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Migration and Innovation Diffusion: An Eclectic Survey

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Migration et Diffusion de l'Innovation : Une revue éclectique

Résumé

Dans la nouvelle ère de migration de masse, dans laquelle des individus hautement qualifiés jouent un rôle crucial, le rôle de la migration dans la diffusion de l'innovation est une question d'actualité. On rassemble plusieurs volets de la littérature, à partir de l'histoire des minorités religieuses jusqu'à l'analyse spatiale des flux de connaissances. Trois thèmes principaux se dégagent: la distinction entre mobilité et migration, les directions des flux ainsi que des contenus. La migration soutient la diffusion de l'origine aux pays d'accueil, mais aussi dans le sens opposé, ainsi que dans et à travers des destinations. La distinction entre l'accès à l'information et les échanges de connaissances reste un élément majeur du programme de recherche.

Mots-clés : migration ; innovation ; diffusion

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Abstract

In the new era of mass migration, with highly skilled individuals playing a key role, the role of migration in innovation diffusion is a topical issue. The paper organizes several strands of literature, from the history of religious minorities to the spatial analysis of knowledge flows. Three main themes emerge: the distinction between mobility and migration, the directions of flows, and their contents. Migration supports diffusion from origin to host countries, but also in the opposite direction, as well as within and across destinations. Distinguishing between information access and knowledge exchanges remain a major item of the research agenda.

Keywords : migration ; innovation ; diffusion

JEL : O33, F22, J61

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"… divers aliens come from beyond the seas and work in London, few or none having served for the trade of weaving, neither have they any certificate of what religion they are or of their learning the said trade or of their good behaviour, or of their honest departure out of their country…" (Weavers Company's complaint against Dutchmen, London, 1635; cited in Luu, 2005, p.204)

"Through the ages, the main channel for the diffusion of innovations has been the migration of people" (Cipolla, 1972; p. 48)

1. Introduction[1]

We live in a new age of mass migration, very similar, in absolute numbers, to that of the XIX century (Hatton and Williamson, 2005). Differently from the past, highly skilled individuals represent a substantial and increasing share of international mobility flows: migration rates for the tertiary educated are higher than for the rest of the population, and generally increase with further education (Arslan et al., 2014, Artuc et al., 2015, Ferrie and Hatton, 2013, Hatton, 2014, Widmaier and Dumont, 2011, Ozden et al., 2011). Far from taking place exclusively along a South-North or East-West axis, highly skilled migration occurs also between advanced economies, as confirmed also by evidence on doctoral holders and scientists (Auriol, 2010, De Grip et al., 2010, Freeman, 2010, Franzoni et al., 2012).

The size and share of highly and very highly skilled migration has resurrected the interest of many scholars in the possible connections between migration and innovation. What was once a research theme typical of economic history is nowadays on the agenda of several other disciplines. Economic geographers examine the impact of migration and related cultural variety on the innovation rates of regions and cities (Cooke and Kemeny, 2016, Niebuhr, 2010, Ozgen et al., 2013) as well as on productivity (Ottaviano and Peri, 2005, 2006, and 2012; Bellini et al., 2013). Labour economists focus on how well foreign scientists and engineers fit in the economies of

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the US and other advanced countries, also in relation to the possible displacement of local knowledge workers (Borjas, 2004, Borjas, 2009, Hunt and Gauthier-Loiselle, 2010, Hunt, 2015) or the disruption of pre-existing geographical equilibria (Kerr, 2009, Grogger and Hanson, 2013). Development economists discuss whether the countries suffering of a "brain drain" can compensate it by gaining access to the destination countries' knowledge, either through social networks, return migration, or foreign direct investments (Beine et al., 2008, Boeri et al., 2012, Docquier and Rapoport, 2012).

Either directly or indirectly, this booming literature makes assumptions, raises research questions or collects evidence on a specific contribution of migration to innovation, namely the diffusion of scientific and technical knowledge, under the form of trade secrets, private information, know-how, or practical skills. This diffusion process has an inherent geographical dimension, both global and local. This is true, in particular, of three research streams, namely:

1) The history of innovation diffusion in modern Europe, with special reference to the role of religious minorities
2) The economic analysis of the role of ethnic minorities and migrants in international trade and FDIs
3) The geographical research on the spatial limits of knowledge spillovers, and the role of social ties

In what follows, we review all of these streams and discuss how much light they cast on three key conceptual issues:

1) The *distinction* between mobility and migration. A large literature exists on the relationship between skilled labour mobility and knowledge diffusion, either domestic or international (Agrawal et al., 2006, Almeida and Kogut, 1999, Breschi and Lissoni, 2009, Oettl and Agrawal, 2008, Song et al., 2003). However, migration is a special instance of international mobility, in which the individual's choice to settle in a new country is part of a more general trend (such as the ongoing migration of scientists and engineers from China to the US; Borjas et al., 2015) or shock (as with the fled of Jewish scientists from Nazi Germany; Waldinger, 2012; Moser et al., 2014). How large the trend or shock is, in absolute numbers or relative to the countries of origin or destination, is a secondary question (albeit an important one). What really matters is whether a distinctive group of migrants affect diffusion more than the sum of unrelated mobility instances. Answering this question implies assigning some importance to the social structure of migrant groups.
2) The *direction* of diffusion flows. Innovation inputs may travel along with migrants, that is from the origin countries to the destination ones, as well as in the opposite direction, as when migrants transfer back home the scientific or technical knowledge they acquired abroad. But they may also circulate among fellow migrants in one or several destination countries. In relation to this, we will also discuss the role of

"diasporas", a concept we find both in the academic literature and in several policy initiatives, aimed at leveraging the migrants' diffusion potential (Kapur, 2001, Kuznetsov, 2006, Kuznetsov, 2010, Meyer and Brown, 1999, Meyer, 2001).[2]

3) The *contents* of diffusion flows. A classic distinction proposed by innovation scholars is the one between knowledge and information (Cowan et al., 2000). The former is usually referred to scientific or technical notions, the second to prices, business opportunities or suppliers' and customer's identity. Both can be private and necessary for innovation, but information alone may suffice to explain industry localisation, even in the absence of innovation (Sorenson, 2003). Hence, we need to appreciate their relative importance in order both to improve our understanding of diffusion phenomena, and to evaluate any policy initiative targeting highly skilled migrants as sources of innovation.

The paper is organized as follows. Section 2 revisits the historical evidence on migration and innovation, and the differences between the former and individual mobility. Based on this, it proposes a 4-entry taxonomy for organizing contemporary studies, according to the direction of diffusion. Section 3 examines each entry in depth. Section 4 concludes.

2. Mobility vs migration: lessons from economic history

The role of migration in diffusion of innovations is a classic topic in economic history (Cipolla, 1972, Hilaire-Pérez, 2008). An especially rich literature exists on modern Europe, from the XVI century to the Industrial Revolution, and on the relative importance of two diffusion channels:

1) The international mobility of individual craftsmen, in response to specific incentives put in place by several European states or cities, with the purpose of importing foreign trade secrets and best practices (Belfanti, 2006, Dolza and Maitte, 2004).

2) The migration of political and religious minorities, in particular Protestants escaping Spanish repression in the Low Countries and Flanders in the late XVI century, and the Huguenots fleeing France after the revocation of the Edict of Nantes in 1685 (Scoville, 1951, Schilling, 1983).

[2] Over the past half-century, "diaspora" has progressively become a passe-partout word to indicate any widely dispersed ethnic community and the social networks therein. Besides the original reference to Jewish history (loaded with emphasis on the absence of a home country), one find nowadays mentions of Chinese, Indian, Russian or Italian diasporas, and many more. References are also made to diasporas-within-diasporas, such as the distinction between an Old and a New Indian diaspora, or to Chinese in South-East Asia (Dufoix, 2008). The economics of migration uses the term even more causally, simply to indicate any stock of migrants from origin country *i* in destination country *j* (Beine et al., 2011).

With reference to the first channel, the incentives offered by the destination countries or cities consisted of temporary monopolies in exchange for the training of local apprentices. These arrangements, which are at the origin of modern patents, required the craftsmen to settle in the destination country for quite some time, thus making them more similar to migrants than to journeymen. To be successful, however, these initiatives required the availability of a skilled and/or receptive workforce at destination as well as of high quality inputs, both of which were hard to obtain if the host city or country lagged very much behind the origin one. In several cases, craftsmen solved the workforce problem by moving along with their employees and extended families, thus making this form of mobility even more closely resembling to migration. As for inputs, their provision required circumventing export prohibitions from the origin countries or cities, as with smuggling. This, in turn, made it necessary to obviate to isolation by keeping commercial contacts with the home cities or countries (Belfanti, 2004, Cipolla, 1972).

