Migration, communities on the move and international innovation networks: an empirical analysis of Spanish regions

Anna D'Ambrosio, Sandro Montresor, Mario Davide Parrilli & Francesco Quatraro

Routledge
Taylor & Francis Group

Regional
Studies
Association

Migration, communities on the move and international innovation networks: an empirical analysis of Spanish regions

Anna D'Ambrosio[a], Sandro Montresor[b], Mario Davide Parrilli[c] and Francesco Quatraro[d]

ABSTRACT

This paper investigates the impact of migration on innovation networks between regions and foreign countries. It posits that immigrants (emigrants) act as a transnational knowledge bridge between the host (home) regions and their origin (destination) countries, thus facilitating their co-inventorship networks. It also argues that the social capital of both the hosting and the moving communities reinforces such a bridging role, along with language commonality and migrants' human capital. Focusing on Spain, as a country that hosted an intense process of migration over the past two decades, patent data are combined with national data on residents and electors abroad and a gravity model is applied to the co-inventorship between Spanish provinces (NUTS-3 regions) and a number of foreign countries. Both immigrants and emigrants affect the kind of innovation networking at stake. The social capital of both the moving and the hosting communities actually moderates this impact positively. The effect of migration is stronger for more skilled migrants and with respect to non-Spanish-speaking countries, pointing to a language-bridging role of migrants. Policy implications are drawn accordingly.

KEYWORDS

migrations; communities on the move; international innovation networks; social capital

INTRODUCTION

Labour migration increasingly intersects with diasporas, i.e., the movement of communities and the scattering of populations across different countries (Brubaker, 2005; Castles, 2002; Portes, 2000; Saxenian, 2006; Sonderegger & Taube, 2010; Vertovec, 1999). Besides recognized changes in the workforce composition and in the skill/wage profile of regions (e.g., De Arcangelis, Di Porto, & Santoni, 2013; Gagliardi, 2015; Lewis, 2013; Niebuhr, 2010; Ottaviano & Peri, 2006; Peri & Sparber, 2009; Piore, 1986), an additional role of migration emerges when the relative cultural and cognitive homogeneity of

communities on the move is contrasted with their diversity with respect to the hosting ones. Migration flows and diasporas have been claimed to act as 'information brokers' between host and home regions, working as a transnational knowledge link, which allows them to obtain different kinds of economic benefits, e.g., in international trade and foreign direct investment (FDI) (Felbermayr, Grossmann, & Kohler, 2015; Peri & Requena-Silvente, 2010; Rauch & Trinidade, 2002; Wagner, Head, & Ries, 2002).

The knowledge flows brought to local economies by migration have recently attracted attention in the analysis of regional innovation patterns and performances. Previous studies have so far concentrated on the migration of skilled

CONTACT

[a] ✉ anna.dambrosio@polito.it
Department of Economics and Statistics 'Cognetti de Martiis', University of Turin, Turin, Italy; and Bureau of Research on Innovation, Complexity and Knowledge (BRICK), Collegio Carlo Alberto, Turin, Italy. Current address: DIGEP, Polytechnic of Turin, Turin, Italy.
[b] ✉ sandro.montresor@unikore.it
Faculty of Economics and Law, Kore University of Enna, Enna, Italy.
[c] (Corresponding author) ✉ dparrilli@bournemouth.ac.uk
Department of Accounting, Finance and Economics, Bournemouth University, Bournemouth, UK.
[d] ✉ francesco.quatraro@unito.it
Department of Economics and Statistics 'Cognetti de Martiis', University of Turin, Turin, Italy; and Bureau of Research on Innovation, Complexity and Knowledge (BRICK), Collegio Carlo Alberto, Turin, Italy.
ⓘ Supplemental data for this article can be accessed at http://dx.doi.org/10.1080/00343404.2018.1426850.

human capital and/or inventors by investigating the effects of international knowledge flows revealed by cross-regional (and cross-country) patent citations, inventors' collaborations and co-inventorships (Agrawal, Cockburn, & McHale, 2006, 2008; Almeida & Kogut, 1999; Breschi & Lissoni, 2006a, 2006b, 2009; Quatraro & Usai, 2017). Special attention has been dedicated to international innovation networks that substantiate in cross-regional, foreign co-inventorships, through which regions can increase their innovation and economic performance (Broekel, Brenner, & Buerger, 2015; Miguélez & Moreno, 2013, 2015).

International co-inventorship networks are also the subject of the present paper, which looks at their determinants with two elements of originality. First, we maintain that co-inventorships are the outcome of knowledge networks that, formally and/or informally, extend beyond the focal inventors. Such networks actually extend beyond strictly professional networks of actors directly involved in the creation of new inventive knowledge, but also encompass wider social networks. On this basis, we do not restrict our analysis to mobile inventors, but rather investigate the impact of regional migrants as a whole on co-inventions, irrespective of their (eventually low) level of formal education and training, for which we, however, try to control. Indeed, the knowledge-bridging role of migrants is not limited to international trade and FDI flows, on which the extant literature has focused so far (e.g., Felbermayr et al., 2015). It extends to international innovation flows too, which are not exclusively related to the migration of skilled human capital and/or inventors either (Breschi & Lissoni, 2009). Following economic geography and combining it with recent local/regional studies on innovation systems (Autio, 1998; Boschma, 2005 Breschi & Lissoni, 2001; Cooke, Heidenreich, & Braczyk, 2004; Paci & Usai, 2000; Tödtling & Trippl, 2005;), we argue that local migrants' stocks enhance the effectiveness of communications amongst geographically dispersed inventors, and thus the efficiency of collaborative knowledge production. They engender a peculiar kind of knowledge externalities concerning habits, specific communication codes, and organizational modes about origin and host countries, which improve the respective absorptive capacity of the inventors residing in the two places, and therefore ease the decoding of exchanged knowledge (Arrow, 1969).

Second, we extend this analysis by considering the bridging role of social capital – defined and illustrated in the second section (Adler & Kwon, 2002; Dekker & Uslaner, 2001; Putnam, 2000) – and integrating it with the literature on diasporas and international knowledge diffusion (Agrawal et al., 2006, 2008; Miguélez, 2016). We maintain that both the social capital of the hosting communities and that 'imprinted' by the local context on migrant communities facilitate channels of communication and collaboration, which make their role of knowledge brokers between home and host inventors more effective. Accordingly, we expect that social capital positively moderates the impact of migration on cross-regional co-inventorship.

Focusing on Spain, as a country that has witnessed intense migration over the past two decades, and combining different sources of available data, we test these arguments with respect to the co-inventorship between Spanish provinces and an ample set of foreign countries over different periods in the last decade. We use a gravity model of knowledge flows that is quite standard in the literature (e.g., Maurseth & Verspagen, 2002; Paci & Usai, 2009; Picci, 2010), which we originally specify at the province–country dyadic level with respect to co-inventorships.

