Research Policy 44 (2015) 833–848

Contents lists available at ScienceDirect

Research Policy

journal homepage: www.elsevier.com/locate/respol

Knowledge flows and the absorptive capacity of regions

Ernest Miguélez [a,b,*], Rosina Moreno [b]

[a] GREThA (UMR CNRS 5113) – Université de Bordeaux, Avenue Léon Duguit, 33608 Pessac, France
[b] AQR-IREA, University of Barcelona, Spain

ARTICLE INFO

Article history:
Received 14 January 2014
Received in revised form 27 January 2015
Accepted 28 January 2015

Keywords:
Absorptive capacity
Inventor mobility
Networks
Patents
Regional innovation

ABSTRACT

This paper assesses the extent to which absorptive capacity determines knowledge flows' impact on regional innovation. In particular, it looks at how regions with large absorptive capacity make the most of external inflows of knowledge and information brought in by means of inventor mobility and networks, and fosters local innovation. The paper uses an unbalanced panel of 274 regions over 8 years to estimate a regional knowledge production function with fixed-effects. It finds evidence that inflows of inventors are critical for wealthier regions, while it has more nuanced effects for less developed areas. It also shows that regions' absorptive capacity critically adds a premium to tap into remote knowledge pools conveyed by mobility and networks.

1. Introduction

Knowledge diffusion and acquisition critically determine the innovative potential of firms (Griliches, 1998). However, absorptive capacity is required to understand and transform flows of external knowledge, essential for innovation production and firms' growth (Cohen and Levinthal, 1990). At a more aggregated level, firms' absorptive capacities determine the overall absorptive capacity of geographical areas, such as regions. This absorptive capacity constitutes a pivotal element of regions' ability to make the most of incoming knowledge and information flows, allowing them to obtain productivity gains and competitive advantages. This paper looks at the role played by regions' absorptive capacity in transforming geographical, external flows of knowledge into local innovation.

A fundamental observation of knowledge diffusion is that it tends to be highly localized in space (Hippel, 1994; Jaffe et al., 1993; Nelson and Winter, 1982). Undeniably, the implications of this for the most peripheral regions in Europe are important – i.e., the stickier the knowledge, the lower the peripheral territories will have access to it (Rodriguez-Pose and Crescenzi, 2008). Skilled mobility and networks become critical to overcome this stickiness. Theoretical and empirical evidence in support of a relation between high-skilled workers mobility and knowledge diffusion is extensive (Almeida and Kogut, 1999; Arrow, 1962; Boschma et al., 2009; Rosenkopf and Almeida, 2003; Singh and Agrawal, 2011; Stephan, 1996). Networks are also critical means to diffuse knowledge and promote the cross-pollination of ideas (Katz and Martin, 1997), and again empirical evidence in support of networks as vehicles for the dissemination of ideas is large (Breschi and Lissoni, 2009; Cowan and Jonard, 2004; Gomes-Casseres et al., 2006; Simonen and McCann, 2008; Singh, 2005). When skilled workers move or collaborate across different places, geographical knowledge diffusion occurs (Bathelt et al., 2004; Breschi et al., 2010; Coe and Bunnell, 2003; Owen-Smith and Powell, 2004).

Policymakers have actively endorsed these issues and the European Commission has encouraged, among others, the promotion of "greater mobility of researchers" within the continent, "improving the attraction of Europe for researchers from the rest of the world", "networking of existing centers of excellence in Europe", and "closer relations between the various organizations of scientific and technological cooperation in Europe" (European Commission, 2000). Along these same lines, it also aims to create an integrated and coherent European Research Area (ERA) where "national systems must be more open to each other and to the world, more inter-connected and more inter-operable" (European Commission, 2012a). Hence, understanding the way in which spatial mobility of high-skilled employees and geographical networks interact with knowledge diffusion and subsequent regional innovation production is critical to effectively promote regional economic growth and cohesion. In this respect, empirical evidence has established a strong link between networks and mobility, on the one side, and regional innovation, on the other, both within (Fleming et al., 2007; Lobo and Strumsky, 2008) as well as across regions (Kroll, 2009; Miguelez et al., 2013; Miguélez and Moreno, 2013a; Ponds et al., 2010). This latter evidence has also motivated a number of papers looking at the determinants of these two phenomena (Chessa et al.,

