%	14.8%	14.7%	53.9%	2.5%
<b>Czech Republic</b>	85%	15%	0.9%	4.6%	5.1%	21.9%	11.4%	55.5%	0.6%
<b>Estonia</b>	76%	24%	0.5%	52.1%	16.9%	10.0%	7.3%	12.7%	0.5%
<b>Croatia</b>	99%	1%	6.4%	15.0%	5.3%	17.1%	34.9%	21.3%	0.0%
<b>Latvia</b>	100%	0%	0.0%	1.1%	1.4%	5.0%	37.9%	47.8%	6.8%
<b>Lithuania</b>	100%	0%	1.6%	30.6%	52.8%	0.0%	5.0%	10.0%	0.0%
<b>Hungary</b>	92%	8%	25.9%	74.1%					
<b>Poland</b>	93%	7%	1.0%	7.4%	17.5%	41.4%	32.1%	0.6%	0.0%
<b>Romania</b>	82%	18%	0.1%	17.0%	3.7%	14.7%	17.9%	46.2%	0.4%
<b>Slovenia</b>	100%	0%	0.5%	0.0%	0.0%	99.5%	0.0%	0.0%	0.0%
<b>Slovakia</b>	100%	0%	1.4%	9.5%	2.0%	12.1%	16.0%	18.0%	41.0%

Source: Eurostat.

## 5. Conclusions

**The analysis carried out on in this report provides evidence that, despite convergence, large gaps still exist between the EU and CESEE cities.** The EIB Investment Survey of municipalities shows that CESEE municipalities have underinvested in urban transport and housing infrastructure over the last five years. As a result, the quality of infrastructure in these areas is assessed by the municipalities as being weak. Furthermore, in key economic indicators, the largest CESEE cities lag behind the main metropolitan areas of Western Europe. In addition, there are larger disparities within CESEE countries compared with the EU-28 average. Cities in CESEE, on average, are below the EU average in terms of productivity, education and employment. From this perspective, both large and small cities in CESEE require an ambitious strategy to catch up with their EU peers. Nevertheless, CESEE capital regions are narrowing this gap, while more investment and effort in CESEE are required in the second-tier cities, which are not converging as rapidly as the capitals.

**The Smart Region Index developed in this report shows that significant gaps between CESEE regions and their EU counterparts exist in quality of life, quality of government, economy and innovation as well as in accessibility.** Moreover, although CESEE capitals perform better on average than the non-capital regions when it comes to smartness indicators, they still lag behind the EU average. Significant gaps are observed in the pillars of Smart Governance and Smart Living. Nevertheless, CESEE capitals perform significantly better than second-tier cities and other non-capital regions when it comes to Smart Society, as well as Smart Economy. The CESEE intra-country regional disparities are greater than in the rest of the EU. These quality and endowment gaps are also reflected in the results on investment gaps from EIBIS, which show that policy action should be taken primarily in these pillar areas and in both capitals and second-tier cities. However, the analysis reports that each CESEE region has different gaps to be filled. Consequently, local action and involvement is crucial in decreasing these major gaps.

**Smart city investment is less than that for traditional infrastructure, but it only has the potential to crowd-in the private sector investment and support innovation if it is accompanied by the right set of policies and incentives.** This potential can be enhanced by clusters of smaller smart cities, which can join forces for projects beyond the technical or financial means of a single institution. In the context of increasingly high regional disparities, CESEE, cities tend to be smaller and therefore (particularly for second-tier cities) smart city clusters could be economically more viable and a mutually complementary option, since this would represent a platform to increase in scale and to generate the development of replicable and market-based solutions.

**According to the 2017 EIBIS, CESEE municipalities rely predominantly on their own resources and EU funds to fund their infrastructure investment.** There is scope for switching from dependence on grant financing to using the grants as a primary cost to make the projects bankable in order to then tap other means of financing. Furthermore, to attract more private sector investment in smart city projects, there is scope for generating investment platforms and clusters of municipalities, with the aim of making such projects more attractive in terms of size and risk diversification.

