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# European Territorial Trends

Facts and Prospects
for Cities and Regions

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**Title** European Territorial Trends – Facts and Prospects for Cities and Regions Ed. 2017

**Abstract**
*This report analyses a set of territorial trends at continental and sub-national scale, looking at patterns and determinants of regional growth, while considering pan-European and national characteristics. Past and prospective demographic and economic trends are analysed to provide a picture of 'what, where, when and how' things happen in European cities and regions. Specific emphasis is placed on urban areas since acknowledged sources of both opportunities and challenges.*
*The indicators used in the analysis herein presented are freely and openly accessible in the Territorial Dashboard of the Knowledge Centre for Territorial Policies, https://ec.europa.eu/jrc/en/territorial-policies*

## Preface

A main policy challenge today at both European and national level is the development of a new paradigm in support of the policy design at the most appropriate level of territorial governance. It has to embed a high degree of flexibility in order to quickly react to current trends and future challenges. This report aims contributing to the production of knowledge and evidence base to highlight strengths and weaknesses, opportunities and threats of European cities and regions, in support to the refinement of European policies.

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# Executive Summary

## The Report

European policies have an intrinsically two-sided nature. On the one hand, they have to encompass continental framework and objectives, while on the other they have to acknowledge national and sub-national driving forces and specific local needs. Recent challenges such as financial crises, migration and security issues made evident that global and local solutions have to be found simultaneously and coherently. Policies are called to reflect on and respond to these challenges with new evidence-based approaches, taking into account the specificities of a territory, while also integrating its broader context.

*European Territorial Trends (Edition 2017)* presents facts and prospects that highlight European regional and urban diversities, as well as their likely future development given ongoing trends and policies. This report analyses a set of territorial trends at pan-EU, national and sub-national scale as projected by the *Territorial Reference Scenario 2017*[1]. Past and prospective demographic and economic trends provide a picture of *'what, where, when and how'* things happen in European cities and regions. Specific emphasis is placed on urban areas since they are acknowledged sources of both opportunities and challenges.

The report complements and further explores some of the analyses included in the 7th Cohesion Report (2017) of the European Commission. Revised and/or new trends will be published in periodic follow-up reports.

## Key Messages

European regions, individually or grouped in clusters, are characterised by spatial and temporal patterns of challenges and opportunities. The analysis suggests a number of policy-relevant considerations:

- ✓ Trends strictly related to the specific social, economic, cultural and natural **characteristics of each territory are "clustered" in nature, persistent over time**. These include, for example, GDP per capita and employment. Policy measures should aim to **maintain the level of high-competitive regions, and foster a transition to higher productivity sectors in the lagging ones**, focusing on specific actions on educational attainment and the development of tradable sectors. Highly specialised regions in the travel and tourism sector seem to be extremely vulnerable to overall global trends and, therefore, diversification should be pursued when and where possible.
- ✓ Trends related to competitiveness and economic resilience, are highly influenced by the behaviour of neighbouring regions and the overall spatial context. **Spillovers** are clear positive signs of growing regions, influencing each other's development. This calls for the **extension and reinforcement of the territorial reach of positive economic spillovers beyond national boundaries**, with specific emphasis on trade and innovation related sectors.
- ✓ Trends, like densification of population and activities, are pronounced mostly around the main metropolitan areas, with a patchy distribution across the EU territory. This well-acknowledged "**agglomeration effect**" of large **metropolitan areas as booster of economic development for the overall region**, should be sustained with specific measures aiming to increase their resilience to potential shocks. Agglomeration benefits are, however, often counter-balanced by an **increase in regional disparities**. Specific measures should be sought for **areas subject to depopulation**

[1] The Territorial Reference Scenario 2017 is implemented by the LUISA Territorial modelling Platform, it assumes socio-economic trends aligned with *The 2015 Ageing Report*, business as usual preferences and the effect of established European policies with direct and/or indirect territorial impacts. Variations to the reference scenario may then be used to estimate impacts of specific policies, or of alternative policy options. The Reference Scenario is periodically updated.

**in some countries**. The combined impact of demographic trends with investment on key infrastructures is a further element to evaluate the territorial efficiency of policies.

- ✓ Trends related to **resistance and recovery capacities to economic and financial crisis**, have asymmetric spreads in time and strength across EU regions. Capitals are generally more resilient than the surrounding regions, although the resilience capacity of a region is heavily co-related to that of the surrounding regions. This observation highlights the existence of some kind of regional resilience clustering in the EU and of disparities at sub-national level. Although the national characteristics generally plays a relevant role concerning economic resilience, **patterns of regional differences are visible also beyond countries' borders**. This calls for **territorial oriented and thematically differentiated policies** to reinforce the most vulnerable aspects (e.g. productivity, employment, GDP) in each region.

## Territorial Trends in details

*Regional convergence and competitiveness*

The 2008 financial and economic crisis illustrated the strong socio-economic differences amongst EU countries. EU-15[2] Member States experienced a smaller fall in the GDP per capita and employment than EU-13[3] Member States. The recovery was, however, quicker and stronger in the EU-13.

Clusters of neighbouring regions with similar characteristics regarding the evolution of competitiveness[4] and economic resilience[5] emerged in the period 2000-2014. Clustering was influenced by various factors across countries and macro-regions. Amongst these, spatial spill-overs (neighbours influencing one another, either in a positive, or a negative way) were the most common. Other factors included: education (more and better educated people brought larger growth); agglomeration economies (concentration of people and activities boosted growth); and prevalence of tradable sectors over non-tradable ones (trading implied competition with productivity front-runners and hence, growth was on the rise). While national borders did matter in most cases due to country differences in socio-economic development, fiscal and monetary policies, clusters were not always confined by them. For example, a North-South strip of highly resilient regions was formed in Germany, Austria and Italy, while a Southern strip of very low resilient regions was observed in Greece, Italy and Spain.

The number of regions with improved competitiveness increased noticeably in the pre-crisis period, especially in Eastern and Southern Europe. The 2008 crisis did not significantly affect many regions in Germany, Scandinavia and Central Europe. Conversely, a few areas in Southern Europe (Portugal, Spain, Italy, Greece, Cyprus) suffered a setback. In 2014, some regions in the best performing countries (Germany, Austria, Slovenia, and the Czech Republic) also retreated, and no EU region progressed from moderate to high competitiveness. Besides these variations, there was one clear positive evolution – the disappearance (already by 2005) of the very low competitive cluster across regions.

In line with the overall GDP and employment trends observed over 2000-2014, many of the most resilient regions emerged in EU-13 – the capital regions of the Czech Republic, Slovakia, Hungary, and Malta (as a whole country). Other resilience front-runners included regions mainly in Sweden, Finland, Baltic countries (Estonia, Latvia and Lithuania), the

[2] EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Spain, Ireland, Italy, Luxemburg, the Netherlands, Portugal, Sweden and the United Kingdom

[3] EU-13: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia

[4] Defined considering the GDP per capita, total employment, employment shares in lower and higher productivity sectors, and young dependency ratio

[5] Defined as the capacity, built over time in a region to cope with a crisis, and the immediate exposure to an unexpected shock

Netherlands, the United Kingdom and Ireland, as well as the capital regions of France, Poland, Romania and Bulgaria.

Disparities in economic development at national and regional level are projected to remain in the future (until 2030 and 2060). GDP will increase significantly in the EU, but important regional differences are likely to occur in Spain, France, Poland, the Czech Republic, Slovakia, Hungary, Bulgaria and Romania. As for GDP per capita, Germany, the Netherlands, Austria, Sweden, Finland, Lithuania, Latvia and Estonia will enjoy a high and even distribution. Conversely, substantial regional disparities will be (still) observed in many Central, East and Southeast European countries (Greece, Bulgaria, Romania, Hungary, the Czech Republic, Slovakia and Poland) where often the capital region will outperform by far the rest of the country.

Regional employment trends between 2015 and 2060 in many EU-15 countries (Spain, France, Belgium, the Netherlands, Italy and Austria) will generally follow GDP trends i.e. where GDP grows, employment grows, too. Diverging trends (GDP grows, but employment declines, suggesting productivity increases) are expected for EU-13 in Central and Eastern Europe (Poland, Slovakia, Hungary and Slovenia). Large employment differences are also projected for Romania and Bulgaria, where the capital regions will (similarly to the GDP per capita) do much better than all the others.

Population is projected to grow in the period 2015-2060 in a number of regions in Spain, France, Belgium, Ireland and Italy, as well as in the regions hosting capitals or other major cities in Sweden, Finland, Germany, the Czech Republic, Hungary, Romania and Bulgaria. Some traditional holiday spots (Balearic Islands, Corsica, Crete and Cyprus) are also expected to experience a boost in population. The largest loss of population is projected for Eastern Germany, followed by the Baltic countries, Portugal (except for Lisbon and Algarve), large areas of Spain (meaning internal migration – see above), Greece, Bulgaria, Romania, Hungary, Slovakia and Poland. At national level, the differences between population and employment dynamics will generally follow similar patterns. For both indicators, Sweden and Belgium are likely to be the EU front-runners, while Portugal, Bulgaria, Latvia and Estonia will be coming last.

*Cities and urban areas*

Capital regions, cities and sometimes even smaller towns (e.g. in traditional holiday zones) have stronger GDP growth, more employment opportunities than other regions and hence, attract people. Consequently, about 75% of the EU population today is concentrated in urban areas. Important differences in the breakdown of urban population (capitals / cities / towns) is, however, observed in the EU. Despite the projected modest increase of the total EU population, peripheral regions are expected to experience a decline in their city population, while capital regions in central Europe are likely to grow. The increase in the bigger cities will often be at the expense of the surrounding smaller cities and towns, especially in many EU-13 countries, as well as in Spain, Portugal and Germany.

Urban development is simultaneously a driver and a consequence of economic growth. The historical analysis of urban development reveals that in the period 1975-2010 the amount of built-up surfaces increased (especially in Central Europe), while the density of human settlements declined noticeably. The falling density of settlements was partially due to the sprawling of built-up areas around cities and towns. In some parts of Europe – Italy, Spain, France, Belgium, Ireland and the United Kingdom, amongst others – this trend began to reverse, and moderate re-densification processes started to emerge over time. Urban densification has important consequences for the overall growth of cities.

In the period 2000-2014, capital metro regions[6] had the highest GDP per capita, followed by smaller metro regions and second-tier ones. Before the crisis, capital metro regions

[6] The EU metro regions cover all metropolitan regions with at least 250,000 inhabitants. The capital region is the metro region which includes the national capital. The second-tier metro regions comprise the largest cities in the country excluding the capital. All other urban agglomerations of at least 250,000 inhabitants are classified as smaller metro regions.

were growing slightly faster than second-tier and smaller metro regions. The crisis reversed this trend. Regarding employment, both urban (metro) and non-urban regions followed the same growth-decline-recovery pattern. Metro regions, nevertheless, led by the capitals, registered increasingly better employment trends than non-metro regions both before and after the crisis. In the post-crisis period, capital metro regions gained more population than what their job markets were able to absorb, while non-metro regions lost net employment and population.

*Case studies*

The potentialities of the 'territorial approach' are highlighted in two applications.

Potential accessibility[7]: By reducing transport costs, transport infrastructure improvements may extend spill-overs over an ever larger territory. European investments in road infrastructure aim to improve potential accessibility in particular of peripheral regions in the EU-13. The shrinking population in those regions diminished the impacts of those improvements on the overall interaction (economic, trade, etc.) opportunities.

Tourism: Tourism is an important sector for growth and employment in the EU. It is characterised by regional divergences due to landscape (sea coasts and mountains), and cultural and temporal (by month and season) variations. Cities are typically less vulnerable to shocks in tourism since they tend to be less affected by seasonality and their dependence on tourism is generally lower.

## Conclusions

The need to take into account the geographical diversity and the specific characteristics of a place or territory is increasingly recognised in European policy-making processes. The need to assess territorial impacts is now fully embedded in the European Commission (EC) "Better Regulation Guidelines" for assessing the impact of newly proposed initiatives and evaluating existing ones.

In this context, the "*LUISA Territorial Modelling Platform*" is now part of the European Commission's toolbox offered to support the elaboration of such territorial impact assessments. The value added of this tool is that it integrates and analyses a wealth of data and indicators at high thematic and geographic granularity, while considering both EU and national characteristics. It can support a new paradigm of policy-making, aiming to address specific needs and exploit opportunities at the most appropriate territorial level and be responsive to expected or emerging challenges.

## Further Information

The indicators in this report are freely and openly accessible in the Territorial Dashboard of the Knowledge Centre for Territorial Policies:

https://ec.europa.eu/jrc/en/territorial-policies

[7] Potential accessibility refers to the overall possibility to the potential amount of interactions at different points in space. It is a function of investments in infrastructures, agglomerations' characteristics, including demographic distribution and is time-dependent

# 1 Introduction: The territorial dimension of EU policies

Local development patterns are much more differentiated and variable than one can learn from the trends seen in national statistics. The concepts of "place" and "territory" are key to understand the source of these variations. Policies need to take into account this geographical diversity and the specific characteristics of a place or territory to ensure their effectiveness at both local and national scale. A better integration of the subnational dimension into broader strategies or policies may also help us address recent challenges such as the effects of the financial crisis, increased migration and security issues.

"Territorial development" refers to the patterns of development of specific portions (units) of territory (EC, 2011). These "territorial units" are mostly composed of sub-national areas such as urban, metropolitan, regional or rural jurisdictions, but they can also include islands, coastal or mountainous areas. "Territorial capital" describes the system of territorial assets of economic, cultural, social and environmental nature that determine the development potential of a territory (OECD, 2001; Perucca, 2013). In this context, the socio-economic performance of a region can be associated with its specific territorial capital, but can also be influenced by the characteristics of the national and international economy and governmental environment in which it is embedded (Camagni and Capello, 2010).

The territorial dimension is increasingly recognised in European policy-making processes. It is fully embedded in the European Commission (EC) "Better Regulation Guidelines" in assessing the impact of newly proposed initiatives and evaluating existing ones:

> *"…*[the potential impacts of the options on] *affected parties, groups or regions: businesses of different sizes (SMEs or not), citizens, workers, learners, consumers, public administrations, third country actors, developing countries, different territories and regions (less developed or prosperous regions, cities, rural areas, border regions, overseas territories etc.)*".

Policies designed on a "territorial approach" have the potential to take into account the specificities of a territory, while also integrating the broader context. The EC-JRC LUISA Territorial Modelling Platform is based on a territorially disaggregated approach[8]. It can pinpoint regions' particularities, combine sectoral assessments and evaluate alternative options. By providing new insights on the effectiveness of policy interventions, on the identification of gaps, and on future trends and challenges, it can help developing more effective policies that aim at increasing the well-being of European regions and cities.

The key element in the series of territorial analyses presented in this report is the '*LUISA Territorial Reference Scenario 2017*'[9]. The scenario makes use of a solid knowledge base including past and future time series of socio-economic variables and spatial information on housing, transport and services infrastructures. It also includes existing European policies and legislation.

This report analyses territorial trends with a set of spatial indicators at continental, national and in particular – sub-national scales as projected by the Territorial Reference Scenario. It looks at patterns and determinants of regional growth, while considering pan-European and national characteristics. Past and prospective demographic and economic trends are analysed to provide a sound and comprehensive picture of '*what, where, when and how*[10]'

[8] Brief description of the LUISA Territorial Modelling Platform is provided in Annex I.

[9] The LUISA Territorial Reference Scenario is briefly explained in Annex I.

[10] Answering the, in principle, underlying question "why" is often falling outside the EU mandate (subsidiarity principle) and the specific JRC mandate as a service of the European Commission. It is therefore only marginally touched upon here and there. Providing sound and comprehensive answers to various "why's typically requests lots of additional data and information, which are not always available and/or accessible.

things happen in European cities and regions. Specific emphasis is given on urban areas since they are acknowledged sources of both opportunities and challenges.

Each trend depicts a specific thematic issue, analysed for the period and geographical units considered the most appropriate to highlight territorial relevance and particularities. Historical or projected data are correspondingly employed in the analysis. Historical economic trends are typically analysed for the period 2000-2014, to include the 2008-2009 crisis' impact. Urbanisation processes are analysed for a longer time span, 1975-2010. Future projections of population, economic variables and potential accessibility values are given until 2030, with some territorial specificities of tourism are illustrated for a recent point of time.

The report is structured as follows:

- Chapter 2 discusses the EU regional convergence and competitiveness, departing from the impacts of the economic crisis looking at GDP and employment trends in 2000-2014 at national level, then defining the factors of regional growth, followed by identifying the competitiveness clusters and the territorial resilience capacity of the EU regions.
- Chapter 3 presents some of the core outputs of the LUISA Territorial Reference Scenario 2017, with specific focus on cities and urban areas. These include analyses of: the EU's reference macroeconomic and demographic projections until 2060; the main urban population trends for the period 2015-2030; the historical trends in urban land use density within 1975-2010 and the evolution of various economic variables in the European urban (metro[11]) regions within 2000-2014, taking thereby into account the impacts of the economic and financial crisis of 2008-2009 and the follow-up 2010-2011 debt crisis.
- Chapter 4 proposes two, partially inter-related case studies – the impact of investments in road infrastructure on potential accessibility by 2030 and a detailed regional assessment of direct and indirect impacts of tourism in the EU.

[11] The definition of European metro regions is provided in Annex III.

# 2 Regional convergence and competitiveness

## 2.1 A snapshot of national economic trends

The EU is characterized by strong cross-country differences, including heterogeneous fiscal and monetary policies. These were reflected in the diverse resistance and recovery capacities to the 2008 global financial and economic crisis and the following 2010-2011 public debt crisis, which altogether had a severe impact both on the mature and catching-up economies in the EU. The economic downturn was even more dramatic in countries with more fragile or unsustainable public finances.

Figure 1 illustrates the evolution of GDP per capita between 2000 and 2014 for the EU-15[12], the EU-13[13], as well as in the whole EU. After the initial period of growth (2000-2007), the EU Member States were differently affected by the crisis. The EU-15 experienced a smaller, but quicker (already in 2008) fall in the real GDP per capita than the EU-13: a decrease of 5.2% versus 6.7% respectively. Within the EU-15 the negative impact was already pronounced in 2008, while in EU-13 the economic downturn took place a year later, in 2009. Within EU-15, Greece, Finland and Ireland suffered the greatest losses in GDP: 15%, 9% and 7% respectively. Amongst the EU-13 countries, Lithuania, Latvia and Slovenia registered the largest falls, with 14%, 13% and 9% respectively by 2009. The post-crisis (2009-2014) recovery was quicker and stronger in the EU-13 than in the EU-15 – almost 4% versus just 1.5%. The 2010-2011 debt crisis in a few EU-15 countries was one of the main reasons for this slower recovery.

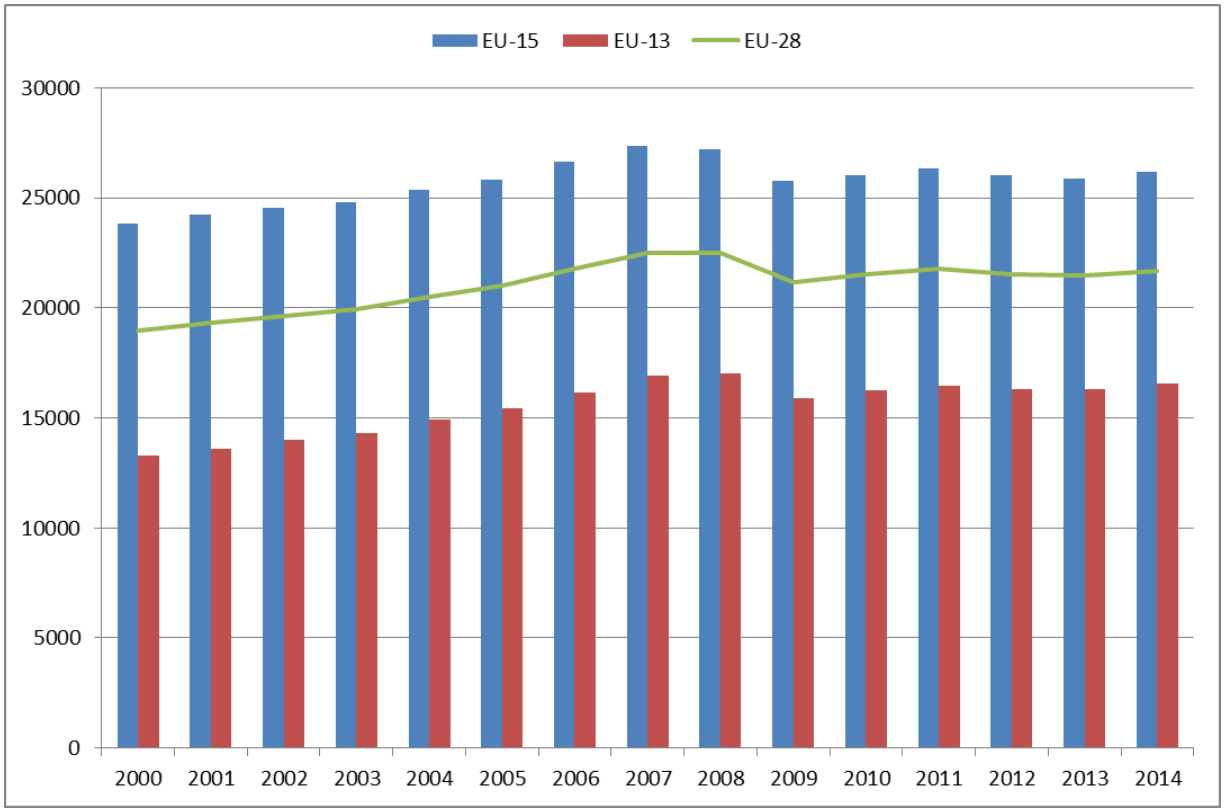


*Figure 1: Real GDP per capita trends in the EU-15, EU-13 and total EU (EU-28) for 2000-2014, in 2005 constant EUR prices. Data source: EUROSTAT.*

[12] EU-15: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Spain, Ireland, Italy, Luxemburg, the Netherlands, Portugal, Sweden and the United Kingdom;

[13] EU-13: Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia.

Figure 2 presents the employment rate of persons aged 20-64 in the period 2000-2014 for the EU-15, EU-13 and EU-28. Employment in all three groups of countries reached a peak in 2008, but then dropped by about 3% at EU-28 level, back to the 2004-2005 values. Similarly to the GDP per capita growth evolution (Figure 1), the decline was greater in the EU-13, but the trend was also reversed upward more quickly (already in 2011) than in the EU-15. EU-15 countries suffered a protracted decline in employment until 2014 and, consequently, signs of employment recovery at pan-EU (EU-28) level were only registered in that same year. Altogether, these developments resulted in a gradual convergence of EU-13 employment rate to the EU-15 / EU-28 rates in the post-crisis period.

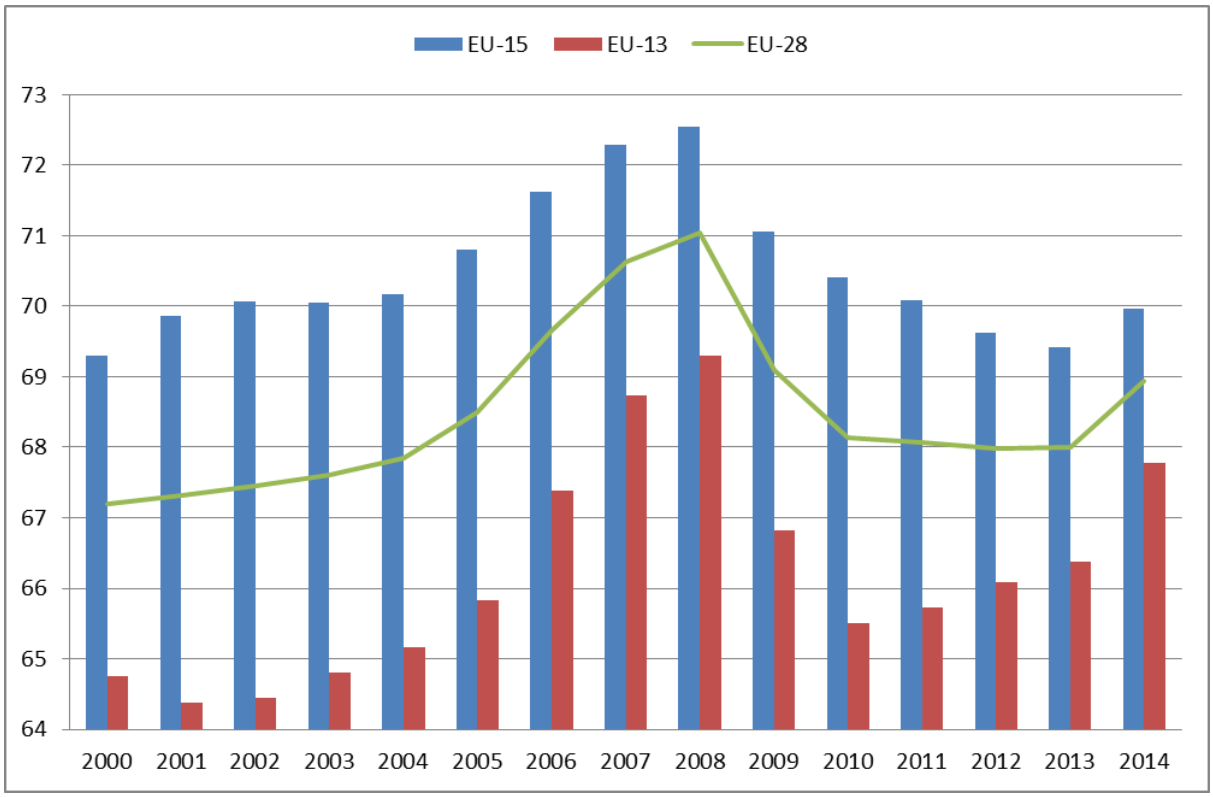


*Figure 2: Employment rate for persons aged 20-64 in EU-15, EU-13 and EU-28 for 2000-2014, in %. Data source: EUROSTAT.*

## 2.2 Spatial factors of regional growth

This section summarises some of the main factors of regional economic growth in the EU within the period 2000-2014 based on the mainstream economic theory that the initial socio-economic conditions largely determine economic growth in the subsequent period. For example, a region with a larger initial share of highly educated people has a greater likelihood for growth than a region with a lower share.

The following factors are considered as potential drivers of regional growth (see Annex IV for details on the methodology):

- ✓ **Spatial spill-over** – the effect that economic growth in a region exerts on the growth of a neighbouring region. It can be positive i.e. regions reinforce each other's growth, or negative i.e. a region grows at the expense of surrounding regions. Based on empirical results, spatial spill-over effects propagate more significantly within a travel time of 150 minutes. The correlation between the GDP growth per capita in each NUTS 3[14] region and in its neighbours in the period 2000-2014 is presented in Figure 3. In the majority of EU regions, both the high (the red group) and the low (the blue group, which together with the red one are the two largest groups) GDP growth is linked to same-trend evolution (spatial spill-overs) in the neighbour regions, albeit to a different extent.

