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

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INTRODUCTION

Diaspora Knowledge Networks in Internationalized Academia

A substantial growth in academic mobility has accompanied the internationalization of higher education (Bilecen, Van Mol, 2017), which has become "systematic, dense, multiple and transnational" (Kim, 2010, 578). The proportion of foreign-born scientists in developed countries of the Global North is significant (Franzoni et al. 2012) and their contribution to economic, scientific development, and technological innovation increasingly important (Levin and Stephan 1999; Stephan and Levin 2001; Lin 2004; Corley and Sabsarwal 2007). As a result, academic communities in developed countries have become more ethnically and culturally diverse. We often assume mobile scientists "spearhead" higher education's internationalization as "drivers of international consciousness" in universities (Yudkevich et al. 2016, 3, 1). We view them as globally minded individuals who successfully embrace diversity, competently work in multicultural environments, and facilitate intercultural dialogue (Trahar and Hyland 2011).

We rarely notice or problematize a second consequence of internationalization. Consider the case of Andre Geim and Konstantin Novoselov, two professors at the University of Manchester. Geim and Novoselov are perhaps the most renowned British scientists of Russian origin who migrated to the UK during Russia's period of acute brain drain (1990s–2000s). They became international celebrities in October 2010, awarded the Nobel Prize in physics for "ground-breaking experiments regarding the two-dimensional material graphene."[2] The University of Manchester has long enjoyed a reputation as one of the most international universities in the world.[3] Yet, graphene turned out to be largely a product of joint efforts by the "Russian team" Geim established at the University of Manchester[4] and his former colleagues at the Institute of Microelectronics Technology in Chernogolovka,[5] a scientific town in the

2 The Nobel Prize, "The Nobel Prize in Physics 2010", n.d., https://www.nobelprize.org/prizes/physics/2010/summary/.

3 Times Higher Education, "Most international universities in the world", Jan 25, 2023, https://www.timeshighereducation.com/student/best-universities/most-international-universities-world#survey-answer.

4 Yaroslav Korobatov, "Andrei Geim and Konstantin Novoselov: "new Russian" Nobel laureates", Komsomolskaya Pravda, March 20, 2015, https://www.kp.ru/daily/26344/3227600/.

5 https://www.spb.kp.ru/daily/24571/743901/.

Moscow Region.[6] What appears to have taken place is a cross-border collaboration, is actually a diasporic collaboration among scientists of similar national origin. Why did Russian-speaking scholars, firmly established at one of the most prestigious and internationalized British universities, collaborate with each other and other Russian researchers? More importantly, how did they become so successful?

The story dates back to December 1990, when young Russian physicist Andre Geim came to the UK on a six-month Royal Society fellowship "with very little money and very poor English."[7] Andre had ambitions and was "determined to make an impression," but his first attempts were hardly successful.[8] He experienced difficulties of "fitting in in a social way"[9] and could experiment with only "practically exhausted" samples (Geim 2011, 851). Following the fellowship, he had several short-term postdoctoral contracts, putting him in "precarious circumstances" for the next few years (1991–1994).[10] Andre and his wife Irina, who in vain searched for a scholarly job,[11] lived "in a miserable situation" and experienced a "tough time,"[12] without stability or money. The associate professor position at Radboud University Nijmegen, Netherlands, which Geim acquired in 1994, brought "some security" to their "new post-Soviet life," but led to new integration difficulties (Geim 2011, 852). Looking for the means to "survive scientifically," Andre applied to his former colleague and a roommate,[13] Sergey Dubonos, at the Institute of Microelectronics Technology in Chernogolovka, to produce samples and assist with measurements (Geim 2011, 852). Andre's wife Irina, again without a job, "had plenty of time" to help Andre in "conquering the subject and writing papers" (Ibid.). It was the start of the network of diasporic ties, yielding Geim several papers in Nature and Physical Review Letters,

6 Maria Rogacheva, "Soviet Scientists Take the Initiative: Khrushchev's Thaw and the Emergence of the Scientific Centre in Chernogolovka", Europe-Asia Studies, 68(7) (2016): 1179-1196, https://www.tandfonline.com/doi/abs/10.1080/09668136.2016.1217502. Maria Rogacheva, The Private World of Soviet Scientists from Stalin to Gorbachev (Cambridge University Press, 2017).

7 Giles Whittell, "The godfather of graphene", 1843 magazine, August 12, 2014, https://www.1843magazine.com/content/features/giles-whittell/andre-geim.

8 Whittell, "The godfather of graphene".

9 Whittell, "The godfather of graphene".

10 Whittell, "The godfather of graphene".

11 Her Russian colleagues report that at some point Irina had to earn a living working as a dishwasher - see Svetlana Samodelova, "One graphene for two", Moskovskiy Komsomolets, October 6, 2010, https://www.mk.ru/science/2010/10/06/534780-odin-grafen-na-dvoih.html.

12 Samodelova, "One graphene for two".

13 Andre Geim, "Biographical", The Nobel Prize, n.d., https://www.nobelprize.org/prizes/physics/2010/geim/biographical/.

which created a basis for his subsequent career advancement to professorship in 2001. The initial period of adjustment was defined by uncertainty, precarious labor conditions, and the sense of being a misfit.

