

Chapter 9

International Research Collaboration Practices and Outcomes: A Comparative Analysis of Academics' International Research Activities



Olivier Bégín-Caouette, Timo Aarrevaara, Anna-Lena Rose,
and Akira Arimoto

Abstract As scientific research is increasingly the product of international collaborations, this chapter aims at examining the relationship between international research collaboration practices and outcomes in Canada, Finland, Germany, Japan, and Lithuania. Relying upon the theory of scientific and technical human capital, and proceeding to correlations and logistic and multiple regressions, findings suggest that collaboration practices and outcomes are correlated but the strength of the relationship is weak. Findings also point to the influence of degrees being obtained abroad, with institutional incentives and international funding on both research collaboration practices and outcomes.

Keywords International research activities · Collaboration practices · Collaboration outcomes · Scientific and technical human capital

O. Bégín-Caouette (✉)
Université de Montréal, Montreal, QC, Canada
e-mail: olivier.begin-caouette@umontreal.ca

T. Aarrevaara
University of Lapland, Rovaniemi, Finland
e-mail: timo.aarrevaara@ulapland.fi

A.-L. Rose
TU Dortmund University, Dortmund, North Rhine-Westphalia, Germany
e-mail: anna-lena.rose@tu-dortmund.de

A. Arimoto
Hyogo University, Kakogawa, Hyōgo, Japan

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A. Çalıkoğlu et al. (eds.), *Internationalization and the Academic Profession*,
The Changing Academy – The Changing Academic Profession in International
Comparative Perspective 24, https://doi.org/10.1007/978-3-031-26995-0_9

Introduction

Scientific research is increasingly the product of international collaborations. Witze (2016) observed that, between 2000 and 2013, the proportion of scientific papers that were internationally co-authored rose from 13.2% to 19.2%. The multiplication and densification of these networks can also be seen by the fact that the average number of co-authors per article has doubled in the last forty years and that the average distance between the location of co-authors has increased (Olechnicka et al., 2018). The documentation suggest that international collaborations contribute to the number of papers (Gazni et al., 2012) and citations (Glänzel & Schubert, 2001). The internationalization of research has also increasingly become a field of strategic intervention (Lee & Haupt, 2019) as governments and higher education institutions (HEIs) increasingly promote international collaborations and partnerships to enhance productivity, research impact, and countries' knowledge diplomacy (Barbosa & Neves, 2020). In a study of 35 countries, Wagner et al. (2018) confirmed that countries that had the most impact in terms of scholarly production were the most involved in terms of collaboration and international mobility.

Although several authors equate academics' international collaborations with the number of international co-publications (Newman, 2004), both Laudel (2001) and Katz and Martin (1997) pointed out that co-authorship is a partial indicator that, by itself, cannot account for the multidimensionality of collaborative practices. If co-publication as the formal recognition of at least two researchers on a scholarly contribution can be considered as an outcome of research collaborations (Adams, 2013), the practice of collaboration includes contacts, meetings, co-operational work, exchange of information (Melin & Persson, 1996), and may include the organization of international activities or the exchange of researchers (Raan, 1997). In addition to the formal recognition of co-publication, collaboration practices are also informal and may include unacknowledged collaborators (Katz & Martin, 1997). A study on international research collaborations should therefore examine the relationship between international research collaboration practices and outcomes.

The literature also suggests that collaboration practices and outcomes are not equally distributed and vary according to academics' discipline, seniority, gender, and institutional affiliation. Abramo et al. (2013) noted that while women researchers relied on collaboration more than their male colleagues, the proportion of international collaborations was smaller. AlShebli et al. (2018) revealed patterns of homophily in terms of race, gender, and affiliation in academic collaborations. Kwiek and Roszka's (2020) study of 25,463 Polish university professors also shows interactions between collaboration, discipline, and seniority. Payumo et al. (2019) revealed that collaboration practices and outcomes varied by institutional type and higher education systems (HES). Like the predictive model developed by Finkelstein and Sethi (2014) for the internationalization of the academy, a study on focusing on international research collaborations should examine the influence of individual, professional, institutional, and national factors on collaboration practices and outcomes.

Scientific and Technical Human Capital

This chapter is based upon Bozeman and Boardman's (2014) theory of scientific and technical human capital (STHC). According to this theory, STHC constitutes a reservoir of skills that individuals mobilize to solve scientific and technological problems. This reservoir includes individuals' human, social, organizational, and material capital, such as formal and informal learning, intellectual capacity, social networks, and links they maintain with organizations that produce, support, consume, and disseminate knowledge. At the base of this STHC reservoir would be the organizational capital (Bozeman & Boardman, 2014) which designates the culture, know-how, and codified processes by which organizations transform the tangible and intangible resources to which they have access into a product that has value.

In the same way as increasing access to higher education, increased funding for research or the free dissemination of knowledge can increase a society's STHC; international activities such as the mobility of researchers or research collaborations contribute to this reservoir and, ultimately, to scientific and technological production (Jonkers & Cruz-Castro, 2013). In STHC theory, collaborations refer to the social processes by which individuals pool their experiences and expertise to produce new knowledge (Bozeman & Boardman, 2014). Research collaborations are institutionalized in networks that frame a common university social space around the same research object (Leite & Pinho, 2017).

Bozeman and Boardman (2014) present a logic model to explain how international research collaborations – as a form of social capital – contribute to research inputs (personnel, training, social networks, materials, and labour), research processes (collaborative projects, leadership, and resource seeking), and research outcomes (publications, patents, citations). In other words, informal and formal networks established between academics are an input, while group meetings, the co-writing of grant proposals, and the sharing of skills and tools would relate to processes, and scholarly contributions could be assimilated to outcomes.

