Beyond recognition: Polish scientific diaspora as a source of social capital

Report by the Polonium Foundation
Beyond recognition: Polish scientific diaspora as a source of social capital

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In partnership with the Polish Society of Arts and Sciences Abroad and the Foundation for Polish Science
Executive summary

What we did

Between October 2017 and October 2018, we polled 464 Polish scientists working abroad (Polish scientific diaspora) in 31 countries, at all career stages, recent and long-term migrants. We asked them about links with the Polish scientific community abroad and in Poland, potential benefits from these contacts, as well as attitudes to return migration. The resulting study constitutes the largest snapshot of the Polish scientific diaspora in recent years.

Untapped social capital abroad

Key findings

1 in 2 respondents declare that they do not intend to come back to Poland. At the same time, a large majority of them report knowing Poles working abroad as scientists (94%) or scientists in Poland (87%). This network has been predominantly forming in a work-related context (contacts between diaspora members) or is a result of old acquaintanceships (contacts between diaspora and scientists in Poland), but rarely via Polish networking events. Most respondents also perceive contacts with other diaspora members or scientists in Poland as beneficial. However, these benefits are often of social or emotional nature and do not directly bring professional gains, particularly for the less experienced scientists and for contacts with scientists in Poland. Based on these results, we argue that the Polish scientific diaspora is well connected and has a substantial social capital, but is currently largely untapped by Polish institutions.

Recommendation

Having in mind that even as much as 50% of the Polish scientific diaspora intends to stay abroad, Polish internationalisation policy should not be based solely on re-emigration. Instead, there should be a wide institutional support and science policy in Poland aimed at facilitating networking between Polish scientists worldwide, by combining grassroots initiatives (e.g., small events) and top-down approaches (e.g., support of embassies). Such policy will positively impact creation of a 'bridging social capital', supporting the Polish scientific community by exchanging knowledge and information (e.g., opportunities for joint projects, job offers, transfer of know-how).

Utilising social capital of the diaspora for Poland

Key findings

There are many potential reasons why Polish scientists working abroad would be interested in maintaining contacts with scientists in Poland. For our respondents who know scientists in Poland these reasons are most often non-professional gains (74%; e.g., maintaining family relations) or professional gains (53%; e.g., forming collaborations with selected research groups). Absence of professional benefits from these contacts is predominantly due to the lack of familiarity with the Polish scientific community (43%), and these respondents are often keen to start a collaboration given the right opportunity (48%). Contacts with Poland are usually a result of old acquaintanceships. Given a shortage of initiatives connecting the Polish scientific diaspora with Poland, formation of new such ties is relatively rare.
Recommendation.
Strengthening ties between the Polish scientific diaspora with Poland requires incentivising both diaspora members and scientists working in Poland. Specifically (i) fellowships for Polish scholars going abroad should encourage them to take part in networking events for Polish scientists abroad; (ii) Polish universities should create high-profile, short-term visiting positions at Polish universities for prominent Polish scholars who work abroad; (iii) Polish institutions should offer competitive scholarships for young scholars to visit top research labs abroad led by experienced diaspora members.

Enhancing social capital of the diaspora

Key findings
Gains derived from the social capital of the diaspora by its members are of both professional and social nature. The types of benefits depend on the career stage and the time spent abroad. While more experienced scientists and long-term migrants are more likely to benefit professionally from contacts with fellow scientists (e.g., help in forming collaborations), younger scientists and recent migrants are more likely to gain social and emotional benefits (e.g., shared understanding).

Recommendation.
Efforts facilitating networking amongst Polish scientists working abroad should be adapted to the modes of interactions the different diaspora members most benefit from. For example, young or future scientists are more likely to be interested in general social networking events and meeting new people, while experienced scientists would be more interested in professional, theme-oriented events which can help them develop international collaborations (although the social context is still important).

Attracting best and brightest to Poland

Key findings
On average 1 in 2 respondents are either willing to return or undecided, but the exact proportion varies with time spent abroad. Polish scientists with short tenure outside of Poland are predominantly in favour of returning or undecided. These attitudes shift however towards predominantly negative after 8-10 years of living abroad. We also find that 39% of those who do not reject the idea of moving back cannot specify the time of return migration. Those respondents who hope to continue scientific research back in Poland often highlight the positive impact they could have on the Polish scientific community with their experience obtained abroad, but often fear a decline in the standard of living and unnecessary bureaucratic burden. When planning for the return, the preferred sources of information are (a) other Polish scientists and (b) Polish universities and research institutions.

Recommendation
A high proportion of respondents undecided about return migration suggests that they are likely to stay abroad unless concrete actions are taken to persuade them to return. This means that the return policy is still necessary. While the efforts to persuade scientists to return should be open to all diaspora members, the priority should be given to young and early-research career scientists who have gained some experience abroad but are still likely to return to Poland. To facilitate in the return process, we recommend universities to delegate specialist staff to assist migrants in the return process (e.g., through aiding in preparation of grant applications) and to connect the migrants with local scientists and academics who can act as mentors. Nevertheless, to attract the best and brightest Polish scholars return policy will not suffice. Thus, we recommend that Polish science institutions should create more open, competitive, research-based academic positions with the potential of long-term core funding and internal administration support, and then use links with the Polish scientific diaspora to advertise such positions. We believe that such policies will help attract the biggest international talents to Poland, and in the long term will improve Poland’s position in international science rankings.
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Forewords
Foreword by the Polonium Foundation

In 2016, we turned the annually organised Science: Polish Perspectives conference into Polonium Foundation – an organisation aiming to create a community of Polish researchers and students abroad. We wanted to focus on three key aims: taking the idea of a meeting of Polish research diaspora further, create a database of Polish scientists abroad, and – last but not least – investigating their attitudes, experiences and thoughts to better understand the community.

Since then, we have organised two conferences in Berlin, and half a dozen of meetings in places such as Stockholm, Florence and New York. This year, we secured funding - from the DIALOG grant programme of the Polish Ministry of Science and Higher Education - to create a database and portal listing Polish researchers abroad, alongside with disciplinary newsletter helping to circulate information.

However, I believe, that the report we are laying in your hands is the milestone, summarising the first two-and-a-half years of Polonium's existence.

The results of this project by any means do not give us full understanding of the Polish research diaspora. We are confident the results we obtained are going to deepen our understanding. However, primarily, they serve as a beginning of research and conversation about Poles doing science abroad and their role in Polish research and innovation system. We want to continue our research into the Polish scientific diaspora. We believe that, in the long term, such knowledge will guide us towards creating a world-wide Polish research diaspora network, and connecting this under-explored social capital with Poland.

We are proud to say it is a collective work. It is a result of two years of work - from the first focus groups to publication of this piece. Majority of work was conducted by our research team – Rafal, Dominika, Gosia and Piotr – but it truly is a result of work of more than 40 people, who voluntarily helped the Polonium's work during those two years. Without the SPP conferences, meetups, communication activities we wouldn't be able to reach out to almost 500 people.

We also would not be able to complete it without the support of our Partners in the project. Foundation for Polish Science has been one of the first patrons of Science: Polish Perspectives, back in 2012, and the rapid development of the community is in no small part a result of their involvement. Polish Society of Arts and Sciences Abroad is an organisation with a long tradition of connecting Polish researchers abroad, and we are glad we can learn from their experience and collaborate - to reach even better results.

Bartosz Paszcza
President of the Executive Board
Polonium Foundation
Foreword by the Polish Society of Arts and Sciences Abroad

The Polonium Foundation (PF)'s research into the Polish scientific diaspora, which began in 2017, gained the enthusiastic support of London based PTNO (Polish Society of Arts and Sciences Abroad). The research aligns with PTNO’s goals and continues the tasks PTNO started just after the Second World War, one of which was compiling a list of Polish scientists who remained in the West after the WWII and documenting their academic achievements. Therefore, PTNO supported also materially PF’s initiative from the very beginning. PF’s aim is to identify a new wave of Polish scientists abroad in leading academic and scientific institutions, who are conducting pertinent research that furthers our knowledge of the world around us, particularly solving problems related to global health, the environment, and food and energy supply for a rapidly growing population. These global issues are reflected in Poland on a more local scale, and Polish scientists abroad may play a key role in solving them at home.

Polish academics all over the world are valued experts and active members of the societies in which they live and maintain relations with each other. We are convinced that the Polish scientific diaspora has great potential, which can also benefit science and the economy in Poland. We believe that this newly identified by PF’s research potential will not only gain respect but also inspire practical action in the form of research groups, which will develop the interdisciplinary Polish knowledge economy.

PTNO congratulates the Polonium Foundation on their research achievements and wish them all the best in their indispensable efforts.

Andrzej Fórmania,k, MSc PhD FIMechE FSaRS
PTNO Chairman
Foreword by the Foundation for Polish Science

The Foundation for Polish Science (FNP) was founded in 1991. It is an independent, non-governmental, non-profit organization, and the largest non-governmental source of funding for science in Poland. The mission of the Foundation is to support outstanding researchers and research teams, innovative projects, and commercialization of inventions and research discoveries. The Foundation offers prizes, fellowships and grants for researchers of every age and at every stage of their career, across all fields of inquiry. Scientific excellence is the most important criterion in awarding support by FNP.

For many years the Foundation has been committed to supporting mobility of researchers. At first it aimed at granting Polish researchers postdoctoral fellowships at the world’s leading research centres. Since 2006 it has focused on reintegration grants and attracting scientists from other countries to Poland. In particular we have offered young researchers a chance to establish their first own research teams. Thanks to EU structural funds, the Foundation has been able to provide its laureates and their teams with remuneration, stipends and working conditions compatible with European standards. Since 2005, 258 grants have been issued to scientist coming from abroad.

All FNP programs are open to researchers regardless of their nationality. International experience and mobility are recognized and valued. Moreover, the candidates are not judged by formal position (habilitation) which would hinder those working abroad.

Along with other international standards we strive to introduce in Polish research system, special importance is placed on open and transparent recruitment procedures in teams funded by the Foundation. Our laureates and beneficiaries are obliged to use transparent recruitment procedures that constitute a part of the financing agreements and, in some of the programmes, are also subject to evaluation of the applications. Recruitment is conducted through open competitions announced throughout the country and abroad in a manner that guarantees reaching potential candidates for working in the team as well as on free websites, (including: http://www.eurosciencejobs.com, http://ec.europa.eu/eracareers, http://www.eracareers-poland.gov.pl).

We work closely with Polish researchers based abroad, not only by supporting their careers, but also by relying on their competence as reviewers in our competitions (we collaborate with over 4700 reviewers from abroad). We consider Polish scientific diaspora an important source of social capital and hope for close collaboration and mutual support. We have been very pleased to be involved in the research run by Foundation Polonium and we look forward to further enhance our knowledge about the needs, aspirations and concerns of Polish researchers working abroad.

Professor Maciej Zylwik
President of the Board
Abstract

In recent decades, Poland has suffered from a large-scale brain drain, particularly in the area of higher education. The resulting Polish scientific diaspora is a large and expanding group of people around the world, but otherwise little is known about it. In this report we aimed to extend the current knowledge about the Polish scientific diaspora by polling 464 Poles working abroad as scientists using an online questionnaire between October 2017 and October 2018. Participants were asked about their social networks and the benefits they gain from them, attitudes towards return migration as well as views on the Polish scientific community as a whole. Based on the results of our research, we argue that the Polish scientific diaspora has a great – though not fully explored – social capital, and that such social capital can be developed further and exploited by creating and strengthening ties between Polish scientists worldwide. The support of the Polish scientific diaspora should play an important role in the development of individual careers and – when supported by smart policies – also in the advancement of the Polish scientific community and economy in Poland.

