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How diaspora knowledge networks make difference to post-Soviet scientists' migration, research and career

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CHAPTER 1

The Notion of Diaspora Knowledge Network Revisited: Highly Skilled Migrants Forming a New Invisible College[32]

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Introduction

Research on diaspora knowledge networks (DKNs) emerges from studies of highly skilled migrants, brain drain, and scientific and technological diasporas. First identified in the early 1990s, DKNs are defined as transnational associations of migrant professionals and scholars from the same home country who demonstrate a willingness "to contribute to the development of their origin countries" (Meyer 2011, 159) and to engage in "mutual aid and information sharing" (Barre et al. 2003, 1). Some scholars called them digital diaspora networks or ICT-enabled (information and communications technology-enabled) diasporic networks, since the internet has been the main medium for facilitating linkages between network members in different destination countries (Grossman 2010). Their organization and potential for "concerted action" among highly skilled migrants distinguishes DKNs from traditional diasporas, which are the "totality of individuals living abroad" (Kuznetsov and Sabel 2008, 85). Scholars have seen DKNs as a new form of transnational cooperation and connection among much valued "brains" abroad and a promising way to stimulate their circulation to benefit the developing countries losing their skilled professionals to powerful competitors. This vision inspired a wealth of DKN studies throughout the 2000s. However, concerned with harnessing the capacities of DKNs to contribute to the development of their members' homelands, these studies predominantly focus on policy and lack substantial theoretical background. Their understanding of DKNs has an applied character and is rather narrow, incorporating such basic features as the link between the highly skilled migrants' associations and their home countries, networking as an internal logic and uniting principle, knowledge flows among migrant professionals and their counterparts at home and the reliance on information and communications technology (Brown 2002; Kuznetsov 2006; Meyer 2007; Grossman 2010). This understanding of DKNs as a "brain gain" strategy and type of diaspora does not allow for fully exploring questions such as the interplay between the transnational and diasporic practices of highly skilled migrants and the interactions between their professional and cultural identities. This chapter suggests reconceptualizing DKNs in a way that will provide tools for investigating previously overlooked aspects of diasporic networking.

I highlight activation and mobilization of the sense of national belonging in professional networking, "re-identification through professional motives" (Meyer, 2007, 10), as a distinctive feature and a driver of DKN formation and development. There is growing evidence that this revitalization of national identity that characterizes professional relations between highly skilled migrants with the same country of origin is not confined to formal, information and communications technology interactions, but occurs across a variety of settings, formally and informally, in academia and industry, locally and transnationally, in host and home countries. However, these relations are not incorporated into current conceptualizations of DKNs. As a result, diasporic networking in professional spheres remains largely invisible and is largely neglected. This is an egregious oversight given that scholarly work is intensively internationalized throughout European Union with a growing number of foreign-born specialists and scientists entering European countries. There is a lack of understanding of how highly skilled migrants organize their lives and careers in different national contexts, why they sustain professional connections with their compatriots, and what the consequences of this are. I argue that, despite seeming differences, the process of diasporic networking and the social structures it produces have common origins and logic and thus require an overarching concept to designate them and to separate them from the other links and networks they create. This chapter aims to explain what these common origins are and how to reconfigure our understandings of DKNs to reflect the essential features of this phenomenon.

I accomplish this by conducting a problem-oriented literature review and developing ideas from existing DKN studies in various branches of social science research, combining and linking them in novel ways. In particular, I suggest applying migration network theory developed to study the migration of low-skilled workers to make sense of the experiences of mobile academics and other knowledge workers. I propose integrating this theory into social research on science, innovation, and knowledge networks. While my argument focuses primarily on mobile academics it is nonetheless relevant for other categories of highly skilled migrants and knowledge workers, since the patterns of DKN formation in those spheres follow a similar logic. We do, however, have to consider the institutional and normative contexts of the relevant professional areas and policy regulations in destination countries because they shape the structure and effects of DKNs.

The chapter is organized as follows: first, I examine higher education studies and migration scholarship to demonstrate that the predominant discourse on academic mobility focuses on positive effects, while underplaying mobility's "darker side" (Richardson and Zikic 2007). In contrast, I argue that foreign-born scholars are migrants who experience

various disadvantages associated with their status in destination country academic environments. Second, I discuss migration network theory and ethnic networks research, showing that foreign-born professionals rely on diasporic contacts as a resource to overcome the difficulties of their migrant status. Third, I refer to innovation and scientific collaboration studies to demonstrate the importance of diasporic identities and common origins in knowledge-exchange and knowledge-generation activities. Finally, I draw on the concept of the invisible college and sociological theory to reveal how a network of highly skilled migrants can become a knowledge-production unit. I present a new notion of a DKN and develop a new conceptual framework to use in empirical studies of DKNs.