It was Dubonos who helped Geim find a doctoral student in 1999.[14] A senior academic, Geim needed a qualified, hardworking, loyal disciple to advance his research. As a young researcher, Novoselov was eager to seize upon a rare opportunity to travel abroad and learn from a "innovative and creative experimentalist."[15] Their similar professional backgrounds—both worked at the Institute of Microelectronics Technology in Chernogolovka and graduated from Moscow Physical Technical Institute (the famous "Phystech")—ensured mutual understanding. Socialized in (post)-Soviet academic culture, Geim and Novoselov developed a distinctive approach to research—marked by fascination with fundamental science, universalism, and playful experimentation—which was partly the cause of their high scientific productivity.

In 2001, Geim obtained a professorship at the University of Manchester. Relocation to the UK and new challenges with funding and equipment there (Geim 2011, 854) stimulated further extension of diasporic ties. Andre continued to rely on "help from other places" (Ibid.) and accumulated more Russian-speaking staff in the new laboratory, at first a circle of a few relatives and friends: Andre and his wife Irina, Novoselov and his wife Irina Barbolina, and a couple of postdoctoral fellows and visitors, including Morozov and Dubonos.[16] Intensive work with similarly minded colleagues, numerous projects, and the UK's "nonxenophobic" funding system enabled them to achieve outstanding results in the new location "unbelievably quickly" (Geim 2011, 854). By 2004, Geim's team had "a fully functional laboratory" and several papers in high-profile journals (Ibid.). The groundbreaking paper on graphene, now cited more than 50,000 times, appeared in Science in 2004 and featured six Russian-speaking authors out of eight,[17] showing the crucial role of diasporic collaboration in this discovery.

14 Tatiana Bateneva, "Is there a life without Nobel Prize?", Izvestia, November 09, 2010 https://iz.ru/news/367827.

15 Konstantin Novoselov, "Biographical", The Nobel Prize, n.d., https://www.nobelprize.org/prizes/physics/2010/novoselov/biographical/.

16 Konstantin Novoselov, "Biographical".

17 Novoselov, K. S., Geim, A. K., Morozov, S. V., Jiang, D., Zhang, Y., Dubonos, S. V., Grigorieva I.V. & Firsov, A. A. (2004). Electric field effect in atomically thin carbon films. Science, 306(5696), 666-669.

By 2010, when Geim and Novoselov became known to the world as Nobel Prize winners, the diasporic connections had multiplied both locally in the UK and transnationally, becoming a stable intellectual foundation for new scientific achievements and enhanced productivity.[18] Eight out of eleven team members working on graphene were migrants from CIS countries ("Russians, Ukrainians, and Siberians").[19] Geim continued to connect to and invite people from the post-Soviet region, proud of assembling a good team.[20] By 2015, the laboratory had grown up to accommodate forty to fifty staff, primarily with migrant backgrounds, and not just Russian-speakers—"Russians, Ukrainians, English, Pakistani, Indians, Chinese."[21] Yet, diasporic ties retained their significance, as "the core of the group" still remained "Russian-speaking."[22] New diasporic collaborations outside the University of Manchester formed. They were no longer essential to scientific survival or academic advancement, but helped to sustain the intensive pace of research and high scientific productivity, to maintain the leading place of the research team and keep it competitive. Having achieved the status of highly cited and "hot" researchers, with an h-index above 100, Geim and Novoselov accumulated a number of honorary professorships and doctorates and acquired numerous academic awards. They enjoyed the pinnacle of scientific recognition and international fame.

The story of Geim and Novoselov sounds like a fairytale, giving hope that migrant scientists can ascend to the top of the Ivory Tower if they are inventive and industrious enough. But a network of Russian-speaking scientists, which grew from a few ties to a rather extensive structure, deeply integrated into the European academic environment, accomplished the major magic in this story.

This study focuses on diasporic connections and their stable associations—networks—that mobile academics form in the context of the ongoing internationalization of higher education and science worldwide, especially in countries of the Global North. Following studies of transnational associations formed by expatriate scientists and professionals of common origin (Meyer and Wattiaux 2006; Meyer 2007,

18 Ria Novosti, "Nobel prize for Physics is awarded to Russian Brits", October 05, 2010, https://ria.ru/20101005/282559646.html

19 Pavel Kotlyar, "Geim and Novoselov magnetized graphen", Infox.ru, April 15, 2011, https://www.infox.ru/news/28/67249-gejm-i-novoselov-namagnitili-grafen.

20 Pavel Kotlyar, "Geim and Novoselov".

21 Yaroslav Korobatov, "Andrei Geim and Konstantin Novoselov".

22 Yaroslav Korobatov, "Andrei Geim and Konstantin Novoselov".

2011), I call these diaspora knowledge networks (DKNs). I trace the formation and development of DKNs as a specific kind of network and demonstrate the importance and impact that such networks have on migration processes and knowledge production. I show that DKNs constitute real, existing, enduring collaboration networks, uniting migrant and non-migrant scientists of common origin locally, nationally, and transnationally. DKNs create a variety of remarkable and important effects for the scientists involved, transforming their migration and professional trajectories and impacting their scientific activities. At the same time, DKNs manifest themselves as an intriguing phenomenon, which defies our expectations: it challenges "an overly romantic" vision of academic mobility (Robertson 2010) as necessarily advantageous, cosmopolitan, and "internationalising" (Song and McCarthy 2019: 20). Rather, as my study demonstrates, the DKN is incorporated into and built upon multiple forms of social inequality. DKNs appear when there are socioeconomic discrepancies between source and destination countries. They arise as a response to the systemic barriers and constraints migrant scholars experience when performing scientific work in destination countries. DKNs thus operate as particular ecologies of innovation, shielding the disadvantages of migrant scholars in foreign academic environments. However, they also reproduce familiar structures of inequality and power relations in academia.

