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Territorial benchmarking methodology: The need to identify reference regions

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Abstract
The aim of this work is to provide an instrument that facilitates the development of the three stages of benchmarking exercises, adding an application to the Basque Country as an illustrative example.

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1. Introduction to regional benchmarking

The decisive role played by innovation in economic growth, productivity and competitiveness is widely recognised (Lundvall, 1992; Nelson, 1992; Nelson and Rosenberg, 1993; Verspagen, 1995; Archibugi and Michie, 1998). There is also common agreement that innovation and competitiveness cannot be solely understood as the fruits of the actions of individual agents; rather, they are social processes. Hence, the actions of innovation agents cannot be separated from the system of innovation in which they operate (Rothwell, 1994). Initially the literature focused on national and sector-based/technological systems, but later, influenced by economic geography, it also turned its attention to the regional sphere. Soon, the publications about regional innovation systems surpassed those that addressed national and sector-based/technological systems (Cooke, 1998; Carlsson et al., 2002). This reflects the growing acceptance that the key factors impacting competitiveness and innovation are largely determined systemically and at the regional level (Porter, 2003). All this has resulted in a confluence of industrial, technological and regional policies around competitiveness and innovation and on a shift from national to regional areas of application (Oughton et al., 2002).

Yet while innovation can be regarded as a relevant competitiveness strategy for all regions (Asheim et al., 2007), a given region should not develop carbon copies of policies designed and used in other regions. The core competitive strategy of a region should establish a unique value proposition, which is likely to be influenced by the particular structural characteristics of the region (OECD, 2011). Even with similar structural characteristics, regions can set different strategies and goals (Niosi, 2002).

Indeed, the literature on regional innovation systems has highlighted the vast richness and diversity of regional innovation patterns, showing that there are no “one size fits all” policies (Tödtling and Trippl, 2005; Nauwelaers and Reid, 2002). Regional policies must pursue two goals: the development of unique regional strengths in some key areas of innovation and competitiveness (in Porterian terminology, “strategic positioning”); and a broad focus on the remaining competitiveness and innovation factors, avoiding the development of weaknesses that are too great in comparison with those of the other competing regions (for Porter, “operational efficiency”) (Porter, 1998, 2003).

What is the role of benchmarking in this respect? Even though there is no universally accepted definition of benchmarking, it can be said that benchmarking is generally understood to be an improvement and learning method based on comparisons and the application of the knowledge generated from them (Huggins, 2008). Benchmarking can facilitate the formulation of a strategy and mission insofar as benchmarking analyses can help to identify the strengths and weaknesses of the organisation or territory being analysed (OECD, 2005). Toward this end, benchmarking seeks to measure the levels of what Niosi (2002) calls “x-inefficiency” (the gap or difference between the current performance in a particular area and the best performance) and “x-efficiency” (the degree to which the mission is being accomplished).

However, as pointed out by Huggins (2008), benchmarking exercises have been met with caution by many innovation analysts. This is because benchmarking exercises in the corporate environment are understood to entail the systematic comparison of one organisation with another organisation, in order to replicate their ‘best practices’ (Lundvall and Tomlinson, 2001). However, these optimum processes and general models are meaningless in the evolutionary theory that is the basis for innovation systems in contexts of uncertainty and high complexity (Edquist, 2001; Paasi, 2005). The literature on innovation systems considers that what is good or bad depends of the systemic context (Tomlinson y Lundvall, 2001) that is empirically determined rather than adjusted to the theoretical ideal (Balzat, 2006). In addition, excessive imitation is problematic because it reduces the diversity required by the system and goes against the very idea of strategy (Huggins, 2008). Even from an operational point of view, we have to consider that data are not perfectly comparable (Mairesee y Mohenen, 2009) and that lags to obtain data would delay the implementation of such strategy. This would result in a "lamb effect", implying that practices that were considered appropriate at one time were deemed as obsolete later on. In summary, what may be valid for simple environments such as corporations is not applicable in environments as complex as innovation systems (Polt et al., 2001).

However, as Huggins (2008) or Pappaioannou et al. (2006) point out, benchmarking analyses have evolved substantially. While the first benchmarking analyses could be labelled as naïve and simplistic by Lundvall and Tomlinson (2001), another type of 'intelligent' or 'systematic' benchmarking that accounts for context has been developed (Nauwelaers et al., 2003). Instead of merely pursuing a "copy and paste" approach, this type of analysis encourages the identification of "good" practices (instead of "best" practices), recognises relative strengths and weaknesses and examines performance areas using more cost-effective and efficient processes than those based on "trial and error" (Balzat, 2006; Paasi, 2005; Nauwelaers et al., 2003).

Hence, the first question regional benchmarking exercises should address is who to be compared with. There are three options: with targets set for oneself,[1] with oneself along the time or with others (Edquist, 2008). In case of comparing one region with others, several options arise: regions can be chosen according to criteria such as location, economic structure or high performance. More simply, they can be regions that wish to enhance cooperation and learn from each other. Generally, benchmarking exercises have taken place according to an intraregional perspective (rather than an interregional approach) due, among other factors, to their requirement of fewer resources. However, advances towards more multi and interregional benchmarking exercises are occurring (Huggins, 2008).

In order to compare oneself with others, a key requirement is what Papaioannou et al. (2006) call the comparison principle, that is, contrasts should take place among analogous entities. You can also learn from those who are very different, but the above mentioned need to take into account the context, means that a comparison is likely to bring more valuable lessons when it is carried out between fundamentally equivalent entities (Archibugui and Coco, 2004; Archibugi et al., 2009). Thus, a first step is the identification of homogeneous areas in which the comparison exercise will be carried out.

This has not been the norm in benchmarking exercises. Regions were compared to those that exhibited a better performance, whether they shared similar characteristics or not. In fact, early benchmarking exercises have been criticized for limiting comparisons to relative performances, merely providing lists or rankings without a proper analysis of the causes of those different performances (Papaioannou et al., 2006; Huggins, 2008; Polt, 2002). Once the

1 This would be the case, for instance, of a system's x-efficiency measure. As we have seen before, Niosi (2002) used this term to assess the degree to which the mission is being accomplished, as opposed to x-inefficiency, that considers the difference between a particular area and others.

identification of regions with similar structural conditions has taken place, it does make sense to prioritize those with better performances, since these will be the ones that will provide the best lessons. Nevertheless, it might also make sense to consider the others later on because, as Polt (2002) or Salazar and Holbrook (2004) point out, unsuccessful cases and those that do not achieve the best results can also provide information and be a source of learning. Good or bad performance cannot be determined according to theoretical rules but must instead be established through empirical comparisons (Lall, 2001; Balzat, 2006; Edquist, 2008). To sum up, the second step will be to identify, among the territories that share similar structural conditions, those that exhibit better performance.

It follows from the above that the third step of every benchmarking exercise should determine the causes of better or worse performances. As noted by Edquist (2001), a proper diagnosis consists of both the identification of performance problems and the analysis of their causes. Weak performing regions should reflect on how they differ in terms of framework conditions, activities or input indicators from regions with high performance (OECD et al., 2004).

This paper stops at the third phase because our main goal here is to provide an instrument to facilitate the development of the three above mentioned stages in benchmarking exercises for European regions. However, we should bear in mind that there are further steps. In particular, such exercises are of no use if their implantation, policy assimilation, control and revision are ignored (Balzat, 2006; Paasi, 2005; Polt, 2002). Proper implementation, aside from requiring a full understanding of the changes required by the system, requires the involvement of policy-makers and stakeholders, their coordination and a permanent evaluation (Nauwelaers and Reid, 2002; Nauwelaers et al., 2003).

It should also be noted that a complete benchmarking exercise requires both a quantitative and qualitative analysis, as quantitative indicators alone cannot encompass all key aspects of innovation systems (Lundvall y Tomlinson, 2001), soft elements (Huggins, 2008) or factors related to more tacit knowledge (Polt, 2002). However, due to the limitations that generally exist, benchmarking exercises are usually restricted to the first phase of the analysis, merely dealing with quantitative data (frequently obtained from secondary sources). Our main contribution rests on this area, focused on the quantitative analysis.

In what follows we will analyse more deeply how to identify reference regions. We will also select the variables that should be considered to identify the best performing regions and to understand the activities that explain such better performance.

2. Procedure for the identification of reference regions

a) Literature on the identification of reference regions

As noted above, while benchmarking was born in the business field, more recently it has been extended to also cover territories. Here the benchmarking exercise will be applied to regions. As statistical units to define regions we will use NUTS2, except in Belgium, Germany and United Kingdom, where NUTS1 will be instead used.[2]

[2] The choice between NUTS2 or NUTS1 has been based on the level where regional powers rest in each country. As Clarysse and Muldur (2001) and Baumert (2006) point out, NUTS usually reflect statistical units that differ in size and, in many cases, they do not coincide with the economic units.

