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**Measuring regional competitiveness:
A survey of approaches, measurement and data**

GÁBOR BÉKÉS

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Measuring regional competitiveness: A survey of approaches, measurement and data

Author:

Gábor Békés
senior research fellow
Institute of Economics - Centre for Economic and Regional Studies
Hungarian Academy of Sciences
CEU and CEPR
e-mail: bekes.gabor@krtk.mta.hu

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Measuring regional competitiveness: A survey of approaches, measurement and data

Gábor Békés

Abstract

This paper reviews a set of issues related to the concept and measurement of regional competitiveness. First, the concept of growth and competitiveness is argued to be different at regional level from the national level. In particular, the relationship between agglomeration and performance, the role of FDI in regions, and the key aspect of local institutions are analyzed. Second, a detailed review is carried out on potential data sources to gauge regional competitiveness using official, private sector as well as academic datasets.

Keywords: regional competitiveness, data audit

JEL classification: R11, R38

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A regionális versenyképesség mérése: Az elérhető módszerek és adatok áttekintése

Békés Gábor

Összefoglaló

E tanulmány a regionális versenyképesség fogalmához és méréséhez kapcsolódó kérdéskörrel nyújt áttekintést. Elsőként arról, hogy a növekedés és a versenyképesség fogalma eltérően értelmezendő regionális és országos szinten. Főként a koncentráció és a teljesítmény, az FDI régiókban betöltött szerepe, illetve a helyi intézmények kulcsfontosságú szempontjait elemezzük. Másodsorban pedig a tanulmány részletesen áttekinti a regionális versenyképesség mérésére szolgáló lehetséges adatforrásokat a hivatalos, a tudományos és a magánszektorból származó adatbázisok felhasználásával.

Tárgyszavak: regionális versenyképesség, adatgyűjtés

JEL kódok: R11, R38

I. THEORETICAL AND POLICY ASPECTS

WHAT IS REGIONAL COMPETITIVENESS?

Enhancing competitiveness is a popular target in economic policy making - both at the national and regional level. While a huge amount of development funds are allocated for serving this purpose, the concept of competitiveness is still rather a mysterious and often debated issue (see Krugman (1994) and the induced debate) for economists. There is neither a single accepted framework and definitions, nor strong agreement on measurement.

Regional competitiveness lacks even a clear, widely shared definition. Instead there are several ideas proposed by academics as well as policy making institutions. 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." While (Dijkstra et al., 2011) proposes: "Regional competitiveness can be defined as the ability to offer an attractive and sustainable environment for firms and residents to live and work." There are two broad strands of propositions: deriving regional competitiveness as an aggregate of firm level competitiveness taken regionally or simply reassigning and redefining concepts from the macro level.

Why shall we discuss this topic separately to national competitiveness? Regional disparities matter at national policy level in a context when GDP per capita is difference across regions within one EU country may be in par than the difference between least and most developed country in the EU. For instance, Romania has a per capita (at PPP) GDP of 32% of Germany, but the poorest Romanian region (North-East) has a per capita GDP just 26% of the richest one (Bucharest). As a result of regional disparities, people living in depressed regions may have much fewer opportunities, less access to education and healthcare, especially when services are financed by local and regional governments.

At the same time, the characteristics of a competitive region are less debated by the literature than the concept itself. For instance, Martin (2005) collects some key issues about regional competitiveness. He argues that no single economic theory (such as export-base theories, endogenous growth theory, cluster theories, evolutionary theory) is able to provide a generally acceptable definition of regional competitiveness. However, key determinants of regional competitiveness may be identified: productive capital, human capital, infrastructure, the competitiveness and adaptive capability of firms (for example innovation) and the interactions of all these factors.

One of the most problematic issue about regional competitiveness is that it aims to transfer a concept of competitiveness defined originally at for national levels (which is itself a debated concept) without rethinking the essential modifications of using the same notion at a sub-national scale (Kitson et al, 2004). For solving this problem Kitson et al (2004) proposes a concept of regional competitiveness that identifies six crucial components: productive capital, human capital, social-institutional capital, cultural capital, infrastructural capital and knowledge/creative capital.

The path dependence of regional competitiveness is also an important issue to be considered for responsible policy making. This problem is discussed by Boschma (2004), who proposes a new approach towards regional competitiveness that builds on the concept of evolutionary economics. Therefore, regions can be interpreted as dynamic entities that show characteristics such as irreversibility or lock-in effects that have important implications about regional competitiveness as a target of development subsidies.

In spite of these attempts, a consensus of the economist profession on the concept of regional competitiveness is still not achieved. Since this of inevitable need due to the large amount of money spent on subsidies under this title and without developing a solid framework, policies lack coherent conceptual and evidential foundations, thus policy outcomes may prove variable and ineffective. This current work aims at contributing to the literature of regional competitiveness by focusing on the proper measurement of growth prospects, rather than providing a new definition or developing a theoretical framework. Thus, we'll focus on sustainable long-term economic growth, often, in comparison with other regions.

GROWTH AND COMPETITIVENESS AT REGIONAL LEVEL – WHY DIFFERENT FROM COUNTRIES?

As argued before, regional competitiveness is often a derivation of the macroeconomic competitiveness, defined at national level, using nationally aggregated statistics. There are several special aspects of regional development. For this brief review, let us focus on a few only, noting that at the regional level knowledge spillovers and dynamics of factor movements are stronger, potential benefits of agglomeration matter more, the role of first geography is more relevant and linkages with other entities are also more important.

At the national level, competitiveness and long run growth potential are often discussed in the both in a framework of human capital extended Solow models as well as endogenous growth theories. Factors of productions as well as technological progress determine the growth path. Both frameworks can also be extended to the regional level with some modifications. Barro and Xala-i-Martin (1992) report the results of Solow growth regressions

showing evidence of some convergence in European regions. The exercise has been frequently repeated and similar results were found (Boldrin and Canova (2001), Martin (2004)). Solow models were then extended to account for knowledge generation, suggesting an important role played by local innovation. Local knowledge matters, because even within a country, knowledge transmission depends greatly of geographical distance (Audretsch and Feldman 2005).