We received responses from scientists in 31 countries, at all career stages, recent and long-term migrants, people educated in Poland and abroad, and a comparable proportion of men and women. The results of the study might be biased because the study sample is not fully representative – a common flow in most studies of diasporas. To overcome this limitation, we adopted a variety of sampling methods. The obtained sample is relatively large and diverse, and gives the largest snapshot of the Polish scientific diaspora in recent years. 94% of our respondents know other Poles working abroad as scientists, and 87% of them know scientists working in Poland. The majority of participants who know other fellow Poles working as scientists abroad found these contacts beneficial (64%), and likewise for contacts with scientists working in Poland (84%). Nevertheless, these ties were rarely a result of previous actions by Polish organisations. We argue that both the size of the diaspora network and benefits that could be obtained through the ties are limited due to lack of institutional support. The absence of wider policy facilitating growth of the Polish scientific diaspora and enhancement of professional benefits constrains untapped potential of this worldwide network of highly skilled Poles. We thus recommend that there should be a wide institutional support and science policy in Poland which combines bottom-up and top-down approaches aimed at facilitating networking between Polish scientists worldwide.

Benefits derived from the social capital of the diaspora by its members are of both professional and social nature. The types of benefits depend on the career stage and the time spent abroad. While more experienced scientists and long-term migrants were more likely to benefit professionally from contacts with fellow scientists, younger scientists and recent migrants were more likely to gain social benefits. Therefore, we recommend that efforts facilitating networking should be adapted to the modes of interactions the diaspora members most benefit from. Our results also point to differences in types of benefits our respondents derived from ties within the diaspora (more likely professional) to those they derived from ties with scientists in Poland (more likely social). While social benefits are important, overlooking professional benefits that could be derived from the same ties would be a loss for both scientific diaspora and scientists working in Poland. We argue that a large and well organised scientific diaspora could thus serve as an international social network and become a bridge between the home country and the host countries. Such a network would give immediate access to the constant flow of information and knowledge in international scientific networks, for example by facilitating international collaborations for scientists working in Poland.
Viewing Polish scientists working abroad as part of the Polish scientific diaspora provides a new perspective on the previously unrecognised social capital. We argue here that such a perspective is crucial as, while only 1 in 4 respondents declared willingness to return to Poland, the vast majority of those who are connected enjoy the benefits from being a part of the Polish scientific diaspora. Hence, while return programmes are welcome, they should not become the sole aim of the science internationalisation policy in Poland. We also found that the longer the migrants stayed abroad, the less likely they were to return, and that the attitudes start to shift towards predominantly negative after around 8-10 years of living abroad. We therefore think that return programmes can be useful when targeted at young and early-career scientists with international experience as many of them are willing to return. However, these programmes cannot resolve more systemic problems which our respondents perceive as the biggest challenges, for instance unnecessary bureaucracy. We think that these issues will be difficult to address with short-term return fellowships. Thus, we recommend that Polish science institutions create more of highly competitive, research-based academic positions with the potential of long-term core funding and internal administration support, open to candidates from all countries, and then use the networks with the Polish scientific diaspora to help advertise such positions.

Polonium Foundation is a strong supporter of open data policy, hence anonymised data collected here are available for wide use as part of the Online Supplementary Material, which can be found at poloniumfoundation.org/research.
1. Introduction

Mobility lies at the heart of an academic career. Studies analysing cross-country data on active researchers have found highly variable mobility patterns between different countries (Franzoni et al., 2012), showing that highly developed economies attract largest and most diverse communities of international, highly-skilled researchers (Van Noorden, 2012). Emergence of those communities has in recent years given rise to the idea of so called scientific diasporas (Meyer & Brown, 1999).

*These groups bring together scientists, engineers and skilled professionals of the same nationality who can collectively collaborate and generate cooperation opportunities with the home country.* Scientific diasporas have been suggested to have a potential of benefitting their countries of origin without having to physically return by creating networks of knowledge, and making a collective involvement in the development of innovative processes surrounding science and technology (Tejada & Bolay, 2010).

In general, the potential impact of diasporas and their sustainability over time have been questioned (Meyer, 2011), and recent studies have been examining this phenomenon in multiple scientific communities, including Columbian, Indian, South African (Tejada & Bolay, 2010), Moldovian (Tejada et al., 2013) or Mexican (Marmolejo-Leyva et al., 2015).

One important conclusion from these studies is that even though all of these communities carry a high impact potential, due to the variable political and economic situation of these countries as well as cultural differences, each community faces its own challenges in strengthening the diaspora’s role, and has to be viewed, examined and analysed separately. Nevertheless, scientific diasporas are on the rise, with many successful examples (e.g. Tejada, 2013, Tejada & Bolay, 2010, Meyer & Brown, 1999).
Social capital

There are many ways to conceptualise gains from scientific diasporas. After questioning a rudimentary brain drain metaphor popularised in the 1980s, researchers and policy makers have acknowledged that migration among scientists might be also beneficial to local scientific systems. Instead of brain drain, a new metaphor of brain circulation has been proposed (Baptiste, 2014; Johnson & Regets, 1998).

The literature on the subject provides examples of benefits from brain circulation for all engaged parties: scientists, scientific communities, countries of origin and hosting countries (Jons, 2009). One of the main hypothesised profits from brain circulation is a more efficient flow of knowledge, mostly from more developed to less developed scientific systems and within the whole scientific community. Here we suggest that recognition of potential gains and losses from academic mobility and emergence of scientific diaspora is best understood via the concept of social capital.

Social capital can be defined in many ways and is used to explain the development of individual and group performance. We adopt Nan Lin’s (2001) definition in which social capital is described as ‘resources embedded in one’s social networks, or resources that can be accessed or mobilised through ties in the networks’. Resources can be understood as means to achieve individual goals. They can be both tangible like funding, equipment or intangible like prestige. Scientists share and obtain resources through social networks.

To rephrase Nan Lin’s definition, social capital is a sum of network ties and resources that a scientist can access through her ties. Social capital helps to enjoy professional and personal benefits that otherwise would be impossible or hard to obtain. In principal, Nan Lin presents social capital as individual characteristics. However, becoming a part of a larger network like scientific diaspora gives access to resources embedded in ties of other group members.
The structure of the network facilitate access to resources that can flow through ties and improve social capital of individuals. For that reason, we will use social capital also as a group characteristics in a sense that the social capital of a group is a sum of the individual social capital of its members.

Social scientists propose two types of social capital depending on the network structure. The first type – bonding social capital – occurs in densely connected groups. This type of social capital develops trust and ease in collaboration, however it may limit access to new resources and opportunities for the flow of knowledge.

Bonding social capital can be difficult to develop in geographically dispersed communities like the one between members of scientific diaspora. This is because these members remain connected to other researchers in their host countries in local institutions, not necessarily from the same diaspora, and developing social capital between them requires connecting different groups. For this reason, developing social capital amongst members of the scientific diaspora requires the second type of social capital – bridging social capital – which enables flow of resources between otherwise disconnected groups (see Figure 1.1).

Such social capital is beneficial for a person who acts as a bridge and for connected groups. The benefits derived from this type of capital were captured by Mark Granovetter in his classic research on job market. Granovetter (1977) argued that people with non-overlapping relations to many groups (bridging) are in a better position to find a job in comparison to people with tight relations within one group (bonding). He argued that access to many groups improves access to information available in local networks and it exposes you to new opportunities.

Figure 1.1. Social capital in scientific diasporas. Scientists working abroad (orange circles) are often well integrated into the foreign social structures and hence well connected to other scientists working in the same host country (red circles). However, they are often disconnected from scientists working in the home country (blue), and from each other. By creating more opportunities for networking between scientists working abroad and scientists working in the home country (creating thick dashed lines), we facilitate mutual access to resources, knowledge and information, thus promoting the flow and the growth of social capital beneficial for the home country.
Benefits of scientific diasporas

An examination of literature on social capital and social networks provides a number of examples how social networks can improve the flow of resources and how individuals benefit from occupying particular positions. For example, Burt (2009) proposed a concept of structural holes, which is based on the idea of bridging disconnected groups. On an individual level, being a bridge between two organisations gives a person access to more diverse resources; for example research methods, laboratories, expertise or data. It also gives a better negotiation position and secures from exclusion because a bridging person obtains access to resources available in a different organisation. Burt (2004) also argues that a person with a personal network rich in structural holes comes up with better and more innovative ideas. The majority of studies about the role of structural holes in individual successes have been conducted in business organisations but Bellotti (2012) and Lopaciuk-Gonczaryk (2016) make a similar case for academic organisations.

Organisations and groups also benefit from developed social capital of their members. A bridge between two groups facilitates inflow/outflow of new knowledge to and from organisation (see also Figure 1.1). It can also help adapt new information to a local situation, facilitate trust and enable shared understanding. Hence, all members of an organisation can have indirect access to people and resources available in organisations in home institution network. For example, if a scientist has a developed network, she can pass information about joint funding opportunities, internships or job offers from external organisations to colleagues from a home institution. If it had not been for a presence of a scientist serving as a bridge, fellow scientists would not have learned about opportunities, or access to the information would have been delayed. Hence, social capital (sum of ties and information flowing through ties) provides benefits to all engaged parties. For example, individual scientists can strengthen their position at their home institutions, researchers in the home and the host country are provided with new collaboration opportunities, etc.

Scientists of a given nationality working in different institutions around the world can become a social network that facilitates flow of resources, goods and information. Such a network has an enormous social capital that translates into specific benefits for many parties. First, members of scientific diasporas can gain access to scientific institutions in their home country. This can be used to exchange information, facilitate turn or build collaborations. Second, scientists working in the host country – when part of the network – can get faster access to foreign scientific institutions and strengthen the position of science in the home country. Third, it could be also profitable for scientific institutions both in the host and in the home country. Crucially, however, the magnitude of social capital and the resulting flow of resources depend on the number of ties in such a network. Therefore, the development of social capital within diasporas relies on enabling and facilitating the growth of such networks in the host and the home countries.
Polish scientific diaspora

Over the last three decades Poland has experienced a large-scale brain drain. In the 1980s there was a significant outflow of highly skilled professionals, especially relevant among scientists and academics. In the 1990s political situation in Poland improved, however there were reduced budgets for science and the number of scientists in academies of science and state research institutes decreased drastically. 24% of technical and engineering science staff in Poland emigrated to the US, Germany, France and the UK (Valavanidis, 2017). Some others left academia to work in the business sector, being offered higher wages and better working conditions. Then, in the 2000s destination of migration changed thanks to an easier access to other European Union countries. Overall, in the last few decades there were several waves of migration. From all of the above mentioned, the least is known about the last wave. Report on Polish scientists’ mobility (Patrzalek et al., 2015) argues that after Poland’s EU accession, the outflow of young scientists increased and the majority of them do not plan to return to Poland. The gains from the increased migration have been conceptualised for some time on an individual level. However, growth of the international scientific labour market has shifted the attention to a group level, namely to scientific diasporas (Larner, 2015). Furthermore, the increase of internationality in academia has also become an issue for national scientific systems. The presented report is an attempt to understand how such systems can benefit from an increased migration and the growth of scientific diaspora. This was one of the motivating factors for us to get an insight into the current Polish scientific diaspora.

In this report, we present results of a questionnaire-based study on the Polish scientific diaspora. It is the first attempt of this scale to examine the personal and professional situation of Polish scholars working abroad, their international links as well as interest in participation in the Polish scientific community. By studying its members and characterising their potential to form links between them, we aim to better understand the potential as well as challenges facing building the Polish scientific diaspora. The goal of this report is to present scientific diaspora as social capital that can be developed and exploited by members of the Polish scientific diaspora, scientists working in Poland as well as Polish and foreign scientific institutions. We also argue here that facilitating the growth of the Polish scientific diaspora lies in the best interest of Poland and of the Polish scientific community around the world.
2. Methodology

Surveys have traditionally been used in social sciences to investigate large populations, including cross-national studies and they have also been used to investigate scientific diasporas across the globe in the past, including attitudes and plans of scientists living abroad (e.g. Tejada, 2013).