Among all NUTS, we want to identify those that are homogeneous or share similar structural conditions to a given one, as it will be from these that we will learn more and their identification is not straightforward. Many authors and studies highlight the need to compare homogeneous entities according to a range of characteristics: industrial structure (Akerblom et al., 2008; Atkinson and Andes, 2008); economic structure and institutional framework (Andersson and Mahroum, 2008); relative patterns of innovation (Arundel and Hollanders, 2008); geographic, cultural and economic factors (Archibugi and Coco, 2004); size, income, infrastructure and human resources (Archibugi et al., 2009); social values, political goals and economic development (Balzat, 2006); geography (including latitude, longitude, extension, elevation, access to the sea and climate), demographics (including population density, ethnic groups and other types of classification), natural resources and history (Fagerberg et al., 2007; Fagerberg and Srholec, 2008); cluster structure (John Adams Innovation Institute, 2009); level of development (Lall, 2001); economic specialisation, history, degree of openness, size of the economy, firms size, culture and social capital (Nauwelaers et al., 2003); institutional factors, industrial specialisation and size (OECD et al., 2004); industrial structure, policy context and geographic and cultural dimensions (OECD, 2005); economic structure and development level, natural resources, size, culture and history (Paasi, 2005); and GDP per capita (World Economic Forum, 2009).

However, despite the numerous studies arguing that comparisons or benchmarking exercises must be carried out with similar regions, or must correct and account for differences, very few have put this idea into practice. Perhaps one of the most significant cases in which this strategy was actually used is the *Index of the Massachusetts Innovation Economy* (John Adams Innovation Institute, 2009), in which the economy and innovation in the state of Massachusetts are only compared with those states that display an elevated concentration of employment in specific clusters. Many of the studies focusing on developing economies (for example, the Fagerberg papers cited above) incorporate a series of external variables in their regression analyses to investigate the influence of technological capabilities. These variables seek to control for the geography, demographics, natural resources and history of the different countries and thus to correct for their heterogeneity. They also incorporate the composition of the economy (which would be equivalent to the industrial structure highlighted above) in the analysis. In reports like *The Global Competitiveness Report* (World Economic Forum, 2009), each of the sub-indexes that are combined in order to construct a composite index of competitiveness is given a different weight, according to the level of development of the country. In any case, with the exception of the *Index of the Massachusetts Innovation Economy*, we barely find in the literature attempts to identify homogeneous territories to base benchmarking exercises.

An alternative for the identification of reference regions is resorting to groups arising from regional typologies of innovation undertaken through different initiatives. Regional typologies seek the identification of common patterns in the territories and therefore they might be considered an alternative instrument to identify similar regions. Nevertheless, the problem rests in the variables chosen to construct the typologies. The review by Navarro and Gibaja (2009) points out that existing typologies include both variables similar to the above mentioned (e.g. industrial specialization), that would reflect the territories' structural conditions, and behavioural variables (e.g. R&D expenditure), that are greatly influenced by the structural conditions (since, for instance, R&D expenditure is greater in the pharmaceutical rather than textile sector) and performance variables (e.g. patents or productivity), that are influenced by the two previous types of variables. That is, existing typologies have not isolated the variables that are relevant for the identification of similar regions according to their structural conditions, even if, as we show below, it is possible to do so.

b) Proposal of variables for the identification of regions with similar structural conditions

Of the factors mentioned in the literature as helpful in evaluating the degree of homogeneity of the territories under study, there are some that are not available from statistical secondary sources (for example, degree of commercial or productive openness). These are therefore left out of this study. The aim of this sub-section is to identify those indicators that may be considered as components of a region's structural conditions and are publically available through Eurostat, OECD or other regional databases. Taking into account such availability and considering their pros and cons, we will proceed to make recommendations. Nonetheless, we will start mentioning two indicators that, despite being cited by some of the above mentioned authors, we would rather not take into account: GDP per capita and business size.

Per capita GDP levels have been used by many studies of economic development or by reports such as the World Economic Forum's and is available in Eurostat. However, a problem is that the causal relationship between GDP per capita and innovative performance operates in two ways (Lall, 2001). As Lall mentions, the majority of analysts consider the principal causal relationship to flow from innovation to technological and competitive performance. As the main goal of benchmarking is to improve innovative and competitive performance, a circular argument would be established if GDP per capita is placed among the factors that explain such performance. We therefore also leave out this variable.

Among the structural statistics, Eurostat publishes data on the average size of local manufacturing units for most European NUTS. In principle, this indicator might be used as a proxy for business size, which Nauwelaers et al. (2003) mention. However, a detailed exam of such data uncovers strange patterns (particularly for German regions) that have made us to decide to avoid their inclusion.

Leaving aside, due to the above mentioned reasons, GDP per capita and business size, the rest of indicators that might be used to identify regions with similar structural conditions can be grouped in for blocks for operational reasons:

(i) Size, demographic and location indicators

The region's size, mentioned by many of the studies we have cited, might be proxied through GDP and population. Both are available in Eurostat. In order not to multiply variables and for coherence with the other variables in the group, in this paper we are only using population.

Among demographic factors, there are two frequently used in innovation economics: population density and aging rate (percentage of the population 65 year old or more). Both are available in Eurostat.

Regarding geographic factors, there are some that encompass the synthetic effect of location on competitiveness: accessibility indexes. ESPON (2009) has recently published multimodal indicators at NUTS3 level for the year 2006. It is possible to aggregate them for higher NUTS and use them here.

(ii) *The economy´s industry structure*

We consider the distribution of employment among the ten major sectors of Eurostat's regional economic accounts (based on the new CNAE rev2: Agriculture, forestry and fishing (Section A), Manufacturing (B, C, D y E), Construction (F), Trade, transportation, accommodation and food service activities (G, H e I), Information and communication (J), Financial and insurance activities (K), Real estate activities (L), Professional, scientific, technical, administration and support service activities (M y N), Public administration, defence, education, human health and social work activities (O, P and Q), Arts, entertainment, recreation and other services (R, S, T and U)

(iii) *Industrial specialization*

Even if the above allows a first approach to the economy's industry structure, it is obvious that the disaggregation of the manufacturing industry is not satisfactory. Industrial sectors are more oriented towards exporting and less limited by the local market, which allows them to develop and specialize more. Based on the OECD's STAN database classification, we divide industrial employment in eleven large sectors. The data was provided by Eurostat, upon a special request to extract this information from the Labour Force Survey.[3]

(iv) *Technological specialization*

Lastly, the region's technological areas of specialisation are defined according to the percentage distribution of EPO patents among the 8 sections of the international patent classification (IPC).[4] The source for this information is the OECD's January 2010 EPO regional patent database. Given the small number of EPO patents in several regions, we have opted for adding the patents applied for over the period 2000-2008.

c) Procedure to obtain reference regions from variables

Having defined a set of variables to identify reference regions, several transformations are required in order to obtain composite indices that measure the distance between a particular region and all others.

Firstly, the indicators are corrected for outliers, asymmetries and kurtosis using the usual statistical techniques. Secondly, in order to add them up, variables are normalized using the mini-max method, re-scaling them so all values fall between 0 and 100. Thirdly, distances are calculated between each NUT and all the others.

There are different alternatives to assign weights to the variables. We have chosen the simplest option: equal weights are given to the variables within each of the above blocks and

[3] The 11 large sectors are: Mining and quarrying (NACE rev2, codes 05-09), Food products, beverages and tobacco (10-12), Textiles, textile products, leather and footwear (13-15), Wood, paper, printing and publishing (16-18), Chemical, rubber, plastics and fuel products (19-22), Non-metallic products (23), Basic metals and fabricated metal products (24-25), Electrical, electronic, computing and optical equipment (26-27), Machinery (28), Transport equipment (29-30) and Other equipment (31-33).

[4] The eight sections of the IPC are: Human Necessities (code A), Performing Operations and Transporting (B), Chemistry and Metallurgy (C), Textiles and Paper (D), Fixed Constructions (E), Mechanical Engineering, Lighting, Heating and Weapons (F), Physics (G) and Electricity (H).

then equal weights are also assigned to each block to come up with the total distance between NUTS.

Hence, total distance between two regions would be calculated through the following formula:

$$d\,(i,i') = \sum_{j=1}^{k} m_j\,(x_{ij} - x_{i'j})^{\,2}$$

where j is the variable, i is the first region, i' the second region and m_j is the weight assigned to the variable. With the distance between one NUTS and all the others, we obtain a distance matrix.

Based on this distance matrix, two different approaches may be followed:

- Firstly, a typology of regions can be established via cluster analysis to identify groups of regions with similar structural conditions that will influence their economic and innovative performance.
- Secondly, the row indicating the distances between the selected region and the other regions can be extracted from the distance matrix. Based on that row, those interested in analysing a particular region can order all other regions according to these distances.

Each approach responds to different needs or interests. Obtaining a typology of regions is particularly interesting for policy-makers or analysts who work with regions at the European regional level as a whole, because it provides a collective vision of Europe's regions. As we have mentioned above, there are already many typologies on regional innovation patterns. However the common flaw they share for benchmarking analysis is that they mix different types of variables: structural conditions, economic and innovation output variables and input variables. The typology we present here is only based on variables that reflect the structural conditions of the regions and, hence, it would not incur in the same flaw.

