Local innovation capacity: a typology for Basque Counties

The article reflects on the right territorial unit to analyse innovation processes, proposing a multilevel approach and taking a step towards developing it in the Basque Country.
From an empirical point of view, it contributes to the relatively scarce literature on the study of the interrelations between innovation systems, agglomerations and entrepreneurship. Connected to these three concepts 21 indicators have been used to carry out a cluster analysis following an initial principal components analysis with the results of a typology that group the 20 Basque counties into 5 different classes: 1) capital-urban zones with diverse industry mix; 2) advanced industrial agglomerations; 3) industrial agglomerations with average technological performance 4) small industrial counties and 5) small rural counties.

El artículo plantea una reflexión en torno a la unidad territorial adecuada para analizar procesos de innovación, proponiendo una aproximación multinivel y avanzando en el desarrollo de la misma en la Comunidad Autónoma del País Vasco (CAPV). Este trabajo, desde un punto de vista empírico, contribuye a la escasa literatura existente relativamente en el ámbito de las interrelaciones entre el sistema de innovación, las economías de aglomeración y el emprendizaje. En relación con estos tres conceptos, se han utilizado 21 indicadores para realizar un análisis clúster, precedido por un análisis de componentes principales con el resultado de una tipología que agrupa las 20 comarcas de la CAPV en 5 tipos distintos: 1) comarcas metropolitanas con una estructura productiva diversificada; 2) aglomeraciones industriales avanzadas; 3) aglomeraciones industriales con un comportamiento tecnológico medio; 4) pequeñas comarcas industriales y 5) pequeñas comarcas rurales.

Artikulu honek hausnarketa bat plazaratzen du berrikuntza-prozesuak aztertzeko lurralde-unitate egokiaren inguruan, eta maila anitzeko hurbilketa bat proposatzen du eta haren garapenean aurrera egiten du Euskal Autonomia Erkidegoan (EAE). Lan honen asmoa da berrikuntza-sistemen, aglomerazioko ekonomien eta ekintzailetzaren arteko erlazioen eremuko literatura enpiriko urriari ekarpenen bat egitea. Hiru kontzeptu horien inguruan, kluster azterketa bat egiteko 21 adierazle erabili dira, baina aurretik osagai nagusien azterketa egin da, eta emaitza hau izan du: EAEko 20 eskualdeak bost mota berezitan taldekatzen dituen tipologia bat: ekoizpen-egitura dibertsifikatuko metropoli-eskualdeak; industria-aglomerazio aurreratuak; portaera teknologiko ertaineko industria-aglomerazioak; industria-eskualde txikiak, eta landa-eskualde txikiak.

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Keywords: innovation systems, agglomeration economies, entrepreneurship regional science.

JEL classification: O31, D85, O18

1. INTRODUCTION

In a monographic issue on innovation systems, this chapter intends to introduce some questions about the territorial level significant to analyse such phenomena. By doing so, some specific challenges are defined for the counties of the Basque Autonomous Community.

The latest trends of thought confer a growing importance to the local scope in the analysis of competitiveness and innovation (Porter 2003). Although globalisation characterizes the new economy, the Innovation Systems literature emphasizes the importance of the territory. Initially, the focus of the analysis was placed on the national level (Freeman 1987, Lundvall 1992 and Nelson 1993). But gradually an increasing number of analysts (Cooke *et al.* 1997, Morgan 1997, Maskell and Malmberg 1999, Asheim and Gertler 2005, Tödtling and Trippl 2005) started to pay attention to the regional level in the study of the innovation processes.

Analysing regional level besides the national one could be considered as an advance in the understanding of the factors that condition the creation and diffusion of knowledge. But this might be not enough, as some authors have criticized the Regional Innovation Systems (RIS) literature for being highly unrealistic in treating regions as homogeneous entities (Balthelt 2003, MacKinnon *et al.* 2002, Muscio 2004).

* The support of Gobierno Vasco (through the Grant Program to support the activities of research teams from the Basque University system) is gratefully acknowledged. The authors would like also to thank Mikel Navarro and Juan José Gibaja (researchers of the Basque Institute of competitiveness) for their kind comments on this article. The remaining errors and omissions are, of course, entirely responsibility of the authors.

For instance, despite its small extension and population (7,200 km^2 and 2,1 million inhabitants), the Autonomous Community of the Basque Country (Basque Country, for short, hereafter), is a very heterogeneous geographical and economic reality. Navarro and Larrea (2007) have shown that the economic environment –and, therefore, the ability to generate and absorb knowledge- is very different in the 20 “comarcas” (counties, thereafter) as shown by the Basque Institute of Statistics. As Lundvall (2007) states, the innovation system literature should try to understand and grasp the diversity of the innovation and learning processes by means of cluster analysis and similar, rather than search for general rules. This paper aims to advance in this line, highlighting the need of going beyond the regional level in the analysis of the innovation processes. This could help contextualize the innovation policy, facilitate benchmarking analysis and support the setting up of innovation strategies at the county level. All this, coordinated with initiatives at regional, national and even supranational level, would mean taking steps towards a multilevel approach to innovation systems.

One of the reasons for the late development in the studies of local learning and innovative processes and economic development is the lack of appropriate indicators for that territorial level. The Basque Institute of Competitiveness has recently developed, in cooperation with Garapen, the Eskudal database, within the Depure project supported by the Basque Government, containing roughly 200 indicators of innovation, competitiveness and economic performance for the 250 municipalities and 20 counties of the Basque Country. In this study 21 variables have been chosen from that database, and then factorial and cluster analysis have been applied, in order to get a typology of counties that help to understand the different ways of innovation, agglomeration economies and entrepreneurship processes that take place in them. All with the goal of contributing to the knowledge about subregional processes that might -from a multilevel approach- help better understand innovation systems.