**Population projections in CESEE countries are also unfavourable and could further add to the pressures on the labour market.** Over the coming decades, no country in CESEE is expected to see an increase in total population. The capital cities are expected to show a relatively positive dynamic, while second-tier cities are expected to lose population, to a large extent in most cases. Second-tier cities might therefore be expected to play a crucial role in retaining and attracting population by offering

alternatives to the capital cities in terms of studying, working and doing business, with lower localisation costs or alternative economic specialisation. In addition, in the CESEE countries, population ageing, outward migration and low fertility could add to the existing problems due to the lack of availability of young skilled staff.

**Investing in education and training needs to go hand in hand with the transformation of cities.** As production processes in cities become more reliant on automation and the use of robotics, which replace some manual work and can create unemployment and income inequality, adapting skills to the new environment is crucial. On the other hand, new technologies and new talent can lead to new sorts of business and new jobs. Smart cities could help to support education and to link business needs with the type of graduates that schools produce, to ensure a better supply of people with the right skills to satisfy these needs.

**Increasing investment is necessary but not sufficient. Improvements in planning and regional coordination of infrastructure investment in CESEE are needed.** The whole EU is doing rather poorly on infrastructure investment planning. Where the CESEE municipalities lag behind the EU average is in the coordination of their investment projects with neighbouring municipalities, their region and with the networks of municipalities. This could result in inefficient planning and implementation. More effort needs to be made in improving the coordination between municipalities.

**The smart cities and regions initiative of the EU Bank is built on the pillars of advising, blending and lending, with an active engagement in CESEE.** To support sustainable regions and cities and their smart development, tailored advice in the preparation of smart development strategies is needed. Moreover, investment platforms can play an important role in facilitating better access to finance, through the aggregation of projects that would otherwise be too small or be too risky to access the finance needed. Investment platforms are flexible, which allows the EU Bank to focus on delivering dedicated financing structures, co-financing or risk-sharing arrangements, which channel public and private financing into several investment projects. In addition, the EIB provides direct loans and framework loans to municipalities and regions all over Europe, and in CESEE in particular. It has also established investment funds and created investment programmes with commercial banks to finance urban investment.

**The EIB's Urban Investment Advisory Platform (URBIS) is an example of an EU-level initiative that can help raise the technical capacity of, and coordination between, urban authorities across Europe.** Given the positive investment outlook of the CESEE municipalities and the existing investment impediments, planning and coordination weaknesses and fiscal constraints, the CESEE municipalities need to act to ensure the high quality of projects under preparation. This will require improvements in technical capacity, planning, prioritisation and coordination, and in identifying optimal financing options. Enhancing coordination and the technical capacity of municipalities can also help ensure that EU funds are put to their most effective use.

## Appendix 1 – Smart Region Index: data transformation

The presence of outliers can lead to inflated error rates and substantial distortions in parameter and statistical estimates when using either parametric or nonparametric tests. Although this exercise did not involve regression analysis, we identified and treated outliers, as they could seriously bias or influence the smart pillars. As a result, outliers were clearly defined as observations three standard deviations above or below a variable’s corresponding mean. We stress, however, that these outliers were not removed from the sample, but were capped at the corresponding outlier maximum or minimum when applicable to avoid losing important information from the sample.

For ease of comparability between the different variables, sub-pillars and pillars, we needed to perform a feature scaling exercise. This transforms all the indicators into normalised indicators  $\in [0,1]$ , making the variables, sub-pillars and pillars comparable. Therefore, the metric information is maintained, while the relative importance of each pillar, sub-pillar and variable is obtained. The equation below illustrates the transformation:

$$x_i^* = \frac{x_i - x_{i,\min}}{x_{i,\max} - x_{i,\min}}$$

where  $x_i$  = original value;  $x_i^*$  = normalised value/score;  $x_{i,\min}$  = minimum value (within outlier boundaries);  $x_{i,\max}$  = maximum value (within outlier boundaries);  $i$  = region.

Two types of aggregation operators were used throughout this exercise: the arithmetic mean for the scores within each sub-pillar and pillar, and the generalised mean operator to achieve the final smart scores across pillars. We confirmed the internal consistency within the pillars and sub-pillars, and the limited compensability effect across the included variables, which therefore guaranteed that the arithmetic mean is the ideal method to aggregate within each dimension.