As the knowledge about the Polish scientific diaspora is very limited, we decided to conduct three preliminary focus group interviews. They took place in three different European cities in small groups of four to five people (14 participants altogether), namely in Berlin (October 2016), Oxford (November 2016) and London (December 2016).

Participants were recruited by the authors of this study during meetings organised by Polonium Foundation. We attempted to include people representing a diverse range of experiences, from PhD students to early-career researchers, academic and non-academic researchers, as well as people who had obtained their PhDs in Poland and those who had obtained it abroad.

The issues discussed during the interviews covered relations of professional and personal nature with Polish scholars working abroad and in Poland, attitudes towards re-emigration to Poland and opinions about roles of organisations for the Polish scientific diaspora. All focus groups were recorded and information was used to build the online questionnaire.

Online questionnaire

The online questionnaire consisted of three parts and ended with questions pertaining to personal background. The first part was devoted to respondents’ social networks among Polish scientists working abroad.

First, we selected respondents with relations among the Polish scientific diaspora and we asked them about the nature of these relations.

Second, scientists with no relations in the Polish scientific diaspora were asked about reasons for not establishing these kinds of relations. In the second part we asked about respondents’ social networks among scientists working in Poland.

Scientists who had reported relations with colleagues in Poland were asked about the nature of the relations. Scientists with no established relations were asked for the underlying reasons. We also inquired about return migration plans and asked about opportunities and threats they were expecting.

In the third section we asked about opinions regarding the role of associations of Polish scientists working abroad. Personal background consisted of questions about gender, education, discipline, academic degree, current status in a foreign scientific institution.

The questionnaire began with an introduction and ended with an invitation to the Polonium Foundation mailing list, and a kind request to disseminate the invitation to other fellow Polish scientists working abroad.
Questionnaire launch

The full questionnaire was launched in October 2017 via an online platform (typeform.com), and closed in October 2018. During this time we recorded 484 responses, of which 464 respondents fulfilled the basic criterion of being a 'Pole working abroad as a scientist'. The questionnaire was promoted via multiple communication channels, which included meetings organised by the Polonium Foundation (e.g., Science Polish Perspectives Oxford 2017), the Foundation’s social media (Facebook & Twitter) and mailing sent to members or associates of the fellow institutions and organisations, mainly the Foundation for Polish Science and the Polish Society of Arts and Sciences abroad and partner institutions in the UK and in Germany and others, as well as online recruitment (see below).

Purposive sampling

A scientific diaspora is a type of population which is inherently difficult to research. The size of the scientific diaspora is too small to be captured in a national census. Members of the diaspora are very mobile and often move across countries. They often have a different status (e.g. PhD students, R&D personnel, visiting researchers) and therefore are differently registered at institutions of their host country.

For many years, research on scientific diasporas has been limited to snowball sampling (respondents are asked to invite further respondents). Thanks to the development of communications technologies, reaching out to disconnected parts of the group has become easier than ever before.

To maximise the outreach of the study, we decided to mix different recruitment methods and purposive sampling. First, the Polonium Foundation has utilised its professional network which has been built upon several editions of Science: Polish Perspectives (SPP) conference and professional networks of scientists engaged in the SPP conference and Polonium Foundation.

Second, the study was organised with the support of the Polish Society of Arts and Sciences Abroad and the Foundation for Polish Science, which has likely improved its outreach.

Third, we had compiled a list of institutions which we asked to disseminate the survey among their members or associates. To build the list, we reached out to (1) organisations which associate Poles abroad, (2) schools of Polish or Slavonic studies at foreign universities, (3) international collaboration offices at foreign universities, (4) post doctorate and staff associations at foreign universities, (5) science foundations.

Finally, we used an online recruitment using an open source data gathering (see Online recruitment).
Online recruitment

The goal of online recruitment was to recruit active scientists who are unlikely to be associated with the Polonium Foundation (e.g., meeting attendance or personal contact) or be active via social media. To this end, we proceeded in four steps: choice of approach, data collection, filtering and contact.

First, we evaluated various databases of researchers as potential sources of contact. We decided to focus on web pages of academic institutions who, at least in the UK, openly publish contact information pertaining to their academic staff. The advantage of this choice was that these databases were free to use, publicly available, up-to-date, and as complete as any data resource of this kind could be. This decision was accompanied by another decision not to pursue analysis of other databases (like Microsoft Academic Graph, Scopus and ORCiD) which did not universally provide both name and email of listed researchers.

Next, we collected publicly available data from university websites in the UK and Germany. As each institution (and, more often than not, each department) has a different format of their staff inventory, we wrote a set of computer programmes specifically adapted to the target. Depending on the web page, which could be a list of people or a search form, the programme would parse and download the list in a tabular format, or send a request matching Polish names or surnames before parsing and downloading search results. The results have been stored locally and encrypted to ensure they would comply with the personal data processing principles under the GDPR. To maximise the output per institution, we focused on twenty universities with the greatest number of staff in a given country (based on numbers reported by the Times Higher Education summary of research institutions and Wikipedia).

Having downloaded the names and emails of researchers from a given institution, we then carried out automatic filtering by name. To do this, we sourced over 15,000 Polish surnames from genealogical records (pgsa.org/databases and polishgeno.com) and used simple text transformations to ensure we had both masculine and feminine name variations. The Polish government publishes a number of public datasets, one of which (https://www.gov.pl/cyfryzacja/statystyki-imion) is a list of most popular names across the population; we have manually enhanced that dataset with diminutives (e.g., we added ‘Kasia’ derived from ‘Katarzyna’ entry), knowing that some Poles, especially those living and working abroad, prefer the shorter version of their given name. As automatic filtering is prone to a large false-positive detection rate of Polish names (e.g., popular names like ‘Anna’ or ‘Magdalena’ are common in other Western countries), we manually curated the dataset to exclude names very likely to be foreign. In the case of uncertainty (e.g., for example a clearly Polish female name with a foreign surname), we decided not to exclude the entry to minimise the false-negative detection rate at the expense of the false-positive rate (e.g., many Polish women scientists might have acquired names of their foreign partners).

With the shortlisted name/surname/email/affiliation database, one of the authors of this study contacted the researchers by sending a private mail, shortly explaining the goal of the questionnaire and asking them to take part. Emails were sent to each person once.

Statistical tests

As the analysed sample is non-representative, we could not apply many of conventional statistical test. Therefore, to test whether differences in proportions observed between different subgroups of the study (e.g., what percentage of respondents educated in Poland vs. those educated abroad report professional benefits from contacts with scientists in Poland) are due to actual differences and not random differences due to small sample size, we carried out non-parametric chi-squared test using prop.test() function in R. Test for continuous value differences between several population subsamples were performed using a one-way ANOVA on ranks (so called Kruskal-Wallis test by ranks using kruskal.test() function in R).
Definitions

In this study we have undertaken several important definitions. First and foremost, throughout this document we use the term ‘scientists’ according to the same definition as the one used by The Science Council, namely that a scientist is someone who systematically gathers and uses research and evidence, making a hypothesis and testing it, to gain and share understanding and knowledge. Given such a definition, a scientific diaspora is a group of people in which all members meet the following conditions: (1) they are active scientists (i.e. publishing in scientific journals) and (2) they have contacts either with their fellow countrymen abroad who are working as scientists or with scientists in Poland. Identifying oneself as Polish was a sole criterion by which we decided to include scientists to the group of Poles. We did not ask the participants about their citizenship. Furthermore, we defined two groups of contacts: Poles working abroad as scientists, i.e. professionally active (i.e. publishing in scientific journals) scientists working in foreign scientific centres, living outside Poland but identifying themselves as Poles; and scientists working in Poland - professionally active (i.e. publishing in scientific journals) scientists working in Polish scientific centres, currently living in Poland, not necessarily Poles. Respondents were acquainted with these terms describing scientists in the beginning of the study. Nevertheless, only the former group was invited to take part in the study.

To investigate how some replies given by the respondents depended on various characteristics of the population sample, we defined three kinds of subpopulations reflecting three important attributes based on the answers given. Below, n denotes the sample size based on all respondents and n_e denotes the sample size based on respondents who fulfil the definition of ‘scientific diaspora’ above (i.e., know at least one Pole working as a scientist or a scientist working in Poland).

1 Education completed abroad
We distinguished two subgroups: (a) those who completed a PhD degree abroad ('educated abroad'; n=231, n_e=220), and (b) those who completed all levels of education in Poland ('educated in Poland'; n=156, n_e=156). We decided to exclude those who completed solely their primary level of education abroad (Bachelor or Master) as this group was relatively small (n=72, n_e=70) and we reasoned that it likely included a diverse mixture of respondents with regards to their education. We excluded all respondents who did not provide an answer (n=5, n_e=5).

2 Years spent abroad
We distinguished three subgroups: (a) those who have lived abroad 5 years or less (recent migrants'; n=155, n_e=155), (b) those who have lived abroad more than 5 years but less or equal 10 years (intermediate migrants'; n=136, n_e=135), (c) those who have lived abroad more than 10 years (long-term migrants'; n=165, n_e=156). We excluded all respondents who did not provide an answer (n=8, n_e=7).

3 Level of research experience
We distinguished three subgroups based on the reported year of obtaining a PhD degree, possibly in the future: (a) those for whom it was year 2018 or later (‘future scientists’; n=160, n_e=157), (b) those for whom it was between 2013 and 2017 (‘young scientists’; n=143, n_e=138), (c) those for whom it was in 2012 or before (‘experienced scientists’; n=135, n_e=134). We excluded all respondents who did not provide an answer (n=26, n_e=24).
3. General characteristic of the population sample

While the population sample of Poles working abroad as scientists in this study is non-representative and hence suffers from the same “snowball effect” (as other diaspora studies), it gives a wide snapshot of the Polish scientific diaspora. We obtained answers from 484 participants from 31 countries, at all stages of their academic career, from recent to long-term migrants, in all major scientific areas, as well as both those educated in Poland and those educated abroad. Respondents are well embedded in foreign scientific institutions, although many of them retain strong links with Poland. Our data thus represent the largest attempt to describe the Polish scientific diaspora in recent years.
We received responses from 453 people who identified themselves as Polish scientists living and working abroad and who met our criteria for a diaspora member. There was a slight overrepresentation of female (50.8%) over male respondents (45.7%); 3.5% of all respondents either skipped the question or deliberately chose the third option "I'd rather not say".

**Host countries**

The majority of people who completed the questionnaire live and work in the United Kingdom (52.1%), followed by USA (12.8%) and Germany (12.4%). These three countries together constitute working locations for 77.3% of our respondents, and are known to be amongst the top destinations for academic scholar migrations. However, the strong dominance of the UK in the poll is a result of the recruitment focus (see Methodology). Nevertheless, we received responses from 31 countries, including scientists in distant places like Singapore, New Zealand, China, South Korea, Russia or even United Arab Emirates. The map with origins of poll responses is shown in Figure 3.1.

![Figure 3.1. In which country do you currently live? The map showing the country of origin for respondents. Intensity of red represents the frequency of responses. Blue denotes lack of responses (sample size: n=453).](image)

**Area of study**

Two thirds of all people who completed the questionnaire work in the area of Natural Science or Medical Sciences (n=302; 66%). Of the remaining disciplines, Agricultural Sciences are the most underrepresented (<1%). The barplot with areas of studies of respondents is shown in Figure 3.2. We also compared these proportions to those reported by OECD in 2015 and found a large over-representation of respondents from the field of natural sciences. Since there have been no reliable data on the areas of study of the Polish scientific diaspora, it is unclear whether such bias is a consequence of the non-representative sampling of our study or reflects a true characteristic of the studied population.
Professional experience

We asked respondents to provide the year when they obtained their PhD (either defended or expected). Based on these replies we deduce that almost all people who completed the questionnaire had already obtained or intend to obtain a PhD degree (94.7%).