Isolation was less of a problem for migrant minorities, whose historical accounts have a distinctive geographical flavour and anticipate many contemporary themes. These religious refugees tended to move in large number and to settle in selected towns or areas within cities. In a few instances, these locations developed important clusters (such as glassmaking and clockworks in London, or textiles in Prussia) some of which lasted over a considerably long time. The debate on the extent of their contribution to innovation diffusion can be subsumed by the contrast between two perspectives: the transfer-based and the community-centred (Luu, 2005).

i. *Transfer-based.* In classic accounts of religious minorities' contribution to diffusion, migrants arrived at destination bringing along their home-grown skills, and passed them on to local workers, who in turn developed the local industry. Possible obstacles in the process were local hostility towards strangers or the resistance by local guilds and trade associations. According to this view, the Protestant migration was more successful than others thanks to the climate of religious tolerance in the destination countries, the protection of high authorities, and its coincidence with a progressive liberalisation of markets (Scoville, 1952a, Scoville, 1952b).

   A number of case studies, however, have re-examined the original case-study evidence and found it wanting, opening the way for a "revisionist" literature (Hilaire-Pérez and Verna, 2006). This has focussed on instances of reverse causation, with migrants being attracted to pre-existing clusters and benefiting from local technologies, rather than contributing to them. As a reaction, cliometricians have attacked the problem with econometric weaponry. In particular, Hornung (2014) has established a clear migration-to-innovation causality by exploiting the exogeneity of Huguenots' locational patterns in post XVII century Prussia. Huguenots who found refuge in Prussia did not choose where to locate, but were sent by the Prince Elector of Brandenburg to repopulate cities ravaged by the Thirty Years War. There they specialized in the textile sector. It is then possible to compare the productivity growth in different cities, using the Huguenots'

presence as a treatment in a difference-in-difference framework. It is found that the percentage of resident Huguenot population in 1700 still predicts significantly per-worker productivity in the textile industry in 1802, with elasticity higher than one. The same does not apply to other industries. This implies that immigrants provided not only a discrete increase in the technological level of recipient cities, but also set up a long-term dynamics.

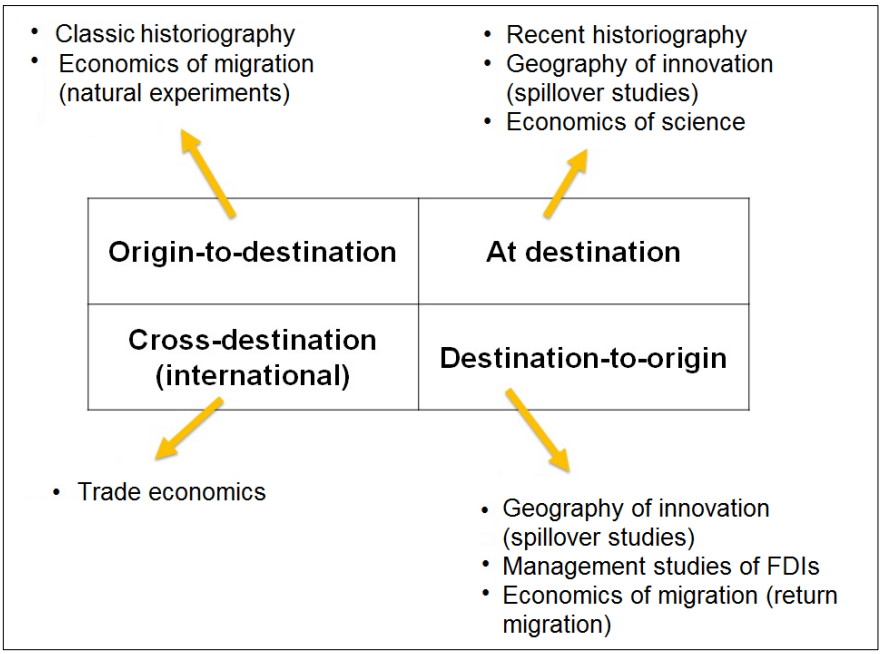
ii. *Community-centred.* The most recent historiography stresses that it is quite unlikely that all religious refugees were skilled individuals, or at least skilled in the trades in which their community specialized. For example, many Huguenots who reached London were artisans versed in different trades than those for which their coreligionists had become successful. Others were just peasants. Still, migration played an important role in diffusion, as a result of the interplay between opportunities, constraints, and social networks (Luu, 2005). Migrants specialised in the few trades that were left open to them by social discrimination, legal restrictions or simply lack of capital and business opportunities. New arrivals picked up the skills from masters from within their own community, to whom they were often referred by the local churches, and to whom they related more easily than to English masters for language or cultural reasons. Availability of such workforce helps explaining why technology transfer through migration often worked better than that the import of isolated masters. In fact, it allowed enough time for the skills to be passed on to local apprentices, through the natural blending of the foreign community in the local one, as opposed to more abrupt attempts of technology transfer.

This historical debate suggests an important dimension around which to regroup and organize the booming literature on migration and innovation, namely the geography (direction and spatial extension) of diffusion flows, thus compensating for its disciplinary fragmentation. As illustrated by figure 1, four directions are possible, each of which has been investigated by different streams of literature:

1) Origin-to-destination. This is both the main theme of the transfer perspective of classic historiography and of a recent wave of studies on the migration of scientists. Much attention is paid to the endogeneity problem we highlighted above, which explains the econometric turn taken by this literature
2) At destination. By investigating the relative importance of social ties vs. spatial proximity, the geographical literature on localized knowledge spillovers has paid increasing attention to ethnic communities and their role in knowledge or information dissemination. Some evidence also comes from the economics of science. Both are reminiscent of the community perspective in history.
3) Destination-to-origin. While historical studies focussed mainly on migration from more to less advanced countries, a large part of today's highly skilled migration runs in the opposite direction. Scholars from different fields have investigated different diffusion channels expatriates can contribute to, such as spillovers, foreign direct investments, and return migration.

4) Cross-destination. Historians insist on the diasporic dimension of migration phenomena, that is on exchanges among migrants across different destination countries and, in several cases, their persistence over time (that is well beyond the first generation of migrants). International trade scholars have been so far the only economists to pursue systematically this line of research.

Figure 1. Migration and diffusion flows: a direction-based taxonomy



The historical debate provides us with a further template to organize the recent literature on migration and innovation, which refers to the contents of diffusion flows. Far from channelling only technical or scientific knowledge, migrants carry with them information of all sorts. It is important to assess to what extent the latter is a complementary, and possibly necessary input to innovation, or just a way for migrants to obviate to the exclusion from top scientific or technological networks. We will come back more than once to this issue.

3. Directions and contents of diffusion

3.1 Origin-to-destination

The best example of contemporary origin-to-destination studies concerns the migration of Russian scientists right after the collapse of the Soviet Union, especially to the US. Besides being interesting *per se*, this historical episode can be regarded as a natural experiment, one in which migration is the result of an exogenous

shock (which neither the migrants nor the destination countries could anticipate). This is most useful to establish a clear causal link from migration to diffusion, thus preventing any revisionist critique.[3]

Ganguli (2015) focusses on the differential impact of Russian scientists by city of destination, within the US. Based on publications listed on the Web-of-Science, she identifies a large number of Russian authors active both before and after 1990, with a pre-1990 exclusive USSR affiliation, and a post-1990 US one. First, the analysis is conducted at the city and scientific field level. It is shown that the city-field inflow of Russian scientists affects positively and significantly the number of post-1990 citations to pre-1990 USSR publications (the inflow of Russian scientists is instrumented by the percentage of city residents of Russian origin). Second, based on a matched sample of pre-1990 publications by migrant and non-migrant USSR authors, difference-in-difference analysis shows that citations to migrants' publications increase sensibly after the latter's move to the US (self-citations are excluded).

Ganguli's (2015) results are rather persuasive in showing that Russian migrant scientists carried with them important knowledge assets, complementary to those in print, and that managed to diffuse them locally (that is, through direct social interaction). Still, the paper is silent on their overall impact on the US science system.