The fact that notions of regional growth have a special dimension is based on observations of greater dynamics of factor movement. While the assumption of fixed capital, labor and human capital is fairly acceptable at a national level, migration and free flow of capital across regions is certainly a key feature of European countries. This leads to the “hard problem” of regional economics (Krugman 1995, Breinlich et al 2014, Desmet and Rossi-Hansberg 2015): one has to deal with distribution of economic activity over time and space in the presence of price equalization determined by trade and mobility. As Krugman argued the growth process at the regional level is closely related to various patterns of agglomeration and dispersion. Growth will both react to and affect skill composition, industrial structure and productivity of firms and people. In addition, several localized pecuniary externalities will complicate this dynamic process making endogenous growth regressions inadequate to access growth potential.

Location of regions is even more heterogeneous as that of countries, with the role of first geography being rather important. Mountains may take up a small fraction of country, but deeply affect economic structure and even values of some regions located solely on high altitude. Also, given their smaller size and hence, smaller internal markets, regions are interdependent much more than countries are. This implies that conditions of neighboring entities matter more for regions than for countries. A prosperous region (within the country or in neighboring country of the EU) will offer market for goods produced locally as well as allow ideas to spread helping adaptation of innovative methods. At the same time, it might attract the best students and professional thus draining the region’s human capital base.

As a result, spatial dynamics, growth and competitiveness are rather difficult to model – a “hard problem” indeed. Issues related to level and change of population, income, local prices (such as rents) shall be considered at once (Glaeser and Gottlieb 2009). Hence, analysis of regional growth and competitiveness requires a rather eclectic approach -considering several strands of the literature such as modified growth models, new economic geography, location and transport networks or agglomeration externalities.

AGGLOMERATION, PERFORMANCE AND GROWTH

Concentration of economic activity in one region versus another, or in cities within a region, was identified as key driver of performance and growth potential.

Firms agglomerate to benefit from Marshallian externalities enjoyed at proximity of each other as well as to save on transaction costs when working together in a supply chain or network of knowledge and innovation. This proposition was suggested by New Economic Geography models (e.g. Fujita, Krugman and Venables 1999) as well as theories on regional growth with knowledge externalities (Ciccone and Hall 2006). These theories suggest that positive externalities will be arising from several channels, such sharing indivisible goods, saving on matching costs of workers and firms and learning (Duranton and Puga 2004). At the same time, competition of co-localized firms will yield centrifugal forces, reducing the effect of agglomeration benefits.

In models of new economic geography, proximity will have several major implications. First, when firms co-locate, they will offer a great deal of job opportunities and hence attract people as well. This will increase the size of the internal market and reduce the average transport of the consumption bundle of people living in this region. A second channel is savings caused by cheaper transport between firms, as producer of intermediate goods will be located closer to users of these goods. Finally, total factor productivity of firms may also increase because of knowledge spillovers of other producers. Furthermore, given productivity benefits, the impact in income will be more than proportional to the number of firms.

One additional channel is related to labor productivity in larger and denser regions, in particular, in cities (Puga 2010). This greater efficiency of labor may be partially explained by productivity benefits at the firm level translated into gains of marginal productivity labor. However, in addition to this, more competitive regions will attract talented people and hence, spatial sorting will lead to wider differences across regions. Indeed several estimates find that about half of earning surplus achieved in agglomerated areas come from sorting. Finally, there are some aspects of large urban areas that are constructive to learning and personal improvement fostered by peer pressure and easier access to a variety of educational services.

Proximity to other firms, often leads to improved performance of firms located in more agglomerated areas. While forces of positive agglomeration benefits and costs of competition may not be measured individually, their combined effect can be estimated. Evidence of such agglomeration economies was suggested by Ciccone and Hall (1996) and Ciccone (2002) showing the elasticity of labor productivity to density is 6 and 5 percent on average in the US and EU, respectively. In the past decade, similar exercises showed that agglomeration effects

in European countries will typically range between 3-8% even once selection and first geography effects are accounted for (Duranton et al 2012).

Another approach mixes the aforementioned models of endogenous growth spurred by technological progress, regional spillovers and agglomeration externalities may be more interesting from a policy purpose. In this setup, innovation is key, as development of additional varieties will generate growth. Importantly, regional growth models also build on the notion that transaction costs and frictions of spreading ideas will offer benefits to co-location in a given region. Importantly, several channels are strongly interrelated, and an important feature of NEG models is cumulative causation a la Myrdal, where localization enhances the agglomeration of innovation and manufacturing and agglomeration and growth can reinforce each other.

One combination of agglomeration and knowledge generation is Minerva and Ottaviano (2008) who emphasizes the dynamics of regional growth process when geography matters. In their model, transactions across regions are affected by transport costs of exchanging goods as well as communication costs of exchanging knowledge. Innovation takes place in one region first, generating additional growth and income. This increases expenditures in that region thereby creating even more job in manufacturing. In the model, agglomeration and growth are jointly determined: forces that promote more innovation and growth will also generate higher agglomeration and agglomeration will yield more new products and hence, faster growth.

ATTRACTING FDI

Attracting large and important firms that will offer well-paying jobs as well as help local firms improve, are prime policy targets. There is a growing body of evidence suggestion that it is the already agglomerated and specialized regions that may benefit the most.

Eckhardt and Nunnenkamp (2011) investigates the effects of inward FDI on per-capita income and growth of the US states since the mid-1970s and finds that the type of FDI received matters. As FDI is attracted by already richer states, FDI itself contributes to regional divergence. Furthermore, the purpose of FDI is important: employment intensive FDI has been conducive to income growth, but capital-intensive FDI has not. This may come from the observation that employment-intensive FDI may generate more agglomeration externalities (labor pooling or knowledge spillovers) among multinationals and the local economy.

De Propris – Nigel (2006) looks at the relationship between regional concentration and inward foreign direct investment focusing on clusters. Particular attention is paid to clusters

as a vehicle for regional development. Cluster firms are characterized by a high degree of specialization and complementarity which generates dynamic processes of knowledge creation and knowledge transfer. As a result, clusters can be extremely competitive in some sectors; and innovative clusters may well produce positive externalities to its entire region.

The authors employ a standard augmented production function approach, when they compare spillovers between foreign and domestic firms in the UK in cluster and non-cluster cases. The identification of clusters in the UK is based on employment by firm size and by travel-to-work-area (TTWA). It is found that total factor productivity growth is greater in clusters than in non-clusters. Furthermore, knowledge spillovers from foreign domestic firms prevail in industry/region combinations that possess significant clusters. Firms in clusters gain significantly from local FDI, both within the industry of the domestic firm, and across other industries in the region. Overall, FDI is attracted to agglomerated areas and improve knowledge flows, but will not in itself generate clusters.

