



Working Papers

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The EU Regional Competitiveness Index 2016

Paola Annoni, Lewis Dijkstra and Nadia Gargano

*Regional and
Urban Policy*

> EXECUTIVE SUMMARY

The new edition of the Regional Competitiveness Index (RCI) shows the continuing strength of the capital regions and other regions with metropolitan areas. In the northwest of the EU, these competitive regions generate substantially spatial spillovers, improving the competitiveness of the neighbouring regions. In eastern and southern Member States, however, being close to the capital region does not seem to boost competitiveness.

Compared to the two previous editions, published in 2010 and 2013, Malta and several regions in France, Germany, Sweden and the UK have improved their score, while the scores declined in Cyprus and regions in Greece, Ireland and more recently in the Netherlands. In eastern EU regions competitiveness has mostly remained stable.

New online and interactive scorecards allow for easy benchmarking of a region relative to all other regions, as well as to regions with a similar GDP per head.

The RCI builds on the approach of the Global Competitiveness Index by the World Economic Forum. It covers a wide range of issues including innovation, governance, transport and digital infrastructure, and measures of health and human capital. A growing number of regions use it to identify their strengths and weaknesses and shape their development strategies.

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Disclaimer: This Working Paper has been written by Paola Annoni, Lewis Dijkstra and Nadia Gargano, European Commission Directorate-General for Regional and Urban Policy and is intended to increase awareness of the technical work being done by the staff of the Directorate-General, as well as by experts working in association with them, and to seek comments and suggestions for further analysis. The views expressed are the authors' alone and do not necessarily correspond to those of the European Commission.

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1. Introduction

This paper presents the results of the third edition of the Regional Competitiveness Index (RCI) which measures the different dimensions of competitiveness at the regional level in the European Union (EU). The regional dimension is important because most competitiveness factors are not evenly distributed over space and many are influenced or even determined by regional and local authorities.

The 2016 edition follows two previous ones published by the European Commission in 2010 and 2013 (Annoni and Kozovska, 2010; Dijkstra, Annoni and Kozovska, 2011; Annoni and Dijkstra, 2013). They are all built on the approach of the Global Competitiveness Index of the World Economic Forum (GCI-WEF). The 2016 index is based on 74 mostly regional indicators covering the 2012-2014 period, but with a number of indicators from 2015 and 2016.

The index should, above all, be seen as an instrument providing a range of comparable information at the regional level. It aims to provide a consistent, comparable and actionable measure of economic and social issues for the regions in the EU. It helps regions to measure their competitiveness and compare it with that of their peers. The RCI can encourage regions to look beyond the other regions in their country to plan their long-term development. Within this perspective, we hope that regions will use the results to guide their development strategies.

Even though the RCI is not entirely comparable over time, due to recurrent and often unavoidable revisions of regional indicators and NUTS classification, the three RCI editions provide a unique policy tool for monitoring and assessing regional competitiveness in the EU. This paper shows the most relevant changes over the three editions, changes which are more likely to reflect a change in the region's performance than small adjustments to the method.

2. WHAT THE REGIONAL COMPETITIVENESS INDEX MEASURES

2.1 The concept and definition

National competitiveness, according to the World Economic Forum (WEF), is the 'set of institutions, policies and factors that determine the level of productivity of a country' (Schwab, 2012; Schwab and Porter, 2007). This was developed to steer their well-known Global Competitiveness Index (GCI). This definition links firms to the country they operate in. Company-level competitiveness, i.e. a firm's capacity to compete, grow and be profitable (Martin et al., 2006), is a relatively uncontested concept. Applying the same concept to countries or regions, however, has given rise to criticism that a country or region cannot go out of business. In addition, competition between countries can be a positive sum game, while competition between companies tends to be a zero sum game (Krugman, 1996).

A region is neither a simple aggregation of firms nor a scaled version of nations (Gardiner et al., 2004). Meyer-Stamer (2008) states that: 'We can define (systemic) competitiveness of a territory as the ability of a locality or region to generate high and rising incomes and improve the livelihoods of the people living there.' This definition, however, is based entirely on the benefits to people living in a region and does not assess the strengths or weaknesses of the firms.

We have proposed a definition of regional competitiveness that integrates the perspective of both firms and residents (Dijkstra et al., 2011):

Regional competitiveness is the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work.

This balances the goals of business success with those of personal well-being. In this way, it responds to the discussion that gross domestic product (GDP) is insufficient by itself and should be complemented by a broader range of measures.

Sustainable in this definition means a region's capacity to provide an attractive environment in both the short and long term. For example, increasing public investment and expenditure, while lowering tax revenue, is not a sustainable approach.

2.2 Political, functional or statistical regions?

National competitiveness indicators benefit from a clearly defined geographical and political border. At the regional level, however, this becomes more complicated. Should we focus on political, functional or statistical regions?

Using political regions raises a number of problems. In highly centralised countries, such as Romania or Bulgaria, regions do not have an important policy role. In other countries, such as Germany, there is more than one regional level with a policy function (the *Länder* and *Kreise*). Some political regions cover only part of their functional economic area, and small regions tend to have less data availability. Fortunately, the goal of the competitiveness index is not to follow the geography of regional decision-making but to capture regional variations of issues that influence the attractiveness for firms and residents. Therefore, the RCI does not target political regions.

Should the RCI target functional economic regions? For example, should it use labour market areas or functional urban areas? There are good reasons to use functional areas as they capture the skills available in that labour market area and the services offered in that functional area. However, two obstacles prevent this approach. First, so far there is no harmonised definition of a labour market area at the EU level, although Eurostat is working on this. Second, functional urban areas do not cover the entire territory and have limited data availability.

The RCI is based on the statistical, NUTS 2 (Nomenclature of Units for Territorial Statistics) regions with one important change: NUTS 2 regions that are part of the same functional urban area are combined. This ensures that the RCI fully captures the skills available in the local labour market. For example, a firm in Brussels can easily draw on the labour force living in Brabant Wallon or Vlaams-Brabant. These regions have a higher share of the population with a university degree than Brussels. So only looking at the qualifications of Brussels' residents would misrepresent the full skill set available to this firm.

For most regions, this is not a problem as they contain one or more functional urban areas. Some, however, clearly slice up a functional whole into multiple parts. For example, London and Paris, with their respective commuting zones, have approximately the same population (around 12 million). But while a single French NUTS 2 region (Île de France) covers most of this area, the London functional urban area is spread out over seven NUTS 2 regions (following the 2013 NUTS classification revision). These problems also arise for a small number of EU capital cities, including Amsterdam, Berlin, Brussels, London, Prague and Vienna. NUTS 2 regions with more than 40 % of their population in the same functional urban area (FUA), defined according to the EU-OECD approach (Dijkstra et al., 2012), are combined and considered as a single region.

3. WHAT THE REGIONAL COMPETITIVENESS INDEX SHOWS

3.1 The most competitive regions in the EU

As in the previous two editions, the geographical distribution of competitiveness features wide variations not only between but also within countries (Map 1).

The so-called 'Blue Banana', a highly urbanised and industrialised corridor defined in 1989 by a group of French geographers led by Roger Brunet, which linked the region of Greater London all the way to Lombardia, passing through the Benelux countries and Bayern, does not appear on the RCI map. On the contrary, the RCI shows a more polycentric pattern with strong capital and metropolitan regions in many parts of Europe. Some capital regions are surrounded by similarly competitive regions, indicating the presence of spillover effects, but in many countries the regions neighbouring the capital are far less competitive. A key question for the future is whether the strong performance of these capital and metropolitan regions will help to increase the performance of neighbouring regions or whether the gap between them and the other regions will widen.

London and its commuting zone, which includes seven NUTS 2 regions¹, is ranked top in 2016 (Table 1). For the first time since the publication of the RCI, the Dutch region of Utrecht is not the most competitive but is joint second with the British region of Berkshire, Buckinghamshire and Oxfordshire. It is important to note that, due to the margins of error in the set of indicators included in the index, the difference between some of the scores may not be considered as statistically significant. Instead of focusing on single scores, a more accurate reading of results is obtained by grouping regions around similar score values. As in previous RCI editions, most of the top regions host either capitals or large metropolitan areas which help to boost the region's competitiveness.

At the other end of the scale, we find Greek and Romanian regions, one Bulgarian region and one French region, Guyane, which is an outermost region. As noted in Article 174 of the Treaty on the Functioning of the European Union, the outermost regions have specific characteristics, not all of which are captured by the RCI. This should be taken into account when analysing RCI results for the outermost regions and comparing them to other regions.

Capital regions tend to be the most competitive region in their country (Figure 1). The only exceptions are: Germany, Italy and

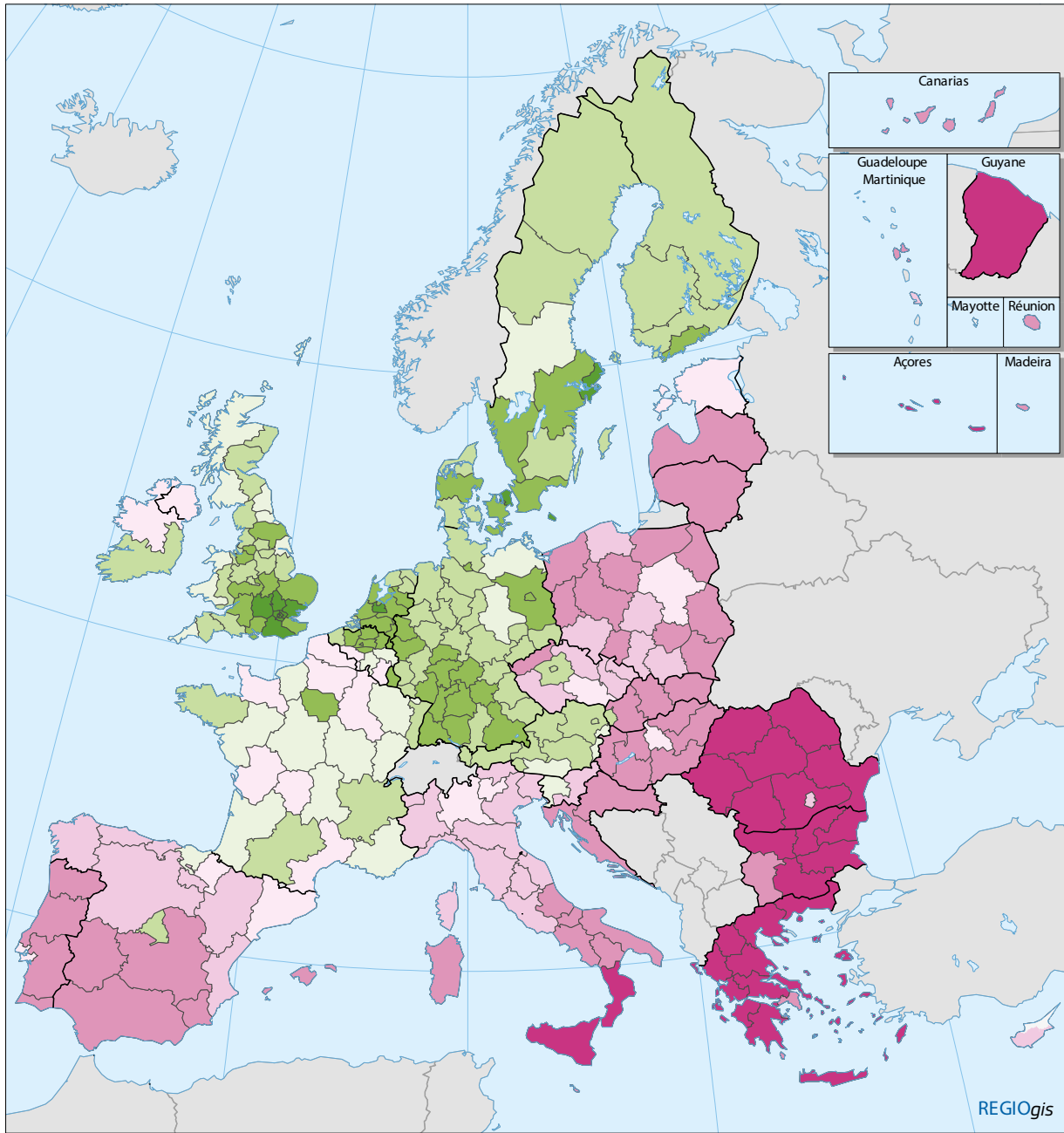
the Netherlands. In the Netherlands, the capital region is ranked second, while in Italy, Lombardia, a historically highly productive region, continues to be the best Italian region as it was in previous RCI editions. Many other German regions outperform Berlin, which may be due to its relatively short history as the capital of a reunited Germany.