* Corresponding author. Tel.: +33 556846270; fax: +33 556848647.
E-mail addresses: ernest.miguelez@u-bordeaux.fr (E. Miguélez), rmoreno@ub.edu (R. Moreno).

http://dx.doi.org/10.1016/j.respol.2015.01.016
0048-7333/

2013; Ejermo and Karlsson, 2006; Hoekman et al., 2010; Maggioni and Uberti, 2009; Morescalchi et al., 2015).

The main hypothesis of this paper states that regions' absorptive capacity determines mobility and networks returns to innovation. Innovation is an evolutionary and cumulative process; only with the necessary capability to identify, assimilate and develop useful external knowledge can regions effectively benefit from incoming technology flows through networks and labor mobility. In such scenario, we argue that absorptive capacity is needed to understand and transform inflows of extra-regional knowledge – those that mobility and networks convey – into regional innovation. With this aim in mind, we estimate a regional knowledge production function (KPF) in an unbalanced panel data framework, for the case of 274 European regions of 27 countries, from 2000 to 2007. In line with our previous research, we include among our explanatory variables measures of knowledge workers geographical mobility – i.e., inventors[1] – and cross-regional technological networks – co-inventions.

A second contribution of the present analysis deals with the differentiated effects of networks and mobility on regional innovation across groups of regions. This is an important issue, given that one critical aim of European policymakers is to reduce brain drain, notably from weaker regions, as well as the wide regional variation in research and innovation performance (European Commission, 2012b). In our view, however, this is at odds with the "one-size-fits-all" policy inferred from the Lisbon 2000 and Europe 2020 agendas (Camagni and Capello, 2013). If innovation returns to geographical networks and mobility are significantly different, policies aimed to encourage such phenomena – e.g., EU's Framework Programmes or Marie Curie Actions – need to be redefined and adapted to each region's specificities – which is precisely at the heart of the smart specialization strategy (Foray et al., 2009). We investigate this issue by making use of an ad-hoc regional typology in Europe, based on EU's Cohesion Policy classification of regions according to different economic policy objectives.

Overall, we contribute to the literature in three main respects. First, we confirm our previous results (Miguélez and Moreno, 2013b) and show that both labor mobility of knowledge workers as well as the participation in research networks are critical means to transmit knowledge as they positively affect the patenting activity of European regions. However, different from previous studies, we show that these effects are likely to be causal. Our identification strategy is based on exploiting cross-regional variation in mobility and networks arising from the gravitational structure of these variables. From this setting, we produce predictors for both mobility and networks, which will be used in a 2-stage least squares (2SLS) approach afterwards. Second, the impact found is far from being homogeneous across the EU territory, with more developed regions obtaining higher returns from incoming knowledge flows brought in by mobile inventors; while less advanced areas relying more on networks. Finally, when disentangling what makes them more efficient in assimilating and using these knowledge flows, our results point that the absorptive capacity of regions has a main role.

The rest of the paper is organized as follows: in Section 2 we present the empirical model and our main hypotheses; Section 3 shows the data; while Section 4 includes the descriptive and econometric results. Finally, Section 5 presents the conclusions and implications of our research.

[1] In the absence of a better proxy for mobile high-skilled workers, the present paper uses mobile inventors. We acknowledge that, without further information on their educational level or specific occupation, it is hard to say whether inventors are indeed high-skilled workers or not – although, quite likely, they are in the upper tail of the skills distribution. However, in order to avoid confusion, we refer to them as inventors or knowledge workers from now on.

