Migration, Institutional Context, and Global Network Formation: Evidence from female scientists in developing countries

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Abstract

Migrants are ideally positioned to contribute to the formation of global networks as a consequence of their ability to develop and to share connections across organizational and national borders. Female migrants, however, may face challenges in leveraging their cross-border networks as a result of diminished legitimacy. In this paper, we investigate whether the extent to which female migrants share their international networks with non-migrants back at home depends on institutional context. We propose that national environments that provide legitimacy to organization-spanning female migrants will enable greater network sharing. We explore this idea in the context of a South-South PhD fellowship program for female scientists by evaluating whether migrant females connect researchers in their home organization with their international network. We find that female migrants are more likely to share international connections with non-migrants at home if their home countries have high levels of gender parity, particularly when their host country also has high levels of gender parity. These findings document a relationship between institutional environments and network sharing and inform a contextual perspective of cross-border brokerage and the globalization of knowledge production.

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Section 1. Introduction

Migration plays a central role in entrepreneurship, knowledge transfer and resource flows. As a result, it has become an issue of increasing interest for social science research (Saxenian 2002, 2005, 2006; Kerr 2008; Oettl and Agrawal 2008; Nanda and Khanna 2010; Agrawal et al 2011; Hernandez 2014; Wang, 2015; Choudhury 2016; Choudhury and Kim 2019; Hernandez and Kulchina 2021; Balachandran and Hernandez, 2021). One particularly interesting issue for this research agenda regards the role migrants play in the formation of global networks.

Migrants can be conceptualized as cross-country brokers who may facilitate the formation of relationships among their connections across national and organizational borders. Celebrated cases suggest that they can play this role. Saxenian (2002) describes several instances in which migrants contribute to the formation of global networks, writing: *"For example: the region's Chinese engineers constructed a vibrant two-way bridge connecting the technology communities in Silicon Valley and Taiwan; their Indian counterparts became key middlemen linking U.S. businesses to low-cost software expertise in India."* (Saxenian 2002, p. 18). This is especially important for organizations in developing countries that may have limited alternative access to connections, resources, and knowledge (Balachandran and Hernandez, 2021).

But recent work suggests that cross-border brokering is challenging and that context affects both the extent to which benefits accrue to organizations either through challenges to the direct effects on brokers themselves (Xaio and Tsui 2007; Vasudeva et al 2013) and the extent to which they transfer knowledge transfer from host to home organization (Wang 2015). For example, Wang (2015) finds that migrants' ability to transfer knowledge back home is constrained by their embeddedness in their host and home countries. This and related studies suggest that challenges difficulties associated with cross-country brokerage could also extend to the formation of global networks (Galunic et al 2012; Clement et al 2018). Indeed, recent research documents limits in the extent to which scientists returning to Africa following training in the United States share their American based connections with their peers back at home (Fry 2021).

The extent to which migrants are able to contribute to global network formation may vary in ways that are systematic and important. Prior work suggests that the ability of brokers to share

connections depends on the broker's perceived legitimacy (Burt 1997, 1998, 2010; Fernandez and Gould 1994; Gabbay and Zuckerman 1998). This may be especially salient for female migrants, as a long line of research in sociology suggests that women face numerous challenges in leveraging their networks (Brass 1985; Burt 1998; Brands and Kilduff 2014; Ely et al 2011) and in particular in adopting and leveraging brokerage positions, as these are often perceived to be less 'suitable' roles for women (Brands and Kilduff 2014). If perceptions vary across institutional environments, these may drive variation in the extent to which female migrants share their networks across countries and organizations. In this paper we investigate whether and when female migrant scientists can broker across countries and share their networks with their peers at home in developing countries.

To inform our hypotheses, we draw upon research on the contingencies of social capital and brokerage. Specifically, there is an interplay between institutional context and individual level processes (Scott 2001). For female migrants, the broader environment can drive expectations about women's roles (Kanter 1977; Lockheed 1985; Ely 1995; Eden and Gupta 2017) and thus affect the way in which they adopt and leverage a network position. We argue that country level differences in gender parity reflect the perceived legitimacy of the female cross-country broker through the persistence of expectations of traditional gender roles and the presence of other women in similar positions. This could subsequently influence the extent to which others are receptive to information from, or willing to be associated with, the female migrant, or the likelihood that the female migrant occupies a formal or informal position within an organization that is conducive to sharing their network. We explore the relationship between sharing of international connections, an important and under-studied brokerage outcome and home and host country level gender parity. We hypothesize that female migrants from countries with high levels of gender parity, and also going to countries with higher levels of gender parity are more likely to share their international connections with non-migrants in their home organization.