Borjas and Doran (2012, 2015) provide a sceptical view on this point. In accordance with a research line typical of labour economics, the two authors focus on the migrants' specialisation and the displacement of similarly specialised native workers. In particular, they pick up the case of mathematicians, for whom very detailed microdata are available, including each authors' location and a classification of papers by field. Borjas and Doran (2015) propose a simple formal treatment of the two effects of migration: an increased competition for resources and attention (both presumed scarce) and some positive externalities in the forms of knowledge spillovers. The former pushes native scientists away from the migrants' fields of specialization, while the latter acts as an attraction force. After claiming that measuring separately the two effects is very hard, if not impossible, the authors propose various proxies of what they call "cognitive mobility", whose sign and extent is meant to capture the net result of the two countervailing forces. One such measure is the probability, for a paper published at time $t>1$ by US mathematician i, to occur in a field different from the same mathematician's paper at $t=1$ (which is taken as representative of i's initial specialization). This probability is found to be higher for mathematicians whose initial specialization occurred in a field typical of Russian immigrants and, most importantly, to increase after the migration shock. The result is interpreted as evidence of the net outcome to be

[3] A similar, and historically more significant, natural experiment concerns the Jewish scientists fleeing Nazi Germany. Moser et al. (2014) estimate the long-run effect of this migration wave on US Chemistry. In order to do so they compile biographical records for all German and Austrian Chemistry professors active around 1930, and identifyl their patents at the USPTO until 1970. This allows to identify, among all the technological fields related to Chemistry, those that were affected by German Jewish migration and those that were not. Through a difference-in-difference regression they show that the US inventors in the affected fields became more productive after the migrants' arrivals, and more and more so over several decades.

dominated by the competition effect. This conclusion, however, does not hold when focussing on highly productive local scientists. In this case, no cognitive mobility occurs as a response to migration. This is indicative of knowledge spillovers to depend on the local scientists' skill level, with the most skilled ones standing to benefit from migration, at the expenses of the others. Complementary findings by Borjas and Doran (2012) show that young US mathematicians active in the Russian migrants' fields of choice saw their publication and career prospects significantly curtailed by immigration, and that the associated loss of scientific publications was barely compensated by the additional activity of the migrant scientists and their US students.[4]

While impressive for its data richness and econometric accuracy, Borjas' and Doran's analysis is not yet conclusive. The authors document the extent of displacement effects within academia, but do not capture entirely the diffusion effects of immigration, for example those accruing to industry (through technology transfer) or to human capital formation (through teaching). By their own admission, they also fall short of documenting whether displaced local scientists improved total welfare by moving into fields in which they hold a comparative advantage.

3.2 At destination

As heirs of the transfer-centred tradition, studies on Russian migrant scientists are all but silent on the interactions among migrants and their implications for the overall knowledge diffusion. Some evidence in this direction comes from another set of studies, which share a community-centred perspective and a focus on larger-scale, more policy-relevant migration phenomena. Their main goal is not to establish a causal connection between movement of people and knowledge transfer (which explains why they abandon the natural experiment methodology), but to assess the importance of social ties among fellow expatriates (conventionally, albeit imprecisely, called "ethnic" ties).

Agrawal et al. (2008) build upon Jaffe et al.'s (1993) classic experiment on the localization in space of knowledge flows, as measured by patent citations (self-citations at the company or individual level are excluded). With reference to a set of patents by US-resident inventors of Indian origin, the authors build a matched sample

[4] Borjas and Doran (2015b) also study the effects of post-Soviet scientists' migration in terms of knowledge loss for their origin country, in the footsteps of a recent line of research that exploits exogenous shocks to ongoing scientific collaborations. (See Waldinger (2012) on the fled of Jewish scientists from Nazi Germany and the consequences for the collaborators they left behind; and Azoulay et al. (2010) on the collaborators of scientific "stars", after the latter's death, when unexpected). Borjas and Doran focus on the Russian scientists of Jewish origin (whose propensity to leave for the former USSR was particularly high) and find both positive and negative effects of their migration on non-migrant scientists. They explain the former with the lower competition for resources and attention faced by non-migrants, and the latter with a loss of social capital (and related knowledge assets) endured by migrants' former collaborators. Keeping up with their sceptical view of migration and diffusion, Borjas and Doran suggest that the negative effect hardly offsets the positive ones, and only in case the migrant scientist was a very productive one.

of citing and non-citing patents (all from the US) and test whether the probability of citation depends not only on the physical distance between inventors, but also on whether the inventors are tied by a common Indian origin. The latter is assessed by looking at the inventors' surnames, focussing on the most frequent ones in the phone directories of large Indian cities. By focussing only on patents by US-resident inventors, Agrawal and co-authors choose to ignore international knowledge flows, and limit their results to knowledge circulation within the migrants' destination country. Ethnic ties are found both to increase the probability of citation, albeit not as much as co-location in space, and to act as substitutes of physical distance. This means they kick in when inventors are dispersed in space, thus providing an alternative diffusion channel.

Breschi et al. (2015) extend this type of analysis to other groups of foreign inventors in the US, who are assigned to different countries of origin based on extensive name and surname analysis[5]. They consider ten out of the top twenty countries of origin of highly skilled migrants to the US, according to DIOC data (China, India, Iran, Japan, and South Korea for Asia; France, Germany, Italy, Poland, and Russia for Europe) [6]. In addition, they control for other forms of social distance between inventors, namely path lengths on the network of inventors, as derived from co-inventorship patterns (Breschi and Lissoni, 2009). Ethnic ties are found to matter, but only for Asian countries and Russia. In addition, they tend to kick-in only at high social distances in the network of inventors, that is as substitutes of other professional links very much in line with the community perspective. The lack of evidence for Europeans (non-Russians) may be explained either by a cohort effect and/or a composition effect. In the first case, inventors associated to these countries of origin may include US-born individuals with just remote European ancestry, but with few or no co-ethnic ties. In the second case, many inventors may be temporary migrants working for multinational companies, whose corporate ties matter more than ethnic ones.[7]

Overall, findings on patent citation patterns are suggestive of a "diaspora effect" at work, at least for some countries of origin. In the jargon of social network analysis, country-based homophily seem to play an important role in the individual's choice of contacts, and in the resulting diffusion patterns.

A more explicit test is attempted by Freeman and Huang (2015), based upon a very large sample of scientific publications by US-resident authors (over 2.5mil observations, 1985- 2007). Based on surnames, the

[5] The authors exploit IBM-GNR, a large dataset of names and surnames and their worldwide/within-country frequency. See also Breschi et al. (2016)

[6] DIOC is a reference database on international migration for cross-country analysis. Originally limited to OECD countries, it has been progressively extended to non-OECD ones (Widmaier and Dumont, 2011; Arlsan et al., 2014; Artuc et al., 2015).

[7] On the substitutability of ethnic ties with physical proximity and professional ties, see also Nanda and Khanna (2010). The two authors do not consider diffusion at destination, but diffusion within the home country of migrants (in their case, India). By comparing IT entrepreneurs located in major hubs to others located in minor centres, they find the latter to rely more on contacts with the Indian diaspora, in response to the paucity of local sources. They also find that firms owned by return migrants have higher profits than those of natives, conditional on being located in minor centres.

authors are distributed across nine, rather heterogeneous ethnic groups.[8] Each paper is assigned an homophily score (a simple Herfindhal index calculated on the shares of authors from each ethnic group). This is compared to a benchmark value of the same index, based on a random distribution of authors by group, conditional on the relative numerosity of groups for each position on the authors' by-line. The observed score is found to differ significantly from its benchmark value, which suggests that co-authorship is at least partly driven by co-ethnicity. Exploratory regression analysis also finds an inverse correlation between the homophily of a paper and the academic prestige of first and second authors, as well as with the paper's citation impact. Overall, these results suggest that fringe scientists, who have limited access to scientific leaders, rely more on co-ethnic ties. This is a sign of weakness, rather than strength, but whether it is a peculiarity of migrant or foreign-origin scientist, or a more general finding for all ethnic groups (including autochthones), is hard to say, due to the loose surname classification system[9]. The causality link is also left undetermined. Still, Freeman's and Huang's results, joint with the evidence on the very high rates of scientists' migration, resonate with the community perspective in the historical literature, and the role it assigns to local diasporas in supporting its members' careers in the lines of activity left open to migrants and minorities.