LOCAL INSTITUTIONS

The branch of institutional theories represents another popular view to explain the divergence in income levels across countries (Acemoglu and Robinson 2012). Originally, these theories provide a particularly powerful tool for explaining the path dependence of growth trajectories, thus the long term origins of national underdevelopments. Therefore, a natural consequence of such empirical power at the national level is an attempt to apply the institutional view of economic development also for explaining economic development at the regional level. This is not an easy task. While we know that local institutional variation have a substantial long term consequences for the economies of developing countries, the underlying reasons and mechanism are still not entirely clear (Dell, 2010).

Similarly to growth models, institutional views of the origins of development can be regarded at a regional level as well. The same institutional factors that work at the national level also have an important role in the economic performance of regions, with a particular attention on long run effects. The determinants of the institutional environment, such as political institutions, crime and social norm will also have a large role in the regional level of economic development.

Analysis of local institutions matters, as there exist great deal of variation within the same country, and differences in local institutions are able to explain part of income disparities at the sub-national level. For instance, the historically large divisions between Northern and South Italy might be also explained by the different development path of institutional environments. Also, the case of declining cities and regions, such as Detroit in the US or

Italian region of Sicily shows that the changes institutional factors, such as social norms and crime are important to consider as amplifier factors of economic changes of different roots.

Applying the complex institutional theories of economic development at the regional level is a topic that is currently particularly interesting for growth and development economists, resulting in a new strand of empirical literature that uses sub-national data to analyze the effects of institutional variations (e.g. Holmes (1998) or Tabellini (2010)). Tabellini (2010) shows that cultural and institutional variations have a causal effect on economic development using data from European regions.

REGIONAL POLICY, INFRASTRUCTURE AND PUBLIC INVESTMENT

Public investments, particularly infrastructural developments will likely affect regional competitiveness. However, mostly due to the non-transparent operation of the distributional institutional networks and the widespread corruption issues the effectiveness of the allocation of regional subsidies is often a subject of policy debates. As a result, a large pool of empirical literature aims to investigate the role of regional subsidies and public investments on economic growth and development across regions. Given European political aspirations of territorial cohesion and available policies, several studies have used EU regional grants and projects financed from these grants to study effectiveness of infrastructure investments.

Public infrastructure capital may be considered as perpetual inventory on public investment by discounting flows of regional public investments. One of the scarce pieces of evidence on how infrastructure may be driving regional productivity comes from Italian data. Bronzini and Piselli (2009) show that in Italian regions, in addition to human capital and R&D, infrastructure development may have also contributed to higher firm performance.

Some public projects such as building transport infrastructure linking various regions can increase or decrease regional development depending on evolution of agglomeration forces (Ottaviano and Thisse 2004). In some cases a new motorway will simply allow people from poorer regions to commute to jobs in richer regions thus, enforcing competitiveness of the richer rather than the poorer region.

Typically national governments believe that local public investments will have an unquestionably positive impact on growth. Crescenzi and Rodríguez-Pose (2012) measure the impact of transport infrastructure spending (as part of the EU's cohesion strategies) on regional growth and find no such positive effect. After controlling for other factors which may condition economic growth, such as innovation, migration, and local socioeconomic conditions, they find that infrastructural investments have a relatively poor explanatory power for regional economic growth. Their results show that growth results from the

combination of other determinants controlled for. They argue that most likely the potential benefits of transport infrastructure investments are jeopardized by pure political consideration that largely influence the selection of development projects as well as their spatial allocation.

Similarly, Rodríguez-Pose et al (2012) analyzes the effect of public investments on regional economic growth and convergence in Greece and argue that only some types of projects may work. Using data on several different types of public expenditure in Greece they find a positive long-run impact of public investment on regional economic growth with substantial spillover effects between regions, however their results show no evidence for convergence. The main finding of their paper is that the growth effects of public investments vary between different types of investment, and impact is the highest for education and infrastructural spillovers.

An alternative view is that subsidies and public works may have a positive effect, but the magnitude of subsidies shall not be too high, and in any case it will only work in selected areas (O.Becker et al 2010). In this spirit of heterogeneous effects, Hospers (2006) examines what kind of regional policies are the most efficient, investigating if best practices in regional policy are actually useful for regional development. He argues that the most successful regional development strategies should always enhance region specific advantages as many regional development success stories in Europe show (such as Ruhr Area, Manchester, or Swedish region Landskrona)

Finally note that the use of public funds for regional development purposes will be closely linked to effectiveness of local institutions. For instance, Lambregts et al (2008) analyzes the case of the Dutch region Randstad where EU regional development funds are inefficient due to the lack of effective governance. The paper investigates the factors and their origins that hinders the efficient usage of EU regional funds and concludes that inter-governmental competition, ambiguous loyalties, unconvincing reasoning and the lack of leadership that results in an ineffective governance are the most important factors that hinders the effective usage of EU funds. These arguments of course can be extended to most Eastern European regions as well.

INDICES OF COMPETITIVENESS

There are several measures regional competitiveness on the basis of composite indicators. Official institutional versions include the European Regional Competitiveness Index (European Commission, Joint Research Unit 2010), Regional Innovation Scoreboard (European Commission, DG Enterprise and Industry, 2009), but several other approaches are presented in the literature.

The motivation behind complex indices is to construct a convenient but objective tool which allows for comparison of different region's competitiveness. Measurement of competitiveness is difficult and a large number of factors create the competitive advantage of a region. To account for the complexity of the concept as well as lack of single best accepted measure, several indices were created to aggregate a diverse set of potential measures.

One of the early measures developed in the EU was the Robert Huggins Associates' (2006) European Competitiveness Index (ECI). It is motivated by the observation that "The long-term economic performance of any region or nation depends on its ability to adapt to change and provide new opportunities for workers and enterprises." The ECI measures, compares and examines "competitiveness as the capability of an economy to maintain increasing standards of living for those who participate in it, by attracting and maintaining firms with stable or rising market shares in an activity."

To calculate the index, key "ingredients" of economic competitiveness were grouped into three categories: Creativity, Economic Performance, and, Infrastructure and Accessibility. The selected indicators include levels of investment and employment in research and development activities, education participation and expenditure, economic and business activity rates, transport and ICT infrastructure density and employment in knowledge-based services.