2. REGIONAL INNOVATION SYSTEMS AND AGGLOMERATION ECONOMIES

This section presents the main concepts that have been used to define a tipology of counties according to their innovative capabilities and then to select the appropiate indicators: the regional innovation systems, agglomeration economies and entrepreneurship and firm´s demography theories.

As competitiveness of the advanced countries has moved from depending on factors such as the availability of natural resources and low labour costs to depending on productivity achieved through innovation, the interest of economic analysis has been moving toward the study of the determinants of development, dissemination and use of innovations. While initially the emphasis was focused on the features of the innovation process that were specific to each industry and technology, soon the conceptual framework suggested that the rules were marked by the system of organizations and institutions that, located in a particular geographic area, influence the processes of learning and innovation (Morgan 1997 and 2004).

Even when initially the concept of innovation system was applied to the national level (Freeman, 1987, Lundvall 1992 and Nelson 1993) a growing interest in regional scope soon emerged, giving rise to the concept of Regional Innovation System (RIS) (Cooke 1992, Cooke and Morgan 1998, Maskell and Malmberg 1999, Asheim and Gertler 2005, Tödtling and Trippl 2005). As Doloreux and Parto (2004) suggest, the RIS literature was the fruit of two big schools of thought: the national innovation system and the regional science. The appearance and flourishing of the RIS literature was the result of the conviction that innovation is an interactive process, requiring intensive communication and collaboration between different actors (Lundvall 1992, Edquist, 2005) and that communication and collaboration requires proximity between agents, easier to achieve in the regional level than in the national one (Cooke and Morgan 1998).

Following Lundvall (1992), we understand the innovation system as consisting of an economic structure and the institutional set-up affecting innovation and learning. More precisely, Cooke (1998) distinguishes two subsystems: the knowledge generation and diffusion subsystem, which consists of the institutional sources of knowledge creation as well as the institutions responsible for training and the preparation of highly qualified labour power; and the knowledge application and exploitation subsystem, which subsumes productive systems, firms and organizations that develop and apply the scientific and technological output of the supply side in the creation and marketing of innovative products and processes. Asheim and Gertler (2005), in fewer words, define a regional innovation system as “the institutional infrastructure supporting innovation within the production structure of a region”. In short, the structure of production and the institutional set-up are two dimensions that, embodied in a territory, would determine their innovation behaviour and performance.

With regards to the institutional infrastructure supporting innovation, according to Tödtling and Trippl (2005) the most significant are the public research organizations, the educational organizations and the technology mediating organizations. Anyway, the relations developed between the different actors operating in the territory are as relevant as the existence of these organisations (Fritz, 2002).

Regional science is another stream of the economic literature dealing with the characteristics of the territory that pays increasing attention to the innovation processes that take place in it. One of the core concepts in regional science is agglomeration economies, which describes the benefits that firms obtain when locating near each other (Krugman 1991 and 1995).

Frenken *et al.* (2007) distinguish three kinds of external economies. They mention localization economies -available to all local firms within the same sector-; Jacobs externalities -available to all local firms stemming from a variety of sectors- and urbanization economies -available to all local firms irrespective of sector and arising from urban size and density- (see also Glaeser et al. 1992, Feldman and Audretsch 1999, Henderson 2005).

So according to these authors, the urban diversity is conducive to the generation of new ideas and provides the variety of experience that spurs innovation. The exchange of complementary knowledge across diverse firms and economic agents facilitates search and experimentation in innovation. A diversified production structure is therefore expected to increase the stock of knowledge available for the individual firm and give rise to “diversification” externalities. In contrast, the specialization hypothesis (Marshall-Arrow-Romer externalities) argues that knowledge tends to be industry-specific. Some studies (Glaeser et al. 1992; Feldman and Audretsch 1999) claim that diversity triumphs over specialization contexts, whereas others (Porter 2003, Ó hUallacháin and Leslei 2007) support the reverse.

Entrepreneurship and firms´ demography theories have tried also to connect their field with innovation (in Schumpeter’s theory, product innovations are usually the work of independent entrepreneurs, whereas process innovations are the routine results of large enterprises with large and specialized research laboratories) and more recently also with territory (Audretsch 1995; Acs and Audretsch 1990, Audretsch *et al*. 2008). Audretsch *et al*. (2008) have tried to integrate three bodies of research, namely, the regional innovation system, the regional science and the entrepreneurship and firm’s demography theory, into a single theory: the spatial lifecycle. Using an analogy related to the industry lifecycle model, they test the hypothesis that regions can be characterized as evolving over a predictable lifecycle. The model shows: (1) an initial entrepreneurial phase where Jacobs externalities and inter-industry start-ups prevail; (2) a routinized phase where innovation takes place within top-performing incumbents; (3) a second entrepreneurial phase characterized by Marshall-Arrow-Romer externalities, leading to intra-industry start-ups in niches; and (4) a second phase of routinization, in which no further innovation takes place, but is instead a phase of structural change. The contributions of entrepreneurship literature have also been used, together with the ones related to innovation systems and regional science to define the variables later used in the empirical analysis. Consequently, the different types of counties defined in Section 4 differ from each other, on the one hand, in economic and technologic output and, on the other hand, in how the local innovation system, agglomeration economies and entrepreneurship are conformed.

3. COUNTY LEVEL ANALYSIS, A STEP FORWARD TOWARDS A MULTILEVEL APPROACH IN THE BASQUE COUNTRY

Hommen and Doloreux (2005) argue that explanations based on only a single scale of analysis will be likely to prove inadequate. Following Brunnell and Coe (2001) they affirm that it has been strongly argued that there is a need for a qualitative shift away from work which focuses on particular scales as the focus for understanding innovation, towards that which gives more credence to relationships operating between and across different scales.