The community perspective complements the transfer one not only with respect to the directions of diffusion and the role of social ties among migrants. It also attracts our attention to other innovation inputs being diffused, beyond scientific and hi-tech knowledge, which are decisive for entrepreneurial success. A large literature exists on migrants' exceptional rates of entrepreneurship in selected low-tech sectors, which is largely due to the circulation of basic skills and/or private information on prices and business contacts. Luu (2005) draws a parallel between the high specialisation and entrepreneurial propensity of Dutch and Huguenots in XVI century London and the role of ethnic minorities in the New York garment industry, as reported by Waldinger (1986). Kerr and Mandorff (2015) provide both a theoretical model and a quantitative test for recent migration to the US. The theoretical model opposes two explanations for migrants' specialisation: the existence of restrictions on selected activities (either legal or derived from socio-linguistic obstacles) vs information acquisition through social interaction. Based on US census 2000 data for the 30-65 year old male population, by country of birth and language spoken, the authors identify 77 ethnic groups active in 200 industries, further distinguishing between self-employed (entrepreneurs) and other workers. Entrepreneurial specialisation, by ethnic group, is found to depend negatively on the group size and positively on its endogamy (intra-ethnic marriage, to be interpreted as

[8] The ethnic groups come from Kerr (2008), who pioneered large scale analysis of surnames by exploiting a classification system originally conceived for ethnic-based marketing in the US. The groups range from the very generic (such as "Anglo-Saxon", "European", or "Hispanic") to the rather specific (such as "Chinese", "Indian", "Japanese", "Korean", "Russian" and "Vietnamese"). In some instances, the same author may be assigned to more than one group, with probabilities attached.

[9] More specific evidence is provided by Almeida et al. (2015) for US-resident Indian inventors, whose patent quality decreases when reliance on co-ethnic inventors is very high (the latter is measured by either the percentage of co-invention ties with other Indian inventors or the percentage of backward citations to such inventors' patents).

an index of cohesiveness of the group). In addition, Kerr and Mandorff find an earning premium for entrepreneurs active in the sectors of specialization of their own ethnic group, which indicates that specialisation results from information access rather than entry restrictions.

3.3 Destination-to-origin

The emigration of scientists and engineers has been for long regarded as a threat to the innovation potential of the origin countries, witness the popularity of the "brain drain" concept in both the scholarly literature and the public discourse. Allegedly, the term first appeared in 1963 in an advanced country such as the UK, along with a Royal Society's report on the migration of local scientists and engineers to the US (Johnson, 1965, Balmer et al., 2009). It was popularised in the following 20 years or so, in order to emphasize the loss of human capital endured by countries such as India or South Korea, at a time when they were then scaling up their investments in higher education (Bhagwati, 1976). Starting in the 2000s, migration economists have resurrected the topic, but they have mostly explored the extent of compensating "brain gain" mechanisms, the most important one for this survey being reverse knowledge flows (survey by Doquier and Rapoport, 2012; see also Bhagwati and Hanson, 2009, and Boeri et al., 2012).[10]

The literature on reverse knowledge flows can be organised in three groups. The first group is a direct extension of geographical research on knowledge spillovers and ethnic networks. The second group explores the role of highly skilled migrants in facilitating foreign direct investments (FDIs). The third group, from both migration economics and management studies, concentrates on return migration.

3.3.1 Spillovers via ethnic networks

The pioneer study on migration and international knowledge diffusion is that of Kerr (2008), who calculate the number of citations running from USPTO patents by non-US resident inventors (1985-97) to patents filed up to ten years before by US-resident ones[11]. Inventors are classified according to the same ethnic groups in Freeman and Huang (2015)[12]. Each ethnic group corresponds to a set of possible countries of origin. Co-ethnic citations (in which the cited inventor's country of origin and the citing inventor's country of residence coincide) are found to be on average 50% more numerous than mixed ones, controlling for the technological class. Kerr

[10] A further brain gain channel, less immediately connected to knowledge diffusion, consists in increasing the "education incentive" in origin countries (Beine et al., 2008). According to this view, the possibility to migrate increases the value of education offered by local universities (although not all the graduates will eventually migrate). This allows the higher education system to survive, if not to grow, especially where the local demand for highly educated workers would be insufficient to generate enough students of scientific and technical subjects to compensate for the fixed costs of the system.

[11] For another early study, based upon total factor productivity analysis and DIOC data, see Lodigiani (2009)

[12] See footnote 6.

(2008) further uses patent data as regressors in a first-difference panel data econometric exercise, with economic growth in countries of origins as the dependent variable. He finds that a one percentage point increase of ethnic patents in the US is associated to a significantly larger percentage increase in the country of origin's growth. The result weakens, but resists, when excluding either China from the origin country set, or Computer and Drugs from the technologies considered. This suggests that ethnic-mediated spillovers, while having a stronger impact in high technologies and in one particular economy (China), are not irrelevant for a more general set of countries and technological fields.

Agrawal et al. (2011) extend their previous analysis of patents by US-resident Indian inventors and consider the citations they receive from abroad (as opposed to domestic citations, as in Agrawal et al., 2008; see section 3.2). The evidence for a role of ethnic ties considerably weakens, with the only (partial) exception of Electronic technologies. In other words, while Indian inventors in the US have a clear advantage in accessing the knowledge produced by co-ethnic inventors also based in the US, the same does not apply to inventors in India. Notice that Agrawal et al. (2011) do not consider patent citations running from Indian subsidiaries to headquarters of US companies, nor returnees' self-citations, all of which are included in Kerr's (2008) aggregate measures. Therefore, their results are better seen as a qualification of Kerr's, suggesting that, if any brain gain occurs (for India), it is not through pure knowledge spillovers (but possibly through other feedback mechanisms).

Miguelez (2016) studies how migrant inventors in industrialized countries help increasing the internationalization of inventive activity in their countries of origin. Migrant inventors are identified on the basis of information on their nationality, as provided by patent applications filed according to the Patent Cooperation Treaty (PCT) procedure from 1990 to 2010[13]. Using a gravity model, and instrumenting in order to obviate to endogeneity problems, the author finds evidence of a strong and positive relationship between international collaboration in patenting activities between pairs of developing-developed nations and the stock of migrant inventors from that particular developing nation living in the host developed nation. Noumedem Temgoua and Miguelez (2015) extend this approach to patent citations as indicators of bilateral knowledge flows, finding similar results.

3.3.2 Migrants and FDIs

Knowledge feedbacks measured by patent citations, as well as knowledge exchanges we presume to take place though international co-inventorship, have great importance for innovation because of their scientific or technological contents. Still, as the historical literature teaches us, migrants also acquire and transmit other important immaterial inputs, such as information on prices, business contacts and local practices (legal,

[13] The PCT database is also used for robustness checks by Breschi et al. (2015) and is rapidly establishing itself as an important open access resource for studies on migration and innovation. A detailed description of the data can be found in Miguelez and Fink (2013).

organizational or, broadly speaking, cultural) in both the origin and destination countries. Some consolidated literature exists, which documents the association between past migration flows and FDIs (mostly from the US) into the migrants' origin country, with an increasing effort to establish causality links (Gao, 2003, Buch et al., 2006, Kugler and Rapoport, 2007, Docquier and Lodigiani, 2010, Javorcik et al., 2011, Burchardi et al., 2016). A similar literature exists on the relationship between migration and trade, on which we come back below.

A few recent papers focus more explicitly on the role of migrant inventors, and the special role they may have in linking FDIs to innovation. Foley and Kerr (2013) exploit Kerr's (2008) database to investigate the specific role of ethnic inventors in relation to R&D-active multinational companies and their investment decisions. In particular, they find that US multinationals with a high share or number of patents by migrant inventors invest and innovate more in such inventors' countries, while at the same time relying less on joint ventures with local companies for doing so. This suggests that migrant inventors act as a substitute of local intermediaries, thus diminishing their companies' costs of engaging into foreign direct investments.