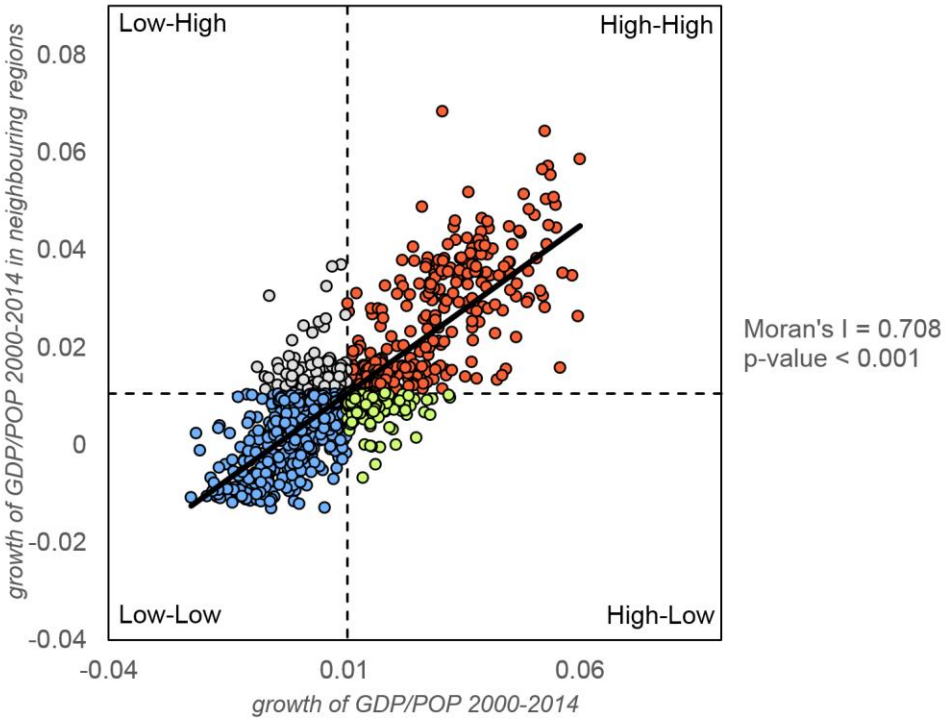


*Figure 3: Econometric correlation between the GDP growth per capita in each NUTS 3 region and that in their neighbours in the EU for the period 2000-2014. Data source: Cambridge Econometrics. Legend: red group – high-growth regions surrounded by other high-growth regions (HH); grey group – low growth regions surrounded by high growth regions (LH); blue group – low growth regions surrounded by other low-growth regions (LL); green group – high growth regions surrounded by low growth regions (HL). Dotted lines indicate the EU average.*

As illustrated by Figure 4, most Central and East European countries (Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Romania, Bulgaria) were chiefly populated by high-growth regions surrounded by other high-growth regions, forming thereby a high-high growth Eastern cluster. This could have been due to various factors, such as the lower initial level of GDP per capita (and hence, the greater potential for

[14] The NUTS classification is briefly explained in Annex II.

incremental growth[15]) and the quicker recovery from the 2008 financial and economic crisis (see Figure 1). At the other end (regions having low own growth combined with low neighbours' growth) were Greece, Italy, France and Denmark, followed by Spain and Portugal, thus forming a low-low growth Southern and Western cluster. This could be explained by the higher initial level of GDP per capita (and consequently, the smaller potential for incremental growth) and the protracted recovery from the 2008 financial and economic crisis, also due to the later 2010-2011 public debt crisis in many of those member states. In quite a few countries – Sweden, Finland, the United Kingdom, Belgium, Germany, Austria, Hungary, Slovenia, Croatia, etc. – a diverse picture was observed nationwide, since all four types of regions were identified, highlighting thereby substantial regional disparities. Figure 4 also reveals that national borders could prevent spill-over impacts e.g. the evolution pattern of Northeast Austria was clearly different from the one in the neighbouring regions of Czech Republic and Slovakia.

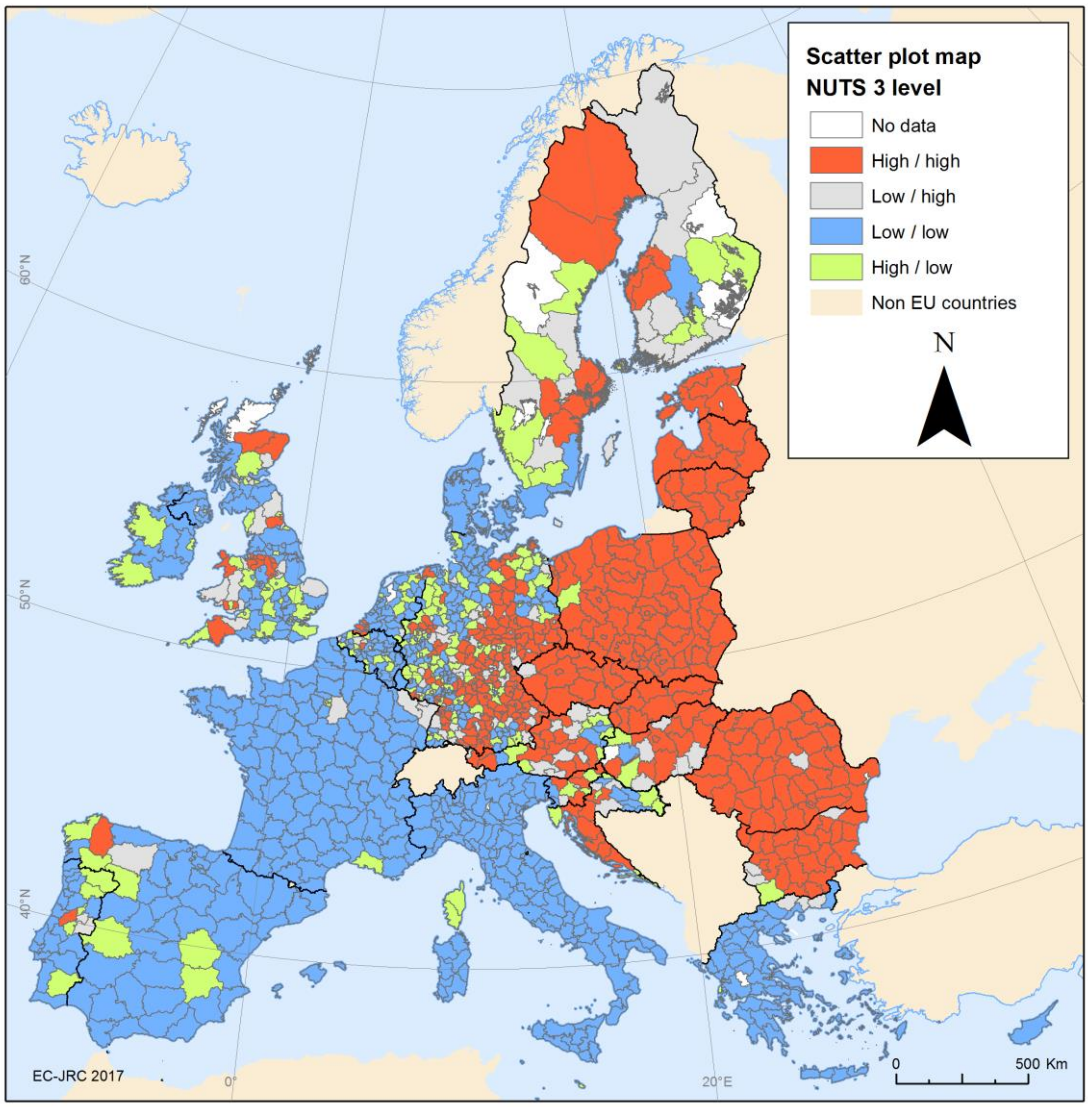


*Figure 4: Distribution of NUT 3 regions in the EU depending on the econometric correlation between the own GDP growth per capita and the GDP growth per capita in the neighbouring regions within 2000-2014. Data source: Cambridge Econometrics. Legend: Red – high-growth regions surrounded by other high-growth regions (HH); Grey– low growth regions surrounded by high growth regions (LH); Blue – low growth regions surrounded by other low-growth regions (LL); Green – high growth regions surrounded by low growth regions (HL).*

[15] To be more thoroughly discussed in the next bullet point.

- ✓ **GDP per capita in the base year** (2000) – as already assumed above, a negative correlation with GDP per capita growth has been revealed, i.e. the more developed regions grew more slowly than the less developed regions. This evolution is clearly displayed in Figure 5, where, for example, the less-developed regions of the newer Member States (with accession in 2004, 2007 and 2013) in Central and Eastern Europe recorded much faster GDP growth than the more-developed regions in the elder Member States in Western and Southern Europe. Owing to the spatial spill-over effects, the pace of growth of less developed regions was partially dependent also upon the neighbouring regions.
- ✓ **Education** – a positive impact on growth was observed, i.e. more and better educated people typically lead to larger growth. The empirical results about the linkages between productivity growth in the EU at NUTS 3 level within 2000-2014 and the respective education levels (secondary and tertiary) are plotted in Figure 6. Figure 6 proves that secondary and tertiary education attainments are both strong drivers of growth, but with the former having a greater impact. The softer impact of tertiary education could have been due to skill mismatching, i.e. there may have been a gap between individual job skills and job market demand. In any case, the results clearly show that investing in education is important.
- ✓ **Agglomeration economies** – agglomeration is defined as total population over residential built-up areas multiplied by total population. It captures both the demographic size and the level of geographical concentration of population within a region. The spatial concentration of economic activities triggers innovation[16], which in turn helps increase productivity and GDP per capita in the agglomeration[17]. On the other hand, excessive agglomeration might have negative implications due to congestion costs, high land rents and wages, higher pollution levels, etc.
- ✓ **Tradable and non-tradable sectors** – According to the OECD[18], tradable sectors favour productivity growth because they are forced to compete in global markets and hence, are better positioned to catch up with the productivity frontrunners. A high local presence of tradable services (typically in metro areas) can create demand for local non-tradable (lower skill) service workers in e.g. food or personal care sectors[19]. New jobs in tradable sectors thereby eventually result in some incremental jobs in non-tradable sectors[20,21].

[16] The impact of innovation on competitiveness and convergence is thoroughly assessed by the Regional Innovation Scoreboard, http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en

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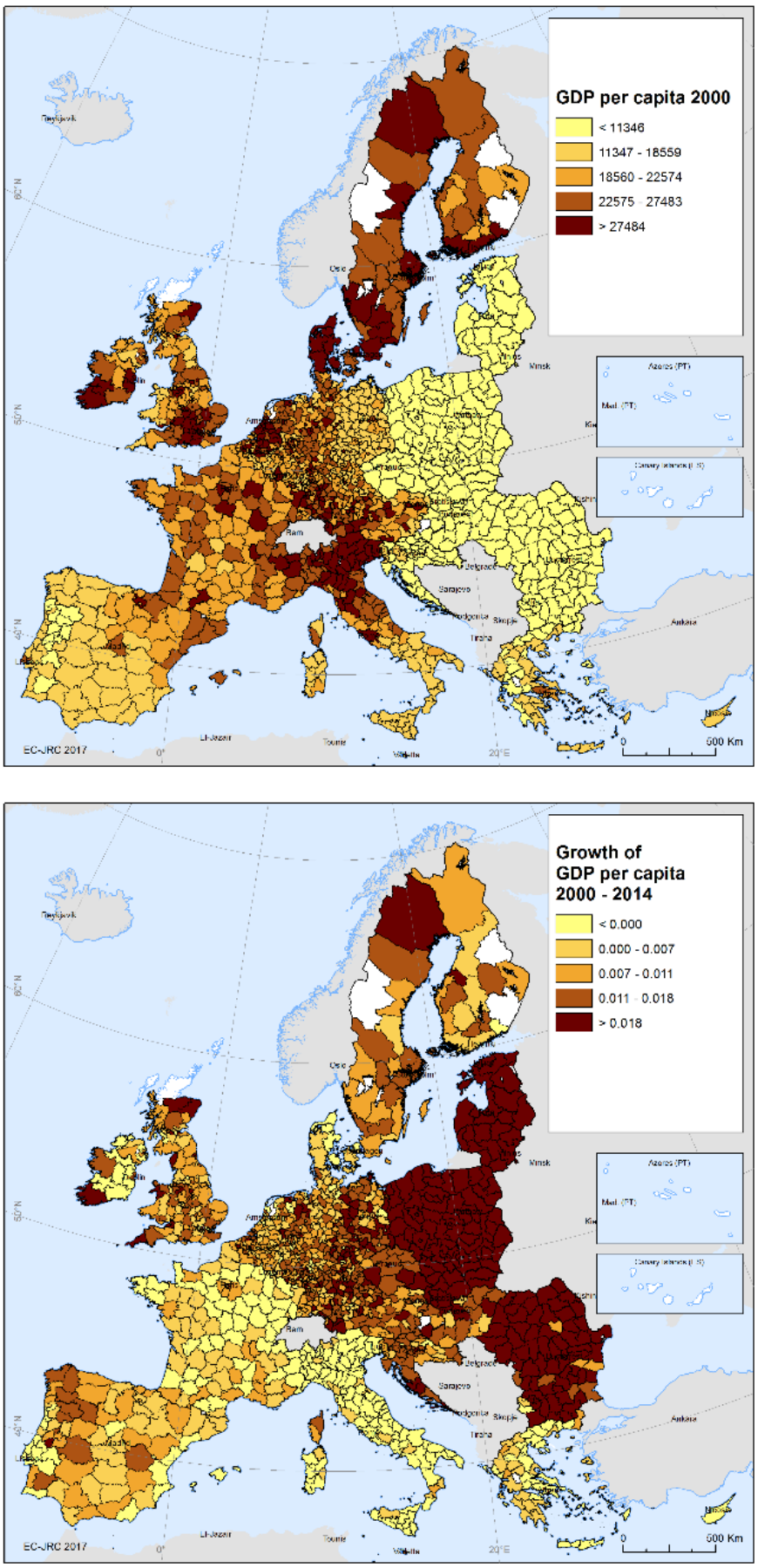



*Figure 5: GDP per capita in 2000 (top) and growth of GDP per capita in 2000-2014 (bottom) at NUTS 3 level in the EU*

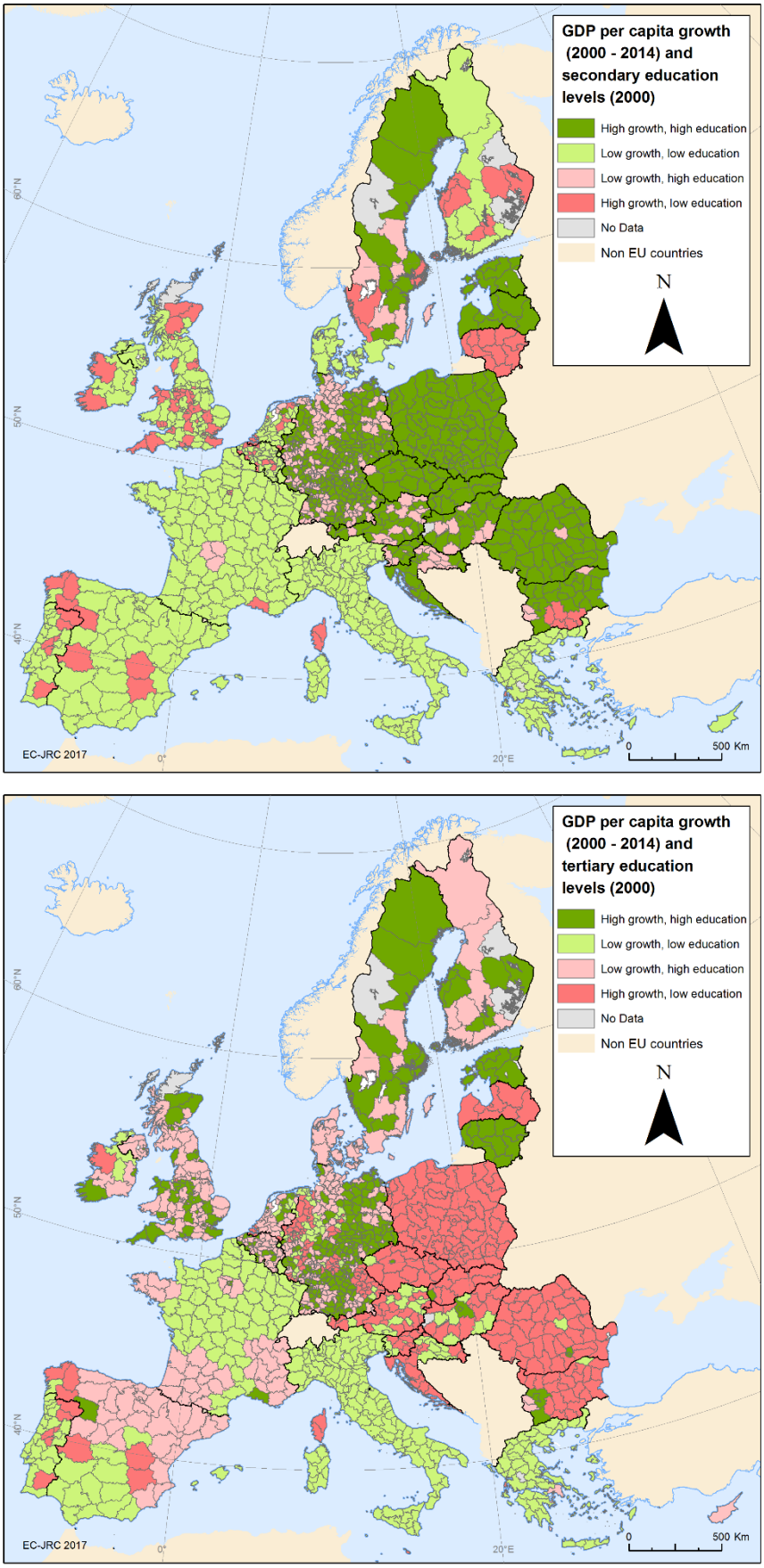



*Figure 6: Relation between GDP per capita growth 2000-2014 and secondary (top) and tertiary (bottom) education levels in 2000 at NUTS 3 level*

## 2.3 Regional competitiveness clusters

The regional competitiveness in the short- and medium-term is a component of the overall evaluation of the territorial socio-economic trends in the EU. Three inter-related features of local economies, in addition to the two overarching indicators (GDP per capita and total employment), are proposed for consideration[22] hereinafter:

- ✓ Employment in lower productivity sectors, in particular – agriculture. Regions with a high share of employment in agriculture have proven to be typically more vulnerable and can potentially experience lower growth.
- ✓ Employment in higher productivity sectors – opposite to the previous parameter and usually includes the employment in manufacturing and high-level services, which are the main drivers of the economy.
- ✓ Young dependency ratio. The young dependency ratio represents the share of population less than 15 years old over the working age (15-64) population. It generally defines the sustainability of the health and pension system. A higher dependency means a higher substitution rate of working age people with young people, and thus less pressure on health and pension system.

Out of all possible combinations, four generalised clusters of regions at NUTS 3 level are defined (Figure 7) according to the following levels of competitiveness:

a. Very low – with very low levels of GDP per capita, total employment and employment in productive sectors, but with very high employment in low productivity sectors and very high young dependency ratio.

b. Low – having high employment shares in agriculture and low shares in productive sectors. These regions are peculiar with both low GDP per capita and total employment rate, but with a high young dependency ratio.

c. Moderate – with high employment shares in productive sectors and low shares in agriculture. Their GDP per capita and the total employment rate are high, but the young dependency ratio is low.

d. High – having very high GDP per capita, total employment and employment share in productive sectors. The dependency ratio is very low, as well as the employment in agriculture.

| **Competi-tiveness Clusters** | GDP per capita | Total employment | Low productivity employment | High productivity employment | Young dependency ratio |
|---|---|---|---|---|---|
| **Very low** | Very low | Very low | Very high | Very low | Very high |
| **Low** | Low | Low | High | Low | High |
| **Moderate** | High | High | Low | High | Low |
| **High** | Very high | Very high | Very low | Very high | Very low |

*Figure 7: Generalised definition of the four competitiveness clusters of NUTS 3 regions in the EU*

The distribution of these four clusters at NUTS 3 level on the EU territory is presented in Figure 8 (for the years 2000 and 2005) and in Figure 9 (for the years 2010 and 2014).

[22] Combined through a Principal Component Analysis.

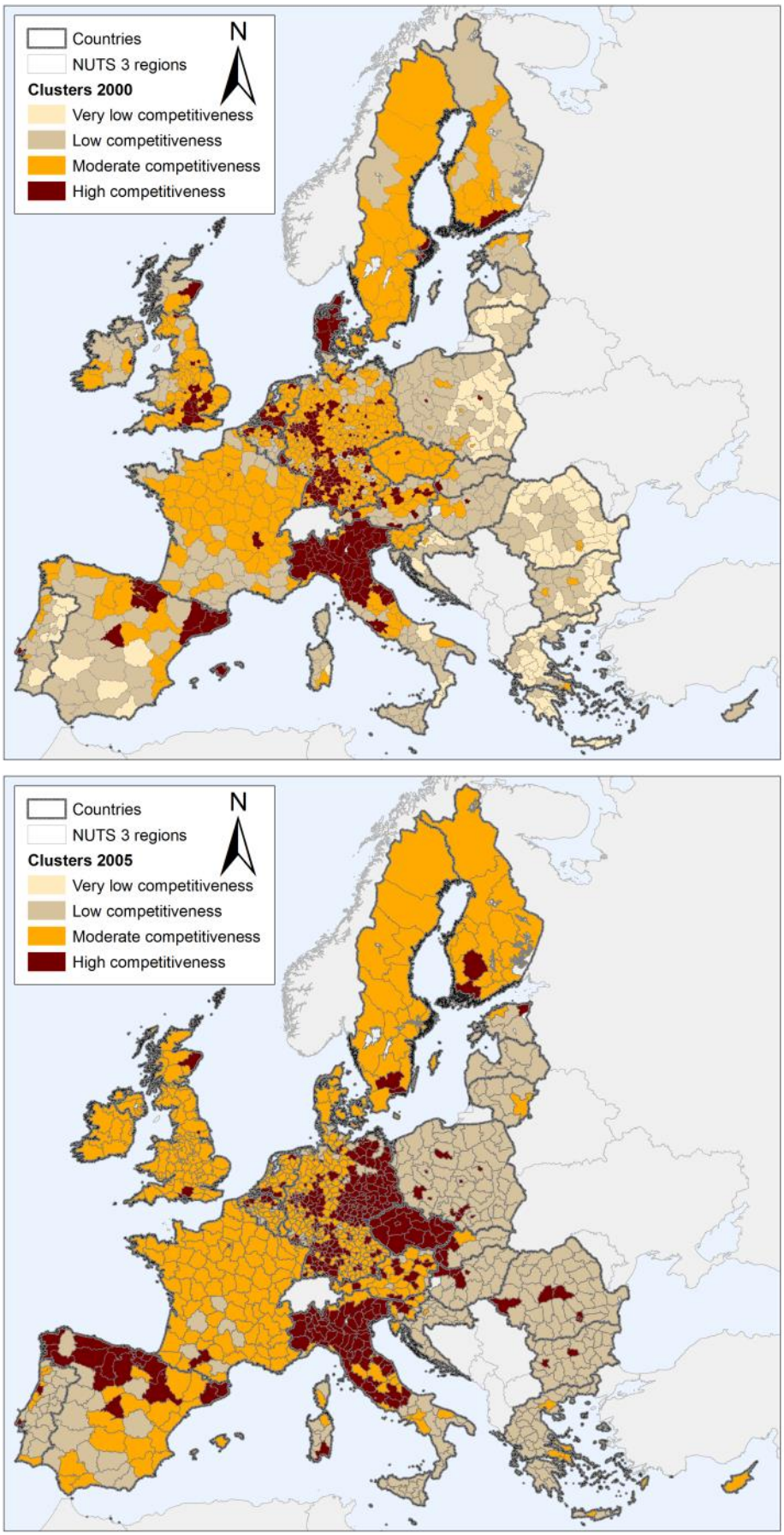



*Figure 8: EU cluster maps of relative competitiveness at NUTS 3 level for 2000 (top) and 2005 (bottom). Data sources: Cambridge Econometrics and OECD*

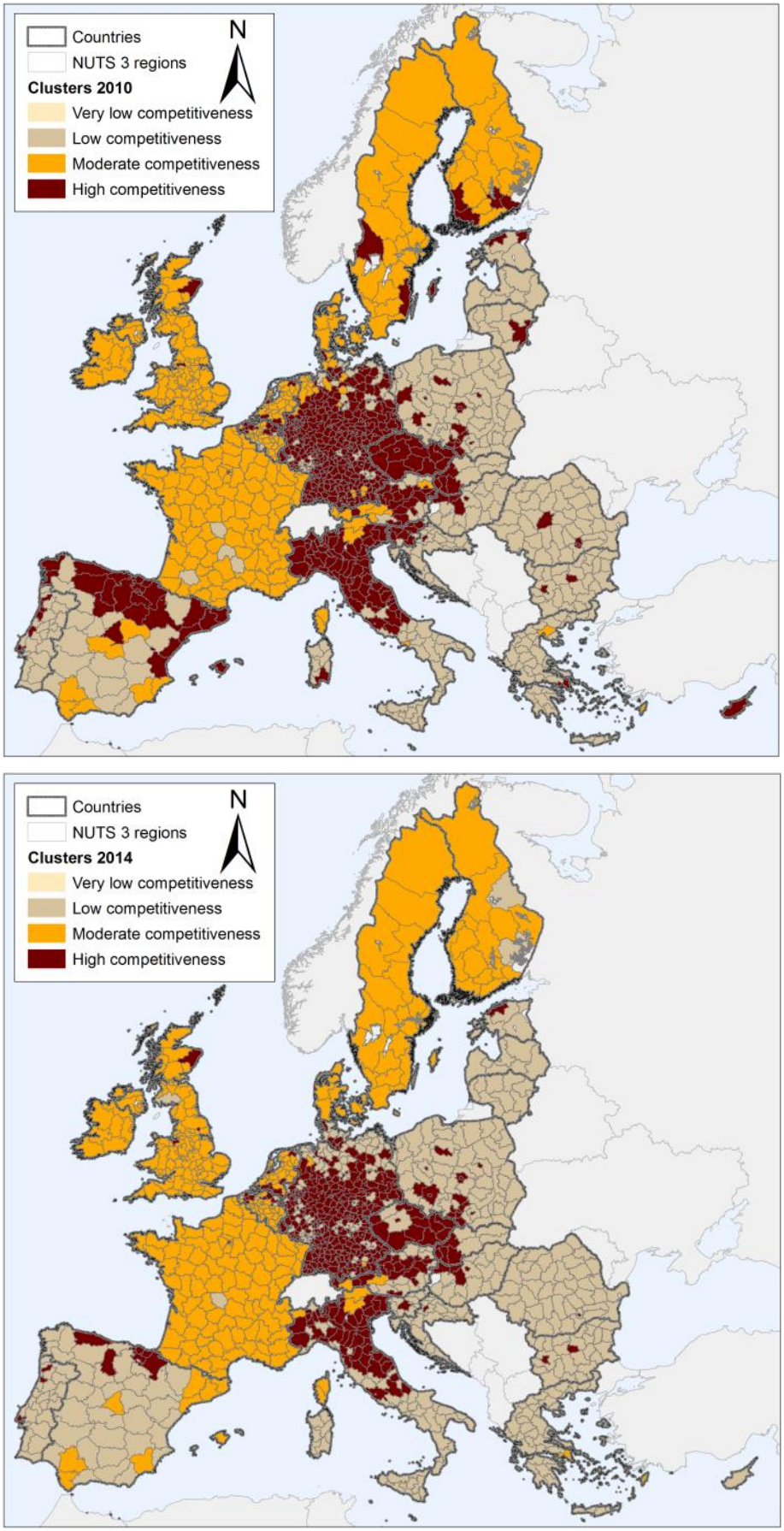



*Figure 9: EU cluster maps of relative competitiveness at NUTS 3 level for 2010 (top) and 2014 (bottom). Data sources: Cambridge Econometrics and OECD*

Figure 8 reveals that in the year 2000 the situation was quite diverse not only EU-wide, but also nation-wide. The highly competitive regions were largely located in northern Italy and Denmark, as well as in some areas of Spain, the UK, Germany, Austria, Benelux and other (besides Denmark) Scandinavian countries, typically around the main cities. At the other extremity, regions with low and very low competitiveness were observed in Eastern and Southern Europe, including in countries with highly competitive regions (e.g. in the southern parts of Italy and Spain), pointing out wide disparities at national level (e.g. in Ireland and Finland). Moderately competitive regions were also quite dispersed across the EU – in the UK, France, Benelux countries, Germany, Czech Republic, Austria, Slovenia, Hungary, Sweden and Finland.