Lorenzen (2008) argues that innovation spaces are socially constructed through the generation of knowledge networks on a variety of scales. She also considers that the re-territorialization of the state leads to multiscalar governance, with institutions and policies related to knowledge production, diffusion and innovation on different spatial scales. She goes further, considering that many functions have become decentralized at subnational administrative and political levels, but these regions are not autonomous or crucial to knowledge generation, sharing and innovation. On the contrary, investments and policies of great importance to knowledge and innovation are still to be found at the national level of the state.

Asheim (2007) explains that the knowledge base and modes of innovation vary from one sector to another. More precisely, he distinguishes three different knowledge bases: analytical (or scientific basis), synthetic (based on engineering) and symbolic (basic creative), depending on the different combinations of codified and tacit knowledge, skills and abilities, organizations and institutions involved or required, and types of innovation. Isaksen (2008), after analyzing six local clusters in Norway, concludes that the relevance of international or local levels for learning and innovation is related to the type of knowledge base of the cluster. This way, firms in analytical knowledge based clusters frequently find their strategic customers, suppliers and knowledge providers, i.e. their innovating partners, on an international level. On the other hand, the clusters dominated by synthetic knowledge bases rely more on cluster upgrading mechanisms, such as local recruiting, local supplier base and local rivalry. These results are presented as coherent, for instance, with those by Gertler and Wolfe (2006).

The authors share the proposal of Lorenzen (2008) for a multiscalar governance approach, but do not discard the regional level as a relevant one for knowledge generation, sharing and innovation. In that sense, the approach proposed by Isaksen to understand the specificity of how different groups of firms learn to identify relevant levels for interaction fits better, as it does not discard any of the different levels a priori.

One of the main contributions of this article is to take a step towards a multilevel analysis of innovation processes in the Basque Country by complementing the research already developed on RIS at the regional level with a typology at county level.

As the empirical analysis in Section 4 will show, the Basque Country is not a homogeneous territorial unit regarding economic activity. Productive structure or science and technology infrastructure, among others, differ significantly from one county to another. That makes understanding subregional learning and innovation dynamics a key issue to get an insight into the regional system of innovation. Of course, the more we descend in the territorial level of analysis, the more problematic it becomes to consider this territorial level as a system, because it will lack more of the ideal components and relationships of an innovation system (Navarro and Larrea 2007). But, in contrast, taking into account the local level allows for a better characterization of the socio-economic characters of the territory (Muscio 2004), and it is at that level where most of the “local buzz” takes place (Bathelt, 2004).

Once the interest of analysing subregional territorial units has been presented, it is necessary to justify why the 20 counties defined by the Basque Institute of Statistics have been chosen as units of analysis. Doloreux (2002) says that regions can be (have been) defined either administratively or functionally –in the latter case as social construct or connectors that may facilitate certain processes scaled at the regional level-. Following the same reasoning, subregional levels can also be defined either administratively of functionally. The functional approach requires departing from the analysis of certain processes to later define the relevant territorial units for such processes. Defining a typology based on a variety of aspects such as the one presented here, requires using the same territorial unit to analyse every element and having it defined from the beginning. That is why the administrative delimitation has been considered as the most adequate for this case. Although different administrative delimitations exist for an intermediate level between the region and single municipalities in the Basque Country (statistically defined counties, functional areas), the availability of data makes the classification of Eustat the best option. Besides, it is important to note that the process followed to delimit counties was based, among others, on social and economic criteria. This way, although it is an administrative delimitation, it takes into consideration some functional aspects too.

Finally, it should also be considered that county development agencies, that are the main policy making entities at this intermediate level between municipalities and provinces, do not follow the administrative delimitation presented here. In some cases there is one agency in one county but quite often several agencies have been created in one statistically defined county.

4. A TYPOLOGY OF COUNTIES IN THE BASQUE COUNTRY BASED ON THEIR APPROACH TO INNOVATION

4.1. Previous research on typologies or territorial pattern of innovation

This article presents a typology of counties that builds on previous experiences in defining typologies: both for regions and for counties. From the two possible approaches for obtaining typologies of innovation (theoretical and empirical), this article deals with the latter and identifies patterns of innovation in the 20 counties of the Basque Country by using statistical analysis. In order to make the contribution of the article to the literature distinctive, it is convenient to review two kinds of attempts to tackle similar issues.

First of all, typologies of regional innovation systems developed in the European Union should be considered. The article by Navarro and Gibaja 2009 included in this monographic issue present a complete review of the empirical attempts to obtain typologies of innovation in the European regions. As these authors show most typologies are based on secondary data-sources and obtained by means of a cluster analysis. The number of variables considered and the number of groups obtained in the typologies varies in a wide range.

A typology closely related to the one developed in this article is the one obtained by a research team led by Navarro and Larrea (2007), for the 20 counties of the Basque Country. They first worked with 193 variables related to competitiveness, with which they created 31 synthetic indicators. The aforementioned synthetic indicators reflected economic performance, and competitiveness factors of the Porter' diamond model, but the study was not focused on innovation as this one is. Based on the 31 synthetic indicators, a factorial and two cluster analysis were carried out. As a result, the following groups of counties were identified: 3 counties specialized in agriculture and good economic performance, 11 industrial counties and 6 counties polarized by capitals of provinces.[1]

4.2. Data, sources and methodology of data analysis

According to the literature review 21 variables have been selected, most of them from the Eskudal database[2]. The indicators have been organized around three main concepts, the regional innovation system, the agglomeration economies and entrepreneurship and firm' demography theories. In the case of Regional Innovation Systems, the variables have been classified related to the knowledge application and exploitation subsystem (R1), the Knowledge generation and diffusion subsystem (R2) and other RIS elements included in a category named "other elements" (R3).