According to the STHC theory, people, prior knowledge, and labour represent inputs (Bozeman & Boardman, 2014) that universities can mobilize through the international recruitment of professors or students. The recruitment of international professors (or professors who obtained their doctoral degrees abroad) is, for several large universities, a key objective of their international strategy since their presence is an indicator in several international rankings (Altbach & Yudkevich, 2017). These researchers contribute to STHC because they are more likely to collaborate with international colleagues (Melkers & Kiopa, 2010), which Scellato et al. (2015) named the diaspora effect. In addition to this cross-border social capital, they increase the prestige of the institution, broaden the range of publications and journals to which articles are submitted, and, in non-English speaking circles, increase the proportion of publications in English, which are more often cited (Altbach & Yudkevich, 2017).

International research funding is a form of material capital that would contribute to the number and proportion of articles written with an international partner

(Checchi et al., 2019). On average, in the OECD (2021), 7% of the research funding comes from foreign sources. Defazio et al. (2009) studied 294 researchers from 39 European research networks over a period of 15 years and found that international funding had increased research collaborations, but that the effects on research output were weak. Other studies (König, 2017) would nonetheless suggest that the multiple funding incentives of the European Union (EU) have had notable influence on the research ecosystem and collaborations.

Bozeman and Boardman's (2014) theory suggest that researchers' personal and professional characteristics could also interact with their institution's STHC. These include age, gender, academic rank, and discipline. While according to Bozeman and Boardman (2014), who considered age as a proxy for research experience, there are inconclusive findings about the effect of age on research collaborations; findings could be different in some higher education systems (HES) (such as in former Soviet republics) where senior scholars were socialized during Soviet times and younger scholars would be more proficient in English. As pointed out above, gender seems to play an important role in research collaboration, where women collaborate more overall but are less active in international collaborations (Abramo et al., 2013). Researchers' disciplinary areas could also influence collaborations. Leahey's (2016) literature review reports that if collaboration rates have increased for all disciplines, they remain higher in the natural and health sciences. The objective of this chapter is therefore to analyze the influence of individual, professional, institutional, and national factors on international research collaborations as practices and outcomes, in five countries on three continents: Canada, Finland, Germany, Japan, and Lithuania.

International Variations in Collaboration Practices and Outcomes

This chapter compares five countries that were selected through a maximum variation sampling method, which consists of collecting data from entities whose diversity is relevant to the research question (Cohen & Crabtree, 2006). Since the literature suggests that internationalization is influenced by countries' language and geographic location (Hughes, 2008) as well as their political-economic structure (Graf, 2009), funding, and international policies (Hong, 2020), we selected five small-to-medium-sized countries located on three continents (Asia, Europe, and North America) which differ in terms of language (English and French, Finnish, German, Japanese, and Lithuanian), political organization (Canada and Germany being federations) and welfare regimes (liberal, conservative and social-democratic; Esping-Andersen, 1999). Since this chapter examines research collaborations, it is worth noting that the five countries differ by higher education research and development (HERD) expenditures (HERD representing 1% of the GDP in Lithuania and 3.20% in Japan; OECD, , 2021), the proportion of different research funding

mechanisms (Reale, 2017), and research productivity (Japan producing 777 papers per capita and Canada 1617; World Bank, , 2018). Taken together, these national variations will allow for a careful contextualization of findings and, if some observations appear relevant across contexts, to propose more robust generalizations.

Since our objective is to analyze the influence of individual, professional, institutional, and national factors on international research collaborations, the following subsection will describe those levels of factors in each country.

Canada

Canada is a sparsely populated North American country. The constitution establishes a federation and divides authority over policy issues between federal and provincial levels of government. While institutions of higher education are created, regulated, and funded by the provinces, international relations are of federal jurisdiction (Tamtik & Sá, 2020) and the proportion of research funding allocated by the federal government is larger than that allocated by provincial governments (Statistics Canada, , 2017). Canada produces 3.8% of global research publications (52 publications per researcher), and these publications are cited 43% more frequently than world average (CCA, 2018). In terms of national factors, if the government and business sectors contribute a smaller proportion of the gross expenditures in research and development (GERD) than the OECD average, HEIs contribute 50% of the national total, 37.14% of all researchers work in the higher education sector, and HERD increased by 30.16% over 20 years and is above the OECD average. The relative weakness of the business sector is seen in Canada's share of patent applications, which represents around 1% of the world's total, placing Canada only 18th in the world (CCA, 2018).

Federal support for international academic relations was politically motivated until the 1990s and then economically motivated, with the signature of General Agreement on Trade in Services (Knight, 2008). The first internationally oriented science and technology policy was proposed in 2001 and, since then, in addition to being part of Canada-United States-Mexico Agreement (CUSMA), Canada signed eight bilateral agreements with other countries. Canadian research funding agencies have also adopted various policies to increase the international dimension of research, as well as implemented programs such as the Canada Research Chairs, the CFI International Funds, or the Canada First Research Excellence Funds (Tamtik & Sá, 2020). It is worth noting that a lack of co-funding mechanisms limits Canadian academics' participation to international programs, such as those of the European Union. As a result, only 0.9% of research and development (R&D) expenditure performed by the HESs are internationally funded (Statistics Canada XE "Canada" , 2021), and 7% of Canadian academics' external research funding comes from foreign sources (Huang et al., 2014).