Within 2000-2005 there was a general upward trend of development. All regions with very low competitiveness managed to progress into the low competitiveness category and hence, the so-defined very low competiveness class disappears from the EU map, proving thereby successful convergence. Quite a few regions in Germany and Spain, but also in Italy, Czech Republic (the whole country) and Slovakia, Sweden and Finland managed to convert from moderately to highly competitive. Conversely, Denmark and the UK experienced the opposite shift – from high to moderate competitiveness. Low competitiveness largely evolved into moderate competitiveness in the UK, Ireland, France, Spain, Austria, Sweden and Finland.

Within 2005-2010 the upward trend commonly continued, but at a relatively slow pace, as the first signs of the crisis became visible. The most widespread evolution from moderate competitiveness into high competitiveness occurred in Germany, followed by Italy, Spain, Austria, Slovenia and Slovakia. On the other hand, there were regions in Spain, Italy and Greece that stepped back in terms of competitiveness.

By 2014 the negative impacts of the economic downturn were still visible, Spain and Slovenia being hit the hardest. Downward trends were also observed in Germany, Czech Republic, Austria, Slovenia and Italy. There were no cases of convergence from moderately competitive into highly competitive regions.

## 2.4 Territorial resilience capacity

As already revealed in section 2.3, the economic and financial crisis that started in 2008, spread asymmetrically in time, strength and speed across EU regions. Not all regions experienced a strong economic decline and the territorial impact of the crisis varied greatly also within the same country. While some regions experienced a swift return to pre-crisis levels of employment and output, the recovery was much more protracted in many other regions, which entered a period of sustained stagnation. In this complex and heterogeneous context, we accounted for the importance of a balanced territorial development, conceived as one of Europe's core priorities both from the Territorial Agenda 2020 and Europe 2020 strategy.

The resulting composite "Regional Resilience Indicator" to external shocks is defined by two processes:

- ✓ the so-called *slow burning process*, which measures the capacity, built over time in a region to cope with a crisis. During this process policy-induced changes can strengthen the resilience capacity of a region.
- ✓ the *shock wave* or *dynamic process*, which is based on the immediate exposure to an unexpected shock, which a region can exercise rather limited control over.

A three-step approach was followed for the identification of regional disparities in the resilience capacity to crisis - data collection and indicators selection, weighting and aggregation and pattern, and spatial clusters analysis[23].

Figure 10 illustrates the resilient capacity of the 278 NUTS 2 regions in the EU to the economic and financial crisis. The Regional Resilience Indicator varies between 0 and 1, where the lower values represent less resilient regions (in lighter colours), while the higher values – the more resilient regions (in darker colours). The data from Figure 10 reconfirm the strong disparities in the resistance and recovery capacities of EU regions. There is a very limited number of highly resilient NUTS 2 – the capital ones of Hungary, Slovakia, Czech Republic, Hamburg in Germany, as well as Luxembourg and Malta (as whole countries). These front-runners are followed by quite a large group of resilient regions, which encompasses the Baltic States (Lithuania, Latvia and Estonia), many regions in Germany, Austria and the UK, some NUTS 2 in the Netherlands, Sweden, Finland, Poland and Romania, as well as single regions in Ireland, Denmark (Copenhagen), France (Paris), Italy (Bolzano), Czech Republic, Hungary and Bulgaria. At the opposite end, many NUTS 2 in the EU Member States that suffered the most from the economic and financial crisis, rank at the bottom of the EU regional resilience. These include Greece (almost the whole country, except for Athens and few islands, which are traditional touristic hotspots), Italy and Spain (mostly their Southern parts, including the two main Italian islands – Sicily and Sardinia), as well as one region in Belgium and Bulgaria.

Figure 10 also suggests the existence of some kind of regional resilience clustering in the EU. Regions with relatively high level of resilience are often surrounded by other, generally highly resilient regions. Good examples of this high-resilience clustering are the UK and Germany. The high resilience clustering is not always constrained by national border, as illustrated by the North-South regional strip in Germany, Austria and Italy. The opposite is, however, also true. Relatively less resilient regions are often surrounded by other, less resilient regions and national borders do not always prevent spreading the negative trends. The relatively less resilient circle around Paris in France is an obvious example of this phenomena, while the already identified lagging Southern strip that crosses Greece, Italy

[23] `Data collection and indicators selection was done based on annual data in 2005 constant euro price over the period 2000-2015 from Cambridge Econometrics' European Regional Database (GDP per capita, employment rate and productivity, defined as GDP per employee). As regards weighting and aggregation, a multivariate method usually applied for space reduction, namely the Principal Component Analysis (PCA) has been used for weight elicitation. Finally, for the pattern and spatial clusters analysis, a global Moran's I has been performed to investigate the presence of spatial clusters.

and Spain [albeit direct contagion might be partially questioned due to landscape (sea) barriers] is the clear pan-EU example.

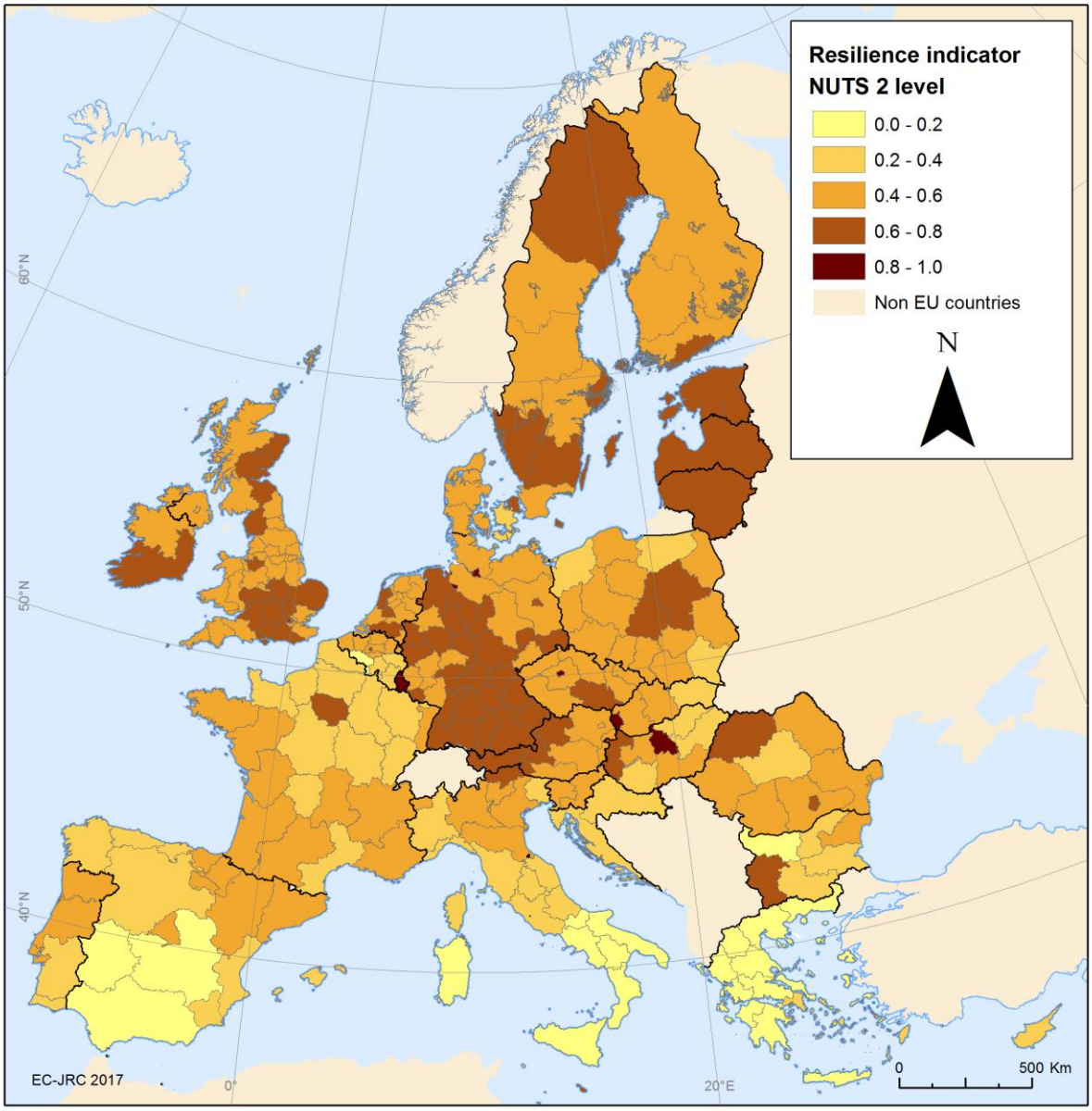



*Figure 10: Regional resilience within 2000-2015 in the EU at NUTS 2 level*

Figure 10 clearly reveals that in the majority of cases national borders really matter. Amongst others, this is due to historical differences in socio-economic development, fiscal and monetary policies, etc. In this context, Figure 11 plots the regional degree of resilience by country. With some exceptions, regions tend to center on national averages, despite a visibly pronounced variability within countries.

As also shown in Figure 10, the resilience clustering (positive or negative) is however not always constrained by national borders. Figure 12 further explores those cross-border correlations and identifies statistically significant spatial clusters of high resilience and low resilience regions, confirming thereby the divide within countries. Southern regions of Italy, Spain and Portugal, as well as Greece and Cyprus belong to a group of 'cold-spot' regions, while a cluster of highly resilient regions is located in northern Sweden, southern Denmark and Finland, Latvia (as a whole country), central and southern Germany and neighbouring regions in Czech Republic and Austria, and around London.

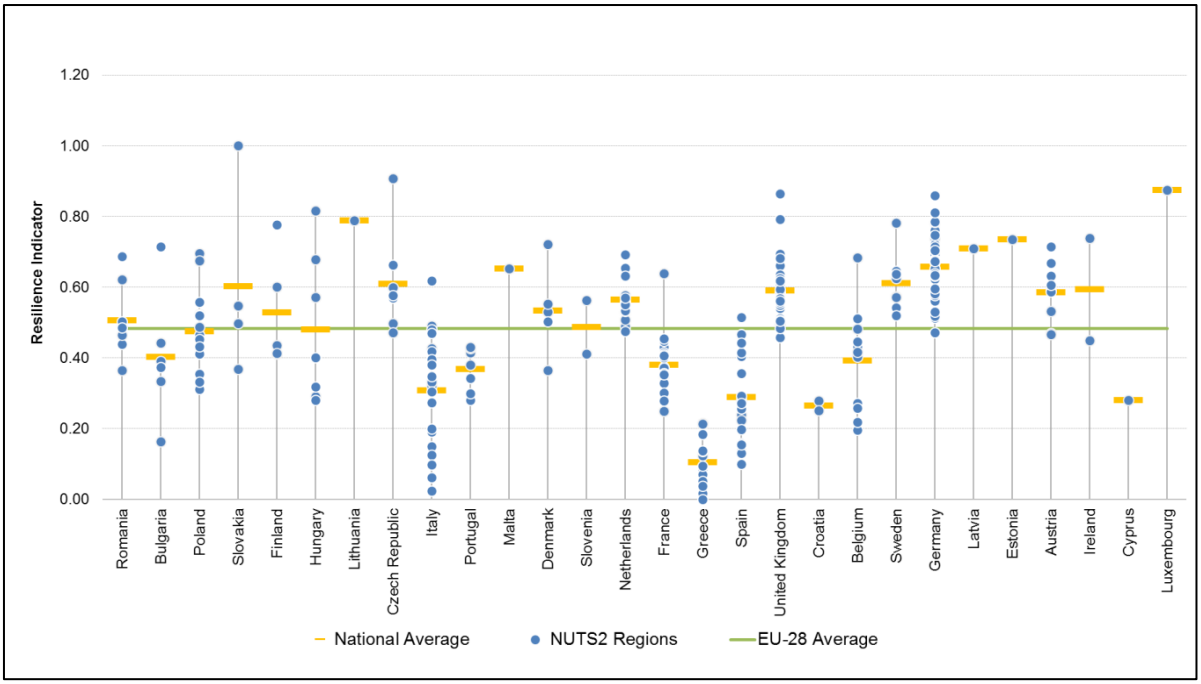



*Figure 11: Resilience indicator by NUTS 2 regions and countries in the EU*

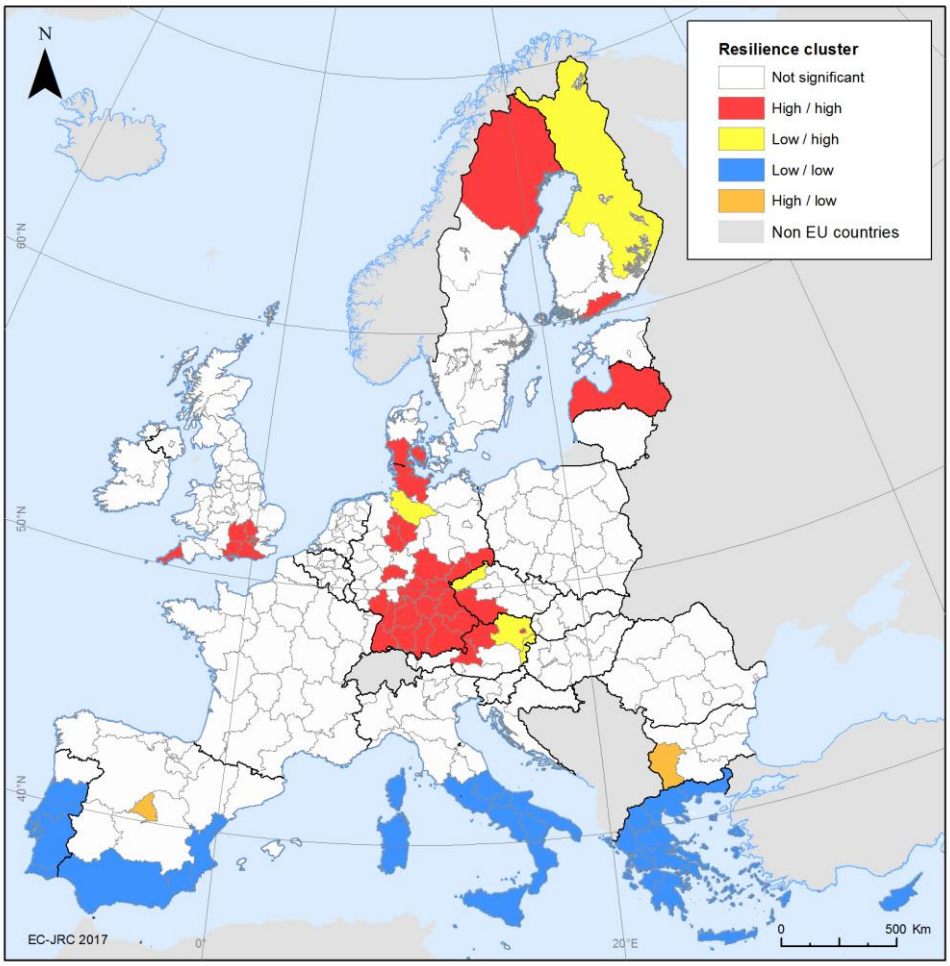



*Figure 12: Statistically significant spatial clusters of high resilience and low resilience regions at NUTS 2 level. Legend: Red – high resilience regions surrounded by other high resilience regions (HH); Blue – low resilience regions surrounded by other low resilience regions (LL); Yellow – low-resilience regions surrounded by high resilience regions (LH); Orange – high resilience regions surrounded by low resilience regions (HL)*

# 3 Cities and urban areas

## 3.1 Reference demographic and economic projections

The macroeconomic trends of the Territorial Reference Scenario are primarily based on DG ECFIN projections, which include variables such as Gross Domestic Product (GDP), employment, productivity and labour force. DG ECFIN's projections rely on EUROPOP 2013 demographic projections for the period 2015-2060 and are originally released at national (NUTS 0) level. These pan-EU projections are plotted together and summarised in Figure 13. Figure 13 reveals that GDP is expected to almost double between 2015 and 2060, but employment will tend to slowly decline especially after 2025, while population will slightly increase mostly until 2040.

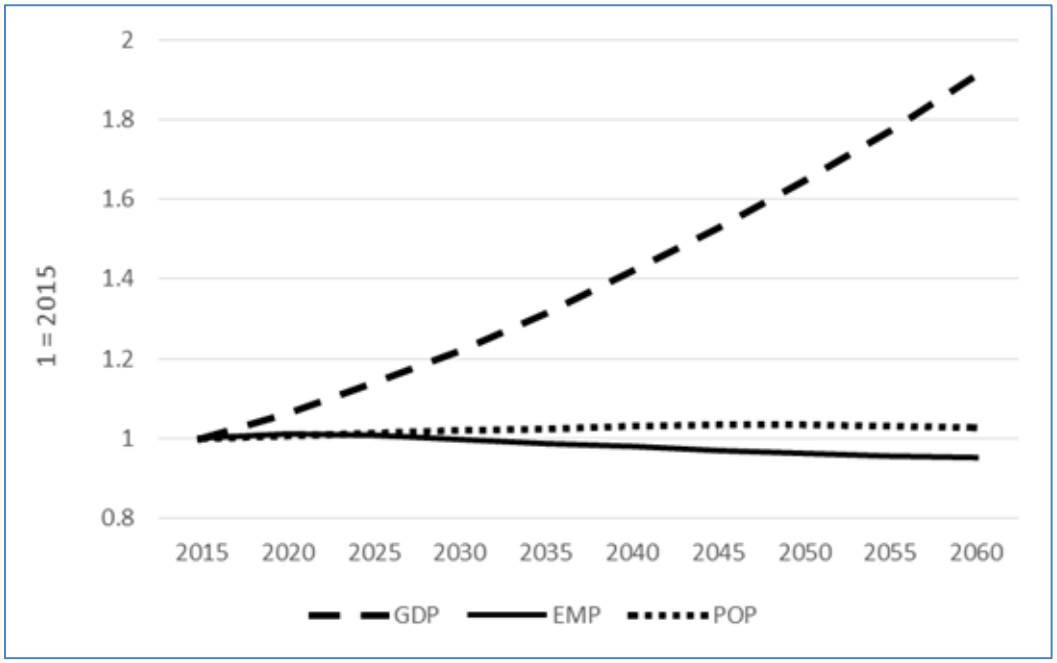



*Figure 13: Overall trends for GDP, employment and population in the EU, 2015-2060 (Source: Batista et al., 2016)*

The national level projections were disaggregated to regional NUTS 3 level, assuming that past regional and sector growth rates would be maintained over time. The variables were then rescaled to fit the national totals from the reference projections (Batista e Silva et al., 2016).

Figure 14 presents the projected average annual growth rates of GDP for the period 2015-2060, while Figure 15 shows the GDP/capita in 2060 relative to the EU average. Figure 14 reveals that although GDP in the EU is projected to increase significantly (as illustrated in Figure 13), substantial differences are likely to persist not only amongst different EU member states, but also within countries, amongst their regions. For example, Sweden is expected to enjoy one of the largest incremental GDP growth in the EU, but it will be more pronounced in its Northern regions. Important regional differences are projected also for Spain, France, Poland, Czech Republic, Slovakia, Hungary, Bulgaria and Romania.

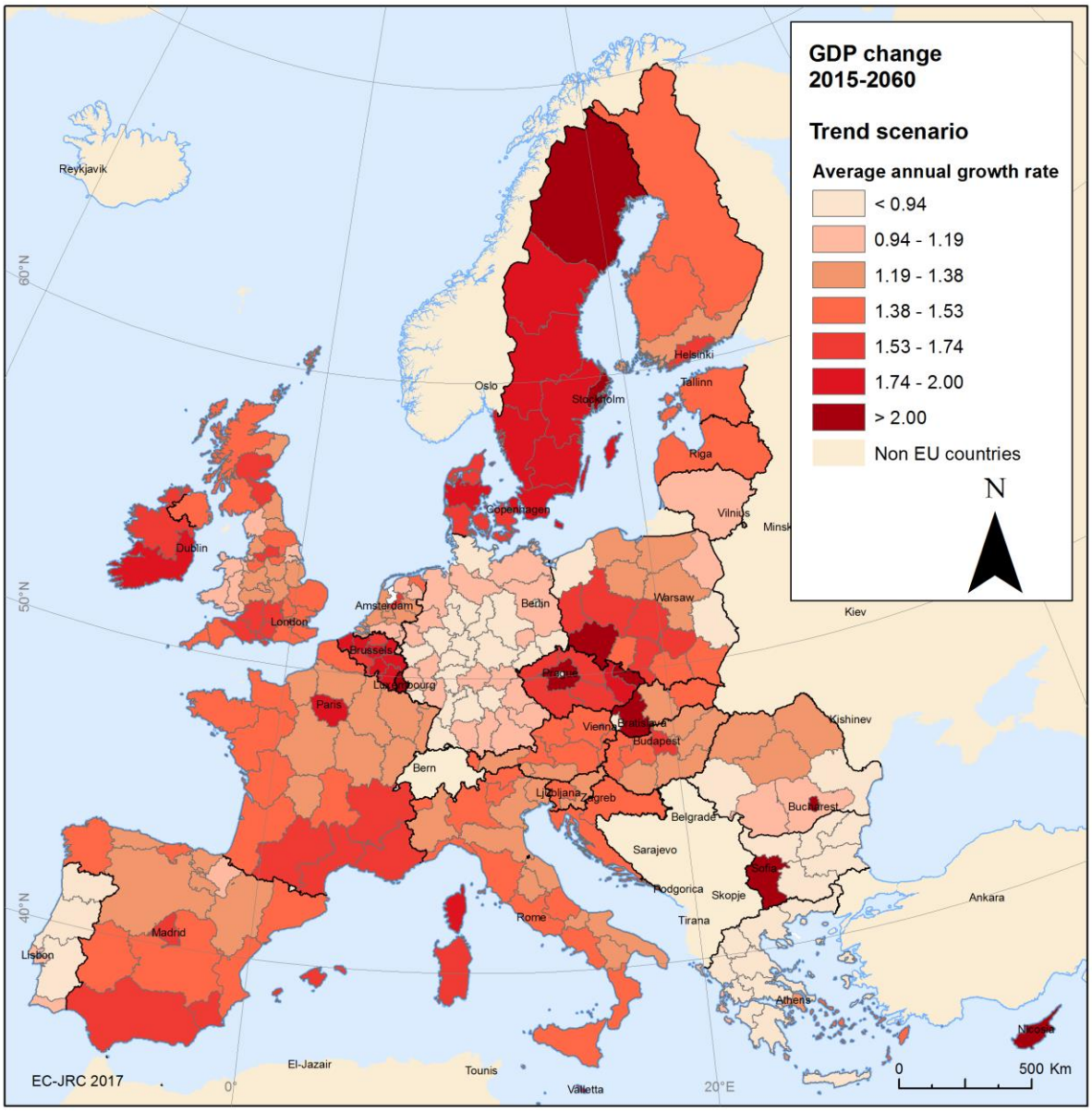



*Figure 14: GDP growth rates per NUTS 2 for the Reference Scenario*

The so-projected trends in GDP evolution will result in quite a diverse picture of GDP per capita relative to the EU average in 2060 (Figure 15). Germany, the Netherlands, Austria, Sweden, Finland, Lithuania, Latvia and Estonia will enjoy high levels of GDP per capita, which will be equally distributed across regions. Northern parts of Spain, France and Italy, as well as Southern Ireland will largely see high GDP/capita, too. Conversely, substantial differences in GDP/capita amongst regions will be (still) observed in many Central and East European countries, such as Greece, Bulgaria, Romania, Hungary, Czech Republic, Slovakia and Poland, where often the capital region will outperform by far the rest of the country. Southern parts of Belgium and Italy will continue to under-perform at national level, too.