Results generally support our arguments about the innovation networking role of migrating communities and of their social capital, while this is not the case of language communality, as the impact of migration is stronger towards non-Spanish speaking countries. The implications of these results are discussed in the fourth section, after having grounded our hypotheses in the literature in the second section, and presented the empirical application in the third section. The fifth section concludes.

BACKGROUND LITERATURE AND RESEARCH HYPOTHESES

In a recent stream of research, across regional and innovation studies, a link has been ascertained between regional innovation and the mobility of skilled human capital and inventors (e.g., Faggian & McCann, 2006; Gagliardi, 2015; Niebuhr, 2010; Trippl, 2013). This mobility increases the spatial proximity among inventors and their face-to-face interaction, augmenting the chances of making mutual use of their innovative knowledge – as for patent citations – and of participating in common innovation networks – as for co-inventorships (e.g., Maurseth & Verspagen, 2002; Paci & Usai, 2009; Quatraro & Usai, 2017). Still, other forms of proximity, such as their belonging to the same disciplinary and/or professional network, their sharing of a common language, experience, mutual appreciation and trust, reduce the salience of geographical distance (Agrawal et al., 2006, 2011; Breschi & Lissoni, 2009; Singh, 2005; Thompson & Fox-Kean, 2005).

When we focus on co-inventorships, and on the knowledge exchange and innovation networking they entail, an additional kind of mobility can affect their occurrence: that of immigrants and emigrants in general. Indeed, unlike patent citations and other codified knowledge flows, co-inventors are asked to confront their learning routines and practices, exchange also tacit and procedural knowledge and, in so doing, access wider and nested networks and sub-networks (Montobbio & Sterzi, 2013; Quatraro & Usai, 2017) to which immigrants and emigrants can also take part.

Focusing on the flows of skilled human capital and inventors, regional studies have hardly addressed this impact of general migration on international co-inventors' networks. Yet, from our standpoint, migrants can play a role as facilitators of these mechanisms of knowledge exchange, given their simultaneous involvement in both their home and the host country (Basch, Glick Schiller, & Szanton-Blanc, 1994; Coe & Bunnell, 2003; Williams, 2007). In other words, by extending previous research

about the drivers of international co-inventorships (e.g., Miguélez, 2016; Montobbio & Sterzi, 2013; Picci, 2010), we argue that, given the importance of place-specific communication codes and sub-codes and of individuals' absorptive capacity (Arrow, 1969), migrants contribute to mitigate the barriers to co-inventorship by lowering the communication and cultural obstacles between inventors that hamper their occurrence.

Two research perspectives provide theoretical support to these arguments. First, following a 'complexity' approach to innovation networks (Frenken, 2000), we maintain these are made of different sub-networks that, while possibly specializing, are nested among them and complementary to each other in terms of competencies and knowledge requirements. In our case, 'generic' migration flows create networks of people, which exchange knowledge and practices that, while far from having direct effects on the generation of innovation processes, get nested with the networks of inventors where these processes actually occur, providing them with useful externalities. The interactions between local innovation networks and foreigners' networks could thus 'contaminate' the innovation networks in the host communities with elements of the migrants' business networks and culture, as well as with innovation-relevant information drawn from their home-country networks. In brief, migration networks can work as 'mechanisms to learn about innovation' and to learn to interact with inventors in other places (Chiffoleau, 2005; D'Ambrosio, 2015).[1] Such a complex hybridization process clearly operates in the presence of proximity among the focal actors, similarly to what is argued by Rauch (1999) with respect to the information flows of relevance to trade. Accordingly, individual-level information about business and social contacts of inventors would represent the ideal unit of analysis for such a research question. In the absence of such data with respect to the variables of our empirical application, we choose to resort to the most disaggregated level of analysis for the relationships at stake, that is, the province. Drawing on Gould (1994) and Rauch and Trinidade (2002), we assume the discussed hybridization process is more likely the larger the size of the migrant communities and of the stock of inventions.[2]

This argument can also be supported by looking at the economic geography literature on the complementarity/ substitutability between different kinds of proximity (Boschma, 2005; Maggioni, Uberti, & Nosvelli, 2017; Paci, Marrocu, & Usai, 2014; Ponds, Van Oort, & Frenken, 2007). The geographical distance between regional and foreign inventors, which represents an obstacle to their co-inventorship, could be compensated by the interplay of two other kinds of proximity: on the one hand, the spatial proximity between regional (foreign) inventors and the immigrants (regional emigrants) in the same location, entailing an embodied exchange of tacit and procedural knowledge (see above); and, on the other, the social proximity between the immigrants (regional emigrants) and the foreign (regional) inventors of the same nationality, entailing a commonality of language, habits and customs. In a sort of transitive propagation of the proximity effects,

even in the absence of their own mobility, regional and foreign inventors can become closer because of the mobility of their national counterparts, and thus increase the chance of collaborating and co-invent.

The previous arguments constitute the basis of the first research hypothesis, which is twofold:

> *Hypothesis 1a: Immigrants favour the occurrence of co-inventorship between their hosting regions and their countries of origin.*

> *Hypothesis 1b: Emigrants favour the occurrence of co-inventorship between their home regions and their destination countries.*

The second research hypothesis concerns the role of social capital, of both the hosting and the moving communities, in the occurrence of cross-regional foreign co-inventorships. Meant as the pool of values, norms, routines that are shared across a community and that promote trust and cooperation (Fukuyama, 1995), social capital emerges from the way in which people interact (Dekker & Uslaner, 2001)[3] and concerns those social 'assets' through which their coordination and cooperation can become mutually beneficial (Putnam, 1995, p. 67). Among the different conceptualisations provided for it (see Adler & Kwon, 2002, for a review), one appears particularly relevant to our case of communities migrating towards other communities: that of 'bridging social capital' (Dekker & Uslaner, 2001; Putnam, 1995). This 'outward' configuration of social capital refers to those cooperative connections and inclusion practices that help the interaction of people belonging to different networks/communities, as marked by different sociocultural traits, different countries of origin and ethnicities (Schuller, Baron, & Field, 2000). This contrasts with an 'inward' configuration of social capital – called 'bonding social capital' – that refers to the role that networks have in bringing together people who already share important sociocultural commonalities, among which *ethnicity* is the most important (Putnam & Goss, 2002, p. 11): this configuration is not relevant in our research context.