When Scientists are Migrants or an Invisible Immigrant Minority in Academia

Migration, characterized as "systematic, dense, multiple and transnational" (Kim 2010, 579), has been on the rise among scientists in the last few decades. Associated with the "neoliberal globalization" of science and higher education (Dervin 2011, 4) such migration engenders increasing competition among institutions and countries for research excellence and talent supply. Shaped by "regional and international political and economic relations of power" (Kim 2009, 387), academic mobility and migration have an uneven, hierarchical character, with the "global North" acting as a powerful magnet for highly qualified professionals and researchers from the "global South." This is especially visible in the increased recruitment of international students (Tremblay 2005), a priority concern in developed countries incorporated "into their strategies to attract and retain highly skilled migrant workers" (She and Wotherspoon 2013, 1). Academic mobility's uneven character also reveals itself in the massive, multiple, and short-term migrations of PhD students and junior researchers, which is linked to the proliferation of project-based and contractual labor, a shrinking number of permanent positions, and the increase in the number of temporary ones (Kim 2009, 399–400).

Both a component and effect of the neoliberal reorganization of science and higher education, scientific mobility sometimes acquires a "forced" character (Karaulova 2016, 235), becoming a pressing necessity rather than a matter of choice (Morano-Foadi 2005). Still, many scholars working on this topic concentrate on the various positive effects and consequences of spatial mobility for academics, including increased productivity and increased visibility for their research, as well as expanded and increasingly diverse collaboration networks (Stephan and Levin 2001; Scellato et al. 2012). The higher productivity of migrant scholars compared to non-migrants is presented as a "mover's advantage" (Franzoni et al. 2014), stemming from the "position of arbitrage, where they can exploit

rich or unique knowledge sets" (Franzoni et al. 2014, 2) and benefit from their central role in the formation of global collaboration networks (Larner 2015). Thus, scholars recognize mobile researchers as a valuable asset that contributes substantially to scientific research and technological innovations in destination countries (Levin and Stephan 1999; Lin 2004; Corney and Sabharwal 2011; Kim 2011). They represent transnational scientific migration as an important factor in scholarly productivity and achievement on individual and national levels. However, such representation presents migration as an overwhelmingly unproblematic process and does not reveal the costs, risks, and tensions migrant scientists experience from the moment they decide to migrate period until they have adapted to their new circumstances after migration.

An alternative explanation for the "more mobility-higher productivity" trend may be the "discriminating environment in the host country," where "migrants feel pressure to perform better than domestic scientists" (Franzoni et al. 2014, 9). Indeed, some studies find that foreign-born faculty spend more time on research than on teaching (Weber 2012) and prioritize publications over grants and collaboration compared to their non-migrant colleagues (Lee 2004). Furthermore, foreign-born faculty are "producing more, but getting less" in salaries, job satisfaction, and promotions to permanent positions in comparison to non-migrants (Corley and Sabharwal 2007, 909). Postdoctoral researchers are particularly affected: despite making a significant contribution to destination institutions' and countries' research output, they constitute "low-cost, high-yield scientific workers" in "exploitative" conditions with inadequate remuneration, a lack of professional autonomy, and few opportunities "to move into tenure-tracked faculty jobs" (Cantwell 2009, 10, 212).[33]

Disparities in remuneration, rare opportunities for promotion, and high competition are not the only difficulties foreign-born scientists encounter in destination-country academic settings. They also face legal and visa issues, a lack of language skills and local connections, and absence of knowledge of taken-for-granted rules and norms of interaction both in everyday life and professional contexts, all resulting in cultural adaptation

33 These findings are consistent with statistical data from the US indicating that higher numbers of migrant scholars are concentrated in temporary positions. Thus, foreign-born postdoctoral scholars on temporary visas comprised 58.8% of the postdoctoral research staff in 2002 (Bonetta 2007), compared with 20% of foreign-born faculty in science and engineering overall (National Science Board 2000). Higher rates exist in engineering (38% of faculty), medicine (35%), and mathematics (29.2%) (Lowell et al. 2010), though these numbers are still much lower than the share of doctoral degrees foreign students earn (up to 60% in computer science) and the proportion of international postdoctoral scholars, especially in STEM areas (Gahungu 2011).

and integration problems, social isolation, and stress. Even when research discuss such issues, they often approach them from the perspective of the destination country. For example, a lack of language skills and foreign-born faculty's accents attract attention as a factor that undermines the quality of teaching in destination-country universities (Marvasti 2005; Alberts 2008). Difficulties in cultural adaptation of international faculty and their visa issues are treated as threatening the retention of valuable human capital, which potentially undermines the host university's or country's research strengths (Sabharwal 2011). Foreign-born scientists are also seen as non-migrants' unwelcome competitors for highly skilled positions and as part of the reason for the underrepresentation of "domestic" minorities in national education systems (Tapia 2007).