The gap between the capital region and other regions is particularly wide in some countries, for example, Romania, Greece, Slovakia, Bulgaria and France. These countries are also characterised by a high level of variability within the country, mostly due to the outperforming capital (Figures 1 and 2). A big gap between the capital region and the rest of the country is generally a reason for concern as it puts substantial pressure on the capital region while it may leave some of the resources in other regions underutilised. The gap between the capital region and the second-highest-performing region is relatively small in the United Kingdom (UK), Austria and Belgium. However, a small gap between the capital region and other regions does not mean that the entire country performs well. For example, Belgium and the UK have quite heterogeneous scores (Figures 1 and 2). Within-country variability highlights the limitations of national-level analyses and can foster a debate about whether regional competitiveness gaps are harmful for national competitiveness and to what extent the internal inequality can be remediated.

The map of the three RCI sub-indices (Map 2) shows that the Basic group has the least within-country variability, while the Efficiency group and especially the Innovation group vary more. There are two reasons for the relatively higher homogeneity of the Basic group: first, two of the five pillars in the Basic group are measured only at the country level; second, as the group describes basic aspects, a certain level of homogeneity across the EU is expected. The high variability in the Innovation group suggests substantial differences in the innovative capacity of regional economies both across but also within countries.

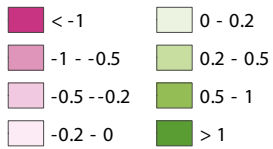
RCI results, data tables, and interactive maps are available on the [EU Regional Competitiveness Index webpage \(http://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness\)](http://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness)

¹ Table A.1.1 of the Appendix lists the NUTS 2 regions comprising London and its commuting areas.



Regional Competitiveness Index - RCI 2016

Index: values range from low (negative) to high (positive)



EU-28 = 0
Source: DG REGIO



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Map 1: RCI 2016 scores (z-scores, EU-28 = 0)

TOP 10				
country	region code	region name	score (on a 0-100 scale)	rank*
UK	UK00	London and regions covered by its commuting zone	100.00	1
UK	UKJ1	Berkshire, Buckinghamshire and Oxfordshire	97.67	2
NL	NL31	Utrecht	97.63	2
SE	SE11	Stockholm	97.21	4
UK	UKJ2	Surrey, East and West Sussex	93.95	5
DK	DK01	Hovedstaden	92.94	6
LU	LU00	Luxembourg	91.06	7
FR	FR10	Île de France	90.27	8
DE	DE21	Oberbayern	89.68	9
UK	UKJ3	Hampshire and Isle of Wight	88.61	10

BOTTOM 10				
country	region code	region name	score	rank*
RO	RO31	Sud-Muntenia	5.69	254
RO	RO41	Sud-Vest Oltenia	5.56	255
EL	EL62	Ionia Nisia	4.87	256
EL	EL63	Dytiki Ellada	3.18	257
EL	EL65	Peloponnisos	1.95	258
BG	BG31	Severozapaden	1.89	258
EL	EL64	Stereia Ellada	1.84	258
EL	EL51	Anatoliki Makedonia, Thraki	0.20	261
RO	RO22	Sud-Est	0.07	262
FR	FRA3	Guyane	0.00	262

* Equal same rank is assigned to two regions if their score difference (on a 0-100 scale) is not above 0.1

Table 1: Top-10 and bottom-10 regions

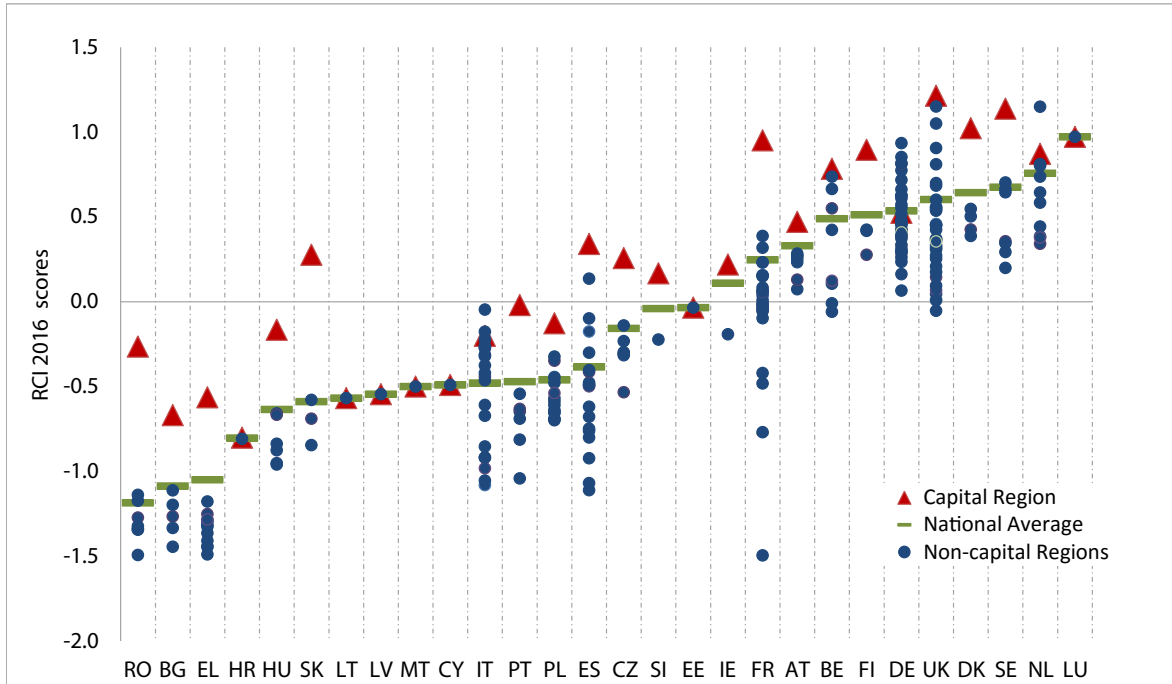


Figure 1: Distribution of RCI scores within countries

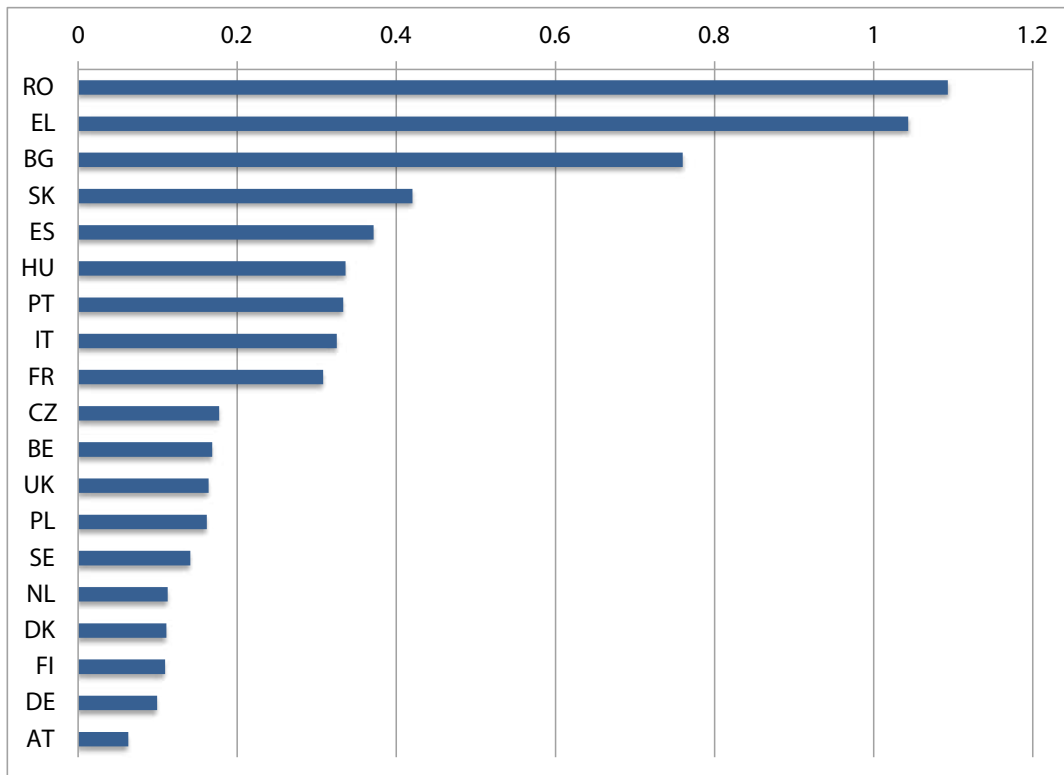
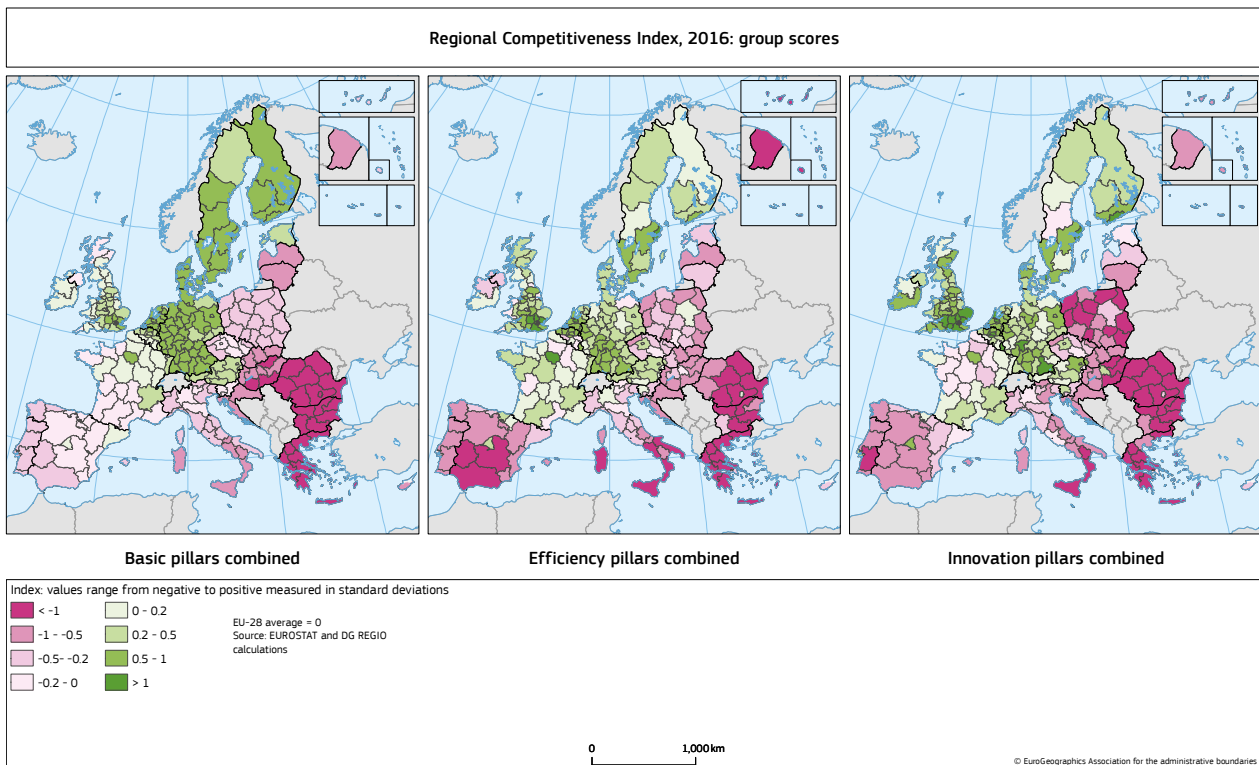