In the analysis of the agglomeration economies, variables have been classified into three groups: one related to economies of agglomeration in general (A1); the second to Jacobs externalities (A2); and the third, to MAR externalities (A3). Finally, variables related to entrepreneurship and innovation (E) have been considered. Table 1 presents a full description of all the indicators, summarizing the relationship of each variable with the above-mentioned concepts.

Several indicators have been used to proxy the knowledge application and exploitation subsystem (R1). The employment rate and other productive structure related indicators operates as "social filters" of a region and condition the regional ability to transform R&D into innovation and economic growth (Rodriguez-Pose 1999). These indicators have been widely used in previous studies (see Navarro and Gibaja 2009 for more details). Three additional variables have been used to proxy the commitment of a county's firms with innovative activities: R&D expenditure, the percentage of Enterprises enrolled in R&D activities, and Patents per 1000 inhabitants.

Universities and Technological infrastructure has been considered as a proxy for the knowledge generation and diffusion subsystem (Ecotec 2005, Muller and Nauwelaers 2005). Vocational training infrastructure -which measures the number of students enrolled in Vocational training schools located in a county- has been included in this group, as a proxy for the educational infrastructure of a county.

Four variables have been included in the "Other RIS element" group. The *per capita* GDP and the Population above 65 have been used as indicators of the degree of sophistication of the demand (Muller and Nauwelaers 2005, Arundel and Hollanders 2005). Moreover, the percentage of inhabitants born in the province has been considered as a proxy for the mobility of labour force based on the notion that knowledge spillovers are transmitted

[1] By going more deeply into the industrial counties, four subgroups were found: the counties with a favourable environment for technology and training and with institutions for collaboration; the counties lacking educational infrastructures; counties with a higher weight in agriculture and small foreign population; and counties with larger public sector.

[2] There are four new variables incorporated to our analysis (namely, the R&D expenditure as a percentage of the GDP the specialisation index, the number of inhabitant born in the province and number of high tech enterprises created in the last 6 years) that have required to collect data from other sources (from the Spanish Social Security service, from the Spanish institute of statistics and from the Basque Institute of Statistics). Moreover, several indicators have been updated (i.e. *per capita* income and GDP of the county)

Table 1

Indicators used for the elaboration of the typology of counties

Code	Indicator	Relationship with literature stream (1)	Method of calculation	Source	Year
CS3	Employment in medium-high manufacturing (% of total workforce)	R1	Population employed in high and medium-high tech / Total population employed (%)	INE	2001
C49	Employment in knowledge intensive industries (% of total workforce)	R1	Population employed in knowledge intensitive services / Total population employed (%)	INE	2001
CS2	Enterprises over 50 employees (% of total)	R1, E	Number of enterprises > 50 employees / Total enterprises (%)	Eustat	2005
NC0	R%D expenditure / GDP (%)	R1	R&D expenditure / GDP (%)	Eustat	2007
C42	Enterprises enrolled in R&D activities (% of total)	R1	Enterprises enrolled in R&D activities / Total enterprises	Eustat	2005
C43	Patents per 1000 inhabitant	R1	Patents issued 2000-2005 / Inhabitant 2004 (‰)	OPE	2000-2005
FS1	Universities	R2	Aggregation	Gobierno Vasco	2004
FS2	Technological infrastructure	R2	Saretek members + Knowledge intensive services NACE 72, 73, 74 (not included 74.5, 74.7) / Total enterprises (%)	Saretek; Eustat	2007 2004
F24	Vocational training (% of total population)	R2	Students enrolled in vocational training / Population (%)	Eustat	2005
D1	Per capita GDP	R3, A1	Automatic	Eustat	2005
D2	Population above 65 (% of total)	R3, A1	Population over 65 / Total population (%)	Eustat	2001
F16	Inhabitant born in the province (% of total)	R3, A1	Inhabitant born in the province / Inhabitant born in the municipaly (5)	INE	2006
F25	Population over 16 with tertiary education (% of total)	R3, A3	Population with tertiary education / Total population (%)	INE	2001
F45	Population density (inhabitant per km^2)	A1	Population / Extension	Eustat	2004
ND2	% GDP of the county	A1	GDP per capita × population county / GDP per capita × Population Basque Country (%)	Eustat	2005, 2006
IE	Specialisation index	A2	See (2+D19)	INSS	2005

.../...

.../...

E1	Employment in primary sector (%)	A2, R1	Employment in primary sectors × 100 / Total employment	INSS	2005
E2	Employment in manufacturing (%)	A2, R1	Employment in manufacturing × 100 / Total employment	INSS	2005
E3	Employment in services (%)	A3, R1	Employment in services × 100 / Total employment	INSS	2005
C45	High-tech establishments created in the last 6 years (% of total)	E	*High tech* enterprises created 1999-2005 / Total establishment 2005	Eustat	2000, 2005
CS1	Net rate of creation of companies	E	Total enterprises created (2000-2005) – Total enterprises destroyed (2000-2005) / Enterprises 2000 (%)	Eustat	2000-2005

Each code stands for:

R1: RIS: Knowledge application and exploitation subsystem
R2: RIS: Knowledge generation and diffusion subsystem
R3 RIS: Other RIS elements
A1: General agglomeration economies
A2: MAR externalities
A3: Jacobs externalities
E Entrepreneurship

Note (1):

Definition: Specialisation is measured according to the Balassa-Hoover index, which measures the ratio between the weight of an industry in a region and the weight of the same industry in the country:

$$BH_i = \frac{Y_{ij} / Y_j}{Y_i / Y}$$

where Yij is total employment of industry i in region j, Yj is total employment in region j of all industries, Yi is the national employment in industry i, and Y is the total national employment of all industries. A value of the index above 1 shows specialisation in an industry and a value below 1 shows lack of specialisation.