Another branch of research focuses on "international academics' lived experiences" (Kim and Locke 2010, 32), highlighting the perceptions and views of foreign-born faculty in highly internationalized countries (the US, the UK, Australia). International academics in the UK encountered "problems of cultural disconnectedness," such as dissatisfaction with the individualistic work culture prevalent in British universities and a lack of knowledge of the "cultural nuances of the language," leading to embarrassment and feelings of inadequacy in interactions, especially in professional settings (Pherali 2012, 330, 323). In addition, relations with students are undermined by a reduced awareness of their "prior curricular knowledge" acquired in British schools (Pherali 2012, 325). The difficulties were found to be more pressing for the non-EU faculty and particularly acute upon arrival, when settling into a new environment is coupled with a substantial professional workload. The study of foreign-born faculty in Australian universities revealed similar tensions of "cultural dislocation," especially for scholars with non-English-speaking backgrounds (Saltmarsh and Swirski 2010, 295). Dealing with everyday life necessities, understanding particular jargon and informal language, finding their place in a new higher education system, and cultivating satisfactory interactions with students were challenging for foreign-born scientists, despite their considerable work experience and expertise in their field.

Migrant scholars in the US face the same problems (Price et al. 2005; Bonetta 2007; Collins 2008; Foote et al. 2008; Gahungu 2011). They express concerns regarding "incivility" and "obnoxious behaviour" among American students and colleagues (Gahungu 2011, 12) and complain of stereotyping and discrimination (Foote et al. 2008; Ngwainmbi 2006). Discrimination manifests itself, for example, in course assignments: foreign-born staff are assumed to be suitable instructors in disciplines with some "international and global perspective," like geography. But subjects like American history and even general

education courses are typically viewed as improper for foreign-born academics (Foote et al. 2008, 171; Gahungu 2011, 15), who risk being "rightfully perceived as unqualified impostors stealing positions from rightful native-born counter-parts" (Gahungu 2011, 15). Moreover, even when teaching a "suitable" course, foreign-born faculty "can easily be marginalized" because of their unconventional and "remotely critical" views on the US way of life, economic, and political affairs (Foote et al. 2008, 171). It is likely that discrimination contributes to the concentration of migrant scientists in particular disciplinary areas in the US' higher education and research systems, such as natural sciences (Lin et al. 2009) and STEM areas.

Foreign-born scientists also experience disadvantages in the high-tech industries of destination countries. Thus, a study of biotechnology firms in New England discovered that immigrant scientists suffered from stereotyping and had to "struggle for credibility on a daily basis," despite making "a disproportionate contribution to biotech entrepreneurship" (McQuaid et al. 2010, 1055, 1053).[34] Foreign-born entrepreneurs in Silicon Valley reported glass ceilings and being treated like outsiders as factors pushing them to start their own businesses, while again their immigrant status often acted as a barrier to securing funding (Saxenian 1999). Foreign-born scientists and engineers working in Silicon Valley as employees are disadvantaged in terms of financial compensation, earning lower salaries in comparison to their non-migrant counterparts, despite higher levels of education (Alarcon 2000).

These studies demonstrate that migrant and foreign-born scholars constitute a distinctive group in increasingly internationalized academia and high-tech sectors, transcending traditional racial and ethnic divisions. Being a foreign-born scientist implies enduring difficulties in everyday life and specific disadvantages in professional activities that begin before migration, intensify upon arrival and possibly never fully dissipate, even after successful adaptation to a new environment.[35] Therefore, we should abandon "the notion that an academic's journey will be seamless when moving to a new academic post and location," along with the view that internationalizing science is a de-territorialization process (Saltmarsh and Swirski 2010, 297). On the contrary, we should pay attention

34 Immigrant scientists were founders of 42% of regional biotechnological enterprises, the majority of which are "science-intensive" and have impact on therapeutics and treatment of human diseases (McQuaid et al., 1055).