DKNs' "Nature" and Effects: Insights from and Shortcomings of Main Approaches

There is a growing visibility and evidence of the significance of diasporic ties in academia. DKN activities include co-authoring papers with former compatriots, recruiting graduate students from home countries, participating in diaspora projects, and populating laboratories with research staff of common origin. Studies of transnational associations of expatriate scientists and engineers in the 1990s–2000s originally shed light on the importance of DKNs (Brown 2002; Meyer 2001, 2007; Meyer and Wattiaux 2006). The associations were called diaspora knowledge networks or DKNs because they "weave professional and associative ties," while orienting towards "the common origin as a pivotal centre" (Meyer and Wattiaux 2006, 8). I use this term to refer to the networks of connection and association between migrant and non-migrant scientists and professionals of common origin. It effectively captures the essence of their networking, underlining the mutually constitutive relationship between "diaspora," "knowledge" and "network."

The proliferation of DKNs, their durability, and "original and irreplaceable develop-

mental action" (Meyer 2007, 3) inspired a wealth of interest and "deeply changed the way highly skilled mobility used to be looked at" (Meyer and Wattiaux 2006, 4). Recognizing them fundamentally transformed the conversation away from the "brain drain" to "brain circulation" and "brain gain," invoking the productive, positive effects of DKNs. It shifted the perspective from human capital framework to "network approaches," which view highly skilled migrants, their movements, skills, and knowledge activities as deeply embedded in and shaped by social networks (Meyer 2001). As a result, research on ethnic and diasporic ties among academics and other highly skilled migrants has substantially expanded and evolved. Systematizing existing scholarship, I distinguish three main approaches:

1 **DKN as a transnational internet-based association;**

2 **DKN as a transnational collaboration network;**

3 **DKN as an ethnic network.**

Each approach offers a different perspective on DKNs, their origins, and consequences.

Defining DKNs as *transnational internet-based associations* calls attention to how they unite highly skilled expatriates of common origin dispersed across the globe "to contribute to the development of their origin countries" (Meyer, 2011, 159) and ensure the "educational, social, cultural and professional advancement" of their members (Brown 2002: 172).[23] This approach emphasizes the significance of an affinity for the home country and DKNs' developmental impact, linking the networks to the professional activities and interactions of highly skilled migrants. It highlights the mobilization of national belonging in professional networking, that is, the process of "re-identification through professional motives" (Meyer, 2007, 10). The distinctive features of these DKNs are reliance on the internet as a mediating technology, networking as a driving force, and coupling shared nationality to professional motives. These features interact with and reinforce each other: highly skilled migrants connect to each other and form associations through information and communication technologies (Grossman 2010). A mixture of professional aspirations with national feelings inspires engagement in the association and stimulates members' further

23 The Colombian Network of Scientists and Engineers (Red Caldas) and the South African Network of Skills Abroad (SANSA) are the most internationally renowned networks of this kind. However, there are more than 150 DKN worldwide (Meyer and Wattiaux 2006, 19–24). These associations generally arise as spontaneous initiatives of highly skilled migrants, becoming "non-profit, independent entities" (Brown 2002, 171) with a name, membership, and organizational structure (Barre et al., 2003). Some associations maintain links to government agencies and partially rely on home states' support (Brown 2002).

intermingling (Meyer 2007, 10; Meyer and Wattiaux 2006). Networking occurs in various DKN activities (meetings, conferences, working groups, and projects) and facilitates information exchange and knowledge transfer to the country of origin (Brown 2002; Barre et al. 2003; Meyer 2007; Meyer and Wattiaux 2006; Grossman 2010; Meyer 2011; Chaparro et al. 2006; Minoian and Freinkman 2006; Tettey 2016; Cruz and Sabillon 2019).

