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Innovation Gaps and Intermediaries in Regional Innovation Systems

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Title: Innovation gaps and intermediaries in Regional Innovation Systems

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Abstract

Intra- and inter-firm innovation gaps (i.e. *managerial gaps*, *openness* and *learning gaps*, *technological gaps* or *financial gaps*) and other broader systemic problems may produce ineffective regional innovation systems. These innovation gaps need to be solved to generate a stronger impetus for both business and institutional innovation. This dissertation focuses on the role of "intermediaries" as agents or organizations that help bridge these gaps. A number of developments are presented. First, intermediaries are identified and categorized according to the specific innovation gaps they tap into, while also including them as a component in a novel system. Second, sets of quantitative variables are operationalized and multivariate techniques are applied that permit novel assessments. The analysis is rooted in an ad hoc utilization of data gathered from various surveys conducted by the Spanish Official Statistical Institute (INE) and the Spanish Venture Capital Association (ASCRI). Third, the methodology produces typologies that sort Spanish regions according to the presence or absence of intermediaries who are tapping into the gaps of interest. This can also be used to set up more effective innovation policies. All in all, the study supports the main hypothesis of this dissertation, namely that *dense intermediary components predict well-integrated (Spanish*) *regional innovation systems (RISs)*.

JEL Classification : O18, R15, R50, R58

Keywords: regions, innovation systems, innovation gaps, intermediaries, Spain, Multiple Factor Analysis

Contents

1. Innovation gaps

The main objective of this contribution is to review and evaluate a number of innovation gaps and their connection with specific categories and the diversity of intermediaries. The aim is also to identify the cohesion and effective functioning of regional innovation systems (RISs) based on the proactive role played by such organizations, and then to assemble different typologies (or even trajectories) of RISs in the context of Spain. The innovation gaps of interest are the following:

Gap 1: *Managerial gaps* originate as an after-effect of the lack of, or poorly developed, management capabilities of private firms when starting innovation processes (Bessant and Rush, 1995; Nauwelaers and Wintjes, 1999; Alberdi et al., 2014). These processes will not be successful or long-lasting if firms do not have the required competences (i.e. marketing, organizational, strategy, distribution, commercial, etc.). We evaluate to what extent these capabilities are present in Spanish *exploitation subsystems* (i.e. mainly composed of firms, especially where they display clustering tendencies).

Gap 2: *Openness and learning gaps* occur when firms lack new external *antennas* or networks, which means that firms that benefit from the position of a favored network are likely to perform better because of their better access to novel information and knowledge (Burt, 1992; Hargadon, 1998; Alberdi et al., 2014). Consequently, to interpret the density of the Spanish exploitation subsystems, our study focuses on the evaluation of the linkages that firms have.

Gap 3: The *technological gap* could be described as the lack of technological capabilities of private companies (Nauwelaers and Wintjes, 1999; Parrilli et al., 2010; Alberdi et al., 2014). These gaps arise due to the disparity in goals and performance measures between private companies and universities, technology centers, and other organizations that occur in the *exploration component*.

Gap 4: Lastly, there is a *financial gap* when the *regional policy* component *(*i.e. *regional agencies)* has not developed the tools to help firms to overcome the lack of available finance supporting their innovation (Parrilli et al., 2010; Alberdi et al., 2014). Our evaluation focuses on understanding whether regional policies have participated in financial markets and settled the means necessary for the creation of alternative tools (i.e. venture capitalists).

2. Intermediary organizations: beyond transfer

These innovation gaps may hinder regional innovation. Therefore they become a field of opportunity for *intermediary organizations*[1]. However, intermediaries need to adapt from working in a *narrow market* to working in a *wider system* service-provision scheme. Helping firms to overcome the gaps requires managing knowledge flows not only through research and education, but also by creating industry-industry linkages or even linkages among industrial and government sectors. The creation of these linkages turn straightforward intermediation into an increasingly multilateral and dynamic function (Howells, 2006; Nauwelaers, 2011). However, adaptation is not an easy process, and consequently the role of intermediaries has not generally been theoretically well grounded. Some simplistic assumptions and umbrella definitions remain.

There is an urgent need to identify, define and assess the performance of intermediaries and their influence on firms' competitiveness, which calls for academic consensus. In this regard, the aim of the present dissertation is to make the following contributions: First, it provides the frameworks to facilitate the categorization and assessment of a system of intermediary organizations. Second, it provides a sufficient number of indicators to facilitate the evaluation of innovation gaps and intermediary categories. Third, it categorizes regions based on the presence or absence of intermediary categories when investigating innovation gaps, based on the assumption that they support system integration (i.e. lack of gaps) and its effective functioning.