Snieska and Brubeckiené (2009) created their Regional Competitiveness Index (RCI) to measure the regional competitiveness by a composite index. The factors of regional competitiveness have been divided into four groups: factors of conditions of productions, demand conditions, factors increasing competitiveness of regional firms and factors conditioning the development of regional clusters. In the next step a total of 50 indicators have been selected.

Models used to create indices like the EU's RCI or the index by Snieska and Brubeckiené (2009) are built on a set of models of the systems approach of competitiveness. In Porter (1990), the National Diamond model combines the most essential factors of competitiveness into a solid system, but its application for analysis of regional economies is limited. Moon et al (1995) created the "Double Diamond" model, which is more suitable for the assessment of small countries competitiveness, including regional competitiveness.

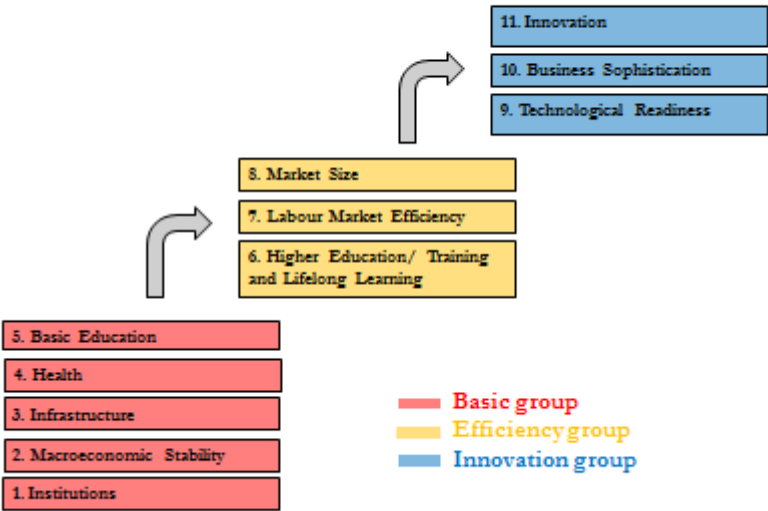
Martin (2003) introduced the "Regional competitiveness hat" model, consisting of several layers: results of regional activities, production volume, labor productivity and competitiveness factors. Another directly regional approach is that of Lengyel (2003), whose "Pyramid model of Regional Competitiveness" shows revealed regional competitiveness through GDP/per citizen, labor productivity, employment, import and export (regional openness) indexes. Importantly, a set of regional success and development factors were

identified along with their effect on competitiveness. This latter approach has hence separated outcome and input variables.

The EU Regional Competitiveness Index by Annoni P. and Dijkstra L. (2013) is made up from three groups of indices.

Graph 1

The concept if EC - RCI



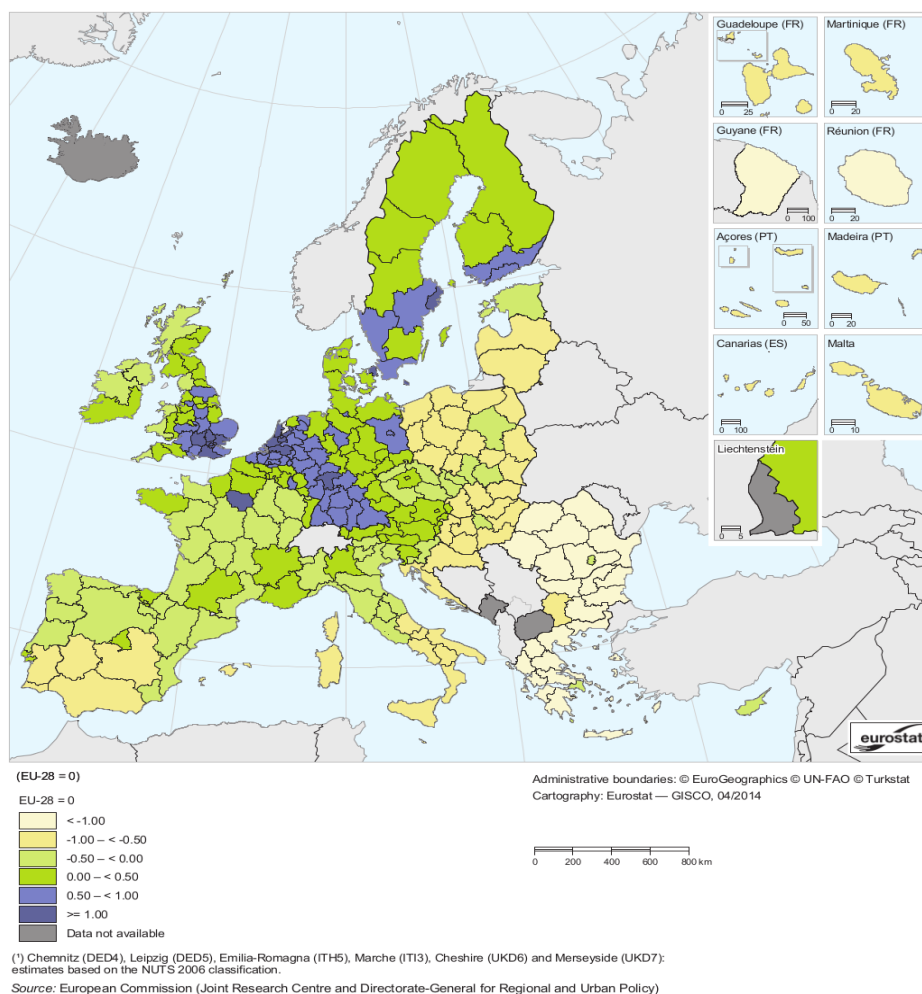
Source: Annoni P. and Dijkstra L. , 2013

The basic sub-index is composed of some classic variables like Institutions, Macroeconomic stability and investment, but also included „Good health among the workforce” and Quality of basic education. The efficiency sub-index composed of: Higher education, training and lifelong learning, Labor market efficiency and Market size. The innovation sub-index is a mix of Technological readiness (level at which households and enterprises use technology), business sophistication (enterprise productivity and potential for responding to competitive pressures, including FDI inflow) and innovation in products and processes.

According to the latest report, the most competitive regions in the EU in 2013, as measured by the RCI, were found in the north-west of Europe, south-east of the United Kingdom and northern France. Not surprisingly, the least competitive regions were generally located in the south-east of Europe, in particular within Bulgaria, Greece and Romania.