The DKN as a *transnational collaboration network* approach considers collaborations between scholars of common origin: exchanging papers, arranging conference panels, co-authoring papers, and conducting joint research projects. This approach also focuses on diasporic and ethnic ties, but concerns connections individuals sustain independent of associations and views them through the lens of transnationalism. The transnational perspective is visible in notions of "transnational research collaboration" (Jonkers 2010, 229), "transnational knowledge network" (Zhang 2014, iv), and "transnational science diaspora field" (Karaulova 2016, 232). Though some commonality forms the basis for these networks: language and culture (Jin et al. 2007), national academic culture (Karaulova 2016), or "ethnic origin and migration experience" (Jonkers 2010, 228), migrant scientists are involved in professional activities and sustain attachments to multiple national contexts (Jin et al. 2007; Chen and Koyama 2013; Yang and Welch 2010; Karaulova 2016). Expatriate scholars collaborate with scientists in home countries, but do not necessarily identify with diaspora (Karaulova 2016, 221)[24] and consider themselves "cosmopolitan" persons, "rich in international experience" (Yang and Welch 2010, 602). They view crossborder ties with former compatriots as just another segment of their international scientific networks, which create a "new space of transnational engagement and subjectivity building" (Chen and Koyama 2013, 25). Transnational diasporic collaboration "requires more than passion" for the country of origin (Yang and Welch 2010, 600) and depends on many factors. These include individual attributes such as gender, academic rank, and research interest (Welch and Zhen 2008), the conditions at receiving universities as "transnational platforms for knowledge diaspora" (Yang and Welch 2010, 596), and opportunities at home country universities, priorities, and demands home and host country science systems make, along with government policies in origin and destination countries (Jin et al. 2007; Jonkers 2010; Yang and Welch 2010; Sun and Bian 2012; Karaulova 2016).

24 "Being, but not belonging" or pragmatic kind of diasporic engagement (Karaulova 2016, 221)

The DKN as an *ethnic network* approach includes studies of ethnic ties in innovation (inventor networks), scientific collaboration (co-authorship networks), and in high-tech industries and entrepreneurship (highly skilled migrant networks). The major contribution of inventor network studies is proving that ethnic ties act as "drivers of knowledge interactions" (Schneider et al. 2019, 18), mediating knowledge flows and enabling knowledge transfer, both transnationally (Kerr 2008; Breschi and Lissoni 2013; Breschi et al. 2015) and in host countries (Agrawal et al. 2008; Almeida et al. 2014; Schneider et al. 2019). Ethnicity also shapes the formation of co-authorship networks (Freeman and Huang 2015) and the "evolution of research communities" (Wu et al. 2014, 1). Studies of highly skilled migrants in high-tech industries reveal the coupling of "diaspora," "knowledge" and "network" in DKNs. Networking in Silicon Valley professional associations facilitated a revival and reconstruction of ethnic identities among highly skilled professionals of Chinese, Indian, and other national origins (Saxenian 1999, 31). In transnational Indian IT specialists networks, ethnicity and profession peculiarly converged in an individualized meritocratic ideology and discourse about "professional excellence" (Xiang 2006, 111, 8). Though these scholars present various understandings of ethnicity and sometimes conflate native-born co-ethnics with foreign-born ones, they view ethnicity as produced and reproduced in the professional, knowledge-related activities of the highly skilled. Highlighting the disadvantages migrant professionals experience in host countries, from glass ceilings to a lack of entrepreneurial opportunities and social isolation, these studies show how ethnic networks become a crucial strategy to compensate for highly skilled migrants' lack of resources and opportunities. Ethnic networks help overcome those disadvantages, facilitating migrant integration, career advancement in mainstream professional communities (Saxenian 1999; Shih 2006 and Wong 2006), or supporting returning to the home country (Qin 2011). Participation in "expatriate social networks" tends to fade, once migrants do not need their support to integrate into local professional milieux (Harvey 2009). This partially explains why ethnic networks are prevalent among third-country nationals and rarely observed among highly skilled migrants from developed countries (Ryan and Mulholland 2014).

A number of other studies of diasporic connections, though not part of the approaches outlined above, are still important to studying DKNs. These include research on monocultural or "ghetto" laboratories (Wagner 2014, 2015), recruitment of co-ethnics and co-nationals to research teams (Artiushina 2014; Tanyildiz 2015; Ortiga et al. 2020), and attempts to reconstruct national scientific schools in destination countries (Bronnikova 2010). These studies are insightful in demonstrating the surprising significance of diaspora networks in academia, typically viewed as cosmopolitan

milieux, where "national differences do not exist" (Wagner 2014, 147). Typically senior scholars, laboratory directors, and principal investigators play the major roles in initiating and managing these networks (Wagner 2014; Tanyildiz 2008; Bronnikova 2010), since they are responsible for recruiting research staff. Diaspora networks provide various advantages to all scholars involved including: ensuring a supply of qualified personnel and a "comfortable lab environment that makes communication and information exchange easier" (Tanyildiz 2008, xii), professional adjustment for early-career scholars, and coping mechanisms to deal with increasing competition in academia (Wagner 2014).

In sum, existing scholarship shows that DKNs proliferate across different national, institutional, and organizational contexts, manifest in different forms, and generate various positive effects for individuals, communities, regions, and whole countries.

Productive and important as they are, existing studies of what effectively falls under the umbrella of DKNs have a number of limitations. The major shortcoming is that scholars widely use the concept of DKN in brain drain/gain and migration-as-development research, but do not been systematically apply it to exploring academic mobility in the context of higher education internationalization. They consider diasporic ties "not particularly strong or significant to the professional lives of mobile scientists" (Ackers et al. 2007, 4). The ideology prevalent in internationalisation studies presents academic mobility as encouraging interculturality (Kim 2009) and "cross-cultural engagement" (Gopal 2011, 379). From this perspective, ethnic and diasporic solidarities are viewed as "old," "conservative" and "unsettling," endangering international character of education (Matthews and Sidhu 2005, 50). An important empirical slice of reality thus disappears. In this study, I argue that ethnonational affiliations and associations not only persist in academia and play a vital productive role, but they also expand with the globalization of scientific mobility and knowledge production and rely on and contribute to the realization of national and institutional internationalization strategies.