35 We note that the adaptation process is often mutual. Some components and features of destination-country environments are also transformed by migrant academics flows. For instance, Soviet emigre mathematicians impacted the US' mathematics community (Borjas and Doran 2012) .

to the migration and visa regulations tied to certain territories and locations, the ways in which they stratify migrant flows into different categories and create a hierarchy of migrant statuses, and how foreign-born scientists perceive, live through, and deal with these statuses. We should also note foreign-born scientists' experiences of cultural disconnectedness or dislocation, which depends on the cultural distance between home and destination countries (Black and Mendenhall 1992, cited in Libaers and Wang 2012, 256).[36] Accordingly, due to favorable legal regulations and comparative cultural proximity, scholars from the EU and English-speaking countries find themselves in a much less foreign position in leading research nations than people from other countries. The formers' migrant status is not restricted. As a result, they have a considerably different and often more positive migrant experience than the latter group. Successful adaptation and integration into the destination countries' communities and professional milieux are intensified by a "culture of silence" combined with "hyperindividualism" and "survival-of-the-fittest" neoliberal ideology (Thomas and Malau-Aduli 2013, 35). Viewing migration as an exclusively private and personal affair, migrant academics prefer not to raise concerns or ask for support, while hosting institutions provide only formal, brief orientations, on the assumption that newcomers will manage the whole adjustment process independently. As a result, foreign-born scholars must manage adjustment by themselves, while help from institutions and colleagues often has an unsystematic, informal character.

Diaspora Knowledge Networks are Migration Networks

The previous section demonstrates that foreign-born scientists experience various difficulties and disadvantages due to being migrants. Moreover, the highly competitive, culturally diverse, neoliberal academic environment in developed countries, which attracts mobile scholars, exacerbates these tensions. The question is: how do these scholars negotiate these tensions? What resources and contacts do they rely on during migration and afterwards? What strategies do they develop to ensure professional integration and career advancement in destination countries? What role do ethnic ties and networks based on common origin play? Scholars of migration network studies help us answer these questions by researching commonly overlooked aspects of foreign-born scientists' experiences, such as relying on social connections and manifestations of ethnic and cultural solidarity in professional settings. Social networks are key here as they play

36 The concept of cultural distance (Hofstede 1980) based on quantitative measurements presupposes that countries such as China, India, Korea, Japan, Iran, and Turkey are the most culturally distant from the US and other English-speaking countries like Canada, the UK and Australia. Though strongly criticized for certain conceptual and methodological assumptions (Shenkar 2011), the concept can still be helpful when discussing cultural similarities and dissimilarities on a national scale.

a role in both migration network studies and scientific collaboration research, allowing us to connect migration with STS scholarship and extend the logics of ethnic affinity and cultural homophily into the domain of scientific knowledge production.

Migrant networks are famously defined as "sets of interpersonal ties that connect migrants, former migrants, and non-migrants in origin and destination areas through the ties of kinship, friendship, and shared community origin" (Massey et al. 1993, 448). Social ties constitute a vital source of support and necessary resources during transnational migration (Gurak and Cases 1992). Access to information about labor markets and prospective employment, assistance with housing and legal issues, financial help and advice all substantially reduce the costs and risks of migration and influence its outcomes, significantly improving the migrant experience. During the adaptation period, migrants often maintain ties with their compatriots and may become deeply incorporated into ethnic networks. The documented consequences of immigrants' interactions in ethnic networks include the formation of ethnic communities and neighborhoods, ethnic businesses, ethnic occupational niches, ethnic enclaves, and even entire ethnic economies. Ethnic clustering and segregation of migrants, in terms of space, occupation, and sector of the economy are pronounced when migrants encounter difficulties in integration, experience social isolation or alienation, or suffer from discrimination in destination societies. Thus, migrant ethnic networks have ambiguous effects and consequences. Acting as a vital source of support during the migration and the settling-in stages, they may prevent full cultural integration into a host society and impede professional advancement.

The experiences of foreign-born scientists and professionals in the destination countries indicates that engagement in migration networks also has relevance for highly skilled migrants. Highly skilled migrants generally rely heavily on social ties when moving to a foreign country, although their social networks are assumed to be of "a different nature" and lead to "different migratory outcomes" than those of migrants with few professional qualifications (Vertovec 2002, 5).

Namely, qualified professionals typically rely on "networks of colleagues and organizations" (professional contacts) instead of the kinship or family ties (interpersonal contacts), which low-skilled migrants use (Vertovec 2002). The professional contacts highly skilled migrants mobilize are seldom classified into ethnic or non-ethnic ones, that is, this division is not specifically addressed or problematized (Johnston et al. 2006, 1231). They assume that professional networks are non-ethnic, in contrast to interpersonal ethnic

networks associated with chain migration (Poros 2011). Some find non-diasporic and diasporic ties to be "intertwined and sometimes difficult to distinguish" (Karaulova 2016, 143).