Kerr and Kerr (2016) examine this evidence more in depth, with reference to the role of migrant inventors in the off shore patenting activity of US multinationals. In particular, they distinguish between purely foreign and "collaborative" patents, the former being produced only by inventors residing abroad, the latter also including US-resident inventors. These are further classified by ethnicity, so that a subset of collaborative patents can be identified, which include those whose inventors are likely to be migrants from the same country with which the collaboration is established ("own-ethnicity" collaborative patents). It is then shown that the percentage of collaborative over total foreign patents grows over the 1990s, at a time when US multinationals started patenting not only in other advanced countries, but also in developing and emerging ones. In addition, the same percentage declines with the multinational's inventive experience in a country (time elapsed since the first patent by country-resident inventors), but only in developing and emerging countries. A simple econometric exercise shows that the probability for a foreign patent to be collaborative, especially of the own-ethnicity type, is the higher the lower the average English proficiency of the foreign country, as well as the weaker the rule of law and the IP protection. Overall, this evidence is compatible with the need of foreign-patenting multinationals to learn about the countries wherein they wish to conduct inventive activity, and this is made possible by collaborating with local inventors and further eased by relying on migrant inventors in US.

A further indication of migrants' brokerage role come from FDIs going in the opposite direction, that is from less to advanced countries. This may be especially important for companies for developing countries' acquisition of developed countries' technologies (Amighini et al., 2013, Giuliani et al., 2014). Hernandez (2014) finds a positive relationship between the level of migrant concentration in a US state and the presence/survival of new subsidiaries of firms from the same country of migrants. Migrant concentration is measured by taking into account all individuals from the same country of origin in the given location, that is both the low and the high

skilled, and, most importantly, not only those already working for the investing company, but all residents. The results are stronger for firms without previous investment experience in the state and for investment decisions in which knowledge acquisitions is more likely to be an objective (high-tech vs low-tech industries, as well as more vs less important clusters). Problems of endogeneity are tackled by focussing on first investments (that is, the acquisition marks the entry of the acquiring company into the local market) and by instrumenting the migrant concentration for measures of weather and cultural similarity between the country of origin and the US state of destination.

3.3.3 Return migrants

Return migration represents an important share of present-day total migration flows[14]. Despite the absence of official statistics, cohort analysis of national census data suggests that, for destination countries such as Germany, the UK, and the US, the estimated rates of return after 20 years of permanence abroad vary between 20% and 80%, albeit with much variation across sending-receiving country pairs, year of entry, and the skill level of migrants. Return rate after 5 years, which may be affected by students' migration, is significant, too (Dustmann and Weiss, 2007, Gundel and Peters, 2008, Mayr and Peri, 2008). Highly skilled migrants' rate of return is generally higher than that of the low skilled, although the interaction with the conditions of the home economy is once again crucial. To put it differently, return migrants appear in general to be positively selected according to education and their home country's conditions.[15]

Early research on return migration and diffusion mainly consisted of case studies of entrepreneurs and managers moving along the US-East Asia corridors. Saxenian and Hsu (2001) document the importance of ethnic Chinese entrepreneurs from Silicon Valley for injecting both knowledge and capital in the Taiwanese IT industry, while Saxenian (2005) discusses the opportunities and obstacles faced by similar ventures in mainland China and India (some cases of return scientist-entrepreneurs in the life sciences are documented also by Zucker and Darby, 2009). Kenney et al. (2013) provide a critique of this evidence, based upon the revisionist arguments we have already encountered in the historical literature on religious minorities.

Von Zedtwitz (2004) documents the reliance of US multinationals on return Chinese engineers for filling up the positions of R&D directors in their overseas operations. Even in this case the revisionist argument creeps in, in

[14] Dustmann and Weiss' (2007) define return migrants as those who settle back in their home country by their own choice, after having spent several years abroad. As far as innovation diffusion is concerned, contract migrants are important too, as they include individuals whose whose migration spell is exogenously determined by a working contract (as for Germany's *Guestarbeiters* in the 1960s) or a visa (as for most foreign students).

[15] This is in contrast with classic migration models, which posit negative selection, as they associate return migration to lack of economic success or integration in the host country (Borjas and Bratsberg, 1996). One possible reconciliation of the two views consists in observing that while positive self-selection cuts across general levels of education, negative self-selection can still occur within each category. Some evidence in this sense is provided by Gaulé (2014) for academic scientists.

two ways. First, Chinese directors often arrived as replacements of non-Chinese ones, who were trusted with the first opening of the laboratories. Second, when one draws a distinction between research and development, return migrants are found to be most important in the second case. On one hand, this suggests that return migrants follow, rather than initiate, innovation at home. On the other hand, it suggests they may be needed to mediate (through knowledge of the language, culture or local contacts) the technology transfer operated by the overseas companies they work for.

Such reliance on case studies is partly explained by the special difficulty of building large enough samples in this field. Besides facing gaps in official statistics, scholars are confronted with the difficulty of extracting *ad hoc* information from archival data, due to the possibility that, at return, some migrants change profession or task, thus exiting the same archival resources that helped identifying them in first place.[16] However, some recent studies have begun to fill the gap, based on a combination of patent data and local surveys. Albeit affected by sample size and endogeneity issues, they obtain interesting results.

Twin papers by Liu et al. (2010) and Filatotchev et al. (2011) exploit a 4-year panel dataset of around 1300 enterprises located in the Zhongguancun Science Park (Bejing, China)[17]. They regress the number of patents filed by each firm at SINO (the Chinese patent office) over ownership by a returnee and the density of returnees in the industry which the company belongs to (based on within-sample data), finding a positive relationship in both cases. Luo et al. (2013) conduct a similar exercise, one in which the absolute number of SINO patents filed by around 500 Chinese firms in the photovoltaic industry is found to be positively related to the international experience of their top management (information on the latter is hand collected from online and press material for the 1998-2008 decade).

Choudhury (2015) investigates the extent to which return migrants have an impact on within-the-firm knowledge transfer. He examines the Indian R&D centre of a large US multinational. He tests the hypothesis that local staff reporting to return managers (i.e. managers formerly employed at the US headquarters) are more likely to patent at the USPTO, and to file patents of better quality (highly cited), than staff reporting to local managers (i.e. managers with no experience abroad). The exercise is presented as a natural experiment, not affected by endogeneity issues, based on the observation that local staff are randomly assigned to different managers. While the main hypotheses are confirmed, their interpretation cast some doubt on the role of return managers as

[16] This is clearly the case of inventors. Both Agrawal et al. (2011) and Breschi et al. (2015) find very few return inventors, which may be due to the limited mobility of inventors, but also to the possibility that moves in the physical space are associated to career moves, most typically from operational (inventive) roles, to managerial ones (no more tracked by patent data). Alnuaimi et al (2012) who manually examine around 3500 USPTO patents assigned to over 500 India-located patentees (local firms, foreign subsidiaries, and universities) in between 1985 and 2004, also find very few inventors moving from foreign companies to local firms.

[17] Dubbed by many as China's Silicon Valley, the Zhongguancun Science Park has been the object of several case studies on return migration and innovation. See for example Chen (2008a,b).

providers of knowledge inputs. Return managers, who have stronger ties with the headquarters, may simply be better positioned than their local colleagues to obtain support for their staff's research projects.

Moving away from patent data, Kahn and MacGarvie (2012) study the impact of return scientists on their home countries. To circumvent endogeneity problems, they concentrate on return scientists who took their PhD or postdoc in the US thanks to a Fulbright scholarship, which requires its beneficiaries to return home upon completion of their studies. Based on comparisons with a control sample of similar students with no return obligation, they find that Fulbright scholars, albeit producing fewer and lower quality papers, produce more papers in collaboration with US-based co-authors than their local colleagues, thus contributing to keep their home science system in touch with that of their former destination country. Similar findings are obtained by Jonkers & Tijssen (2008) and Jonkers & Cruz-Castro (2013), respectively for samples of Chinese and Argentinean scholars, and Baruffaldi and Landoni (2012) for a survey of 497 foreign researchers in Italy and Portugal.

3.4 Cross-destination diffusion

In considering within-destination diffusion we have introduce the term "diaspora", with reference to migrants and ethnic minorities from the same country of origin and in the same destination country. However, this is just an adaptation from the more common use of the term to indicate a community dispersed over several destinations (see footnote 1).