Another challenge is how to conceptualize these ethnonational associations in academia. The understandings of DKNs existing approaches offer are not satisfactory. The notion of DKN as a transnational association focuses on migrants' affinity to their home countries. The term "transnational collaboration network" erodes the significance of common origins with immersion in transnationalism. "Ethnic net-

work" conflates ethnicity with national belonging and does not differentiate ethnicity from the experience of having a migrant background. By contrast, my study develops a concept of DKNs that foregrounds the co-constitutive diasporic and professional relations that emerge in migrant scientists' interactions.

Concerning how DKNs emerge, the approaches I cite above primarily focus on macro level factors, including brain drain dynamics and favorable features in host and home country contexts. They present DKNs as ready-made entities without "investigating the agency required to initiate, transform, or weaken" them (Mainwaring 2016, 291). Unlike highly skilled migrants, we still know very little about how migrant scholars establish, engage in, and maintain diaspora networks. This study fills this gap, tracing how migrant academics' individual aspirations and motivations, strategies, and maneuvers give rise to and sustain DKNs. Understanding agency as a "socioculturally mediated capacity to act" (Ahearn 2010, 28), I treat scientists as "active social and political agents negotiating, interpreting, contesting their social worlds" (Robertson 2010). Recognizing that structural forces, "power inequalities," and "cultural repertoires" constrain their "capacity to act" (de Haas 2010, 5), I focus on how migrant scholars navigate and inhabit these constraints and create space for action and negotiation with institutions, other migrants, and non-migrants in an attempt to adapt to the new environment and improve their career chances (Mainwaring 2016, 293).

Produced from migrant scientists' actions and interactions, DKNs are social structures that "exercise their own causal powers, independently of the agency which produced them" (Parker 2000, 73, cited in Bakewell 2010, 1696). Existing approaches do not comprehensively capture their "emergent properties" (Bakewell 2010, 1703), since they mostly pay attention to macrolevel consequences (countries, regions), without properly examining migrant scientists' experiences. Instead, they are concerned with how DKNs affect knowledge transfer and exchange, with little focus on their impact on academic mobility. The relation between migration, mobility, diaspora networks, and knowledge production, especially at the level of individual biographies, remains unclear and requires revealing. This study takes as its premise that growing academic mobility deeply transforms the everyday realities of scientific knowledge production, interfering in the process of academic community building in both positive and negative ways. We should not assume that mobile scientists invariably develop post-migration collaboration networks. Cultivating new connections in destination countries while maintaining old ones in home countries does not occur "naturally" or automatically, but depends on many factors and conditions (Antosh-

chuk et al. 2022). Mobility experiences shape foreign-born scientists' collaboration strategies and networks and consequently scientific outcomes. Therefore, we should explore the development of DKNs and their emergent effects in the context of foreign-born scholars' migration trajectories and scientific activities.

Doing so requires integrating insights from two bodies of literature—migration network theory (Portes and Bach 1985; Tilly 1990; Massey 1990; Gurak and Cases 1992; Massey 1993) and invisible college scholarship (Price 1963; Crane 1972; Lievrouw 1989; Zuccala 2005). The first body of literature approaches academic mobility as a phenomenon sustained by social connections and "a process of network building" (Portes and Bach 1985, 10). It envisions foreign-born scientists as migrants who rely on diasporic ties for support and assistance. Thus, it sheds light on how migration processes become involved in the formation of collaboration networks. Invisible colleges scholarship underlines the networked character of knowledge production and "the informal collectives of closely interacting scientists" (Price 1963, 74) as basic constituents of academic communities. Combined with migration literature, it helps us understand how networks uniting migrant and non-migrant scientists ensure knowledge generation, circulation, and exchange in an internationalizing and culturally diverse academia.

I use network as a central concept to connect migration network and invisible colleges scholarship and balance agency and structure, combining "networking" as an agent-driven process with "network" as a stable structure. Networking entails a dynamic process of interaction and relationship-building among migrant scientists based on "intersubjectivity of experience and meaning" (Erikson 2013, 219). Networks are "discrete and fixed entities," which "give form to transactions" and have a specific composition, structure, and boundaries (Ibid., 225). In this study I explore DKNs as both process and structure, tracing how diasporic ties emerge and develop in the individual migration trajectories of Russian-speaking computer scientists (RCS), giving rise to DKNs as enduring collaboration networks.

Finally, existing studies assume a homogeneity within DKNs and rarely focus on internal inequalities and conflicting interests among scientists who appear to be united by a common origin. This creates the impression that diaspora networks "operate for the near equal benefit of one and all" (Goza 2004, 4). However, academic mobility (Jöns 2011; Leung 2014) and scientific collaboration are both strongly stratified by

gender (Larivière et al. 2013; Abramo et al. 2013; Belle et al. 2014; Ghiasi et al. 2015; Jadidi et al. 2018) and academic rank (Abramo et al. 2011; Wang et al. 2017; Abramo et al. 2018). In my study, I identify internal inequalities in DKNs and seek to understand how intersecting migrant and academic hierarchies among foreign-born scientists shape DKN structure and the distribution of the benefits they generate.