Table 1 presents a novel categorization of intermediary organizations to simply and precisely identify their profiles in RISs. It introduces four complementary categories. Our scheme is based on previous research in the field, and we claim that in fact these categories consist of specific gaps and create *pairs*. Therefore the table establishes the predominant profiles that span specific gaps according to their knowledge base and specialization. It also presents the system components (i.e. the exploration and exploitation components) where innovation gaps and intermediaries meet in a logical and systematic way.

Secondly, building on previous studies (Susiluoto, 2003; Iammarino, 2005; Navarro and Gibaja, 2009; Chaminade et al., 2012), this dissertation provides two sets of indicators that facilitate the evaluation of innovation gaps, and more importantly, a beta approximation to evaluate the

[1] *The literature has grouped these organizations as: third parties, knowledge brokers, intermediate organizations, innovation brokers, innovation intermediaries, intermediate agents, intermediary agencies, catalysts, intermediate institutions, bridging institutions and networking partners, to name some.*

performance of intermediaries. The data we gathered for the empirical analysis is based on ad hoc exploitations sourced from various studies conducted by the Spanish Official Statistical Institute (INE) and the Spanish Venture Capital Association (ASCRI). Our data is gathered in two matrices: the rows represent regions in Spain and the columns represent eight separate sets of continuous variables grouped under the names of Cat1, Cat2, Cat3, Cat4 and Gap1, Gap2, Gap3, Gap4.

Thirdly, Table 1 allows a novel empirical assessment of the activity of a number of categories of intermediaries in Spanish regions. The assessment is, to the best of our knowledge, a pioneering practice that provides information about the activity performed by these intermediaries and their relation to the absence or presence of innovation gaps in RISs.

Table 1: Categorization of intermediary organizations

Cat.	Gap	Description of the gap	Components involved	Predominant profile	Empirical evidence
Cat. 1	Managerial gap	Gap 1: Lack of or poorly developed management capabilities of private firms (Bessant & Rush, 1995; Nauwelaers & Wintjes, 1999).	Knowledge exploitation component	Knowledge-Intensive Business Service Organizations (KIBS)	Bessant and Rush 1995; Nauwelaers and Wintjes, 1999; Alberdi et al., 2014
Cat. 2	Openness and learning gap	Gap 2: Lack of antennas to the outside (Burt, 1992; Nauwelaers & Wintjes, 1999).			Burt, 1992; Hargadon, 1998; Alberdi et al., 2014
Cat. 3	Technologi-cal gap	Gap 3: Lack of technological capabilities (Nauwelaers & Wintjes, 1999; Parrilli *et al.,* 2010).	Knowledge exploration and knowledge exploitation components	TTAs, technical advisory groups, business and trade associations.	Nauwelaers and Wintjes, 1999; Parrilli et al., 2010; Alberdi et al., 2014
Cat. 4	Financial gap	Gap 4:Lack of financial capabilities (Parrilli et al., 2010; Alberdi et al., 2014).	Policy and knowledge exploitation components	Venture capitalists, banks, business angels.	Parrilli et al., 2010; Alberdi et al., 2014

In brief, category 1 (Cat. 1 in Table 1) assesses the existence of Knowledge-Intensive Business Service (KIBS), which helps companies to improve their *managerial resources* (Bessant and Rush, 1995). Category 2 assesses the existence of KIBS companies, which allows firms to learn from others and develop antennas (Burt, 1992; Hargadon, 1998). Category 3 determines the existence of technology transfer agencies, technical advisory groups, and business and trade associations, helping firms to incorporate technological options and adapt state-of-the-art technology to their

own situation (Nauwelaers, 1999; Parrilli et al., 2010). Finally, category 4 assesses the existence of venture capitalists, banks or business angels, helping firms to overcome financial difficulties (Parrilli et al., 2010; Alberdi et al., 2014).

In addition, we have introduced a second main contribution of this dissertation. Figure 1 locates the gaps in or between the components where they are arise. Accordingly, intermediary categories are co-located in or between the components where their activity is developed. A new *intermediary component* is also presented, which aggregates the intermediary categories of interest. A new system is thereby produced, which highlights the importance of their specific role. In addition, a novel system of intermediary organizations could also allow the coordination and evaluation of their profiles and missions over time and space. Figure 1 makes it easier to understand and increases the possibilities of exploring the performance of RISs by setting appropriate boundaries across categories of intermediaries and innovation gaps and the components and agents they liaise with.