Bridging social capital could reinforce the immigrants' impact on co-inventorship, as posited by hypothesis 1a, in two ways: on the one hand, through the social capital of the hosting community, eventually leading to a higher socioeconomic integration of immigrants in the focal region (Portes & Sensenbrenner, 1993; Putnam, 1995); and, on the other, through the social capital of the immigrant community itself, which presumably makes it more cohesive and willing to convey and spread in the hosting region the cultural aspects of their home countries. In this context, bridging social capital unlocks channels of communication that set the basis for practical cooperation in economic and innovation activities. For similar and symmetrical reasons, we argue that the impact of the regional emigrants on co-inventorship as from hypothesis 1b could be reinforced by the social capital of their destination community, as well as by their own social capital as a community on the move. Indeed, from both sides, bridging social capital helps to promote the integration and

collaboration processes likely to have an impact on co-inventorship networks.

On the basis of the previous arguments, and referring to the bridging nature of social capital, we posit the second, twofold hypothesis:

Hypothesis 2a: The impact of immigrants on the co-inventorship between their hosting regions and their countries of origin is positively moderated by (1) the social capital of the hosting community; and (2) the social capital of the immigrant community.

Hypothesis 2b: The impact of emigrants on the co-inventorship between their home regions and their destination countries is positively moderated by (1) the social capital of the destination community; and (2) the social capital of the emigrant community.

While hypotheses 1 and 2 are the focal hypotheses of this paper, the analysis of migration for co-inventorship in international innovation networks should also consider other aspects, which have already been addressed in the extant literature: in particular, language commonality and migrants' human capital. The hypotheses on the effect of language commonality draw on the literature on migration and international trade (e.g., Felbermayr et al., 2015; Wagner et al., 2002); those on human capital rely on the literature on inventors and skilled labour mobility, with respect to human capital (Faggian & McCann, 2006; Gagliardi, 2015; Niebuhr, 2010; Trippl, 2013). Each is expected to magnify the impact that immigrants and emigrants have on international co-inventorship.

EMPIRICAL APPLICATION

The empirical application refers to 50 of the 52 administrative provinces (NUTS-3 regions – Nomenclature of Territorial Units for Statistics) of Spain (excluding Ceuta and Melilla, for data availability[4]), and 73 countries worldwide (see Table B1 in Appendix B in the supplemental data online), hence there are 3650 dyads. Dyadic immigration data are available for a panel of 13 years (1998–2011), while emigrant data are for 2006–11, limiting the joint analysis to a five-year panel.

The choice of Spain, marked by intense immigration and emigration flows and by a strong sub-national heterogeneity in terms of exporting capacity, is first of all one of relevance. Having chosen a specific geographical context of application, however, the results inevitably will be affected by its idiosyncrasies (see Appendix A in the supplemental data online for a detailed discussion). Yet, as we argue in the conclusions, we are confident that they could be generalized at least to other countries that have similar processes of regionalization and/or of international migration in Europe, such as, for example, Italy (Bettin & Cela, 2014; D'Ambrosio, 2015).

Model

The model used to test our research hypotheses is a gravity model for the analysis of knowledge flows widely used in the literature (e.g., Maurseth & Verspagen, 2002; Paci & Usai, 2009). Extending Isaac Newton's law of gravity to the interaction between two locations, bilateral flows – for example, of goods, services and capital – between a focal region, i, and a foreign country, j, at time t are predicted to increase with the importance of one or both of the locations, typically in terms of gross domestic product (GDP) and population stock, and to 'decay' with their geographical distance. Widely applied to international trade and FDI, this model has been adapted to the analysis of knowledge flows across countries and/or regions, such as those represented by patent citations and co-inventorships (Maggioni, Uberti, & Usai, 2011; Montobbio & Sterzi, 2013; Picci, 2010; Quatraro & Usai, 2017). In this case, the knowledge masses of the two locations are measured not only by their GDP but also by their research and development (R&D) intensity, proxied by province-level stocks of patent applications that are possibly entailed by them. On the other hand, migrants between each province–country dyad are viewed as factors that, because of the above arguments, reduce the bilateral costs of co-inventing and, thus, expectedly increase their occurrence. Drawing on the gravity literature at the sub-national level, we account for country-level, region-level and bilateral determinants of co-inventorships through country–time, region–time and region–country dummies (ψ_{jt}, φ_{rt} and χ_{rj}) respectively. Formally, our model is completed by including the regressors that vary by province, which are also our main variables of interest (see Appendix C in the supplemental data online):

$$\ln\left(1 + \text{Co-inventorship}_{jit}\right) = \psi_{jt} + \varphi_{rt} + \chi_{rj}$$
$$+ \beta_1 * \ln\left(GDP_{it-1}\right)$$
$$+ \beta_2 * \ln\left(1 + \text{Patent\_Stock}_{it-1}\right)$$
$$+ \beta_3 * \ln\left(1 + \text{Immigrants}_{jit-1}\right)$$
$$+ \beta_4 * \ln\left(1 + \text{Emigrants}_{ijt-1}\right)$$
$$+ \beta_5 * \ln\left(\text{Distance}_{ij}\right) + \varepsilon_{jit} \quad (1)$$

Different specifications of model (1) are run to test the first set of research hypotheses, about the co-invention effect of migrants. First, we focus on immigrants and exploit the full length of our panel, 1998–2011. Second, we then look at emigrants for the shorter period at which they are available: 2006–11. Finally, over the latter period, we include both immigrant and emigrant stocks.

The second set of hypotheses is tested by estimating the interaction effects between immigration and emigration variables, on the one hand, and two complementary dummies for high (H) and low (L) levels of social capital, on the other, at both province level – $Prov\_Soc\_Cap\_H_{it}$ and $Prov\_Soc\_Cap\_L_{it}$ – and country level – $Country\_Soc\_Cap\_H_{jt}$ and $Country\_Soc\_Cap\_L_{jt}$. Similar interaction terms are estimated to address the role of human capital and language commonality by building up respectively two dummies for high (H) and low (L) levels of human capital ($Qualified_j$ and $Non\text{-}Qualified_j$); and two complementary dummies for $Spanish\text{-}Speaking_i$ and $Non\text{-}Spanish\text{-}Speaking_i$ countries (see Appendices B and C in

the supplemental data online for details). The relative magnitude and significance of the associated coefficients represent the tests for the hypotheses and for the role of human capital and language.

In choosing the appropriate estimator, the count nature of our dependent, which is also quite zero inflated, requires special care. As argued more extensively in Appendix C in the supplemental data online, a Poisson maximum likelihood estimator (PPML) might seem the most suitable choice. However, following Head and Mayer (2014), ordinary least squares (OLS) turns out to be more accurate in the case of non-constant elasticities and thus will be followed in the benchmark estimates. As a robustness check, the PPML results are reported in Appendix D in the supplemental data online.