The average degree of specialisation in region j is measured by averaging the sum of the absolute deviations from 1 of the Balassa-Hoover indexes over all industries:

$$\sum_{I=1}^{N} |BH_i - 1| \Big/ N$$

where: BHi is the Balassa-Hoover index of industry i

Source: Taken from *OECD Regions at a glance 2007* through people (Feldman, 1999). And finally, the Population over 16 with tertiary education has been considered to proxy the knowledge and technological absorptive capacity of a county (Ecotec 2005, Hollander 2003, Bruijn and Lagendikjik 2005, Muller and Nauwelaers 2005, Navarro *et al.* 2008).

With respect to the agglomeration economies, Population density (Muller and Nauwelaers 2005, Martinez Pellitero 2007, Navarro *et al.* 2008) and the percentage of GDP of the region can be regarded as a proxy for the economies of agglomeration in general. Nevertheless, the above mentioned per capita GDP, population above 65 and inhabitants born in the province would also serve to have a deeper insight into this aspect.

A specialisation index -measured according to the Basassa-Hoover index- has also been considered, which measures the ratio between the weight of an industry in a county and the weight of the same industry in the region. Therefore the specialisation index is used to describe the degree of specialization of the economic structure of a county and could indicate the existence of MAR externalities (Ó hUallacháin and Leslei 2007). Moreover, we have considered the employment in services and the population over 16 with tertiary education as proxy for the existence of Jacobs externalities, since these variables have been broadly used in those studies trying to link urban zones with Jacobs externalities (Glaeser *et al*. 1992, Henderson 2005, Feldman and Audrestch 1999, Duranton and Puga 2001, Audretsch *et al*. 2008).

Moreover, when a territory presents high values on the specialisation index, and therefore is highly concentrated on specific activities or sectors, it would be used to proxy MAR externalities

Finally, entrepreneurship has been proxied on the basis of the number of high-tech establishments created in the last 6 years and the net rate of creation of new establishments.

The availability of such a selection of indicators for the 20 counties has made it possible to obtain a typology of counties according to their innovation pattern. In order to achieve such typology, multivariate analysis similar to those applied by Claryse and Muldur (1999), Bruijn and Lagendijk (2005); Navarro *et al.* (2008), Muller and Nauwelaers (2005); and Martinez-Pellitero (2007) has been used:

— A principal components analysis on original variables which seeks an initial exploratory analysis of the characteristics of the different counties performed using SPAD v 5.5.

— An automatic classification or cluster analysis with the aim of defining a typology of counties grouping them according to the degree of similarity in the values of the indicators selected.

4.3. **An innovation typology for the 20 counties of the Basque Country**

Before dealing with the results of the multivariate analysis, and in order to understand its results, it is convenient to contextualize by saying that the Basque Country is characterized by a polycentric urban system with three main cities, capitals of the provinces that make up the autonomous community, located no more than a 100km distance from each other: Bilbao (350.000 inhabitants), San Sebastian