Figure 2: Coefficient of variation (ratio between standard deviation and average) of RCI scores by country (countries with 2 regions or less have been omitted: CY, EE, HR, IE, LT, LU, LV, MT and SI)



Map 2: RCI sub-indices (scores)

3.2 More competitive regions have higher GDP and attract more migrants

Comparing the RCI to gross domestic product (GDP) per head – an economic measure not directly included in the index – indicates a strong and positive relationship (Figure 3). Nevertheless, many regions still lie around the main curve which implies that at every level of economic performance there are opportunities for more competitiveness as well as risks for less. Regions at different stages of development are marked differently in Figure 3. As expected, higher RCI values are generally associated with higher GDP per head values. But the relationship tends to weaken as GDP per head increases. For less-developed regions, the relationship is strong: a slight increase in GDP per head is linked to a large increase in competitiveness. In rich regions, each extra euro of GDP per capita buys less and less competitiveness and the range of variation in competitiveness for a fixed GDP value is much wider than that for less-developed regions. Apart from Luxembourg, which is always an outlier in terms of GDP per

capita, most of the top-ten regions (London, Berkshire, Buckinghamshire and Oxfordshire, Utrecht, Surrey and Sussex, Hampshire, Stockholm, Hovedstaden) outperform their economic level, as they score higher than their GDP per head would imply. Some regions have a relatively low level of RCI relative to their GDP per head, such as Hamburg, Groningen and Bratislava. Among the regions in the highest stage of development (GDP per head > 110 % of EU-28 average), many Italian regions are underperforming. This is the case for most of the regions in the north-east as well as Lombardia, Lazio and Valle d'Aosta.

In these cases, as well as in more successful ones, the RCI can be used to help regions assess which aspects of competitiveness are the strongest and which ones need improvement. The index makes it easy for a region to compare itself to all other EU regions, to spot regions with a similar level of competitiveness, and to identify regions it could learn from. Regional development strategies could use the RCI to identify possible regional development priorities.

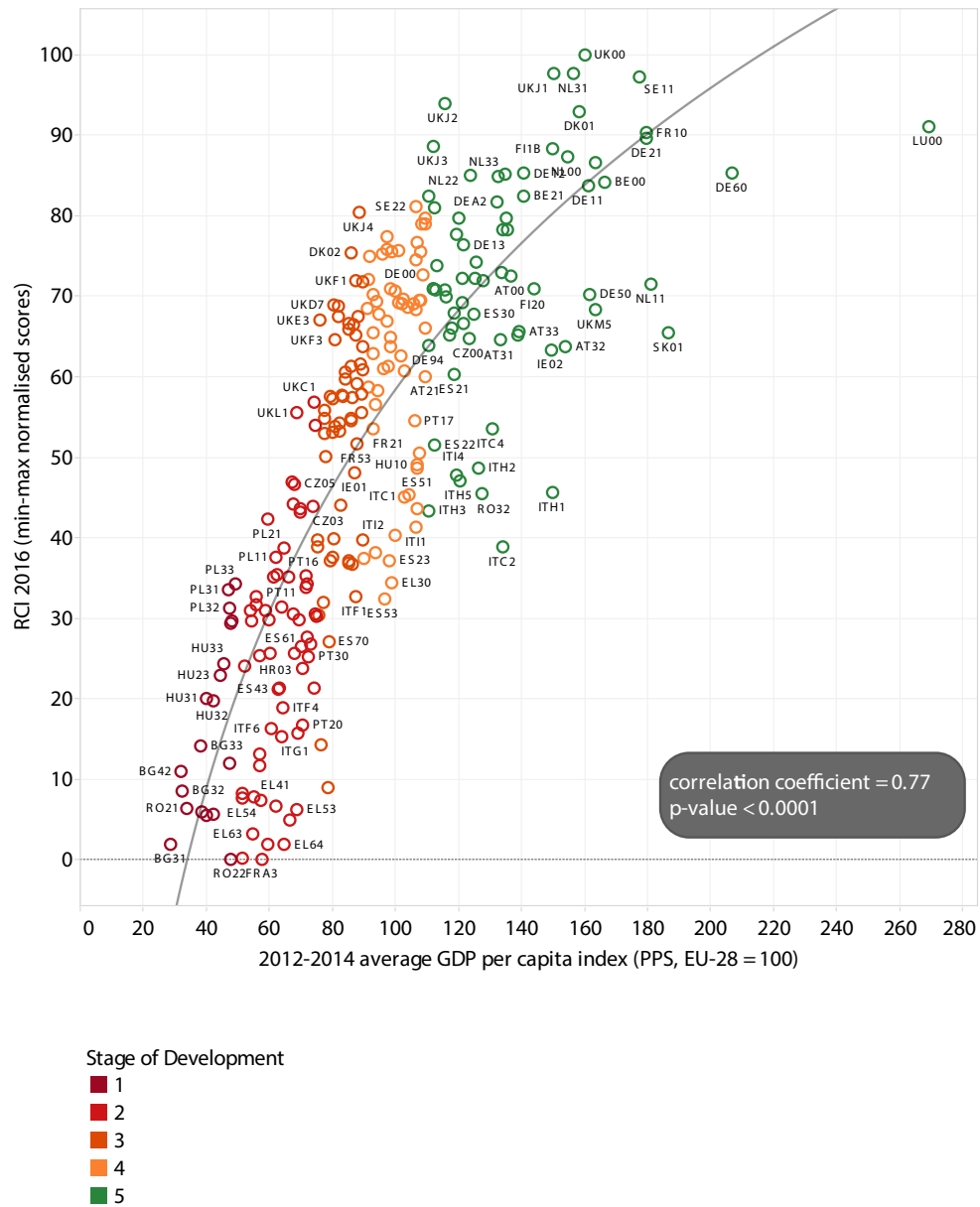


Figure 3: Relation between RCI scores and GDP per capita index (PPS, EU-28 = 100) averaged across 2012-2014; the different colours correspond to the regions' five development stages. See section 4.3

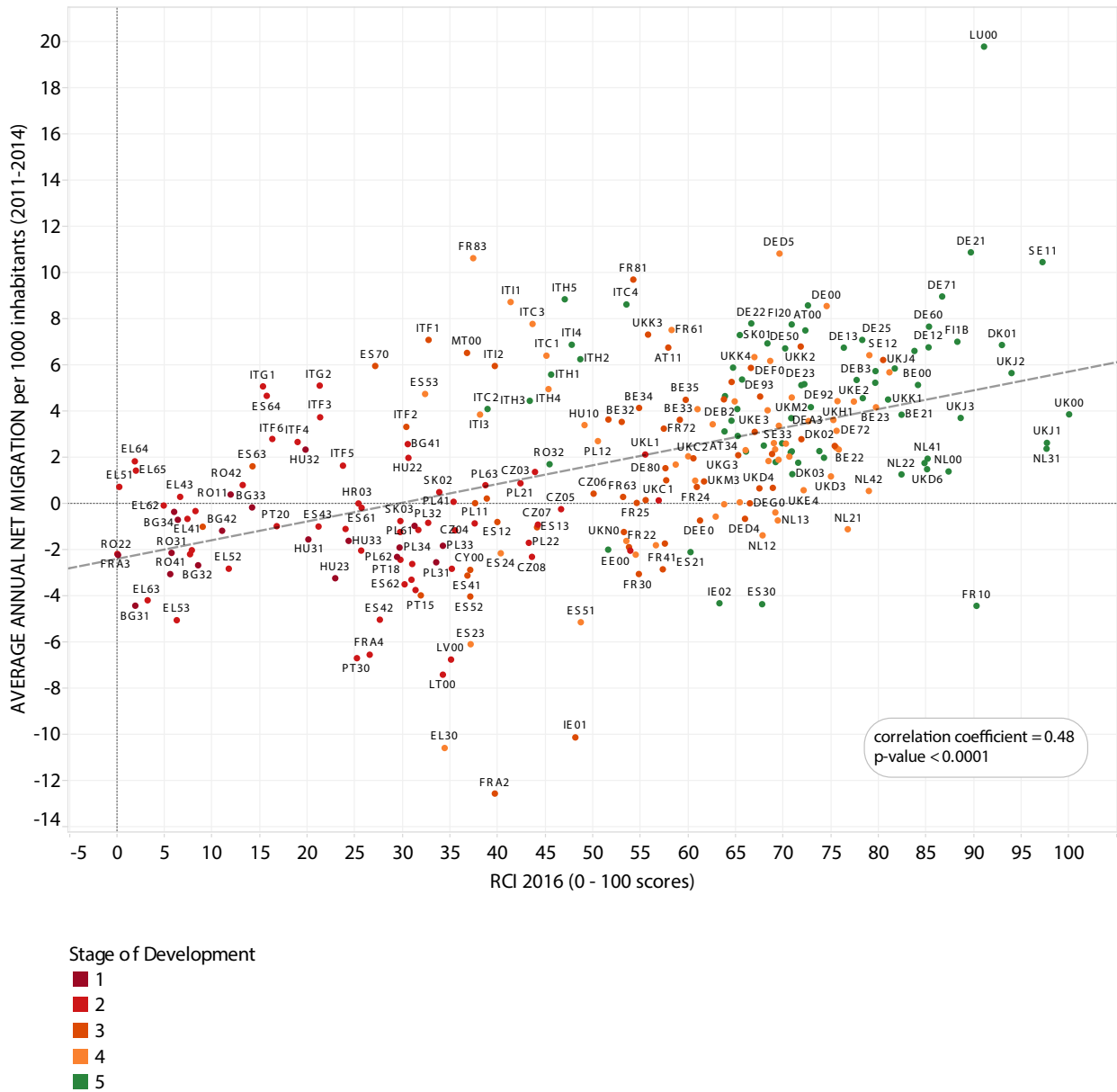


Figure 4: Net migration rate (per 1000 inhabitants) and RCI 2016. Positive numbers mean a region has had more in-migration than out-migration, while negative numbers mean the opposite. Different colours correspond to the regions' five development stages. Net migration is averaged across 2011-2014. Please note that, due to a mismatch between regional and national populations, the period considered for the following countries is: France: 2013-2014; Romania: 2012-2014; United Kingdom: 2011-2012

Competitive regions have higher rates of net migration (Figure 4). The net migration rate is the difference between in-migration and out-migration divided by population. Net-migration is captured as the difference between total population change and natural change (births minus deaths). As a result, over- or underestimating population growth will lead to a bias in net migration. Luxembourg's high net-migration rate may be due in part to such bias, as the population register is better at recording people moving to Luxembourg than those moving away. This can lead to an overestimation of population growth and, consequently, an overestimation of net migration.