In terms of institutional factors, it is worth noting that, although 95% of Canadian universities mention internationalization in their strategic plan (AUCC, 2014), international research collaborations are more frequent in research intensive than in comprehensive or primarily undergraduate institutions (Lacroix & Maheu, 2015). Regarding professional and individual factors, in Canada, academics who are hired into full-time, tenure-stream positions move through three ranks: assistant, associate, and full professor. Women are under-represented at the ranks of assistant (42.3%), associate professor (46.6%), and full professor (26.8%) (Statistics Canada, 2017). About 40% of university professors were born outside of Canada (CAUT, 2017), and universities actively recruit professors from abroad to strengthen research capacity, alleviate brain-drain, and enhance diversity (Barbaric & Jones, 2017).

This is the context in which collaboration practices and outcomes take place. In 2007, 57% of academics characterized their research as international in scope and 64% claimed to collaborate with international colleagues in research projects (Rostan et al., 2014). Huang et al. (2014) suggested that senior and junior academics did not differ substantially in the frequency of international research activities, but that the proportion of mobile or migrant academics was higher among senior than junior faculty.

Finland

Finland is a small northern country whose population accounts for around 1% of the population of the European Union. Its economy traditionally relied on its forest, raw material, food, and chemical industries. For the past few decades, information technology has increasingly played a key role in the national economy. The principles of the welfare state have required a strong service sector and extensive production of social and health services, which are supported by the education system and the research and innovation system. In terms of national factors potentially influencing research collaborations, Finland has been one of the top OECD countries in GERD investments in the twenty-first century, but investments have dropped since 2009 and are now close to the OECD average (OECD, 2021). While references to the education and innovation systems were omnipresent in Finnish policymaking during the 1990s and 2000s, Alaja and Sorsa (2020) argued that it would have lost part of its place in government programs. It is nonetheless worth highlighting that Finnish scientific production rose from 32,900 to 43,2000 publications between 2005 and 2018, and that 72% of these were produced by universities (Academy of Finland, 2021).

Internationalization has been seen as way to develop a highly productive innovation system since the 1980s (Puuska et al., 2014). In a study conducted in 2005, 96% of research units' respondents in Finland characterized internationalization as somewhat important or very important for research, especially to learn about scientific methods, conduct comparative projects, and promote research careers (Ahonen et al., 2009). It was also found that university departments agreed that international

research collaborations were essential to obtain international funding. In Finland, more than 21% of the total research funding granted to universities and universities of applied sciences comes from international sources, and 85% of that international funding comes from European sources (Vipunen, 2021). The total sum of external funding of universities is five times higher than in universities of applied sciences. However, the difference is that the universities of applied sciences benefit more from the European Regional Development Fund and European Social Fund than universities do. For the EU Framework and Horizon programs, universities are almost 15 times more successful than the volume of universities of applied sciences.

Regarding institutional factors, international research funding and peer-reviewed publications are indicators in the competitive funding formula. Finland counts 10 universities and although they all offer bachelor's degrees to the PhDs (Aarveaara & Pekkola, 2010), an institution's size, history, and disciplinary emphasis would explain why some institutions count more international co-publications (Ahonen et al., 2009).

In terms of individual and professional factors, as foreign funding programs require applications from research teams and large international consortia, the primary responsibility for implementation lies with senior academics. One should also consider the influence of professors' academic discipline since science, technology, engineering, and mathematics tend to be more successful in obtaining international research funding than other disciplines. In the year that the Academic Profession in the Knowledge-Based society (APIKS) was implemented in 2018, the share of external research funding was more than 60% in medicine and health sciences, more than 55% in technology and natural sciences, more than 40% in social sciences, and about 35% in humanities (OSF, 2019). Women represented 52% of the Finnish academic staff (UIS-UNESCO, 2021), but represent a larger proportion of junior academics. In 2020, 27% of the total number of teaching and research staff were other than Finnish nationals (Academy of Finland, 2021).

The various factors mentioned above contribute to international research collaborations practices and outcomes. In 2007–2008, 59% of academics were characterizing their research as international in scope, 69% reported collaborating with international colleagues, and 58% were publishing in a language (often English) other than the one of their institutions (Rostan et al., 2014). According to the Academy of Finland (2021), international co-publications increased from 42% of all publications in 2005–2008 to 63% in 2015–2018. Finland, however, had a lower integration of international collaboration networks (Puuska et al., 2014).

Germany

The Federal Republic of Germany is the most populous and richest (in terms of gross domestic product [GDP]) Western European country. Like Canada, Germany is a federal system but, although the 16 Länder have local research policies, the central government has greater influence on research policy coordination through

the intervention of the Federal Ministry of Education and Research, the EFI agency (Christensen & Serrano Velarde, 2019), and the Excellence initiative (Edler et al., 2003).

Regarding international and national factors influencing academic research collaborations, we must consider the sums invested in research and development. According to the OECD (2021), both Germany's GERD and HERD (as a percentage of the GDP) are relatively higher than the OECD average, and the proportion of HERD financed by the business sector is also higher in Germany than most OECD countries. Despite obtaining a large share of the Horizon Europe program (Abbott, 2020), however, the percentage of GERD financed by international sources in Germany remains lower than the OECD average. Just as for Lithuania, European research funding fosters international research collaborations (Defazio et al., 2009).

In terms of institutional, professional, and individual factors, it is important to note that evaluation, performance-based measures, and government incentives have further separated research and teaching (Müller & Schneijderberg, 2020), and increased vertical and horizontal stratification which influence international research opportunities for academics (Ananin & Kreckel, 2020). Within universities, statistics from 2016 reveal that, although women represent 45% of PhD students, they represent only 30% of academics who reach habilitation and 23% of professors (Statista, 2017). Around 7% of all faculty members are foreign-born.