Table 2

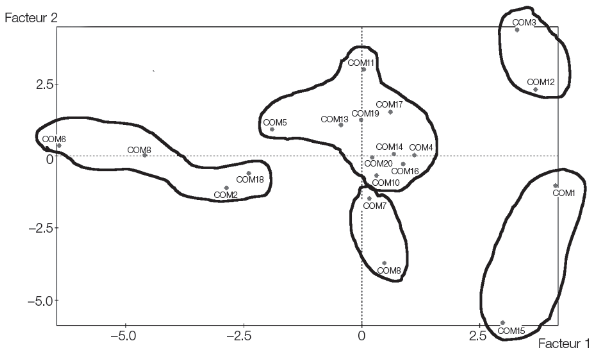
Original data

Group of the Typology	Code of the county	Name of the county	Employment in medium -high and high- tech manufacturing (% of total workforce)	Employment in knowledge intensive industries (% of workforce)	Enterprises over 50 employees (%)	R&D expenditure/GDP (%)	Enterprises enrolled in R&D activities (% of total)	Patents per 1000 inhabitant	Higher Education Centres	Technological infraestructure	Vocational training (%)	Per capita GDP (€)	Population above 65 years (%)	Inhabitant borned in the province (%)	Population over 16 years with tertiary education (% of total)	Population density (inhab. per km^2)	% of the Basque GDP	Specialisation index	Employment in primary sector (%)	Employment in manufacturing (%)	Employment in services (%)	High-tech enterprises created in the last 6 years (‰)	Net rate of creation of companies (%)
G1	COM6	Gran Bilbao	5,6	32,7	1,1	1,5	0,5	0,3	20,0	16,7	1,5	25619	19,2	67,3	18,0	2359,5	38,5	0,4	0,5	13,9	74,0	0,9	1,5
	COM9	Donostialdea	6,9	31,7	1,0	2,1	0,5	0,4	14,0	17,4	1,4	26391	18,2	71,0	18,5	1043,5	14,4	0,4	0,7	13,8	75,4	1,0	3,2
	COM18	Plentzia-Mungia	9,2	32,5	1,2	1,0	0,8	0,3	0,0	17,6	0,4	20080	14,1	81,9	23,5	225,8	1,8	0,8	3,8	32,2	54,2	0,9	6,7
	COM2	Llanada Alavesa	12,2	26,4	1,6	1,5	0,8	0,5	10,0	17,0	1,6	29874	15,6	56,5	17,2	305,9	12,6	0,6	0,8	24,4	65,1	1,0	2,2
G2	COM8	Alto Deba	29,2	18,9	2,3	4,4	1,8	1,2	4,0	10,0	1,9	36384	18,7	68,7	15,0	178,9	3,8	1,0	0,9	51,6	40,5	1,2	0,9
	COM7	Bajo Deba	25,1	18,7	1,5	2,6	1,5	1,1	1,0	10,6	2,1	27013	21,1	69,9	12,3	296,5	2,5	0,9	1,2	43,4	48,4	1,1	-1,2
G3	COM5	Bajo Bidasoa	5,3	23,3	0,8	0,4	0,3	0,8	0,0	11,1	1,5	21521	16,2	66,6	14,1	1053,7	2,8	0,8	1,3	18,7	69,1	1,1	4,1
	COM10	Duranguesado	16,6	19,4	1,8	1,8	1,0	0,3	0,0	9,6	0,9	33436	16,3	64,6	12,4	292,4	5,5	0,7	1,6	41,3	48,8	0,7	3,5
	COM20	Urola Costa	13,6	17,8	1,2	1,0	0,8	0,6	0,0	11,2	0,9	27218	15,9	83,5	13,8	210,1	3,3	0,9	2,9	44,2	40,7	0,5	4,7
	COM16	Cantábrica Alavesa	7,3	19,8	1,7	0,7	0,7	0,3	0,0	9,5	1,9	31801	17,6	41,9	12,5	100,2	1,9	1,3	3,2	53,9	32,9	0,0	1,4
	COM14	Goierri	20,1	18,3	1,3	2,0	0,6	0,3	0,0	8,4	1,1	30846	18,9	74,9	12,4	183,4	3,4	0,9	1,9	50,5	39,1	0,8	0,8
	COM4	Arratia-Nervión	13,7	21,0	1,3	1,2	1,0	0,8	0,0	7,1	0,9	29135	19,6	78,3	12,4	54,8	1,1	1,0	4,0	49,0	36,0	0,6	3,2
	COM19	Tolosaldea	11,7	19,8	1,0	0,4	0,6	0,3	0,0	8,7	1,6	25571	17,2	84,6	11,8	137,6	2,0	1,0	3,1	33,4	46,2	0,5	-0,2
	COM17	Markina-Ondarroa	11,4	17,7	0,8	1,4	0,8	0,5	0,0	7,5	1,7	21656	20,7	82,7	12,7	127,0	1,0	1,9	15,6	33,3	40,7	0,0	-3,5
	COM13	Gernika-Bermeo	5,9	26,8	1,1	1,8	0,6	0,4	0,0	10,5	0,5	21663	21,1	84,3	15,9	161,3	1,7	1,4	10,5	26,9	50,0	1,9	3,8
	COM11	Encartaciones	5,0	21,2	0,8	0,0	0,1	0,1	0,0	8,2	0,7	21696	20,8	78,2	10,0	70,4	1,1	1,0	9,5	14,6	58,3	0,5	2,7
G4	COM15	Estribaciones del Gorbea	13,5	23,4	3,0	1,4	3,6	1,1	0,0	11,2	1,2	57558	15,7	64,6	18,6	19,0	0,8	4,5	3,4	56,4	30,3	1,3	15,6
	COM1	Valles Alaveses	12,1	15,5	2,7	0,4	1,1	0,0	0,0	7,2	0,0	48140	23,1	58,6	11,4	8,1	0,5	2,6	10,0	65,4	19,4	2,8	9,3
G5	COM3	Montaña Alavesa	7,0	14,8	0,8	0,9	0,0	0,0	0,0	5,7	0,0	28836	27,6	75,6	8,4	6,6	0,2	1,9	57,8	20,6	9,4	0,0	4,6
	COM12	Rioja Alavesa	3,3	15,1	1,1	0,6	1,2	0,8	0,0	5,2	0,3	61428	21,3	54,6	10,2	33,8	1,2	1,9	70,0	9,0	14,2	0,0	1,2
Total			9,5	27,8	1,2	1,7	0,6	0,4	49,0	14,8	1,4	27753	18,2	68,4	16,6	299,8	100,0	–	1,7	22,9	64,9	0,9	2,2

Source: Made by the authors.

Figure 1

Location of the Basque counties regarding the two first principal components



The following paragraphs give a more detailed description of these groups.

Source: Made by the authors.

(180.000) and Vitoria (230.000). Whereas most of the population and economic activity of the provinces of Bizkaia and Álava are concentrated in the counties corresponding to their capital (Gran Bilbao and Llanada Alavesa), the population and economic activity of Gipuzkoa is more homogeneously distributed throughout the territory and the weight of the capital's county (Donostialdea) is not so big (see table 2).

Regarding the principal components analysis with the 20 variables, the histogram of the eigenvalues of the factors suggest retaining three factors that explain roughly the 70% of the variance. The positions of the variables regarding the selected three principal components are shown in Figure 1.

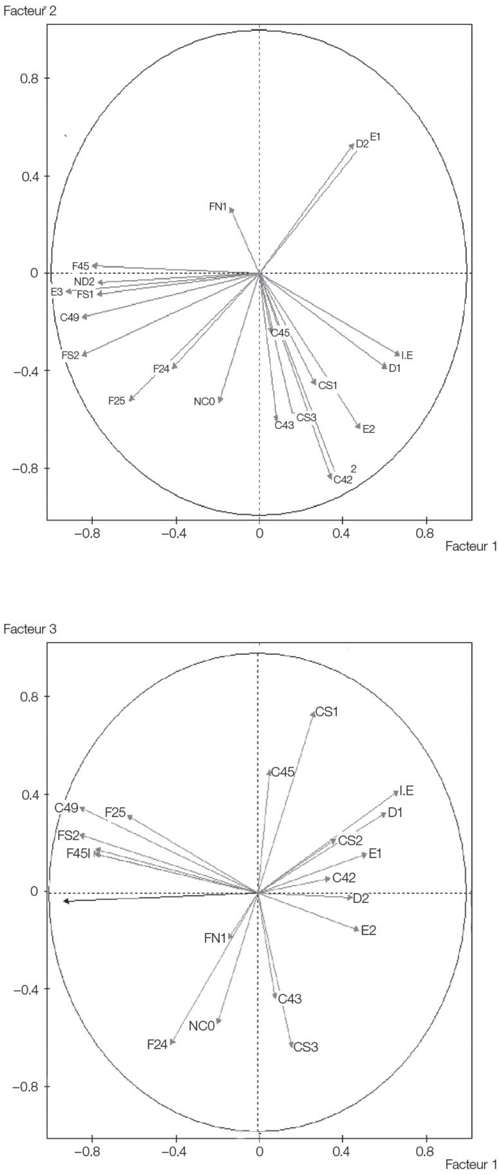
— The first principal component, measured in the horizontal axis, explains 32% of the variance and represents, to a great extent, the ***Influence of urban agglomerations,*** as it is shown by the coordinates of *Employment in services (%)*, *Employment in knowledge intensive industries (%)*, *Technological infrastructure*, *Population density and Universities.*