There are considerable challenges in investigating these propositions. An individual's connections and outcomes are often jointly determined. This means that an examination of the connections of non-migrants in the home institution of a migrant could conflate the role of the migrant with innate qualities of the individual or organization (Manski 1993; Jackson and

Wolinsky 1996) or connections made independently of the migration event. Our empirical context provides us the opportunity to overcome this empirical challenge by enabling us to exploit variation in the timing of migration events. Specifically, we evaluate the impact of the migration of scientists who are awarded fellowships to study in other countries and compare the outcomes of non-migrants affiliated with organizations with a successful fellow to those in organizations with unsuccessful applicants to the same fellowship program in a difference-in-differences framework.

We conduct our analysis using data that reflect the migration of scientists participating in the PhD fellowship program of the Organization for Women for Science in Developing Countries (OWSD) PhD, during the years 1996 to 2016. OWSD is a Program Unit of the United Nations Educational, Scientific and Cultural Organization (UNESCO). OWSD's innovative and unique fellowship program awards grants to female scientists in developing countries in order to support their PhD studies in another country in the Global South. It is, to our knowledge, the largest South-South research fellowship for female scholars. OWSD grants typically involve students attending more resource-rich institutions for their doctoral degrees (full or part time) and returning to their home countries to continue their professional careers. We construct a panel dataset of 5,096 non-migrant scientists in developing countries who work in the same scientific field and at the same academic institution as 127 OWSD applicants. We assess changes in outcomes for these non-migrant scientists, controlling for individual heterogeneity and for calendar year and career age trends. Our focus is on the conditions under which non-migrants in an organization with a successful applicant are more likely to be connected with the migrant's host organization after the fellowship as compared to non-migrants in organizations with unsuccessful applicants (and their respective proposed host organization).

The results reveal that organizations with OWSD-winning fellows experience an increase in scientific collaboration with researchers in the country that hosted the applicant. This average effect masks important and interesting heterogeneity. Consistent with our central hypotheses, we find that non-migrants in countries with high levels of gender parity are more likely to be connected with host country scientists than are those in countries with lower levels of gender parity. These results are accentuated if the host country also has high gender parity. The findings

support the idea that the institutional context can influence the extent to which particular groups are perceived as legitimate and therefore able to leverage their network position to generate positive spillovers. In a consideration of alternative mechanisms that could be driving the observed findings, we report limited evidence that the results are driven by a mechanical correlation between a possible elevated effect of a female migrant on non-migrant women and higher proportions of female scientists in organizations in countries with higher levels of gender parity. In addition, the results do not appear to be driven by a spurious correlation between country level gender parity and migrant quality, location or country level scientific or economic advancement.

Our findings contribute to three main literatures. First, we contribute to research on migration and knowledge spillovers. Specifically, we document that migrant researchers can transfer connections back home and build global networks. It is important to note that the nature and extent of these connections are contingent on institutional environments. We also extend research on migration to the novel context of South-South exchanges of individuals engaged in knowledge creation. Second, we contribute to literature on brokerage and gender by noting that national characteristics influence expectations regarding brokers roles and their perceived legitimacy. Third, we contribute to research on women in science. In particular, we document limitations in ways in which female scientists leverage their networks and demonstrate that institutional environments may condition network construction among female scientists in a manner that can contribute to the gender gap.

The rest of the paper proceeds as follows. Section 2 discusses the theoretical framework. Section 3 provides some descriptive facts about female scientists in developing countries. Section 4 describes the empirical setting, data and provides some descriptive statistics. Section 5 presents the results and section 6 concludes and outlines implications of the findings.

Section 2. Theoretical Development

Migrants as global networks builders

Spanning organizational or country borders, migrants can be conceptualized as brokers in a social network. In other words, they can be considered as individuals who connect two or more otherwise disconnected individuals. Whether the migrant stays abroad or comes back home, recent empirical studies have documented that migrants can leverage this position in the network to transfer knowledge back home (Saxenian 2002, 2005, 2006; Kerr 2008; Nanda and Khanna 2010; Agrawal et al 2011; Choudhury 2016; Wang 2015; Balachandran and Hernandez, 2021), which can be particularly useful for sending countries that are less developed.