These factors might influence how German academics collaborate and co-publish with international colleagues. Studies have shown that Germany takes a central position in collaboration networks both in Europe and worldwide (Gui et al., 2019). Germany is among the most frequently cited partners in a majority of European countries, irrespective of the size of their higher education and research systems (Kwiek, 2021). Kwiek (2021) found that, between 2009 and 2019, the proportion of intra-institutional collaborations and single-authored papers had decreased, whereas the share of national collaborations had remained stable at a level of 57% (Kwiek, 2021; White, 2019). The countries with which the professors collaborate the most are the United States, the United Kingdom, China, France, and Italy (DAAD, 2021).

Japan

The Japanese modern university system was established in 1977 with the objective of catching up with HESs in the advanced countries. The following national factors have influenced international research collaborations in Japan from 1868 to today: Japanese universities attempted to emulate their world-leading counterparts (Arimoto, 1996; Ben-David, 1977); high ranking bureaucrats in Japan focused on building a “University of Nation” rather than a “University of Learning” (Clark, 1983); and modern institutions carried forward a research orientation, rather than to

teaching and service orientation, not only in research-intensive universities but also in teaching-focused universities (Ushioji, 1997). On the one hand, it is argued that a value of particularism (rather than universalism) would have sustained a climate of academic inbreeding, impeding academic productivity from a national and international perspective (Parsons & Platt, 1970) and reducing the rate of internationalization (Arimoto, 2015). On the other hand, funding for research could contribute positively to research collaboration. While HERD in Japan is around the OECD average (0.39 compared to 0.40), the country does invest more into R&D than the average; its GERD was 3.24 in 2019, compared to the OECD average of 2.47, but the percentage of GERD performed by the HESs is below the OECD average (12.01 compared to 17.16).

Regarding institutional factors, it is first important to consider that national, public, and private universities provide different internationalization opportunities to their academics (Huang, 2017). Ota (2018) notes that government's competitive funding (such as the Global 30 project) for international projects has increased national competition between Japanese universities but might not have improved internationalization overall. The author also characterizes many Japanese universities' initiatives as superficial. As Leydesdorff and Sun (2009) indicated, Japan is the opposite of Canada in the sense that university-industry collaborations appear much stronger than international academic collaborations. This trend of collaboration style sloping toward applied science rather than basic science coincides with Clark's (1995) characterization of the Japanese university as an "applied" university. In terms of individual factors, 82% of the 70,000 university professors are men (Kakuchi, 2019), and 4% are international, mostly coming from China, South Korea, the United States, the United Kingdom, and Australia (Huang, 2017).

Data suggest a decline in the proportion of Japanese academics engaged in international collaborations. In 2007, 24% of Japanese academics reported collaborating with international partners, 8% internationally co-authored a paper, and 20% published in a foreign country (Huang et al., 2014). Japanese academics collaborate with their colleagues from the United States, but it is worth noting the increasing level of collaboration with Chinese academics (Yarime et al., 2010). Like for China, Taiwan, and South Korea, the proportion of domestic collaborations in Japan exceeds the proportion of international collaborations (Chinchilla-Rodríguez et al., 2019). Intending to promote internationalization and international collaboration, the Japanese government has established a "promotion package" for all universities and colleges as well as a "university fund" in 2022. However, previous governmental investment into the top 13 Japanese HE institutions has not been successful in improving internationalization, as indicated by their positions in THEWUR2022 ranking. Considering international collaboration to be of utmost importance, not only for academics in top-level institutions but in all institutions, the success of these new policies remains to be seen. For the authors, Japan, like the United States, has a well-developed scientific system that relies less frequently on international relations.

Lithuania

Lithuania is a small Central-Eastern European country, one of the three Baltic States, inhabited by less than three million and shows a demographic decline. Since 1999, Lithuania has been a full member of the Bologna Process, a mechanism promoting intergovernmental cooperation between European states in higher education. In 2004, the country joined the European Union, thus becoming part of the European Higher Education Area. Although the country has a longstanding higher education tradition, the Lithuanian HES has been subject to turbulent historical and political developments. During the Soviet era, the HES was restructured according to a Soviet model with a high degree of centralization and serving the needs of the agricultural and industrial sectors. University teaching followed a state-imposed curriculum, whereas research activities took place in research institutes and the Academy of Sciences (Leišytė et al., 2018). After the restoration of independence in 1990, the autonomy of universities was restored, and they began to conduct research again.

The internationalization of the Lithuanian higher education (HE) and research system were strongly influenced by supranational actors such as the World Bank, the OECD, and the European Union and embedded in processes of Europeanization. Processes of European integration and modernization of the HES remain supported through European funding schemes, such as the Tempus (trans-European cooperation scheme for higher education) program in the early days (Leišytė et al., 2015), and European Union Structural Funds, which have been crucial for updating the infrastructure of universities in Lithuania more recently. The literature attributes the increase of international research collaborations within the European Research Area to the increasing role of European research funding (Defazio et al., 2009; Gui et al., 2019; Hoekman et al., 2013).

In terms of national factors, it is worth noting that Lithuania is one of the fastest-growing economies in the European Union. Yet, despite vast investments through European Union Structural Funds, its innovation performance is relatively low (OECD, 2021). While research expenditure as percentage of GDP has increased rather slowly in Lithuania, absolute expenditures have grown significantly over the past decade. It is to be noted that approximately 22% of research and development funds in Lithuania come from abroad, while the EU-average is only 9% (Eurostat, 2021). Research funds allocated to Lithuanian researchers by national agencies tend to result in collaborations with international partners (Urbanovic & Wilkins, 2013). Multiple national grant programs and mobility schemes also tend to recognize and prioritize candidates' international co-publications.