RCI in 2013

Regional competitiveness index, by NUTS 2 regions, 2013 (*)
(EU-28 = 0)



FIRM LEVEL OUTCOME MEASURES

One paper, using firm level data is Konings and Marcolin (2011) who uses firm level data to access the competitiveness of Belgian and German regions. In line with our work, the concept authors use does not “engage in measuring different potential drivers of productivity (with the risk of omitting some), but will directly capture the productivity level of firms that are active in a particular region.” Similarly, they note the importance of large firms, arguing that by using firm level data they are “also able to analyze the dependence of regions on a few large firms, which reveals potential vulnerability in terms of relocation threats”.

The data are derived from EU company accounts of the Amadeus dataset by Bureau Van Dijk (BvD) for 2005 and 2008 for medium and large sized companies. Authors compute labor productivity (value added per worker), take the ratio of the average labor cost and the

average labor productivity, a measure a relative cost of a unit produced – the preferred measure of competitiveness.

In a recent paper, Békés and Ottaviano (2015) propose an alternative index. They argue that as firms compete, measuring regional competitiveness should be also based on comparing firm performance across EU regions. Given available data, a new way is proposed to measure how firms fare is to look at their ability to access and penetrate world markets. Given available data, we propose a new way to gauge how firms fare is to look at their ability to access and penetrate world markets.

The key index is export per worker from a region to non-EU destinations relative to the EU average – a ‘regional competitiveness’ index that captures the capacity of a region’s firms to outperform the firms of the average EU region in terms of exports. This approach is practical because it measures ‘regional competitiveness’ in terms of actual rather than potential outcomes, and focuses on an outcome variable that is correlated but more easily measurable than several other obvious outcome variables.

II. REGIONAL DATA AUDIT

The aim of this study is to review the main sources of European regional data to support statistical and econometric analysis. For each database, the most important variables, their coverage and aggregation levels are discussed together with their limitations. The main official sources of regional data in Europe are Eurostat and OECD, however several unofficial databases are also reviewed.

OFFICIAL REGIONAL DATABASES

EUROSTAT

Eurostat – together with OECD – is the main source of European regional statistics. Regional statistics are freely available from the website of Eurostat (Eurostat, 2014) by the NUTS classification system. The concepts and definitions used for regional statistics are the same as used by Eurostat for statistics at the national level. The database contains several regional-level indicators covering a wide range of topics discussed below.

Agriculture Statistics

Regional data on agriculture are available for indicators related to farm land use, live stock of animals, labor force/management and organic farming. Generally data are available at NUTS 2 level (information on manure storage facilities and holding structures are available

at NUTS3 level) for all member states as well as for Norway and Switzerland. The overall coverage of the agricultural statistics in terms of time is not good, the time series contain many missing values and the earliest observations correspond to 2000. The coverage of the farm live stock variable is the most detailed, since observations are available for years 1990, 1993, 1995, 1997, 2000, 2003, 2005, 2007.

Demographic Statistics

The Demography section includes variables like population, change in population as well as information about the regions' area allowing to calculate population density. Typically data is available for all member states at NUTS3 level but variables on fertility and mortality are measured only at NUTS2 level. Most basic measures have been available since 1990, but some detailed census variables such as population or employed persons by sex, age group, current activity status, citizenship, economic activity are measured only in a cross section of 2001.

Economic accounts

The data on economic accounts correspond mainly to variables measuring the level of regional development. Most variables are related to GDP, GDP growth, GVA, GDP dispersion and household income. Data related to GDP and GVA are available at NUTS3 level for all member states, but indicators like fixed capital formation, compensation of employees and household income are measured only at NUTS 2 level. The coverage in terms of time is very detailed, data are available from 2000 on the Eurostat website. For special request, GDP data going back to 1995 are also available from Eurostat.

Education statistics

The topic of education contains regional-level data such as the number of students by different levels of education, participation rate in education or population age groups by different levels of education. The data cover all member states and most of the time series are available for the 2000-2013 period. The time span of the series corresponding to the number of students is 1998-2012. Typically these time series for the new member states contain many missing observations or cover only shorter periods.

Science and technology statistics

The science and technology section includes indicators like R&D expenditure and personnel by sectors, employment in technology and knowledge-intensive sectors as well as data on human resources in science and technology. Typically data are available at NUTS 2 level,

however the human resource series correspond only to NUTS 1 level observations. The series cover all member states and the general time span is 1995-2011. Data on R&D expenditures and personnel contain many missing observation, especially before 2000.

Structural business statistics

Structural business statistics describe the economy through the observation of the activity of units engaged in an economic activity. These statistics correspond to the amount of wealth created in an activity, the size of work force needed to create this wealth, the contribution of different activities to economic growth or the amount of investment realized from such activities. The section contains variables such as the number of enterprises and output- (value added, turnover) and input- (employment, hours worked, total of purchases, material investments) related measures. These statistics are available for 27 member states for the period of 1995-2011 but contain many missing observations.

Regional business demography

This section covers indicators corresponding to important firm characteristics like the population of active enterprises by year, the number of births of enterprises in t ; the number of deaths of enterprises in t or the number of high growth enterprises. Indicators can be downloaded by sectors or by size class. The data are available only for a limited number of member states: BG, CZ, DK, EE, ES, FR, IT, HU, NL, PL, PT, RO, SI, SK, FI and cover only the 2 year period of 2008-2010.

Transport statistics

The transport section includes variables such as the measures of road freight transport, the length of road, rail and navigable inland waterways networks, stock of vehicles by category or measure of transport by different modes of transportation (air, railway, different road vehicles). Typically the data cover all member states and measured at NUTS 2 level. Road transport of goods (journeys made by vehicles) covers only the EU 15. The general time span is the period of 2000-2012, however the road, rail and navigable inland waterways networks starts earlier (1990) and air transport of freight are measured only from 2005.

Labour market statistics

The labour market section covers the widest range of indicators including economically active population by sex and age, employment by sex and age, economic activity, professional status, full-time/part-time employment, highest level of education attained, unemployment measures, dispersion of regional unemployment rates or mean annual earnings. The data

cover all member states typically at NUTS2 level. Some variables are available at NUTS3 level (Dispersion of regional unemployment rates, long-term unemployment) and a few of them are measured only at NUTS 1 level (earnings). The time period covers years 1999-2013, however the variables related to earnings are available only in a cross section of 2006 and 2010.

