Regional scientific capacities in Europe. Specialization and determining factors

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(Extended abstract)

1. Introduction and research questions

Despite the theoretical and empirical relevance of several economic aspects involving research activities in universities (see the surveys by Dasgupta and David, 1994; Stephan, 1996), the empirical analysis concerning the production of science for universities is very scarce; only a few papers have addressed this issue from an economic view[1]. While there is some evidence of the short-term usefulness of incentives at country level to promote scientific research (Adams and Griliches, 1996; 1998; Payne and Siow, 2003; Adams et al., 2005; Crespi and Geuna, 2008), regional information seems to be largely missing in the literature. In this paper we try to fill this gap providing some insight on the distribution and academic scientific specialization across European regions; additionally, we particularly focus on the role of financial funds on the development of university-based research at regional level. More specifically our research questions are as follows:

1. How is the production of scientific research distributed across European regions? Which regions lead in scientific production by discipline? What are the regional scientific specialization patterns across European regions?.

2. What are the effects of academic R&D expenditures in promoting the production of scientific research at regional scale? Is there any difference according to the level of regional development? What other factors may determine the production of science?.

2. Data

The main data set to capture the regional scientific production consists of a regionalization of roughly 1,000,000 papers from 1998 to 2004 obtained from the Thomson ISI (Information Sciences Institute) database. The procedure to account for university scientific papers at NUTS II level in the EU-15 is described in Acosta et al. (2011).

[1] A stream of literature focused on the individual productivity of researchers has sometimes considered R&D funding as an "environmental attribute", along with other personal characteristics (researcher sex, age, education, etc.) and institutional attributes of the institutions for which those researchers work (see for a review, Carayol and Matt, 2006). However, this growing literature is far from the view followed in our paper.

The descriptive analysis shows that that the production of scientific knowledge is highly concentrated in a few regions. For instance, the top ten regions in terms of publications accounted for 22.61% of total number of publications. This high concentration holds for all disciplines, although the composition of the top scientific regions differs across scientific fields. Addionally, we classified regions into four groups according to if they were above or below 75 % of EU-15 average of GDP per capita and HERD per capita. This analysis shows an unbalanced picture of the generation of academic papers since the average capacity for publication of a less developed region is about 45% of the capacity of a developed region in the core group. The disparities are rather stronger when we consider a classification of regions based on HERD (on average, a region with less amount of funding produced 79% fewer papers than a region HERD above 75% of EU-15 average HERD per capita).

3. Model and variables

In order to evaluate the impact of academic R&D expenditures on scientific production, we put forward a regional version of the knowledge production function suggested by Adams and Griliches (1996) in terms of inputs and outputs. The inputs are academic R&D funds; the outputs are scientific publications. The empirical panel model takes the form:

$$SP_{it} = \beta RD(r)_{it} + \alpha_i + \eta_t + u_{it}$$

where the dependent variable SP_{it} is the scientific knowledge production proxied by the logarithm of papers for the region *i* in the year *t*. The explanatory variables are as follows:

- RD(r) is the logarithm of a distributed lag function of past academic R&D expenditures.
- Lambda represents regional specific effects.
- Nu represents time effects;
- u represents all other unaccounted forces determining this particular measure of output.

4. Results

To study the effects of academic R&D funds on regional scientific, we estimated several fixed effects regressions including HERD with different time lags. Models t-1, t-2, t-3, t-4, t-5 include HERD data lagged 1, 2, 3, 4, 5 years respectively. Models named weight 3t and weight 5t include the inverted V-lag for R&D in the previous three and five years, respectively.

4.1 Effect of Higher Education R&D expenditures on scientific production

From the estimation of the models, we obtained that HERD is only significant for the two-year lag model and for the three-year weighted model. The higher significance of HERD variable in the 2-year lag model than for the 3-year weighted model suggests that, for the regions in the sample, the 2-year lag model is the best representation of the effects of HERD on publications. This result suggests that HERD take two years in promoting scientific production, and then this positive effect disappears. Regional effects and time effects are significant for all the models, which confirm the presence of regional differences in the scientific capability to transform the input in outputs and the existence of a temporal effect, since scientific publications tend to increase over time. The Hausman tests show that the fixed effect model is to be preferred in all the estimated models. The number of observations and regions vary across the models due to the lack of data for HERD in some years.

4.2 Centre-periphery models of scientific production

In order to test the centre-periphery hypothesis, we divided the regions in our sample into objective 1 regions (those with a GPD per capita below the 75% percent of the EU-15 average), and non objective 1 regions (the others). Then, we estimated separated econometric models for each group of regions. From these estimations, we found that HERD in more developed regions produced results within the two and three subsequent years. This lag is shorter than for less developed regions, in which HERD take five years to positively affect the amount of scientific publications. However, the impact of such investment is greater for objective 1 regions than for more developed regions. This could be explained because the second group of regions is likely to have a ready-to-use knowledge infrastructure, which allows them to convert faster HERD into new scientific knowledge, but also to be less dependent on new funds than objective 1 regions. Conversely, objective 1 regions are likely to lag in knowledge pool and innovative capacity, which takes time to be developed. This has two main consequences: (1) it takes more time to convert HERD into new knowledge in these regions and (2) they are more dependent on research funding, which could also explain the greater impact of HERD on scientific production in these regions. For both types of regions and for all the estimated models, regional and time effects are significant.

Authors' note: This is a paper in progress. Future versions will include spillover effects. Additionally, other explanatory variables, such as inter-regional scientific collaboration, may be added to the empirical model.

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