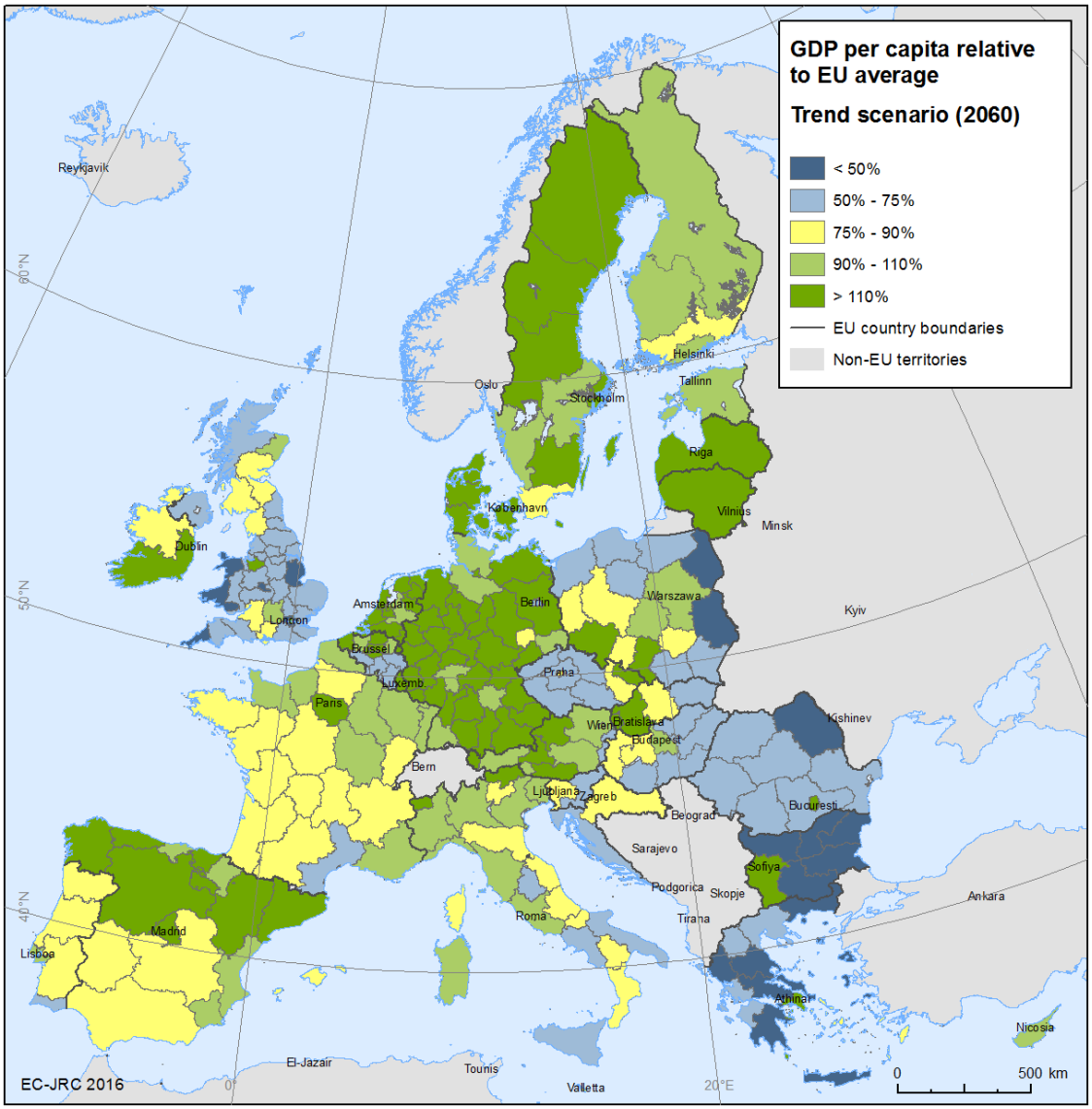



*Figure 15: Geographical distribution of GDP per capita (PPS) in 2060 relative to the EU average per NUTS 2 (Source: Batista et al., 2016)*

Figure 16 and Figure 17 present the projected employment and population change respectively at NUTS 2 level for the period 2015-2060[24]. The estimates of employment dynamics (Figure 16) reveal a similarly diversified (to the GDP evolution – Figure 14) picture. Again, Sweden, but this time – joined by Belgium, is the EU frontrunner, but unlike GDP, the employment growth is more evenly distributed across Swedish territory. In many countries (Spain, France, Belgium, the Netherlands, Italy, Austria, etc.), the regional employment trends are generally in line with the respective GDP trends, i.e. when the GDP grows, employment grows, too. There are, however, also regions, mostly in Central and Eastern Europe (e.g. Poland, Slovakia, Hungary, Slovenia) where diverging trends are expected, i.e. GDP grows, but employment declines, suggesting processes of productivity increase. Finally, huge differences in employment trends are projected also nationwide, in particular amongst the regions in Romania and Bulgaria, where capital regions will outperform by far all the others.

[24] The regional demographic projections have been dynamically allocated at NUTS 3 level for each time step (every 5 years) throughout the simulation period (2015-2060).

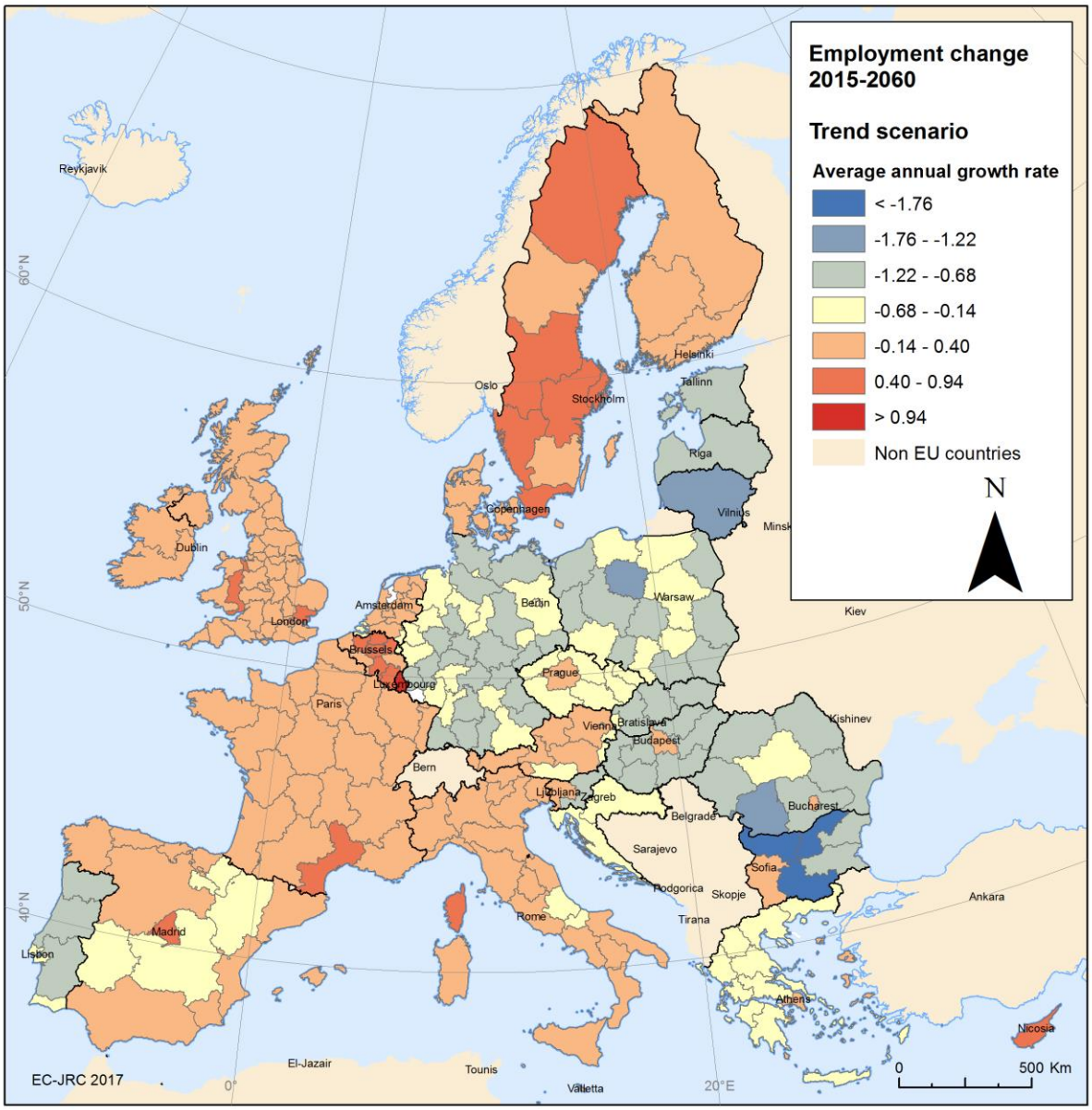



*Figure 16: Employment growth rates per NUTS 2 for the Reference Scenario*

The projected population change at (Figure 17) does not necessarily correlate with the employment change (Figure 16), especially at regional level. The variations in regional population dynamics will be generally greater than the variations in regional employment dynamics within countries. Population is projected to grow in a number of regions of Spain, France, Belgium, Ireland and Italy. Population will increase also in the capital and other major cities regions in Sweden, Finland, Germany, Czech Republic, Hungary, Romania and Bulgaria. Some traditional holiday spots, such as Balearic Islands, Corsica, Crete and Cyprus, are also expected to experience a boost in population. At the other end, the largest loss of population is projected for Eastern Germany and North-eastern Bulgaria. Baltic countries, Portugal (except for Lisbon and Algarve), as well as large areas in Spain (meaning internal migration – see above), Greece, Bulgaria, Romania, Hungary, Slovakia, Poland and Germany will also suffer of shrinking population. At national level, the differences between population dynamics and employment dynamics are much less pronounced and generally follow similar patterns. For both indicators, Sweden and Belgium are likely to be the EU front-runners, while Portugal, Bulgaria, Latvia and Estonia are coming last.

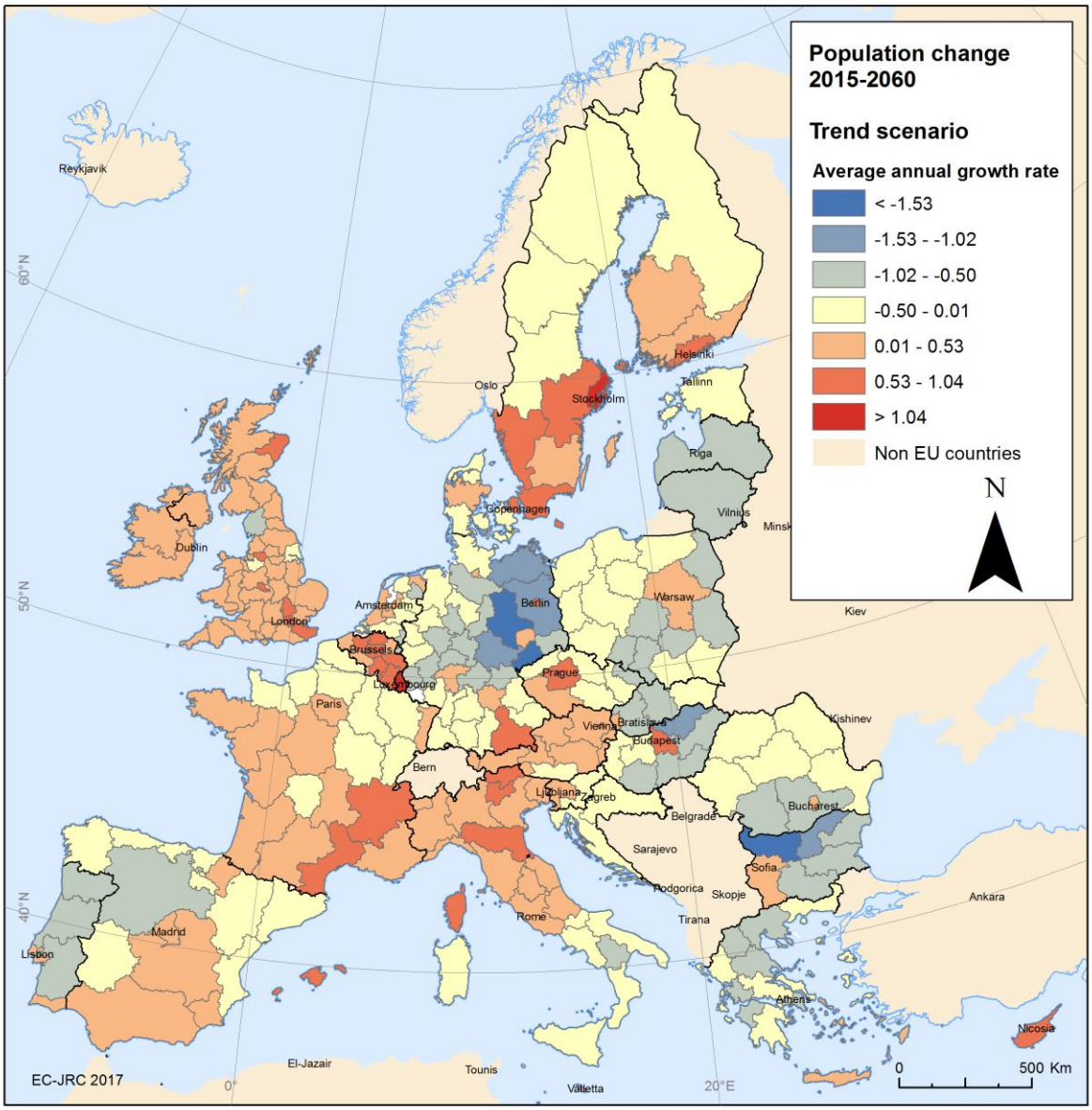



*Figure 17: Population growth rates in 2060 relative to the EU average per NUTS 2 (Source: Batista et al., 2016)*

## 3.2 Urbanisation trends

The analysis from section 3.1 revealed that in many EU countries, the regions that host capitals, cities and sometimes even smaller towns are peculiar with much stronger GDP growth, more employment opportunities and hence, boost population compared to the other parts of the countries. About 75% of the EU population today is concentrated in various types of urban areas (Figure 18[25]), more specifically about 40% in capitals and other big cities and the remaining 35% in towns and suburbs. Consequently, only 25% of EU citizens live in the vast rural areas.

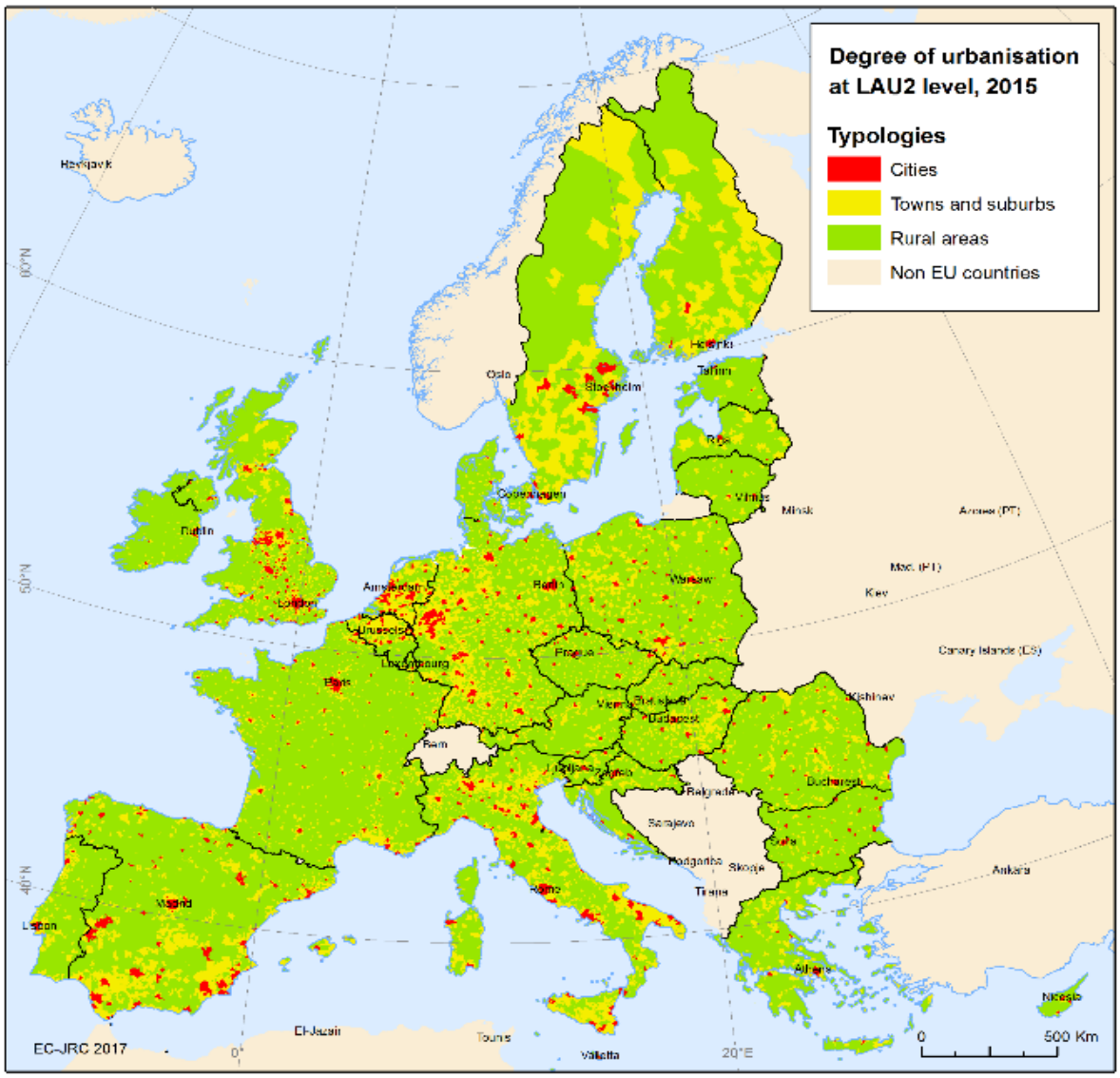



*Figure 18: The degree of urbanisation by communes (LAU2 level – see Annex II) in the EU, 2015*

Important differences can, however, be observed at national and regional levels. According to Figure 19 the population distribution among different degrees of urbanisation is very diverse across the EU. Malta, the Netherlands, the United Kingdom, and Spain have 50% or more people living in cities, whereas Slovakia and Slovenia – with only some 15% of the population living in cities. Rural population accounts for 35% or more in a number of

[25] The degree of urbanisation was computed based on the techniques described in Dijkstra and Poelman (2014) and Kompil et al. (2015, p.20) using LAU2 as classification units.

countries, such as Austria, Croatia, Ireland, Estonia, Latvia, Romania, Poland, Slovenia, Slovakia, Denmark and France. In contrast, rural population is particularly low (below 15%) in Malta, the Netherlands and Belgium. In Belgium, Germany, Luxembourg, Sweden, Finland and Italy the population is predominantly located in urban areas classified as towns and suburbs (40% or more).

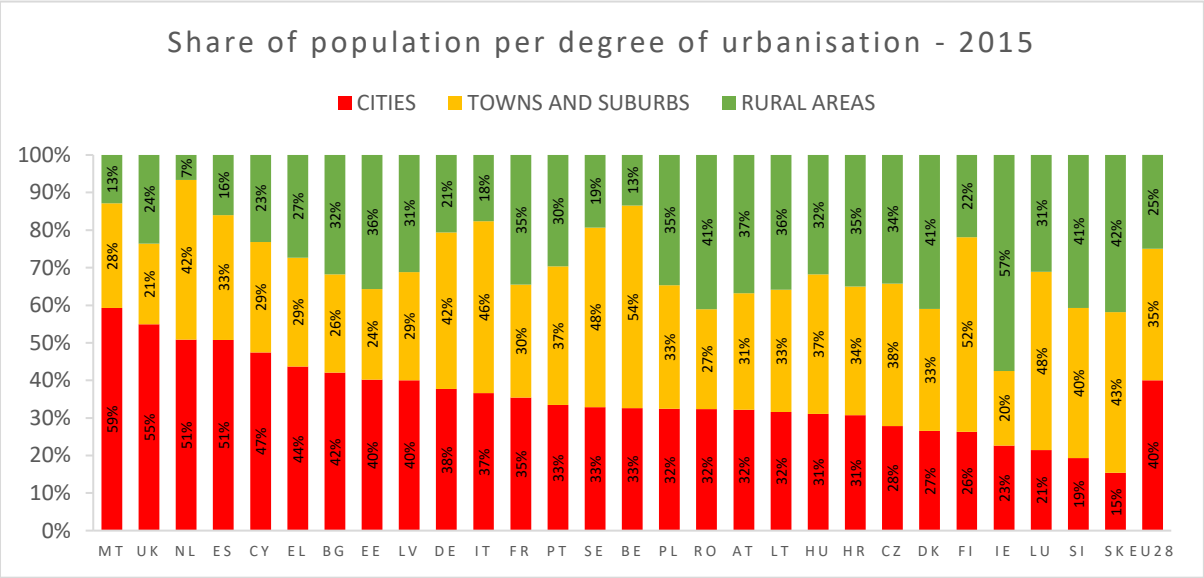



*Figure 19: The share of people living in cities, towns & suburbs and rural areas in EU Member States in 2015.*

Given the large proportion of EU population living in urban areas and consequently, its importance for the overall demographic trends, the urban population analysis is further disaggregated at finer, NUTS 3 level. Figure 20 presents the urban population density in 2015, while Figure 21 illustrates the projected urban population dynamics between 2015 and 2030.

Figure 20 confirms that NUTS 3 regions that contain capitals or other major cities are peculiar with the highest urban population density. More specifically, the NUTS 3 regions hosting substantial (above 1.5 million) urban population are:

- Spain: Madrid (6.4), Barcelona (5.4) and Valencia (2.5);
- Italy: Rome (4.2), Milan (3.2) and Naples (3.1);
- Germany: Berlin (3.5);
- Portugal: Lisbon (2.8) and Porto (1.7);
- France: Paris (2.3), Hauts-de-Seine (1.6) and Seine-Saint-Denis (1.5);
- Sweden: Stockholm (2.2) and Västra Götalands (1.6);
- Romania: Bucharest (1.9),
- Austria: Vienna (1.8);
- Hungary: Budapest (1.8);
- Finland: Helsinki (1.6).

Besides capitals and other big cities, substantial urban population is also residing in Important economic and industrial centres (e.g. South UK, Western Germany, Northern Italy), as well as in traditional holiday zones (e.g. Balearic islands, Mediterranean coasts of Spain and France, Sicily, Cyprus). Densely populated countries, such as Belgium and the Netherlands, are also distinct with high urban population densities.

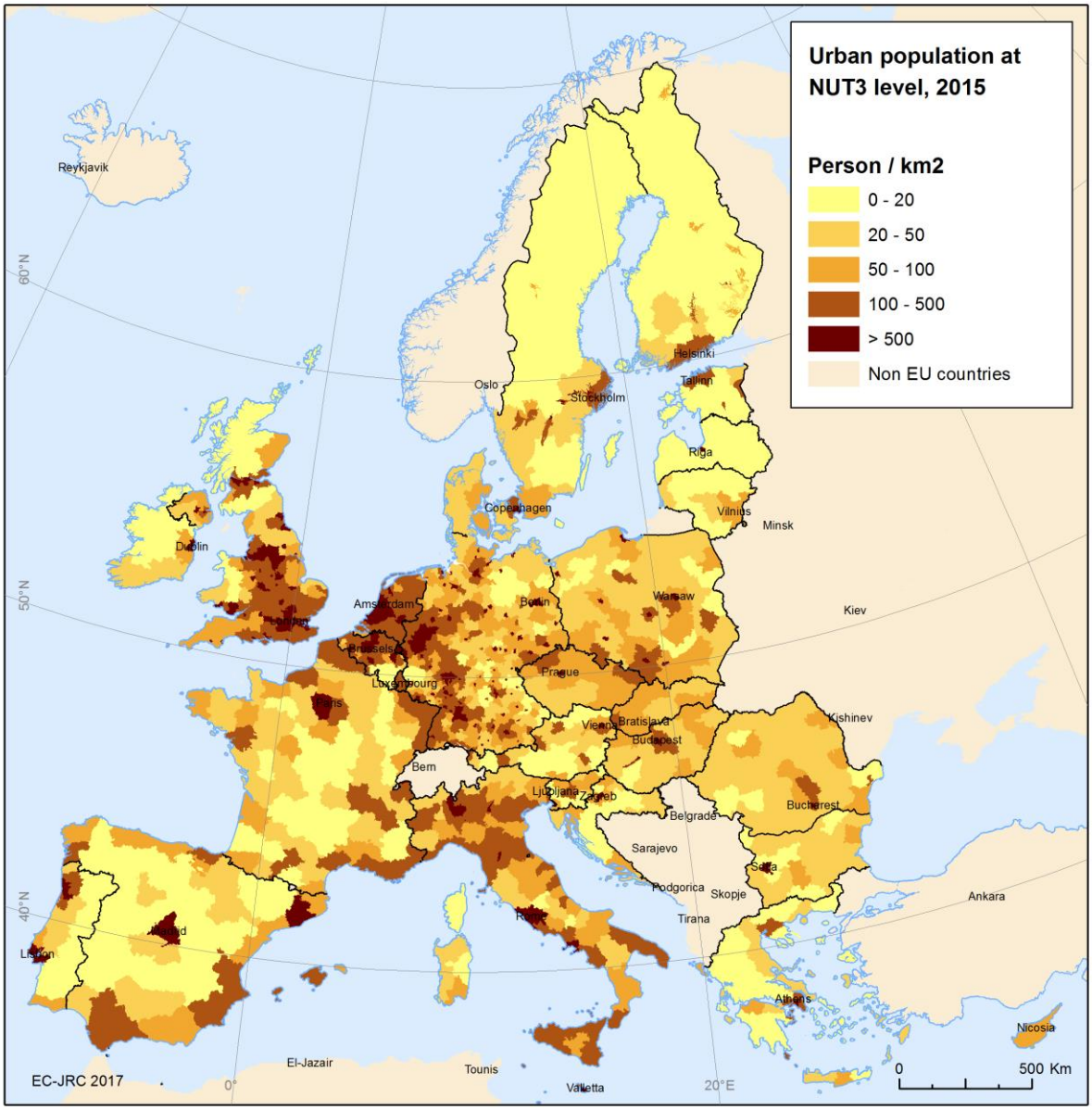



*Figure 20: Urban population density at NUTS 3 level in the EU in 2015, in persons per square kilometre*

Figure 21 reveals that most NUTS 3 regions with major cities are expected to experience population growth. The largest increase is anticipated for Stockholm (almost 60%). Some groups of NUTS 3 regions are also projected to undergo steep (>35%) growth in their urban population, particularly in Southern France, Northern Italy and Southern Germany, but also selected regions in Ireland, Belgium and Austria. On the other side, losses of population are projected for core cities in Spain (Madrid, Barcelona and Valencia), Portugal (Porto), and Lithuania (Vilnius). Clusters of NUTS 3 regions with steep (<-35%) declines in urban population are identified in Portugal, Bulgaria, Greece, Hungary, Lithuania, Latvia, Poland, central and Northern Spain, Northeast Germany, Southern Romania. The data from Figure 21 suggest that often these urban population cutbacks seem to be due to the some kind of "suction" by the capitals or other big cities from the surrounding smaller cities or towns. Such indications are observed in many Central and Eastern countries, such as Estonia, Latvia, Poland, Slovakia, Hungary, Croatia, Romania, Bulgaria, but also in Greece and Portugal, and even – in Germany.