2. Theory and methods

2.1. Knowledge workers mobility, spatial networks and innovation

We test our hypotheses in a regional KPF framework (Anselin et al., 1997; Bottazzi and Peri, 2003; Buesa et al., 2010; Cabrer-Borrás and Serrano-Domingo, 2007; Cowan and Zinovyeva, 2013; Feldman and Audretsch, 1999; Rondé and Hussler, 2005). In particular, we start with the following baseline specification:

$$\ln \mathrm{PATp.c.}_{\mathrm{it}} = \beta_0 + \beta_1 \cdot \ln \mathrm{R\&Dp.c.}_{\mathrm{it-1}} + \beta_2 \cdot \mathrm{HK}_{\mathrm{it-1}} + \rho_n \cdot Z_{\mathrm{it-1}} + \\ + \beta_3 \cdot \mathrm{MOBILITY}_{\mathrm{it-1}} + \beta_4 \cdot \mathrm{NETWORKS}_{\mathrm{it-1}} + \delta_i + \epsilon_{\mathrm{it}} \quad (1)$$

where PATp.c. is the knowledge output of a given region – patents per capita, which depends upon regional Research & Development (R&D) expenditures per capita ($\mathrm{R\&Dp.c.}_{\mathrm{it-1}}$) as well as regional endowments of human capital ($\mathrm{HK}_{\mathrm{it-1}}$). Eq. (1) includes a large set of controls, $Z_{\mathrm{it-1}}$, taking into account spatial differences in regional structures that may correlate with innovation. In particular, we include here a technology specialization index to test the existence of Marshall-Arrow-Romer (MAR) externalities – regional specialization in one or few industries associated with a pool of skilled labor, the co-location of suppliers and customers, as well as intra-industry technology spillovers – versus Jacobs externalities – associated with inter-industry knowledge flows. The larger the index, the more specialized in one or few sectors is the regional economy.

Spatial differences in the economic structure of regions are also controlled for by introducing the share of manufacturing employment, as well as the share of patents produced in highly-patenting sectors in the previous year – these include audio-visual technology, telecommunications, information technology, semiconductors, organic chemistry, polymers, pharmaceuticals, and biotechnology.

In addition, δ_i stands for regional time-invariant fixed-effects (FE), which enable us capturing unobserved time-invariant heterogeneity that might importantly bias our estimates if they are not considered. In particular, we refer to institutional features that may affect innovation, technology-oriented regional policies, research and higher education institutions, social capital and, in general, all the historical path-dependent features that may importantly affect spatial differences in knowledge production rates. Note that Eq. (1) includes the subscript t-1 in all the explanatory variables, which indicates that we lag one period all these variables to lessen endogeneity problems due to system feedbacks.

Like previous studies in the field (Kroll, 2009,b; Miguélez and Moreno, 2013a,b; Ponds et al., 2010), we hypothesize that regions' innovation capability benefits from accessing extra-regional pools of ideas by means of inventors' mobility (MOBILITY) and bilateral technological linkages (NETWORKS).

As a proxy for MOBILITY, we use the inward migration rate (IMR), i.e., the number of incoming inventors to region *i* over the number of local inventors in *i*, in a given time period *t*. Alternative mobility variables are computed – running different models for each of the variables in order to avoid collinearity problems. In particular, we include the net migration rate (NMR) – inflows minus outflows to the current number of inventors. Recent studies pinpoint at outward migration of knowledge workers as an alternative source of knowledge flows and interactions back to the home location of the left employee, reverting the 'brain drain' phenomenon into 'brain gain' or 'brain circulation' (Saxenian, 2006). For instance, Agrawal et al. (2006); Corredoira and Rosenkopf (2010) and Oettl and Agrawal (2008) report disproportionate knowledge flows from inventors leaving a region, a firm or a country back to their former colleagues. Following these ideas, we also test the role of the