In terms of individual and professional factors, while European mobility programs enable the short-term mobility of students and academic staff, incoming and especially long-term academic mobility remain scarce, one of the main reasons being low salaries and language barriers (Leišytė et al., 2018). Consequently, the proportion of international academic staff remains low (Eurostat, 2021). In Lithuania, more women than men obtain a PhD degree, and they form almost half

of the R&D personnel in the governmental and higher education sectors (European Commission, 2021).

In 2018, the share of international co-publications for journal articles in Lithuania was close to 40% (Kwiek, 2021). Between 2009 and 2019, international co-publications increased by 21%, whereas institutional and national collaborations and single authorship decreased. Yet, Lithuania is among the three countries within the European Union in which intra-institutional collaborations exceeded 25%. Previous research has shown that research collaborations in Lithuania are highly dependent on personal relationships (Leišytė & Rose, 2016). In a study of research collaborations in Europe, Kwiek (2021) found that international co-publications were particularly attractive for researchers in the Eastern and Southern European member states. In these countries, including Lithuania, co-authorship with partners from abroad leads to substantial citation premiums, especially in the social sciences and humanities.

The five countries chosen for this study therefore present sufficiently different geographical, historical, linguistic, political, and economic contexts to verify the influence of national, institutional, professional, and personal factors on the practices and results of international collaborations.

Research Questions

This chapter analyzes international research collaborations, as practices and outcomes in Canada, Finland, Germany, Japan, and Lithuania. More precisely, it aims at answering the two following research questions:

RQ1. What is the relationship between international research collaboration practices and international research collaboration outcomes?

RQ2. What are the individual, professional, institutional, and national factors explaining the practices and outcomes of international research collaborations?

Methodology

Data Collection

This chapter is based on the study *Academic Profession in the Knowledge Society* (APIKS), and data for analysis is based on the APIKS international database (APIKS-IDB, 2020) reported in the contextual framework (Aarveaara et al., 2021). A 54-question survey was translated into the national languages of the participating countries and disseminated to academics. The sample for the five countries consists of $n = 10,405$ respondents.

In Canada, an invitation was emailed to professors at 64 publicly funded universities across Canada's 10 provinces. A total of 2968 surveys were valid, a response rate of 9.4%. In the sample, 50.6% were female professors and 49.4% male; 16% were assistant professors, 37.7% associate professors, and 41.2% full professors. The Finnish data was collected in 10 universities and 23 universities of applied sciences. The 1377 respondents from universities (13% response rate) were selected from each institute following simple random sampling without replacement. The sample included both junior and senior academics. In Japan, the number of respondents was 2124 and in Germany, 3547. In Japan, the sample included 81.1% male professors and 18.9% female professors, as well as 43.1% full professors, 24.2% associate professors, 21.2% assistant professors, 9.4% lecturers, and 1.8% others. In Lithuania, the survey was distributed by e-mail to all academic staff via the rectorates of the 10 largest public universities, which employed more than 90% of the total population of academic staff at public universities at the time of data collection. The survey was offered in Lithuanian and rendered 787 responses, out of which 389 responses were considered valid (5.3% response rate after cleaning). Among the respondents, 58% of the respondents were female and 42% were male; 57.7% were senior researchers (full and associate professors as well as senior and associate senior researchers) and 42.2% were early- and mid-career researchers (lecturers, assistants, researchers, junior researchers). It is worth noting that, for the purpose of this chapter, we only used responses from academics in the university sector to facilitate comparison (Kyvik & Lepori, 2010).

Data Analysis

To meet the research objective, we identified three dependent variables (DVs), one accounting for collaboration practices and two for collaboration outcomes: (1) Do participants collaborate with international colleagues (dichotomous variable); (2) To what extent participants characterize their research as international in scope or orientation (discrete variable that we transformed into a dichotomous variable); (3) The percentage of scholarly contributions co-authored with colleagues located in other countries (continuous variable). We then identified 15 independent variables (IVs) accounting for individual, professional, institutional, and national factors (see Table 9.1). To answer RQ1, we conducted correlations between the three DVs. To answer RQ2, we ran two logistic regressions (including the five countries) for the DVs that were dichotomous. For the third DV, we ran a multiple regression. We then ran the same analyzes for each country separately to examine if the national context influenced findings.

Table 9.1 Academics' international research collaboration and descriptive statistics

Variables		Canada	Finland	Germany	Japan	Lithuania
<i>Dependent variables</i>						
Do you collaborate with international colleagues?	Yes %	65.6	51.9	43.7	31.1	59.6
	No %	27.9	15.8	39.5	69.3	23.9
	N/A %	6.5	32.3	16.8	0.6	16.5
Would you characterize your primary research as international in scope or orientation?	Much or very much %	49.3	42.6	38.1	36.2	37.2
What percentage of your co-authored publications with colleagues located in other (foreign) countries in the last three years?	%	17.7	35.1	19.2	12.2	19.2
<i>Independent variables</i>						
Gender	Man %	49.0	45.2	49.3	78.6	38.3
	Woman %	49.2	52.2	30.3	18.4	54.0
	N/A %	1.8	2.7	20.4	3.0	7.7
Academic rank	Senior %	93.9	20.8	22.8	96.5	56.3
	Junior %	6.1	78.5	76.3	2.5	43.7
	N/A	0	0.7	0.9	2.0	0
Disciplinary area	Natural and medical sciences %	41	57	60	72	54
	Humanities and social sciences %	59	43	40	28	46
Employment status	Full-time %	96	95	72	99	73
	Part-time %	2	5	28	1	27
Bachelor's degree obtained abroad	Yes %	26	25	21	1	3
	No %	74	75	79	99	97
Master's degree obtained abroad	Yes %	25	14	9	3	3
	No %	75	86	91	97	97
Doctoral degree obtained abroad	Yes %	34	13	13	5	10
	No %	66	87	87	95	90
The proportion of time dedicated to research per week	%	31.7	51.7	48.9	39.6	33.2
Research funding from government entities	%	5.7	9.8	15.3	18.0	6.8
Research funding from business firms or industry	%	3.2	3.76	4.9	6.6	5.1
Research funding from private not-for-profit agencies	%	4.9	8.7	3.7	3.7	1.1
Research funding from international funding agencies	%	2.5	8.8	4.2	0.2	8.5