The link between net migration is statistically significant and quite strong (Figure 6) but not as strong as its relation with GDP. Regions with a low RCI, including many of the Bulgarian, Greek and Romanian regions, experienced very low or negative net migration rates. Regions with a high RCI experience positive net migration, the only exception being Île de France (FR10). Regions with an RCI in the middle range show the most diverse values in net migration. Some show a high level of attractiveness. For example, many of the Spanish, Italian and French regions along the Mediterranean coast have high net migration, while some other Spanish and French regions with similar competitiveness levels have negative net migration. Over the last two decades, some countries such as Latvia and Lithuania have been losing population due to significant migration out-flows, and are continuing to do so, while the two Irish regions went from positive to negative migration due to the crisis (see the 6th Cohesion Report (European Commission, 2014) for more analysis of migration trends).

3.3 Comparison with peers: the scorecards

Regions can use RCI scores to compare themselves to any other regions in the EU or to the EU average. It can also be helpful to compare a region with regions at a similar level of economic development. For example, a less-developed region may have an overall low score but outperform regions with similar GDP per capita. Conversely, a highly developed region may have a high absolute score but still fall short of what is typical for comparably wealthy regions.

To facilitate a comparison with peers, we created scorecards that show a region's strengths and weaknesses relative to regions with a similar GDP per head. These scorecards were developed following the approach used for those of the Global Social Progress Index^[2].

Scorecards are tables – one for each region – presenting a region's scores and rankings for the RCI index, the three sub-indices and the 11 pillars. In addition, the region's performance is compared with that of a group of its economic peers, defined as the 15 regions closest to the one under analysis in terms of average 2012-2014 GDP per capita index (PPS, EU-28 = 100). Each region's GDP per head is compared with every other region, and the 15 regions with the smallest absolute difference are selected for the peers group.

Once the group of peer regions has been defined, the region's performance is compared to the average score of regions within the group. The standard deviation of the peer region scores is taken as a measure of the score variability within the group. If the region's score deviates from the group average by less than

one standard deviation, then the region is considered to have neither strengths nor weaknesses with respect to its peers. If a region has a score that is more than one standard deviation above (below) the average, then it is considered as over-performing (underperforming). Strengths and weaknesses that are very close to the cut-off threshold are indicated with an asterisk to show that they have a minor strength or weakness.

The scorecard for the region of Lombardia, in the north-west of Italy, is provided in Box 1.A as an example. The upper part of the scorecard shows the region's scores and rankings in the RCI index, sub-indices and pillars. All the scores range from 0 (lowest level of competitiveness) to 100 (highest level of competitiveness). Equal rankings are assigned to regions if their score differs not more than 0.1.

The lower part of the scorecard lists the 15 regions with GDP per head similar to Lombardia. Then each score is characterised by a colour. Yellow signifies that Lombardia's performance is typical for regions at similar levels of economic development; green indicates that Lombardia performs better than its peer group, while red signifies that the region performs worse than its peer group. The asterisk indicates a strength or weakness that is only just above or just below the divide, in other words, the region performs only slightly better (or worse) than its peers.

Lombardia, which is at the highest stage of development, underperforms in terms of overall RCI with respect to most of the regions with a similar GDP per capita (region labelled ITC4 in Figure 3). In fact, the region's RCI is marked as red in the scorecard (Box 1.A) meaning that its RCI score is lower than the average RCI of its 15-region peer group. Lombardia has no strengths compared to its peers, given that all the different aspects of the RCI are either yellow or red. The competitiveness aspects in most need of attention are the quality of institutions, higher education, the labour market, and the technological readiness of households and enterprises. The reader should note that the quality of institutions and the technological readiness pillars include both a regional and a national component. The region's poor performance in these aspects of competitiveness is therefore the result of national as well as regional poor performance. Macroeconomic stability is another point of weakness but, as it is only measured at the national level, regional policies cannot provide a solution for this, at least not exclusively. Please note that all of the weaknesses identified in Lombardia are flagged as minor weaknesses.

Box 1.B illustrates the case of the Malopolskie region, in the south of Poland, with a Class 2 development stage. Despite reaching only 42 % of the maximum RCI score, the region shows many strong points with respect to its peers. It scores substantially better in the quality of institutions and basic education, making the Basic sub-index score higher than that of the peer group average. Market size is also an asset for the region and its innovation capability is better than that of other regions with a similar level of economic development.

Interactive scorecards are available on the [EU Regional Competitiveness Index webpage](#) where users can select the regions they are interested in.

² <http://www.socialprogressimperative.org/global-index/>

Box 1.A: Scorecard for Lombardia ITC4, Italy
















<i>Italy</i>	<i>Lombardia</i>		<i>ITC4</i>
	Score	Rank	
RCI 2016	0-100	53.5	143/263
GDP per head (PPS)	EU-28=100	131	37/263
Stage of development	1-5	5	


	Score	Rank		Score	Rank		Score	Rank
	0-100			0-100			0-100	
Basic dimension	57.0	158/263	Efficiency dimension	64.1	130/263	Innovation dimension	47.4	148/263
Institutions	26.9	223/263	Higher Education and lifelong learning	51.1	215/263	Technological Readiness	42.8	200/263
Macroeconomic Stability	52.5	21/28	Labour Market Efficiency	60.9	144/263	Business Sophistication	46.8	59/263
Infrastructure	53.62	69/263	Market Size	60.4	27/263	Innovation	45.7	97/263
Health	88.6	32/263						
Basic Education	58.8	18/28						


- Equal ranking is assigned if the difference in score is not above 0.1
- Macroeconomic Stability and Basic Education at the country level

COMPARATIVE ANALYSIS

Peer Regions: Köln, Bucuresti Ilfov, Oberpfalz, ZuidHolland, Oberösterreich, Unterfranken, Provincia Autonoma di Trento, Braunschweig, Düsseldorf, Comunidad de Madrid, Valle d'Aosta/Vallée d'Aoste, NoordBrabant, Tübingen, Mittelfranken and Schwaben

RCI 2016							
		*					
Basic dimension			Efficiency dimension		*	Innovation dimension	
Institutions		*	Higher Education and lifelong learning		*	Technological Readiness	
Macroeconomic Stability		*	Labour Market Efficiency		*	Business Sophistication	
Infrastructure			Market Size			Innovation	
Health							
Basic Education							

 Strength relative to the 15 regions with most similar GDP per capita

 Neither strength nor weakness relative to the 15 regions with most similar GDP per capita

 Weakness relative to the 15 regions with most similar GDP per capita

* Indicates a strength or weakness that is close to the expected range

Box 1.B: Scorecard for Malopolskie PL21, Poland
















Poland	Malopolskie		PL21
	Score	Rank	
RCI 2016	0-100	42.4	171/263
GDP per head (PPS)	EU-28=100	60	228/263
Stage of development	1-5	2	


	Score	Rank		Score	Rank		Score	Rank		
	0-100			0-100			0-100			
Basic dimension	53.6	170/263		Efficiency dimension	57.3	155/263		Innovation dimension	26.7	211/263
Institutions	39.3	186/263		Higher Education and lifelong learning	66.2	107/263		Technological Readiness	38.1	228/263
Macroeconomic Stability	63.3	16/28		Labour Market Efficiency	52.2	179/263		Business Sophistication	16.5	227/263
Infrastructure	18.82	183/263		Market Size	26.3	153/263		Innovation	31.8	166/263
Health	57.6	215/263								
Basic Education	80.2	6/28								


- Equal ranking is assigned if the difference in score is not above 0.1
- Macroeconomic Stability and Basic Education at the country level

COMPARATIVE ANALYSIS

Peer Regions: Peloponnisos, KözépDunántúl, Stredné Slovensko, Calabria, Kontinentalna Hrvatska, Voreio Aigaio, Vest, Jadranska Hrvatska, Kentriki Makedonia, Kriti, Latvija, Guyane, Łódzkie, Severozápad and Campania

RCI 2016							
							
Basic dimension			Efficiency dimension			Innovation dimension	
Institutions			Higher Education and lifelong learning			Technological Readiness	
Macroeconomic Stability			Labour Market Efficiency			Business Sophistication	
Infrastructure			Market Size			Innovation	
Health							
Basic Education							

 Strength relative to the 15 regions with most similar GDP per capita

 Neither strength nor weakness relative to the 15 regions with most similar GDP per capita

 Weakness relative to the 15 regions with most similar GDP per capita

* Indicates a strength or weakness that is close to the expected range

3.4 Have regions improved their competitiveness?

Comparing the RCI over time is complicated because each edition of the index incorporates improvements and slight modifications. These do not affect the overall structure of the index, but they limit the possibilities to measure change over time. The reasons for the changes are multiple: new indicators become available at the regional level, while others are not updated or no longer fit the statistical framework of the index. In addition, methodological improvements, especially between the first and the second RCI editions, and changes in the NUTS regions make these comparisons complex. Nevertheless, the method has not changed substantially and there is a high degree of continuity in the indicator list. Changes in the indicator list, as compared to the 2013 edition, are listed in Table A.3.1 in the Appendix.