My study contributes to understanding the contradictory consequences and challenges of higher education internationalization by expanding the scholarship on DKNs. It seeks to determine the essential features of DKNs, trace their formation and development processes, and identify their effects and internal divisions. I accomplish this by developing and implementing a specific analytical approach that emerges from viewing foreign-born scientists as agents who construct and maintain DKNs and connecting their migration experiences with their scientific knowledge production activities.

Research Aims and Objectives

The aim of this study is to deepen the knowledge of DKNs as a specific type of social structure proliferating in internationalizing academia in developed countries, which increasingly rely on a highly skilled immigrant workforce to develop higher education and research. **The primary research question is:**

Why do DKNs emerge and persist in today's academia and what consequences do they have?

I address this question by focusing on Russian-speaking computer scientists in the UK as an empirical case, conducting mixed methods analysis of semi-structured interviews and publications data.

In the literature review, I identified major characteristics of DKNs that are not sufficiently explored: the mechanisms by which they emerge and develop, their distinctive features, their effects, and how they reflect and reproduce social inequalities. Based on these elaborations, I segmented my primary research question into the following **research sub-questions:**

1. **What are the mechanisms that cause DKNs to emerge and develop?**
2. **What are DKNs' distinctive features?**
3. **What are DKNs' benefits and disadvantages to involved scientists?**
4. **How do social inequalities shape DKNs' structures, development, and the distribution of their benefits?**

To examine these sub-questions, I view DKNs in the context of academic mobility, focusing on migrant agency and connecting DKNs' migration and knowledge characteristics. To answer the first sub-question, I trace how migrant scientists establish and maintain DKNs, navigating and responding to constellations of macro- and meso-level factors in their cross-border movements and professional adjustments to destination country conditions. The second sub-question presupposes identification of specific DKN features that differentiate it from other networks in which migrant academics are involved. The third sub-question entails identifying the effects of DKN, explaining how migrant scientists receive benefits or suffer losses in terms of integration, career advancement, and scientific research. In responding to the fourth sub-question, I seek to understand how intersecting dimensions of social inequality (gender, academic position, migrant status) affect the process of DKN formation and development, shape their internal structures, and determine distribution of their benefits.

Russian-speaking Computer Scientists in the United Kingdom

RCS living and working in the UK present an exemplary case for exploring these research questions for several reasons. First, as one of the world's leading research countries (International Comparative Performance, 2016), characterized by a high level of internationalization in science and higher education, the UK is a highly suitable context for such a study. Foreign-born scientists of EU and non-EU origin constitute a substantial proportion (30% in 2016-2017) of UK academic staff (Patterns and Trends 2018, 25), while the share of international postgraduate students is 35,5% (Patterns and Trends 2018, 15). The UK circulates large inflows and outflows of junior researchers (Bekhradnia and Sastry 2005) and occupies "a central position in the international co-authorship network"(International Comparative Performance 2016, 72). Third-country non-EU nationals, including scientists from the former Soviet Union, encounter particularly high barriers for entering and integrating into the country and face fierce competition for scarce positions and funding. This may impact foreign-born scholars' career strategies and likelihood to engage in collabora-

tion , increasing their propensity for working with co-nationals or co-ethnics. Beyond having a culturally diverse academic environment, the UK has restrictive migration policies and a highly competitive labor market, making it a particularly good setting for exploring the formation and development of DKNs.

Second, RCS represent a suitable migrant and non-migrant population for study because of their legal status, distinctive post-Soviet background, and history of migration. IT specialists and computer scientists are among the most numerous highly skilled migrants from the former USSR (Biagioli, Lepinay 2019). The UK is one of their major destinations (Lepinay et al. 2014; Zemnukhova 2015; Yurevich and Aushkap 2018). Beyond this, migrants from the former Soviet Union have the legal status of non-EU third country nationals, subject to high barriers for entering and settling in the country. But RCS are less numerous than other groups of non-European Union third-country academics working in the UK (for instance, Chinese or South Asian). This makes them a convenient group to research because I can include all the scientists fitting this category. Moreover, RCS have a rather short history of migration from the former Soviet Union, about thirty years beginning in the 1990s, which enables me to capture DKNs in the process of their formation and development. Furthermore, RCS are part of larger flows of post-Soviet migrants who speak Russian, share a common "historically-specific socio-cultural background" (Byford 2009, 55), and share the "specificity of Russian history and culture, media and diasporic activities, and current political processes in Russian and post-Soviet space" (Pechurina 2017, 40). Finally, socialized in the USSR or post-Soviet states, a particular professional and academic culture distinguishes Russian-speaking scientists (Karaulova et al. 2016). The Soviet system was "quite different from the European notion of a university" (Kuraev 2016, 181) and occupied a "position of isolation" (Schott 1992, 434) in international scientific exchanges. After the fall of the USSR, scientists started migrating to the West in large numbers (Graham and Dezhina 2008; Korobkov and Zaionchkovskaia 2012; Subbotin and Aref 2020). Lacking familiarity with the institutional research systems abroad, how did they manage to adjust professionally? Did they mobilize diaspora connections or use other strategies?