Labour costs statistics

This section includes variables such as wage statistics, % of labour cost of total cost, number of employees and hours worked. Data are collected through four-yearly Labour Cost Surveys at NUTS 1 level and cover only a limited number of member states: BE, BG, DE, EL, ES, FR, IT, HU, NL, AT, PL, RO, SE, UK. Only cross sections are available for years 2000, 2004 and 2008.

OECD

OECD – together with Eurostat – is the main source of European regional statistics. Regional statistics are freely downloadable from the website of OECD Regional Database. The data are measured at TL 2 (larger regions) and TL 3 (smaller regions) levels. This classification system is largely consistent with the Eurostat NUTS regions, facilitating comparability of regions at the same territorial level. The database contains several regional-level indicators covering a wide range of topics discussed below.

Regional Demographic Statistics

The section of demographic statistics covers variables like population by age, gender, population as well as information about the regions' area for calculating population density. The series are available for less countries than the similar Eurostat data (AT, BE, CZ, DK, EE, FI, FR, DE, GR, HU, IS, IE, IT, LU, NL, NO, PL, PT, SK, SI, ES, SE, CH, TR, UK). The dataset covers the period of 1990-2012. All variables are available both at the OECD equivalents of NUTS 2 and NUTS 3 levels.

Regional Innovation Indicator

The topic of innovation indicators covers variables such as different measures of R&D expenditures (percentage of GDP, PPP, sectoral), R&D personnel and patent applications (count, sectoral, domestic vs. foreign ownership). Typically data are available for a limited number of countries (AT, BE, CZ, DK, EE, FI, FR, DE, GR, HU, IS, IE, IT, LU, NL, NO, PL, PT, SK, SI, ES, SE, UK) at the OECD equivalents of NUTS 2 and/or NUTS 3 levels. Most

variables cover the period of 1990-2010, however data on R&D expenditures are available only from 1995.

Regional Education Statistics

This section contains data on enrollment by education levels and education levels as percentage of labour force. The variables are available for the following countries: AT, BE, CZ, DK, EE, FI, FR, DE, GR, HU, IS, IE, IT, LU, NL, NO, PL, PT, SK, SI, ES, SE, CH, TR, UK at the OECD equivalent of NUTS 2 level for the period of 1995-2012. The time series contain many missing observations before 2000.

Regional Labor Market Statistics

The section of labour market statistics includes a wide range of variables related to labour force, employment and unemployment. Typically data are available both at the OECD equivalents of NUTS 2 and NUTS 3 levels for a limited number of countries: AT, BE, CZ, DK, EE, FI, DE, GR, HU, IE, IT, LU, NL, NO, PL, PT, SK, SI, ES, SE, UK and the time series cover the period 1990-2012 with frequent missing observations before 2000.

Regional Accounts

Regional accounts contain variables like GDP, GDP per capita, GVA and household income. All time series are available both at the OECD equivalents of NUTS 2 and NUTS 3 levels except of household income that is measured only at NUTS 2 level. The series cover the following countries: AT, BE, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LU, NL, NO, PL, PT, SK, SI, ES, SE, UK, typically over the period of 1995-2010 (at NUTS 2 level until 2012).

UNOFFICIAL REGIONAL DATABASES

CAMBRIDGE ECONOMETRICS

Cambridge Econometrics (CE) is a consulting company specializing in applied economic modeling and data analysis techniques. Their European Regional Database is a well-known source of European regional data that contains a wide range of sub-national EU-wide economic indicators such as GDP (by sectors), GVA (by sectors), employment (by sectors), population, compensation of employees (by sectors) or gross fixed capital formation (by sectors).

The CE European Regional Database relies mostly on the Eurostat Regional Database, however it is merged with further data coming from national statistical offices in order to

provide full time series from 1980 (from 1990 for the new member states) to 2011. The indicators are measured at both NUTS 2 and NUTS 3 levels of the EU. The sectoral decomposition is available for industries: agriculture, manufacturing, construction, wholesale, retail, hotels & catering, transport & distribution, financial & business services, non-market services.

The database is available for both commercial and academic purposes, for further details and fees contact js@camecon.com.

ESPON

ESPON (European Observation Network for Territorial Development and Cohesion) is a program adopted by the European Commission with the participation of 32 European countries. The aim of the program is to establish a vigorous basis for regional development within the EU and to set up a scientific research network devoted to regional issues. One of the main priorities of the ESPON program is the support of own applied research projects organized around different topics (eg. FOCI -Future Orientation for Cities; Innovation: KIT - Knowledge, Innovation, Territory; Specific types of territories GEOSPECS - Geographic Specificities and Development Potentials in Europe; Transport: TRACC - TRansport ACCessibility at regional/local scale and patterns in Europe).

ESPON also maintains a database portal with data, indicators and interactive tools that cover different levels of geographical units within the EU. The sources of the data included in the ESPON Database are European institutions such as EUROSTAT and EEA, and all ESPON projects.

The Territorial Database contains several large sections of local data:

1. SIRE database: Data from national censuses of EU15 and EFTA countries at LAU2 level;
2. NUTS5 database;
3. Eastern European database: Local level database covering 5 countries of Eastern Europe (CZ, SK, HU, RO, BG) at LAU 2 units;
4. GDP in LAU2 units;
5. Location quotient and land use at LAU2 level;
6. GEOSPECS database: LAU2 level database with 6 themes covered: total population, population potential, age structure 2001, employment by sector, physical environment, access to airport and time distance to nearest urban centres);
7. urban data (FOCI database, SGPDT database), world data (Europe in the world database, ESPON DB World Indicators, Globalization – TIGER), grid data, historical

data (NewCronos, ESPON 2006 Database) and other data (airport accessibility, islands, mountain grid, universities, remoteness from cities).

ESPON also provides an ESPON OLAP Cube, a multidimensional database tool to access the spatially very disaggregated data of the territorial databases.

Typically access to the data files are restricted, however some of the databases (ESPON OLAP database, Location quotient and land use at LAU2 level), are freely downloadable from the ESPON Database Portal. For further information contact the ESPON Coordination Unit.