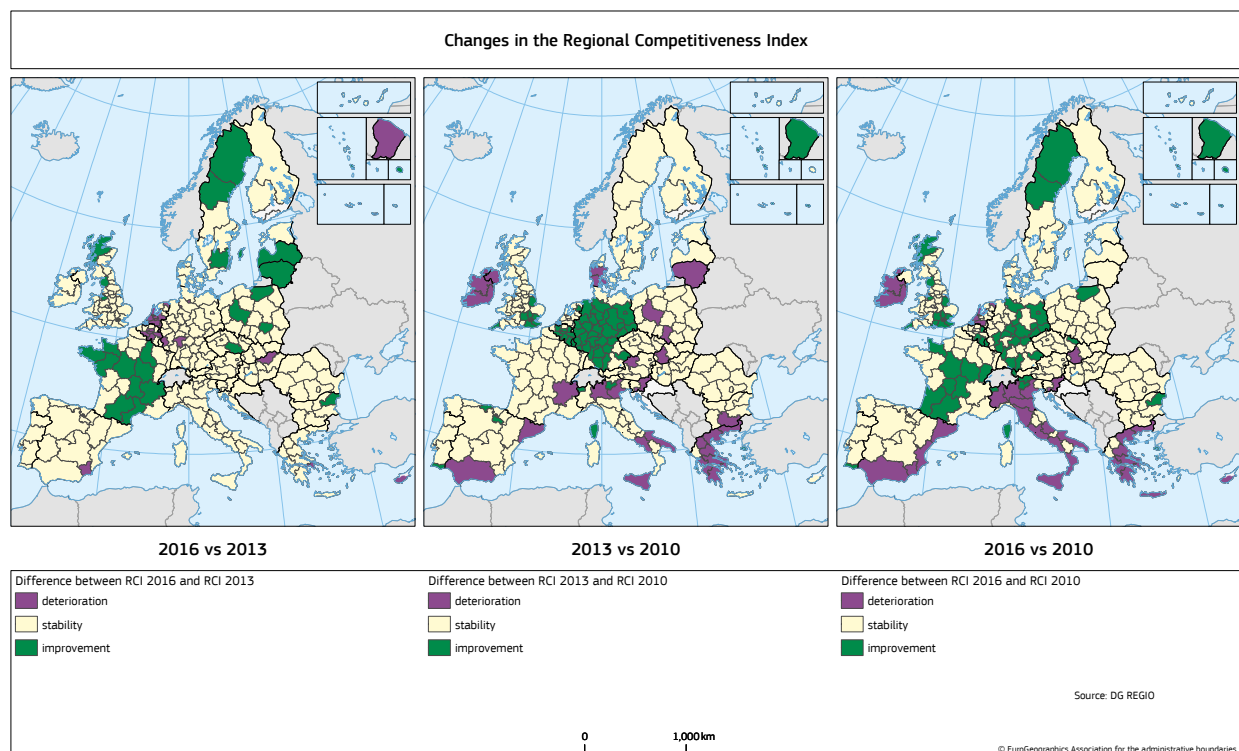
Changes in a region's ranking over time are not always meaningful. Rankings are based solely on the sequence of the scores (the ordinal properties) and do not take into account the actual differences between scores. It may happen that a change in the ranking is due to a very small difference in scores, which is not significant. This is often the case for scores around the average.

Analysing the major changes in the scores, as opposed to the rankings, over time can be highly informative. Map 3 shows the regions where the scores changed by more than 5 % of the difference between the highest and the lowest across three editions (that is the maximum score range). The three maps

show the comparison of two consecutive editions, 2016-2013 and 2013-2010, as well as the comparison across the whole period, 2016-2010. Between 2013 and 2016, around 10 % of the regions improved and 10 % reduced their level of competitiveness, while between 2010 and 2013 more regions increased (26 %) than decreased (11 %) their score.

Between 2010 and 2013, most of the Belgian and German regions saw a significant improvement. Between 2013 and 2016, the German regions mostly maintained their scores, while several Belgian regions, including the capital region, saw a reduction of their score. Greek and Irish regions deteriorated significantly between 2010 and 2013, with no significant improvements since 2013. In most countries (Austria, Bulgaria, Czech Republic, Denmark, Spain, Finland, Hungary, Poland, Portugal, Romania, Sweden and Slovakia), the regional scores are quite stable across the three editions.

The remaining countries saw a number of shifts. In France, improvements accelerated: 12 regions improved between 2013 and 2016 compared to only four between 2010 and 2013. In the UK, improvements slowed down: only four regions improved between 2013 and 2016, compared to nine between 2010 and 2013. Four regions in Italy saw a reduction in their scores in 2013 and have remained stable since then. Among the Baltic countries, Latvia and Lithuania recently improved their level of competitiveness while Estonia's relatively high score has not changed significantly. Luxembourg improved in 2013 and maintained its score in 2016.



Map 3: Changes in RCI, 2016-2013; 2013-2010 and over the whole period, 2016-2010. Regions with an increase of more than 5 % in the RCI range (z-scores) are categorised as an improvement, while a reduction of more than 5 % is deterioration

4. CONCEPTUAL FRAMEWORK

The RCI adopts and builds on the methodology developed by the GCI-WEF with some key differences, mainly due to the RCI's European and regional dimension. The 2016 framework has not changed with respect to that of 2013.

4.1. Eleven pillars in three groups

The RCI is composed of 11 pillars that describe the different aspects of competitiveness (Figure 5). They are classified into three groups: Basic, Efficiency and Innovation. The Basic group includes five pillars: (1) Institutions; (2) Macroeconomic Stability; (3) Infrastructure; (4) Health; and (5) Basic Education. These represent the key basic drivers of all types of economies. As a regional economy develops and advances in its competitiveness, factors related to a more skilled labour force and a more efficient labour market come into play as

part of the Efficiency group. This includes three pillars: (6) Higher Education, Training and Lifelong Learning; (7) Labour Market Efficiency; and (8) Market Size. At the most advanced stage of a regional economy's development, drivers of improvement are part of the Innovation group, which consists of three pillars: (9) Technological Readiness; (10) Business Sophistication; and (11) Innovation.

Two pillars are described at the country level only: Macroeconomic stability and Quality of Primary and Basic Education. Macroeconomic stability is determined by actions taken by the national government and can therefore only be measured at the national level. Basic education is based on data from the Programme for International Student Assessment (PISA) by the OECD, which produces almost exclusively national figures. As in RCI 2013, the Institutions and Technological Readiness pillars comprise two sub-pillars: one at the national level and the other at the regional level.

Table A.3.1 in the Appendix describes all the indicators in the RCI dimensions and sub-dimensions.

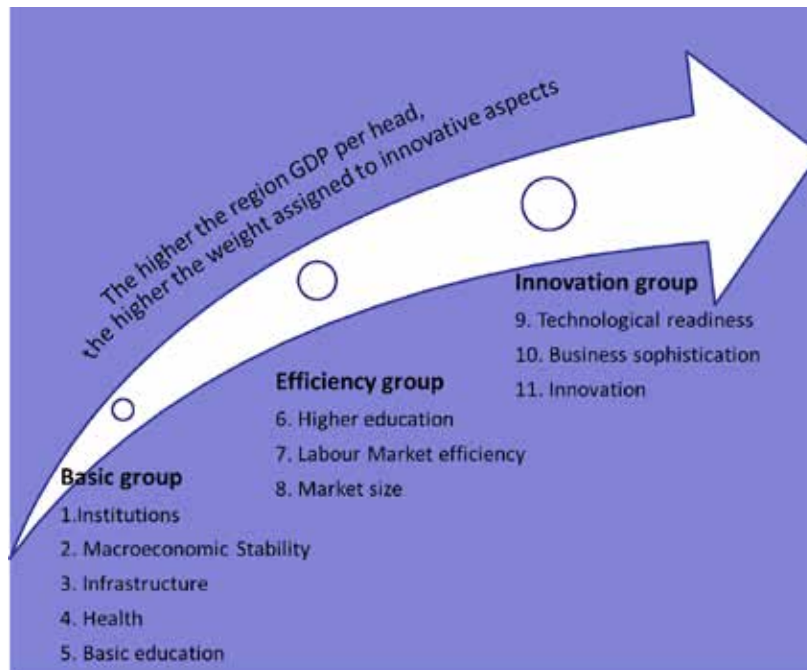


Figure 5: The Regional Competitiveness Index framework

4.2 The indicators set: what has changed?

All the indicators come from official and publicly available sources, mainly regional statistics from Eurostat, but also the World Bank Worldwide Governance Indicators, the Global Competitiveness Indicators by the World Economic Forum, the Quality of Government Index by the Quality of Government Institute, the Programme for International Student Assessment (PISA) indicators by the OECD, Scopus indicators on publications by Science-Metrix, innovation indicators from the Regional Innovation Scoreboard project, and other indicators developed by the Directorate-General for Regional and Urban Policy³¹.

When developing the new edition, we tried to keep the set of indicators as similar as possible to the previous editions. Nonetheless, a regional composite index of this complexity is always subject to modifications and adjustments, not least because the NUTS classification is constantly changing. With respect to the previous editions, a limited set of refinements has been implemented. The whole set of candidate indicators and their detailed description is provided at this link.

Institutions – sub-pillar at the regional level

A rich set of indicators measuring the quality of government and institutions at the national level is available for the EU. These cover aspects ranging from public procurement, recently published by the European Commission as part of the EU Single Market Scoreboard, to the judiciary system, assessed each year by the EU Justice Scoreboard, or from the Commission's e-Government project to the Rule of Law Index, by the World Justice Project. These national measures are very informative about the overall performance of a country's institutions, but cannot show within-country variations.

The only data on the quality of government available at the sub-national level is the EU Quality of Government Index – (QoG), published in 2010 and 2013 by the Quality of Government Institute, University of Gothenburg (Charron et al., 2012, 2013 and 2014). While the RCI 2013 included the 2010 edition of the QoG, which was the only year available at that time, this new edition makes use of the 2013 QoG indicators. They measure the extent to which citizens think their public-sector services are free from corruption, are of good quality and are allocated impartially. The group of 16 core questions used to build the 2013 QoG index are centred around three core concepts: 1) corruption, 2) quality, and 3) impartiality of public sector institutions and services. The RCI 2016 includes the three corresponding sub-indexes, computed for each concept and then anchored at national level to the corresponding World Bank Governance Indicators.

Infrastructure

A recent indicator on high-speed railways, made available by the Directorate-General for Regional and Urban Policy in 2016 and based on detailed timetable information, has been added to the infrastructure pillar (Poelman and Ackermans, 2016). The

indicator, called 'Intensity of high-speed railways', is measured as the total length of rail connections with a speed of more than 80 km/h, departing between 06:00 and 20:00 from any station in the region, divided by the regional population⁴¹. As the values are relative to the regional population, high values can sometimes reflect a low population density (this is the case for some regions in Sweden, Finland and Spain). Nonetheless, the indicator clearly shows that central, northern and western regions offer the best service, in terms of frequency of fast trains, while most of the eastern regions and some of the southern ones still need to improve.

The other three indicators – 'Access to motorways', 'Access to railways' and 'Accessibility to passenger flights' – have been updated with the latest available figures, but use the same sources and methods as in the previous RCI editions.

Basic education

As in the two previous editions, the OECD's Programme for International Student Assessment (PISA) indicators is included at the national level in this pillar. The aim is to describe the basic levels of a student's skills, using the most recent data available (OECD, 2016). The indicator assesses a student's proficiency in three core subjects: science, reading and mathematics.

Compared to the previous edition of PISA, science and reading proficiency is classified into seven rather than six levels. The lowest level (1) has been split into two: 1a (better) and 1b (worse). We used the share of pupils not above level 1a to identify insufficient proficiency in these fields. Mathematics has six proficiency levels. Level 2 is considered by OECD as the baseline level of proficiency required to participate fully in modern society. Therefore, we used levels 1 and 2 to identify the share of pupils with insufficient mathematics proficiency.

Higher education

The indicator 'early school leavers' was discarded from the Higher education pillar in 2013 because too many values were missing. In this edition, the indicator has been included as its regional coverage has improved substantially.

Business sophistication

A new indicator from the Regional Innovation Scoreboard (RIS) 2016 enriches the Business sophistication pillar (Hollanders and Kanerva, 2016). The indicator is called 'Innovative SMEs collaborating with others' and measures the degree to which SMEs are involved in innovation co-operation. It is limited to SMEs because almost all large firms are involved in innovation co-operation. The indicator measures the flow of knowledge between public research institutions and firms as well as between firms and other firms. Its role in the RCI is to describe the level of dynamism and vitality of the business environment, which is why it has been added to the Business sophistication pillar. Statistical analysis of the pillar confirmed its consistency with the other two indicators, Employment and GVA in the most advanced sectors (K-N NACE sectors).