Beyond transferring knowledge back home, an additional and complementary role of brokers that can be applied to migrants and that has received considerably less attention in the literature is the migrant's role in connecting people across country borders. By sponsoring individuals or organizations, by making introductions and acting as an intermediary between groups that may not otherwise understand or trust one another (Choudhury and Kim 2019), and by facilitating the transfer of information about disconnected groups between countries, migrants can share their international connections that they generate during their time abroad. In this way, migrants can play a role in the formation of global networks, which can facilitate the transfer of knowledge, resources and recognition to non-migrants back home. In the network literature, this has been identified as a feature of second-hand brokerage, or the benefits from associating with a broker who is motivated to share their knowledge and connections with neighbors (Obstfeld 2005; Burt 2007, 2010; Galunic et al 2012; Clement et al 2018). Recent empirical evidence has found that African scientists returning home from the United States can connect non-migrants in the institutions they return to with American based scientists, which results in significant productivity improvements for their peers back at home (Fry 2021).

However, there are limitations to the benefits from second-hand brokerage. In particular, the success of a broker in sharing their connections depends on the broker's perceived legitimacy in that position (Burt 1998; 2007; 2010; Fernandez and Gould 1994; Gabbay and Zuckerman 1998). Some groups suffer from legitimacy issues in brokerage roles more than others. For example, women are often perceived to be less legitimate brokers than men because of the notion that

brokerage, sometimes considered arbitrage, is `man's work' (Brands and Kilduff 2014, p. 1531). More generally, it has been documented that women face significant challenges accessing and leveraging social networks (Brass 1985; Burt 1998; see Ibarra 1993 for a review of the literature). Expectations of women shaped by stereotypes are at odds with leveraging social networks and in particular with the role of a broker. Men more than women are expected to occupy roles that involve control over resources (Kanter 1977), and leadership (Eagly et al 1992), roles that are assumed implicitly by brokers.

Brokerage and institutional context

We argue that institutional context will affect perceptions regarding whether female migrants are legitimate brokers, which will, in turn, influence the extent to which female migrants share their international connections with non-migrants at home.

Institutions shape the norms, roles and conventions of actors (Scott 2001). Prior research has established a relationship between institutional context and the manner in which actors leverage a particular network position by affecting individuals' behavioral expectations (Xaio and Tsui 2007; Vasudeva et al 2013). We combine this perspective on the role of institutional context in the operation of particular network positions with theory regarding the factors that influence the legitimacy of specific groups, in this case, women. We argue that country characteristics influence expectations of female migrant scientists and that this, in turn, affects their ability to behave as brokers and share their connections. Based on this logic, we develop hypotheses regarding the extent to which female migrants from developing countries share their international research connections with non-migrants back at home.

Country level gender parity

Several recent studies highlight the idea that variation across countries in culture, norms and values can affect the functioning and benefits gained from specific network positions. Xaio and Tsui (2007) study brokerage benefits for firms in China and conclude that they are not present as a result of the high value placed on co-operation in the country. Vasudeva et al (2013) evaluate the extent to which firms spanning countries with different levels of corporatism gain brokerage

benefits, concluding that firms spanning highly corporatist countries experience the greatest benefits.

Economic barriers, policies, cultural differences all contribute to what Pfau-Effinger (2012) calls the `gender culture' of a given country. Hofstede (1980) describes culture as a social program that determines the set of values and norms shared by members of a social community. There is significant cross-country variation in gender culture, or societal norms about women and women's work and the stereotypes and expectations about the roles they assume, and this has been found to be correlated with levels of education of women (Yount 2005) and labor force participation (Fortin 2005; Fernandez 2007). Countries with high levels of gender parity are those with high levels of female education, health and labor force or economic outcomes and gender parity of a country has been found to correlate with expectations of roles for men and women (Eden and Gupta 2017). We argue that women are more likely to be perceived as legitimate brokers in high gender parity countries and, thus, are more likely to occupy brokerage positions in social networks and to share their connections with others.

In developing our argument we draw from the insight that organizational values are reflective of the environments in which they are situated (Powell and DiMaggio 1991, Stinchcombe 1965). Organizations tend to adhere to institutional values and norms in order to become more legitimate in those environments.

In particular, the level of gender parity in a country can frame the extent to which women share their international connections with others in their home country organization by shaping perceptions regarding the legitimacy of the female migrant as a broker in the home organization. There are two main interrelated mechanisms by which country level gender parity could affect perceptions of women in a brokerage role.