More is known about ethnic networks during highly skilled migrants' adaptation to and integration into destination countries. In a well-known study of immigrant entrepreneurs, Saxenian (1999) found that the highly skilled created Chinese, Indian, and Taiwanese ethnic associations in Silicon Valley as a response to barriers to their professional and business activities. Bound together by common ethnicities and languages, along with similar education backgrounds and professional identities among members, these local ethnic networks proved a viable source of support for foreign-born professionals, facilitating "immigrant job search, information exchange, access to capital and managerial know-how" (Saxenian 1999, ix). Providing consultations, training, investments, mentoring, and expansive networking opportunities, they compensated for immigrants' lack of resources and became crucial to their professional advancement and successful entrepreneurship. They also helped increase their credibility and enhance the "visibility and success of Chinese- and Indian-run businesses" regionally, facilitating immigrants' integration into the "mainstream technology economy" (Saxenian 1999, 50, ix). However, there is always the "danger of insularity," should ethnic associations become closed to outsiders and distance themselves from broader professional milieux (Saxenian 1999, 40). Ethnic networks are beneficial, when they bridge foreign-born and professional communities. International extension of local ethnic ties may provide additional benefits, when this creates a "rich fabric of professional and business relationships" with the home country and its specific regions (Saxenian 1999, 56).

Other important results of ethnic networking are tight, interactive, mutually enhancing connections between professional and ethnic identities and the incorporation of national or cultural belonging into professional activities, interests, and aspirations. Thus, organizations of immigrant specialists "combine the elements of traditional immigrant culture with the distinctly high-technology practices: they simultaneously create ethnic identities within the region and facilitate the professional networking and information exchange" (Saxenian 1999, 31). For instance, networking in an Indian professional association facilitated formation of a broad Indian identity and a sense of belonging to an Indian community, though Indians are "deeply divided and typically segregate themselves by regional and linguistic differences" in India itself (Saxenian 1999, 49). Moreover, professional ties with people who share common origins can have a special meaning for immigrants and be experienced as relations of a different character from other

professional connections. Professionals speak about "greater comfort" working with their compatriots and feeling more familiarity and trust "because the language and cultural approach are so similar" (Saxenian 1999, 43, 48). Consequently, ethnic or national belonging and common education, professional background, and career ambitions are mutually reinforcing. On one hand, when combined, they transform the meaning and quality of ethnic ties and national identification; on the other, they multiply professional connections and enhance professional development, changing professional interactions by infusing them with trust.

Ethnic networks also play a significant role in students' and scholars' migration (Tanyildiz 2008, 2015). Analysis of the role of social networks in doctoral students' migration from Turkey to the US and in student populations in US higher education institutions showed that students extensively rely on contacts with "students, alumni, faculty and local community of the same nationality" (Tanyildiz 2008: xii). These contacts influence their decisions to migrate and choice of institution. While fellow students provided general information about education programs, alumni acted as mediators, connecting students to senior faculty; foreign-born professors who were laboratory directors served as "active nodes of ethnic networks, mobilising foreign students from their country of origin" (Tanyildiz 2015, 61). Thus, ethnic professional contacts were found to both stimulate transnational migration and to direct it towards certain locations and institutions. As a result, an increased concentration of foreign-born students of certain nationalities was observed in particular US universities.

There is also ethnic clustering in research laboratories, with laboratories directed by foreign-born scholars being "more likely to be populated by students from the same country of origin" than those directed by non-migrant faculty (Tanyildiz 2008, 60–61). Thus, ethnicity and nationality affinity affect the composition of research collectives. This phenomenon is unevenly distributed and more pronounced in low-ranked departments, among Korean and Turkish students, and in some branches of engineering. This pattern of ethnic-based student-professor cooperation brings a number of professional advantages to all involved. Foreign-born professors can better evaluate the qualifications of candidates from the same country of origin than they can those from elsewhere and thus ensure their laboratories are staffed with researchers with the appropriate skills. For students, interacting with compatriots already established in academia becomes "additional support to help absorb both tacit and codified knowledge" and facilitate their incorporation into destination-country scientific communities (Tanyildiz 2008, 61). Moreover, the "presence of compatriots" positively influences knowledge-generation

activities, creating a "comfortable environment" and encouraging the "easy flow of information as a result of their shared culture" (Tanyildiz 2008, xii, 50).