³ Metadata of RCI 2016 indicators are available at http://ec.europa.eu/regional_policy/en/information/maps/regional_competitiveness

⁴ For the following insular regions/countries the value of the indicator is given as 'missing' to take into account the region specificities: EL41, EL42, EL43, EL632, ES53, ES63, ES64, ES70, CY00, MT00, PT20, PT30 and FI20. This means that this indicator is not taken into account in the computation of the infrastructure pillar score for these regions.

Innovation

Two other indicators from the Regional Innovation Scoreboard 2016 have been tested for the Innovation pillar: 'Exports in medium-high/high tech manufacturing' and 'Sales of new to market and new to firm innovation' (Hollanders and Kanerva, 2016). The export-based indicator describes a region's technological competitiveness. It measures a region's ability to commercialise the results of research, development and innovation in an international market. It complements the indicators on patent applications with a measurement that captures the technological and economic value of patented inventions and the possible impact these may have on technological developments. The underlying assumption is that the quality of new patents, which result from R&D and innovation investment, is reflected by their actual use. The measurement of patent quality has recently been discussed by the OECD (Squicciardini, Dernis and Criscuolo, 2013). The indicator proved to be statistically consistent with the others included in the pillar, which are also the same as those in the two previous versions of the RCI.

'Sales of new to market and new to firm innovation' measures the turnover of new or significantly improved products to the firm as a percentage of the total turnover. It is considered as a proxy for the degree of diffusion of state-of-the-art technology. As for the Regional Innovation Scoreboard indicator on exports, its role in the RCI is to complement the quantitative information on patent applications with a more qualitative one. Unfortunately, this second indicator did not pass the internal consistency statistical test and was discarded from the index computation.

Another difference with respect to the previous edition concerns the indicator 'Employment in technology and knowledge-intensive sectors'. This was discarded in 2013 because of a high share of missing values, but is included in this edition as the regional coverage of this indicator has improved considerably. All the other indicators remain the same.

The complete list of all 79 candidate indicators in RCI 2106 is provided in Table A.3.1 in the Appendix (the complete table is available on the EU Regional Competitiveness Index webpage). The statistical assessment allowed us to retain 74 indicators to construct the RCI 2016 (Section A.2 in the Appendix).

4.3 A differentiated weighting scheme

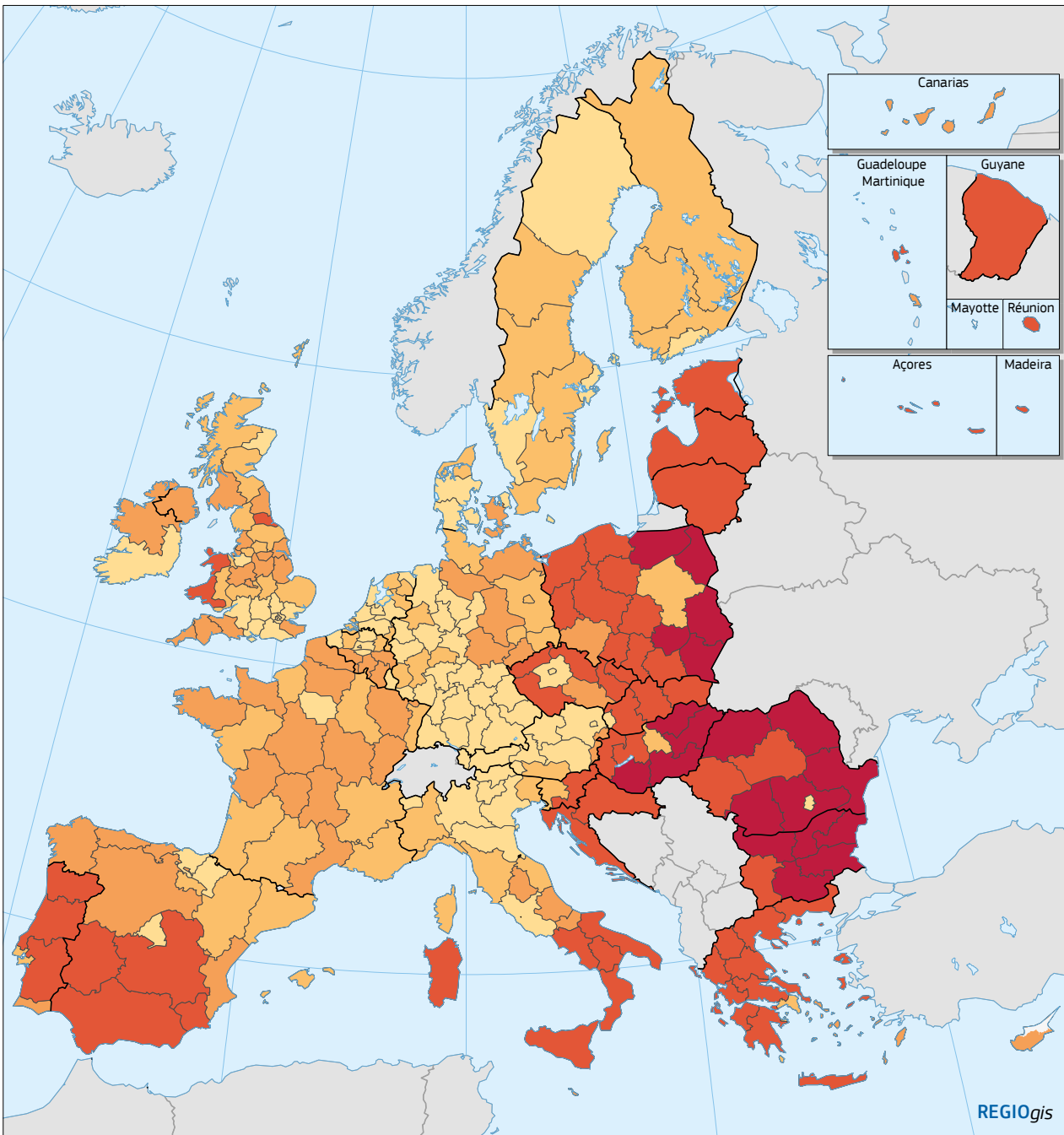
The three RCI groups – Basic, Efficiency and Innovation – are linked. A region with a good performance in the Innovation group is expected to have a good performance in the Basic and Efficiency groups as they are instrumental in increasing levels of competitiveness. In this sense, Basic and Efficiency aspects can be seen as necessary conditions for good levels in Innovation aspects. Conversely, regions with poor or insufficient levels in the Basic group cannot be expected to perform well in the other two groups. It is assumed that as regions move along the development path, their socio-economic conditions change and different determinants become more and more important for competitiveness. As a result, improving the competitiveness of more-developed regions will require other priorities than for a less-developed region.

This is reflected by a weighting system that takes into account the stage of development. As in the 2013 edition, EU regions are divided into five development stages based on their average 2012–2014 GDP per head in purchasing power standard (PPS) expressed as an index (EU-28 = 100). The five development stages are defined according to the following thresholds:

- ◇ Stage 1: <50;
- ◇ Stage 2: 50-75;
- ◇ Stage 3: 75-90;
- ◇ Stage 4: 90-110;
- ◇ Stage 5: >110.

The 75 and 90 thresholds play a key role for cohesion policy as the limit values for the region to be considered in the Less Developed or Transition category, respectively. The distribution of development stages across EU regions is shown in Map 4.

The RCI score is computed for each region as the weighted average of the scores the region gets in the three groups (sub-indexes), with weights depending on the region's development stage. At the lowest development stage, below 50 % of the EU average GDP per head (PPS), the basic group is assigned a higher weight (0.35) than the innovation group (0.15) (Figure 6). This trend is smoothly reversed as the development stage increases and, at the highest stage, above 110 % of the EU average, the basic group has a lower weight (0.20) while the innovation group has a higher weight (0.30). The efficiency group is always given the same weight, 0.5, regardless of the region's development stage.

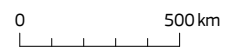


GDP per head (PPS), average 2012-2014

Index, EU-28 = 100

- < 50
- 50 - 75
- 75 - 90
- 90 - 110
- > 110

Source: Eurostat



© EuroGeographics Association for the administrative boundaries

Map 4: Average GDP per head (PPS) for the period 2012-2014

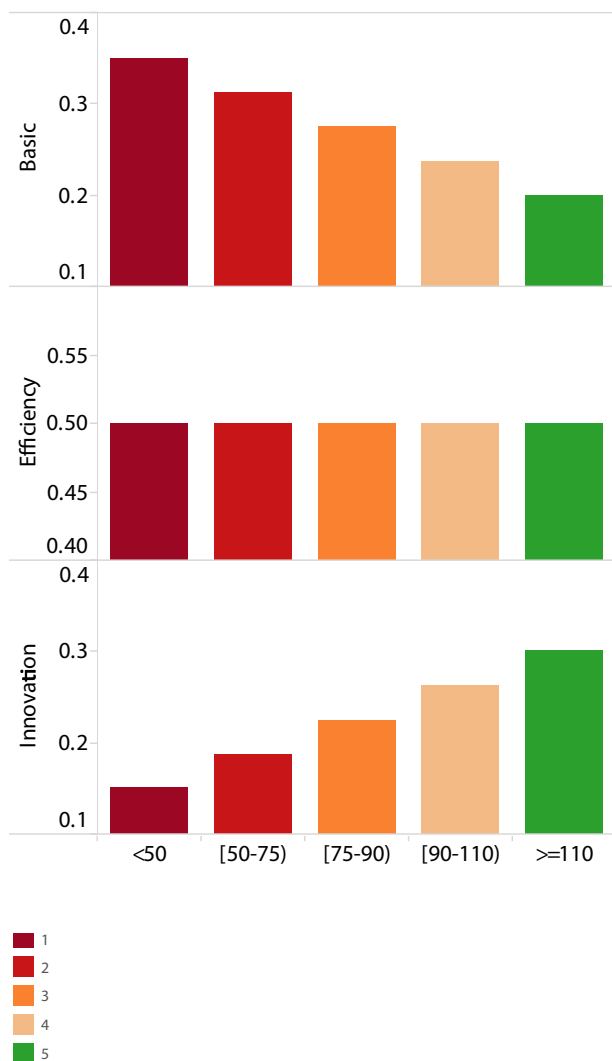


Figure 6: The differentiated weighting scheme for the three RCI groups of pillars – Basic, Efficiency and Innovation, depending on the region’s development stage

In more than 70 % of the cases, the development stage remains unchanged from 2013, whilst about 8 % of the regions improved their development stage (from one class to the one immediately above it). These regions are in Austria, the Czech Republic, Germany, Poland, Romania and Slovakia. On the other hand, 47 regions (about 18 %) dropped to a lower stage of development, including Cyprus and some regions in Greece, Spain, Ireland, Italy, the Netherlands, Portugal and Sweden. The Greek region Notio Aigaio (EL42) and the Portuguese region of Madeira (PT30) are classified in two classes below their 2013 stage.

5. CONCLUSIONS

The RCI is the only measure to provide a European perspective on the competitiveness of all NUTS-2 regions in the EU. Through its 11 pillars, it assesses not only aggregate competitiveness but also the strengths and weaknesses of a region. In many countries, the capital region is far more competitive than the others in the same country and many countries show highly heterogeneous scores. The gaps and variations in regional competitiveness can feed the debate on the extent to which they have an adverse effect on national competitiveness and, if so, how they could be addressed. The within-country variation also underlines the limits of a purely national-level analysis.