The second approach is a better option for those who are interested in the benchmarking analysis of a particular region. This procedure has significant advantages over considering regions corresponding to groups determined using cluster analysis:

- Given that the cluster analysis process does not reveal the distance between the centre of gravity of the group and each one of its components, it is possible that those components most distant from the centre are in fact closer to some regions assigned to other categories than to some regions in its own group. Cluster analysis does not usually allow for direct visualisation of the distance between a given region and regions placed in other groups.
- From each region's ordered row of distances, the number of NUTS to be compared with can be selected. In cluster analysis the number of regions varies among groups. The number of regions in which our target region is included might not be appropriate for our purposes.

3. Regional performance

a) Economic and innovation output performance

Having identified reference regions for benchmarking, the following step consists in identifying, among them, those regions that exhibit better performances, as these are the ones we are more likely to learn from.

As Edquist (2008) points out, the analysis of the innovation system should not get mixed up with the analysis of the whole economic system; economic performance is affected by innovative performance, but also by other factors. Thus, following Archibugi and Coco (2005: 177), "it is useful and necessary to separate the two concepts and find independent measurement tools for each of them." The inclusion of production indicators among the measures of innovation would prevent us from exploring the effects of innovation on production and vice versa.

It is also interesting to distinguish between the performance that a territory has achieved in a moment in time (the last year with available data) and the evolution the performance has undergone over a period (five years, in our exercise).

Given data availability from European regional databases, the following indicators might be used:[5]

- Level of economic performance: GDP per capita, employment rate and productivity.
- Variation in economic performance: annual percentage change of employment, productivity, real GDP and real GDP per capita.
- Level of innovation output: EPO patents (per million inhabitants), scientific publications (per million inhabitants), employment in high and medium-high technology manufacturing sectors (%) and employment in knowledge intensive services (%).
- Variation of the innovation output: percentage change of EPO patents, publications, employment in high and medium-high technology manufacturing sectors and employment in knowledge intensive sectors.

As with the variables used to identify reference regions, the values corresponding to the performance indicators are subjected to some treatments in order to correct potential asymmetries, kurtosis and outliers, and their values are standardized are weighted to obtain four composite indicators of output (namely, those of economic and innovative performance in a moment in time, and those of evolution of economic and innovative performance).

b) Inputs for the innovation process

After having identified among regions with similar structural conditions those that exhibit the best performance, we want to explain the reasons for the disparities in performance. In particular, we want to identify which innovation activities have been undertaken by regions with top performances, in order to learn from them and reveal some of their key elements for success.

Taking into account available data,[6] we have selected three types of indicators regarding human resources, R&D and connectivity. The following indicators have been considered:

- Level of human resources: human resources in science and technology (% of population), population aged 25-64 that has attained upper secondary and tertiary educational level (% of population aged 25-64), students in tertiary education (% of population aged 20-24) and population aged 25-64 taking part in long-life learning (% of active population).

[5] All of these indicators can be obtained from Eurostat regional dababases, except for publications, that are available from Erawatch.

[6] All of these indicators can be obtained from Eurostat regional dababases, except for co-invention, which is our own calculation from the OECD regional patent database; and new foreign firms, which is taken from ISLA-Bocconi.

- Variation in human resources: percentage change in human resources in science and technology, population aged 25-64 that has attained upper secondary and tertiary educational level and population aged 25-64 taking part in long-life learning.
- Level of R&D: business R&D expenditure (% of GDP), public R&D expenditure (% of GDP), business R&D personnel (% of employment) and public R&D personnel (% of employment)
- Level of connectivity: families with broadband Access (%), patent co-invention (% of patents) and new foreign firm (per million inhabitants).
- Variation in connectivity: percentage change in patent co-invention.

As in previous steps, after having selected the variables and estimated the missing values, data was subjected to some treatments - correction of asymmetries, kurtosis and outliers -, standardized and weighted to construct composite indices.

4. Illustration of the Procedure: The Basque Country Case

As mentioned above, the identification of reference regions can be carried out following two different approaches:

- By an individual approximation that ranks regions by distance from any region of interest and allows us to consider any number of regions for comparison with the one we are interested on.
- By a cluster analysis that identifies groups of similar regions.

Table 1 shows the resulting reference regions for the Basque Country using both approaches: the left column lists regions with the lowest distance to the Basque Country, and the right column lists the regions included in the Basque Country's group according to the cluster analysis.

Table 1: Basque Country's reference regions

Individual approach				Cluster approach			
NUTS	NUTS name	DistPV	Cluster	NUTS	NUTS name	DistPV	Cluster
ES21	Pais Vasco	0	1	ES21	Pais Vasco	0	1
AT12	Niederösterreich	209	1	AT12	Niederösterreich	209	1
AT22	Steiermark	233	1	AT22	Steiermark	233	1
AT31	Oberösterreich	189	1	AT31	Oberösterreich	189	1
AT32	Salzburg	332	1	AT32	Salzburg	332	1
AT33	Tirol	336	1	AT33	Tirol	336	1
AT34	Vorarlberg	240	1	AT34	Vorarlberg	240	1
DEC	Saarland	243	1	DEC	Saarland	243	1
FR22	Picardie	286	1	FR22	Picardie	286	1
FR24	Centre	335	1	FR24	Centre	335	1
FR41	Lorraine	307	1	FR41	Lorraine	307	1
ITC1	Piemonte	185	1	ITC1	Piemonte	185	1
ITC4	Lombardia	298	1	ITC4	Lombardia	298	1
ITD2	P. A. Trento	309	1	ITD2	P. A. Trento	309	1
ITD3	Veneto	196	1	ITD3	Veneto	196	1
ITD4	Friuli-Venezia Giulia	215	1	ITD4	Friuli-Venezia Giulia	215	1
ITD5	Emilia-Romagna	281	1	ITD5	Emilia-Romagna	281	1
ITE2	Umbria	333	1	ITE2	Umbria	333	1
DE1	Baden-Württemberg	290	2	AT21	Kärnten	353	1
DE9	Niedersachsen	284	2	ITF1	Abruzzo	393	1
DEA	Nordrehein-Westfalen	292	2	FR26	Bourgogne	394	1
DEB	Rheinland-Pfalz	333	2	FR51	Pays de la Loire	401	1
DED	Sachsen	198	2	FR21	Champagne-Ardenne	410	1
DEE	Sachsen-Anhalt	319	2	SE23	Västsverige	434	1
DEG	Thüringen	250	2	FR43	Franche-Comté	449	1
ES51	Cataluña	229	2	AT11	Burgenland	460	1
FR71	Rhône-Alpes	304	2	FR23	Haute-Normandie	469	1
ES22	C. F. de Navarra	323	4	FR53	Poitou-Charentes	485	1
DEF	Schleswig-Holstein	221	6	SE21	Småland med öarna	487	1
ITC3	Liguria	253	6	ITE3	Marche	497	1
UKG	West Midlands	259	6	ITE1	Toscana	501	1
DK04	Midtjylland	334	7	NL12	Friesland	529	1
SE12	Östra Mellansverige	319	7	FR72	Auvergne	583	1

The identification of regions is quite different, depending of the approach that is chosen: in the Basque Country case, almost half of the 30 closest regions were not in the Basque Country's cluster group and, conversely, some of the regions in that group were quite far from it according to the distance calculated from the structural conditions. The individual approach includes mainly German, Italian and Austrian regions, followed by French and Spanish regions and a couple of regions from Sweden and the United Kingdom. Previous exercises carried out to identify reference regions for the Basque Country come up with regions that are closer to those identified by the individual approach than the cluster approach. Nevertheless, and compared to previous attempts, the current exercise offers some advantages: apart from being based in a more objective and quantitative approach, it offers an array of regions for comparison. Despite being quite obvious, some of them had been previously ignored due to the lower visibility of their countries (e.g. Austrian regions). Implicitly, as there are no regions from Nordic countries or from the Benelux among the closest regions, this approach warns us about the difficulty to import experiences from such regions, despite having been the focus of attention from our innovation policies.

Once the reference regions have been identified, the benchmarking exercise can attempt the characterization of the group vis-à-vis all other regions regarding structural conditions. It can also attempt the characterization of the Basque Country with respect to the regions in the reference group. Tables 2, 3, 4 and 5 have been produced with such purposes in mind.