Similar to Tanyildiz's findings, a study of Russian-speaking computer scientists working in British universities reveals the "pervasive significance of ties based on common origins, ethnicity, and nationality" to the scholars' migration and careers in the destination country, with a strong pattern of diasporic supervisor-student relations (Antoshchuk 2019). Seeking qualified personnel for their research projects, senior faculty played a crucial role in initiating recruitment of doctoral students from the former Soviet Union. Ties with Russian-speaking professors substantially reduced the costs, risks, and stress of students' migration and significantly influenced their subsequent integration into British academia. The majority of young scientists subsequently remained in the UK to pursue careers in academia or industry, with many young researchers continuing to work under Russian-speaking professors after defending their PhDs. This situation resulted in formation of diasporic knowledge networks, which dramatically increase the number of articles produced in diasporic collaboration.

Strong ethnic concentrations in research laboratories are called "ghetto labs" or "mono-cultural research teams" because they are "composed of scientists of similar origins" (Wagner 2014, 145). Ghetto labs are a distinctive type of research organization, markedly different from multicultural laboratories. They emerge as a response to rising competition and challenging professional requirements in internationalized academia. Principal investigators with migrant backgrounds play the main role in creating and sustaining ghetto labs, since they are responsible for choosing and hiring research staff. In accordance with the hypothesis regarding cultural distance, scholars from Western Europe typically integrate into multicultural teams, while scientists from Asia (China or Korea) and Eastern Europe (Russia or Poland) usually find themselves incorporated into ghetto labs.

Thus, ethnic and diasporic clusters of migrant scientists acquire different forms, that vary in terms of density and homogeneity. These include: ethnic communities, diasporic networks, ethnic concentrations in specific organizations, monocultural research laboratories. We see examples of this diversity among Russian-speaking scientists working abroad. For instance, the laboratory of Andrei Gudkov, a prominent cancer researcher in the US, with fifteen employees out of twenty from Russia, could be considered a "ghetto lab" (Allahverdjan and Agamova 2012, 48). Another example is Severinov's laboratory

at Rutgers University in the US, called "the Russian lab," as it is comprised only of Russian-speaking staff Severinov recruited (Artiushina 2014, 135, 138). Less homogeneous Russian mathematics communities exist in some British universities (Bronnikova 2010, 146). These communities began forming after the first mathematicians from formerly Soviet countries (pioneer migrants) settled in the UK and gradually brought their former colleagues to the same institutions (Ibid.). There are dense collaboration networks of Russian-speaking computer scientists incorporated into broader professional networks in highly ranked UK universities (Antoschyuk 2015). Russian-speaking nanoscientists also engage in transnational and local "science diaspora networks" (Karaulova 2016), which serve as a "mechanism of scientific migration" and a "strategy of reconciliation" for mobile scientists who experience an "adaptation challenge" due to "tension between the academic identity and the local academic culture" (Karaulova 2016, 209, 232). Primarily driven by professional motives and needs, migrant scientists become involved in diasporic networks for pragmatic reasons. Involvement intensifies when there is a professional need (for instance, a lack of a qualified staff) and decreases when there is a risk of "reputational hazards" (Karaulova 2016, 232).

Based on this evidence, I conclude that highly skilled professionals and academics substantially rely on professional ties to their co-ethnics and compatriots both before and after migration. They form migrant networks that function to reduce the costs and risks of cross-border movement and as an adaptation strategy to help overcome the disadvantages of being a migrant after arrival. These networks are tied together and maintained by pragmatic career considerations, a common language, and shared cultural belonging, similar to how educational background and professional experience operate in other contexts.

Diaspora Knowledge Networks are Knowledge-Creation Networks

The previous section demonstrated that scientists build and maintain migrant networks that support cross-border movement and facilitate integration into destination countries. Below, I discuss scholarly collaboration and innovation, demonstrating that professional diaspora ties promote scientific research and technological development, facilitating knowledge diffusion and transfer. Drawing on social studies of science and sociological theories of interaction rituals, I suggest why and how ethnic connections of highly skilled migrants relate to systematic knowledge generation and eventually transform into knowledge-creation networks.

Examination of scientific publications in recent decades demonstrates that research is becoming increasingly collective. The proportion of single-author articles continuously declines, while the share of co-authored articles and the number of co-authors per article increases (Glänzel and Schubert 2005). Moreover, scientific cooperation is increasingly internationalized, although it remains highly concentrated in the research-intensive states of Europe and the US (Wagner 2008; Leydesdorff et al. 2013). These countries function as academic-mobility hubs and accommodate a substantial number of foreign-born scientists (Franzoni et al. 2012),[37] who demonstrate distinctive collaboration patterns compared to non-migrant faculty. Namely, they tend to maintain professional ties with their compatriots both in their country of origin and elsewhere (Scellato et al. 2015).