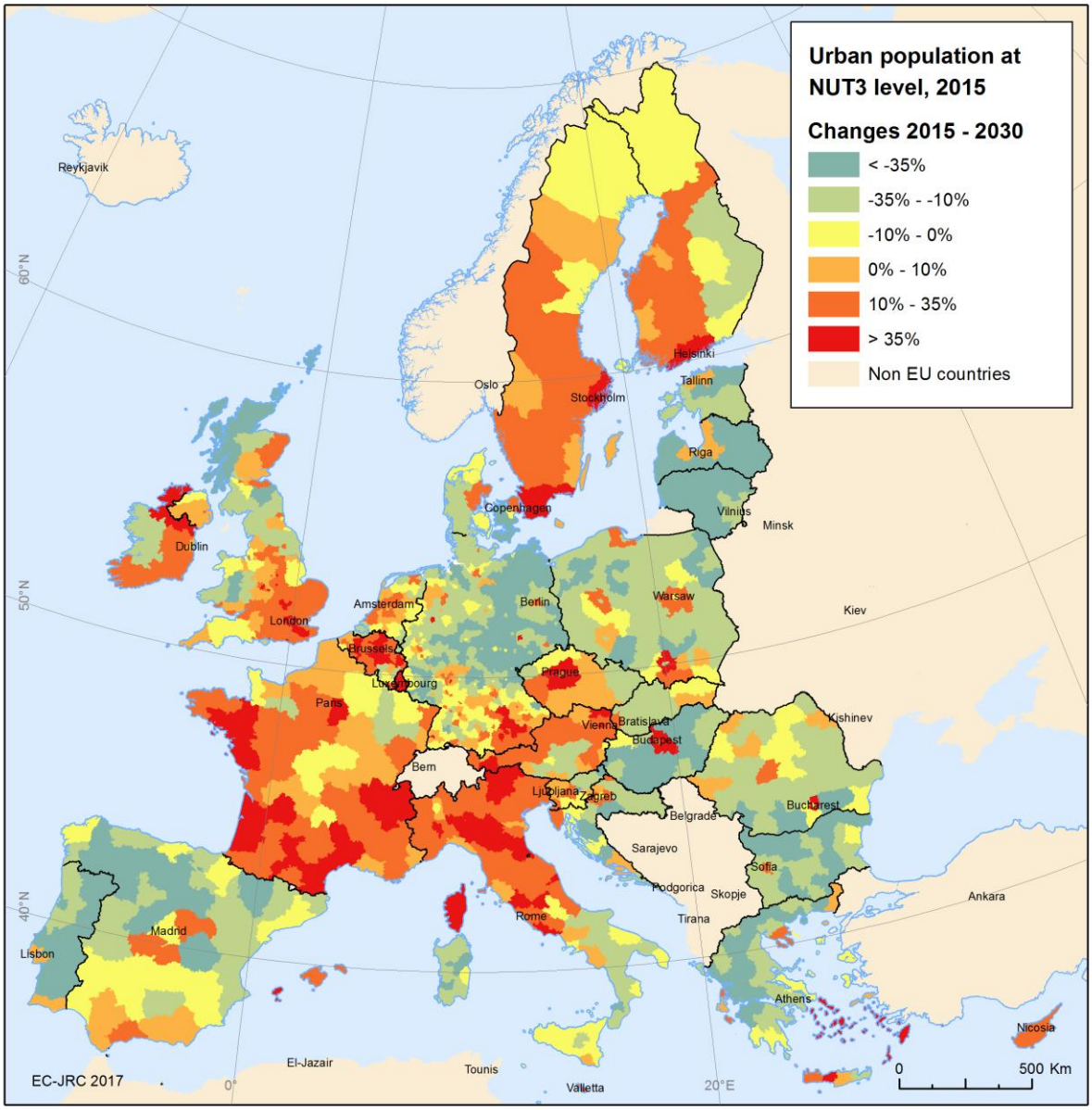



*Figure 21: Urban population change at NUTS 3 level in the EU between 2015 and 2030, in percentage*

## 3.3 Historical trends in urban land use density

Large and dense cities generate positive impacts as a result of agglomeration effects, in particular increasing returns to scale and economies of scale. Urban agglomerations also drive innovation processes and thereby – growth and productivity, as they offer more services and opportunities for interaction and exchange. They tend to generally use resources (e.g. energy, land, materials) more efficiently[26] when compared to smaller cities or rural areas. Monitoring growth of cities over time in terms of their physical and demographic size is therefore very important for both economic and environmental reasons.

In this section we look at the evolution of the urban land use density, herein defined as the average number of inhabitants per hectare of residential built-up, in the EU over the period 1975-2010. A region with higher population density holds, on average, more people for each hectare of residential built-up than a region with lower population density. In other words, the same number of inhabitants can be accommodated using less land in the former region (more land use-efficient) than in the latter (less land use-efficient).

The main data sources on which this study (Batista, et al., 2017) was based include the 'Global Human Settlement Layer' (European Commission, Joint Research Centre) and a time series population statistics per municipality (European Commission, DG REGIO).

Figure 22 presents the share of built-up areas[27] per NUTS 3 for the most distant (1975) and recent (2010) years of the available time series. The data indicate that the share of built-up areas increased widely and significantly during this period in France, Belgium, The Netherlands, Germany, Italy, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Cyprus, etc., in particular in the main metropolitan areas and in the coastal zones, which represent major touristic hotspots.

The trend in population density (Figure 23) was, however, the opposite. It declined from the European average of 106 inhabitants per hectare of residential build-up area in 1975 to only 75 inhabitants in 2010. The reduction took place mostly between 1975 and 1990.

The distribution of urban density at NUTS 3 level in 1975, 1980 and 2010 is shown in Figure 24. Two principal evolutions within 1975-2010 ought to be highlighted

- the growing number of regions with low population densities, and
- the abrupt reduction in the number of heavily packed (400+ inhabitants / ha of residential built-up) regions.

The observed decline in urban density, however, seems to be losing steam over time. In fact, the main reduction in urban land density was observed in the period 1975-1990, with the decline slowing down substantially afterwards (Figure 23).

[26] Jaeger J., Bertiller R, Schwick C. and Kienast F., (2010) "Suitability criteria for measures of urban sprawl", Ecological Indicators 10(2): 427–441.

[27] Defined as percentage of the surface occupied by built-up versus the total surface of each NUTS 3 region

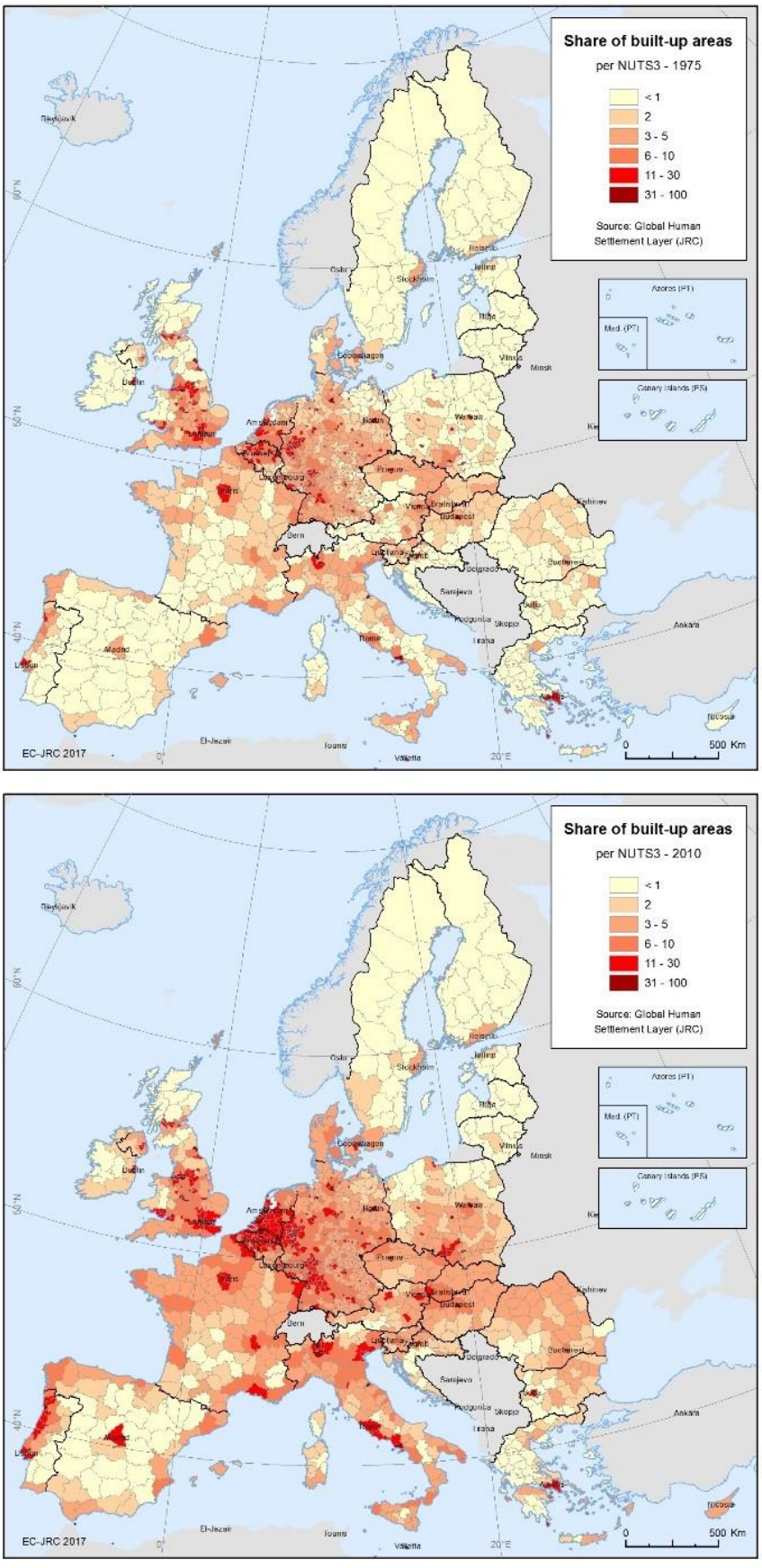



*Figure 22: Share of built-up areas per NUTS 3 in 1975 (top) and 2010 (bottom) in percentage (%).*

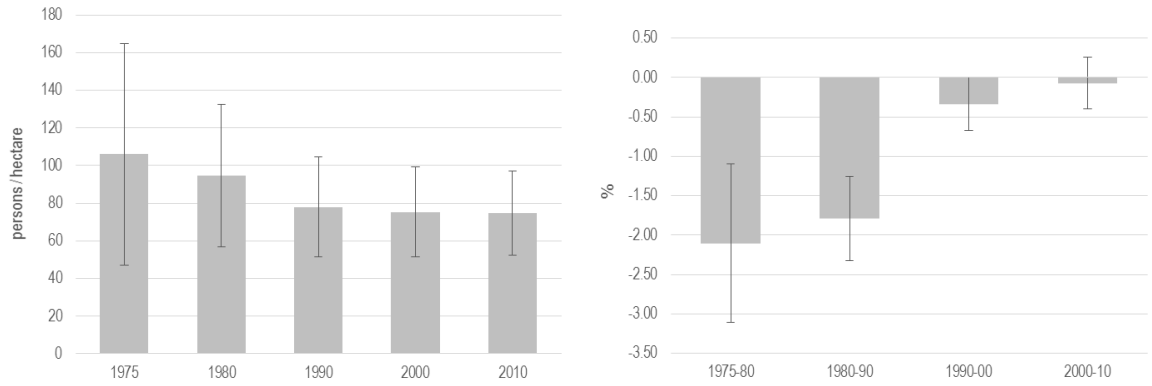



*Figure 23: Average urban density in Europe's regions (left hand side) and average annual urban density growth rate (right hand side) within 1975-2010*

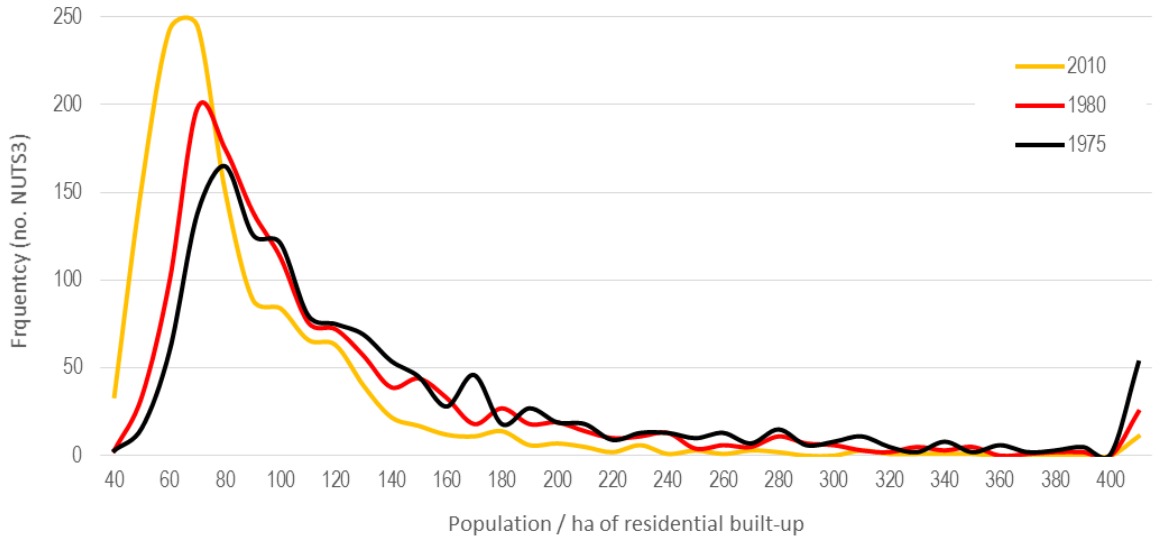



*Figure 24: Distribution of urban density levels at NUTS 3 level in 1975, 1980 and 2010*

The analysed data indicate that in the period 2000-2010, despite the still slight overall decrease in urban land density at EU level (Figure 23), a significant number of regions observed increases in urban density (see Figure 25, bottom map). This means that in recent years, urban areas in many European regions, primarily in Spain, France, Italy, Ireland, the United Kingdom and Belgium, but also in Germany, Sweden, Poland, Czech Republic, Austria, Slovenia, Hungary, Greece, Cyprus, etc. may have started to (re-) densify.

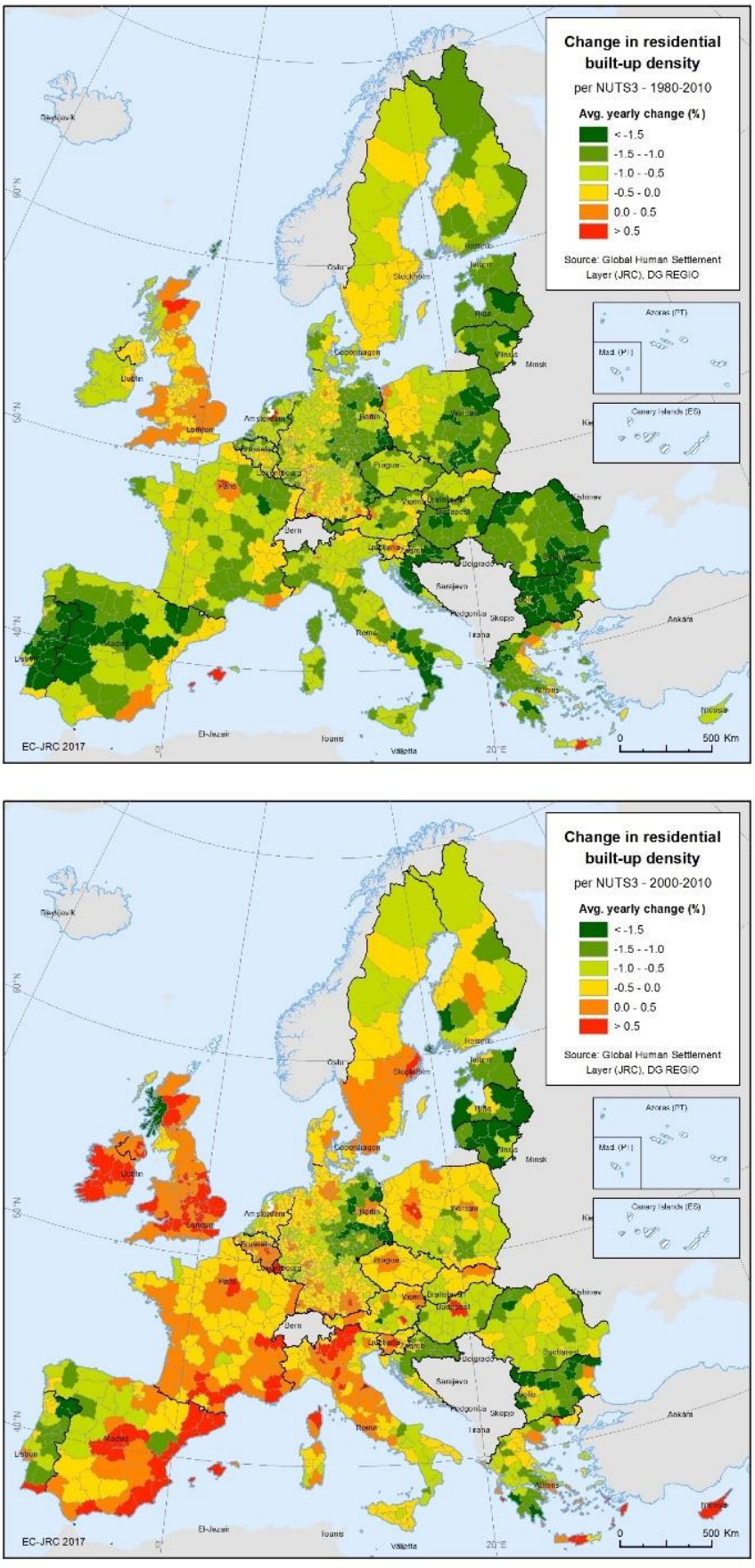



*Figure 25: Change in residential built-up density per NUTS 3 for the periods 1980-2010 (top) and 2000-2010 (bottom)*

The overall reduction of urban density, revealed in Figure 23, Figure 24 and Figure 25, is consistent with the so-called '*urban sprawl*' phenomenon. Urban sprawl represents a faster (than population growth) expansion of built-up area around towns and cities. Figure 26 reveals that urban sprawl was widely present (but at different extent) in the EU, especially in less developed (as of 1975) regions and countries (Portugal, Spain, Southern Italy, Greece, Cyprus, Bulgaria, Romania, Hungary, Poland, etc.), which were gradually catching up with the more advanced regions and countries in the EU over the period 1975-2010. Urban sprawl was also taking place in peripheral and rural regions in the more developed countries, maybe because there was more room for cost-effective built-up expansion[28].

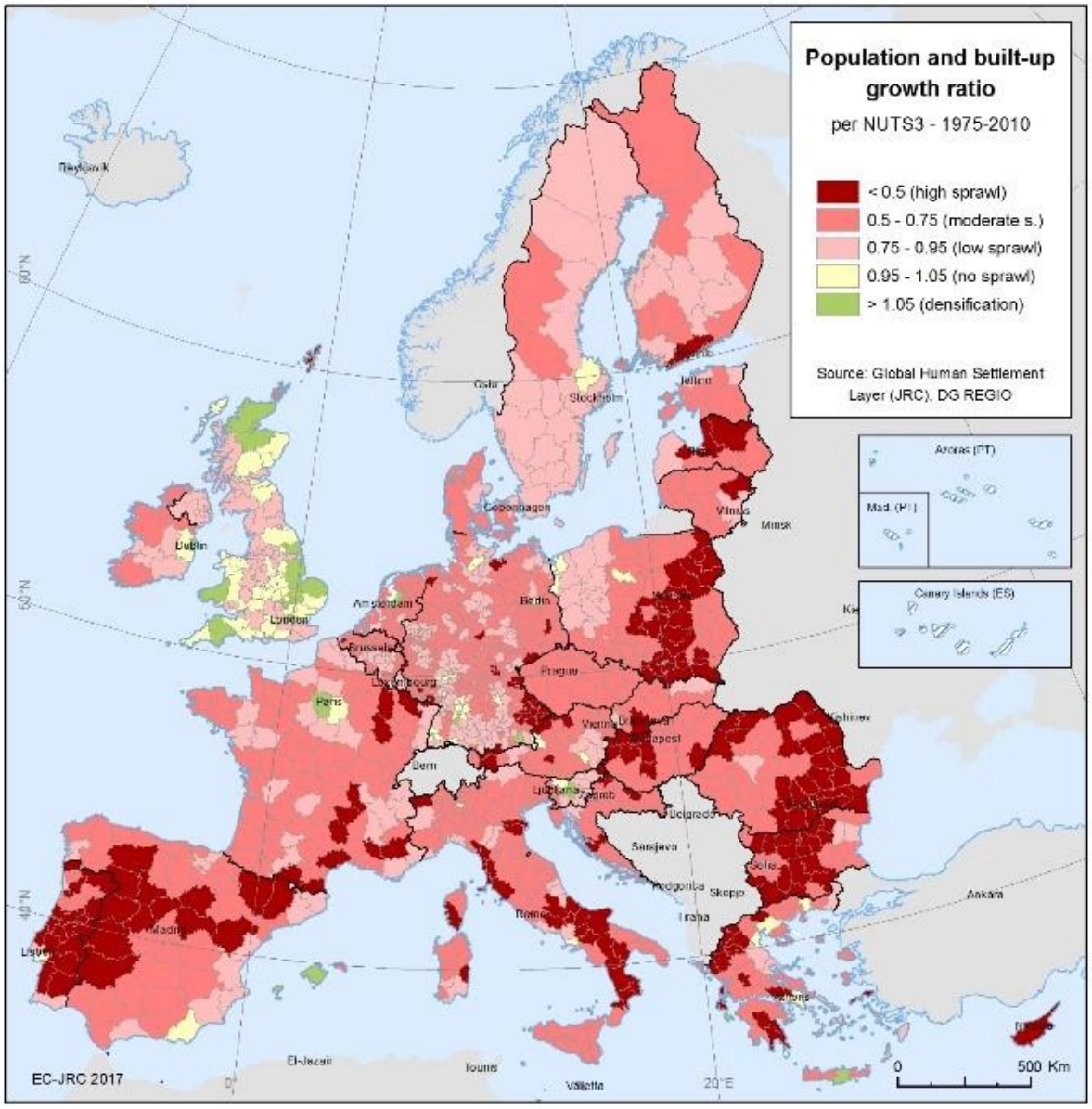



*Figure 26: Population and built-up growth ratios per NUTS 3 in the EU within 1975-2010*

[28] Since the sprawl is defined as growth of urban areas in respect to population growth, the population growth is assumed to be equal or greater than zero, to avoid overestimating sprawl in regions with negative population growth.

Based on an extensive econometric analysis, the recent (2000-2010) densification of urban land use was found to be generally driven by the following factors:

- ✓ Metro / capital regions: A region, which is or belongs to a metropolitan area, boosts population density, especially if it contains the national capital city.
- ✓ In rural regions built-up is generally growing faster than population, resulting in population density decline.
- ✓ Total population, GDP per capita, employment growth and potential accessibility, altogether representing important determinants of regional attractiveness (for people and investments) encourage population density growth. Consequently, the pressure on land prices is likely to be high, leading to denser types of urban development.
- ✓ A large Percentage of Available Land (PAL) impacts negatively population density growth and vice-versa. Regions with high PAL have no or few physical constraints to development. The pressure on land prices is likely to be low and extensive land developments are relatively inexpensive.
- ✓ Regions with already high density levels experience low population density growths due to existing or expected diseconomies of scale and/or technical, legal or economic constraints to further densification.
- ✓ Regions with low (or high) population density growth tend to be close to other regions with low (or high) population density growth.
- ✓ The evolution of a given region is not only affected by its own characteristics, but also by those of nearby regions, i.e. competition effect. As a result, a region may enjoy population density growth (due to the factors, listed above, e.g. GDP or employment growth) also at the expense of its neighbours.

Whether re-densification of urban areas is an emerging trend, or sprawling will eventually pick up again cannot be inferred yet. Given the positive impacts of agglomeration and the economies of scale, an urban densification process could potentially bring benefits, subject the negative externalities are mitigated via effective planning towards smarter and more inclusive cities.

## 3.4 Economic trends in metro regions

The following econometric analysis looks at the economic trends in various European metro regions[29], focusing on their resilience i.e. their recovery after the Global Recession of 2008-2008.

Figure 27 depicts the evolution of inequality among EU metro regions within 2000-2014, based on GDP per capita, measured with the *Gini* index (ranging between "0" and "1", where "0" means perfect equality, while "1" means perfect inequality). The upper figure presents the size and the trend of inter-regional inequality, while in the lower figure interregional inequality is standardized to 100 index points, first from 2000 and then from 2009. This allows the comparison of the evolution of interregional inequality in the different classes of metro region before and after the crisis.

The highest interregional inequality is revealed in capital metro regions. This is due to the large gap in GDP per capita between capital regions and their surroundings. The capitals' Gini index was about 6% higher than the second-tier regions and around 14 % higher than the smaller metro regions, with the gaps remaining quite stable over time (Figure 27, top). The pre-crisis trend was generally downward for all metro regions, being more pronounced for capitals and second tier ones (Figure 27, bottom). After 2009, smaller metro regions reversed the trend upward, in capitals it remained relatively stable (albeit with variations), while second tier metro regions continued to pursue a decline, but at a flatter pace.