This suggests that the diaspora effect we discussed in section 3.2 could be found not just to take place within one destination country, but across several of them. Hints in this direction come from the international trade literature (surveys by Rauch, 2001; Parsons and Winters, 2014). Based on the robust finding of a positive and non-negligible correlation between migration and bilateral trade flows between origin and destination countries, authors in this field have further investigated in two directions:

1. Assessing the relative weight of the preference and network effects
2. Testing the hypothesis that network effects may extend beyond origin-destination country pairs (direct effect), and also affect trade between any two destination countries (indirect effect)

The preference effect refers to the diaspora's taste for goods and services imported from the country of origin. As such, it is not welfare enhancing and it may affect only the bilateral flows involving the origin country. The network effect refers to any reduction in trade costs that diaspora members may bring about. It is welfare enhancing and, in principle, it may take place across any two countries hosting sizeable groups from the same diaspora. Trade cost may be reduced both thanks to exchanges of otherwise hidden information (on prices and/or preferences in export markets) and to mutual trust brought about by embeddedness (Rauch and Trindade, 2002).

It is not difficult to hypothesize that the same channels that vehicles information may also circulate some knowledge inputs, or at least some pieces of information specific to technology transfer (such as the availability and price of some key machinery or service, or training).

There is no consensus among the authors on the relative weight of the preference and network effects, but no study dismisses the importance of the latter. In particular, the network effect seems to be associated to highly skilled migration (Felbermayr and Toubal, 2012). As for the distinction between direct and indirect effects, very few studies have so far investigated the latter, with mixed results (Rauch and Trindade, 2002, Felbermayr et al., 2010, Giovannetti and Lanati, 2015).

The possible existence of indirect network effects in trade should encourage similar research on innovation diffusion. So far, no dedicated study has been produced. Some bits of evidence, though, can be gauged from Breschi et al. (2015) and Scellato et al. (2015). The former, besides investigating within-destination diffusion (see section 3.2), include a test on patent citations patterns at the international level. It is tested whether the citations to patents by migrant inventors in the US come disproportionally either from their countries of origin (brain gain effect) or/and from co-ethnic inventors in other countries (excluding the US; international diaspora effect). Comparing the results of the two tests is relatively uninteresting for advanced countries such as Germany or France, as they host the overwhelmingly majority of their native inventors (in other words, the inventor diaspora is very small compared to the number of home-based inventors). But the same is not true for middle-income countries such as China or India, who have as many if not more native inventors abroad than at home (at least when international, high value patents are considered). In the case of India, in particular, the brain gain hypothesis is rejected, while the international diaspora hypothesis is not. This suggests that while Indian inventors in India may not stand to gain from co-ethnic inventors in the US, Indian inventors to other destination countries do.

As for Scellato et al. (2015), based on the *GlobSci* survey[18], they find that foreign-born in selected OECD countries have larger collaboration networks than natives; and that large networks always include contacts in both the home countries and with fellow migrants to other destination countries.

[18] The GlobSci database contains highly detailed bibliometric-cum-survey information for authors of scientific publications in selected journals, for 16 destination countries (Franzoni et al., 2012; Scellato et al., 2012)

4. Conclusions and further research

Once the preserve of economic history, most notably of pre-industrial Europe, the study of migration and innovation diffusion has now become an important topic in several related disciplines and fields. In this paper, we have organized a rather sparse empirical evidence around three main themes: the distinction between individual mobility and migration, the direction of diffusion flows, and their contents. In what follows, we summarize the key findings and outline the main research questions that remain open.

As for the first theme, the argument rests on the importance of social ties for diffusion efforts to be successful. The tacit dimension of knowledge makes mobility of skilled individuals necessary for diffusion; its systemic dimension and distributed nature make it necessary for mobility not to occur in isolation. Overall, the literature we surveyed suggests a role for ethnic ties. They may help migrants diffuse tacit knowledge and private information, even at long distances. Still, they also help overcoming isolation in the social space. It is then important to assess the extent at which the importance ethnic ties may reveal segregation instances, as when migrants are excluded from some professions or positions in the host countries, or migrants' choice set is limited by bounds to other migrants.

Future research ought also to find ways to compare individual episodes of mobility, or mobility mediated by multinationals, with mobility taking place as part of a larger migration movement. At present, instead, many studies treat migration as a generic instance of mobility, one that it is possibly easier to trace than individual moves, and therefore more tractable; while others focus on the relative weight of spillovers and displacement effects, and do not dig into the mechanisms behind them. We have also limited comparative evidence. A few studies based on inventor or trade data find remarkable differences across migrants' countries of origin, but do not explain them. In particular, we do not know whether the observed differences are due to cohort effects (with older migrant communities being better integrated and therefore less reliant on ethnic ties) or sociological reasons (different communities nurture ties of different strength, due to composition effects or cultural values).

For what concerns the directions of diffusion, the literature we surveyed make clear that migrants, and the associated diasporas, operate both within the destination countries and (bilaterally) along the destination-origin axis. Still, diffusion across destination countries is largely unexplored. Besides being interesting for innovation scholars, this line of research would contribute to explain why and how ethnic minorities appear to ease bilateral trade flows, as diffusion of innovation would be a clear instance of a "network effect" as opposed to a "preference effect".

Finally, it remains to clarify to what extent the indirect instances of diffusion we have examined (such as those affecting foreign direct investments, trade, and entrepreneurship) concern scientific and technical knowledge assets, and not just information on prices, availability of inputs, and business opportunities. While the

latter are necessary for innovation to occur, they are not sufficient. The answers to these open questions may vary according to the countries of origin involved, with advanced or middle-income ones standing better chances to access knowledge, and not just information. Some evidence in favour of the knowledge hypotheses exists on diffusion at destination, in particular for studies on inventors. Here knowledge spillovers have been detected, but social ties between migrants appear to be of second-order importance with respect to other ties, such as those based on physical proximity or common professional experiences.

Overall, research on migration and innovation diffusion appears to be a new, promising field, one which may both benefit from past research on the geography of knowledge spillovers, and contribute to its development in new directions.

References

AGRAWAL, A., COCKBURN, I. & MCHALE, J. 2006. Gone but not forgotten: knowledge flows, labor mobility, and enduring social relationships. *Journal of Economic Geography,* 6**,** 571-591.

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**,** 258-69.

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**,** 43-55.

ALMEIDA, P. & KOGUT, B. 1999. Localization of knowledge and the mobility of engineers in regional networks. *Management science,* 45**,** 905-917.

ALMEIDA, P., PHENE, A. & LI, S. 2015. The Influence of Ethnic Community Knowledge on Indian Inventor Innovativeness. *Organization Science,* 26**,** 198-217.

AMIGHINI, A., COZZA, C., GIULIANI, E., RABELLOTTI, R. & SCALERA, V. 2013. Technology-Driven FDI: A Survey of the Literature. Lund University, CIRCLE-Center for Innovation, Research and Competences in the Learning Economy.

ARSLAN, C., DUMONT, J.-C., KONE, Z., MOULLAN, Y., OZDEN, C., PARSONS, C. & XENOGIANI, T. 2014. A New Profile of Migrants in the Aftermath of the Recent Economic Crisis. *OECD Social, Employment and Migration Working Papers n.160.* OECD Publishing.

ARTUC, E., DOCQUIER, F., ÖZDEN, Ç. & PARSONS, C. 2015. A global assessment of human capital mobility: the role of non-OECD destinations. *World Development,* 65**,** 6-26.

AURIOL, L. 2010. Careers of doctorate holders: employment and mobility patterns. *OECD STI Working Paper.* Paris: OECD Publishing.

BALMER, B., GODWIN, M. & GREGORY, J. 2009. The Royal Society and the 'brain drain': natural scientists meet social science. *Notes and Records of the Royal Society,* 63**,** 339-353.

BARUFFALDI, S. H. & LANDONI, P. 2012. Return mobility and scientific productivity of researchers working abroad: The role of home country linkages. *Research Policy,* 41**,** 1655-1665.

BEINE, M., DOCQUIER, F. & RAPOPORT, H. 2008. Brain drain and human capital formation in developing countries: Winners and losers*. *The Economic Journal,* 118**,** 631-652.

BEINE, M., DOCQUIER, F. & ÖZDEN, Ç. 2011. Diasporas. *Journal of Development Economics,* 95**,** 30-41.

BELFANTI, C. 2004. Guilds, patents, and the circulation of technical knowledge: Northern Italy during the early modern age. *Technology and culture,* 45**,** 569-589.