— The second principal component, measured in the vertical axis, explains 22% of the variance and represents the ***Technological capacity of the industry,*** as it is shown by the coordinates of *Enterprises enrolled in R&D activities, Enterprises over 50 employees, % Employment in manufacturing, Patents per 1000 inhabitant and Employment in medium-high and high technology manufacturing.*

— In addition to those explained above, the third principal component

Figure 2

Results of the principal components analysis for the Basque Country-20 counties



Source: Made by the authors.

explains 13% and represents the **Entrepreneurial activity of a county**, as it is shown by the coordinate of *Net rate of creation of companies*.

In Figure 1 the position of the 20 counties regarding the two principal components is displayed. According to the values reached by the variables included in the study, five groups of counties with a different innovation pattern have been identified. A first group, formed by the three capitals and its catchment area, which lies to the left of the first axis, related to the existence of Jacobs externalities. On the right side there are two groups of counties of the province of Alava: in the lower part, two counties with high innovative capacity despite their late industrialization; and in the upper position two small rural counties. Finally, the majority of counties tend to be located around the centre of coordinates, where two counties outstand by their innovative capacity, forming another group.

Group 1: Capital-urban zones with diverse industry mix[3]

The counties included in this first group are those corresponding to the three capital cities and influence area in the case of Bilbao. They concentrate 67% of GDP and 69% of the total population in the Basque Country. Similar categories have been defined in other studies (Navarro *et al*. 2008, Audrestch *et al*. 2008).

They have a diversified economic structure (as indicated by the lower value in the specialization index), high employment in services and important presence of knowledge intensive industries. A large part of the research infrastructure of the Basque Country and most universities are located in these counties. Accordingly, they show an important R+D expenditure. In other words, they present a conducive environment for the generation of analytical knowledge, which comes from the application of scientific methods and principles. Moreover these are counties with a favourable context for Jacobs externalities.

High population density and a skilled workforce can facilitate the materialization of those externalities and these can help the creation of new firms. This occurs in terms of high-tech firms created in the last six years, but not related to general entrepreneurial activity.

Group 2: Advanced industrial agglomerations

This second group is made up of the counties of Alto Deba and Bajo Deba, representing 6.4% of Basque GDP and 5.4% of population.

These regions are characterized by a relatively high presence of manufacturing industries of high and medium high-technology. Technological development of these counties is based on a high commitment to industrial R&D expenditure, helped by its larger than average firm size. There is also a technology centre in each of the counties of this group. Moreover, the Alto Deba is the base of a small university, created by the a group of cooperative firms (the MCC group), very connected to the industry world, which can be considered an exception to the prevailing rule that university centres are based in capitals in Spain. It shows a relatively high production of patents per capita, which gives the area

[3] The counties in this group are: Llanada Alavesa, Gran Bilbao, Plentzia Mungia and Donostialdea.

an outstanding position on the generation and explotation of innovation. The close connection of the educational system to the industry is reinforced by the existence of a strong vocational training infrastructure in the area.

However, the net rate of business creation is small -or even negative in Bajo Deba-, though paradoxically the percentage of high-tech created is relatively high.

In contrast to Jacobs externalities observed in the first group, the characterization described above suggests the existence of MAR type externalities in this group, resulting from the development of a skilled workforce, suppliers and specialized infrastructure and spillover of knowledge coming from the concentration of activities in the territory that favours the transmission of existing tacit knowledge.

Group 3: Industrial agglomerations with average technological performance[4]

This third group is made up of ten counties representing roughly 23,6% of Basque GDP and population, most of them are in the provinces of Bizkaia and Gipuzkoa. While it is a group of counties characterized by average values of the Basque Country, noteworthy differences are observed in relation to certain variables. For example, the population born in the province is higher than the average for the Basque Country, indicative of a more endogenous growth and less mobility. They are manufacturing counties, with diverse levels of technology. The percentage of companies engaged in R&D activities is in general higher in this group than in the group of capitals, but at a significant distance from the two counties in Group 2. Additionally, businesses have a weaker support of technology infrastructure. Finally, in terms of entrepreneurial activity, we see a very large diversity of behaviour: while in some counties industrial tissue is destroyed, in others it is created. In terms of creation, they do not seem to be attracting high-technology companies.

Group 4: Small industrial counties[5]

Two small industrial counties of Alava are embodied in this group which account for 1.36% of GDP and less than 1% of population of the Basque Country. They show a high entrepreneurial dynamism (reflected in its high net rate of business creation), although its small size prevents a significant impact in the Basque Country as a whole. They are extremely specialized manufacturing counties. Their reduced size, combined with their capacity to attract a dozen manufacturing enterprises with over 50 employees, R&D activities and patents have allowed Estribaciones del Gorbea to obtain a good performance in the variables related to innovation. Besides, all of these have been translated into a high *per capita* income.