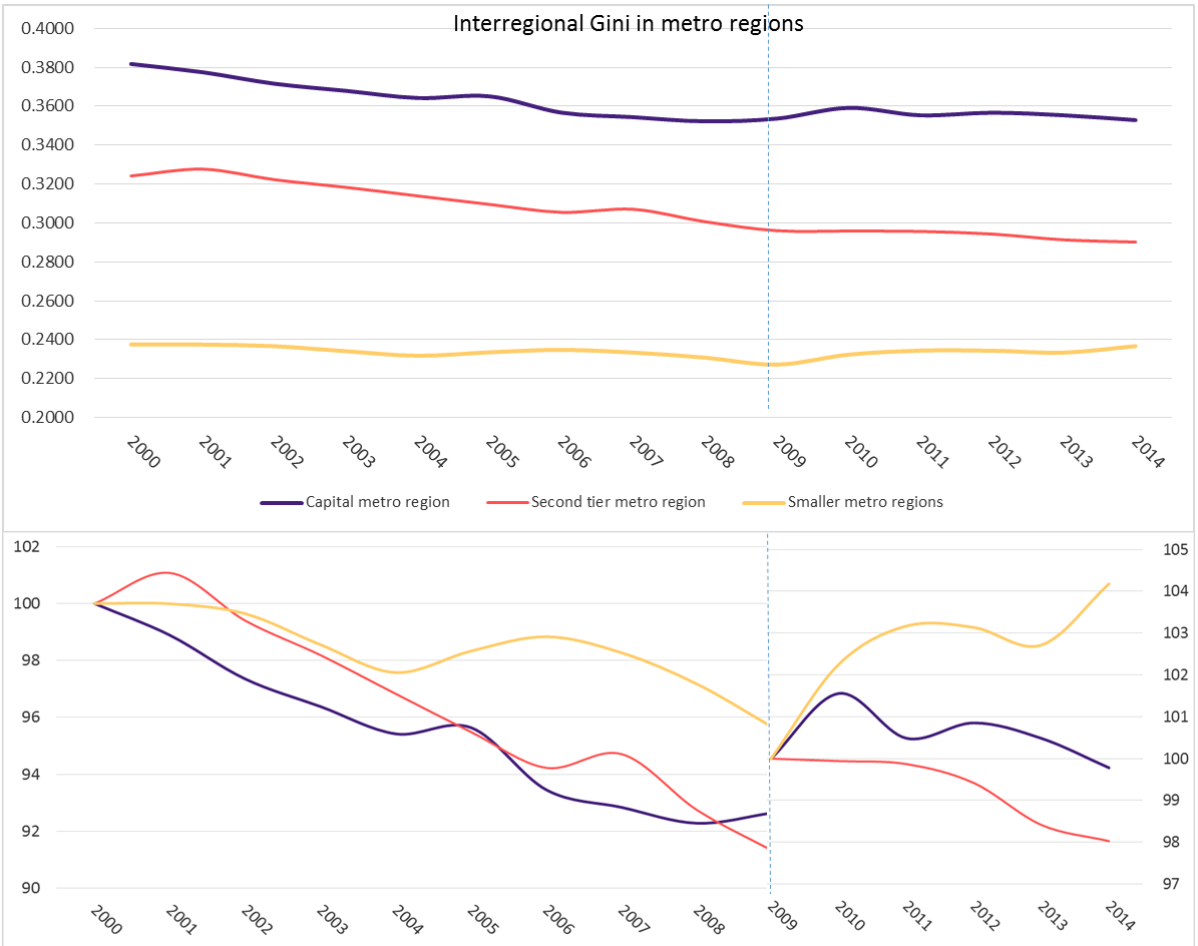



*Figure 27: Evolution of inequality in EU metro regions of the same class within 2000-2014. Top: Gini index 2000-2014. Bottom: Relative change in Gini coefficient with reference to 2000, and 2009 levels*

[29] For the definition of EU metro regions please refer to Annex III.

Figure 28 shows the evolution of GDP per capita in each class of metro regions for 2000-2014 in a similar way to the presentation of the Gini index in Figure 27. In absolute terms (Figure 28, top), the capital metro regions performed the best over the whole period, followed by the smaller metro regions, and lastly – the second tier regions. The smaller and the second tier metro regions managed, nonetheless, to recover to pre-crisis levels already by 2011, while the capital metro regions did not succeed to reach those levels even by 2014. In relative terms (Figure 28, bottom), the capital metro regions were doing slightly better than the second-tier and the smaller metro regions until 2009. Afterwards, the situation was reversed.

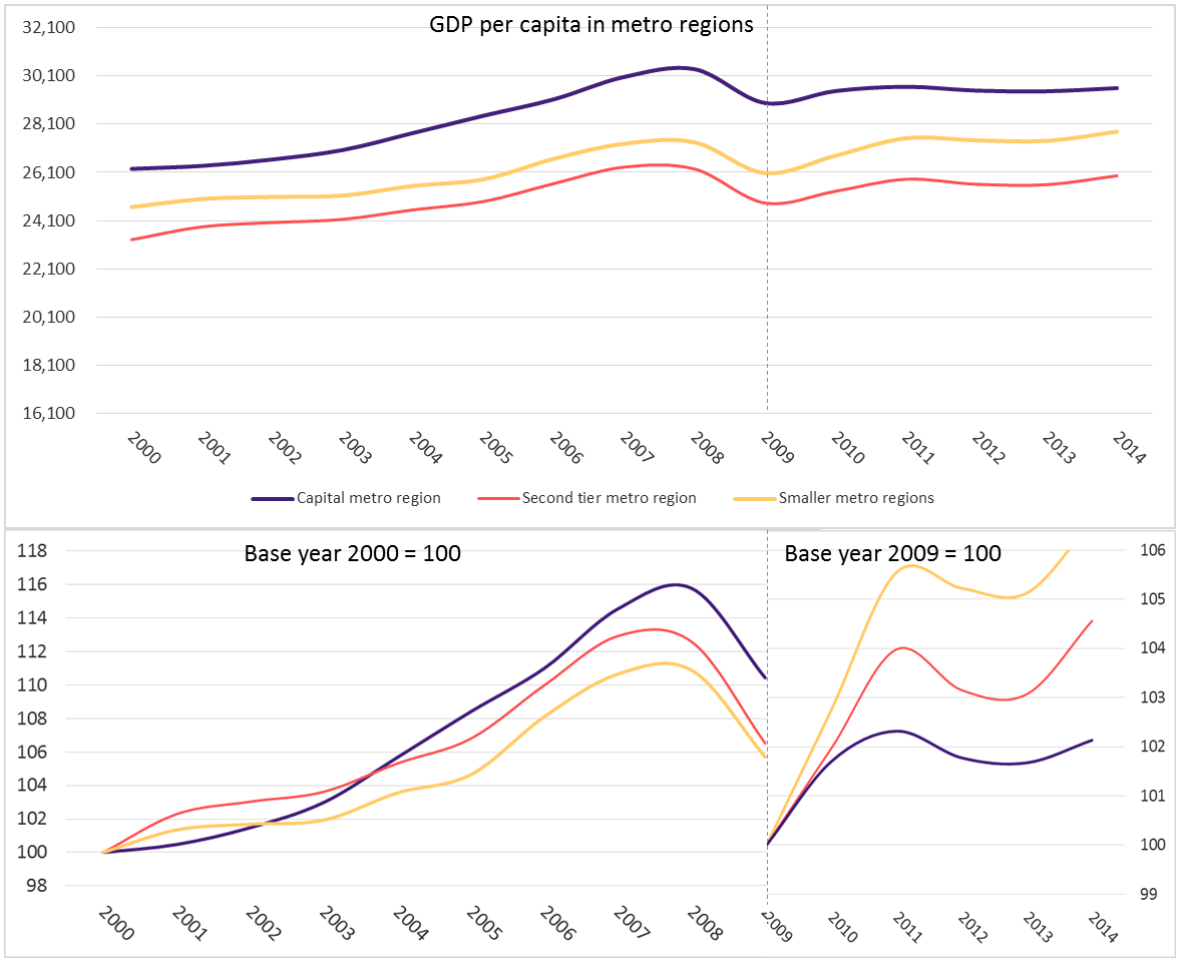



*Figure 28: Evolution of GDP per capita in EU metro regions within 2000-2014*

Figure 29 presents the correlation between the inequality growth and the GDP growth per capita per type of metro region. The correlation varies between "-1" (meaning totally opposite trends) and "1" (indicating parallel trends/perfect synchronization). Before the crisis, all three types of metro regions experienced a rather strong reduction of inequality, in a situation of robust GDP growth. This evolution was the most evident in the capital regions, closely followed by the second-tier and to a lesser extent in smaller regions. In the post-crisis period, the trend reversed to positive values in the capital regions and to even higher levels in the smaller regions. In the second tier metro regions, the GDP growth resulted in declining inequality also after 2009.


*Figure 29: Correlation between GDP growth per capita and inequality growth in EU metro regions for the periods 2000-2008 and 2009-2014*

Figure 30 presents the evolution of employment in various classes of metro regions over 2000-2014 in relative terms (100 points = year 2000 level in each case). Employment trends in all four types of regions followed similar patterns in general – increasing until 2008, then a decrease, followed by a recovery. The dynamics were not, however, the same in all regions. The capital regions demonstrated the best performance, followed (at quite a large distance) by the smaller and second tier metro regions with more or less identical behaviour. Non metro regions showed the poorest results, including (amongst others) the latest recovery, which started only in 2013.

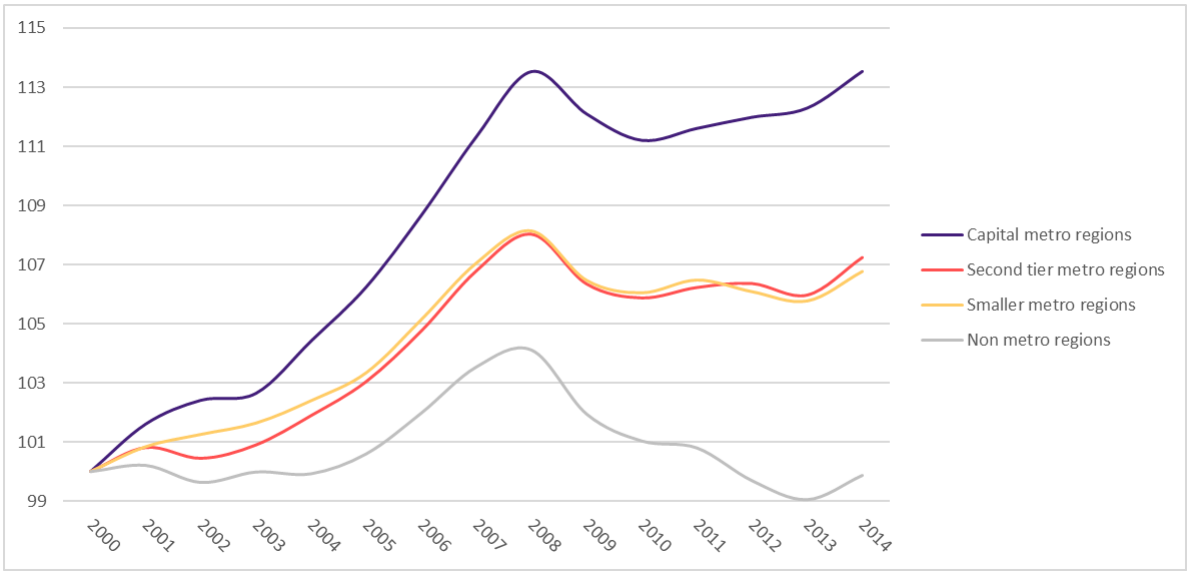
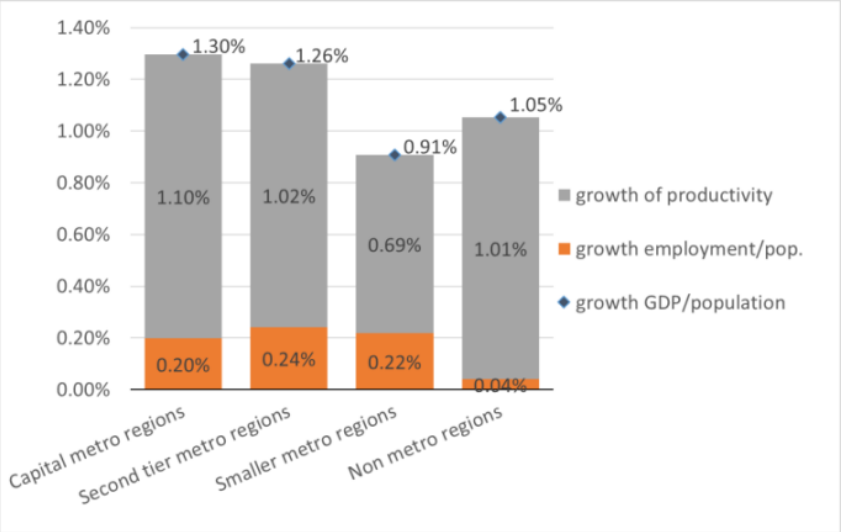


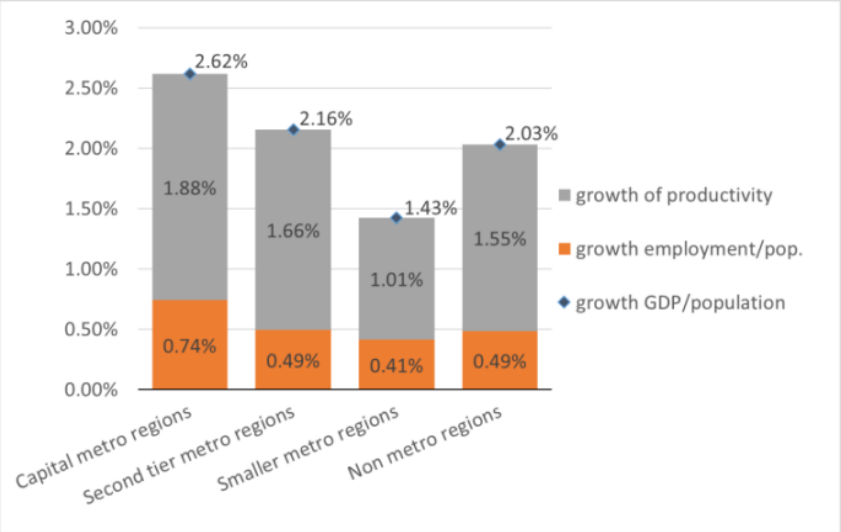

*Figure 30: Evolution of employment in EU metro regions over the period 2000-2014, relative to the 2000 levels in each case*

Figure 31 presents the breakdown of GDP growth per capita into its components (productivity and employment/population) for the four types of metro regions over the whole period 2000-2014, as well as separately for the pre-crisis (2000-2008) and the post-crisis (2009-2014) periods.

a) 2000-2014




b) 2000-2008




c) 2009-2014

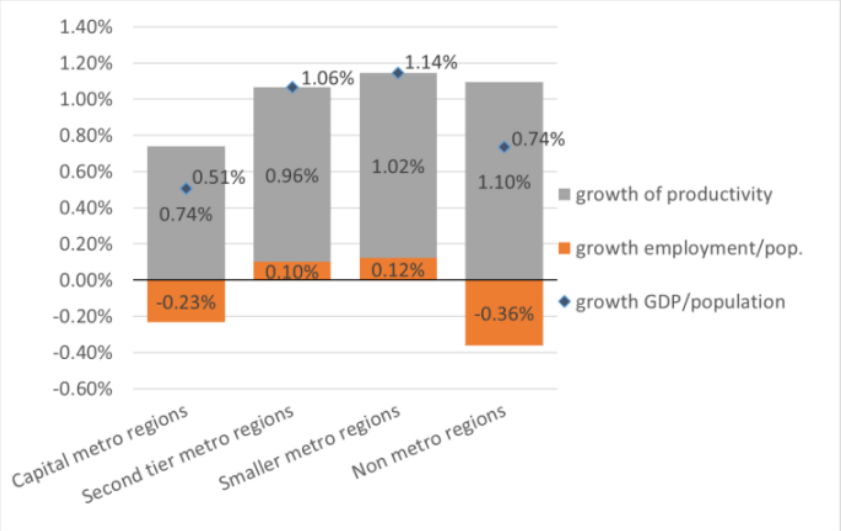



*Figure 31: Decomposition of annual average change in GDP per capita in metro regions: a) 2000-2014; b) 2000-2008; c) 2009-2014*

With regard to the productivity, capital metro regions were the best performers both before the crisis (2000-2008) and over the whole period 2000-2014, followed (with the same pattern) by the second-tier metro regions. For both types of regions, the productivity growth before the crisis (2000-2008) was much higher than after the crisis (2009-2014). Unlike the employment trends, the non-metro regions performed better than the smaller metro regions in all three time periods.

The employment/population component had almost no effect on the overall GDP growth per capita in non-metro regions over the period 2000-2014, while the impact in the other three types of metro regions was of similar magnitude, and again, much smaller than that of productivity. When looking at the overall evolution of the employment/ population element, the second-tier and smaller metro regions demonstrated comparable behaviour – a steady upward trend, which was stronger in the pre-crisis period. This fact indicates that both types of metro regions were capable of absorbing incremental employment, despite the (still) ongoing crisis. On the contrary, capital metro regions registered wider variations – steeper (as compared to the two other classes of metro regions) increases before 2008, followed by a decline (albeit less pronounced) afterwards. This decline was smaller than that observed in the non-metro regions for the period 2009-2014. The driving forces for these downward trends in the two types of regions were different. Amongst others, reasons for the after-crisis decline in the capital regions were the faster increase of population versus employment (i.e. the job markets in capitals did not manage to fully absorb the migration from non-urban areas), and the mismatch of labour competences. In non-metro regions, the negative trend was driven by the greater reduction in employment compared to that in population.

The relationship between educational attainment (broken down into secondary and tertiary levels) at base year 2000 and the GDP growth per capita in various metro regions within 2000-2014 has been also explored. The following conclusions have been drawn:

- ✓ Both secondary and tertiary education drove economic growth in smaller metro regions, with the impact of secondary education being much more pronounced.
- ✓ Secondary education also contributed to the growth in capitals and second-tier metro regions. The relative extent of its impact was similar in all three types of metro regions throughout 2000-2014.
- ✓ Unlike in smaller metro regions, tertiary education had almost no effect on growth in capital metro regions.
- ✓ In second tier metro regions the influence of tertiary education was more diverse. In those where the share of the working population with tertiary education was lower than 15%, the impact was null; where this share was higher than 15%, the effect was slightly positive. In any case, similarly to the smaller metro regions, the impact of tertiary education on growth was less pronounced than the impact of secondary education.

# 4 Case studies: Potential accessibility and tourism

The added value of the "territorial approach" is remarkably pronounced when a deeper understanding of spatio-temporal processes is needed to evaluate opportunities and/or criticalities of a territory. Two case-studies are herein illustrated to highlight the potentialities of the approach.

Potential accessibility refers to the overall possibility to the potential amount of interactions at different points in space. It is a function of investments in infrastructures, agglomerations' characteristics, including demographic distribution, and is time-dependent. As such, the estimation of potential accessibility is relevant in fields related to economic development, transport and also a range of social applications.

Tourism is a phenomenon with a particular territorial dimension, uneven spatial distribution and local impacts. The fine spatial (e.g. local) and temporal (e.g. by season) analysis is therefore crucial to understand the dynamics of the tourism sector and its role in the overall regional context. Enhancing the knowledge base is one of the priorities of the action plan set by the European Commission for the touristic sector.

## 4.1 Potential accessibility trends 2015-2030

Potential accessibility (called also interaction opportunity) of a region is a function of two components:

- the cumulative potential of available activities, and
- the generalised cost to reach them, such as distance, time or money.

A higher accessibility means a greater potential of activities that a region can reach with a smaller effort. Potential accessibility is often considered as a crucial requirement for economic development. In this study, it has been computed using population and travel time. The resulting potential accessibility levels are sketched in four indicative classes in Figure 32.

| **Potential accessibility** | Long travel time | Short travel time |
|---|---|---|
| Sparsely populated area | Low | Moderate |
| Densely populated area | Moderate | High |

*Figure 32: Generalised presentation of potential accessibility components and their inter-relation*

Figure 33 presents the patterns of potential accessibility in the EU in 2015. It clearly shows that potential accessibility levels are the highest in the centre of the EU, in the territory roughly from the southeast of the UK to the north of Italy, but also including parts of Poland and Czech Republic. Outside of that core area, larger urban agglomerations (e.g. Madrid) are clearly visible as hotspots of interaction opportunity.


*Figure 33: Estimated potential accessibility levels in the EU in 2015*

The future levels of potential accessibility are based on assumed changes in the road network and on modelled population distributions. Figure 34 shows changes in average accessibility levels per EU Member State; on the horizontal axis – changes caused only by improvements in the road network, and on the vertical axis – changes caused by road network improvements and changing population distributions. The countries around the Baltic Sea (Sweden, Finland, Estonia, Latvia and Lithuania) show large increases in potential accessibility due to road network improvements. Other Member States that demonstrate lesser, but still substantial increases in potential accessibility due to road network improvements are Ireland, Denmark, Spain, Portugal, Poland, Bulgaria and Romania. As shown before[30], population changes can considerably affect final potential accessibility outcomes. In some countries, growing population numbers cause extensive increases in potential accessibility either mostly due to expected population growth (for instance all original 1957 EU Member States) or in conjunction with road network improvements (for instance Sweden and Finland). In other countries, expected potential

[30] Jacobs-Crisioni et al. (2016)

accessibility growth is less than what could be expected from road network improvements because of population decline in those countries (Spain, Portugal, Poland, Romania, Bulgaria, Lithuania, Latvia, Estonia). In Figure 34 the countries that have potential accessibility increases due to population change are above the diagonal, while the countries, where potential accessibility improvements are reduced due to population change, are below the diagonal.

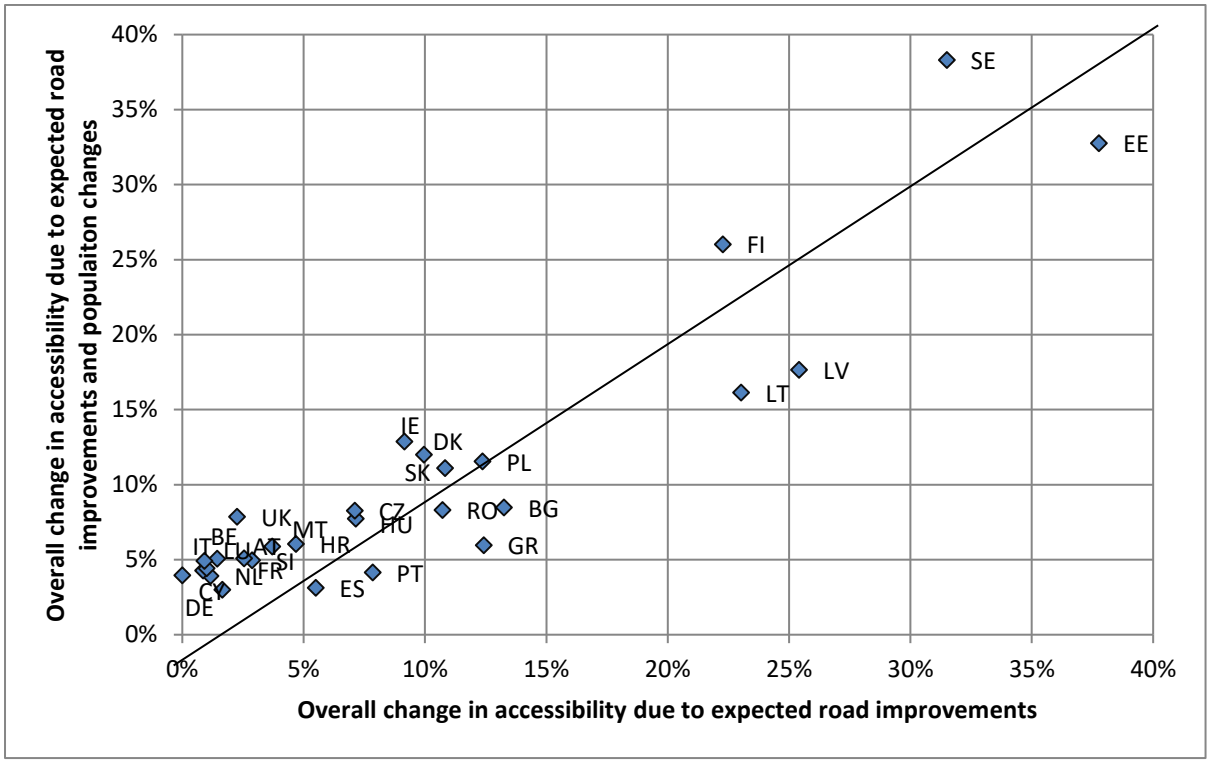



*Figure 34: Changes in average accessibility levels in EU member states between 2015 and 2030, only including road network improvements (horizontal axis), and additionally including the effects of modelled population changes (vertical axis)*

The aggregated national numbers do not tell the complete story in accessibility patterns. Figure 35 shows local changes in potential accessibility between 2015 and 2030 without or with modelled population changes in the top and bottom maps respectively. Expected road network improvements and their impacts on accessibility in Poland, Czech Republic, Slovakia, the Baltic States and the north of Sweden and Finland are immediately clear from the top map. When including the effects of population changes as well, the picture becomes less clear. Existing urban areas in the west of Europe, which often already have very high accessibility levels, improve substantially regardless of their good starting position. On the other hand, potential accessibility levels may drop substantially, for example, in the centre and East of Spain, due to the foreseen population decline.