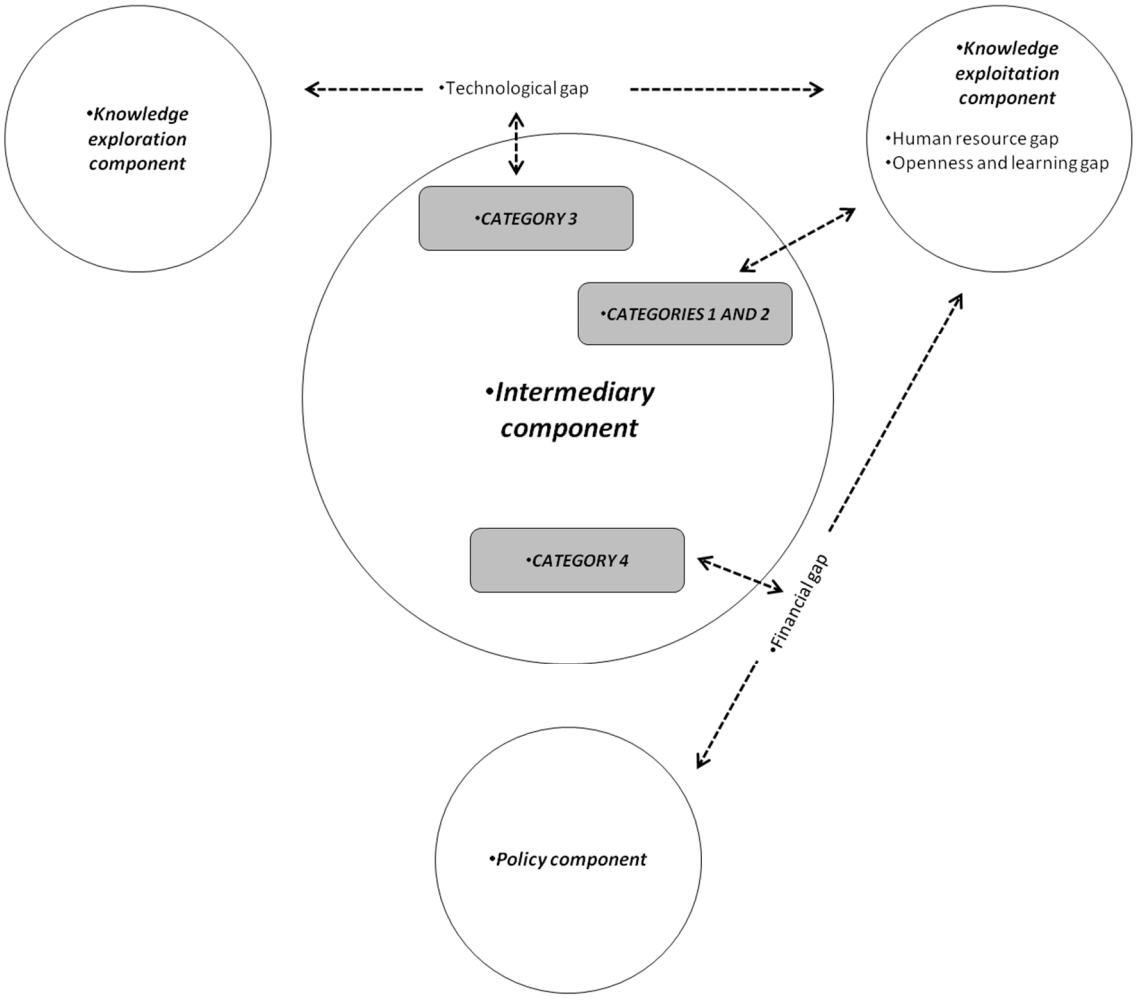

Figure 1: Categories of intermediaries along with innovation gaps and the fundamental components of RISs

These novelties permit simpler classification and assessments along with better communication between complementary schools of thought that specialize in innovation gaps and categories of intermediaries. However, this view can be completed with important interactions *between and in* other components which, up to this point, have been overlooked by both the literature and policy makers. This brings to the fore a crucial concern of this dissertation. A fundamental problem is the excessive path-dependent foci of both international (UNU-MERIT, 2009) and national (Spanish) (INE) statistics on both *firms* and their *technological capabilities* to explain regional competition. Most indicators are based on a dichotomous firm-based *input-output* perspective which limits systemic observation. As a consequence, policy designs will always be limited to available data, thus leveraging a very narrow and biased approximation of the real dynamics of a given RIS.