BELFANTI, C. M. 2006. Between mercantilism and market: privileges for invention in early modern Europe. *Journal of Institutional Economics,* 2**,** 319-338.

BELLINI, E., OTTAVIANO, G. I. P., PINELLI, D. & PRAROLO, G. 2013. Cultural diversity and economic performance: evidence from European regions. *Geography, Institutions and Regional Economic Performance.* Springer.

BHAGWATI, J. N. 1976. *The brain drain and Taxation: Theory and Empirical analysis*, North-Holland Publishing Company.

BOERI, T., BRÜCKER, H., DOCQUIER, F. & RAPOPORT, H. (eds.) 2012. *Brain Drain and Brain Gain: The Global Competition to Attract High-skilled Migrants*: Oxford University Press.

BORJAS, G. J. 2004. Do foreign students crowd out native students from graduate programs? : National Bureau of Economic Research.

BORJAS, G. J. 2009. Immigration in High-Skill Labor Markets: The Impact of Foreign Students on the Earnings of Doctorates. *In:* FREEMAN, R. B. & GOROFF, D. L. (eds.) *Science and Engineering Careers in the United States: An Analysis of Markets and Employment.* University of Chicago Press.

BORJAS, G. J. & DORAN, K. B. 2012. The Collapse of the Soviet Union and the Productivity of American Mathematicians. *The Quarterly Journal of Economics,* 127**,** 1143-1203.

BORJAS, G. J. & DORAN, K. B. 2015. Cognitive Mobility: Labor Market Responses to Supply Shocks in the Space of Ideas. *Journal of Labor Economics,* 33**,** S109-S145

BORJAS, G. J., DORAN, K. B. & SHEN, Y. 2015. Ethnic Complementarities after the Opening of China: How Chinese Graduate Students Affected the Productivity of Their Advisors. National Bureau of Economic Research.

BRESCHI, S. & LISSONI, F. 2009. Mobility of skilled workers and co-invention networks: an anatomy of localized knowledge flows. *Journal of Economic Geography,* 9**,** 439-468.

BRESCHI, S., LISSONI, F. & MIGUELEZ, E. 2015. Foreign inventors in the US: Testing for Diaspora and Brain Gain Effects. *8th International Conference on Migration and Development, June 8-9.* World Bank - Washington DC.

BRESCHI, S., LISSONI, F. & NOUMEDEM TEMGOUA, C. 2016. MIgration and Innovation: A Survey of Recent Studies. *In:* SHEARMUR, R., CARRINCAZEAUX, C. & DOLOREUX, D. (eds.) *Handbook on the Geography of Innovation.* Edward Elgar.

BRESCHI, S., LISSONI, F. & TARASCONI, G. 2016 (forthcoming). Inventor Data for Research on Migration & Innovation: The Ethnic-Inv Pilot Database. *In:* FINK, C. & MIGUELEZ, E. (eds.) *The International Mobility of Talent and Innovation: New Evidence and Policy Implications.* Cambridge University Press.

BUCH, C. M., KLEINERT, J. & TOUBAL, F. 2006. Where enterprises lead, people follow? Links between migration and FDI in Germany. *European Economic Review,* 50**,** 2017-2036.

BURCHARDI, K. B., CHANEY, T. & HASSAN, T. A. 2016. Migrants, Ancestors, and Investments. National Bureau of Economic Research.

CHEN, Y.-C. 2008a. The limits of brain circulation: Chinese returnees and technological development in Beijing. *Pacific Affairs,* 81**,** 195-215.

CHEN, Y.-C. 2008b. Why do multinational corporations locate their advanced R&D centres in Beijing? *The Journal of Development Studies,* 44**,** 622-644.

CHOUDHURY, P. 2015. Return migration and geography of innovation in MNEs: a natural experiment of knowledge production by local workers reporting to return migrants. *Journal of Economic Geography***,** lbv025.

CIPOLLA, C. M. 1972. The Diffusion of Innovations in Early Modern Europe. *Comparative Studies in Society and History,* 14**,** 46-52.

COOKE, A. & KEMENY, T. 2016. Immigrant Diversity and Complex Problem Solving. *US Census Bureau Center for Economic Studies Paper No. CES-WP-16-04*.

COWAN, R., DAVID, P. A. & FORAY, D. 2000. The explicit economics of knowledge codification and tacitness. *Industrial and corporate change,* 9**,** 211-253.

DE GRIP, A., FOUARGE, D. & SAUERMANN, J. 2010. What affects international migration of European science and engineering graduates? *Economics of Innovation and New Technology,* 19**,** 407-421.

DOCQUIER, F. & LODIGIANI, E. 2010. Skilled migration and business networks. *Open Economies Review,* 21**,** 565-588.

DOCQUIER, F. & RAPOPORT, H. 2012. Globalization, Brain Drain, and Development. *Journal of Economic Literature,* 50**,** 681-730.

DOLZA, L. & MAITTE, C. 2004. « L'appel aux étrangers ». Circulations et intégration des savoir-faire dans le Piémont de l'Ancien Régime : le cas de la teinture en laine et de la verrerie. *In:* COTTE, M. (ed.) *Circulations techniques en amont de l'innovation: Hommes, objets et idées en mouvement.* Presses universitaires de Franche-Comté.

FELBERMAYR, G. J., JUNG, B. & TOUBAL, F. 2010. Ethnic networks, information, and international trade: Revisiting the evidence. *Annals of Economics and Statistics/Annales d'Économie et de Statistique***,** 41-70.

FELBERMAYR, G. J. & TOUBAL, F. 2012. Revisiting the trade-migration nexus: Evidence from new OECD data. *World Development,* 40**,** 928-937.

FERRIE, J. & HATTON, T. J. 2013. Two Centuries of International Migration. IZA Discussion Paper.

FILATOTCHEV, I., LIU, X., LU, J. & WRIGHT, M. 2011. Knowledge spillovers through human mobility across national borders: Evidence from Zhongguancun Science Park in China. *Research Policy,* 40**,** 453-462.

FOLEY, C. F. & KERR, W. R. 2013. Ethnic innovation and US multinational firm activity. *Management Science,* 59**,** 1529-1544.

FRANZONI, C., SCELLATO, G. & STEPHAN, P. E. 2012. Foreign-Born Scientists: Mobility Patterns for 16 Countries. *Nature Biotechnology,* 30**,** 1250-53.

FREEMAN, R. B. 2010. Globalization of scientific and engineering talent: international mobility of students, workers, and ideas and the world economy. *Economics of Innovation and New Technology,* 19**,** 393-406.

FREEMAN, R. B. & HUANG, W. 2015. Collaborating With People Like Me: Ethnic co-authorship within the US. *Journal of Labor Economics,* 33**,** S289-S318.

GANGULI, I. 2015. Immigration and Ideas: What Did Russian Scientists "Bring" to the United States? *Journal of Labor Economics,* 33**,** S257-S288.

GAO, T. 2003. Ethnic Chinese networks and international investment: evidence from inward FDI in China. *Journal of Asian Economics,* 14**,** 611-629.

GIOVANNETTI, G. & LANATI, M. 2015. The indirect pro-trade effects of Indian ethnic networks. *DEMO-India Research Report 2015/14, European University Institute, Florence*.

GIULIANI, E., GORGONI, S., GÜNTHER, C. & RABELLOTTI, R. 2014. Emerging versus advanced country MNEs investing in Europe: A typology of subsidiary global–local connections. *International Business Review,* 23**,** 680-691.

GROGGER, J. & HANSON, G. H. 2013. Attracting talent: Location choices of foreign-born PhDs in the US. National Bureau of Economic Research.

HATTON, T. J. 2014. The economics of international migration: A short history of the debate. *Labour Economics,* 30**,** 43-50.

HATTON, T. J. & WILLIAMSON, J. G. 2005. *Global migration and the world economy: Two centuries of policy and performance*, Cambridge Univ Press.

HILAIRE-PÉREZ, L. 2008. Savoirs techniques, et migrations: l'histoire face aux mythes. *Documents pour l'histoire des techniques***,** 3-9.

HILAIRE-PÉREZ, L. & VERNA, C. 2006. Dissemination of technical knowledge in the Middle Ages and the Early Modern Era: New approaches and methodological Issues. *Technology and culture,* 47**,** 536-565.

HUNT, J. 2015. Are Immigrants the Most Skilled US Computer and Engineering Workers? *Journal of Labor Economics,* 33**,** S39-S77.