(continued)

Table 9.1 (continued)

Variables		Canada	Finland	Germany	Japan	Lithuania
Your institution has a clear strategy for internationalization	5 = strongly agree; 1 = strongly disagree	3.0	3.4	3.6	3.4	3.4
Your institution provides opportunities/funding for faculty members to undertake research abroad	5 = strongly agree; 1 = strongly disagree	2.5	3.7	3.5	3.4	2.6
Your institution encourages faculty members to publish internationally	5 = strongly agree; 1 = strongly disagree	3.6	4.3	2.9	3.0	3.9

Findings

This chapter's objective was to analyze the influence of individual, professional, institutional, and national factors on international research collaborations, as practices and outcomes in five countries. Table 9.1 presents the descriptive statistics and reveals that, when taken together, 58% of academics collaborate with colleagues in other countries, around half of them characterize their research as "international" in scope or orientation, and academics report that almost 19% of their co-authored publications are with colleagues located in other countries. Findings would also suggest that the propensity to collaborate is higher in Finland, Lithuania, and Canada than in Germany or Japan. Finnish academics also count a greater proportion of scholarly contributions co-authored with international colleagues, followed by Lithuania and Germany.

Before analyzing how different factors influence those two DVs, it is worth noting that a similar proportion of academics reported having obtained their bachelor's and doctoral degree abroad, but there are apparent variations between countries. While Canada, Finland, and Germany present similar rates regarding the bachelor's degree, the proportion of PhD degrees obtained abroad is lower in Finland and Germany, while it is higher in Canada. Academics in the five countries tend to agree that their institution encourages them to publish internationally but appear generally more neutral regarding the clarity of their institution's international strategy or funding opportunities for conducting research abroad.

If there seems to be little variation between countries regarding institutional factors, one should note that the proportion of research funding allocated through international funding agencies is notably higher in Finland and Lithuania than in Canada, Germany, or Japan. This finding is consistent with previously presented data, as Finnish universities have been successful in attracting funding from the European Research Council and the Framework Funding (Vipunen, 2019), while Lithuania has been an important beneficiary of the European Structural Funds (Leišytė et al., 2015). Being outside Europe, Canada and Japan do not have access to equivalent international funding sources.

The Relationship Between Research Collaboration Practices and Outcomes

Some authors (e.g., Katz & Martin, 1997; Laudel, 2001) have suggested that co-authorship alone could not capture the complexity of research collaborations. The first research question was therefore to examine correlations between the three DVs (1 related to practices and 2 to outcomes). Table 9.2 presents a correlation matrix which suggests that collaboration practices and outcomes are correlated, but that the strength of the relationship is weak ($r < 0.5$). Collaborating with international colleagues is positively correlated the proportion of internationally co-authored papers, but large proportion of the variance in one variable is not related to the variance in the other variable. We also calculated correlations for each of the five countries separately and obtained similar results. It concurs with the authors who pointed out that co-publications were only a partial indicator of collaborations, which tend to be informal and include other components such as meetings, exchange of information, or the co-organization of research activities (Melin & Persson, 1996).

The relationship between co-authorship and one’s characterization of research as international in scope is even weaker, and that could be explained by the fact that, in some disciplines (such as the natural and medical sciences), the research is conducted with international peers but is not necessarily considered as “international” in scope. There is also a “country effect” where in some countries there is a stronger tendency to consider research as international in scope than others, notwithstanding the proportion of co-publications (Kwiek, 2017).

The Influence of Individual, Professional, Institutional, and National Factors on International Research Collaborations

The second research questions required identifying the individual, professional, institutional, and national factors that had an influence on academics’ practices and outcomes of international research collaborations, as well as to compare the relative

Table 9.2 Correlations between collaboration practices and outcomes

	Collaborate with international colleagues	Characterize research as international	Percentage of international co-authored publications
Collaborate with international colleagues	1.00	0.39 ^a	0.39 ^a
Characterize research as international	0.39 ^a	1.00	0.21 ^a
Percentage of international co-authored publications	0.39 ^a	0.21 ^a	1.00

^ap. < 0.001

influence of each factor. Table 9.3 presents two logistic regressions and one multiple regression, performed on the three DVs. Four IVs appear to explain both research practices and outcomes: (1) the country in which they obtained their bachelor's and (2) doctoral degrees, (3) the proportion of research funding coming from international sources, and (4) the institutions' expectation to publish internationally. Data

Table 9.3 Factor's influence on research collaborations, characterization of research and proportion of internationally co-authored publications