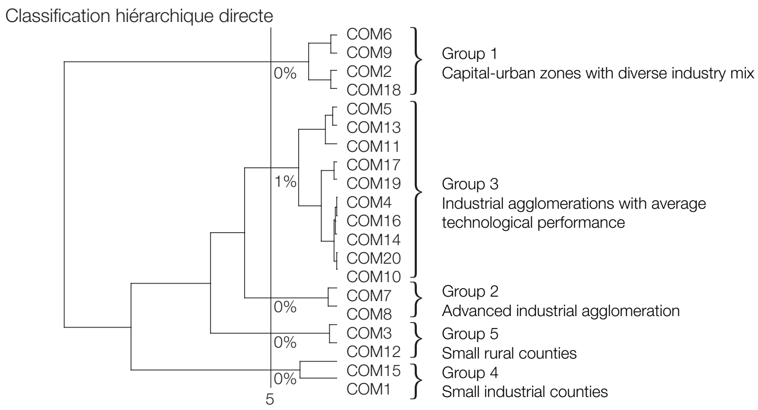
These counties are a good illustration of the idea that a small territory, even having weak scientific and technological infrastructures, can overcome that

[4] The counties in this group are: Duranguesado, Urola Costa, Cantábrica Alavesa, Goierri, Arratia-Nervión, Tolosaldea, Markina-Ondarroa, Gernika Bermeo, and Encartaciones. Bajo Bidasoa has been included in this group but shows a mixed profile, having relevant elements that it shares with the ones classified as capital-urban zones.

[5] The counties in this group are: Valles Alaveses and Estribaciones del Gorbea.

Figure 3

Dendogram



Source: Made by the authors.

disadvantage by developing connections with other territories (see Lagendijk and Lorentzen 2006).

Group 5: Small rural counties[6]

Two small rural counties of Alava configure this group with 1.24 of GDP and less than 1% of the population of the Basque Country. They have a more aged population than average and therefore a lower degree of sophistication of existing demand. Although being basically rural, one of them, Rioja Alavesa has reached the second highest *per capita* income among the Basque counties, thanks to its favourable specialization in high quality and branding wine, supported by modern and advances production facilites.

[6] The counties in this group are: Montaña Alavesa and Rioja Alavesa.

5. **CONCLUSIONS**

The article aimed at reflecting on the right territorial unit to analyze innovation processes, proposing a multilevel approach and taking a step towards developing it in the context of the Basque Country. Specifically, a typology of counties has been defined related to innovation which helps understand the multilevel approach from a regional perspective downwards. To further develop such approach, research on the incidence of supraregional elements on the innovation system of the Basque Country should be carried out.

The results obtained -in terms of diversity of the counties related to their ability to generate and absorb knowledge, and transform R&D into innovation and economic growth- confirm the interest of this focus on the subregional level. So it seems that it makes sense to adapt policies at county level that, coordinated with other broader regional measures, would strengthen local development.

In addition, this research will contribute to the relatively scarce empirical literature on the study of the interrelations between innovation systems, agglomerations and entrepreneurial activity. Connected to these three concepts 21 indicators have allowed the carrying out a cluster analysis following an initial principal components analysis with the results of a typology that group the 20 Basque counties into 5 different classes: 1) capital-urban zones with diverse industry mix; 2) advanced industrial agglomerations; 3) industrial agglomerations with average technological performance 4) small industrial counties and 5) small rural counties.

The empirical results differentiate urban, rural and industrial counties which present a different behaviour in terms of innovation. Capital-urban areas concentrate most of the elements of the knowledge creation and diffusion subsystem. But knowledge creation in these areas is not based on the expected technological activities, as evidenced by the apparent low scores in the percentage of companies enrolled in R&D activities or number of patents issued. Some evidence of inter-industry start-ups prevalence is detected in these areas, which fits expectations derived from literature on cities.

Size is a critical issue related to agglomeration economies, and one of the main challenges that these counties are facing is that the Basque capitals only have a minor position in the European urban system due to their small critical mass among city-regions. Related to this, Meijer *et al*. (2008) recommend the three cities should work as a net looking for economies of scale and bringing about complementarities.

In industrial counties different profiles have been detected related to innovation, which presents possibilities for bench marking between them, always considering that each county must have an strategy adapted to their specific characteristics and no recipes can be found for local development.

The challenge for the counties of Alto Deba and Bajo Deba should be to reinforce their actual strengths, improving interaction between enterprises and the technological infrastructure. This is a hard challenge considering that not being a capital city and having a relatively small size might have a negative incidence to develop such infrastructure. Low dynamisms might also be a handicap for keeping competitiveness in the future.

The economic and technological development of the rest of industrial counties included in group 3 should be rooted in boosting their absorptive and knowledge creation capability. They have limited critical size to develop innovation infrastructure such as universities or technology centres, so cooperation strategies should be sought to help firms located in them use infrastructure in other counties. As Lorentzen (2005) states, the core of the process of innovation in a competitive economy is the search for knowledge by individual firms, this knowledge is seldom in the county, but there might be mechanisms at county level that facilitate access to it.

One of the results obtained that reinforce the idea of heterogeneity at subregional level is the persistence of rural counties, one of them with very good economic performance due to a globally competitive industry around the primary sector. The challenge for these counties should be to create opportunities to retain young people. It is necessary to slow down the decline of the rural population, incorporating young population through the creation of a favourable environments and future prospects for the primary sector, connecting it and creating synergies with other activities (i.e. tourism, art and so on).

The final conclusion after analysing the four different types of counties related to innovation is that -as Tödtling and Tripple (2005) say- “One size does not fit all” and we need further research to understand which the relevant territorial unit is in every case.

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