First, in countries with lower levels of gender parity we would expect there to be a greater persistence of the expectation of traditional gender roles and discrimination both generally, and specifically when women occupy more 'masculine' roles. Gender discrimination is institutionalized in a set of norms and values and beliefs about women's ability at the country level that permeates the organizational level. In environments where women are more equal, they

are more likely to be accepted and valued in the workplace (Ely and Thomas 2001). Thus, we expect that this will result in a high likelihood that women are perceived as legitimate brokers in countries with high gender parity.

Second, organizations in high gender parity countries are more likely to have women working in more traditionally 'masculine' roles. Status construction theory suggests that there would be less discrimination against a group if there is direct contact with the group (Ibarra 1992; Kanter 1997; Lucas 2003). In other words, if individuals in an organization have interacted with more women, and seen a woman in a brokerage role before, they are more likely to perceive women as legitimate brokers.

Insofar as members of the organization perceive a woman to be a legitimate broker they are more likely to trust in their ability to broker and be receptive to the information they are sharing. Across various contexts, people have been found to make assumptions about the performance of men and women, believing that women are less competent than men generally (Ridgeway and Erickson 2000), or see women as less able to assume roles that men typically assume because of a lack of fit (Lyness and Heilman 2006). The greater the perceived legitimacy of the woman, the less likely these barriers are to exist and the more likely the woman will be able to share her connections. In addition, individuals in contexts that confer legitimacy upon female brokers are more likely to be willing to be associated with women and to face lower risk to their own reputations (Abraham 2020).

In addition, the perceived legitimacy of a woman can impact the challenges she faces in occupying an optimal formal or informal position in the organization and attempting to share her connections. Specifically, perceived legitimacy could influence the formal or informal authority of women in an organization and the probability that they occupy more influential positions in their social network, which, in turn, can influence the likelihood that they share their connections with others (Galunic et al 2012; Wang 2015).

Consistent with multiple possible mechanisms, we expect that female migrants in a country with high levels of gender parity are more likely to be perceived as legitimate brokers. This leads us to our first hypothesis:

H1. Female migrants from countries with higher levels of gender parity are more likely to connect non-migrants in their home country organization with their host country.

Following a similar line of logic, the gender parity level in the host country of the female migrant also matters in the extent to which they connect home and host country individuals. Female migrants visiting host countries with higher levels of gender parity are more likely to be perceived to be legitimate by host country individuals. This in turn influences the likelihood that they connect individuals in their host country with those in their home country through a similar set of mechanisms as described above.

However, in order to connect otherwise disconnected individuals, a migrant requires both sides of the potential new relationship to be willing. Therefore, both sides of the potential relationship need to perceive the migrant as legitimate in order to participate in the relationship formation process. This suggests that the benefits of high gender parity in the home country and the host country will be complementary. High levels of legitimacy for the migrant in the host country mean little if the migrant cannot convince home country individuals to engage in the relationship and vice versa. Therefore:

H2: The positive effect of home country gender parity in the extent to which female migrants connect non-migrants in their home country organization with their host country organization increases with the level of host country gender parity.

Section 3. Female Scientists in Developing Countries

We test our hypothesis using data on female migrant scientists from developing countries. A number of studies have reported gender differences in participation in science and publishing productivity (Cole and Zuckerman 1984; Etzkowitz et al 2000; Ceci et al 2014). While several demand and supply side reasons are given as explanations for this gender gap, challenges in women's abilities to develop and leverage diverse networks, which are important for accessing

complementary knowledge, resources and recognition, are among the plausible contributory factors.

These challenges are likely to be exacerbated in developing countries, which have lower levels of female engagement in general in the labor force, and particularly in science. Women in developing countries have fewer possibilities to network and build international relationships because of prohibitive cost, family constraints, cultural, and social limitations (Quadrio-Curzio et al., 2020). While there has been plenty of research on gender dynamics amongst scientists in more developed countries, an examination of the phenomenon in less developed countries has been somewhat neglected.

We provide some basic facts about the gender gap amongst scientists based in countries in the Global South. Using the Elsevier Scopus publication database, we identify the full sample of scientists across any subject area between 1996 and 2016 who are affiliated with any of the developing countries that are considered science- and technology-lagging countries by the Organization for Women in Science for the Developing World (OWSD) and that have a successful OWSD PhD fellow at some point in that time period. A scientist is included in the full sample in a given year if they are affiliated with the focal country that year, or any time with the five-year career bracket into which the year falls. This allows us to capture scientists who do not publish in each year.