	Collaborate with international colleagues			Characterize research as international			% of international co-authored publications	
	B	S.E.	Exp(B)	B	S.E.	Exp(B)	B	S.E.
Gender	-0.09	0.09	0.92	0.21 ^a	0.09	1.23	0.16 ^c	0.01
Academic rank	0.38 ^c	0.11	1.46	0.04	0.11	1.04	0.00	0.01
Disciplinary area	-0.13	0.09	0.87	-0.58 ^c	0.09	0.56	0.57 ^c	0.01
Employment status	-0.31	0.28	0.73	-0.54 ^a	0.27	0.58	-0.06 ^a	0.03
Bachelor's degree obtained abroad	0.80 ^c	0.16	2.22	0.43 ^b	0.15	1.54	0.14 ^c	0.02
Master's degree obtained abroad	0.11	0.17	1.11	0.05	0.16	1.05	0.22 ^c	0.02
Doctoral degree obtained abroad	0.54 ^c	0.14	1.72	0.42 ^c	0.13	1.52	0.30 ^c	0.01
The proportion of time dedicated to research per week	0.01 ^c	0.00	1.01	0.01 ^a	0.00	1.01	0.00	0.00
Research funding from government entities	0.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00
Research funding from business firms or industry	0.00	0.00	1.00	0.00	0.00	1.00	-0.01 ^c	0.00
Research funding from private not-for-profit agencies	0.01 ^b	0.00	1.01	0.00	0.00	1.00	0.00	0.00
Research funding from international funding agencies	0.06 ^c	0.01	1.06	0.03 ^c	0.01	1.03	0.01 ^c	0.00
Your institution has a clear strategy for internationalization	-0.03	0.04	0.97	-0.04	0.04	0.96	-0.07 ^c	0.00
Your institution provides opportunities/funding for faculty members to undertake research abroad	-0.04	0.04	0.96	0.12 ^b	0.04	1.12	0.02 ^c	0.00
Your institution encourages faculty members to publish internationally	0.27 ^c	0.04	1.31	0.15 ^c	0.03	1.16	0.12 ^c	0.00
Constant	-0.65	0.35	0.52	-0.33	0.34	0.72	1.92	0.04

^ap < 0.05; ^bp < 0.01; ^cp < 0.001

suggest that academics who obtained their doctoral degree abroad (whether they are citizens of the country or not) are 1.72 times more likely to collaborate with international colleagues, 1.52 times more likely to characterize their research as “international” in scope or orientation and count a proportion of internationally co-authored publications 30 percentage points higher than those who obtained their doctoral degree in the country where they are working. The literature suggests that researchers who come from abroad are more likely to participate in a diaspora effect (Scellato et al., 2015) and to continue collaborating with international colleagues (Melkers & Kiopa, 2010). In non-English speaking circles, academics who have completed degrees abroad would also increase the proportion of publications in English (Altbach & Yudkevich, 2017). Some countries (such as Canada and Lithuania) have developed funding programs (such as the Lithuanian Research Council’s Brain Gain and Reintegration scheme) to bring back to their country academics who would have completed and/or be working abroad (Rose & Leišytė, 2017; Tamtik & Sá, 2020). In our sample, the three foreign countries most frequently cited by professors who had completed a doctorate outside of Canada were the US, the UK, and France.

Similarly, when the five countries under study are taken together, academics who report that their institution expects them to publish internationally are 1.31 times more likely to collaborate with international colleagues, 1.16 times more likely to characterize their research as “international” in scope or orientation and count a greater proportion of internationally co-authored publications. Studies have shown that universities – and especially research-intensive institutions – put pressure on academics to publish in internationally recognized journals (Xu et al., 2021), for which one strategy is to collaborate with international colleagues (Gazni et al., 2012). The proportion of research funding from international agencies is statistically significantly related to the three DVs, but the effect size is very small. In Europe, Defazio et al. (2009) studied 294 researchers from 39 research networks over a period of 15 years and found that international funding meant increased research collaborations, but that the effects on research output were weak.

It is worth noting that some factors have an influence on collaboration practices but not on outcomes, or vice-versa. For instance, our findings regarding gender might nuance some previous observations. Studies employing co-authorship as a proxy for collaborations have suggested that national (or domestic) research collaborations were more frequent among women, that international collaborations were more frequent among men, and that this difference could partly explain the gender productivity gap (Kwiek & Roszka, 2020; Padilla-Gonzalez et al., 2011). Our findings suggest that men count a higher percentage of internationally co-authored publications, but that the propensity to collaborate with international colleagues is not statistically different from female academics. We might hypothesize that the collaborative networks in which men and women participate are different, and that male academics are more frequently granted recognition (co-authorship) for their partition in these networks. As Jadidi et al. (2018) suggested, compared to their male colleagues, female academics are more frequently integrated into smaller and more clustered research networks that are more short-lived and contain fewer

brokerage opportunities. Moreover, the “Matilda Effect” (Knobloch-Westerwick et al., 2013) relates to this phenomenon according to which there is generally lower recognition and misattribution of work by female academics. Studies have shown that bias may influence how colleagues perceive men and women’s contributions to science (Knobloch-Westerwick et al., 2013) and their papers’ citation rates (Sá et al., 2020).

On the contrary, senior academics are more likely to collaborate with international colleagues (Bozeman & Boardman, 2014), but it is not necessarily reflected in internationally co-authored publications. Regarding disciplinary areas, academics in the natural and medical sciences are less likely to consider their research as “international” in scope or orientation (Kwiek, 2017) but count a higher proportion of internationally co-authored publications than their colleagues in the social sciences and humanities (Leahey, 2016). Regarding institutional factors, while the perception of universities’ international strategies seems to have little effect, the opportunities provided for academics to conduct research in other countries is positively (although weakly) associated with one’s likelihood to characterize research as “international” and one’s internationally co-authored publications. The literature suggests that academics being experts in their field, they can identify by themselves the most promising partners (Kato & Ando, 2016), but that institutional support is often required to consolidate and reinforce those collaborations (Ulnicane, 2021).