The resulting distribution of the reported graduation year is shown in Figure 3.3. While this shows that the large majority of the respondent pool are young scientists, we received many responses from experienced scientists. Specifically, 27.6% of them obtained their PhD before 2012.

Figure 3.2. What is your area of study? (Left) Proportion of respondents who work in a given area of study. Numbers add up to more than 100% as respondents could choose up to two answers. (Right) Over- and under-representation of different areas of study based on the proportions as reported by OECD (2018). As the former add up to 100%, the proportions observed in this study were normalised to 100% before dividing by the OECD numbers. Points to the left of the dashed line are under-represented, while points to the right of the dashed line are over-represented (sample size: n=448).

Figure 3.3. In which year did you receive your PhD? Histogram shows the distribution of the claimed year of PhD graduation. Red line shows 2017, which was the year of conducting this study and thus separates respondents who have likely already graduated from those who are either PhD students or intend to complete their PhD degree (sample size: n=429).
When asked about the role in the institution the respondents are currently affiliated with, 42.6% of them declared being 'employed by a scientific institution abroad', 27.8% as PhD students and 22.7% as postdocs or fellows. Altogether, this makes up 93.2% of all respondents (see Figure 3.4). Of those who answered 'employed', 34.6% identified themselves as 'group leaders'.

**Time spent abroad**

We next asked the respondents about the time spent living abroad and levels of education obtained during this time. 73.1% of respondents have lived outside of Poland for 5 years or longer, while 43.3% for more than 10 years. For 58.1% of them, the current location is the first foreign location (see Figure 3.5).

Years spent abroad by the respondents also reflect their academic degrees obtained abroad (see Figure 3.6). 49.6% of them obtained a PhD degree abroad, while 20.8% obtained PhD together with Bachelors or Masters degrees. Only about a third (34.8%; n=157) did not complete any level of higher education abroad.
Ties with the home country

To investigate strength of ties with the home country, we first asked respondents whether they currently receive funding from a Polish institution. Only 4.9% of them replied ‘Yes’ while 93.4% replied ‘No’. Therefore, we can assume that respondents are well embedded in the foreign scientific systems. We next asked about the frequency of visiting the home country (see Figure 3.7). For two-thirds of them, the reported visiting frequency was ‘several times a year’, and for 22.1% it was ‘once a year’. We also found a strongly significant correlation between the time spent living abroad and the frequency of visiting Poland: respondents who have lived longer abroad visited the home country less frequently than those who have lived abroad for a shorter time (Kruskal-Wallis test, p<2.2e-16).

Figure 3.6. Which stages of education you have completed at a foreign university? Percentage of respondents with the reported level of education obtained abroad (sample size: n=448).

Figure 3.7. How often do you visit Poland? Left: Percentage of respondents per answer. Right: boxplots showing the distribution of the number of years spent abroad per frequency of visit as shown on the left (sample size: n=446).
4. Social network

In this chapter we explore the scientific social networks of our respondents. We find that they are well connected to their Polish fellow scientists, regardless of the time spent abroad or their level of research experience. However, we found two major pathways of ties emergence within the diaspora: members who have lived abroad longer typically meet their Polish colleagues in a work-related context, while more recent members know their Polish colleagues abroad from their time spent in Poland. The respondents were also well connected to scientists working in Poland, however recent migrants and those educated in Poland are the better connected group. Contacts between the respondents and scientists in Poland have been predominantly formed during their time in Poland.

Chapter summary

The substantial part of Polish diaspora social capital are ties embedded in a social network. We have distinguish two types of ties: ties with other scientists of Polish descent working abroad and ties with scientists working in Poland. Both types of ties constitute one network, which in turn facilitates the flow of resources.
Ties with Poles working abroad as scientists

In the beginning of the questionnaire, we asked the respondents whether they know ‘Poles working abroad as scientists’. The overwhelming majority of them (94.0%; n=464) answered “yes”, and these respondents were next asked about two most frequent ways of meeting their Polish colleagues. Figure 4.1 shows the most common ways in which our respondents have met other Poles working abroad as scientists.

More than half of them met fellow researchers at conferences or similar events (51.4%). Other sources of contact included working or having worked together (42.0%), via old acquaintances from period when they had lived Poland (31.9%), via friends of friends (20.6%), by chance (18.1%), networking through Polish networking meetings or organisations associating Poles abroad (12.2%) or other (0.9%). Custom replies included “via scientific literature”, “my brother’s ex wife”, and “got in touch with them out of my own initiative”. We can conclude that ties within the Polish scientific diaspora represented in our study are mostly established in the professional context as via work or conferences.

We next investigated how these modes of social interactions varied depending on the three previously defined characteristics of the population sample (research experience, living abroad and education abroad; see Methodology for details).

First, we found no impact of any of these characteristics on the likelihood of meeting Poles working abroad as scientists (see Supplementary Figures S4.1-S4.4).

Figure 4.1. How did you meet Poles working abroad as scientists? Percentage of respondents per answer (up to two answers per person; sample size: n=436).
Then, we analysed how different modes of social interactions varied between different characteristics. In other words, we investigated how the level of research experience, time spent abroad and education obtained abroad affected the way respondents have met other Poles working abroad as scientists (see Supplementary Figures S4.5-S4.8).

These results point to a few interesting observations. First of all, while scientific conferences seem to be an important way of meeting colleagues abroad, they seem to work particularly well for experienced scientists (p<0.001) and long-term migrants (p<0.05).

Furthermore, the answer "old acquaintances from the period when I lived in Poland" was significantly more frequently chosen by recent migrants (p<0.001) and the respondents educated in Poland (p<0.001).

Finally, Polish networking events and organisations which associate Poles abroad were a more common source of contact for future and young scientists (p<0.001) as well as for the respondents educated abroad (p<0.05).

Ties with scientists working in Poland

We next asked the respondents whether they knew scientists working in Poland. Again, the large majority answered ‘yes’ (87.1%; n=464), although the proportion was lower than in the case of Poles working abroad as scientists (Chi-squared; p<10-4). Figure 4.2 shows the distribution of frequency of answers to the question ‘How did you meet scientists working in Poland?’ The most frequent replies were ‘Old acquaintances from the period when I lived in Poland’ (75.5%), and ‘We used to work together’ (46.8%). The other replies were ‘At conferences or other scientific events’ (27.5%), ‘Friends of my friends’ (10.9%), ‘I was actively looking for contacts in Poland’ (5.7%), ‘By chance’ (2.7%) or ‘Other’ (1.5%). Custom replies included ‘We’d met abroad and they returned to Poland’, “People approach me”, “Common interests; she contacted me having read an article”, “Family members”, “Lived there” and “Continuous collaboration”. We can conclude that the personal context plays a more important role in emergence of ties between the Polish scientific diaspora and scientist working in Poland compared to emergence of ties with the diaspora.

![Figure 4.2. How did you meet scientists working in Poland? Percentage of respondents per answer (up to two answers per person; sample size: n=404).](image-url)
How did these numbers vary between the three subsample categories considered above? Interestingly, unlike in the case of Poles working abroad as scientists, in all three categories we found significant differences between the subgroup of question and the chance of knowing a scientist in Poland (p<0.01 in all three cases, see Supplementary Figures S4.1-S4.4). And so we found that:

- level of research experience increased the likelihood of knowing scientists in Poland (experienced scientists: 97.8%, young scientists: 88.1%, future scientists: 80.6%),
- time spent abroad decreased the likelihood of knowing scientists in Poland (recent migrants: 96.1%, intermediate migrants: 85.3%, long-term migrants: 80.0%),
- education obtained abroad decreased the likelihood of knowing scientists in Poland (educated in Poland: 96.8%, education abroad: 84.7%).

These observations might be an effect of interactions of variables. For example, less experienced scientists tend to have smaller collaboration networks, which would also impact the number of ties with scientists working in Poland. This sort of interactions could be verified in further analysis.

We then investigated how sources of contact between the respondents and scientists working in Poland vary between the main population characteristics (see Supplementary Figures S4.9-S4.12). We found that old acquaintances from Poland were a significantly more important source of contacts for recent migrants compared to intermediate or long-term migrants (p<0.001).

Similarly, we found that having previously worked together was a more important source of contacts for recent migrants compared to intermediate or long-term migrants (p<0.01) and for the respondents educated in Poland compared to those educated abroad (p<0.001). By contrast, conferences and similar events were more often a source of contact for long-term migrants compared to more recent migrants (p<0.001), and, though non-significant, also for the respondents educated abroad. Finally, long-term migrants (p<0.01) and experienced scientists (p<0.05) were more likely to actively search for contacts in Poland compared to other groups.

Altogether, based on these results, we can speculate that there are different modes of ties in the studied population. On the one hand, recent migrants, younger scientists and diaspora members who completed their PhD in Poland are more likely to know other scientists through personal and professional relationships developed during the time spent in Poland.

As time goes by, these relationships slowly dissipate, and these scientists are more likely to start developing these contacts through work, conferences and other events. Occasional, random contacts via friends and from active looking seem thus secondary and much less important than organised events aimed at associating Polish scientists working abroad. In any case, both professional and social modes of interactions can help to integrate members of the diaspora with each other and with scientists working in Poland.
5. Resources & benefits

In this chapter, we show that contacts within the diaspora and between the diaspora and scientists in Poland are mostly perceived as beneficial by our respondents. Almost two-thirds (64%) of our participants who know Poles working abroad as scientists reported these contacts as beneficial. These benefits are of both professional and social nature, however we found that the types of benefits often depended on the level of academic experience and migration history. A huge majority (84%) of respondents who know scientists in Poland said they gain some benefits from contacts with them. One half of them (52%) claimed to receive professional benefits from such contacts, but while for advanced scientists these benefits related to helping form international collaborations, younger migrants saw an important role of such contacts in helping them come back in the future. Three-quarters (74%) of respondents who know scientists in Poland reported non-professional benefits of such contacts, thus emphasising the importance of personal relationships maintained by our respondents.
Ties in the Polish diaspora scientific network provide access to a variety of resources which are means to gain benefits. Resources in this network might be of different nature, both professional and personal. Because of the variety of resources, measuring their flow is a challenge. Hence, we decided to focus on benefits of contacts with fellow Polish scientists, i.e. what benefits are a result of having network social capital.

We wanted to distinguish between the type of (1) benefit one gains from contacts with scientists in Poland and (2) with Poles working abroad. This is because in our understanding, the scientific diaspora - as defined in the methodology – is a network between individuals living outside of their homeland as well as between them and individuals living in their homeland. Moreover, we wanted to look at the benefits that would attract the respondents to collaborate with Polish scientists abroad and scientists in Poland, if they do not have such contacts now.

Importantly, 280 out of 436 respondents who know Poles working abroad as scientists said that they get professional or non-professional benefits having contacts with other Poles working abroad as scientists (64.2%, n=436). In regard to contacts with scientists working in Poland, 84.2% of respondents admitted that they gain benefits from them (professional or non-professional). We will look closer at the two groups of contacts separately.
Relations with Poles working abroad as scientists

First of all, we have observed a diverse range of answers to the question about the kinds benefits of having contacts with Polish scientists abroad (see Figure 5.1). In general, the most frequent answers given by the respondents were: professional benefits, e.g. “cooperation with another research group” (45.4%, n=280), social benefits (“I enjoy spending free time together”; 41.8%, n=280, sharing common language; 30.7%, n=280), emotional benefits (“shared understanding of the situation of Poles working abroad as scientists”) (37.9%, n=280). The least chosen answer by the respondents was “we share interests - I want to be in touch with people for whom today’s Polish affairs are important” (see Figure 5.1). It seems that professional networks intertwine with social networks of the respondent. Polish scientists abroad like spending time with fellow Polish scientists and thanks to these relations they can gain not only social benefits also they can access professional benefits.