Much of the debate around the use of composite indicators for measuring regional competitiveness has concentrated on the implications of creating league tables and the danger of stigmatising lagging regions while disregarding the broader picture (for example, Bristow, 2005). The RCI takes a wider approach to competitiveness, looking at a number of relevant dimensions not strictly related to company productivity, but also covering societal well-being, and long-term potential. In so doing, it departs from traditional discourses which maintain that regional economic performance derives only from firms’ competitiveness, and reflects the current debate on the fact that prosperity should not only be measured by income-related indicators but should include other aspects such as health and human capital development, (Stiglitz et al., 2009) and the EU’s ‘GDP and beyond’ process (European Commission, 2009).

Because of its weighting scheme which considers the region’s stage of development, the RCI does not measure all regions with the same yardstick, but focuses on the most relevant aspects given their level of development. This also offers a guide for policymaking. For example, the competitiveness of a medium-developed region is likely to benefit more from improving institutions and basic education than from trying to increase its patent applications or R&D expenditure. In addition, the simple and transparent weighting scheme allows a region to see what the impact could be from moving to the next stage of development.

RCI 2016 results are in line with those for 2013. Once again, a polycentric pattern can be observed with strong capital and metropolitan areas as the main drivers of competitiveness. Spillover effects can be seen in most of north-western Europe, but this is much less obvious in the EU regions to the east and south. High levels of within-country variation are observed in many cases which are caused by a clearly outperforming capital region compared to the other regions in the country.

This paper presents a general picture. However, the new interactive web tool allows for a more detailed analysis and comparison of each region either with its peers or with all the EU regions. The RCI scorecards, available on the EU Regional Competitiveness Index webpage together with data tables, maps and indicators, provide easy access to a wide range of comparable information, having been designed to inform regional development strategies.

APPENDIX

A.1 Regions and functional urban areas

RCI 2016 is based on NUTS-2 regions, as defined by Eurostat in the latest 2013 revision (Eurostat, 2015). As in the previous editions, the NUTS-2 regions that are part of the same functional urban areas are combined: this concerns six capital functional urban areas. The regions are listed below:

A.2 Statistical assessment

Through the statistical assessment, we can assess the statistical quality of each single indicator included in the framework – univariate analysis – and verify whether the set of indicators within each dimension is internally consistent – multivariate analysis.

The univariate analysis first checks for missing values. The maximum allowed share of missing values is set at around 10-15 %, above which the indicator is excluded. In RCI 2016, only one indicator, 'Biotechnology patent applications', is excluded because 16 % of the values are missing. In a few cases, only the NUTS-1 level is available which means this value is simply repeated for all the NUTS-2 regions within the parent NUTS-1 region.

Where it is necessary to adjust for outliers, the Box-Cox transformation is adopted. Box-Cox transformations are a set of continuous, monotonously increasing, power transformations which include the logarithmic one as a particular case (Box and Cox, 1964). They depend on a power parameter λ contracting (expanding) higher values for $\lambda < 1$ ($\lambda > 1$). Ten indicators included in the index required the Box-Cox transformation. These are listed in Table A.3.2, together with the corresponding λ value adopted for the transformation.

To correct for different range and measurement units, weighted z-scores are adopted with the regions' population sizes as weights.

The internal consistency within each pillar is verified by the Principal Component Analysis (PCA), a multivariate explorative technique (Morrison, 2005). The PCA is useful in composite index construction, mainly for the following reason. Each pillar in a composite index is meant to describe a particular aspect of the latent phenomenon to be measured, in this case regional competitiveness. As such aspects are not directly observable, they can only be measured by proxies – in other words, by indicators which are assumed to be related to the aspect they describe and, hence, to each other. These two conditions should ideally be verified: 1. each pillar shows a unique, most relevant PCA component accounting for a large amount of variance; and 2. all the indicators contribute to roughly the same extent

Country code	Country name	NUTS CODE 2010	NUTS CODE 2013	NUTS NAME	Change	Explanation (old = new)	In RCI 2016
AT	Austria	AT12	AT12	Niederösterreich			AT00
AT	Austria	AT13	AT13	Wien			AT00
BE	Belgium	BE10	BE10	Région de BruxellesCapitale			BE00
BE	Belgium	BE24	BE24	Prov. VlaamsBrabant			BE00
BE	Belgium	BE31	BE31	Prov. Brabant Wallon			BE00
CZ	Czech Republic	CZ01	CZ01	Praha			CZ00
CZ	Czech Republic	CZ02	CZ02	Strední Cechy			CZ00
DE	Germany	DE30	DE30	Berlin			DE00
DE	Germany	DE40	DE40	Brandenburg			DE00
NL	Netherlands	NL23	NL23	Flevoland			NL00
NL	Netherlands	NL32	NL32	NoordHolland			NL00
UK	United Kingdom	UKH2	UKH2	Bedfordshire and Hertfordshire			UK00
UK	United Kingdom	UKH3	UKH3	Essex			UK00
UK	United Kingdom	UKI1	UKI3	Inner London	New region = Inner London	UKI3 + UKI4 = UKI1	UK00
UK	United Kingdom	UKI1	UKI4	Inner London	New region = Inner London	UKI3 + UKI4 = UKI1	UK00
UK	United Kingdom	UKI2	UKI5	Outer London	New region = Outer London	UKI5 + UKI6 + UKI7 = UKI2	UK00
UK	United Kingdom	UKI2	UKI6	Outer London	New region = Outer London	UKI5 + UKI6 + UKI7 = UKI2	UK00
UK	United Kingdom	UKI2	UKI7	Outer London	New region = Outer London	UKI5 + UKI6 + UKI7 = UKI2	UK00

Table A.1.1: Functional urban areas adopted in RCI 2016

and with the same orientation to the most relevant PCA component. The PCA is then used to check for the internal consistency of each RCI pillar to detect non-influencing indicators or indicators that describe something different from what is described by the other indicators in the pillar. Being a data-driven technique, the PCA is repeated every time the indicator set is updated.

Almost all the pillars in RCI 2016 show a clear, unique, underlying dimension with a well-balanced contribution from each indicator. Only three indicators have been discarded following the internal consistency check:

- ◇ Annual average change rate of Harmonised Indices of Consumer Prices (inflation) in the Macroeconomic stability pillar. The same was observed in the previous editions and the indicator has never been used for the RCI.
- ◇ Gender balance on tertiary education in the Higher education pillar. The same occurred in the previous edition.
- ◇ Sales of new to market and new to firms innovation in the Innovation pillar. This indicator is new in this edition but proved to be inconsistent with the other indicators included in the pillar.

A.3 Tables

Table A.3.1: RCI 2016 framework. Full description of the indicators available on the EU Regional Competitiveness Index webpage

Pillar name	Indicators	Source	Geographical level	Reference year	Included (I)/Discarded (D)	Reason for discarding	Notes
Institutions regional	Corruption	Quality of Government Index by the Quality of Government Institute (University of Gothenburg)	NUTS2	2013	I		
Institutions regional	Quality and accountability	Quality of Government Index by the Quality of Government Institute (University of Gothenburg)	NUTS2	2013	I		
Institutions regional	Impartiality	Quality of Government Index by the Quality of Government Institute (University of Gothenburg)	NUTS2	2013	I		
Institutions national	Corruption is a major problem in (OUR COUNTRY)	Special Eurobarometer 325	country	2011	I		
Institutions national	There is corruption in regional institutions in (OUR COUNTRY)	Special Eurobarometer 325	country	2011	I		
Institutions national	Voice and accountability	Worldbank Worldwide Governance Indicators	country	2011	I		
Institutions national	Political stability	Worldbank Worldwide Governance Indicators	country	2011	I		
Institutions national	Government effectiveness	Worldbank Worldwide Governance Indicators	country	2011	I		
Institutions national	Regulatory quality	Worldbank Worldwide Governance Indicators	country	2011	I		
Institutions national	Rule of law	Worldbank Worldwide Governance Indicators	country	2011	I		
Institutions national	Control of corruption	Worldbank Worldwide Governance Indicators	country	2011	I		
Institutions national	Easy of doing business	Worldbank - Doing Business	country	2011	I		
Institutions national	Property rights	World Economic Forum - Global Competitiveness Index	country	2011	I		
Institutions national	Intellectual property protection	World Economic Forum - Global Competitiveness Index	country	2011	I		
Institutions national	Efficiency of legal framework in settling disputes	World Economic Forum - Global Competitiveness Index	country	2011	I		
Institutions national	Efficiency of legal framework in challenging regulations	World Economic Forum - Global Competitiveness Index	country	2011	I		
Institutions national	Transparency of government policymaking	World Economic Forum - Global Competitiveness Index	country	2011	I		
Institutions national	Business costs of crime and violence	World Economic Forum - Global Competitiveness Index	country	2011	I		
Institutions national	Organised crime	World Economic Forum - Global Competitiveness Index	country	2011	I		
Institutions national	Reliability of police services	World Economic Forum - Global Competitiveness Index	country	2011	I		

Pillar name	Indicators	Source	Geographical level	Reference year	Included (I)/ Discarded (D)	Reason for discarding	Notes
Macroeconomic stability	General government deficit/surplus	Eurostat	country	Average 2012-2014	I		
Macroeconomic stability	National savings	Eurostat	country	Average 2012-2013 (2014 not available)	I		
Macroeconomic stability	Inflation	Eurostat	country	Average 2012-2014	D	PCA detects the indicator as non-fitting	
Macroeconomic stability	Government bond yields	Eurostat	country	Average 2012-2014	I		
Macroeconomic stability	Government debt	Eurostat	country	Average 2012-2014	I		
Infrastructure	Motorway potential accessibility	Spiekermann & Wegener, 2016	NUTS2	2014	I		
Infrastructure	Railway potential accessibility	Spiekermann & Wegener, 2016	NUTS2	2014	I		
Infrastructure	Number of passenger flights (accessible within 90' drive)	Eurostat/EuroGeographics/National Statistical Institutes	NUTS2	2013	I		
Infrastructure	Intensity of high-speed railways	TomTom, RRG, Eurostat, EuroGeographics	NUTS2	2014	I		new with respect to previous RCI editions
Health	Road fatalities	Eurostat	NUTS2	Average 2012-2014	I		
Health	Healthy life expectancy	Eurostat, DG Regio	NUTS2	Average 2012 and 2014 (2013 not available)	I		
Health	Infant mortality	Eurostat Regional Statistics	NUTS2	Average 2012-2014	I		
Health	Cancer disease death rate	Eurostat	NUTS2	2011-2013	I		
Health	Heart disease death rate	Eurostat	NUTS2	2011-2013	I		
Health	Suicide death rate	Eurostat	NUTS2	2011-2013	I		
Basic Education	Share of low-achieving 15-year-olds in reading (level 1a or lower)	OECD Programme for International Student Assessment (PISA)	country	2016	I		
Basic Education	Share of low-achieving 15-year-olds in maths (level 2 or lower)	OECD Programme for International Student Assessment (PISA)	country	2016	I		
Basic Education	Share of low-achieving 15-year-olds in science (level 1a or lower)	OECD Programme for International Student Assessment (PISA)	country	2016	I		