UNIVERSITY OF GOTHENBURG; THE QUALITY OF GOVERNMENT INSTITUTE

The Quality of Government Institute of the University of Gothenburg provides a survey-based measure of quality of government at the regional level within the EU that fluctuates around the national-level value the World Governance Indicator (World Bank, 2013). The corruption survey of the Quality of Government Institute covers all 27 member states and 172 NUTS 1 and NUTS 2 regions and it was answered by 34 000 respondents.

The regional quality of governance index and its component indicators (Per capita number of small firms, Autonomous dummy, Capital region dummy, regional survey scores) are freely downloadable in xlsx format from the website of the Quality of Government Institute, together with a detailed description of the data file.

TABELLINI 2010

Tabellini (2010) in his empirical paper that investigates whether culture have a causal effect on economic development using data on European regions. The regional level, cross-sectional dataset constructed for this paper contains variables like per capita GVA, education (enrolment in primary and secondary schools in percent of the population of the relevant age group), historical urbanization (city size is measured in 1850), historical data on literacy, and culture measured by indicators of individual values and beliefs, such as trust and respect for others, and confidence in individual self-determination. The sample consists of 69 regions in 8 European countries: France, Germany (except East Germany and Berlin), the UK, Italy, the Netherlands, Belgium, Spain and Portugal.

The dataset is not directly downloadable, however Tabellini includes some variables in the Appendix and provides detailed references for reproduction. The culture-related data are available in Table 2 of the paper (trust, obedience, respect, etc). The source of these data is the World Values Survey (Inglehart et al. 2000) and the measures are calculated by taking regional averages. The source of historical urbanization rates is the work of Bairoch, Batou and Chèvre (1988). The historical literacy data came from different national sources (see Appendix A2 of Tabellini).

EU DIRECTORATE-GENERAL FOR REGIONAL POLICY

EU Directorate-General for Regional Policy published a dataset on regional Human Development Index (HDI) and Human Poverty Index (HPI) in Fifth Cohesion Report (EC 2010) to gain a better perspective of regional disparities within the EU, since despite the very high national level HDI scores in Europe, there is significant variation between EU countries and regions in terms of human development and poverty (see EC 2010). The indices are analyzed and the data are available from the 2011 edition of Regional Focus (EC 2011) in xls format (through a link in the pdf report), containing also regional level data of the component indicators. The source of the regional data is Eurostat.

The indices are calculated for the EU27 countries at NUTS 2 levels. The indices are composed of 4 indicators measured in a cross section of 2007: HDI: Population aged 25-64 with low educational attainment (% of population aged 25-64), Population aged 25-64 with high educational attainment (% of population aged 25-64), Net adjusted disposable income per capita - Index EU27, Healthy life expectancy – Years; HPI: Share of population aged 25-64 with a low educational attainment, Long term unemployed as share of the labour force, Probability of not living at 65 at birth, % population with an at-risk-of-poverty income relative to the national median.

MITTON, 2013

Mitton (2013) in his paper *The Wealth of Subnations: Geography, Institutions, and Within-Country Development*, analyzes the fundamental determinants of economic development, focusing on within-country effects of geography and institutions. For the paper he constructed a new cross-sectional dataset covering 1,867 subnational regions from 101 countries.

Mitton's dataset is organized round the topics economic variables (GDP per capita, Cost of living), first geography (Latitude, Ocean access, Storm risk, Earthquake risk etc), climate variables (Temperature, Humidity, Wind speed etc), Natural resource variables (Oil and gas, Precious metals, Water, etc), institutions variables (Property rights, Corruption control, Regulatory efficiency, etc) other variables (Autonomy (subnational), Municipal elections, Ethnic fractionalization, etc).

The dataset is not directly downloadable, however the data appendix provides a very detailed description of the sources (eg. Climatic Research Unit, University of East Anglia; USGS and Petroconsultants International Data; World Language Mapping System). For further information on the availability of the data contact the author: todd.mitton@byu.edu.

WEIDMANN ET AL. (2010): GREG DATABASE

The GREG project ('Geo-referencing of Ethnic Groups') of ETH Zürich attempts to disaggregate ethnicity spatially by geo-referencing ethnic groups around the world. The dataset provides information on the location of 1276 ethnic groups around the world. The GREG dataset is freely downloadable in shapefile format on the website of the project together with a user guide written for the R statistical package.

The paper 'Representing ethnic groups in space: A new dataset' of Weidmann et al. (2010) introduces the structure of the GREG dataset and gives an example for its application by examining the impact of group concentration on conflict. The paper also shows that groups with a single territorial cluster according to GREG have a significantly higher risk of conflict. The authors also provide a replication code for the use of the dataset written in R.

GENNAIOLI ET AL 2013

Gennaioli et al. (2013) in their paper 'Human Capital and Regional Development' investigate the determinants of regional development using a newly constructed cross-sectional database of 1,569 subnational regions from 110 countries covering 74% of the world's surface and 97% of its GDP.

The dataset mostly covers the broader topics of income (GDP per capita, population, employment, and human capital), geography (Climate, geography, and natural resources), institutions (Informal payments, Tax days, Access to finance, Government predictability), infrastructure (Power line density, Travel time), and culture (Trust, number of ethnic groups). The sources of the variables are different national databases, international organizations (World Bank's Enterprise Surveys, PRS Group's International Country Risk Guide, etc), or other empirical papers (Weidmann et al. (2010), Inglehart et al. (2000)).

The database is not publicly available, however the authors provide a detailed description of variables and sources in Appendix B of the paper. More information about the dataset is presented in the online appendix, for the availability of the data contact nicola.gennaioli@unibocconi.it.

LESSMANN 2014

Lessmann (2014) in his paper 'Spatial inequality and development – Is there an inverted-U relationship?' analyzes the hypothesis of an inverted-U-shaped relationship between spatial inequality and economic development. To test this hypothesis, Lessmann constructed a unique panel dataset of spatial inequalities in 56 countries (mostly at NUTS2 equivalent level) at different stages of economic development, covering the period 1980–2009 (countries and periods covered are presented in Table A2 of the paper).

The dataset contains regional level measures of variables like Population-weighted coefficient of variation of regional GDP per capita, Gini coefficient of regional GDP per capita, Ethnic fractionalization, Urbanization or Democracy. The main source of the dataset is the World Development Indicators of the World Bank (2010).

The dataset is not publicly available, for replication the definitions of the variables and sources are presented in Table A4 of the paper. To access the database, contact christian.lessmann@fau.de.