3. Methodology

Regarding methodology, Multiple Factor Analysis (MFA) (Adbi et al., 2013) allows the integration of heterogeneous groups of variables (intermediary categories and innovation gaps) which describe the same observations (Spanish regions). We chose this technique because it is tailored to handle multiple data tables that measure sets of variables collected on the same observations. It provides each data table with a set of partial scores for the observations that reflect their specific viewpoint, and thus gives an integrated image of the observations as well as the relation among the groups of variables (Navarro and Gibaja, 2009; Alberdi et al., 2014). Secondly, we completed our study by performing a cluster analysis of the results of the MFA. Cluster analysis is the grouping of a set of objects in such a way that those in the same group (called a cluster) have more similarities to each other than to objects in other clusters. This analysis will therefore help us to classify regions into homogeneous groups. In terms of data analysis, our outputs are derived from an analysis carried out using R (R Development Core Team, 2011) and the FactoMineR package (Lê et al., 2008)

The empirical results present two complementary typologies for Spanish regions. The first categorizes regions according to their integration level. The second differentiates among four groups according to the categories of intermediaries. After these analyses were completed, we explored any existing relationship among the outputs. This called into question the potential relationship between the density of *intermediary components* and the level of integration of Spanish regions as multi-operationalized in both data sets. Building on complementary analytical techniques, we accepted the hypothesis of this dissertation, which states that ***dense intermediary components predict well-integrated (Spanish) RISs***.

4. Main results

The results of the study are output in the creation of four complementary groups of regions. This information is summed up in the following groups:

Group 1. Industry-oriented integrated RISs

Navarre and the Basque Country comprise the first group of regions output by the analysis. They are the most integrated regions according to the indicators we employed in the analysis. The comparative development of the managerial capabilities of their firms and their intensive participation in networks are important strengths of their economies. This statement is supported by their higher R&D expenditures and the presence of financial support to spur innovation projects, which translate into habitual collaborative practices between universities, research centers and their medium and high-tech firms and industries.

Group 2. Service-oriented integrated RISs

Madrid and Catalonia comprise the second group of regions output by the analysis. These regions specialize in service industries and have a concentration of important high-tech, consultancy and financial KIBS organizations. Perhaps due to their service specialization, the regions are less outstanding with regard to collaborative projects between universities, research centers and private organizations. Their *intermediary components* also reveal good practices and high network densities.

Group 3. Moderately integrated RISs

La Rioja and Aragon comprise the third group of regions fed back by the analysis. Paradoxically, according to the indicators employed in our assessment, the *intermediary components* of these regions perform well and reveal good practices and high network densities. However, although intermediary organizations are present, perhaps a strategy to improve the efficiency of the system itself could be lacking.

Group 4. Disintegrated RISs

The last group comprises the rest of the Spanish regions: the Balearic Islands, Canary Islands, Andalusia, Castille La Mancha, Murcia, Extremadura, Castille Leon, Valencia, Cantabria and Galicia. Due to their lack of integration, in our estimation the RISs of these territories are at a very early stage or just do not exist. Consequently, the challenge faced by *intermediary components* is even greater than that of the rest of the regions. In this regard, we may observe

two different scenarios. First, communities such as Cantabria, Galicia, Castille Leon, Valencia and Asturias comprise a first subgroup with moderately active *intermediary components.* Second, the remaining regions could lack the presence of intermediary organizations. Consequently, policy implications are dissimilar. The first subgroup demands a strategy that could drive *intermediary components* to activate networks with special attention to the individual visions and strategies of their RISs. Conversely, the second subgroup could demand that policy intervention should aim at the creation of a well-integrated network of intermediary organizations.

5. Further research

This dissertation ultimately suggests three main directions for further research. The first could be practical and straightforward: the *partial analyses* of the dissertation leave room to elaborate on specific and focused policy recommendations regarding individual needs and development possibilities of regions. The second direction would elaborate on evolutionary system innovation indicators that could facilitate further steps towards wider and more enlightened assessments over a wider range of system problems, i.e. (a) organizational thinness, (b) lock-in, or (c) fragmentation problems. This direction would require intensive investment in the design of novel variables dedicated to new focal organizations, such as TTAs, university liaison offices, business advisory bodies, technology or science parks, territorial agencies of cluster management organizations, to name a few, and also the employment of complementary techniques such as SNA which could return improved observations of the interactions that take place in RISs. The third direction requires further elaboration. A higher level of integration is not necessarily good as it may bring about undesirable lock-in effects in regions. The drive for connectivity requires redundant relations to be eliminated and the right ones to be encouraged in a process that varies across longitudinal and latitudinal dimensions. For this reason, we need to understand whether integration occurs among the right organizations and at the right time to produce a regional advantage under unique value propositions. This dissertation is therefore only be the starting point leading to the following open questions:

- What are the specific system problems caused by the selection of individual strategic paths towards the construction of regional advantage?
- How can we identify and measure possible additional gaps between *regional policy* and *knowledge exploration* components?

The full dissertation can be viewed at http://www.xabieralberdi.es/tesis-doctoral/

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