Table 2: Geo-demographic variables of the Basque Country reference group

NUTS Code	NUTS name	Cluster group	Population	Population density	Population 65+ year old	Accesibility
AT12	Niederösterreich	2	1,600,830	83	18.4	112
AT22	Steiermark	2	1,206,213	74	18.6	97
AT31	Oberösterreich	2	1,408,534	118	16.9	104
AT32	Salzburg	1	528,335	74	16.0	116
AT34	Vorarlberg	1	366,721	141	14.9	108
DE1	Baden-Württemberg	2	10,749,631	301	18.7	136
DE9	Niedersachsen	2	7,959,464	167	20.0	121
DEA	Nordrehein-Westfalen	2	17,964,843	527	19.7	152
DEB	Rheinland-Pfalz	2	4,036,997	203	20.1	137
DEC	Saarland	2	1,033,461	402	21.6	130
DED	Sachsen	2	4,206,501	228	23.1	108
DEE	Sachsen-Anhalt	2	2,397,172	117	22.5	100
DEF	Schleswig-Holstein	2	2,835,817	179	20.4	111
DEG	Thüringen	2	2,278,491	141	21.6	108
ES21	**Pais Vasco**	**2**	**2,137,400**	**295**	**19.1**	**93**
ES22	C. F. de Navarra	2	610,380	59	17.6	75
ES51	Cataluña	3	7,264,172	226	16.6	114
FR22	Picardie	6	1,904,750	98	14.8	112
FR41	Lorraine	6	2,341,500	99	16.6	103
FR71	Rhône-Alpes	7	6,136,500	140	15.8	113
ITC1	Piemonte	2	4,416,919	174	22.7	119
ITC3	Liguria	2	1,612,443	297	26.8	114
ITC4	Lombardia	2	9,692,541	406	19.9	135
ITD2	P. A. Trento	1	516,579	83	19.2	85
ITD3	Veneto	2	4,858,944	264	19.7	119
ITD4	Friuli-Venezia Giulia	2	1,226,499	156	23.2	92
ITD5	Emilia-Romagna	2	4,306,891	195	22.5	110
ITE2	Umbria	2	889,336	105	23.2	83
SE12	Östra Mellansverige	7	1,540,058	37	18.2	81
UKG	West Midlands	6	5,396,500	415	16.5	126
Average of 30 closest regions			**3,780,814**	**194**	**19.5**	**110**
Average of all 206 NUTS			**2,407,231**	**296**	**17.2**	**86**

Table 3: Employment distribution in the Basque Country's reference group (%)

NUTS Code	NUTS Name	Cluster group	Agriculture	Industry	Construction	Trade, transport, hotels and restaurants	Information and communication	Financial and insurance services	Real estate activities	Professional, scientific, technical, admin and support service	Public administration, education and health	Arts, entertainment, recreation and other services
AT12	Niederösterreich	2	7.3	16.0	8.0	26.6	2.7	3.9	0.6	7.6	23.5	3.8
AT22	Steiermark	2	7.5	19.5	8.4	25.1	1.8	2.8	0.6	6.8	23.5	4.2
AT31	Oberösterreich	2	7.5	21.2	9.9	25.7	1.6	2.6	0.5	7.2	20.4	3.4
AT32	Salzburg	1	4.3	14.9	9.2	31.1	1.9	3.3	1.0	8.0	21.6	4.7
AT34	Vorarlberg	1	2.9	26.5	8.3	26.6	1.7	3.7	0.4	7.0	19.0	4.0
DE1	Baden-Württemberg	2	1.3	29.9	5.8	19.3	3.6	3.5	0.5	8.6	23.2	4.4
DE9	Niedersachsen	2	2.6	21.4	6.5	23.6	2.0	3.4	0.5	9.2	25.9	4.9
DEA	Nordrehein-Westfalen	2	0.8	22.9	6.0	22.2	3.0	3.6	0.7	10.0	25.6	5.1
DEB	Rheinland-Pfalz	2	2.1	22.2	7.2	22.0	3.1	3.3	0.5	8.3	26.4	4.9
DEC	Saarland	2	0.6	22.2	6.5	22.8	2.0	4.1	0.2	9.6	26.9	5.1
DED	Sachsen	2	1.7	21.0	9.2	21.0	2.5	2.3	1.0	10.2	26.6	4.6
DEE	Sachsen-Anhalt	2	2.5	18.5	10.5	23.2	1.2	2.0	0.6	9.6	26.8	5.2
DEF	Schleswig-Holstein	2	2.2	15.6	6.6	25.1	2.7	3.4	0.9	10.2	28.4	4.7
DEG	Thüringen	2	2.2	22.8	9.9	21.6	2.1	2.2	0.7	8.6	25.5	4.4
ES21	**Pais Vasco**	**2**	**1.4**	**22.9**	**8.0**	**24.3**	**2.8**	**2.4**	**0.5**	**10.6**	**19.5**	**7.3**
ES22	C. F. de Navarra	2	4.5	28.1	8.9	21.7	1.2	1.8	0.3	8.2	18.5	6.8
ES51	Cataluña	3	1.8	19.6	10.2	27.0	3.3	2.5	0.8	9.8	18.1	6.9
FR22	Picardie	6	2.5	20.8	6.5	25.1	1.6	3.1	0.7	6.2	27.3	5.9
FR41	Lorraine	6	1.2	20.3	7.6	22.0	1.3	1.9	1.3	6.7	31.0	6.0
FR71	Rhône-Alpes	7	1.7	18.9	7.8	22.2	2.4	2.8	1.3	8.1	27.9	6.5
ITC1	Piemonte	2	3.7	24.9	7.8	23.5	2.6	3.2	0.6	9.3	17.7	6.6
ITC3	Liguria	2	2.0	13.1	7.4	29.7	1.9	3.3	0.8	11.5	23.1	7.2
ITC4	Lombardia	2	1.6	27.0	8.1	22.1	3.5	4.0	0.8	10.8	15.6	6.5
ITD2	P. A. Trento	1	3.4	18.3	9.2	23.1	1.8	2.9	0.5	9.6	26.4	4.8
ITD3	Veneto	2	2.7	30.2	8.2	24.1	1.5	2.5	0.4	9.1	16.0	5.2
ITD4	Friuli-Venezia Giulia	2	2.2	26.9	7.3	23.2	1.3	3.0	0.6	9.3	20.8	5.4
ITD5	Emilia-Romagna	2	3.9	26.7	7.4	23.9	2.1	3.1	0.4	9.6	16.6	6.2
ITE2	Umbria	2	4.2	21.4	9.1	23.2	1.3	2.1	0.4	9.6	21.5	7.2
SE12	Östra Mellansverige	7	2.7	15.8	7.3	19.7	3.2	1.4	1.5	10.9	32.9	4.5
UKG	West Midlands	6	1.1	15.1	7.9	22.8	2.6	3.1	0.8	10.0	30.5	5.4
Average of 30 closest regions			**2.9**	**21.5**	**8.0**	**23.8**	**2.2**	**2.9**	**0.7**	**9.0**	**23.6**	**5.4**
Average of all 206 NUTS			**6.6**	**17.9**	**8.4**	**24.2**	**2.3**	**2.6**	**0.7**	**7.6**	**24.3**	**4.9**

Table 4: Industrial employment distribution in the Basque Country’s reference group (%)