Figure 5.1. What are the benefits for you from having contact with Poles working abroad as scientists? Percentage of respondents per answer (up to two answers per person). The question was addressed to the respondents who know Poles working abroad as scientists and reported that these contacts provide them with professional or non-professional benefits (sample size: n=280).
Second, there are some differences in the way young and experienced scientists, and scientists before PhD (future scientists) perceive benefits (see Supplementary Figure S5.1). For the young scientists, the most important are social and emotional benefits (50.6%; professional benefits are chosen by 44.6% of them and common language together with shared understanding are chosen by 30.1% of them), while for the experienced scientists the most important are professional benefits (58.2% of them indicate it, 39.2% indicate common language and 31.6% indicate social benefits). For future scientists, i.e. scientists before PhD, the most important were social benefits, common language, shared understanding and professional benefits (45.6%, 42.7%, 38.8% and 34.0%, respectively).

In general, we can say that the level of scientific career has an influence on the way scientists perceive benefits from contacts with other Poles working abroad as scientists.

We might speculate that the increased importance of social benefits amongst younger scientists is a result of age difference. Younger scientists are also less advanced in their scientific career, thus they might perceive their social capital through the light of social activities for which they have more time and that provide them with other benefits (e.g. sense of belonging, life satisfaction, etc.). In contrast, experienced scientists might have benefitted in that way already in the past, and at this stage of their career they gain from social capital having a full focus on their career or even on their own specific research area.

Overall, social capital gives opportunities to all groups of scientists to gain some benefits and the types of benefits are moderated the career stage. It is possible that, with time, the group of younger scientists will start to gain other benefits from their social network, e.g. professional benefits once they become independent researchers and start having more autonomy.

Third, time spent outside of Poland also influences the way scientists perceive benefits of contacts with other Poles working abroad as scientists (see Supplementary Figure S5.2). We found a significant difference in the perception of shared understanding as a benefit (p<0.05), which was more important for the recent and intermediate migrants compared to the long-term migrants (recent migrants – 34.3%; intermediate migrants – 35.8%; long-term migrants – 20.4%).

The distribution of benefits for the long-term migrants was narrower and more spread around the professional benefits (53.8% of them pointed to professional benefits, while the second most common, social benefits, were chosen by 39.8% of long-term migrants), while such distributions for recent and intermediate migrants were flatter and wider.

This suggests that younger migrants perceive benefits differently, and as they live longer abroad these benefits start focusing more on the professional benefits. Also, the fact that a shared understanding is important for younger migrants sheds light on some aspects of adaptation in a new place.

We might speculate that there are two reasons for that. First, social contacts in the home country make people use a cultural code which is comprehensible only for one’s countryman; it might be attractive to spend more time with other Poles because it is easier to express oneself. Second, outer migration might cause some initial decrease of social status, which leads many to spend more time with people who are alike, e.g. of the same nationality, who would respect the same social status as one has had.
Relations with scientists working in Poland

The second group of relations concerns contacts with scientists working in Poland. As stated already in the previous part, our respondents do have contacts with those in their homeland, having a network of fellow Polish scientists abroad in parallel. Results in the survey confirm that the majority of the tested group gain benefits from contacts with scientists working in Poland (52.5% get professional benefits, 74.0% get non-professional benefits and 84.2% get professional or non-professional benefits). We next analysed the kind of benefits they gain from such relations.

Professional benefits

Figure 5.2 shows a range of professional benefits our respondents get from contacts with scientists in Poland. They most often indicated ‘possibility to establish international collaboration’ (58.0%), ‘possible return to Poland’ (41.5%), ‘understanding of research activities in Poland’ (34.9%), ‘collaboration with a select researcher or research group’ (33.0%).

Figure 5.2. What professional benefits do you get from contacts with scientists working in Poland? Percentage of respondents per answer (up to three answers per person). The question was addressed to the respondents who know scientists working in Poland and reported that these contacts provide them with professional benefits (sample size: n=212).
There are a few interesting aspects of professional benefits which were revealed by taking into account the career stage, the declaration of return migration and time spent outside Poland. These factors have impact on benefits of having a network social capital.

First, there is a difference in perception of professional benefits between young scientists, experienced scientists and future scientists (see Supplementary Figure S5.5). We found a significant difference in answers in the following categories:

• possible future return to Poland (55.0% of young scientists indicate it, 46.7% of future scientists and 27.9% of experienced scientists, p<0.01),

• understanding of research activities in Poland (51.7% of future scientists indicate it, 33.3% of young scientists and 23.3% of experienced scientists, p<0.01),

• lecturing at a Polish university (16.3% of experienced scientists indicate it, 6.7% of future scientists and 5.0% of young scientists, p<0.05).

Interestingly, the difference between experienced scientists and the less advanced groups of scientists might be explained by the fact that benefits vary depending on the career stage. At a later stage, benefits like establishing international collaboration become more important since experienced scientists are already very well specialised. Younger scientists would also like to establish such collaborations, however they are also more interested in research activities in Poland compared to more experienced scientists.

This might be due to the fact that they are still learning and developing their research niche; consequently, younger scientists could be more open to various career options, including those in Poland. Alternatively, less advanced scientists could be also unsure about their career as scientists abroad and that is why alternative career in Poland might be attractive to them.

Second, professional benefits of contacts with scientists in Poland are interestingly connected with the time spent abroad (see Supplementary Figure S5.6). Scientists who have spent less time abroad indicated significantly more frequently that one of the benefits from contacts with scientists in Poland is facilitating a possible future return to Poland (57.3% of recent migrants, 40.9% of intermediate migrants and 20.3% of long-term migrants, p<0.001).

Also, a higher proportion of intermediate scientists compared to other groups indicated “understanding research activities in Poland” as a benefit of such contacts (50.0%, compared to 33.7% for recent migrants and 27% of long-term migrants, p<0.05). There is an opposite pattern in the perception of lecturing at a Polish university, and it is more important for the experienced scientists (17.6%) compared to recent or intermediate migrants (6.7% and 4.5%, respectively; p<0.05).

Furthermore, this exact benefit is differently perceived by men and women. Significantly more male participants have chosen lecturing at a Polish university compared to female participants (14.5% vs 4.7% respectively, p<0.05; see Supplementary Figure S5.8). Finally, the level of education obtained abroad did not significantly affect the perception of professional benefits.
Overall, we have found that both scientists who have lived outside of Poland for a long time and those who have left Poland more recently, they all gain professional benefits from having a social network in Poland. For those who have spent the shortest time abroad, it seems to be natural because they have contacts established in Poland and not yet that many abroad.

Conversely, scientists who have lived outside of Poland the longest have probably already established positions as scientists, which translates into the social capital, and hence they can benefit from it and actively use it. Our findings thus support an observation that experienced scientists gain professional benefits from their contacts with other Poles working abroad and scientists working in Poland.

Non-professional benefits

In addition to professional benefits, scientists gain non-professional benefits from their social networks (see Figure 5.3). These are: maintaining family relationships or friendships (69.9% of the respondents indicate it), satisfaction stemming from the ability to help Poland and scientists working in Poland (36.1%), contact with Polish culture (16.4%) and better understanding of the current state of Polish science (10.7%).

Our results also show a few significant differences between groups (see Supplementary Figure S5.9-S5.12). Satisfaction stemming from the ability to help Poland and scientists working in Poland is was chosen significantly more often by scientists educated in Poland compared to those educated abroad (45.9% vs 29.4% respectively; p<0.01).

Figure 5.3. What non-professional benefits do you gain from contacts with scientists working in Poland? Percentage of respondents per answer (up to two answers per person). The question was addressed to the respondents who know scientists working in Poland and reported that these contacts provide them with non-professional benefits (sample size: n=212).
because the ones educated abroad usually keep stronger connections with Polish academe. Also, the "help" benefit was more frequently chosen by male scientists (45.8% of them indicated it compared to 28.3% of female scientists; p<0.01) and by experienced scientists (46.4% of this group compared to 29.8% of future scientists and 28.7% of young scientists; p<0.05). On the other hand, maintaining family relationships or friendships was more frequently chosen by female scientists (77.9% compared to 60.6% of male scientists who indicated it). This is one of the very few instances when we found a significant difference between the answers of female and male respondents. In general, gender does not differentiate the way scientists benefit from having contact with the Polish scientific diaspora.

We can speculate that these results show a few characteristic of these groups. Satisfaction stemming from the ability to help Poland and scientists working in Poland is probably felt more intensely at a certain level of scientific career when one feels already accomplished and when one can give more when gets oneself.

Furthermore, one should have a certain level of self-agency to be able to acknowledge this satisfaction. If these assumptions were true, it would explain why experienced scientists chose this benefit more frequently. They might be less oriented toward individual careers, as they feel already accomplished, and happy to help others.

Moreover, people who obtained their higher education in Poland might value helping Polish academia now when they are abroad, because they feel emotionally bound and also obliged to share some of their knowledge and skills to the environment from which they gained a lot at an early stage of their career. Again, if these assumptions are true, it might have an impact on the way groups of Polish scientists abroad are targeted and encouraged to become engaged in initiatives improving economy and science in Poland.
6. Obstacles

In this chapter, we look at obstacles in the growth of the Polish scientific diaspora and in utilising social capital from such networks. For the very few respondents who do not know Poles working abroad as scientists or scientists working in Poland, a lack of opportunity to meet them stood out as the predominant reason for the absence of these relations. Respondents who know scientists working in Poland but do not perceive such contacts as beneficial were generally open and willing to collaborate with scientists in Poland provided the high quality of research; however, they were rarely keen to initiate such collaborations.

Obstacles in the growth of the Polish scientific diaspora network

In general, we know very little about Polish scientists with no ties to the Polish scientific diaspora. It is understandable as it is a difficult group to reach and hence difficult to get to know. This study is no exception since out of 464 respondents, only 28 (6.0%) do not know any Poles working abroad as scientists, 60 (12.9%) do not know any scientists working in Poland, and 11 (2.8%) do not know either. We do not think that these numbers represent actual proportions of disconnected Poles working abroad as scientists since, by definition, our sampling method was much more likely to reach connected researchers than those who are unconnected. Having said that, it is still interesting to look at the reasons given by those respondents for why they do not have or maintain these relations.
For the 28 respondents who do not know any Poles working abroad as scientists, the main reason for no contacts with fellow Polish scientists is a lack of opportunity (85.7%; n=28). The 11 respondents who have neither contacts with the Polish scientific diaspora nor with the scientists working in Poland have all obtained some education level abroad and have all been living abroad for 7 years or longer (median=13). Nevertheless, they maintain some ties with Poland because they usually visit the country at least once a year.

What about those who do not know any scientists in Poland? They have been usually living abroad for over a decade (median=11 years). Interestingly, they visit Poland regularly (but usually not very often) so we can assume they maintain private ties in Poland. The majority of those who do not know any scientists working in Poland explained that the reason for not having these relationships is that they have not had the opportunity to meet scientists working in Poland (61.7%; n=60).

When asked about potential benefits that would attract them to initiate a collaboration with scientists working in Poland, the respondents most often indicated professional reasons, including having similar research interests (47%), a possibility to establish international collaboration (37%), a possibility of securing financial support for international collaboration (22%), and a possibility of lecturing at a Polish university (20%). Non-professional reasons were of secondary nature (“possibility of spending time in Poland” was chosen by 15.0% of respondents), which probably is due to the fact that this group of respondents have mostly lived abroad for a long time and are well integrated into the social and professional networks of their host country.