The expression below indicates the operation for the sub-pillars:

$$\text{Smart SP}_i = \frac{1}{N} \sum_{j=1}^N x_{i,j}^*$$

where SP = sub-pillar;  $j$  = variable;  $i$  = region; and  $N$  = total number of variables in the sub-pillar.

Similarly, the same arithmetic average exercise was performed to construct the six pillars:

$$\text{Smart } P_i = \frac{1}{N} \sum_{j=1}^N \text{Smart SP}_{i,j}^*$$

where  $P$  = pillar;  $j$  = sub-pillar;  $i$  = region; and  $N$  = total number of sub-pillars within the pillar.

However, when aggregating across pillars, it is important to address the effect of compensability. The final indicator should ensure that the smartest region identifies a generally good performance in all

pillars. Therefore, we used the generalised weighted mean to ensure that full compensability was contained, given its nature as a combination of the arithmetic and geometric average.<sup>72</sup>

The unweighted generalised mean of order  $\gamma$  is expressed as:

$$\text{Smart Region}_i = \begin{cases} \left( \frac{1}{N} \sum_{j=1}^N \text{Smart } P_{i,j}^{*\gamma} \right)^{\frac{1}{\gamma}} & \text{for } \gamma \neq 0 \\ \left( \prod_{j=1}^N \text{Smart } P_{i,j}^* \right)^{\frac{1}{N}} & \text{for } \gamma = 0 \end{cases}$$

where Smart Region = final smartness score;  $j$  = pillar;  $i$  = region;  $N$  = total number of pillars.

It can be deduced that, for  $\gamma = 1$ , Smart Region<sub>*i*</sub> is aggregated through the arithmetic mean operator. However, under the assumption that  $0 < \gamma < 1$ , as  $\gamma$  approaches 0, the importance of low scores in a single pillar increases, as we use the geometric average. As a result, the final smart scores are aggregated through a generalized mean procedure with power  $\gamma = 0.5$ . This penalises the regions with very low scores in an individual pillar but that perform well in the remaining pillars, while adjusting for the degree to which this is important. The final rankings were produced based on the highest smart region score.

<sup>72</sup> Annoni, P., and Weziak-Bialowolska, D., "A measure to target anti-poverty policies in the European Union regions", *Applied Research in Quality of Life*, No 11, 2016, pp. 181–207; Ruiz, N., "Measuring the joint distribution of household's income, consumption and wealth using nested Atkinson measures", OECD Working Paper No 40, 2011, pp. 1–37.

## Appendix 2 – Smart Region Index: description of the variables

Variable Description and Reference Years	Geographical Coverage	Source	Sub-Pillar	Pillar
Employment in financial and insurance activities and professional, scientific, technical sectors (2011–13)	NUTS-2	Eurostat	<b>BUSINESS SOPHISTICATION</b>	<b>SMART ECONOMY</b>
Gross Value Added of financial and insurance activities and professional, scientific, technical sectors (2011–13)	NUTS-2	Eurostat		
Number of small and medium size enterprises (SMEs) with innovation co-operation activities (2011–13)	NUTS-2	European Commission		
European Union trade mark (EUTM) applications per million population (2014–15)	NUTS-3	Eurostat	<b>INNOVATION</b>	
Firm-level technology absorption (average 2013–14, 2014–15, 2015–16)	Country level	World Economic Forum		
Enterprises having received orders online (at least 1%) (average 2013–15)	Country level	Eurostat		
Enterprises with fixed broadband access (average 2013–15)	Country level	Eurostat		
Total intramural R&D expenditure (2012–13)	NUTS-2	Eurostat		
Human Resources in Science and Technology (HRST) (2013–14)	NUTS-2	Eurostat		
Employment in technology and knowledge-intensive (average 2013–14)	NUTS-2	Eurostat	<b>EFFICIENCY OF ENVIRONMENTAL MANAGEMENT</b>	
Electricity generated from renewable sources, % of gross electricity consumption (2015)	NUTS-2	European Commission		
Recovery rates for packaging waste, % (average 2014–15)	Country level	Eurostat		
Recycling rate of e-waste, % (average 2014–15)	Country level	Eurostat		
Share of renewable energy in gross final energy consumption, % (2015)	Country level	Eurostat		
Pollutant emissions from transport, Index (2000 = 100) (2015)	Country level	Eurostat		<b>QUALITY OF ENVIRONMENT</b>
Concentration of airborne particulate matter (PM <sub>10</sub> ) in cities, annual average concentration (µg/m <sup>3</sup> ) (2014)	NUTS-2 and NUTS-3	European Environmental Agency		
Corruption (2013)	NUTS-2	Quality of Government Institute	<b>LOCAL INSTITUTIONS</b>	<b>SMART GOVERNANCE</b>
Quality and accountability (2013)	NUTS-2	Quality of Government Institute		
Impartiality (2013)	NUTS-2	Quality of Government Institute		
Online services (2016)	Country level	United Nations	<b>REGULATION AND DOING BUSINESS</b>	
Voice and accountability (2011)	Country level	World Bank		
Government effectiveness (2011)	Country level	World Bank		
Regulatory quality (2011)	Country level	World Bank		
Ease of doing business (2011)	Country level	World Bank		
Reliability of police services (2011)	Country level	World Economic Forum		