RESULTS

We begin the analysis from the baseline specification of the model (Table 1). Both the 'mass-attractor' variables at the province level (GDP and stock of patents) and the distance variable are significant and with the expected sign, supporting the choice of a gravity model.

The fit of the model – explaining 59% of the dependent variable variation in the baseline specification with fixed effects – increases when including the stock of immigrants in 1998–2010 (Table 1, columns (1)–(2)). Supporting hypothesis 1a, increasing immigrant stocks by 10% is found to increase the count of co-inventions by approximately 0.3%. The effect gets smaller, but is still positive

in the period 2006–10, for which we have emigration data (column (4)).

Turning to emigrants, in 2006–10, hypothesis 1b is also confirmed. With a further increase in the model fit, emigrants affect the occurrence of co-inventorship between their home province and their destination country (Table 1, columns (3)–(5)), and to a larger extent than immigrants (column (6)). The emigrants' elasticity is about three times larger, possibly due to the higher degree of education of the Spanish emigrants compared with the immigrant population reaching the Spanish provinces.

Summarizing, migration networks at large seem to intersect with inventor networks and even affect their co-inventorship outcome. As we argue in the robustness checks (see Appendix D in the supplemental data online), this effect is indeed autonomous and not confounded with other bilateral international channels, such as exports. However, it changes significantly before and after 2006, pointing to a dampening role of the recent crisis.

Table 2 reports the estimates obtained by interacting migration variables with social capital variables at the province and country levels. Although with a different order of presentation than in the second section, these provide a test for the hypotheses about the role of social capital. In all cases, including these terms improves the fit of the baseline model (R^2 and Akaike information criterion (AIC) statistics).

The left panel of Table 2 tests the role of social capital of hosting (hypothesis 2a.1) and emigrant (hypothesis 2b.2) communities. When the stock of immigrants is interacted with $Prov\_Soc\_Cap\_H_{it}$ (model (1)), its effect on co-

Table 1. Estimation results. Baseline model: stocks of immigrants and emigrants.

Dependent variable: ln (1 + $Coinv_{ijt}$)	(1)	(2)	(3)	(4)	(5)	(6)
	1998–2011		2006–11			
ln (GDP_{it-1})	0.088***	0.074***	0.095***	0.080***	0.051***	0.044**
	(0.014)	(0.013)	(0.018)	(0.018)	(0.017)	(0.017)
ln (1 + $Patent\_Stock_{it-1}$)	0.016***	0.012***	0.024***	0.021***	0.027***	0.025***
	(0.004)	(0.004)	(0.008)	(0.008)	(0.008)	(0.008)
ln ($Distance_{ij}$)	−0.203***	−0.172***	−0.233***	−0.202***	−0.174***	−0.157***
	(0.033)	(0.032)	(0.043)	(0.043)	(0.041)	(0.042)
ln (1 + $Immi_{ijt-1}$)		0.031***		0.020***		0.012**
		(0.005)		(0.006)		(0.006)
ln (1 + Emi_{ijt-1})					0.049***	0.046***
					(0.007)	(0.007)
Region–time effects	Yes	Yes		Yes	Yes	Yes
Country–time effects	Yes	Yes		Yes	Yes	Yes
Country–region effects	Yes	Yes		Yes	Yes	Yes
N	46,800	46,800	21,600	21,600	18,000	18,000
R^2	0.585	0.588	0.629	0.630	0.641	0.641
AIC	1658.788	1268.653	4036.367	3975.248	3277.008	3258.307
BIC	17,240.265	16,850.130	13,309.649	13,264.490	11,667.792	11,649.092

Note: Ordinary least squares (OLS) estimates. Robust standard errors clustered at the country–province pair level in parentheses. AIC, Akaike information criterion; BIC, Bayesian information criterion. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$.

Table 2. Estimation results. Interaction effects of immigrants' and emigrants' stocks with social capital.

(a) Dependent variable: ln (1 + $Coinv_{ijt}$)

			Social capital variables									
									Country social capital			
									High		Low	
			Province social capital			Country social capital			Province social capital			
Interaction effects	Period	Model	High	Low	N	High	Low	N	High	Low	High	Low
Immigrants	1998–2011	(1)	0.035***	0.026***	(5)	0.095***	−0.001	(9)	0.106***	0.084***	0.003	−0.004
			(0.005)	(0.005)		(0.016)	(0.006)		(0.017)	(0.016)	(0.006)	(0.006)
	2006–11	(2)	0.030***	0.012**	(6)	0.082***	−0.009	(10)	0.098***	0.062***	0.001	−0.015*
			(0.006)	(0.006)		(0.018)	(0.008)		(0.019)	(0.018)	(0.008)	(0.008)
	2006–11	(3)	0.016***	0.008	(7)	0.031*	0.002	(11)	0.037**	0.012**	0.017	−0.002
			(0.006)	(0.006)		(0.018)	(0.006)		(0.019)	(0.006)	(0.018)	(0.006)
Emigrants	2006–11	(3)	0.055***	0.038***	(7)	0.129***	0.004	(11)	0.136***	0.123***	−0.000	0.003
			(0.007)	(0.007)		(0.022)	(0.009)		(0.023)	(0.022)	(0.009)	(0.009)
	2006–11	(4)	0.062***	0.040***	(8)	0.147***	−0.000	(12)	0.161***	0.135***	0.007	−0.000
			(0.008)	(0.007)		(0.022)	(0.010)		(0.022)	(0.022)	(0.009)	(0.010)

(b) Model statistics

Model number	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
N	46,800	21,600	18,000	18,000	23,850	13,000	10,900	10,900	23,850	13,000	10,900	10,900
R^2	0.59	0.63	0.64	0.64	0.64	0.66	0.68	0.68	0.64	0.67	0.69	0.68
AIC	1180	3849	3140	3165	7009	4228	3161	3184	6882	4062	3051	3091
BIC	16,788	13,146	11,562	11,563	16,131	10,169	8546	8555	16,053	10,018	8473	8483

Notes: Ordinary least squares (OLS) estimates for 12 models including interaction effects between different combinations of migration (rows) and social capital variables (columns). Robust standard errors clustered at the country–province pair level are shown in parentheses. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. Variables are labelled for clarity: immigrants = ln (1 + $Immi_{ijt−1}$); emigrants = ln (1 + $Emi_{ijt−1}$); province social capital = $Prov\_Soc\_Cap_{it}\_H$ or $Prov\_Soc\_Cap_{it}\_L$ as relevant; country social capital = $Country\_Soc\_Cap_{it}\_H$ or $Country\_Soc\_Cap_{it}\_L$ as relevant. Models (3), (7) and (11) include interaction terms of both immigrants and emigrants with social capital. In the other models, the interactions of one of the migration variables are included. All specifications include country–time (which absorb the effects of country-level social capital), region–time and region–country effects as well as ln ($GDP_{it−1}$), ln (1 + $Patent\_Stock_{it−1}$) and ln ($Distance_{ij}$), whose coefficients are robust and not shown for brevity. The model statistics are reported in the bottom rows. AIC, Akaike information criterion; BIC, Bayesian information criterion.

inventorship is 35% larger than with $Prov\_Soc\_Cap\_L_{it}$, confirming hypothesis 2a.1. The differential gets even larger when we refer to 2006–11 (model (2)).[5] When considering both immigrants and emigrants (model (3)), the effect of immigrants in low-social-capital provinces even vanishes.