Figure 6.1. What do you attribute the lack of professional benefits from contacts with scientists working in Poland to? Percentage of respondents per answer (up to three answers per person). The question was addressed to the respondents who know scientists working in Poland but reported that these contacts do not provide them with any professional benefits (sample size: n=121).

1 The questionnaire was sent in both Polish and English. The English version of this question had a mistake, and therefore we decided to exclude all answers given by respondents who filled the English version of the questionnaire.
Obstacles in utilising social capital from ties with scientists in Poland

Even though the majority of the respondents who know scientists working in Poland obtain professional benefits from such contacts, a considerable group of respondents who know scientists working in Poland do not perceive such contacts as professionally beneficial (47.9%; n=121).

We asked them about the reasons for the lack of professional benefits with scientists in Poland. The results, shown in Figure 6.1, point to a large diversity of answers, including low quality of the research field (37.2%), other career priorities (36.4%), lack of familiarity (43%) and that their field “is not being pursued in Poland” (25.6%). The less common answers include “I have not thought about this before” (24.8%), “Polish scientific community is not open to collaborations” (16.5%) and “lack of work ethic in Poland” (11.6%). Interestingly, we found that the unfamiliarity of the Polish scientific community is a significantly less frequent reason for the experienced scientists (24.1%) compared to the future and young scientists (47.9% and 45.4% respectively; p<0.1; see Supplementary Figure S6.1).

These results suggest that the obstacles to developing collaborations with scientists working in Poland do not stem from a lack of willingness of the Polish diaspora members to start such collaborations. Instead, it would seem that the respondents do not perceive Poland as a top research location, but would be willing to start such collaborations if the quality of the Polish research group is high and this group is the side initiating the collaboration. Again, more experienced researchers are more familiar with the Polish scientific community because their interactions are more likely to have a professional context.

Figure 6.2. What factors could lead you to collaborate with scientists working in Poland? Percentage of respondents per answer (up to three answers per person). The question was addressed to the respondents who know scientists working in Poland but reported that these contacts do not provide them with any professional benefits (sample size: n=192).
In the next question, the respondents were asked about factors which could lead them to start a collaboration with scientists working in Poland. Unlike in the previous question, here the replies were dominated by “chance to collaborate with a select researcher of research group” (48.4%), followed by “prospects of obtaining joint financing” (39.1%) and “similar research interests” (32.3%).

These answers again point to the match and the quality of the collaboration being the most important factors. Furthermore, we found that for experienced scientists a prospect of obtaining joint funding is a significantly more important factor than for young and future scientists (58.7% vs. 33.3% and 36.2% respectively; p<0.05; see Supplementary Figure S6.5).

In summary, these results strongly suggest that members of the Polish scientific diaspora are very open to collaborations with Polish scientists, however they value quality of research above all, and are probably unlikely to initiate such collaborations themselves. We speculate that these attitudes are a consequence of a limited knowledge about the Polish scientific community amongst the diaspora members. We thus hypothesise that one way of enhancing collaborations between Polish and foreign research groups could be achieved via appropriate networking events linking the Polish scientific diaspora and scientists working in Poland. In the long-term, Poles working abroad as scientists could and should become bridges between Polish universities and foreign universities, with an important role played by Polish institutions (see Outlook and recommendations).

“We enhancing collaborations between Polish and foreign research groups could be achieved via appropriate networking events linking the Polish scientific diaspora and scientists working in Poland.”

We also found that while male respondents were more interested in the prospects of obtaining joint financing (48.6% vs 34.2%; p<0.05), female respondents were more interested in a possibility of establishing an international collaboration and obtaining joint financing (27.9% vs. 12.2%; p<0.05; see Supplementary Figure S6.8). There are many potential reasons for this, but one could be that for women it is more difficult to get a promotion so they are looking for alternative strategies to advance in their careers or that they are more opportunity-oriented.
7. Return migration

In this chapter we look at return migration and find that our respondents had very different attitudes towards it. We find that the time spent abroad is an important predictor of such attitudes (the longer one lives abroad, the less willing one is to return), but not a perfect predictor (many long-term migrants consider going back given the right opportunity). The majority of respondents (52.7%) either declared a willingness to return or were undecided (27.1% declare willingness to return and 25.6% are undecided). Predominantly, this group perceived return as a chance to continue scientific research at home and help the Polish scientific community with their experience obtained abroad, however they often feared a decline in the standard of living and unnecessary bureaucracy. Almost one-half (47%) of our respondents do not intend to come back to Poland. As the previous group, they predominantly pointed to differences in the standard of living as the main discouragement, and – unlike the previous group – to the socio-political differences between the host and the home country. We interpret this as a sign that many of them will not be persuaded to return.
Attitudes towards return

To understand attitudes of the Polish scientific diaspora towards return to Poland, we asked the participants about their general attitude toward return migration and, if they intend to return, when they would like to move to Poland. Almost one half (46.8%) of the researched group said that they would probably not or definitely not return (probably not: 28.3%; definitely not: 18.5%; see Figure 7.1). A quarter of respondents (25.6%) were hesitant saying that it is difficult to say at the moment, while another quarter (27.1%) answered positively (definitely yes: 13%; probably yes: 14.1%).

The attitudes towards return migration also differed between different subgroups of respondents (see Supplementary Figures S7.1-S7.4).

First, we found that long-term migrants were more unwilling to return: they chose “probably not” and “definitely not” significantly more often than recent/intermediate migrants, and “probably yes” and “definitely yes” significantly less often than these groups (Figure S7.2). Young scientists were more likely to declare “definitely yes” than future or experienced scientists (21.0% vs. 10.2% and 9.7% for future and experienced scientists, respectively).

Finally, male respondents were significantly more likely to answer “probably yes” (19.3% vs. 9.6%; p<0.01) and “definitely yes” (16.9% vs. 9.1%; p<0.05) than female participants.

The group that responded positively was then asked about the expected time when they plan to come back to Poland (see Figure 7.2). Interestingly, almost 40% of the respondents were not able to define it. It could be an indication that many members of that group are likely to stay abroad unless concrete actions are taken to persuade them to return.

Figure 7.1. Do you consider returning to Poland and continuing your academic career there? Percentage of respondents per answer (one answer per person). The question was addressed to all respondents (sample size: n=453).

Figure 7.2. When do you plan to return to Poland? Percentage of respondents per answer (one answer per person). The question was addressed to those respondents who replied “probably yes”, “definitely yes” or “difficult to say” in the previous question (sample size: n=239).
Considering return influences the perception of benefits from contacts with fellow Polish scientists

Figure 7.3 shows a relationship between an average time spent abroad and different attitudes towards return migration. In accordance with the analysis above, we find that the longer participants have lived outside of Poland, the less likely it is that they are to consider returning to Poland and continuing their academic career there. The differences across categories are strongly significant (Kruskal-Wallis test, p<2x10^-16).

One can hypothesise based on this plot that the average time spent abroad when the attitudes start to shift is 10 years (or 8 years when looking at median instead of mean), however this is highly speculative due to the non-random characteristic of the population sample. Moreover, the variation within each category is substantial, suggesting that the time spent abroad explains only a small proportion of variance in attitudes towards migration.

Shifting attitudes towards return with time spent abroad are an important result, although not surprising. We think that this conclusion should be taken into account in programmes or funding schemes created for Polish scientists living abroad (see Outlook and recommendations).

Furthermore, scientists with less experience abroad might have less contacts with the Polish scientific diaspora but instead have a larger network built in their home country. The positive attitude towards return of the more recent diaspora members might be a result of having this network built, or conversely, they would like to return and thus perceive the benefit of having relations with scientists in Poland as essential.

Nevertheless, we would like to caution against excluding scientists with more experience abroad in return programmes altogether – even though our results suggest that they are less likely to return, many of them would still consider moving back to Poland given the right opportunity.
Migration opportunities

All the respondents who did not reject the idea of returning to Poland (i.e., replied ‘definitely yes’, ‘probably yes’ or ‘difficult to say at the moment’ to the question about their attitudes to return migration) were next asked about the opportunities they see in such returns (see Figure 7.4) and seeking advice about potential return (see Figure 7.5).

Results of the former question show that two-thirds of respondents pointed to “non-professional benefits such as the possibility of living in their home country” as the most important opportunity of return migration. Next two answers given by the respondents were connected with a positive impact they could make on the Polish scientific community (positive influence on the Polish scientific community: 53.6%, and transfer of knowledge acquired in other countries: 42.3%).

Interestingly, opportunities related to strictly professional benefits were in each case indicated by less than one-third of respondents (i.e., chance to create a research group: 33.1%, competitive advantage thanks to international experience: 27.6%, taking advantage of research niches: 11.7%, greater availability of financial resources for research: 5.9%, opportunity to gain experience in a new location: 2.9%).

Nevertheless, we found that professional benefits were relatively more important for younger scientists (see Supplementary Figures S7.4-S7.8). Specifically, “chance to create my own research group” was selected significantly more often by young scientists (43.9%) compared to future scientists (27.2%) and experienced scientists (27.7%; p<0.05), and by recent migrants (48.1%) compared to intermediate (27.4%) or long-term migrants (16.9%; p<0.001).

Figure 7.4. What opportunities do you associate with your return to Poland? Percentage of respondents per answer (up to three answers per person). The question was addressed to those respondents who replied “probably yes”, “definitely yes” or “difficult to say” to the question about attitudes towards return migration as shown in Figure 7.1 (sample size: n=239).
A similar pattern was found with another answer pertaining to professional benefits (“competitive advantage thanks to international experience”), however the differences were trending and not significant.

All of this points to an interesting observation namely that many Polish scientists working abroad do not perceive returning to Poland as a career advancement which they could benefit from personally, presumably because they do not view their home country as a top place for scientific excellence. Instead, they see Poland as a place where they could live, and where they could altruistically contribute to the society with their knowledge and experience.

However, our results also suggest that there might be generational differences in thinking about Poland as a competitive place to do research, in that younger scientists are more likely to view return to Poland as a career advancement, at least in the long-term. Nevertheless, whether the reasons for this lie in the improving Polish economy or something entirely else is unclear.

When asked where or from whom they would seek advice about a potential return (see Figure 7.5), the three most frequent replies were “scientists who have already returned” (59.8%), “directly in Polish scientific institutions” (49.8%) and “from scientists with experience from Poland” (33.9%). Other replies – which included sources like traditional media, social media or job portals – were chosen by less than 15% of respondents in each case.

These answers point to the importance of interpersonal relations between members of the Polish scientific diaspora and the Polish scientific community when seeking advice about facilitating successful return migration. Presumably, scientists working abroad prefer the experience of colleagues working in Poland from non personal sources of information since the former possess in-depth knowledge about the intricacies about the Polish academic environment that the latter do not offer.

Nevertheless, every second respondent who did not reject the idea of return also pointed to the importance of Polish scientific institutions in aiding...
Migration challenges

Returning to Poland and continuing scientific career there can raise some concerns amongst scientists, particularly those working in top scientific institutions abroad. We thus next asked the respondents who do not reject the idea of returning about potential challenges they see in such a return (see Figure 7.6); we also asked those who do not want to return about factors that mostly discourage them (see Figure 7.7).

For those considering return or undecided (see Figure 7.6), the main challenges were related to limitations of the scientific life in Poland in the areas of administration and funding (53.1% indicated difference in the salaries and standard of living in Poland and in the country in which they currently live; 45.6% indicated the necessity to deal with bureaucratic barriers and opaque procedures; 36.4% indicated acquiring the necessary funding required for scientific work).