Methodology

My theoretical approach is based on conceptualizing DKNs as simultaneously a structure and a process. My methods combine formalist and relationalist perspectives in social network analysis (Erikson 2013) and constructivist and essentialist approaches to diaspora studies. I employ a mixed methods research strategy that integrates

qualitative analysis of semi-structured interviews with scientists with quantitative analysis and social network analysis of RCS publications data. Though rarely used, mixed methods are increasingly recognized as an empirically and theoretically valid approach for investigating migrants' (Bilecen 2012; Ryan 2016; Ryan, Angelo 2018) and scientists'relationships (Lievrouw 1990; Velden, Lagoze 2013; Karaulova 2016). The benefits of mixed methods are that they overcome the dichotomy between essentialist and constructivist orientations and micro- and macro level network analysis (Erikson 2013). They "improve to quality of data" and "enhance the explanatory power and generalizability of results" (Hollstein 2014, 3). Combining qualitative and quantitative analysis is especially useful for exploring "processes, dynamics and consequences of social networks" (Ibid.). It enables the understanding of internal structures and contents of networks "within dynamic personal (micro), relational (meso) and wider (macro) structural contexts" (Ryan, Angelo 2018, 157). Among mixed methods strategies I adhere to the integration of quantitative and qualitative methods when they are "inter-meshed with each other" (Moran-Ellis et al. 2006, 51) and used in "an interdependent way" so that the data and results "obtained by one method feed directly into the other" (Velden, Lagoze 2013, 2407). An integrated approach reveals how diasporic ties are embedded in the migration and scientific experiences of post-Soviet scientists, how diasporic interactions give rise to DKNs as social structures, and how these structures in turn affect research outcomes and the careers of migrant scientists.

In operational terms, I define DKNs as networks of migrant and non-migrant scientists united by common origin who collaborate nationally and transnationally to produce, exchange, and transfer scientific knowledge. How did I uncover RCS and ensure they were Russian-speaking persons coming from post-Soviet regions? I initially identified RCS in the UK using Web of Science data (1985–2014).[25] I checked the first list of Russian-speaking computer scientists manually using open internet sources to exclude false identifications. I subsequently expanded the list, using information from interviews and information from publications in Digital Bibliography & Library Project Computer Science Bibliography.[26] I used the following criteria to compile

25 I refer to the Web of Science data Andrei Mogoutov and Exvisu processed for the "Russian computer scientists at Home and Abroad" mega-grant project (2013–2015). Using a special data search and extraction algorithm, I composed a list of authors with UK affiliation engaged in computer science research (including: artificial intelligence, information systems, software engineering, and hardware architecture) and potentially Russian background. The search algorithm identified persons with typically Russianized surnames ending with "-ov/ ev, -ova/ -eva," "-ky/ -kiy," "-ko," "-ich/ otch," "-in/ an/ un," and "-uk/ ak."

26 The dblp computer science bibliography, https://dblp.uni-trier.de/

the database of RCS: places of origin (former Soviet Union countries),[27] Russian language (native or higher education language), former or current affiliation to UK universities and research centers and research activity in computer science evidenced by publications.[28] I later supplemented these formal criteria with oral enquiries regarding RCS diaspora, national, ethnic, and professional self-identification, when possible. I used the list of RCS both to collect information on RCS publications and diaspora co-authors and to identify and contact potential respondents for interviews.

The Digital Bibliography & Library Project became the main source of quantitative data on RCS publications and co-authors,[29] being the most comprehensive and reliable database of works in computer science (Franceschet 2011). I collected and checked data manually, entered them into an Excel database (298 scientists), and then processed them using Excel statistical functions. The database includes the following information: total number of papers and period of publication activity (in years), number of papers RCS produced in the UK and period of publication activity in the UK (in years), total number of co-authors and number of diasporic co-authors, number of papers written with diasporic and other co-authors and the number co-written exclusively with diaspora co-authors while working in the UK,[30] locations of diasporic co-authors (UK, Russia, former Soviet Union countries, other countries). In quantiative analysis, I used different tests to check the statistical significance of my findings: the Chi-square test (categorical data), the Mann-Whitney test (numerical data, non-normal distribution), and the T-test (numerical data, normal distribution). To determine associations or its absence between variables, I employed Spearman's correlation coefficient (r_S). I determined the normality of distribution using the Shapiro-Wilk and Kolmogorov-Smirnov tests. I performed social network analysis on 214 RCS collaborating with UK-based, Russian-speaking co-authors. These ties constitute

27 These include Russia, Ukraine, Belarus, Kyrgyzstan, Kazakhstan, Moldova, Armenia, and Georgia, but exclude the Baltic countries, which are part of the EU and have different visa regulations. However, I included a few scientists from this region on the list because of their educational background, research experience in the USSR, and ties to other Russian-speaking scholars. I included a couple Bulgarian scientists for the same reasons.

28 Publications indexed in specialized databases served as the main criterion: a minimum of two publications or one publication for doctoral students or RCS collaborating with Russian-speaking colleagues.

29 The publication period covers 1990 to 2018, with the period during which scientists published in the UK extracted and analyzed in detail. The data was updated in December 2018. I sometimes supplemented DBLP data with ACM digital library (https://dl.acm.org) and IEEE Xplore digital library materials (https://ieeexplore.ieee.org/Xplore/home.jsp).