Also hypothesis 2b.2 is supported when emigration is both considered alone (model (4)) and with immigration (model (3)). In both cases, the interaction between the stock of emigrants and $Prov\_Soc\_Cap\_H_{it}$ is significantly positive and greater than that with $Prov\_Soc\_Cap\_L_{it}$.

The hypotheses about the social capital of immigrant (hypothesis 2a.2) and destination (hypothesis 2b.1) communities are tested in the central panel of Table 2, which considers social capital measurements at the country level. Both get confirmed. Specifically, the immigrants' effect is only significant in the interaction with $Country\_Soc\_Cap\_H_{jt}$ (and not with $Country\_Soc\_Cap\_L_{jt}$), implying that the knowledge-bridging role of immigrants for co-inventorship is entirely due to migrants from countries with a high level of bridging social capital (models (5)–(7)).[6] Similarly, only emigrants to high-social-capital countries result in the significant promotion of co-inventions (models (7)–(8)).

Overall, according to the results, the positive effect of immigration and emigration on knowledge flows in international innovation networks is not only augmented, but it is even activated by the social capital in both the hosting and the migrant communities.

Finally, in the right panel of Table 2, we allow the effect of immigrants' and emigrants' stocks to vary by levels of province social capital (high and low, i.e., $Prov\_Soc\_Cap\_H_{it}$ and $Prov\_Soc\_Cap\_L_{it}$) and of country social capital ($Country\_Soc\_Cap\_H_{jt}$ and $Country\_Soc\_Cap\_L_{jt}$) jointly. R^2 rises to 0.69, and the results support our expectations. There is actually evidence of a match-specific, interaction-based premium: the network-promoting effect of both immigrants (models (9)–(11)) and emigrants (models (11)–(12)) is greatest when the high social capital of the community on the move is coupled with the high social capital of the host community.[7]

Table 3 reports the results relating to the role of language commonality and human capital. As to the former, the results contradict our expectations. The positive effect of migration stocks is mainly observed for immigrants from countries speaking languages other than Spanish (columns (1)–(4)). While apparently counterintuitive, this supports a commonly observed result in the literature on the pro-trade effects of immigration (Dunlevy, 2006; Girma & Yu, 2002), where immigrants are mainly found to promote trade with countries that do not share a common language: the lack of a common

Table 3. Estimation results. Interaction of migration with language commonality and human capital.

Dependent variable: $\ln(1 + Coinv_{ijt})$	(1)	(2)	(3)	(4)		(5)	(6)
		Language	commonality				Human capital
	1998–2011		2006–11			1998–2011	2006–11
$\ln(GDP_{it-1})$	0.077***	0.085***	0.043***	0.040**	$\ln(GDP_{it-1})$	0.075***	0.084***
	(0.013)	(0.018)	(0.016)	(0.017)		(0.014)	(0.020)
$\ln(1 + Patent\_Stock_{it-1})$	0.012***	0.022***	0.029***	0.027***	$\ln(1 + Patent\_Stock_{it-1})$	0.013***	0.024***
	(0.004)	(0.008)	(0.008)	(0.008)		(0.005)	(0.009)
$\ln(Distance_{ij})$	−0.178***	−0.218***	−0.181***	−0.169***	$\ln(Distance_{ij})$	−0.177***	−0.223***
	(0.032)	(0.043)	(0.041)	(0.042)		(0.034)	(0.047)
$\ln(1 + Immi_{ijt-1})$*Spanish-Speaking$_j$	−0.026***	−0.047***		−0.022***	$\ln(1 + Immi_{ijt})$*Qualified$_j$	0.057***	0.046***
	(0.005)	(0.007)		(0.005)		(0.008)	(0.010)
$\ln(1 + Immi_{ijt-1})$*Non-Spanish-Speaking$_j$	0.040***	0.031***		0.017***	$\ln(1 + Immi_{ijt})$*Non-Qualified$_j$	−0.017***	−0.032***
	(0.006)	(0.007)		(0.007)		(0.004)	(0.006)
$\ln(1 + Emi_{ijt-1})$*Spanish-Speaking$_j$			−0.025***	−0.009**			
			(0.006)	(0.004)			
$\ln(1 + Emi_{ijt-1})$*Non-Spanish-Speaking$_j$			0.075***	0.067***			
			(0.009)	(0.009)			
N	46,800	21,600	18,000	18,000			39,648
R^2	0.591	0.634	0.646	0.647			0.601
AIC	903.070	3764.048	3012.082	2966.952			3635.456
BIC	16,484.547	13,061.271	11,402.867	11,373.333			16,860.661

Note: Ordinary least squares (OLS) estimates. Robust standard errors clustered at the country–province pair level are shown in parentheses. All specifications include country–time, region–time and region–country effects (which absorb the direct effect of language commonality and country level human capital on co-inventions). *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$. AIC, Akaike information criterion; BIC, Bayesian information criterion.

language makes the role of migrants more salient.[8] Note that the inclusion of language and human capital further increases model fit.

On the other hand, as expected, Table 3 (columns (5)–(6)) confirms that more qualified immigrants turn out to be more capable of favouring the occurrence of transnational co-inventorship; the effect appears persistent over the crisis time and is distinct from that of social capital (see Appendix D in the supplemental data online).

In conclusion, the results are robust when a different estimator (i.e., the PPML) is used, and when a more stringent account of fixed effects is incorporated, in order to address possible problems of endogeneity and simultaneity. The robustness checks confirm an even larger, positive and significant effect on co-inventorship of both immigrants and emigrants, when taken in isolation. As it gives more weight to the stronger co-invention ties, the PPML estimator emphasizes the role of emigrants, with elasticities up to 5%, and deflates the effects of immigrants in the sub-period 2006–11. The robustness checks also confirm the moderating effects of province-level social capital for immigrants, of country-level social capital for emigrants, as well as the persistent effect of human capital.