HUNT, J. & GAUTHIER-LOISELLE, M. 2010. How Much Does Immigration Boost Innovation? *American Economic Journal: Macroeconomics,* 2**,** 31-56.

JAFFE, A. B., TRAJTENBERG, M. & HENDERSON, R. 1993. Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *The Quarterly Journal of Economics,* 108**,** 577-598.

JAVORCIK, B. S., ÖZDEN, Ç., SPATAREANU, M. & NEAGU, C. 2011. Migrant networks and foreign direct investment. *Journal of Development Economics,* 94**,** 231-241.

JOHNSON, H. G. 1965. The economics of the "brain drain": The Canadian case. *Minerva,* 3**,** 299-311.

JONKERS, K. & CRUZ-CASTRO, L. 2013. Research upon return: The effect of international mobility on scientific ties, production and impact. *Research Policy,* 42**,** 1366-1377.

JONKERS, K. & TIJSSEN, R. 2008. Chinese researchers returning home: Impacts of international mobility on research collaboration and scientific productivity. *Scientometrics,* 77**,** 309-333.

KAPUR, D. 2001. Diasporas and technology transfer. *Journal of Human Development,* 2**,** 265-286.

KENNEY, M., BREZNITZ, D. & MURPHREE, M. 2013. Coming back home after the sun rises: Returnee entrepreneurs and growth of high tech industries. *Research Policy,* 42**,** 391-407.

KERR, W. 2009. The Agglomeration of US Ethnic Inventors. *In:* GLAESER, E. L. (ed.) *Agglomeration Economics* The University of Chicago Press.

KERR, W. R. 2008. Ethnic Scientific Communities and International Technology Diffusion. *Review of Economics and Statistics,* 90**,** 518-537.

KERR, W. R. & MANDORFF, M. 2015. Social Networks, Ethnicity, and Entrepreneurship. National Bureau of Economic Research.

KUGLER, M. & RAPOPORT, H. 2007. International labor and capital flows: Complements or substitutes? *Economics Letters,* 94**,** 155-162.

KUZNETSOV, Y. (ed.) 2006. *Diaspora networks and the international migration of skills: how countries can draw on their talent abroad*: World Bank Publications, Washington, DC.

KUZNETSOV, Y. (ed.) 2010. *Talent Abroad Promoting Growth and Institutional Development at Home: Skilled Diaspora as Part of the Country*: World Bank, Washington, DC (http://hdl.handle.net/10986/10117).

LIU, X., LU, J., FILATOTCHEV, I., BUCK, T. & WRIGHT, M. 2010. Returnee entrepreneurs, knowledge spillovers and innovation in high-tech firms in emerging economies. *Journal of International Business Studies,* 41**,** 1183-1197.

LODIGIANI, E. 2009. Diaspora externalities and technology diffusion. *Economie internationale***,** 43-64.

LUU, L. B. 2005. *Immigrants and the Industries of London, 1500-1700*, Ashgate Publishing Ltd, Aldershot (UK).

MEYER, J.-B. 2001. Network Approach versus Brain Drain: Lessons from the Diaspora. *International Migration,* 39**,** 91-110.

MEYER, J.-B. & BROWN, M. 1999. Scientific diasporas: A new approach to the brain drain. *MOST discussion Paper No. 41, UNESCO - Paris*.

MIGUELEZ, E. 2016. Inventor diasporas and the internationalization of technology. *World Bank Economic Review,* forthcoming.

MIGUELEZ, E. & FINK, C. 2013. Measuring the International Mobility of Inventors: A New Database. World Intellectual Property Organization-Economics and Statistics Division.

MOSER, P., VOENA, A. & WALDINGER, F. 2014. German-Jewish emigrés and US invention. *NBER Working Paper w19962, National Bureau of Economic Research*.

NANDA, R. & KHANNA, T. 2010. Diasporas and domestic entrepreneurs: Evidence from the Indian software industry. *Journal of Economics & Management Strategy,* 19**,** 991-1012.

NIEBUHR, A. 2010. Migration and Innovation: Does Cultural Diversity Matter for Regional R&D Activity? *Papers in Regional Science,* 89**,** 563-85.

NOUMEDEM TEMGOUA, C. & MIGUELEZ, E. 2015. Highly Skilled Migration and Knowledge Diffusion: A Gravity Model Approach. *paper presented at the EU-SPRI Conference, Helsinki June 10-12*.

OETTL, A. & AGRAWAL, A. 2008. International labor mobility and knowledge flow externalities. *Journal of International Business Studies,* 39**,** 1242-1260.

OTTAVIANO, G. I. P. & PERI, G. 2005. Cities and cultures. *Journal of Urban Economics,* 58**,** 304-337.

OTTAVIANO, G. I. P. & PERI, G. 2006. The economic value of cultural diversity: evidence from US cities. *Journal of Economic Geography,* 6**,** 9-44.

OTTAVIANO, G. I. P. & PERI, G. 2012. Rethinking the effect of immigration on wages. *Journal of the European economic association,* 10**,** 152-197.

OZDEN, Ç., PARSONS, C. R., SCHIFF, M. & WALMSLEY, T. L. 2011. Where on earth is everybody? The evolution of global bilateral migration 1960–2000. *The World Bank Economic Review,* 25**,** 12-56.

OZGEN, C., NIJKAMP, P. & POOT, J. 2013. Measuring cultural diversity and its impact on innovation: Longitudinal evidence from Dutch firms.

PARSONS, C. R. & WINTERS, L. A. 2014. International migration, trade and aid: a survey. *In:* LUCAS, R. E. B. (ed.) *International Handbook on Migration and Economic Development.* Edward Elgar Publishing.

RAUCH, J. E. 2001. Business and social networks in international trade. *Journal of economic literature***,** 1177-1203.

RAUCH, J. E. & TRINDADE, V. 2002. Ethnic Chinese networks in international trade. *Review of Economics and Statistics,* 84**,** 116-130.

SAXENIAN, A. 2005. From brain drain to brain circulation: Transnational communities and regional upgrading in India and China. *Studies in Comparative International Development,* 40**,** 35-61.

SCELLATO, G., FRANZONI, C. & STEPHAN, P. 2012. Mobile Scientists and International Networks. *National Bureau of Economic Research Working Paper Series,* No. 18613.

SCELLATO, G., FRANZONI, C. & STEPHAN, P. 2015. Migrant scientists and international networks. *Research Policy,* 44**,** 108-120.

SCHILLING, H. 1983. Innovation through migration: the settlements of Calvinistic Netherlanders in sixteenth-and seventeenth-century Central and Western Europe. *Histoire Sociale/Social History,* 16.

SCOVILLE, W. C. 1951. Minority migrations and the diffusion of technology. *The Journal of Economic History,* 11**,** 347-360.

SCOVILLE, W. C. 1952a. The Huguenots and the Diffusion of Technology. I. *The Journal of Political Economy***,** 294-311.

SCOVILLE, W. C. 1952b. The Huguenots and the Diffusion of Technology. II. *The Journal of Political Economy***,** 392-411.

SONG, J., ALMEIDA, P. & WU, G. 2003. Learning–by–Hiring: When is mobility more likely to facilitate interfirm knowledge transfer? *Management science,* 49**,** 351-365.

SORENSON, O. 2003. Social networks and industrial geography. *Journal of Evolutionary Economics,* 13**,** 513-527.

VON ZEDTWITZ, M. 2004. Managing foreign R&D laboratories in China. *R&D Management,* 34**,** 439-452.

WALDINGER, F. 2012. Peer effects in science: Evidence from the dismissal of scientists in Nazi Germany. *The Review of Economic Studies,* 79**,** 838-861.

WALDINGER, R. D. 1986. *Through the Eye of the Needle: Immigrants and Enterprise in the New York Garment Industry*, New York: New York University Press.

WIDMAIER, S. & DUMONT, J.-C. 2011. *Are recent immigrants different? A new profile of immigrants in the OECD based on DIOC 2005/06,* Paris, OECD Publishing.

ZUCKER, L. G. & DARBY, M. R. 2009. Star scientists, innovation and regional and national immigration. *In:* AUDRETSCH, D. B., LITAN, R. E. & STROM, R. (eds.) *Entrepreneurship and Openness: Theory and Evidence.* Edward Elgar Publishing.

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