We attempt to identify the gender of those scientists in the sample who have a first name in the Elsevier Scopus database by mapping a commercial database of first names to our database (more details provided in Section 4.2). This gives us a sample of 34,328 women and 65,581 men across thirty-six countries in Asia, Africa, and South America. We match each scientist matched to her/his publication records in order to generate descriptive statistics about gender dynamics in the sample countries. These data are used to report some descriptive facts about the gender gap in science in developing countries.

First, the data reveal that there are fewer women than men across all stages of scientific career in countries in the Global South (Figure 1a). Across all years, the proportion of senior women is

around 29%, which is lower than the proportion of junior women, which is around 34%, implying that female scientists drop out of the profession throughout the course of their career at a higher rate than men do. The proportion and trends of women in academia are roughly comparable to those in the United States (Ginther 2004, 2006). While the gap is not driven by women and men entering into different fields, the ratio of women to men is lowest in the life sciences. The gap appears to be narrowing slightly over time (Figure 2a).

Second, women produce fewer annual publications on average than men (Figure 1b). This trend that remains relatively flat over time (Figure 2b). Regression estimates of the relationship between gender and productivity appear in Table 1. Controlling for calendar year, career age, scientific field, and country, column 1 documents that women produce around 5.4% fewer publications per year than men.

Third, women have fewer publications with foreign collaborators than men (Figure 3a). However, it is interesting to note that the few senior women in the sample have more foreign collaborators than men have (Figure 3b), perhaps suggesting that in order to progress in science, the women have to be exceptional.

Fourth, women tend to migrate at a lower rate than men do (Figure 3c). The proportion of migrants that are women is around 31% (which the average proportion of all scientists that are women is around 34%). This is not a surprising finding, given that female scientists in low-income countries face additional challenges in migrating (Quadrio-Curzio et al., 2020), but it a somewhat unexpected finding is that women comprise just 24% of South-South migrating scientists. This implies that despite the potential benefits to women of migrating to another country in the Global South, it is more likely that they will migrate to a higher-income country, perhaps because of challenges associating with living and working as a female scientist in the Global South.

Fifth and finally - There is variation across countries. The gender gap in terms of numbers of researchers is lower in countries with higher levels of gender parity (Figure 4a). Interestingly, women in countries with higher levels of gender parity tend to have fewer international

collaborators (Figure 4c) and have more domestic collaborators (Figure 4d). This suggests that women could be substituting worse conditions at home with foreign collaborators. As a proportion of the overall fraction of women in high and low gender parity countries, women in countries with lower levels of gender parity tend to migrate more often than both men and women in countries with higher levels of gender parity (Figures 4e). This relationship is not observed in the case of South-South migration, which implies that women in countries with low gender parity are more likely to seek opportunities in high-income countries.

These facts suggest that there exists a friction in the formation and use of international networks for female scientists. The Organization for Women in Science in the Developing World (OWSD) was established to alleviate these frictions. OWSD encourages female scientists based in developing countries through supporting fellowships in other developing countries, and through facilitating relationship building amongst women in the Global South. The remainder of the paper describes the OWSD PhD fellowship program that is the empirical setting for this paper and the data used to evaluate the factors that contribute towards successful sharing of international networks of OWSD fellows.

Section 4. Setting, Data and Measurements

The Organization for Women in Science for the Developing World.

Established in 1987, the Organization for Women in Science for the Developing World (OWSD) is a program unit of UNESCO. Its mission involves uniting eminent female scientists from the developing world and strengthening their role in scientific and technological leadership. OWSD provides training, career development and networking opportunities for female scientists in the developing world across all stages of scientific careers. Explicit elements of the program's mission of the program are to develop networks without inducing a brain drain and to support South-South relationship building (Quadrio-Curzio et al., 2020).

Since 1996, the flagship program of OWSD has been the Global South PhD fellowship program. Under this program, female scientists from science- and technology-lagging countries are eligible to apply for a fellowship to undertake PhD research in natural, engineering and information technology sciences at a host institute in another developing country in the Global South. The fellowship covers a monthly living allowance, conference allowances, travel costs, and study fees.

At the point of application, women can choose between a *full-time fellowship,* which supports the completion of their degree research at a host institute for up to a maximum of four years, or a *sandwich fellowship*, under which they undertake part of their studies at a host institute in another country in the Global South. The applicants select their host institute and provide a letter of support from the host organization supervisor during the application process. Amongst successful fellows in our sample, the average length of a fellowship is 2 years 9 months (average *sandwich* fellowship – 1 year 7 months; average *full-time* fellowship – 3 years 6 months). The average time to graduation from their PhD program is 5 years from the point of application.