CONCLUSIONS

This paper adopted a gravity model to study whether migrants promote co-inventorship between regions and foreign countries, and if the social capital of their respective communities favours such innovation networking. The results – presented along with a large set of robustness checks and heterogeneity analyses – confirm this relationship and offer some important policy insights.

First, both immigrants and emigrants play a role in opening up local innovation systems to co-inventions and, thus, to new knowledge flows relevant for innovation. According to our estimates, by increasing the emigrant stocks by 10%, bilateral co-inventorships would increase by between 0.46% (lower-bound OLS) and 4% (upper-bound PPML). The same increase in immigrants' stocks would lead to a smaller though significant increase in co-inventions ranging between 0.2% (OLS estimates) and 1.4% (PPML estimates).

We argued that these results could be ascribed to the complex and manifold nature of co-inventorship networks, which appear to include migrants in exchanging a more tacit and embodied kind of knowledge. As to the external validity of the results, we recognize that they were obtained with respect to Spain during a recessionary period that has severely hit its labour market. The larger detected effect for emigrants compared with immigrants could be explained by the fact that the high unemployment rates of Spain have led the most qualified emigrants to leave the country, and have reduced the attraction capacity of Spain as a destination country for qualified immigrants. An implication, supported by the results, is that the magnitude of the immigrants' effects could be larger in more favourable phases of the cycle. Yet, differentials in human capital and in the patenting capacity of the origin and destination countries could confirm a differential effect of emigrants compared with immigrants in the more general case of economies with an attraction capacity for immigration, a good educational system and a well-established diaspora. On these bases, the findings could apply to other countries beyond Spain, such as Southern and Eastern European countries, as well as to other countries that share a similar subnational variation in the structure of entrepreneurship and innovation opportunities, as well as similar intense processes of immigration and emigration, with the entailed opportunities (e.g., increased trade and remittances) and threats (e.g., brain drain and youth impoverishment). Instead, a peculiar character of the Spanish economy, i.e., the large share of Spanish-speaking immigrants, seems not to drive the results: language commonality negatively moderates the effect of immigrants, allowing one to expect an even larger effect in countries with a less language-biased immigration than Spain.

The first set of results bears clear policy implications: the spectrum of policies for promoting cross-regional innovation networks extends beyond science and technology to embrace regional immigration policies. International mobility and intercultural networks support regional knowledge flows relevant for innovation. Migrants' network-promoting effect could be even stronger in other knowledge networks that rely more on social interactions and individuals' own tacit and procedural knowledge pool, and lead to less radical, non-patented or less openly technological innovations.

Second, both from the side of the host economy and of the communities on the move, social capital is found to magnify the effect of immigrants and emigrants on facilitating co-inventions. This suggests that social capital decreases the barriers to localized knowledge transfers and allows new knowledge to complement the existing knowledge base, even in the scientific and technological realm of co-inventorship. These results confirm the theoretical and qualitative contributions on the impact of social capital of communities on the move on the economic development of recipient countries (Parrilli, 2012; Portes, 1995; Sassen, 1988; Saxenian, 2006). Also, they suggest that inclusion policies, the support to bridging types of associations and to language training, promoting the probability that host and migrating communities exchange relevant knowledge and undertake joint initiatives, have important implications for regional innovation.

The previous policy recommendations accompany a more standard call to support regional innovation and competiveness policies by promoting the inward and outward mobility of human resources. Although this is not its focal result, this paper also highlights the high returns that regional systems may receive from policies attracting skilled immigration. Indeed, across specifications and estimation methods, and differently from the aggregate effect, the effect of highly qualified immigrants on co-inventorship is consistently positive and significant, and does not display the marked post-2006 reduction observed for the average effect. Whether highly skilled immigrants could

contribute to regional resilience in terms of belonging to innovation networks represents a possible extension of this work.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTES

1. One could go even further and, following Saxenian (2006) and Parrilli (2012), argue that transnational co-inventorship ties are enabled by circular migration pathways, embodying tacit and non-scientific knowledge gained in different communities. Unfortunately, these patterns of circular migration will not be addressed in the empirical application, as we can only capture a rather simplistic dual origin–destination migration flow.
2. Unsurprisingly, we find qualitatively identical results when using the stock of inventors instead of the stock of patent applications.
3. Although by taking a regional (province) perspective, we are aware that social capital has a more disaggregated community- and individual-based declination, which draws on network and community-specific attributes and that does not overlap with administrative boundaries. As we discuss more extensively in the third section, by adopting province units of analysis, we aim to come as close as possible to approximating the operation of proximity networks with the data that are currently available.
4. Besides the limited availability of data to measure the phenomenon at stake, one could have chosen to exclude the autonomous towns of Ceuta and Melilla due to their unique territorial specificities. In particular, their geographical location in Moroccan territory, their status as *porto franco* and the intense migration pressure they face from neighbouring countries would likely to lead to a downward-biased estimate of the migration effects on co-inventorships.
5. Social capital does not significantly affect co-inventorship per se, but only in interaction with migration. In this case, its main effect results are negative and significant, pointing to two opposing interpretations: substitution of transnational co-inventorships with domestic co-inventorships, or absolute reduction of co-inventorships. Unfortunately, the data do not allow one to test which interpretation is more suitable. Yet, when immigration is non-zero, the positive coefficients of the interaction terms on average compensate the negative effect (full estimates available from the authors upon request).
6. Hypothesis 2a.2 is confirmed when emigration is considered along with immigration in the same temporal window (model (7)), though immigrants' effect is mitigated.
7. This applies even if the magnitude of the immigrants' effect is drastically reduced when both immigrants and emigrants are included (model (11)).

8. This result does not rule out that co-inventions are promoted by language commonality, as this effect is absorbed by the bilateral effects.

ORCID

Anna D'Ambrosio http://orcid.org/0000-0002-7946-7695
Sandro Montresor http://orcid.org/0000-0002-1195-901X
Mario Davide Parrilli http://orcid.org/0000-0002-1210-403X
Francesco Quataro http://orcid.org/0000-0001-5746-2239

REFERENCES

Adler, P., & Kwon, S. (2002). Social capital: Prospects for a new concept. *Academy of Management Review, 27*, 17–40.