30 I considered an article written in diasporic collaboration if one or more Russian-speaking researcher was listed as co-author. Exclusively diasporic collaborations listed only Russian-speaking co-authors.

the majority of the diasporic connections I studied. I calculated main node properties (degree, different centrality measures, clustering coefficient) and network properties (average degree, diameter, average path length, density coefficient, average clustering coefficient) using Gephi. Gephi was also used for visualizing DKNs.

I conducted semi-structured interviews with fifty-three people[31] in 2013–2018. These served as a source of information on RCS migration and career trajectories, the meaning of diasporic collaboration, and the dynamics of diaspora ties. The interviews lasted from 50 minutes to 3.5 hours (the average length was 1.5 hours). They covered a number of topics: education and work experience in the home country, migration to the UK and previous migration experiences, reasons and motives for moving internationally, the resources and contacts RCS used when migrating, the difficulties and tensions they experienced before and after migration, establishing and maintaining diasporic professional contacts in migration and especially contacts in the UK, the origins and types of these connections, ties to the home country and compatriot scientists based in the former Soviet Union, their evaluations of Britain's higher education and research systems, scientific collaboration, especially diasporic collaboration practices, satisfaction or dissatisfaction with their positions, and their experiences in the UK with a focus on professional activities and career plans. I recorded, transcribed verbatim in full or part, and thematically analyzed the interviews, which allowed me to identify "patterns of meanings" and "make sense of collective or shared meanings and experiences" (Braun, Clarke 2012, 57). I also used university websites, professional (LinkedIn) and social networks (VKontakte, Facebook, Odnoklassniki), CVs, acknowledgement sections in publications, published interviews with RCS and memoirs as additional sources of factual and qualitative information on RCS migration, careers, and diasporic collaboration.

Limitations of the Study

The study's limitations concern its aim and the scope of its research sub-questions, its empirical case, and my research design. First, the study examines Russian-speaking computer scientists in the UK in 1990–2000s, excluding other time periods, other national contexts where post-Soviet academics work, Russian-speaking researchers in other disciplines and migrant scientists of other backgrounds. Therefore, though the present case is highly relevant and makes it possible to reveal vital features of DKNs

31 The informants include eleven women and forty-two men. I conducted the majority of the interviews—forty-four—in 2015–2018 during field research in the UK. I also used nine interviews Liliia Zemnukhova conducted in 2013 as part of the Russian Computer Scientists at Abroad Project.

and the mechanisms of their formation, its results do not apply to all foreign-born scientists worldwide. Comparative research among groups of migrants with other origins and in other national contexts and historical periods could be fruitful directions for future enquiry. Second, my research concentrates on diasporic connections and is little concerned with non-diasporic connections and the role they play in lives of migrant scientists. It yields several hypotheses concerning how DKNs differ from and relate to non-diasporic networks and what impact non-diasporic connections might have on migration and career of foreign-born scholars that require further investigation. Finally, the study reveals the mechanisms of DKN formation and development by tracing the individual and collective strategies of migrant scientists. It explores macro- and meso-level factors indirectly and in constellations, as they reflect in individual biographies. Consequently, the specific role of some important aspects of national context (for instance, migration policies) and institutional context (for instance, research funding system) would have to be the subject of a separate enquiry.

Structure of the Dissertation

The dissertation consists of this introduction, five chapters, and a conclusion. The chapters are articles that are either published or submitted for publication. The first chapter is titled "The Notion of Diaspora Knowledge Network Revisited: Highly Skilled Migrants Forming a New Invisible College." It develops a new conceptual approach to DKNs as a distinctive social structure, uniting the logic of migration and scientific collaboration networks and connecting mobility experiences of foreign-born scholars with their research activities. The second chapter is "Migrating Step by Step: Russian Computer Scientists in the UK." It shows how macro- and meso-level factors interact and induce RCS to mobilize diasporic ties in their migration and career strategies, giving rise to the emergence and expansion of DKNs. It also covers the advantages and disadvantages participation in DKN brings. The third chapter is "From Russia to the UK: On the Migration Mechanisms of Young Russian Computer Scientists," It focuses on the role of DKNs in the migrations of early career researchers and outlines the benefits follower migrants enjoy. This chapter deepens understandings of DKN as an important force that influences migration flows. The fourth chapter is called "When Migrant Scientists Collaborate with Their Co-nationals: Gendered Effects of Diaspora Knowledge Networks on Research and Knowledge Production." Proving that DKNs' positive impact on scientific output and productivity depends on gender, academic rank, and organizational setting, this chapter expands our comprehension of DKNs as a knowledge creation network. The fifth chapter, "Gendering Diaspora Knowledge Networks: Why Diasporic Solidarity Fails to Promote Gender Equality," uncovers how intersecting power inequalities sustain DKNs and explains the unequal distribution of their benefits along gender and academic se-

niority lines. It also reveals the cultural mechanisms that support and consolidate these patterns. Finally, in the conclusion, I summarize and integrate my findings, review the research questions, articulate the theoretical contributions and policy implications of my research, indicate its limitations, and suggest avenues for future research.