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Innovation and R&D spillover effects in Spanish regions: A spatial approach

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Abstract

This paper analyses the spatial patterns of innovation, its regional interdependencies and evolution, as well as its role in determining local innovation in Spanish regions. Results indicate the suitability of a trade-based regional proximity when considering spatial spillovers in innovation. In this context, not only local capacity is relevant in determining domestic innovation, but also spatial innovation spillovers, which result mainly from efforts in both higher education and public administration. Moreover, a minimum level of regional development is required to improve the effectiveness of R&D policies. Therefore, it is necessary for R&D policies to act in combination with other policies focused on the improvement of socio-economic and structural determinants of regional innovative performance.
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1. Introduction

Innovation and technological progress are deemed basic determinants of domestic economic growth (Romer, 1990). In this case, the production–innovation system is considered to be the link between knowledge creation and production systems. Nevertheless, together with the domestic capacity of innovation in a specific area, it has been increasingly recognised in the literature that spillovers of knowledge from external sources may have an important impact on innovation processes and economic growth. In this context, the spatial dimension

of the problem becomes a relevant question in determining how those spillovers occur and the effectiveness of such spillovers in the local innovation process (see Acs and Varga, 2002; Feldman, 1999).

The econometric analysis of the role of localised knowledge flows in the process of innovation has been widely applied within a knowledge production function framework. In this paper, we analyse the innovation process in Spanish regions, its spatial distribution and temporal evolution. In specific terms, we focus on the factors that can determine innovation activities and the role that geographical space can play in terms of the dissemination of technological knowledge, both inside and between regions. In the case of geographical space, the factors we take into consideration are not limited to the geographic proximity of one region to another. Other factors are considered when determining the diffusion of innovation between regions to shed new

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light on the spatial and temporal aspects of Spanish innovation.

Regarding the importance of space for the diffusion of knowledge, one strand of literature emphasises the domestic nature of knowledge spillovers, which are locally bound, based on the geographic proximity to the innovation producers (Acs et al., 1994; Anselin et al., 1997; Audretsch and Feldman, 1996; Jaffe et al., 1993) and on the structural factors that characterise the knowledge capacity of the local economy. Another body of literature highlights the public nature of knowledge that flows freely across borders. In this case, the importance of regional interaction for the flow of knowledge is stressed (Coe and Helpman, 1995; Grossman and Helpman, 1991). In the same way that geographic proximity to innovation producers can favour knowledge spillovers within the region, proximity to other innovative regions can boost local innovation. Consequently, not only the analysis of the effects of R&D spillovers on innovation, but also the analysis of how important other sources of spillovers are (such as spatial spillovers due to regional proximity) could be the key to innovation policy being successful, by speeding up the diffusion of knowledge through actively promoting R&D activities and stimulating regional interactions and interregional innovation networks (Camagni, 1991). Moreover, Moreno-Serrano et al. (2005) point out that externalities across (European) regions are mostly constrained by national borders. Our analysis will therefore concentrate on the role and characteristics of R&D and spatial spillovers owing to innovation interdependencies among Spanish regions that go beyond merely geographical aspects.

The case of Spanish regions is especially interesting for our analysis. Cuadrado-Roura et al. (1999) and De la Fuente (2002) point to the existence of an aggregate convergence process due to the equalisation of education levels, the homogenisation of productive structures and technological catch-up. Despite this convergence process slowing down at the end of the 1980s, the remarkable transformations in the education system as well as the industrial restructuring and technological development still have not come to an end, which suggests that the regional integration process continues. In the context of Europe, Spanish regions have been considered as technologically peripheral regions that over the 1990s experienced a sharp increase in R&D expenditure relative to the European Union average, undertaken by government and very often within the framework of European Structural Funds. This R&D investment has been linked to a neoclassical and regional policy view focused on reducing technological disparities

within the country and with respect to the European core (Bilbao-Osorio and Rodriguez-Pose, 2004; Rodriguez-Pose, 2001). Nevertheless, the technological gap remains significant.

Despite R&D levels in Spain being a long way from allowing significant knowledge spillovers (Rodriguez-Pose, 2001), have those transformations in Spanish regions helped to promote the existence of such technology spillovers? If we consider that Spanish regions are not innovation averse regions in the terms of Bilbao-Osorio and Rodriguez-Pose (2004), with more similar socio-political conditions and commercial interdependencies and lower barriers for technological knowledge to flow, have interregional knowledge spillovers promoted regional innovation? Have public R&D efforts helped to achieve the 'critical mass of knowledge' to enhance such technological spillovers and innovation performance in Spanish regions?

The analysis of these questions in the context of the 17 Spanish regions from 1989 to 2001 provides the opportunity to explore both the spatial and the temporal dimension of the problem, by means of panel data techniques, as a novel approach in empirical research.[1] In this panel data framework we use spatial econometric techniques to analyse the spatial interdependencies of innovation among Spanish regions and also to search for the statistically correct specification of the model. In addition to this, we analyse whether or not the similarity in levels of technology across regions is an advantage in the diffusion of knowledge and if different benefits from interregional knowledge spillovers are implied.

The paper is organised as follows. Section 2 briefly reviews different viewpoints concerning the innovation process and its determinants. Section 3 discusses the measurement of innovative activity and its spatial and temporal characteristics in Spanish regions. The econometric model is specified in Section 4, and the main results of the estimation are presented in Section 5. Finally, Section 6 draws the conclusions.

2. Determinants of innovation

Analysing determinants of innovation has developed inside the knowledge production function framework (Griliches, 1979). As empirical evidence has appeared to demonstrate that the relationship between innovative

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[1] Some cross-sectional examples include: Feldman and Audrestsch (1999) and Jaffe (1989), in the US; Moreno-Serrano et al. (2005), for the European regions; Fritsch and Franke (2004) and Bode (2004), for Germany.