For those considering return or undecided (see Figure 7.6), the main challenges were related to limitations of the scientific life in Poland in the areas of administration and funding (53.1% indicated difference in the salaries and standard of living in Poland and in the country in which they currently live; 45.6% indicated the necessity to deal with bureaucratic barriers and opaque procedures; 36.4% indicated acquiring the necessary funding required for scientific work).

Figure 7.6. What challenges associated with return to Poland do you expect to be the most significant? Percentage of respondents per answer (up to three answers per person). The question was addressed to those respondents who replied “probably yes”, “definitely yes” or “difficult to say” to the question about attitudes towards return migration as shown in Figure 7.1 (sample size: n=239).
It is interesting to see how these proportions vary between different subsets of respondents (see Supplementary Figures S7.13-S7.16). For example, we found that the top concern (difference in salaries) was most often chosen by young and experienced scientists compared to future scientists (young – 65.9%, experienced 55.4%, future – 40.7%; p<0.01), and more often chosen by male compared to female participants (male – 63.1%, female – 45%; p<0.01). A necessity to deal with bureaucracy was the main concern for long-term migrants, who picked this significantly more frequently than recent or intermediate migrants (long-term – 61.0%, intermediate – 42.5%, recent – 40.4%; p<0.05), and likewise for experienced scientists than the rest, though the difference was not significant (experienced – 53.8%, young – 43.9%, future – 40.7%).

Finally, the challenge of acquiring funding in Poland concerned recent migrants much more often than intermediate or long-term migrants (recent – 49.0%, intermediate – 28.8%, long-term – 22.0%; p<0.001), and for future/young scientists more than for experienced scientists, but again not significantly (future – 40.7%, young – 40.2%, experienced – 26.2%). One of the potential explanations for these differences is that recent migrants are the most...
concerned about financial aspects of the scientific life in Poland, which could be why they had emigrated in the first place.

On the other hand, more experienced scientists and long-term migrants, who have already established their professional position, might be less concerned about their scientific market value in Poland (and hence potential funding for example), and more concerned about conditions which may harm their productivity in the long term, as unnecessary bureaucracy.

Another interesting difference observed across different categories is in the perception of a "necessity to gain understanding of the Polish science funding structure", which was chosen significantly more often by intermediate and long-term migrants compared to recent migrants. This observation emphasises the importance of programmes and events informing about the funding opportunities in Poland amongst the more established members of the Polish scientific diaspora.

Respondents who do not consider returning (see Figure 7.7) also pointed to differences in salaries between the host and the home country as the main discouragement (60.4%). In this case, we did not observe any major differences between participants with different levels of research experience (see Supplementary Figures S7.17-S7.20), however it was the most frequent concern amongst recent migrants (recent – 76.5%; intermediate – 58.1%, long-term – 52.6%; p<0.05), and amongst those who completed their PhD in Poland (educated in Poland – 74.2%, educated abroad – 54.1%; p<0.01).

A possible explanation for this is that many diaspora members emigrated being encouraged by higher salaries, and presumably feeling that their skills were underappreciated in Poland. The second most common answer was "socio-political differences between Poland and the country where I currently live" (43.4%). Though we did not find any significant differences in how various subgroups of participants responded to this question, a similar answer was much less frequent amongst those respondents who consider return or are undecided (Figure 7.4).

One might speculate that perceiving such differences as important may be one of the reasons why some migrants do not consider returning. Finally, the popularity of the third most common discouragement, namely that the respondents’ field is not actively pursued in Poland, was highly driven by replies from young and intermediate scientists (future – 33.3%, young – 33.9%, experienced – 11.6%; p<0.01). One of the possible explanations is that these two groups have not had a chance yet to build ties with Polish scientific institutions and might be not fully informed about research areas in Poland. Furthermore, it is possible that these groups are engaged in very interdisciplinary research which does not have a precise equivalent in Poland.

The obtained results are complementary to the findings presented in the report by the Polish Young Academy of the Polish Academy of Sciences (AMU PAN; Durlik et al., 2015). Main barriers of return migration indicated by Polish scientists who live abroad included an unclear recruitment processes for academic posts in Poland, and a small number of vacancies at Polish universities matching competencies of the respondents.

However, respondents pointed also to excessive bureaucracy present at Polish universities, which was also one of the main obstacles indicated in our study. Interestingly, another barrier described in the report by Durlik et al. (2015) was insufficient collaboration of Polish scientists between each other and with foreign scientific institutes. Developing further social capital generated by the Polish scientific diaspora could tackle this issue and help Polish scientists start international collaboration (see Outlook and recommendations).
8. Institutions

This report emphasises the importance of linking members of the Polish scientific diaspora with each other and with the Polish scientific community, and in this final chapter we look at the potential role of institutions in that process. First, we find that most of our respondents have heard about major Polish science institutions (e.g., the Foundation for Polish Science or the National Science Centre), and their popularity could be leveraged onto specific actions aiming to integrate Polish scientists around the world. Second, respondents considering returning to Poland would rather directly contact institutes and universities where they would like to work rather than those Polish science institutions, which points to the importance of engaging Polish universities and research institutes directly into the networking process. Finally, most respondents see a significance of an organisation associating Poles working abroad as scientists and they pointed to a wide range of possible roles such an organisation could and should play.
There are a number of institutions and events, abroad and in Poland, which may be beneficial for Poles working abroad as scientists. Therefore, we asked the respondents which of these institutions they have heard of before.

As shown in Figure 8.1, we found that almost two-thirds (62.5%) of the respondents have heard about the Foundation for Polish Science, while two other most recognised institutions were also Poland-based (National Centre for Research and Development – 50.6% and National Science Centre – 48.1%). Almost one-third (31.8%) of the participants have heard about the annual conference “Science: Polish Perspectives” organised by the Polonium Foundation (authors of this report), while every fifth respondent 20.8% has heard about the Polonium Foundation itself.

These numbers must be interpreted with caution. For example, while Polonium Foundation is a newly established organisation that is growing rapidly, its relatively high recognition is more likely the result of the applied recruitment strategy and consequential bias rather than of an accurate representation.

Nevertheless, the fact that 285 respondents (64.0%) have neither heard about the Polonium Foundation nor about the “Science: Polish Perspectives” conference suggests that our study has reached many Polish scientists who are not part of the networks developed by the Polonium Foundation in recent years.

Figure 8.1. Have you ever heard of the following institutions and science-related events? Percentage of respondents per answer (unlimited number of answers per person). The question was addressed to all respondents (sample size: n=445).
Role of organisations in aiding return

The respondents who consider returning to Poland or are undecided were earlier asked about where they would seek advice about a potential return (see Figure 7.5). Amongst them there was a large group (n=115) who replied that they would seek such advice directly in Polish science institutions. Those respondents were then asked which institutions they have in mind.

The results show that the overwhelming majority (67.8%) replied that they would directly contact the university or institute where they would like to work (see Figure 8.2). The second most frequent reply was the “Foundation for Polish Science”, which was chosen by 21.7% of respondents. This emphasises the importance of linking members of the diaspora who consider returning to Poland with the representatives of Polish research institutions and universities.

![Figure 8.2. Which institution would you first ask for advice on returning to Poland? Percentage of respondents per answer (one answer per person). The question was addressed to those respondents who replied “probably yes”, “definitely yes” or “difficult to say” to the question about attitudes towards return migration as shown in Figure 7.1, and would seek advice directly in Polish science institutions as shown in Figure 7.5 (sample size: n=115).](image-url)
Role of organisations in associating Polish scientists

In the final part of the report we asked the participants about a potential role of an organisation associating Poles working abroad as scientists. As Figure 8.3 shows, 71.0% of respondents see the importance of such an organisation, and these respondents were then asked about the specific roles that organisation should play (Figure 8.4).

We observed a large diversity of answers to this question. Specifically, respondents most often indicated "formation of new institutions which will represent the interests of Poles working abroad as scientists" or "impact on institutions in Poland like Ministry of Science and Higher Education" (both 36.1%), "improving cooperation between Polish and foreign scientific institutions" (33.6%), "opportunity to share the experience with scientists working in Poland" (33%), "help in circulation of scientists between countries by connecting people" (32.4%), etc. The only answer chosen by less than ¼ of all respondents was "promotion of achievements of Poles working abroad in Poland" (13.7%).

We also analysed how these answers vary depending on the same attributes of the respondents as before (see Supplementary Figures S8.1-S8.4), and we did not find any major differences between the subgroups with one exception: "formation of new institutions representing interests" were chosen by male respondents significantly more often than by female respondents (46.9% vs 27.1%; p<0.001).

These results show several interesting things. First, as there are not many institutions associating the Polish scientific diaspora, scientists might feel that there is still a gap that should be filled. To our knowledge there is no official state programme that aims to integrate the Polish scientific diaspora, although some initiatives to integrate members of the diaspora with the Polish scientific community have been undertaken by Polish institutions. These include the UK-Poland Science Forum (a joint initiative of the British Embassy Warsaw and the Polish Ministry of Science and Higher Education, organised in cooperation with Top 500 Innovators), the Polish Scientific Networks conference or other events aimed at university graduates (e.g., Poland 2.0, the Congress of Polish Student Societies in the UK, the UCL Leaders meeting, etc.).

Second, even though most respondents agree that the existence of such an organisation is necessary, they do not really have a predefined vision of a role such an organisation should play, and this is true regardless of their research experience and time spent abroad. They were however open to many of the roles suggested in the poll. Finally, while the respondents did not see the importance of promoting their achievements in Poland, they often see the importance of promoting abroad the achievements of their colleagues working in Poland. This again points to the direction in which these kinds of initiatives should be undertaken.

Research has argued (e.g. Tejada, 2012) that in order to build and strengthen a scientific diaspora, both bottom-up and top-down initiatives are needed.
Examples of successful initiatives which mobilised foreign-based scientists include the creation of the Ad-Astra Network for Romanian scientists in the early 2000s, knowledge and technology transfers of Chinese and Indian scientists living in the US in the 1990s. Due to its long history of migration, Poland has some record of initiatives aiming at gathering its scientific diaspora. There are organisations with long history such as the Polish University Abroad (PUNO) in London or the Polish Society of Arts and Sciences Abroad (PTNO, partner of the discussed survey). Also, there are new organisations formed that with time gain support from the state (e.g. Polonium Foundation has recently started to be funded by the Dialog grant, the programme of the Ministry of Science and Higher Education in Poland).

However, there are not many groups that would support and integrate Polish scientists abroad in a systematic and regular way. The Polish scientific diaspora is mainly integrated through bottom-up initiatives. Such initiatives include many societies and associations created in several parts of the World, e.g. the Polish Scientists Abroad, the Polish Federation of Engineering Associations and also the initiatives like “Science: Polish Perspectives” conferences, organised by the Polonium Foundation (authors of the presented report). The way how these initiatives could fulfil the roles indicated by the respondents is discussed in Outlook and recommendations.

In summary, only when the term ‘Polish scientific diaspora’ is widely used and well understood, can it help to create dedicated programmes that will benefit the Polish scientific community and foster technological and economic advances in Poland.
9. Outlook and recommendations

Scientific diaspora can be conceptualised in many ways. In this report, we would like to propose a new perspective by considering the Polish scientific diaspora in terms of a social capital. In the proposed approach, social capital of a scientific diaspora consists of a network of relations between scientists working abroad and scientists working in their home country. Ties in such a network can be used to convey various resources (e.g., knowledge, experience or emotional support) in order to gain diverse benefits and limit challenges of the scientific life. We argue that the social capital contained within the Polish scientific diaspora is beneficial for its members – regardless of their plans for return migration – and for the Polish scientific community as a whole. In other words, the social capital perspective on scientific diasporas highlights a range of possible roles these diasporas can serve.