NUTS Code	NUTS name	Cluster group	Mining and quarrying	Food products, beverages and tobacco	Textiles, textile products, leather and footwear	Wood, paper, printing and publishing	Chemical, rubber, plastics and fuel products	Non-metallic products	Basic metals and fabricated metal products	Machinery	Electrical, electronic, computing and optical equipment	Transport equipment	Other equipment
AT12	Niederösterreich	2	1.9	13.2	3.2	9.4	6.8	5.4	21.4	7.9	11.3	6.4	13.1
AT22	Steiermark	2	2.3	9.0	4.5	9.4	4.5	5.2	22.1	12.0	10.0	9.7	11.2
AT31	Oberösterreich	2	1.5	10.1	3.2	9.8	10.8	3.4	17.9	6.6	14.8	10.0	12.1
AT32	Salzburg	1	0.6	18.5	2.8	13.9	6.7	3.1	13.3	7.0	10.5	5.5	18.1
AT34	Vorarlberg	1	0.7	9.7	10.7	9.7	7.6	2.2	26.6	9.3	11.5	4.4	7.5
DE1	Baden-Württemberg	2	0.3	8.0	2.7	5.6	10.0	0.8	12.5	11.3	17.9	22.8	8.1
DE9	Niedersachsen	2	2.0	16.4	0.7	4.0	10.6	2.3	14.0	6.7	10.0	28.3	5.1
DEA	Nordrehein-Westfaler	2	1.6	8.3	2.3	7.6	12.5	3.4	23.9	8.2	15.9	9.3	7.1
DEB	Rheinland-Pfalz	2	0.9	11.2	3.0	5.9	26.9	3.4	10.5	4.7	15.2	11.3	7.2
DEC	Saarland	2	5.7	11.5	0.1	5.1	7.4	0.7	32.4	3.9	11.3	12.8	9.1
DED	Sachsen	2	0.6	12.4	2.9	10.8	4.3	4.5	21.6	6.5	13.0	18.0	5.3
DEE	Sachsen-Anhalt	2	3.9	18.7	0.5	4.9	10.3	4.8	26.8	4.9	10.1	6.4	8.9
DEF	Schleswig-Holstein	2	0.6	19.3	0.3	9.7	12.0	0.9	16.5	9.6	10.7	14.9	5.5
DEG	Thüringen	2	0.6	7.7	3.2	5.1	7.1	8.9	16.8	10.1	15.8	16.4	8.3
ES21	Pais Vasco	2	0.2	7.5	0.7	5.9	7.8	2.7	28.8	10.0	14.5	14.2	7.6
ES22	C. F. de Navarra	2	1.3	18.6	2.2	11.1	9.7	4.9	15.7	5.0	7.8	17.6	6.1
ES51	Cataluña	3	0.4	14.0	7.5	7.0	15.8	3.5	13.3	6.3	7.7	11.9	12.6
FR22	Picardie	6	0.0	16.8	2.6	5.8	23.9	4.6	16.2	6.4	7.9	7.1	8.6
FR41	Lorraine	6	2.1	13.4	4.5	8.2	11.3	3.1	20.1	5.6	10.1	14.8	6.8
FR71	Rhône-Alpes	7	0.7	11.4	8.1	6.1	13.8	3.2	18.1	12.8	8.1	6.0	11.6
ITC1	Piemonte	2	0.7	7.3	8.8	7.3	9.1	2.6	15.9	7.9	10.9	20.1	9.4
ITC3	Liguria	2	0.7	13.6	3.2	4.2	11.6	2.5	19.9	6.8	7.0	12.9	17.5
ITC4	Lombardia	2	0.6	5.5	11.2	8.1	13.7	3.0	19.9	9.8	11.8	5.9	10.6
ITD2	P. A. Trento	1	1.7	10.0	5.6	19.5	10.6	6.5	17.0	4.8	10.9	2.2	11.2
ITD3	Veneto	2	0.3	7.1	12.1	8.5	8.4	4.2	18.6	8.7	12.1	3.9	16.3
ITD4	Friuli-Venezia Giulia	2	0.5	5.1	2.4	11.8	5.8	5.1	15.6	12.5	10.7	4.8	25.6
ITD5	Emilia-Romagna	2	0.5	11.4	9.0	5.9	7.1	8.7	15.0	7.0	20.3	5.1	10.0
ITE2	Umbria	2	0.6	12.2	13.8	9.8	7.0	11.7	15.4	4.7	8.7	3.3	12.7
SE12	Östra Mellansverige	7	0.8	6.6	1.7	9.9	10.0	2.7	22.3	9.5	16.8	11.6	7.9
UKG	West Midlands	6	0.4	8.3	2.6	8.0	9.2	4.6	17.6	6.1	11.7	20.7	10.9
Average of 30 closest regions			**1.2**	**11.4**	**4.5**	**8.3**	**10.4**	**4.1**	**18.9**	**7.8**	**11.8**	**11.3**	**10.4**
Average of all 206 NUTS			**2.6**	**16.8**	**6.9**	**9.7**	**10.4**	**4.9**	**14.5**	**7.4**	**7.0**	**8.8**	**11.1**

Table 5: EPO patent distribution in the Basque Country’s reference group (%)

NUTS Code	NUTS name	Cluster group	Human necessities	Performing Operations and	Chemistry and Metallurgy	Textiles and Paper	Fixed Constructions	Mechanical Engineering, Lighting,	Physics	Electricity
AT12	Niederösterreich	2	13.4	22.0	9.1	6.2	11.0	13.0	10.6	14.8
AT22	Steiermark	2	8.4	23.2	14.0	4.1	7.4	11.8	14.3	16.9
AT31	Oberösterreich	2	10.5	33.8	14.0	3.8	10.4	14.5	7.2	5.7
AT32	Salzburg	1	21.3	22.9	5.6	0.9	13.9	12.0	17.9	5.6
AT34	Vorarlberg	1	19.4	20.5	5.6	1.4	12.2	17.6	6.8	16.5
DE1	Baden-Württemberg	2	10.5	25.5	6.6	2.8	3.4	20.2	16.7	14.3
DE9	Niedersachsen	2	13.2	31.2	9.8	0.8	4.1	13.8	14.9	12.2
DEA	Nordrehein-Westfalen	2	13.7	23.1	17.1	2.8	7.7	13.3	10.1	12.3
DEB	Rheinland-Pfalz	2	16.7	25.2	26.8	2.0	3.8	9.4	8.7	7.3
DEC	Saarland	2	13.6	25.9	12.1	1.0	9.1	16.8	14.0	7.6
DED	Sachsen	2	8.4	26.2	12.9	2.3	3.6	8.4	16.3	21.8
DEE	Sachsen-Anhalt	2	18.9	18.7	26.0	0.9	5.9	9.0	12.7	7.8
DEF	Schleswig-Holstein	2	28.6	28.5	7.7	2.1	3.8	11.4	10.7	7.3
DEG	Thüringen	2	17.4	17.0	10.9	1.5	4.4	7.3	27.3	14.1
ES21	Pais Vasco	2	14.5	30.6	6.0	3.2	11.3	15.9	10.0	8.5
ES22	C. F. de Navarra	2	20.2	18.2	6.3	2.5	3.9	26.2	13.9	8.7
ES51	Cataluña	3	27.9	24.5	14.7	2.3	6.1	7.2	7.2	10.0
FR22	Picardie	6	16.1	34.5	12.7	1.8	8.5	14.5	4.9	7.0
FR41	Lorraine	6	19.0	24.2	12.6	0.6	9.6	20.2	8.2	5.7
FR71	Rhône-Alpes	7	17.1	16.9	14.8	2.9	3.8	7.6	15.7	21.2
ITC1	Piemonte	2	11.2	30.5	6.9	2.4	6.0	17.8	11.4	13.8
ITC3	Liguria	2	14.0	24.4	8.4	0.5	3.3	15.9	19.4	14.0
ITC4	Lombardia	2	20.4	22.5	11.5	4.9	5.1	11.3	10.2	14.2
ITD2	P. A. Trento	1	26.7	27.2	3.7	1.4	10.2	12.2	9.7	8.9
ITD3	Veneto	2	26.6	25.5	7.3	4.0	9.0	12.6	6.6	8.4
ITD4	Friuli-Venezia Giulia	2	18.2	25.8	5.0	14.8	8.1	13.4	8.1	6.7
ITD5	Emilia-Romagna	2	20.6	42.4	6.9	0.8	7.0	11.4	6.8	4.2
ITE2	Umbria	2	24.0	30.8	9.8	5.7	6.9	13.0	4.5	5.2
SE12	Östra Mellansverige	7	13.5	21.9	9.5	0.5	4.9	11.3	18.6	19.7
UKG	West Midlands	6	15.2	21.5	7.6	1.1	9.3	15.6	16.4	13.4
Average of 30 closest regions			**17.3**	**25.5**	**10.7**	**2.7**	**7.1**	**13.5**	**12.0**	**11.1**
Average of all 206 NUTS			**20.1**	**20.3**	**12.9**	**1.7**	**6.5**	**12.0**	**12.3**	**14.1**

By comparing the two lowest rows in the above tables, it is possible to characterize the Basque Country’s group of reference regions. Such regions are characterized by their considerable size, aging population, good accessibility and a marked specialization in manufacturing and knowledge intensive sectors (Financial and insurance activities; Professional, scientific, technical, administrative and support service activities; and Arts, entertainment and recreational activities). Within the industrial sector, they are specialized in Metals and Electrical, electronic, computing and optical equipment. In EPO patents they excel in the Performing Operations, Mechanical Engineering and Fixed Constructions sections. By comparing the values in the Basque Country row with those in the last two rows, we can characterize the Basque Country with regards its reference group and all European NUTS, observing that the above features approximately hold for the Basque Country.

a) Economic and innovation performance

Even if we propose to compare regions with those that exhibit similar structural conditions, the data allow for performance comparisons with all other NUTS. However, if we want to follow the procedure described above, Table 6 presents a simple and direct way to assess the position, strengths and weaknesses of a region's performance with respect to its reference group and all the European NUTS.