A growing body of evidence shows that diasporic collaboration has increasing significance in science and other knowledge-intensive activities, leading to the formation and spread of DKNs. Thus, Chinese migrant scholars prefer cooperating with other Chinese researchers both in their home country and overseas (Jin et al. 2007; Jonkers 2010). Foreign-born scholars in Italy and Portugal also engage in collaboration with their compatriots in their home countries, which has a positive impact on their scientific productivity (Baruffaldi and Landoni 2012). Russian-speaking scientists who migrated abroad after the 1990s also cooperate with their compatriots both transnationally and in the host country (Bronnikova 2010; Antoschyuk 2015; Karaulova 2016). An analysis of 2.5 million publications by US-based co-authors from diverse origins confirms that cooperation "with people like me" or ethnic homophily is a "substantive phenomenon" in scientific research (Freeman and Huang 2015, 289, 313).

Diasporic ethnic ties are also an important factor driving innovation. Thus, ethnic networks function as a "transfer mechanism," ensuring a transnational exchange of codified and tacit knowledge, especially in high-tech industries and among Chinese professionals (Kerr 2008, 518). Collaboration with co-ethnics improves the innovative performance of Indian inventors in the US (Almeida et al. 2014). Agrawal et al. (2008) demonstrate that co-ethnicity acts as a predictor and mediator of knowledge flows that intersects with co-location: it serves as a substitute for geographical proximity and reduces the effects of distance between inventors. A study of foreign-born inventors residing in the US and Europe confirms the role of co-ethnicity in "reducing social distances" between inven-

37 For instance, foreign-born scholars constitute 23.2% of all faculty in Germany; 27.7% in the Netherlands, 32.9% in the UK, and 38.4% in the US. Switzerland was found to have the highest share of migrant scientists in the world at 56.7% (Franzoni et al. 2012, 6).

tors and functioning as a resource in building social connections (Breschi and Lissoni 2013, 31).

However, to understand the ethnic or diasporic collaborations that give rise to DKNs and to explain their effects, we need to account for their propensity for generating new knowledge and stimulate innovation. First, I apply the notion of the "invisible college," developed by Price (1963) and Crane (1972) and explain how it helps understanding DKNs as a form of networked knowledge production. Second, I use the concept of tacit knowledge (Collins 1974) and interaction rituals (Collins 2014) to hypothesize why diasporic ties comprising DKNs are conducive to knowledge creation.

Price (1963, 74, 83–84) defines invisible colleges as "informal collectives of closely interacting scientists" who represent an "unofficial organization" in the scientific community, consisting of a "set of interacting leaders" and functioning as a result of regular face-to face and remote contacts. Price considers the invisible college as a self-organized communication network particularly important in the era of "big science," which is characterized by a large number of scientists and a rapidly growing number of publications. The invisible college serves as a key social mechanism enabling information exchange within disciplines and facilitating the coordination and development of scientific ideas. Crane (1972) likewise demonstrates the crucial role of a small group of leading scholars for ensuring the circulation of information through the knowledge field. Crane's (1989, 19) main interest is revealing "the social aspects of scientific change" by examining scientific collaboration networks or the invisible colleges identifiable through co-authorship and citation connections. She finds that such connections comprise a complex social network with a particular structure that can facilitate or impede the growth of scientific knowledge.

Crane's work received criticism for undermining "the central role of communication behaviour and interpersonal ties" by focusing solely on formal means and results of interactions (publications, citations, co-authorship); this "reinforces the primacy of structure over process" and presupposes that informal communication can only grow from formal network structures (Lievrouw 1989, 620). In contrast, other works prioritize informal interactions among scientists (Lievrouw 1989; Cronin 1982). Cronin (1982, 225, 232) views these interactions as "the lifeblood of scientific progress" and asserts they are "likely to remain a pivotal feature of the scientific communication system for the foreseeable future." Lievrouw (1989, 622) also underlines informality as the primary constituting prin-

ciple of invisible colleges and defines this as "a set of informal communication relations among scholars or researchers who share a specific common interest or goal." Zuccala (2004, 10-11) proposes a balanced, comprehensive understanding of invisible colleges, including both formal and informal interactions, and emphasizing scholarly disciplines as the "intellectual basis" for information exchange and the "material contributions," that is, publications, of invisible college participants.[38]