Benefits of linking Polish scientists

As it was acknowledged in the introduction, Poland has been facing a significant brain drain in recent decades, and compared to other countries Poland has a large number of skilled migrants, especially those with higher education (e.g. Poland ranked 10th in the world in the highest emigration stocks in 2000; World Bank Document on International migration, remittances and the brain drain, 2006). It is therefore crucial for Poland to undertake actions to limit losses due to emigration of highly skilled Poles. In this report we argue that an important action against such losses should be to facilitate the growth of social capital in the Polish scientific diaspora by strengthening ties (a) within the Polish scientific diaspora and (b) between the diaspora and the Polish scientific community.

Our results show that the emergence of such ties resembles those we can observe in other scientific networks. Poles working abroad as scientists, particularly more experienced scientists and long-term migrants, meet mainly at work or at conferences. We can thus assume that the scientific context is a crucial part of networking between Polish scientists. This is certainly true when we look at previous (if not many) examples of successful networking events between members of the Polish scientific diaspora (“Science: Polish Perspectives” conferences organised by the Polonium Foundation) or between the diaspora and scientists in Poland (the “Polish Scientific Networks” conference organised by the Polish Academy of Sciences). Interestingly, while our results show that Polish scientific institutions, science-supporting organisations or diaspora-oriented organisations currently play a very limited role in connecting Poles working abroad as scientists, they also show that many Polish institutions are well recognised by our respondents. We think that there is a large room for improvement here with a potentially large impact on the development of social capital. Therefore, our recommendation is that there should be a wide institutional support and science policy in Poland targeted at Poles working abroad with the goal of facilitating networking within the Polish scientific diaspora, as well as between Poles working abroad as scientists and scientists in Poland.

According to the results of our study, the majority of Poles working abroad as scientists perceive contacts with other members of the scientific diaspora as beneficial. Those benefits stem from both ties within the diaspora and ties with scientists working in Poland. Benefits derived from ties within the diaspora...
can be classified into two major groups. The first and the most common group are benefits of professional nature, though they are significantly more important for more experienced scientists. The second group are benefits of social and emotional nature. These kinds of benefits are particularly important for short-term migrants and young scientists. Given these trends in our data, we can speculate that the benefits obtained from ties within the diaspora are strongly linked to trajectories of private and professional lives of its members and their priorities. For example, experienced scientists, who have more freedom in deciding about the direction of their research, seek intellectual stimulation and thus mostly benefit from these kinds of interactions with like-minded individuals. On the other hand, young scientists and recent migrants look for more social and emotional support while advancing in academia, and they reach out to similar peers in order to find that support. With time, these relations can evolve to bring more professional benefits on top of the social ones. Therefore, our recommendation is that the effort to integrate members of the diaspora with each other should be adapted to the modes of interactions characteristic of various members of the diaspora and the benefits they gain from such interactions. For example, young or future scientists are more likely to be interested in general social networking events and meeting new people, while experienced scientists are more interested in professional-oriented events which can help them develop international collaborations (although the social context is still important).

The majority (84%) of our participants also reported to obtain professional or non-professional benefits from contacts with scientists working in Poland. Strengthening ties between the diaspora and scientists working in Poland can aid building international collaborations. The extent to which the respondents indicated that they have contact with scientists working in Poland, and the scope of benefits from such contacts, let us assume that the Polish scientific diaspora can act as a bridge between Poland and their host countries, promoting the transfer of knowledge and skills. It seems that the researched group has already engaged in transnational actions that benefit the scientific community in Poland. On the level of attitudes, our results show that the benefit of collaboration with scientists in Poland is more noticeable for experienced scientists than other groups. Since experienced scientists are less keen to move to Poland, they could be a potential source of international collaborations for scientists working in Poland. This aspect of the social capital of the scientific diaspora can only be explored if scientists who work abroad are well connected with those who work in Poland.

International collaborations are a vital part of the academic world, and scientific groups in Poland have often fewer international collaborations than their European colleagues (Kozak, Bornmann & Leydesdorff, 2015). A network of international collaborations built with the help of the Polish scientific diaspora may have a positive influence on the international position of Polish scientific institutions.

On the other hand, unlike the benefits from ties within the diaspora, ties with scientists working in Poland are more often a source of non-professional benefits. As mentioned previously, respondents who completed their education in Poland – and hence spent on average more time in the Polish academic environment compared to those respondents who completed their education abroad – perceive satisfaction stemming from helping Poland as more important than other groups. This is an important reminder that the goal of initiatives linking Polish scientists abroad should not be solely aimed at those who: (a) have spent the longest time abroad, (b) are already established and (c) have a diverse network of contacts from which they already benefit.

There is a place in the diaspora for newcomers from Poland who have migrated recently. Their role matters because the recent diaspora members are
likely to play an important role linking scientists in Poland with those abroad who have more experience but fewer ties with Poland. Ultimately, scientific diasporas are ever-changing groups with turnover reflecting high rates of academic mobility. Facilitating integration of new members and their interactions with older members is important to maximise the connectivity of a large network which is the scientific diaspora. This in turn should enable further development of social capital in such a network, which benefits all members of the diaspora and the scientific community as a whole. Therefore our recommendation is that diaspora networking events should have programmes and agendas which are attractive to newcomers as well as short-term visitors from Poland. These could be created adapting the form of successful scholarship programmes around the World, e.g. DAAD scholarship programme in Germany or Humboldt scholarship, in which scholars are encouraged to be mobile, travel to other institutions meeting other receivers of the same scholarships, hence build further their social network. Furthermore, there are regular meet-ups for alumni organised in different regions of the World. Such formulas of scholarships reunite the existing network but also help to build the community by being open to new members.
Return programmes

According to our results, ¼ of our respondents want to move back to Poland or consider this possibility while ¼ are undecided. We find that one of the more important reasons underlying reluctance to return migration is a perception of socio-political differences between Poland and the host country, and it is difficult to envisage a return policy which can address such concerns. We thus predict that there are many members of the Polish scientific diaspora who will not be persuaded to come back, regardless of attractive the return programmes are. Therefore, we argue here that, while return programmes are welcome and perhaps necessary, they should not be the sole aim of the science internationalisation policy in Poland. This is in line with the recommendations in the previous section regarding strengthening ties within the Polish scientific community worldwide.

We are aware that these views may stand in contrast to the commonly perceived solutions of the brain drain problem. For example, a relatively recent report on the mobility of Polish scientists (Durlik et al., 2015) polled 134 Polish scientists working abroad about attitudes to migration and found that, similarly to our findings, reluctance to return migration was often a result of the lack of competitiveness and transparency of the Polish academic system. The same report also found that a substantial proportion (55%) of the respondents did not intend to return, which again is in line with our results. Importantly, however, the authors of the report assumed that benefits from scientific mobility can only be gained after scientists return to their home country.

In this report, we propose that scientific mobility can still be beneficial for the home country, even if scientists decide not to come back, provided that the home country has smart systemic solutions and policies to preserve strong ties between those migrants and scientists working in Poland.

If we create return programmes, how can we persuade the most talented Polish scientists working abroad to move back Poland? We can help to sketch an answer to this question through the analysis of attitudes of the Polish scientific diaspora toward the Polish scientific system. Our respondents who consider return rarely see Poland as a place to advance their academic careers. Instead, return migration is more often seen as a chance to live in the home country closer to the family, or an opportunity to have a positive impact on the Polish scientific community and for transfer of knowledge.

Objections toward the Polish scientific system (e.g., uncompetitive salaries in academia, large bureaucratic burden and access to competitive funding) are seen as major obstacles for the majority of respondents who worry about return migration. Return programmes – like HOMING or FIRST TEAM from the Foundation of Polish Science or POLISH RETURNS from the National Agency for Academic Exchange – only partially address these challenges because, while offering competitive salaries, they only provide funding in the short-term and cannot resolve bigger issues like excessive bureaucracy. Therefore, our recommendation is that Polish science institutions should create more of highly competitive academic positions with the potential of long-term core funding and internal administration support, open to candidates from all countries, and then use the networks with the Polish scientific diaspora to help advertise such positions.

An example of such efforts includes Dioscuri, a recent joint initiative of the National Science Centre in Poland and the Max Planck Society in Germany. We argue that further investment in such programmes will help attract international talents and advance Poland in international rankings of top countries for science and innovation.
On the other hand, return programmes should be targeted more specifically at those who are the most likely to return. We find that the negative attitude towards return grows with the time spent abroad, and we speculate that this is a consequence of gradual integration into the social and professional structures of the host country. This suggests that institutional efforts to persuade researchers to come back are most likely to be successful when addressed to the more recent diaspora. On the other hand, an intellectual value of migrants usually grows with their experience obtained abroad. This suggests that there is a trade off between persuading very young members of the diaspora (more likely to return but less experienced) and older members (more experienced but less likely to return).

Therefore, our recommendation is that while the efforts to persuade scientists to return should be open to all diaspora members, they should be more focused on young and early-career researchers who have gained some experience abroad but are still likely to consider returning to Poland.

Finally, the discussed obstacles and challenges can also be seen as an opportunity for the Polish scientific business sector. R&D companies in Poland are often looking to recruit talented people from abroad with research experience, and many of them have the financial means to avoid creating the kinds of problems returnees often face in academia upon return to Poland. Therefore we argue here that companies doing active research can benefit from supporting the Polish scientific diaspora networking events by attending them and hence maximising the chances of finding the right employees. Such support will in turn benefit the diaspora members by providing them with more opportunities for networking and career development.
Limitations of this study

Our approach suffers from several weaknesses which should be taken into account when interpreting the results. First and foremost, people who answered the questionnaire do not represent a random subset of the members of the Polish scientific diaspora. Obtaining a representative sample is a major challenge of all studies about scientific diasporas because these populations have dynamic migration patterns which are quite often temporal. Scientists move from one university to another and from one country to another. Furthermore, lack of a representative sample is further complicated by the fuzziness of the group because it consists of scientists of Polish heritage, brought up and educated abroad, educated both in the host country and in Poland, or educated in Poland and working abroad.

To tackle this problem, one of our main recruitment strategies was to use networks developed by the Polonium Foundation to advertise the questionnaire. While this method helped us to put together the largest-to-date study of the Polish scientific diaspora, it also produced a so-called „snowball effect”, whereby information about the poll spread across social networks and social media which are based on a pre-existing social structure of the diaspora population. Hence, we were much more likely to reach well-connected members than those who are not well connected.

Admittedly, diversification of recruitment methods (particularly the use of social media like Twitter) has helped us to reach many respondents who are not part of the Polonium Foundation networks (65.8% of respondents have never heard of the Polonium Foundation or the Science Polish Perspectives conferences). Nevertheless, we suspect that scientists who felt Polish and wanted to contribute to the research on the Polish scientific diaspora were much more likely to take part in the study than those who are more isolated. By contrast, scientists who are members of the diaspora (i.e. have contacts with Polish scientists abroad or scientists in Poland), but did not feel they could benefit from it in any way, might have not taken part in this survey.

Finally, this study has a large overrepresentation of scientists working in the UK, so the patterns observed here may not necessarily be true about the large population of Polish scientists working in the United States for example.

In spite of these weaknesses, the presented study is one of the largest attempts to describe a national scientific diaspora and its members. The analysed sample has many advantages, which should be underlined. We managed to gather responses from scientists with different experience, e.g. career stage, scientific fields, years spent abroad, educated in different countries and living in different countries. The vast majority of the respondents do not have any funding from Poland.

Therefore, it can be assumed that they are well embedded in foreign scientific institutions. It is thus reasonable to expect that the recommendations provided here are a great starting point for any policy including the members of the Polish scientific diaspora, even if such policies will need to be perfected or modified using evidence-based approach in the future.
10. References


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