Table 6: Level of economic and innovation performance of the Basque Country and its reference group

NUTS Code	NUTS name	Level of economic output ranking	Level of economic output index	GDP per cápita (thousand €)	Productivity (thousand €)	Employment rate (%)	Level of innovation output ranking	Level of innovation output index	Publications per million inhabitants	Patents per million inhabitants	Employment in H and MH technology (%)	Employement in knowledge intensive sectors (%)
AT32	Salzburg	25	68	37	65	75	97	50	571	168	3.5	34
AT34	Vorarlberg	29	67	34	71	74	95	50	119	361	6.8	31
DE1	Baden-Württemberg	34	65	33	65	74	1	79	1494	513	16.8	38
AT31	Oberösterreich	38	63	32	62	74	83	53	342	205	7.7	31
SE12	Östra Mellansverige	46	61	31	69	71	4	74	2426	226	6.8	48
ITC4	Lombardia	49	59	34	70	66	57	57	768	141	9.0	32
ITD5	Emilia-Romagna	50	58	32	63	69	41	60	1210	169	9.3	30
AT12	Niederösterreich	51	58	27	62	72	105	47	157	130	4.4	38
ITD2	P. A. Trento	53	56	31	66	67	91	52	1116	45	3.7	40
FR71	Rhône-Alpes	54	56	30	72	65	24	65	1483	213	5.8	41
AT22	Steiermark	55	56	28	57	71	45	59	1202	162	6.4	35
DEB	Rheinland-Pfalz	57	55	26	57	72	18	67	864	262	10.5	39
DEA	Nordrehein-Westfalen	58	55	29	61	68	21	66	964	226	9.3	39
UKG	West Midlands	61	55	29	63	68	51	58	877	56	5.9	46
DEF	Schleswig-Holstein	62	55	25	58	71	48	59	966	134	6.8	37
DEC	Saarland	66	54	29	60	67	31	62	1127	132	6.5	42
DE9	Niedersachsen	67	54	26	57	70	27	63	890	157	9.9	38
ITD3	Veneto	68	54	31	63	65	86	53	656	124	8.3	28
ES21	Pais Vasco	76	52	31	59	64	85	53	580	56	9.1	33
ES22	C. F. de Navarra	82	51	30	52	67	74	55	1126	84	8.4	29
ITC1	Piemonte	83	51	29	61	64	63	56	545	133	10.4	31
ITD4	Friuli-Venezia Giulia	87	51	29	61	63	70	55	665	123	7.9	33
ITC3	Liguria	92	50	27	64	64	92	51	885	60	3.8	39
DEG	Thüringen	97	49	21	48	72	53	58	894	103	8.1	36
DED	Sachsen	99	49	22	48	71	36	61	1182	85	8.3	38
DEE	Sachsen-Anhalt	100	48	21	51	70	62	57	2031	40	4.2	40
ES51	Cataluña	102	48	28	54	64	80	53	1065	66	6.7	32
FR41	Lorraine	104	48	24	67	62	64	56	819	58	6.7	41
FR22	Picardie	105	48	24	66	62	93	51	344	74	6.5	38
ITE2	Umbria	112	45	24	54	63	100	49	1038	49	4.4	33
Average of 30 closest regions		**69**	**55**	**28**	**61**	**68**	**60**	**58**	**761**	**116**	**7.4**	**36**
Average of all 206 NUTS		**104**	**45**	**23**	**51**	**64**	**104**	**46**	**872**	**87**	**6.3**	**32**

By comparing the two lowest rows in Table 6, we can characterize the output of the reference group with respect to all the NUTS. In this case we observe a superior level of economic performance, mainly caused by a higher productivity, and a superior innovation performance, mainly caused for their better results in patents and employment in high and medium-high manufacturing, that compensate worse results in publications. Similarly, by comparing the Basque Country row with the two lowest rows we can infer that the Basque Country's economic success, while real when we compare it with the European average, is not so bright when compared with the reference regions. Therefore, rather than being the result of policies and behaviours of recent years, the success is largely due to its structural conditions (industrial and technological specialization, accessibility).

Additionally, it is also possible to identify the Basque Country's strengths and weaknesses in economic and innovation performance. Its economic performance is negatively affected by a worse productivity and, after the adverse impact of the economic crisis on the region's employment, by a lower employment rate. Its innovation performance is negatively affected by the bad results is patents and, to a lower extent, in publications. The comparison with the reference regions implies that these results cannot be explained, as it has been often proposed, by the Basque Country's industry specialization.

In addition to compare economic and innovation performances with regards to the level reached the last available year, we can compare the variation in performance over the last five years. In Table 7 we can see that, in general, regions that improve more are those that started from lower levels. We also notice that better or worse performances are shared by regions in the same country, thus indicating that variations are largely due to national rather than regional factors. Consequently, benchmarking analysis that aim to identify regions that exhibit better evolutions in their performances should consider, in addition to similar structural conditions, the level the regions started from and the differential evolution with respect to other regions in its country.

Focusing on the regions with similar structural conditions, Table 7 shows the good relative performance of the Basque Country in innovation output. However, when economic output is considered, the performance has not been so satisfactory. One of the reasons for this poor performance is that the analysis of the employment variable has been extended to 2009, showing the adverse effects of the crisis that is affecting Spain. The other reason is that the Basque Country shares with Spain the inadequate increase in productivity during the 2000 decade (even if the Basque Country's increase has been higher than the Spanish average, or those experienced in Catalonia and Navarra, the other two NUTS in the reference group).

Table 7: Variation in economic and innovation performance in the Basque Country and its reference group

NUTS Code	NUTS name	**Variation of economic output ranking**	**Variation of economic output index**	GDP per capita	GDP	Productivity	Employment	**Variation of innovation output ranking**	**Variation of innovation output index**	Publications per inhabitant	Patents per inhabitant	Employment in H and MH technology	Employement in knowledge intensive sectors
AT22	Steiermark	**55**	**61**	3.1	3.3	2.4	1.3	**88**	**56**	16	4	2.8	3.1
AT12	Niederösterreich	**56**	**60**	2.9	3.5	2.5	1.2	**102**	**55**	25	13	-0.3	3.9
AT32	Salzburg	**58**	**60**	3.0	3.4	2.1	1.3	**149**	**49**	17	19	-1.6	1.9
AT31	Oberösterreich	**59**	**60**	2.9	3.3	2.0	1.4	**133**	**51**	28	12	-0.5	1.9
AT34	Vorarlberg	**71**	**58**	2.4	3.1	2.1	1.3	**76**	**57**	74	20	3.2	2.1
DED	Sachsen	**73**	**58**	2.8	2.2	1.9	1.7	**80**	**57**	26	-5	1.7	4.2
DEC	Saarland	**76**	**58**	3.0	2.5	2.4	1.2	**136**	**50**	30	-4	-0.2	1.8
DEG	Thüringen	**78**	**58**	4.1	2.2	2.3	1.0	**35**	**63**	23	5	4.8	5.2
DE9	Niedersachsen	**96**	**55**	1.9	1.9	1.5	1.9	**112**	**54**	11	-7	2.3	2.6
SE12	Östra Mellansverige	**97**	**54**	2.5	2.9	2.6	0.6	**180**	**46**	12	5	-3.4	1.6
DE1	Baden-Württemberg	**99**	**54**	1.8	2.1	1.7	1.7	**113**	**54**	15	0	2.0	2.4
DEE	Sachsen-Anhalt	**109**	**53**	2.6	1.5	1.7	1.5	**153**	**49**	26	-14	-0.9	1.9
ES22	C. F. de Navarra	**110**	**53**	2.0	3.5	0.2	1.1	**74**	**57**	27	77	-0.7	5.0
DEB	Rheinland-Pfalz	**115**	**52**	1.7	1.7	1.1	1.8	**123**	**52**	15	-3	3.5	0.5
ES21	**Pais Vasco**	**122**	**51**	**2.9**	**3.3**	**0.7**	**0.1**	**59**	**59**	**22**	**50**	**1.5**	**4.7**
FR71	Rhône-Alpes	**135**	**48**	1.5	2.4	1.5	0.7	**166**	**47**	19	2	-1.9	1.2
DEF	Schleswig-Holstein	**136**	**48**	1.1	1.3	1.1	1.7	**128**	**51**	12	-5	0.9	2.2
DEA	Nordrehein-Westfalen	**141**	**48**	1.2	1.2	0.9	1.7	**110**	**54**	14	-5	0.7	3.5
ES51	Cataluña	**149**	**45**	1.1	3.3	-0.2	0.5	**37**	**62**	29	26	1.5	6.3
ITD3	Veneto	**157**	**42**	0.8	1.9	0.4	0.7	**78**	**57**	21	19	1.4	4.1
FR41	Lorraine	**163**	**41**	0.9	1.1	1.3	0.7	**111**	**54**	11	-7	2.3	2.6
ITD5	Emilia-Romagna	**171**	**39**	0.3	1.5	0.1	1.1	**99**	**55**	23	2	1.0	3.5
ITC3	Liguria	**177**	**39**	0.5	1.0	0.0	1.2	**117**	**53**	11	7	0.3	2.9
UKG	West Midlands	**179**	**38**	1.3	1.6	1.4	-0.5	**206**	**36**	5	-24	-9.4	1.6
ITE2	Umbria	**184**	**37**	0.1	1.2	-0.7	1.5	**18**	**65**	18	37	6.5	5.2
FR22	Picardie	**186**	**35**	0.7	0.9	0.9	0.1	**196**	**42**	18	4	-2.0	-1.5
ITD2	P. A. Trento	**187**	**37**	0.0	1.2	0.2	1.2	**98**	**55**	47	-21	-0.6	5.1
ITC1	Piemonte	**188**	**35**	0.4	1.1	-0.2	0.6	**130**	**51**	21	19	-1.9	2.9
ITD4	Friuli-Venezia Giulia	**189**	**35**	0.6	1.1	0.1	0.3	**94**	**56**	12	39	1.1	3.5
ITC4	Lombardia	**197**	**32**	0.0	1.1	-0.2	0.7	**84**	**57**	19	-2	-0.4	5.3
Average of 30 closest regions		**126**	**47**	**1.7**	**2.1**	**1.1**	**1.0**	**110**	**53**	**22**	**9**	**0.5**	**3.0**
Average of all 206 NUTS		**104**	**54**	**2.7**	**3.0**	**1.9**	**1.0**	**104**	**54**	**34**	**23**	**2.1**	**2.7**