Agrawal, A., Cockburn, I., & McHale, J. (2006). Gone but not forgotten: Knowledge flows, labor mobility, and enduring social relationships. *Journal of Economic Geography, 6*(5), 571–591. doi:10.1093/jeg/lbl016

Agrawal, A., Kapur, D., & McHale, J. (2008). How do spatial and social proximity influence knowledge flows? Evidence from patent data. *Journal of Urban Economics, 64*, 258–269. doi:10.1016/j.jue.2008.01.003

Agrawal, A., Kapur, D., McHale, J., & Oettl, A. (2011). Brain drain or brain bank? The impact of skilled emigration on poor-country innovation. *Journal of Urban Economics, 69*(1), 43–55. doi:10.1016/j.jue.2010.06.003

Almeida, P., & Kogut, B. (1999). Localization of knowledge and the mobility of engineers in regional networks. *Management Science, 45*, 905–917. doi:10.1287/mnsc.45.7.905

Arrow, K. J. (1969). Classificatory notes on the production and transmission of technological knowledge. *American Economic Review, 59*, 29–33.

Autio, E. (1998). Evaluation of RTD in regional systems of innovation. *European Planning Studies, 6*, 131–140. doi:10.1080/09654319808720451

Basch, L., Glick Schiller, N., & Szanton-Blanc, C. (1994). *Nations unbound: Transnational projects and the deterritorialized nation-state*. New York: Gordon & Breach.

Bettin, G., & Cela, E. (2014). The evolution of migration flows in Europe and Italy. *Economia Marche Journal of Applied Economics, 33*(1), 37–63.

Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*(1), 61–74. doi:10.1080/0034340052000320887

Breschi, S., & Lissoni, F. (2001). Knowledge spillovers and local innovation systems: A critical survey. *Industrial and Corporate Change, 10*(4), 975–1005. doi:10.1093/icc/10.4.975

Breschi, S., & Lissoni, F. (2006a). *Mobility of inventors and the geography of knowledge spillovers. New evidence on US data* (KITeS Working Papers No. 184, revised). Milan: KITeS, Centre for Knowledge, Internationalization and Technology Studies, Università Bocconi.

Breschi, S., & Lissoni, F. (2006b) Knowledge networks from patent data: Methodological issues and research targets. In F. M. Henk, W. Glänzel, & U. Schmoch (Eds.), *Handbook of quantitative science and technology research* (pp. 613–643). Amsterdam: Springer.

Breschi, S., & Lissoni, F. (2009). Mobility of skilled workers and coinvention networks: An anatomy of localized knowledge

flows. *Journal of Economic Geography*, 9, 439–468. doi:10.1093/jeg/lbp008

Broekel, T., Brenner, T., & Buerger, M. (2015). An investigation of the relation between cooperation intensity and the innovative success of German regions. *Spatial Economic Analysis*, 10(1), 52–78. doi:10.1080/17421772.2014.992359

Brubaker, R. (2005). The 'diaspora' diaspora. *Ethnic and Racial Studies*, 28(1), 1–19.

Castles, S. (2002). Migration and community formation under conditions of globalization. *International Migration Review*, 36(4), 1143–1168. doi:10.1111/j.1747-7379.2002.tb00121.x

Chiffoleau, Y. (2005). Learning about innovation through networks: The development of environment-friendly viticulture. *Technovation*, 25 (10), 1193–1204. doi:10.1016/j.technovation.2004.04.003

Coe, N., & Bunnell, T. (2003). Spatialising knowledge communities: Towards a conceptualisation of transnational innovation networks. *Global Networks*, 3, 437–456. doi:10.1111/1471-0374.00071

Cooke, P., Heidenreich, M., & Braczyk, H.-J. (2004). *Regional innovation systems. The role of governance in a globalized world*, 2nd ed. London: Routledge.

D'Ambrosio, A. (2015). *Migration flows and local systems of production: New comparative evidence on Italy and Spain* (Doctoral thesis), University of Trento, Trento.

De Arcangelis, G., Di Porto, E., & Santoni, G. (2013). *Migration, production structure and exports* (Mimeo). http://doi.org/10.2139/ssrn.2249943

Dekker, P., & Uslaner, E. M. (2001). Introduction. In E. M. Uslaner (Ed.), *Social capital and participation in everyday life* (pp. 1–8). London: Routledge.

Dunlevy, J. (2006). The influence of corruption and language on the protrade effect of immigrants: Evidence from the American states. *Review of Economics and Statistics*, 88(1), 182–186. doi:10.1162/rest.2006.88.1.182

Faggian, A., & McCann, P. (2006). Human capital flows and regional knowledge assets: A simultaneous equation approach. *Oxford Economic Papers*, 58(3), 475–500. doi:10.1093/oep/gpl010

Felbermayr, G., Grossmann, V., & Kohler, W. (2015). Migration, international trade, and capital formation. *Handbook of the Economics of International Migration*, 1, 913–1025. doi:10.1016/B978-0-444-53768-3.00018-7

Frenken, K. (2000). A complexity approach to innovation networks. The case of the aircraft industry (1909–1997). *Research Policy*, 29(2), 257–272. doi:10.1016/S0048-7333(99)00064-5

Fukuyama, F. (1995). *Trust: The social virtues and the creation of prosperity*. New York: Free Press.

Gagliardi, L. (2015). Does skilled migration foster innovative performance? Evidence from British local areas. *Papers in Regional Science*, 94, 773–794. doi:10.1111/pirs.12095

Girma, S., & Yu, Z. (2002). The link between immigration and trade: Evidence from the United Kingdom. *Weltwirtschaftliches Archiv/Review of World Economics*, 138, 115–130. doi:10.1007/BF02707326

Gould, D. M. (1994). Immigrant links to the home country: Empirical implications for U.S. bilateral trade flows. *Review of Economics and Statistics*, 76(2), 302–316.

Head, K., & Mayer, T. (2014). Gravity equations: Workhorse, toolkit, and cookbook. In G. Gopinath, E. Helpman, & K. Rogo (Eds.), *Handbook of international economics* (pp. 131–195). Amsterdam: Elsevier.

Lewis, E. (2013). Immigration and production technology. *Annual Review of Economics*, 5(1), 165–191. doi:10.1146/annurev-economics-080612-134132

Maggioni, M. A., Uberti, E., & Usai, S. (2011). Treating patents as relational data: Knowledge transfers and spillovers across Italian provinces. *Industry and Innovation*, 18, 39–67. doi:10.1080/13662716.2010.528928

Maggioni, M. A., Uberti, T. E., & Nosvelli, M. (2017). The 'political' geography of research networks. FP6 within a 'two speed' ERA. *International Regional Science Review*, 40(4), 337–376.