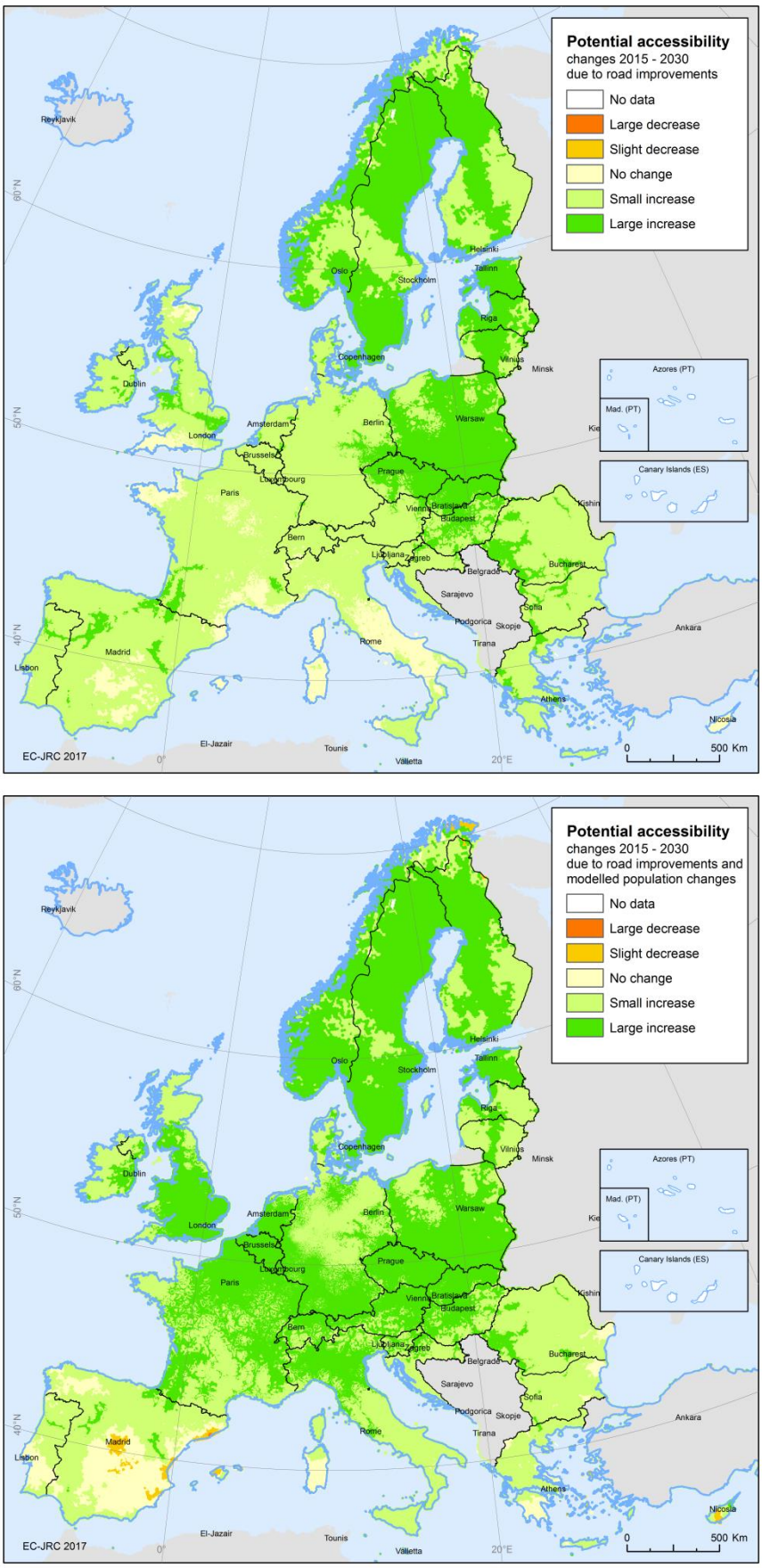



*Figure 35: Changes in potential accessibility from 2015 to 2030 only from road network improvements (top) and additionally including changes in population distribution (bottom)*

## 4.2 Tourism in the EU – territorial insights

Tourism is an important economic sector in the EU. In 2016 the direct contribution of the travel and tourism sector to the EU's GDP and employment was of 3.7% and 5.0% respectively, while the total (direct + indirect + induced[31]) contribution was about 10.2% and 11.6%, respectively[32]. The share of the travel and tourism sector in GDP and employment was significantly higher than the EU average in countries like Malta, Greece, Cyprus, Portugal, Spain, Italy, but also in Germany. Although estimates are largely not available at sub-national level, the economy of many EU regions is heavily dependent on the travel and tourism sector. Tourism is a phenomenon with a particular territorial dimension, uneven spatial distribution and local impacts. The fine spatial (e.g. local) and temporal (e.g. by season) analysis is therefore crucial to understand the dynamics of the tourism sector.

The analysis herein presented is based on a new JRC dataset on tourism, constructed at unprecedented high spatial and temporal resolutions, to characterize the main spatiotemporal patterns of tourism in Europe.[33]

Tourism density is the highest in August. The largest cities in Europe (e.g. Paris, London, Berlin, Madrid and Rome) tend to be hotspots of tourism throughout the year. Coastal areas and islands are also popular year-round, but peak significantly in summer months. Alpine areas are generally very dense in both summer and winter, but comparatively less dense in mid-season (spring and fall). Many parts of Western and Central Europe (the Netherlands, West Germany, etc.) also maintain high tourism densities over the year. Conversely, the Northern and Eastern European countries show significantly lower tourism densities.

Figure 36 displays the top 5% and 10% most popular touristic locations in the EU in the winter and summer. Various locations are persistently popular across the two seasons – the largest cities in Europe, the Alps, many parts of the Netherlands, West Germany, the centre-north of Italy, as well as many seafront parts of Europe. On the other side, the coast of the Black sea, the Greek, Italian and French islands, and the Croatian coast are only among the most popular in the warm months.

[31] Direct impacts include contribution to: 1) GDP generated by industries that deal directly with tourists, including hotels, travel agents, airlines and other passenger transport services, as well as the activities of restaurant and leisure industries that deal directly with tourists, and 2) Employment, i.e. the number of direct jobs within Travel & Tourism. Indirect impacts are the contribution to GDP and jobs from: 1) Capital investment spending of all industries directly involved in Travel & Tourism; 2) Government collective spending in support of general tourism activity, and 3) Supply-chain effects i.e. purchases of domestic goods and services directly by different industries within Travel & Tourism as inputs to their final tourism output. Induced impacts are the broader contribution to GDP and employment of spending by those who are directly or indirectly employed by Travel & Tourism. Source: World Travel & Tourism Council

[32] World Travel & Tourism Council (2017) Travel & tourism – Economic impact 2017, https://www.wttc.org

[33] A more detailed discussion is proposed in the following paper (under review): Batista e Silva F., Marin M., Rosina K., Ribeiro Barranco R., Freire S., Schiavina M. (2018), Analysing spatiotemporal patterns of tourism in Europe with conventional and big data sources. Tourism Management

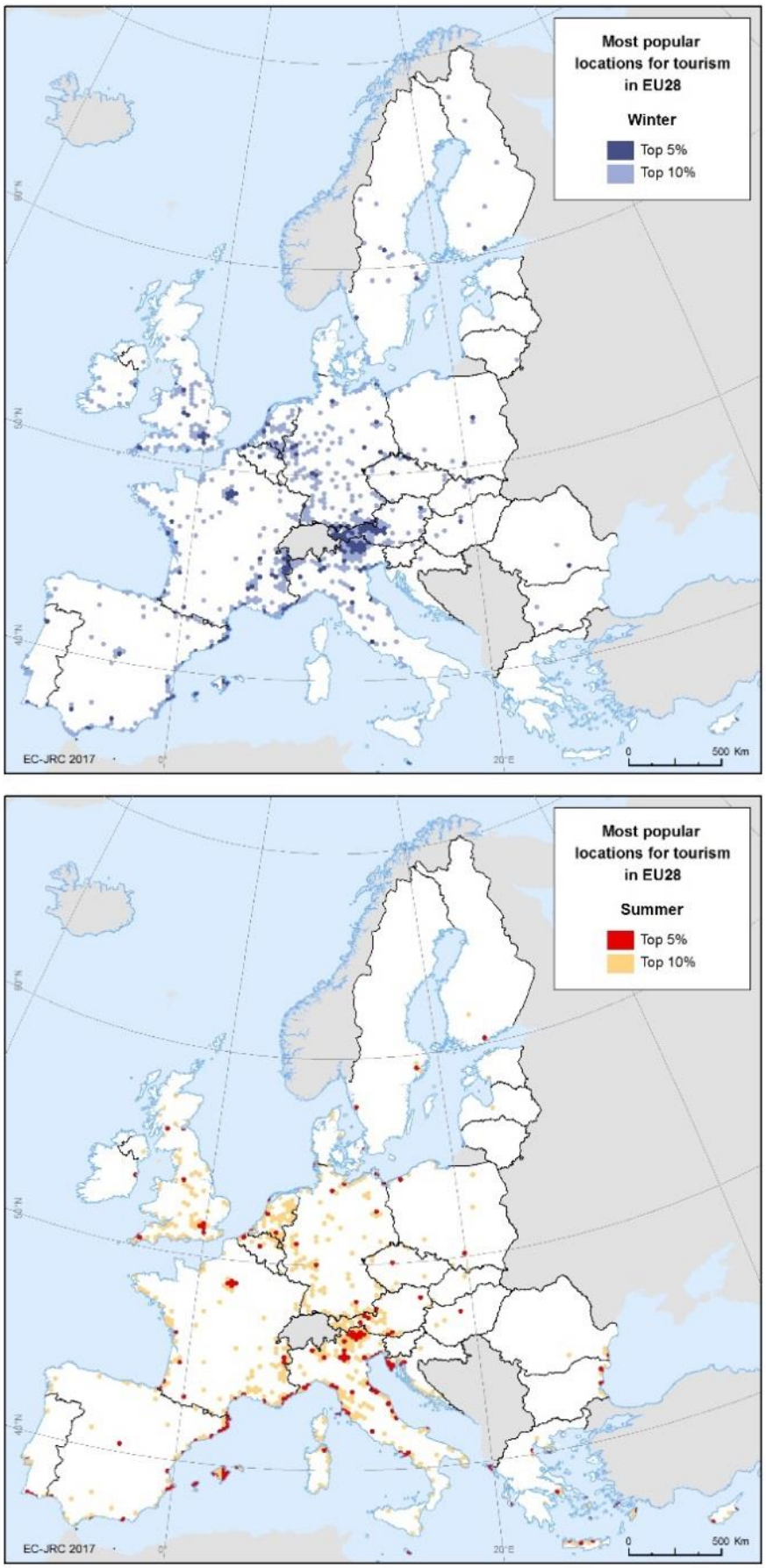



*Figure 36: Top 5% and 10% most popular winter and summer locations for tourism in the EU in 2011*

The most popular summer season for the very large majority of EU regions can be explained by two important and correlated factors:

- ✓ Summer months are those when most people traditionally go on holidays, when many activities are closed (e.g. education) or are running at lower pace (e.g. manufacturing).
- ✓ Warm weather is a very important pull factor for holidays in the majority of the regions.

Nonetheless, there are some exceptions. The winter season is the most popular in some alpine and Scandinavian regions.

Figure 37 displays tourism seasonality (measured as the average daily number of overnight tourists per month versus the average daily number of overnight tourists per year) at NUTS 3 level in the EU. Figure 37 reveals that tourism in many regions in Europe is characterized by high seasonality, i.e. large variation of tourist flows in the course of the year. Tourism seasonality is influenced by climate variations or socio-cultural factors. It determines the fluctuations of revenue, employment and the under or over-utilization of infrastructure, services and resources. On the other hand, seasonality provides a period for rest of personnel, regeneration of natural resources and re-establishment of socio-cultural features. In practical terms, the regions that are mostly affected by seasonality, seem to be the islands and those located by seashores, hence – predominantly oriented towards beach tourism and heavily dependent upon variations in climate conditions.

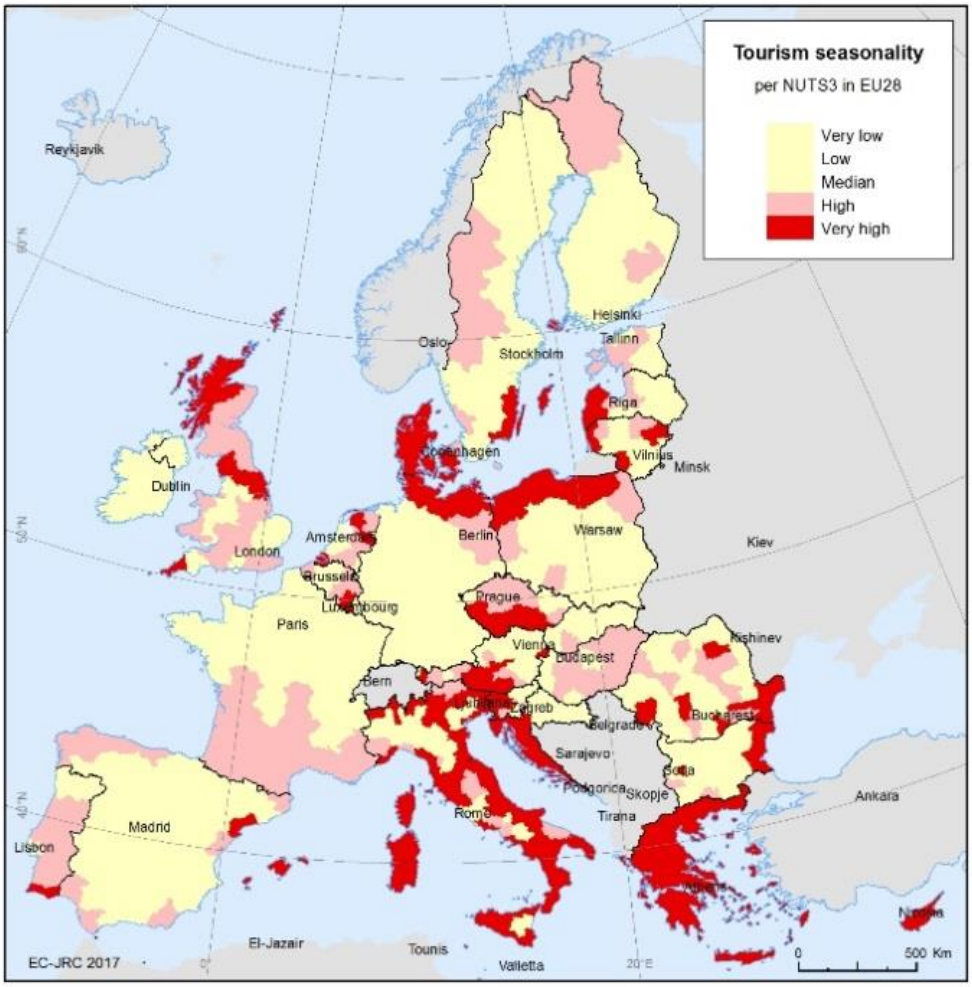



*Figure 37: Tourism seasonality per NUTS 3 in the EU*

Figure 38 presents tourist intensity in the EU at NUTS 3 level. Tourism intensity, expressed by the ratio between average daily number of tourists and residential population, describes

the relative importance of tourism for a region, but also the extent of the tourism pressure. Figure 38 clearly shows that the Mediterranean islands, as well as some of the most popular holiday (both summer/beach and winter/ski) areas in the EU are characterised with the highest levels of tourism intensity.

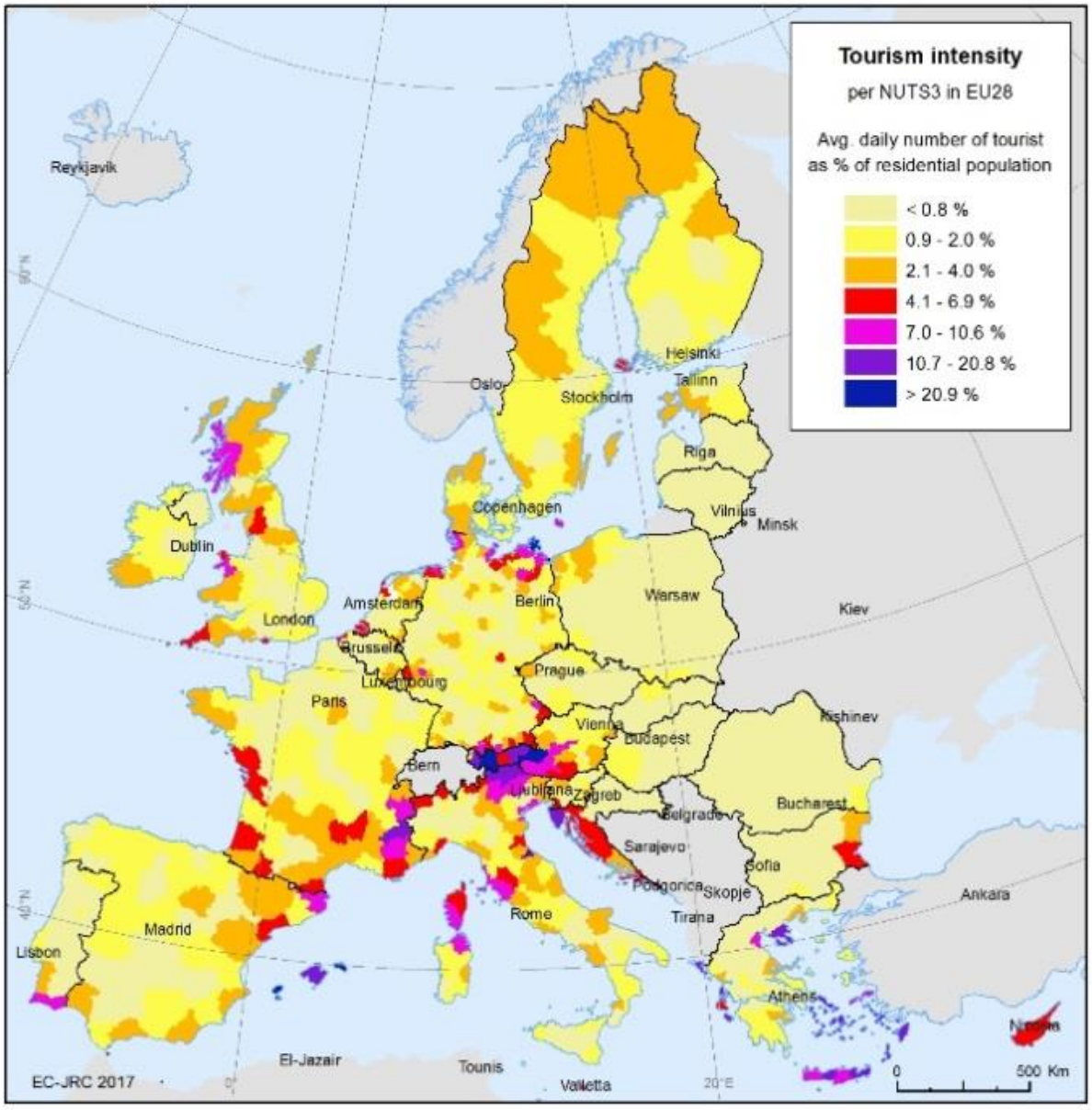



*Figure 38: Tourism intensity per NUTS 3 in the EU*

Figure 39 presents the regional tourism vulnerability index in the EU at NUTS 3 level. It is a function of tourism seasonality and tourism intensity (Figure 40). Regions with both high tourism intensity and seasonality are more vulnerable to shocks (e.g. economic crises, terrorist events, environmental or social disruptions) that may affect the tourism sector. Conversely, regions with low tourism intensity and/or low seasonality are less vulnerable to such shocks. The regions in Figure 39 having both high tourism seasonality and intensity, were identified from those NUTS 3 which were simultaneously amongst the top 40% in terms of both intensity and seasonality. The total number of those highly vulnerable NUTS 3 came up to 276, i.e. about one out of every five regions in the EU. This

means that a large number of EU regions seem to be currenly exposed to socio-economic risks associated with the tourism sector. Proactive consideration of respective mitigation and/or diversification measures might be useful.

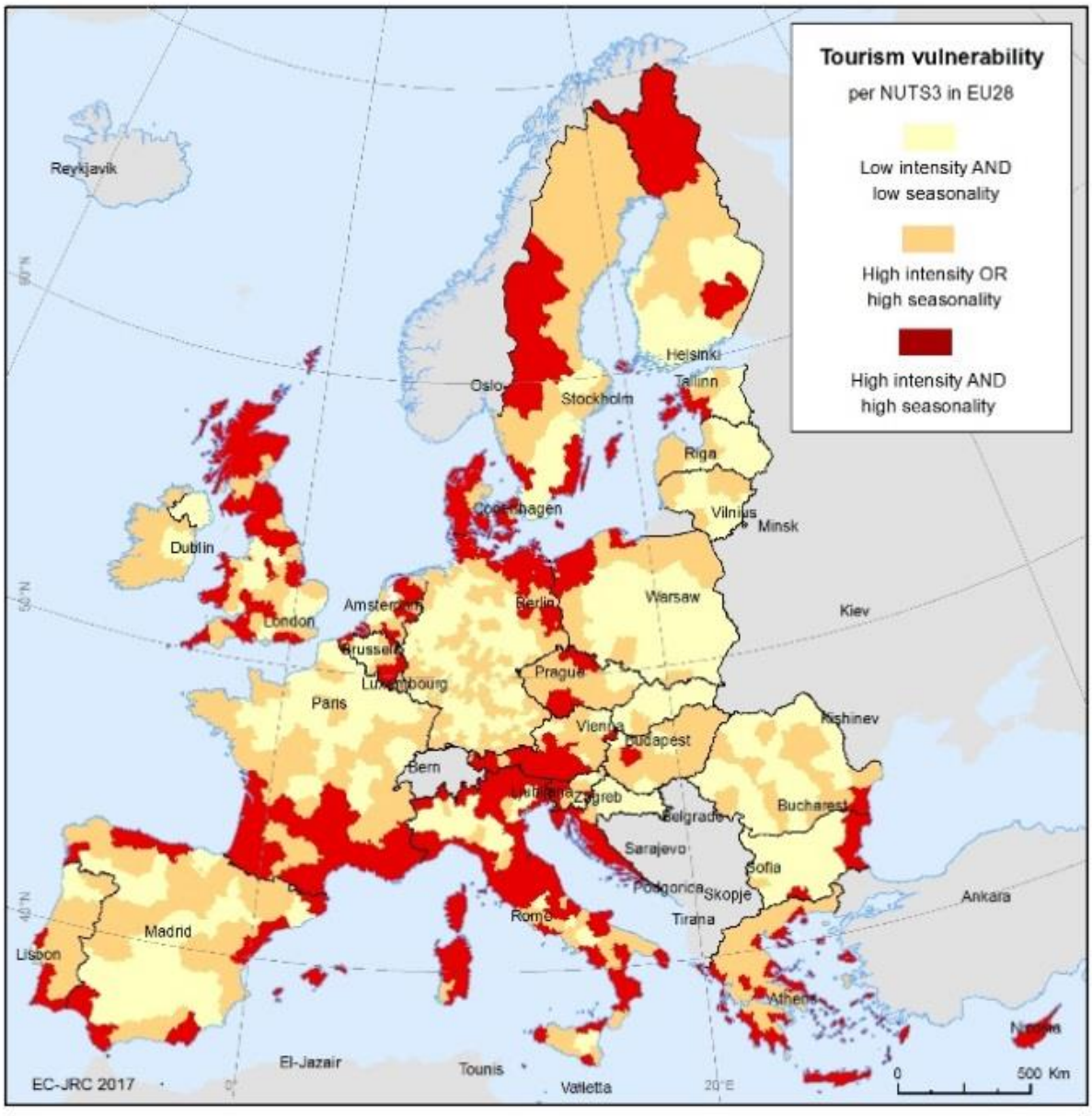



*Figure 39: Tourism vulnerability per NUTS 3 in the EU*

| **TOURISM** | Low intensity | High intensity |
|---|---|---|
| Low seasonality | Low vulnerability | Medium vulnerability |
| High seasonality | Medium vulnerability | High vulnerability |

*Figure 40: Tourism vulnerability as function of seasonality and intensity*

Besides seasonality, intensity and vulnerability, the share of non-domestic (i.e. of foreign residents) nights-spent is another important parameter of tourism industry. Non-domestic

nights-spent are often more appreciated, especially from a macro-economic point of view, because they generate capital inflows and can, therefore, be considered as export of services. Figure 41 displays the share of non-domestic nights-spent at NUTS 2 level in the EU. A comparison of the information on seasonality and non-domestic nights-spent, reveals that the very high tourism density in e.g. the Netherlands and West Germany was indeed mostly due to domestic tourists. Conversely, tourism sector in a number of regions in Bulgaria, Cyprus, Greece, Croatia, Slovenia, Austria, Italy, Spain, Ireland, Baltic countries, etc. was heavily dependent upon foreign tourists.

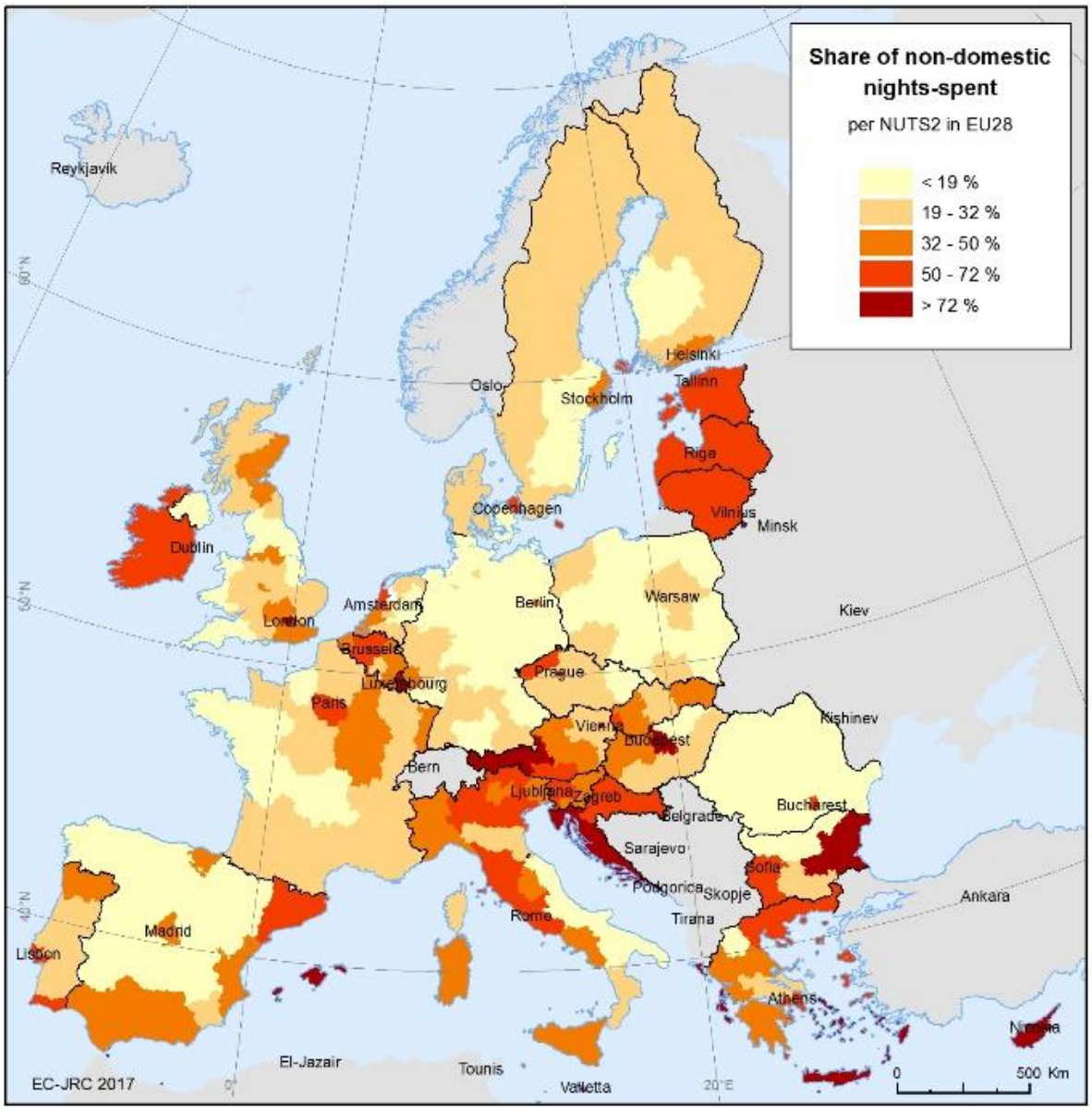



*Figure 41: Share of non-domestic nights spent per NUTS 2 in the EU*

# 5 Summary and Conclusions

This report highlights some important characteristics and trends in the EU territorial development within the framework of the *LUISA Territorial Reference Scenario 2017*. Historical and projected time series of key issues were analysed according to the spatial scale of interest. The outcomes aim to support a better understanding of the status and prospects of European regions and urban areas.