Thus, an invisible college is a self-organized communication network of scientists working in the same research area that forms through interactions both formal and informal, remote and face-to-face, as the result of common research interests and generates publications. Invisible colleges ensure knowledge circulation in academic communities and are associated with the growth of knowledge and scientific disciplines. They reveal the crucial role of collaboration structures in knowledge production. Similarly, DKNs are communication networks among scientists with common professional goals and scientific interests, who produce publications together. Therefore, I argue that DKNs represent a new type of invisible college that emerges as a response to the increasing internationalization and neo-liberalization of science and higher education. DKNs are mechanisms for ensuring information exchange and connection in scientific communities, which include an increasing number of foreign-born researchers and are internally divided by ethnic diversity and cultural heterogeneity. Under these conditions, DKNs emerge as communication networks among scholars of common ethnicity, national identity, or cultural background because opportunities to collaborate with non-migrant scientists are limited or inaccessible, at least during migrants' initial adjustment period. Thus, DKNs are invisible colleges that help maintain high levels of scientific output and contribute to the growth of scientific disciplines. Following Zuccala's definition and considering the criticism discussed above, I consider DKN a network of formal and informal contacts between foreign-born or migrant scientists or professionals united by common research interests and country of origin, who collaborate and produce publications in their field.

Why are common ethnicity, nationality, and cultural origin powerful factors in knowledge production and why do they facilitate the formation of DKNs? First, common ethnicity or nationality typically implies similarities in cultural identification and a common language,

38 Zuccala's (2004, 11) full definition is as follows: "a set of interacting scholars or scientists who share similar research interests concerning a subject specialty, who often produce publications relevant to this subject and who communicate both formally and informally with one another to work towards important goals in the subject, even though they may belong to geographically distant research affiliates."

which facilitate formal and informal interactions, the principal component of invisible colleges. Researchers report that foreign-born scientists and professionals experience comfort and trust when working with their compatriots (Tanyildiz 2008; Saxenian 1999). Second, common ethnicity and nationality indicate shared professional socialization, which plays an important role in interactions, as migrant scientists share specific codified and tacit knowledge of their discipline. This "intangible and unspeakable" part of scientific knowledge is deeply contextual, as it is incorporated in organizational and institutional settings and tied to specific academic cultures (Collins 1974). Consequently, migrant scientists trained in a particular national context, having internalized the norms and values of a particular academic culture, may find it much easier to understand each other and work together than with outsiders (Karaulova 2016, 184). Third, sharing both cultural and professional backgrounds encourages cooperation among scientists because they establish a productive knowledge creation ritual sand maintain a chain of such rituals (Basov 2012, 188). According to interaction ritual theory, new knowledge is produced in group communication with a particular social dynamic, when participants successfully establish a mutual focus and achieve entrainment of their bodily rhythms and moods (Collins 2014). A common background seems to facilitate these processes and drive the cycle of group interactions, which saturates communication with positive emotions, enhances their diasporic solidarity, and leads to the creation of new group symbols in the form of scientific ideas, concepts, and theories.

Conclusion

The chapter focuses on DKNs as a widespread, increasingly important occurrence produced by migration of the highly skilled and scholars. Drawing on previous understandings of DKNs, I suggest broadening our conceptualization of the phenomenon to integrate migration and science studies scholarship.

The dominant discourse depicts highly skilled migrants as globetrotters and cosmopolitans who easily integrate into the professional milieux in destination countries, as people devoid of nostalgia for their homelands. By contrast, existing research suggests that ethnic and diasporic ties and feelings of diasporic belonging among mobile scientists and professionals have persistent significance. Encountering a variety of difficulties and tensions during migration and adaptation to host countries due to their migrant status and foreign background, highly skilled migrants mobilize ties with co-ethnics and former compatriots. This leads to the emergence and development of migration networks, which help reduce the costs and risks of cross-border movement and facilitate professional adjustment to and advancement in host countries. However, the effects of these

diaspora networks go far beyond their consequences for migration. They include collaborations, joint projects and publications, and innovative solutions and inventions. Thus, migration networks simultaneously function as knowledge creation networks, creating the knowledge exchange and generation activities. In a context of internationalization, an increased academic mobility, and internal divisions brought about by ethnic diversity and cultural heterogeneity, diaspora knowledge networks ensure information exchange and connectivity in national and transnational scientific communities. Like an invisible college, DKNs help maintain a high level of scientific output and contribute to the growth of scientific disciplines.

To sum up, DKNs represent a newly emergent and underexplored social structure that unites ethnic support networks with knowledge production. These structures are new sites of interaction, intersection, and co-construction of diaspora and professional identities, with a wide range of consequences at the individual, collective, and organizational levels.