Variable Description and Reference Years	Geographical Coverage	Source	Sub-Pillar	Pillar	
Healthy life expectancy (average 2012 and 2014)	NUTS-2	Eurostat	<b>HEALTH AND WELLNESS</b>	<b>SMART LIVING</b>	
Cancer disease death rate (2011–13)	NUTS-2	Eurostat			
Heart disease death rate (2011–13)	NUTS-2	Eurostat			
Old dependency ratio first variant (population 65 and over to population 15–64 years) (2016)	NUTS-3	Eurostat			
Households with access to broadband (average 2014–15)	NUTS-2	Eurostat	<b>ACCESS TO INFORMATION</b>		
Individuals buying over the Internet (average 2014–15)	NUTS-2	Eurostat			
Availability of latest technologies (average 2013–14, 2014–15, 2015–16)	Country level	World Economic Forum			
Personal safety <sup>73</sup> (2016)	NUTS-2	European Commission	<b>PERSONAL SAFETY</b>		
Motorway potential accessibility (2014)	NUTS-2	Spiekermann and Wegener (2016)	<b>LOCAL ACCESSIBILITY</b>		<b>SMART MOBILITY</b>
Railway potential accessibility (2014)	NUTS-2	Spiekermann and Wegener (2016)			
Number of passenger flights accessible within 90 minutes driving time (2013)	NUTS-3	European Commission	<b>LONG DISTANCE ACCESSIBILITY</b>		
Intensity of high-speed railways (2014)	NUTS-2	European Commission			
Share of low-achieving 15-year-olds in reading (2016)	Country level	OECD - PISA	<b>QUALITY OF PRIMARY EDUCATION</b>		
Share of low-achieving 15-year-olds in mathematics (2016)	Country level	OECD - PISA			
Share of low-achieving 15-year-olds in science (2016)	Country level	OECD - PISA			
Lifelong learning (2013)	NUTS-2	Eurostat	<b>LABOUR MARKET EFFICIENCY</b>	<b>SMART SOCIETY</b>	
Employment rate (excluding agriculture) (2014)	NUTS-2	Eurostat			
Long-term unemployment (2014)	NUTS-2	Eurostat			
Unemployment rate (2014)	NUTS-2	Eurostat			
Labour productivity (2014)	NUTS-2	Eurostat			
Crude rate of net migration plus statistical adjustment (average 2015–16)	NUTS-3	Eurostat			
Population 25–64 with higher educational attainment (2013)	NUTS-2	Eurostat			
Core Creativity Class employment (average 2013–14)	NUTS-2	Eurostat	<b>CREATIVITY</b>		
Knowledge workers (2013–14)	NUTS-2	Eurostat			
Scientific publications (average 2011–12)	NUTS-2	Science - Metrix			
Median age (2016)	NUTS-3	Eurostat			

<sup>73</sup> This indicator corresponds to the Safety Pillar of the European Regional Social Progress, and includes variables related to homicides, crime and road fatalities.



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© European Investment Bank, 06/2018

eBook: QH-03-18-070-EN-E ISBN 978-92-861-3759-4 doi:10.2867/342839  
digital: QH-03-18-070-EN-N ISBN 978-92-861-3760-0 doi:10.2867/4516