Maurseth, P. B., & Verspagen, B. (2002). Knowledge spillovers in Europe: A patent citations analysis. *Scandinavian Journal of Economics*, 104(4), 531–545. doi:10.1111/1467-9442.00300

Miguélez, E. (2016). Inventor diasporas and the internationalization of technology. *World Bank Economic Review*. doi:10.1093/wber/lhw013

Miguélez, E., & Moreno, R. (2013). Research networks and inventors' mobility as drivers of innovation: Evidence from Europe. *Regional Studies*, 47(10), 1668–1685. doi:10.1080/00343404.2011.618803

Miguélez, E., & Moreno, R. (2015). Knowledge flows and the absorptive capacity of regions. *Research Policy*, 44(4), 833–848. doi:10.1016/j.respol.2015.01.016

Montobbio, F., & Sterzi, V.A. (2013). The globalization of technology in emerging markets: A gravity model on the determinants of international patent collaborations. *World Development*, 44(C), 281–299. doi:10.1016/j.worlddev.2012.11.017

Niebuhr, A. (2010). Migration and innovation: Does cultural diversity matter for regional R&D activity? *Papers in Regional Science*, 89, 563–585. doi:10.1111/j.1435-5957.2009.00271.x

Ottaviano, G. I. P., & Peri, G. (2006). The economic value of cultural diversity: Evidence from US cities. *Journal of Economic Geography*, 6, 9–44. doi:10.1093/jeg/lbi002

Paci, R., Marrocu, E., & Usai, S. (2014). The complementary effects of proximity dimensions on knowledge spillovers. *Spatial Economic Analysis*, 9, 9–30. doi:10.1080/17421772.2013.856518

Paci, R., & Usai, S. (2000). Technological enclaves and industrial districts: An analysis of the regional distribution of innovative activity in Europe. *Regional Studies*, 34(2), 97–114. doi:10.1080/00343400050006032

Paci, R., & Usai, S. (2009). Knowledge flows across the European regions. *Annals of Regional Science*, 43, 669–690. doi:10.1007/s00168-008-0256-5

Parrilli, M. D. (2012). Heterogeneous social capital: A window of opportunity for local economies. In P. Cooke, M. D. Parrilli, & J. L. Curbelo (Eds.), *Innovation, global change and territorial resilience* (pp. 230–245). Cheltenham: Edward Elgar.

Peri, G., & Requena-Silvente, F. (2010). The trade creation effect of immigrants: Evidence from the remarkable case of Spain. *Canadian Journal of Economics/Revue Canadienne d'économique*, 43(4), 1433–1459. doi:10.1111/j.1540-5982.2010.01620.x

Peri, G., & Sparber, C. (2009). Task specialization, immigration, and wages. *American Economic Journal: Applied Economics*, 1(3), 135–169. doi:10.1257/app.1.3.135

Picci, L. (2010). The internationalization of inventive activity: A gravity model using patent data. *Research Policy*, 39, 1070–1081. doi:10.1016/j.respol.2010.05.007

Piore, M. J. (1986). Perspectives on labor market flexibility. *Industrial Relations: Journal of Economy and Society*, 25, 146–166. doi:10.1111/j.1468-232X.1986.tb00677.x

Ponds, R., Van Oort, F., & Frenken, K. (2007). The geographical and institutional proximity of research collaboration. *Papers in Regional Science*, 86, 423–443. doi:10.1111/j.1435-5957.2007.00126.x

Portes, A. (1995). *The economic sociology of immigration*. New York: Russell Sage Foundation.

Portes, A. (2000). Globalization from below: The rise of transnational communities. In D. v. d. L. Kalb, R. Starting, B. van Steenbergen, & N. Wilterdink (Eds.), *The ends of globalization: Bringing society back in* (pp. 253–271). Lanham: Rowman & Littlefield.

Portes, A., & Sensenbrenner, J. (1993). Embeddedness and immigration: Notes on the social determinants of economic action. *American Journal of Sociology*, 98, 1320–1350. doi:10.1086/230191

Putnam, R. (1995). Bowling alone: America's declining social capital. *Journal of Democracy*, 6, 65–78. doi:10.1353/jod.1995.0002

Putnam, R. (2000). *Bowling alone: The collapse and revival of American community*. New York: Simon & Schuster.

Putnam, R., & Goss, K. A. (2002). 'Introduction'. In R. Putnam (Ed.), *Democracies in flux. The evolution of social capital in contemporary society* (pp. 1–19). Oxford: Oxford University Press.

Quatraro, F., & Usai, S. (2017). Are knowledge flows all alike? Evidence from European regions. *Regional Studies*, 51(8), 1246–1258. doi:10.1080/00343404.2016.1240867

Rauch, J. (1999). Networks versus markets in international trade. *Journal of International Economics*, 48(1), 7–35. doi:10.1016/S0022-1996(98)00009-9

Rauch, J., & Trinidade, V. (2002). Ethnic Chinese networks in international trade. *Review of Economics and Statistics*, 84(1), 116–130. doi:10.1162/003465302317331955

Sassen, S. (1998). *Globalization and its discontents*. New York: New York Press.

Saxenian, A. (2006). *The new Argonauts: Regional advantage in a global economy*. Cambridge, MA: Harvard University Press.

Schuller, T., Baron, S., & Field, J. (2000). Social capital: A review and critique. In S. Baron, J. Field, & and T. Schuller (Eds.), *Social capital: Critical perspectives* (pp. 1–38). Oxford: Oxford University Press.

Singh, J. (2005). Collaborative networks as determinants of knowledge diffusion patterns. *Management Science*, 51, 756–770. doi:10.1287/mnsc.1040.0349

Sonderegger, P., & Taube, F. (2010). Cluster lifecycle and diaspora effects: Evidence from the Indian IT cluster in Bangalore. *Journal of International Management*, 16, 383–397. doi:10.1016/j.intman.2010.09.008

Thompson, P., & Fox-Kean, M. (2005). Patent citations and the geography of knowledge spillovers: A reassessment. *American Economic Review*, 95(1), 450–460. doi:10.1257/0002828053828509

Tödtling, F., & Trippl, M. (2005). One size fits all?: Towards a differentiated regional innovation policy approach. *Research Policy*, 34(8), 1203–1219. doi:10.1016/j.respol.2005.01.018

Trippl, M. (2013). Scientific mobility and knowledge transfer at the interregional and intraregional level. *Regional Studies*, 47(10), 1653–1667. doi:10.1080/00343404.2010.549119

Vertovec, S. (1999). Conceiving and researching transnationalism. *Ethnic and Racial Studies*, 22(2), 447–462. doi:10.1080/014198799329558

Wagner, D., Head, K., & Ries, J. (2002). Immigration and the trade of provinces. *Scottish Journal of Political Economy*, 49(5), 507–525. doi:10.1111/1467-9485.00245

Williams, A. (2007). Listen to me, learn with me: International migration and knowledge transfer. *British Journal of Industrial Relations*, 45, 361–382. doi:10.1111/j.1467-8543.2007.00618.x