EUROGEOGRAPHICS

Eurogeographics is an international organization that represents the European National Mapping, Cadastral and Land Registry Authorities. The main goal of Eurogeographics is to underpin the European Spatial Data Infrastructure with the definitive reference data collected, maintained and provided by the national member authorities.

Eurogeographics provides multiple European geographic datasets. EuroGlobalMap is a 1:1 million scale topographic dataset that covers 45 countries in the topics of administrative boundaries, water networks, transport networks, settlements, and elevation. The dataset is freely downloadable from the website of Eurogeographics after registration, in Geodatabase or Shapefile formats.

EuroRegionalMap is a 1:250 000 scale topographic dataset that covers 33 European countries. The dataset covers the topics of administrative boundaries, water networks, transport networks, settlements, and vegetation and soil. The miscellaneous theme holds various topographic elements like power lines, landmarks, and buildings. EuroBoundaryMap is a 1:100 000 scale administrative and statistical regions dataset covering 41 countries. These are not open data, for access contact sallie.white@eurogeographics.org.

INTEGRATED PUBLIC USE MICRODATA SERIES (IPUMS), INTERNATIONAL

IPUMS-International is a project dedicated to collecting and distributing census microdata from around the world. Subscription is needed to access the data.

EUROPEAN CLUSTER OBSERVATORY

European Cluster Observatory is the main data source of European clusters. It is an online, free platform managed by the Stockholm School of Economics (Sweden) in collaboration with Orkestra (Basque Institute of Competitiveness, Basque Country, Spain) that provides access to data and analysis of clusters, cluster organizations and regional microeconomic framework conditions in Europe.

There are two useful data tools provided on the website: The regional mapping tool shows statistics for regions (37 countries) and sectors. It shows data that is associated with both a region and a sector (such as a region's number of employees in the automotive sector), or associated with only a region (such as the region's size or unemployment rate). The dataset measures cluster-level indicators such as the number of employees, the number of enterprises, average wage, cluster size, specialization and focus, however country-level indicators can be also obtained: Economic indicators (GDP per capita, Employment, Number of enterprises), Competitiveness drivers: Firms behavior (Number of new foreign firms, R&D share), Competitiveness drivers: Specialization (Knowledge intensive services employment, Employment in industries with high energy purchases), Competitiveness drivers: Business environment (Students in tertiary programs with academic orientation, Population aged 15-34, Trust in people), Others (Area, Population density, Degree of urbanization, Regional Innovation Scoreboard) . The dataset covers the period 1991-2011. Statistics are presented on a map, in a table, on graphs and they can also be downloaded in csv or xml formats.

The organizational mapping dataset shows the location of individual organizations, but firm level statistics are not available. The types of organizations (Business Incubator, Science Park, University, Venture Capital Firm, etc.) are listed by regions and by sectors. The name of the cluster and its website are also presented in the dataset.

The Main Sources of European Regional Data

Dataset	Topics/Variables	Aggregation level	Countries	Years
Eurostat Regional Database	Agriculture, Demographics, Economic Accounts, Education, Science and Technology, Structural business statistics, Regional business demography, Transport, Labour market, Labour costs	NUTS2/NUTS3	EU28	1990-2013
OECD Regional Database	Demographics, Innovation, Education, Labor Market, Regional accounts	NUTS2/NUTS3 (TS2/TS3)	AT, BE, CZ, DK, EE, FI, FR, DE, GR, HU, IE, IT, LU, NL, NO, PL, PT, SK, SI, ES, SE, UK, CH	1990-2012

Cambridge Econometrics	GDP, GVA, Employment, Population, Active population, Compensation of employees, Gross fixed capital formation, Capital stocks	NUTS2/NUTS3	EU28	1980-2011
ESPON	Geography, Demographics, Economic indicators, Agriculture, Infrastructure, Environment	micro (NUTS5, LAU2)	EU	various
The Quality of Government Institute (UoG)	Quality of government, Per capita number of small firms, Autonomy, Language	NUTS1/NUTS2	EU27	2010
Tabellini (2010)	Trust, Per capita GVA, Education, Historical urbanization, Historical literacy	NUTS2	BE, FR, IT, NL, PT, ES, UK, DE	
DG for Regional Policy	Human development index (HDI), Human poverty index (HPI)	NUTS2	EU27	2010
Mitton (2013)	Economic accounts, First geography, Climate, Natural resources, institutions, Autonomy, Municipal elections, Ethnic fractionalization		101 countries	
Weidmann et al. (2010)	Ethnicity data in shapefile format	micro	world	
Gennaioli et al. (2013)	Income, Geography, Institutions, Infrastructure, Culture		110 countries	
Lessmann (2014)	Variation of regional GDP per capita, Gini coefficient of regional GDP per capita, Ethnic fractionalization, Urbanization, Democracy	NUTS2	56 countries	1980-2009
Eurogeographics	Administrative boundaries, water network, Transport network, Settlements, Elevation	micro	EU27	
Integrated Public Use Microdata Series (IPUMS), International	Census microdata	micro	world	various
European Cluster Observatory	Cluster indicators (number of employees, the number of enterprises, average wage, cluster size, specialization and focus), Country level indicators,	sector-country/ organization	37 countries	1991-2011

	Organization name and websites			
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Sources: OECD Regional Database http://stats.oecd.org/Index.aspx?datasetcode=REG_DEMO_TL2#, The Quality of Government Institute, University of Gothenburg <http://www.qog.pol.gu.se/data/datadownloads/qogeuregionaldata/>, Eurostat Regional Database http://epp.eurostat.ec.europa.eu/portal/page/portal/region_cities/regional_statistics/data/database, Cambridge Econometrics <http://www.camecon.com/SubNational/SubNationalEurope/RegionalDatabase.aspx>, EC Regional Focus (2011)The European regional Human Development and Human Poverty Indices http://ec.europa.eu/regional_policy/sources/docgener/focus/2011_02_hdev_hpov_indices.pdf, ESPON Database Portal: <http://database.espon.eu/db2/resource?idCat=42>, Eurogeographics <http://www.eurogeographics.org/products-and-services/euroregionalmap> <http://www.eurogeographics.org/products-and-services/euroglobalmap> , European Cluster Observatory <http://www.clusterobservatory.eu/index.html#!view=regionalmapping;i=C20300,C22300;y=2011;r=CR10-CE;rsl=0;rp=CR10-CE;sp=CC20-STND;p=table>

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