b) Innovation input

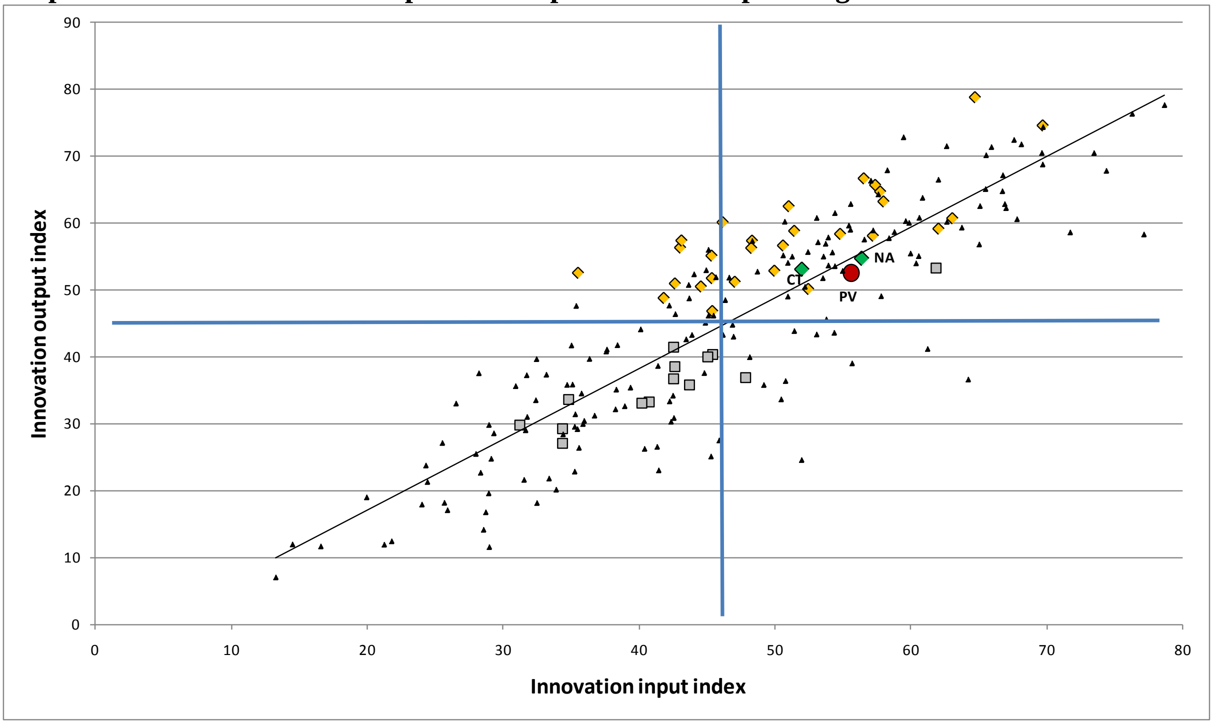
Lastly, the third stage of benchmarking analysis consists in observing how the region behaved in a series of factors that might be considered as innovation input and that affect the innovation performance described above. We can see in Table 8 that, with respect to its reference group, the Basque Country shows an acceptable level of innovation input. In this respect, its main weaknesses (or areas for improvement) reside in the percentage of population aged 25-64 with secondary or tertiary education, clearly below the group's and total averages, but above that of other regions in the group. Likewise, the Basque Country exhibits low levels in patent co-invention and new foreign firms. Lastly, the high values in broadband access that other regions exhibit show that there is also room for improvement in this area.

Table 8: Level of innovation input in the Basque Country and its reference group

NUTS Code	NUTS name	Level of innovation input ranking	Level of innovation input index	Human resources in science and technology	Population aged 25-64 with upper secundary or tertiary	Tertiary students over 20-24 population	25-64 population in life-long learning	Business R&D expenditure	Business R&D personnel	Public R&D expenditure	Public R&D personnel	Families with broadband access	Patent co-invention	New foreign firms
SE12	Östra Mellansverige	**9**	**70**	21	79	76	22.9	2.4	0.86	1.6	0.6	82	73	71
DE1	Baden-Württemberg	**23**	**65**	20	84	48	8.8	3.7	1.65	0.8	0.5	75	69	34
DED	Sachsen	**26**	**63**	21	96	52	7.0	1.4	0.59	1.3	0.6	67	62	18
AT22	Steiermark	**30**	**62**	12	83	65	13.5	2.8	1.30	1.2	0.5	63	77	114
DE9	Niedersachsen	**44**	**58**	14	84	41	6.5	1.8	0.70	0.8	0.4	81	65	22
FR71	Rhône-Alpes	**46**	**58**	18	71	58	6.3	1.6	0.95	0.8	0.6	66	80	136
DEA	Nordrehein-Westfalen	**48**	**57**	16	81	55	7.0	1.2	0.58	0.7	0.4	79	63	43
DEG	Thüringen	**50**	**57**	17	95	47	8.1	1.0	0.48	0.9	0.4	68	65	14
DEB	Rheinland-Pfalz	**53**	**57**	17	83	53	7.4	1.4	0.62	0.5	0.2	74	46	29
ES22	C. F. de Navarra	**54**	**56**	21	60	64	12.9	1.3	1.06	0.6	0.8	59	86	53
ES21	Pais Vasco	**56**	**56**	**25**	**65**	**70**	**13.3**	**1.6**	**1.27**	**0.4**	**0.4**	**63**	**93**	**61**
UKG	West Midlands	**61**	**55**	15	70	46	18.4	1.0	0.62	0.3	0.4	69	69	416
AT32	Salzburg	**75**	**52**	12	85	58	13.5	0.7	0.48	0.4	0.3	64	78	478
ES51	Cataluña	**78**	**52**	17	52	62	9.8	1.0	0.71	0.6	0.6	67	87	88
DEF	Schleswig-Holstein	**80**	**51**	13	86	40	8.1	0.6	0.27	0.7	0.3	81	64	19
DEC	Saarland	**83**	**51**	15	83	45	7.1	0.4	0.28	0.7	0.5	77	68	19
DEE	Sachsen-Anhalt	**88**	**51**	16	93	43	6.4	0.4	0.21	0.8	0.4	65	55	15
AT31	Oberösterreich	**91**	**50**	10	79	30	13.2	2.2	1.07	0.2	0.1	62	76	202
FR41	Lorraine	**95**	**48**	16	69	48	4.5	0.5	0.34	0.6	0.5	64	66	108
ITC3	Liguria	**98**	**47**	16	65	63	7.3	0.7	0.58	0.6	0.5	48	80	21
ITD5	Emilia-Romagna	**104**	**46**	13	59	86	7.0	0.8	0.69	0.5	0.5	51	88	36
AT12	Niederösterreich	**109**	**45**	10	84	15	11.9	1.2	0.54	0.1	0.0	62	64	253
ITD2	P. A. Trento	**110**	**45**	13	65	71	8.9	0.3	0.22	0.8	0.8	57	82	26
ITD4	Friuli-Venezia Giulia	**111**	**45**	11	58	78	7.1	0.6	0.47	0.7	0.7	51	78	26
AT34	Vorarlberg	**119**	**45**	10	78	10	14.3	1.3	0.88	0.1	0.0	65	84	334
ITC4	Lombardia	**126**	**43**	13	57	61	5.8	0.9	0.65	0.3	0.3	53	85	101
ITC1	Piemonte	**127**	**43**	11	55	56	5.1	1.5	1.00	0.4	0.3	48	88	34
FR22	Picardie	**130**	**43**	14	63	34	4.3	0.9	0.70	0.2	0.1	55	60	90
ITE2	Umbria	**138**	**42**	12	62	91	7.2	0.2	0.18	0.7	0.7	51	74	8
ITD3	Veneto	**159**	**36**	10	56	49	6.1	0.3	0.32	0.3	0.3	54	88	33
Average of 30 closest regions		**81**	**52**	**15**	**73**	**54**	**9.3**	**1.2**	**0.68**	**0.6**	**0.4**	**64**	**74**	**97**
Average of all 206 NUTS		**104**	**47**	**16**	**71**	**59**	**9.1**	**0.8**	**0.45**	**0.5**	**0.5**	**58**	**31**	**177**

In any case, the objective is not to increase the innovation input, but rather to increase the innovation output (which, in turn, should help to increase the economic output). In that sense, we should complete the comparison of the level of innovation with an indicator that reflects the efficiency in using this input. In this respect, graph 1 shows that the Basque Country's reference regions (with orange diamonds in the graph) exhibit better efficiency levels in their systems than the European average (with small black triangles), while the contrary is true for the Spanish regions (represented with grey squares, with the exception of those that are also in the reference group, that are represented with green diamonds). During the last years the Basque Country (with a red circle) has substantially corrected the efficiency problem that had attributed to it over the last decade. Currently it practically sits on the adjusted line between innovation input and output for all the European regions.