Pillar name	Indicators	Source	Geographical level	Reference year	Included (I)/ Discarded (D)	Reason for discarding	Notes
Higher education & lifelong learning	Population aged 25-64 with higher educational attainment (ISCED 5-8)	Eurostat (LFS)	NUTS2	2013	I		
Higher education & lifelong learning	Lifelong learning	Eurostat Regional Statistics	NUTS 2	2013	I		
Higher education & lifelong learning	Early school leavers	Eurostat Structural Indicators	NUTS2	Average 2012-2014	I		
Higher education & lifelong learning	Accessibility to universities	Nordregio, EuroGeographics, GISCO, EEA ETC-TE	NUTS2	No update available since 2006	D	latest available year too long ago	
Higher education & lifelong learning	Gender balance on tertiary education	Eurostat LFS	NUTS2	2013	D		
Labour market efficiency	Employment rate (excluding agriculture)	Eurostat Regional Labour Market Statistics (LFS)	NUTS 2	2014	I		
Labour market efficiency	Long-term unemployment	Eurostat Regional Labour Market Statistics (LFS)	NUTS 2	2014	I		
Labour market efficiency	Unemployment rate	Eurostat Regional Labour Market Statistics (LFS)	NUTS 2	2014	I		
Labour market efficiency	Labour productivity	Eurostat Regional Labour Market Statistics (LFS)	NUTS 2	2014 (2013 for HU and FI)	I		
Labour market efficiency	Gender balance unemployment	Eurostat/DG Regio	NUTS 2	2014	I		
Labour market efficiency	Gender balance employment	Eurostat/DG Regio	NUTS 2	2014	I		
Labour market efficiency	Female unemployment	Eurostat Regional Labour Market Statistics (LFS)	NUTS 2	2014	I		
Labour market efficiency	NEET	Eurostat/DG Regio	NUTS 2	2014	I		
Market size	Disposable income per capita	Eurostat	NUTS2	2013	I		
Market size	Potential market size expressed in GDP	Eurostat, DG Regio estimates	NUTS2	2013	I		
Market size	Potential market size expressed in population	Eurostat, DG Regio estimates	NUTS2	2011	I		

Pillar name	Indicators	Source	Geographical level	Reference year	Included (I)/ Discarded (D)	Reason for discarding	Notes
Technological readiness regional	Households with access to broadband	Eurostat Regional Information Statistics	NUTS2	Average 2014-2015	I		
Technological readiness regional	Individuals buying over internet	Eurostat Regional Information Statistics	NUTS2	Average 2014-2015	I		
Technological readiness regional	Household access to internet	Eurostat Regional Information Statistics	NUTS2	Average 2014-2015	I		
Technological readiness national	Availability of latest technologies	World Economic Forum - Global Competitiveness Index	country	Average 2013-2014, 2014-15, 2015-2016 editions	I		
Technological readiness national	Firm-level technology absorption	World Economic Forum - Global Competitiveness Index	country	Average 2013-2014, 2014-2015, 2015-2016 editions	I		
Technological readiness national	Technological adoption	World Economic Forum - Global Competitiveness Index	country	Average 2013-2014, 2014-15, 2015-2016 editions	I		
Technological readiness national	FDI and technology transfer	World Economic Forum - Global Competitiveness Index	country	Average 2013-2014, 2014-2015, 2015-2016 editions	I		
Technological readiness national	Enterprises having purchased online (at least 1%)	Eurostat Community Survey on ICT usage and e-commerce	country	Average 2013-2015	I		
Technological readiness national	Enterprises having received orders online (at least 1%)	Eurostat Community Survey on ICT usage and e-commerce	country	Average 2013-2015	I		
Technological readiness national	Enterprises with fixed broadband access	Eurostat Community Survey on ICT usage and e-commerce	country	average 2013-2015	I		
Business sophistication	Employment (K-N sectors)	Eurostat Regional Statistics	NUTS2	2011-2013	I		
Business sophistication	GVA (K-N sectors)	Eurostat Regional Statistics	NUTS2	2011-2013	I		
Business sophistication	Innovative SMEs collaborating with others	Regional Innovation Scoreboard, 2016 - DG Grow	NUTS 2	2012	I		new with respect to previous RCI editions
Innovation	Total patent applications	Eurostat	NUTS2	Average 2011-2012	I		
Innovation	Core Creativity Class employment	Eurostat (LFS)	NUTS 2	Average 2013-2014	I		
Innovation	Knowledge workers	Eurostat (LFS)	NUTS 2	Average 2013-2014	I		
Innovation	Scientific publications	Science-Metrix based on Scopus data	NUTS2	Average 2011-2012	I		
Innovation	Total intramural R&D expenditure	Eurostat Regional Science and Technology Statistics	NUTS2	Average 2012-2013	I		
Innovation	Human Resources in Science and Technology (HRST)	Eurostat Regional Science and Technology Statistics	NUTS2	Average 2013-2014	I		
Innovation	Employment in technology and knowledge-intensive	Eurostat Regional Science and Technology Statistics	NUTS2	Average 2013-2014	I		
Innovation	High-tech patents	Eurostat	NUTS2	Average 2011-2012	I		
Innovation	ICT patents	Eurostat	NUTS2	Average 2011-2012	I		
Innovation	Biotechnology patents	Eurostat	NUTS2	Average 2011-2012	D	excluded for the high number of missing values	
Innovation	Exports in medium-high/high-tech manufacturing	Regional Innovation Scoreboard 2016, DG Growth	NUTS2	2013	I		new with respect to previous RCI editions
Innovation	Sales of new to market and new to firms innovation	Regional Innovation Scoreboard 2016, DG Growth	NUTS2	2012	D	PCA detects the indicator as non-fitting	new with respect to previous RCI editions

Table A.3.2: Indicators transformed to correct for outliers

Pillar	Indicator	Indicator description	Parameter of the Box-Cox transformation
Labour market efficiency	Long-term unemployment	% of labour force unemployed for 12 months or more	$\lambda = 0.5$
Labour market efficiency	Gender balance unemployment	distance to equilibrium: absolute value of (rate women - rate men)	$\lambda = 0.5$
Labour market efficiency	Female unemployment	% of females unemployed	$\lambda = 0.5$
Market size	Potential market size expressed in GDP	index GDP (in PPS) EU-28 = 100	$\lambda = 0.5$
Market size	Potential market size expressed in population	index population EU28 = 100	$\lambda = 0.5$
Innovation	Total patent applications	number of applications per million inhabitants	$\lambda = 0.3$
Innovation	Scientific publications	publications per million inhabitants	$\lambda = 0.8$
Innovation	Total intramural R&D expenditure	expenditure as a % of GDP	$\lambda = 0.8$
Innovation	High-tech patents	number of applications (high technology EPO patent) per million inhabitants	$\lambda = 0.3$
Innovation	ICT patents	number of applications (ICT EPO patent) per million inhabitants	$\lambda = 0.3$

REFERENCES

- Annoni, P. and Dijkstra, L. (2017), Measuring and monitoring regional competitiveness in the European Union. In Huggins, R. (Ed.): *Handbook of Regions and Competitiveness - Contemporary Theories and Perspectives on Economic Development*. Edward Elgar Publishing (forthcoming).
- Annoni, P. and Dijkstra, L. (2013), *EU Regional Competitiveness Index: RCI 2013*, EUR 26060 Luxembourg: Publications Office of the European Union.
- Annoni, P. and Kozovska, K. (2010), *EU Regional Competitiveness Index 2010*, EUR 24346, Luxembourg: Publications Office of the European Union.
- Box, G. E. P. and Cox, D. R., An analysis of transformations. *Journal of the Royal Statistical Society, Series B*, 1964, 26, 211-252.
- Bristow, G. (2005), Everyone's a "winner": problematising the discourse of regional competitiveness. *Journal of Economic Geography*, 5 (3), 285-304.
- Charron, N., Lapuente, V., Dijkstra, L. (2012), Regional governance matters: A study on regional variation in quality of government within the EU. *DG Regional Policy Working Papers* WP01/2012.
- Charron, N. and Lapuente, V. (2013), Why do some regions in Europe have higher quality of government? *The Journal of Politics*, 75, 567-582.
- Charron, N., Dijkstra, L., Lapuente, V. (2014), Regional Governance Matters: Quality of Government within European Union Member States. *Regional Studies*, 48, 68-90.
- Dijkstra, L., Annoni P., Kozovska, K. (2011), A new European Regional Competitiveness Index: theory, methods and findings. *DG Regional Policy Working Papers* WP02/2011.
- Dijkstra, L. and Poelman, H. (2012), Cities in Europe: the new OECD-EC definition. *DG Regional Policy Working papers* WP01/2012.
- European Commission (2014), *Sixth Report on Economic, Social and Territorial Cohesion*, Luxembourg: Publications Office of the European Union.
- European Commission (2009), *Communication from the Commission to the Council and the European Parliament: GDP and Beyond, Measuring Progress in a Changing World*, 20.8.2009 COM(2009) 433, Brussels, Belgium: European Commission.
- Eurostat (2015), *Regions in the European Union: Nomenclature of territorial units of statistics NUTS-2013/EU28*. Luxembourg: Publication Office of the European Union.
- Gardiner, B., Martin, R. and Tyler, P. (2004), Competitiveness, productivity and economic growth across the European Regions *Regional Studies*, 38 (9), 1045-67.
- Hollanders, H. and Kanerva, M. (2016), *Regional Innovation Scoreboard 2016*. European Union Publication (<http://ec.europa.eu/DocsRoom/documents/17824>).
- Krugman, P. (1996), Making sense of the competitiveness debate. *Oxford Review of Economic Policy*, 12 (3), 17-25.
- Martin, R., Kitson, M. and Tyler, P. (eds) (2006), *Regional Competitiveness*, London, UK and New York, NY, USA: Routledge.
- Meyer-Stamer, J. (2008), *Systematic competitiveness and local economic development Discussion Paper*, Duisberg, Germany: Mesopartner.
- Morrison, D.F. (2005), *Multivariate Statistical Methods*, New York, NY, USA: McGraw-Hill.
- OECD (2016), *PISA 2015 Results (Volume I): Excellence and Equity in Education*. Programme for International Student Assessment, OECD Publishing, Paris (<http://dx.doi.org/10.1787/9789264266490-en>).
- Poelman, H. and Ackermans, L. (2016), Towards regional and urban indicators on rail passenger services using timetable information. *DG Regional Policy Working Papers*, 02/2016.
- Sala-i-Martin, X., Bilbao-Osorio, B., Blanke, J., Crotti, R., Drzeniek Hanouz, M., Geiger, T. and Ko, C. (2012), 'The Global Competitiveness Index 2012-2013: strengthening recovery by raising productivity', in K. Schwab (ed.), *The Global Competitiveness Report 2012-2013*, Geneva, Switzerland: World Economic Forum, pp. 3-48.
- Schwab, K. (ed.) (2012), *The Global Competitiveness Report 2012-2013*, Geneva, Switzerland: World Economic Forum.
- Schwab, K. and Porter, M.E. (2007), *The Global Competitiveness Report 2007-2008*, Geneva, Switzerland: World Economic Forum.
- Stiglitz, J., Sen, A. and Fitoussi, J.-P. (2009), *Report by the Commission on the Measurement of Economic Performance and Social Progress*, Paris, France: Commission on the Measurement of Economic Performance and Social Progress.

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