*Regional convergence and competitiveness trends*

- ✓ As a result of the 2008 financial and economic crisis, the EU-13 Member States experienced a larger fall in the GDP per capita and employment than the EU-15. The recovery was, however, quicker and stronger in the EU-13.
- ✓ The 2000-2014 economic dynamics was much more diverse at regional level than at national or EU-15 / EU-13 level. Regional clusters of competitiveness and resilience emerged as a function of, amongst others: spatial spill-overs, levels of GDP and education, agglomeration economies and structure of economy (tradable versus non-tradable sectors). In most cases national borders did matter, but clusters were not always confined by them.
- ✓ The number of regions with improved competitiveness increased widely and noticeably in the pre-crisis period, especially in Central and Eastern Europe. The 2008 crisis mostly affected Southern Europe – Portugal, Spain, Italy, Greece and Cyprus. The very low competitive cluster across regions disappeared from the EU map already by 2005.
- ✓ Many of the most resilient regions emerged in EU-13 – the capital regions of Czech Republic, Slovakia, Hungary, Malta (as a whole country). Other resilience front-runners included all Baltic countries, the Netherlands, Ireland, etc. as well as the capital regions of France, Poland, Romania and Bulgaria. Large variations in regional resilience were observed in Poland, Slovakia, Hungary, Romania and Bulgaria.
- ✓ The disparities between the development at national and regional level are projected to remain by 2030-2060. The GDP will increase significantly in the EU, but important regional differences are expected in Spain, France, Poland, Czech Republic, Slovakia, Hungary, Bulgaria and Romania. As for the GDP per capita, substantial regional disparities will be (still) observed in many Central, East and Southeast European countries (Greece, Bulgaria, Romania, Hungary, Czech Republic, Slovakia, Poland) where the capital region will often outperform by far the rest of the country.
- ✓ Regional employment trends between 2015 and 2060 in many EU-15 countries will generally follow GDP trends. Diverging GDP / employment trends (suggesting productivity increases) are expected in some EU-13 (Poland, Slovakia, Hungary, Slovenia). Large employment differences are also projected for Romania and Bulgaria, where the capital regions will (similarly to the GDP per capita) do much better than all the others.
- ✓ Population is projected to grow in the period 2015-2060 in a number of regions in Spain, France, Belgium, Ireland and Italy, as well as in the regions hosting capitals or other major cities in Sweden, Finland, Germany, the Czech Republic, Hungary, Romania and Bulgaria. Some traditional holiday spots (Balearic Islands, Corsica, Crete and Cyprus) are also expected to experience a boost in population. The largest loss of population is projected for Eastern Germany, followed by the Baltic countries, Portugal (except for Lisbon and Algarve), large areas of Spain (meaning internal migration – see above), Greece, Bulgaria, Romania, Hungary, Slovakia and Poland. At national level, the differences between population and employment dynamics will generally follow similar patterns. For both indicators, Sweden and Belgium are likely to be the EU front-runners, while Portugal, Bulgaria, Latvia and Estonia will be coming last.

*Cities and urban areas*

- ✓ Capital regions, cities and sometimes even smaller towns (e.g. in traditional holiday zones) have stronger GDP growth, more employment opportunities than other regions and hence, attract people. Consequently, about 75% of the EU population today is concentrated in urban areas. Important differences in the breakdown of urban population (capitals / cities / towns) is, however, observed in the EU. Despite the projected modest increase of the total EU population, peripheral regions are expected to experience a decline in their city population, while capital regions in central Europe are likely to grow. The increase in the bigger cities will often be at the expense of the surrounding smaller cities and towns, especially in many EU-13 countries, as well as in Spain, Portugal and Germany.
- ✓ Urban development is simultaneously a driver and a consequence of economic growth. The historical analysis of urban development reveals that in the period 1975-2010 the amount of built-up surfaces increased (especially in Central Europe), while the density of human settlements declined noticeably. The falling density of settlements was partially due to the sprawling of built-up areas around cities and towns. In some parts of Europe – Italy, Spain, France, Belgium, Ireland and the United Kingdom, amongst others – this trend began to reverse, and moderate re-densification processes started to emerge over time. Urban densification has important consequences for the overall growth of cities.
- ✓ Over 2000-2014 the capital metro regions maintained higher GDP per capita than the smaller and the second-tier ones. Before the crisis, the capital metro regions grew slightly faster than the second-tier and the smaller metro regions. The crisis reversed this trend and both the smaller and the second tier metro regions recovered faster their GDP per capita levels than the capital metro regions.
- ✓ Regarding employment, both urban (metro) and non-urban regions followed the same growth-decline-recovery pattern. Metro regions, nevertheless, led by the capitals, registered increasingly better employment trends than non-metro regions both before and after the crisis. In the post-crisis period, capital metro regions gained more population than what their job markets were able to absorb, while non-metro regions lost net employment and population.

*Case studies*

The potentialities of the 'territorial approach' are highlighted in two applications.

- ✓ Potential accessibility

  By reducing transport costs, transport infrastructure improvements may extend spill-overs over an ever larger territory. European investments in road infrastructure aim to improve potential accessibility in particular of peripheral regions in the EU-13. The shrinking population in those regions diminished the impacts of those improvements on the overall interaction (economic, trade, etc.) opportunities.

- ✓ Tourism

  Tourism is an important sector for growth and employment in the EU. It is characterised by regional divergences due to landscape (sea-coasts and mountains), and cultural and temporal (by month and season) variations. Cities are typically less vulnerable to shocks in tourism since they tend to be less affected by seasonality and their dependence on tourism is generally lower.

**Key Messages**

European regions, individually or grouped in clusters, are characterised by spatial and temporal patterns of challenges and opportunities. The analysis suggests a number of policy-relevant considerations:

- ✓ Trends strictly related to the specific social, economic, cultural and natural **characteristics of each territory are "clustered" in nature, persistent over time**. These include, for example, GDP per capita and employment. Policy measures should aim to **maintain the level of high-competitive regions, and foster a transition to higher productivity sectors in the lagging ones**, focusing on specific actions on educational attainment and the development of tradable sectors. Highly specialised regions in the travel and tourism sector seem to be extremely vulnerable to overall global trends and, therefore, diversification should be pursued when and where possible.
- ✓ Trends related to competitiveness and economic resilience, are highly influenced by the behaviour of neighbouring regions and the overall spatial context. **Spillovers** are clear positive signs of growing regions, influencing each other's development. This calls for **extension and reinforcement of the territorial reach of positive economic spillovers beyond national boundaries**, with specific emphasis on trade and innovation related sectors.
- ✓ Trends, like densification of population and activities, are pronounced mostly around the main metropolitan areas, with a patchy distribution across the EU territory. This well-acknowledged "**agglomeration effect**" of large **metropolitan areas as booster of economic development for the overall region**, should be sustained with specific measures aiming to increase their resilience to potential shocks. Agglomeration benefits are however often counter-balanced by the **increase in regional disparities**. Specific measures should be sought for **areas subject to depopulation in some countries**. The combined impact of demographic trends with investment on key infrastructures is a further element to evaluate the territorial efficiency of policies.
- ✓ Trends related to **resistance and recovery capacities to economic and financial crisis**, have asymmetric spreads in time and strength across EU regions. Capitals are generally more resilient than the surrounding regions, although the resilience capacity of a region is heavily co-related to that of the surrounding regions. This observation highlights the existence of some kind of regional resilience clustering in the EU and of disparities at sub-national level. Despite the national characteristics generally plays a relevant role concerning economic resilience, **patterns of regional differences are visible also beyond countries' borders**. This calls for **territorial oriented and thematically differentiated policies** to reinforce the aspects (e.g.; productivity, employment, ..) most vulnerable in each region.

**Conclusions**

The need to take into account the geographical diversity and the specific characteristics of a place or territory is increasingly recognised in European policy-making processes. The need to assess territorial impacts is now fully embedded in the European Commission (EC) "Better Regulation Guidelines" for assessing the impact of newly proposed initiatives and evaluating existing ones.

In this context, the "*LUISA Territorial Modelling Platform*" is now part of the European Commission's toolbox offered to support the elaboration of such territorial impact assessments. The value added of this tool is that it integrates and analyses a wealth of data and indicators at high thematic and geographic granularity, while considering both EU and national characteristics. It can support a new paradigm of policy-making, aiming to address specific needs and exploit opportunities at the most appropriate territorial level and be responsive to expected or emerging challenges.

**Further Information**

The indicators in this report are freely and openly accessible in the Territorial Dashboard of the Knowledge Centre for Territorial Policies:

https://ec.europa.eu/jrc/en/territorial-policies

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## List of abbreviations and definitions

| | |
|---|---|
| CAPRI | Common Agricultural Policy Regionalised Impact Modelling System |
| CE | Cambridge Econometrics |
| DG ECFIN | Directorate-General for Economic and Financial Affairs |
| DG JRC | Directorate-General Joint research Centre |
| DG REGIO | Directorate-General for Regional and Urban Policy |
| EC | European Commission |
| ESIF | European Structural and Investment Funds |
| EU | European Union |
| FUA | Function Urban Areas |
| GDP | Gross Domestic Product |
| GEM-E3 | General Equilibrium Model for Economy-Energy-Environment |
| GVA | Gross-Value-Added |
| LAU | Local Administrative Units |
| LUISA | EC\JRC Territorial Modelling Platform |
| MS | Member States |
| NUTS | Nomenclature of Territorial Units for Statistics |
| OECD | Organisation for Economic Co-operation and Development |
| PAL | Percentage of Available Land |
| TEN-T | Trans-European Transport Networks in Europe |

# Annex I. The LUISA Territorial Modelling Platform and its Reference Scenario 2017

LUISA is a pan-European territorial modelling platform for the ex-ante evaluation of regional and local impacts of European policies and trends. LUISA allocates (in space and time) the demand and supply of resources (biotic and abiotic, including primary energy resources), the settlement of socio-economic activities (e.g. housing, industry, services) and infrastructure (e.g. transport, energy). Biophysical suitability, policy targets and regulatory constraints, economic criteria and other factors are dynamically considered in LUISA for the allocation of population, economic activities and resources. The projected territorial patterns cover all EU Member States, European Free Trade Association (EFTA)[34] and Western Balkan countries[35] at a detailed geographical resolution (100m$^2$), typically until 2050.

The LUISA modelling platform coherently links specialised macroeconomic, demographic and geospatial models with thematic spatial databases. As truly integrative tool, LUISA incorporates historical trends, current state and future projections, in order to capture complex interactions among human activities that are location-specific and their determinants. The final aim is to translate socio-economic trends and policy scenarios into processes of territorial development.

The main structure of the LUISA platform is articulated on three main elements:

1. A comprehensive Territorial Knowledge Base

*The framework is based upon a coherent structure of data layers at the finest possible granularity, including:*

- *Statistics on economic and demographic trends (long time series, historical and projected);*
- *Infrastructure (e.g. for transport, energy, primary and secondary services);*
- *Human and industrial settlements (e.g. from satellite and cartographic sources);*
- *Building and dwelling characteristics, tourism, meteorological data, etc.;*
- *Micro-data on companies' investments in research and innovation*

2. Advanced analytical and modelling modules

*The modular structure allows the analysis of spatio-temporal processes at various geographical scales (e.g. countries, regions, cities). Main socio-economic variables are analysed at NUTS 2 and NUTS 3 levels and drive the detailed spatial allocation of population, production systems, services and activities. Linkages with exogenous specialised models and databases are set at the appropriate level.*

3. Production and visualization of territorial indicators

*The final output of LUISA is in the form of a set of spatially explicit indicators that can be grouped according to specific themes, defined as 'territorial indicators'.*

*The indicators span over a wide temporal window - from 1975 until 2060 in this report - and can be represented at various levels (national, regional, urban or other).*

*The indicators – some derived also using statistical sources (e.g. E-STAT and Statistical Sources) - cover the following domains:*

- *Population Dynamics*

[34] Iceland, Liechtenstein, Norway and Switzerland
[35] Serbia, Bosnia and Herzegovina, Former Yugoslav Republic of Macedonia, Albania, Montenegro and Kosovo.

- *Economy*
- *Employment*
- *Education*
- *Research & Innovation*
- *Health*
- *Energy*
- *Transport & Accessibility*
- *Environment & Climate*
- *Urban Development*
- *Social Issues*
- *…*

LUISA is typically configured to project a territorial reference (also called "*baseline*" or "*trend*") scenario, assuming official socio-economic trends, business as usual preferences and the effect of established European policies with direct and/or indirect territorial impacts. Variations to that reference scenario may then be used to estimate impacts of specific policies, or of alternative macro-assumptions.

The JRC and DG REGIO set up the *Territorial Reference Scenario 2017* primarily for the production of thematic information for the Seventh Cohesion Report and to be used in the frame of the ex-ante impact assessment of the cohesion policy post-2020. Other EC Services are also involved in various manners.

The core element for the *Territorial Reference Scenario* is the LUISA base map, derived from the combination of the most up-to-date and detailed information from multiple geographical data sources. We refer to Batista e Silva et al. (2013a) for more details on the method used to derive the base map. Improvements of the LUISA base map are continuously on-going to provide further breakdowns of infrastructure and activities (transport and energy infrastructure, commercial areas, industrial areas, social facilities, touristic accommodation, etc.).

Another key element of the *Territorial Reference Scenario* is the gridded layer of population, generated in LUISA by downscaling population reported by the Eurostat's GEOSTAT 1km grid 2011, using methods reported by Batista e Silva et al. (2013b).

Economy and demography are important macro-drivers of territorial development. In the *Territorial Reference Scenario 2017*, the macroeconomic and demographic assumptions are aligned with the official projections published in *The 2015 Ageing Report* (EC, 2015) and used in the *EU Reference Scenario 2016* (EC, 2016a).

The regional agricultural activities follow the CAPRI 2016 Baseline projections, thus being consistent with the *EU Agricultural Outlook 2016-2026* (EC, 2016b).

The Territorial Reference Scenario 2017 also intrinsically takes into account several policy implications, including the Renewable Energy Directive, the Trans-European Transport Network (TEN-T) policy, the Nitrate Directive, The Common Agricultural Policy, the EU Biodiversity strategy to 2020 and protection of Natura2000 areas.

The *Territorial Reference Scenario 2017* is described in detail in Jacobs et al., (2017).

## Annex II: EU Nomenclature of territorial units for statistics

The NUTS classification (Nomenclature of territorial units for statistics) [36] is a hierarchical system for dividing up the economic territory of the EU for the purpose of collection, development and harmonisation of European regional statistics, as well as of socio-economic analyses of the regions.

The NUTS classification comprises three levels / categories (Figure 42):

- ✓ NUTS 1 – major socio-economic regions, with population thresholds 3,000,000-7,000,000 inhabitants;
- ✓ NUTS 2 – basic regions for the application of regional policies (the regions eligible for support from cohesion policy have been defined at NUTS 2 level), with population thresholds 800,000-3,000,000 inhabitants;
- ✓ NUTS 3 – small regions for specific diagnoses, with population thresholds 150,000-800,000 inhabitants;

NUTS 0 is also sometimes used to define national level.

The current NUTS 2013 classification is valid from 1 January 2015 and lists 98 regions at NUTS 1, 276 regions at NUTS 2 and 1342 regions at NUTS 3 level.

Furthermore, to meet the demand for statistics at local level, Eurostat has set up a system of Local Administrative Units (LAUs) compatible with NUTS.

At the local level, two levels of Local Administrative Units (LAU) have been defined:

- ✓ The upper LAU level (LAU level 1, formerly NUTS level 4) is defined for most, but not all of the countries.
- ✓ The lower LAU level (LAU level 2, formerly NUTS level 5) consists of municipalities or equivalent units in the 28 EU Member States.

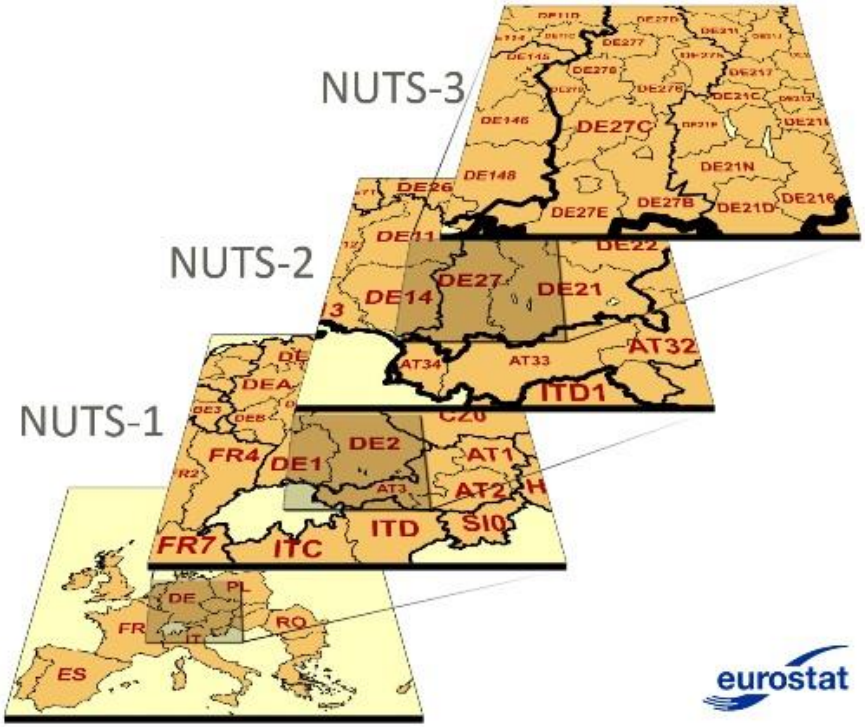


*Figure 42: The NUTS classification (Nomenclature of territorial units for statistics) in the EU*

[36] Text adapted from EUROSTAT, http://ec.europa.eu/eurostat/web/nuts/overview

## Annex III: Definitions of metro regions

The EU metro regions cover all metropolitan regions with at least 250,000 inhabitants. The NUTS 3-based typology of metro regions contains groupings of NUTS3 regions used as approximations of the main metropolitan areas. The initial methodology for the selection of the NUTS 3 components of the metro regions is based on the Urban Audit definition of Functional Urban Area (FUA). These FUAs contain the major cities and their surrounding travel-to-work areas. FUAs are defined as groupings of existing administrative areas (often LAU2 units). Their boundaries do not necessarily coincide with those of NUTS 3 regions. Consequently, NUTS 3 regions in which at least 50% of the regional population lives inside a given Larger Urban Zone (LUZ) were considered to be the components of the metro region related to that FUA. The typology distinguishes three types of metro regions – Figure 43:

- ✓ Capital city regions;
- ✓ Second-tier metro regions;
- ✓ Smaller metro regions;

The capital city region is the metro region which includes the national capital.

The second-tier metro regions comprise the largest cities in the country excluding the capital. For this purpose, a fixed population threshold could not be used. As a result, a natural break served the purpose of distinguishing the second tier from the smaller metro regions. The distinction between second tier and smaller metro regions may be adapted in the future to provide a closer match with the distinctions used in (especially national) policy debates.

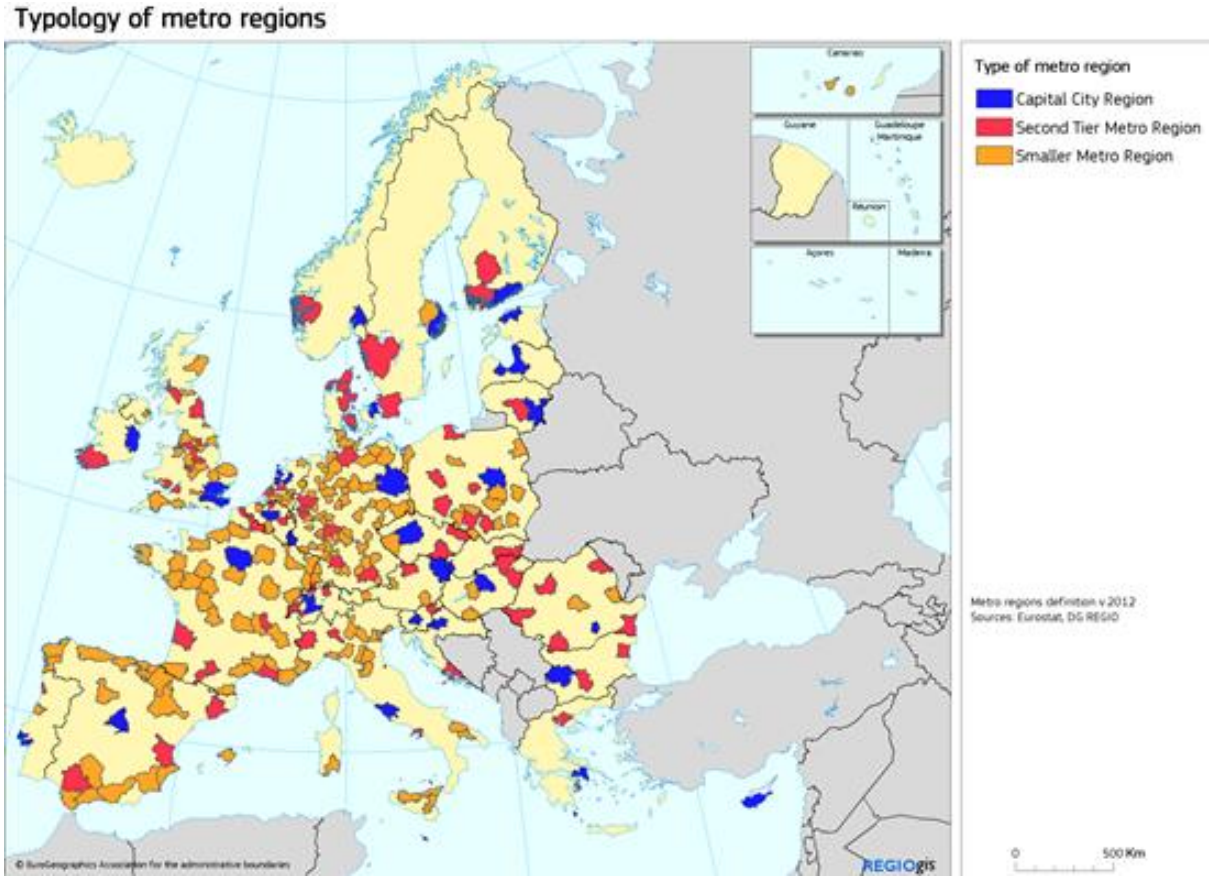


Figure 43: Typology of Metro regions (Source: EUROSTAT)

## Annex IV: Econometric technique

The empirical estimation of the growth equation is based on a spatial lag model. The spatial lag model is a regression methodology that assumes that the value of a georeferenced variable (in our case regional economic growth), is caused by the strength of the same variable in the surroundings (in our case the average economic growth in the neighbour regions) plus another set of additional variables. Formally, the spatial lag model is defined as follows:

$$\boldsymbol{Y} = \rho \boldsymbol{W}\boldsymbol{Y} + \boldsymbol{X}\boldsymbol{\beta} + \boldsymbol{u}$$

where ***Y*** denotes an *Nx1* vector consisting of one observation on the dependent variable. ***X*** denotes an *NxK* matrix of exogenous explanatory variables, $\boldsymbol{\beta}$ is an associated *Kx1* vector with unknown parameters to be estimated, and $\boldsymbol{u}$ is a vector of independently and identically distributed disturbance terms. ***W*** is a *NxN* matrix describing the spatial connectivity of spatial location. In the spatial weight matrix ***W*** a region is considered as a neighbour if it is within the radius of 150 minutes of travel time, which is the result of a optimization technique applied to find the optimal cut-off value. In order to account for the economic interpretation of distance decay, a Gaussian decay function (see Figure 44) has been adopted:

$$\begin{cases} w_{i,j} = \exp\left(-\left(\frac{distance_{i,j}}{\max distance}\right)\right) \text{ if travel time <150 minutes (max distance)} \\ w_{i,j} = 0 \text{ otherwise} \end{cases}$$

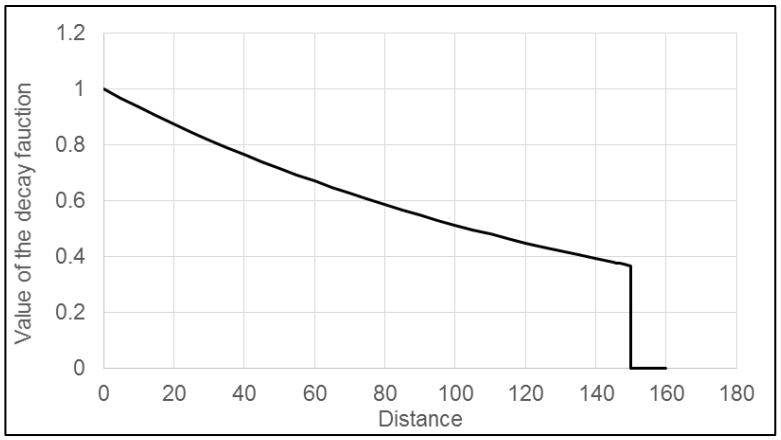


*Figure 44: Decay function*

where $w_{i,j}$ is an element of ***W***. The matrix, as it is based on distance, has been standardized following the approach of Ord [1]: $\boldsymbol{D}^{\frac{1}{2}}\boldsymbol{W}\boldsymbol{D}^{\frac{1}{2}}$ where ***D*** is a diagonal matrix containing the row sums of the matrix ***W***. This, as suggested by Elhorst [2] avoids that this matrix would lose its economic interpretation of distance decay.

The spatial lag model cannot be estimated with ordinary least square (OLS) because it leads to unreliable results due to the presence of $\boldsymbol{WY}$ (see [3], for further technical details) but it is estimated through a Maximum Likelihood technique.

The marginal effects of a variable are defined as $(\boldsymbol{I} - \rho\mathbf{W})^{-1}\boldsymbol{I}\beta$, where ***I*** is a *NxN* identity matrix. LeSage and Pace [4, 5] define the average direct effect as the average of the diagonal elements, and the average indirect effect as the average of the off-diagonal elements, where the off-diagonal row elements are first summed up, and then an average of these sums is taken. Finally, the sum of the direct and indirect effects gives the average total effect.

The spatial lag model has been chosen following the results of the Lagrange Multiplier (LM) and Robust LM tests carried out on OLS residuals to check whether lag or error spatial dependence could be at work [6]. In this case, 'lag' refers to the spatially lagged dependent variable, whereas 'error' refers to the spatial autoregressive process for the error term. If only one is significant, lag or error, we choose the correspondent model. If both are significant, than we have to check the Robust LM tests. As before, if only one is significant, we choose the correspondent model, otherwise, if they are both significant, we choose the test with the biggest value. In this case we prefer the spatial lag model.

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