Graph 1: Levels of innovation input and output in the European regions



Symbols: Basque country (red circle), non-Spanish reference regions (orange diamond), Spanish reference regions (green diamond), other Spanish regions (grey square) and other EU regions (small black triangle)

Lastly, the comparison of innovation inputs may refer to variations, instead of levels. In this respect, Table 9 shows the Basque Country's outstanding advance in innovation input, despite departing from an already high position compared to the reference group.

Table 9: Innovation input variation in the Basque Country and its reference group

NUTS Code	NUTS name	Variation of innovation input ranking	Variation of innovation input index	Variation of human res. in science and technology	Variation in population with upper secundary or tertiary educ.	Variation in population in life-long learning	Variation in patent co-invention
ES22	C. F. de Navarra	12	71	4.2	4.7	29.3	86.1
ITD2	P. A. Trento	23	65	12.0	3.4	2.4	-32.8
ES21	Pais Vasco	32	63	4.5	3.5	15.7	46.9
ITD5	Emilia-Romagna	40	62	6.9	3.3	1.9	1.3
ES51	Cataluña	41	62	1.7	4.0	30.4	33.5
ITC1	Piemonte	49	60	7.1	2.9	-0.2	-2.3
FR41	Lorraine	60	58	7.8	2.8	-6.1	12.2
ITD3	Veneto	61	57	3.6	3.8	0.5	26.6
DEC	Saarland	72	55	5.6	1.8	7.3	-16.9
ITC3	Liguria	73	55	4.3	2.5	2.9	8.3
DE1	Baden-Württemberg	84	53	5.1	1.8	0.6	0.3
ITD4	Friuli-Venezia Giulia	88	53	4.8	2.0	-2.5	61.1
ITC4	Lombardia	96	51	3.8	2.4	-0.2	-8.0
FR22	Picardie	117	48	2.6	3.6	-7.3	4.4
FR71	Rhône-Alpes	123	47	3.5	1.7	-2.5	3.9
ITE2	Umbria	124	47	0.0	3.0	0.2	38.9
AT34	Vorarlberg	126	47	2.1	1.3	3.8	25.2
DEB	Rheinland-Pfalz	132	46	3.7	0.5	3.5	-4.5
AT22	Steiermark	133	46	2.8	0.8	3.2	24.9
UKG	West Midlands	134	46	1.2	2.3	4.3	-17.9
AT32	Salzburg	140	46	1.9	1.2	1.9	33.6
DEA	Nordrehein-Westfalen	141	46	3.9	0.4	0.5	-2.0
AT31	Oberösterreich	153	44	2.1	0.7	3.4	12.6
DEF	Schleswig-Holstein	159	44	1.1	1.8	1.9	-14.9
DE9	Niedersachsen	163	43	2.3	0.8	0.3	-5.9
AT12	Niederösterreich	175	41	0.2	0.9	1.4	10.9
SE12	Östra Mellansverige	185	38	3.2	-0.5	-3.9	1.0
DEE	Sachsen-Anhalt	187	37	1.6	-0.7	4.3	-17.5
DED	Sachsen	189	36	2.8	-0.5	-3.7	-13.9
DEG	Thüringen	194	35	-0.7	0.1	0.4	-1.6
Average of 30 closest regions		110	50	3.5	1.9	3.1	9.8
Average of all 206 NUTS		104	51	3.7	2.0	3.2	28.1

5. Summary and conclusions

Benchmarking can help on the formulation of the competitiveness and innovation strategy every territory should have. It can also help on the evaluation of the activities that have been carried out there. In order to do so, it is necessary to avoid simplistic approaches that do not take into account the territory's context and are based on mere imitation that reduces diversity and goes against the very idea of a strategy. In fact, the first condition every territorial benchmarking exercise should accomplish is that comparisons should take place among homogeneous territories. Among them, particular attention should be placed on those regions with better performances. The analysis should not stop there: it should rather attempt to disclose the causes, analyzing the activities and inputs that have led to such results. Even if the combination of quantitative and qualitative information and the active participation of territorial agents would be preferable, this work focuses on the analyses that may be undertaken using publicly available secondary sources on regional data.

Regarding the first stage of a benchmarking analysis, and despite the numerous authors who have underlined the need to compare homogeneous territories and have highlighted several factors that should be considered to assess homogeneity, existing territorial benchmarking analysis have frequently ignored such requirement and have used a very simple approach to determine homogeneity: grouping territories according to GDP per capita levels. Here we propose the identification of territories based on their structural conditions, that have been grouped in four categories equally weighted: geo-demographic factors (population, population density, aging rate and accessibility), the economy's industry structure (distribution in 10 large sectors), industrial structure (distribution in eleven sectors) and technological specialization (distribution in CIP patent sections). After subjecting the variables to a series of transformations (corrections and standardization) and assigning relative weights (equal for indicators within the same group), we obtain a distance matrix among all EU-27 regions.

Based on this matrix two different approaches may be followed. On one hand, we can take the row of distances from the region we are interested in carrying out the benchmarking for, ordering all the other regions according to their distance to the benchmarked region and choosing the number of regions for a detailed comparison. On the other hand, a cluster analysis can be undertaken to obtain a regional typology based on the structural conditions. The first approach is preferable for those interested in a particular region, since it allows for a finer selection of regions than the cluster analysis. The second option is preferable for those interested in all European regions, since it provides a more complete picture.

Having identified the regions with similar structural conditions, the following step consists in identifying those with better performance to determine the relative strengths and weaknesses of the region the benchmarking exercise is undertaken on. Regarding relative performance, it is advisable to distinguish between economic and innovation variables: even if they are closely related, the distinction allows the analysis of their dynamic interactions. Likewise, performance analysis should distinguish between achievements at a point in time, from variation or evolution analysis.

In order to do so several variables were selected: employment rate, productivity and GDP per capita for the level of economic performance; annual rate of employment growth, productivity, real GDP and real GDP per capita for its variation. With regards to innovation performance, the level was measured through EPO patents and publications per capita, and percentages of employment in high and medium-high manufactures and knowledge intensive services; and the variation through the growth rates of the same four indicators. As before, the original variables were subjected to the usual treatments (correction and standardization) and equal weights were assigned (within each level) to obtain composite indicators.

The third stage of the benchmarking exercise consists in comparing the drivers that affect the above mentioned innovation performance. Three types of indicators have been selected: some linked to human resources (human resources in science and technology (% of population aged 25-64); population aged 25-64 that has attained upper secondary and tertiary educational level (% of population aged 25-64), students in tertiary education (% of population aged 20-24) and population aged 25-64 taking part in long-life learning (% of active population); others linked to R&D (business and public R&D expenditure and personnel) and connectivity (families with broadband access, patent co-invention and new foreign firms). Similarly to performance indicators, they have been subjected to usual treatments and weights have been assigned to compute innovation input composite indicators.

In order to verify its suitability, the benchmarking procedure has been tested on the Basque Country. The identification of reference regions depends on the approach chosen: the individual approach based on the row of distances taken from the distance matrix, or the collective approach based of the typology group from the cluster analysis. The observation of the Basque Country results seems to confirm the suitability of the individual approximation.

Distinguishing between economic performance indicators and innovation performance indicators makes the detection of “innovation paradoxes” possible. The analyses carried out also enable the identification of relative strengths and weaknesses in economic and innovation performances and the assessment on whether these are shared with the other regions in the reference group or quite specific to the region in question.

The analysis of variation performance in order to identify those with top results has uncovered the need to incorporate the starting point of the region’s economic and innovation performance (given the convergence observed) and the differential behaviour with respect to the rest of the country (given the similarities in evolution with other regions in the same country).

Finally, regarding innovation input, the benchmarking exercise we have proposed enables not only the characterization of the reference group with respect to all the NUTS, but also the identification of strengths and weaknesses both with respect to all the NUTS and its reference group (for instance, the Basque Country’s weakness in upper secondary or tertiary education). In any case, having high innovation inputs is not a regional objective *per se*. Rather, high innovation outputs are pursued (and these, in turn, only if they enable a better economic performance). Hence, the comparative analysis of innovation input should be complemented with an indicator that captures the efficient use of such input. This can be achieved by comparing innovation input and output. Thus, for instance, the benchmarking analysis uncovers a certain efficiency problem in the Spanish innovation systems, since their output indicators are considerably worse than their input indicators. Lastly, in order to identify the regions to learn from due to their positive evolution in input performance, we should take into account the dynamics in the reference group, the starting point of the region’s innovation input and the behaviour of the region’s country.

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