International Collaborations as a Converging Phenomenon That Transcends Geographic Idiosyncrasies

Since the objective of this chapter was also to examine how national contexts might inform findings, we conducted the three regressions for each country. Overall, the model remained robust in each country but, in Lithuania, considering the small number of participants ($n = 389$) and the 15 IVs, some relationships became statistically insignificant. Our interpretation is that, despite notable differences in the five countries’ political economy, language, historical development, population size, or investments into R&D, collaboration practices and outcomes can be explain by similar factors. This suggests that the internationalization of higher education is a global, possibly converging, phenomenon (Sonnenwald, 2007) that would follow disciplinary norms (Larivière et al., 2006) and transcend geographic idiosyncrasies (Egron-Polak, 2014).

It is nonetheless important to point out that some individual, professional, institutional, and national factors differed in some countries. In Germany, for instance, the influence of both gender and rank on the percentage of internationally co-authored publications was not significant, and in Finland, disciplinary area did not have a significant impact on academics’ characterization of research as “international”. In Japan and Lithuania, the proportion of academics who reported having obtained their bachelor’s degree abroad was too small to bear an influence.

Regarding institutional factors, institutional support for research activities abroad did not significantly influence international co-authorship in Canada nor Finland. In Canada, Bégin-Caouette and Zambo Assembé ([forthcoming](#)) have found that academics tended to perceive institutional incentives as having a smaller influence on publications than other international activities. Institutional expectations would contribute to international co-authorship in the five countries, but in Finland, they would also be related to academics' likelihood to collaborate and to characterize their research as international. One could explain this finding by the type of institutional management implemented in Finnish universities since the 2010 reform (Kohtamäki, 2019). Finally, although our findings suggested that the proportion of research funding academics receive from government sources had no significant impact on collaboration practices or outcomes, country-specific calculations suggest the relationship with international co-authorship was statistically significant in all countries but Japan, suggesting that academics who succeed in obtaining research grants from national agencies would count a greater proportion of co-publications (Checchi et al., 2019).

Concluding Remarks: International Collaborations as Social Capital

In 2014, Finkelstein and Sethi had developed a model that predicted if academics would have a low or high level of internationalization based on 19 individual, professional, organizational, and national variables. Their model suggested that a country's size, language (English vs non-English), and location (Asian vs non-Asian), as well as the institution type, professional characteristics (discipline, rank, research preference), and personal characteristics (age, gender and degree obtain abroad) all had an influence on the overall level of faculty's internationalization (including research collaborations, but also mobility, language of instruction, and teaching international content). In addition to using more recent data, the model presented in this chapter complements Finkelstein and Sethi's model. Logistic and multiple regressions performed on the responses of $n = 10,405$ academics from Canada, Finland, Germany, Japan, and Lithuania show that, when we focus on collaboration practices and outcomes, the most influential factors are academics' degrees being obtained abroad, the proportion of research funding they obtained from international sources, and institutions' expectation to publish internationally.

In Bozeman and Boardman's (2014) logic model, degrees from abroad represent, in addition to a human capital (i.e., the degree itself), a social capital in the form of social relationships established with previous supervisors or colleagues from abroad. This social capital constitutes an input that may support the research process (i.e., propensity to collaborate), which is partly related to research outcomes (i.e., co-authorship). The conversion of input into outcome may be facilitated by organizational capital, such as institutions' clear expectations to publish in

international journals, and incentive schemes to support academics who conduct research activities abroad. International research funding also represents a material capital that would have a larger influence on research processes and outcomes than would other forms of (domestic) research funding.

Our findings suggest that academics' individual or professional characteristics may undermine their capacity to convert processes (or collaboration practices) into outcomes. For instance, although academics' gender and disciplinary area have no significant effect on their propensity to collaborate with international colleagues, academics who identify as men or who work in the natural and medical sciences count of a higher percentage of publications co-authored with international colleagues. In sum, this chapter indicates that the capacity to participate in and to benefit from international research collaborations is part of a complex system of inter-influences between personal, professional, institutional, and national factors.

Acknowledgement The authors would like to acknowledge the contribution of Nicolai Göetze, who participated in the planning of this chapter and analyses.

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Olivier Bégin-Caouette, Ph.D. is assistant professor of comparative higher education at the Department of Administration and Foundations of Education, at Université de Montréal. His research focuses on the interactions between higher education systems and political-economic structures, as well as on the internationalization of higher education. He is a founding member of the Laboratory for Interdisciplinary Research on Higher Education (LIRES), and an associate member of the Interuniversity Research Center on Science and Technology (CIRST).

Timo Aarrevaara is Professor of Public Management at the University of Lapland and has professional experience in public administration as well as in research and teaching. Aarrevaara has participated in and conducted several evaluating and auditing projects and has acted as the principal investigator of several projects in higher education. Aarrevaara is a co-editor of Springer's *The Changing Academy* series and author or co-author of several papers and book chapters.

Anna-Lena Rose (MSc, MA) is a researcher at the Professorship of Higher Education, Center for Higher Education (zhb), and a PhD student at the Faculty of Business and Economics at TU Dortmund University, Germany. Her PhD project focuses on the emergence of interdisciplinary structures in academic project settings. Her research interests further include organizational change in universities, changing academic work, academic mobility, and entrepreneurship education.

Akira Arimoto is the Advisor to the President at Hyogo University and Director and Professor of RIHE; Professor Emeritus of Hiroshima University and Kurashiki Sakuyo University; President of the National Association of RIHE; Representative of HERA. Dr. Arimoto was UNESCO's Global Scientific Committee Member and Chair in Asian and Pacific Region; Springer's editorial board member of the *Changing Academy* (series editor); President at KSU; Director and Professor at RIHE of Hiroshima University; Associate Member of the Japan Council of Science; President of JAHHER and JSSES. His recent book is *International Comparison of Academic Profession* (Ed., In Japanese, Toshindo Pub.Co., 2020).