The selection of successful fellows is undertaken by a scientific committee. Eligible applicants are reviewed by a panel of scientists, which selects successful fellows based on scientific merit, with weight placed on achieving a distribution of fellowships across geography and scientific fields. By 2020, more than 270 women had graduated from the program. OWSD boasts considerable success in terms of the career paths of the fellows.

Beyond the fellows themselves, one of the central goals of the fellowship program is that the women contribute to their home country development. In this vein, women are expected to return home following their fellowship and work as active scientists. We measure the probability that they return home and work as active scientists after the fellowship by extracting fellows' affiliations in publication records. Out of those fellows for whom we have graduation information, we document that just 16% of fellows are affiliated with foreign institutions after graduation. As a result of the fellowship's support for network building in their host country, its requirement that fellows return home, and the variation that exists across countries and organizations within country in their extent of gender parity, OWSD's PhD fellowship provides

an excellent setting in which to test hypotheses about the interaction between country level and organizational level context and women's use of international networks. The remainder of this section describes the sample used and data collection process.

Sample construction

Sample of OWSD PhD fellows and applicants

We collect the names of OWSD PhD fellows who applied during the years 1996 to 2014 and who agreed to have their names used in the study. This yields 82 fellows and the information on their home organization, proposed host organization, year of fellowship and field of study. Applicants name their home organization in the application process, and we consider applicants' home organization to be the one where they are based as students (e.g., undergraduate or masters) or are working (e.g., as a lecturer or researcher) at the time of their application. In the case of a sandwich fellowship, the home organization is the institution where they are based at the time of the application and to which they return after their visit abroad. We match the names of the fellows with their publication data, if any, using the Elsevier Scopus database, and generate statistics on their location each year using affiliation data, their publication output and collaborative patterns.

To identify the effect of the fellowship on non-migrant scientists we compare outcomes of non-migrants affiliated with the home organization of the fellow before and after the fellowship. However, because the fellowship is mechanically correlated with career age and calendar year (Levin and Stephan 1991), we incorporate a control group of researchers who are in the home organization of unsuccessful applicants. We collect the names of unsuccessful applicants who meet the OWSD eligibility requirements and who have also agreed to have their names used in the study. We identify 96 unsuccessful applicants and their home institutions, proposed host institutions, and field of study.

Non-migrant scientists

The primary objective of this study is to measure the impact of associating with migrant scientists. Therefore, we focus on all scientists working in the home organizations of fellows (or unsuccessful applicants) at the time of the fellowship. Scientists affiliated with the home

organization who have at least one publication in the three years prior to the fellowship year and who produce at least one publication in the subject area of the fellow (or unsuccessful applicant) are considered treated by the event of the fellowship of the OWSD fellow (or not treated by the unsuccessful applicant).

In order to identify those treated (or control) scientists we use publication data in the Elsevier Scopus database. We choice this source because it has considerable representation of African regional journals. Using the database we generate a sample of scientists affiliated with the home organization of the fellow (or unsuccessful applicant) and publishing in the same subject area, and their associated publication history. Using publication data in studies of this type (namely, in generating a plausible set of scientists in a particular location associated with their full publication record) comes with a number of major challenges. The first is the 'common names problem,' i.e., the fact that some scientists have common names (for example, "Smith J"), which makes it difficult to determine which "Smith J" published which paper. As well, individual scientists may change names (e.g., as a result of a change in marital status) or my use multiple versions of their name (e.g., including middle names or abbreviations of their first name, etc.). This is one of the areas in which the Elsevier Scopus publication database offers advantages relative to other sources of publication data. It provides a unique author identifier for each individual whose name appears on a publication in the database. The author identifier is developed using an algorithm that incorporates scientist name, coauthors, and topic type and allows for scientists to change affiliations across publications. The algorithm is not perfect, but it addresses the 'names problem' to a greater extent than alternative data sources, e.g., the Web of Science.

To avoid identification problems outlined in Chaisemartin and D'Houltfoeuille (2020), we want to ensure that the sample of control scientists are never treated. We first select treated scientists without replacement from the entire sample of developing country scientists. From the remainder of the list, we then identify controls that have an unsuccessful applicant in their home organization and field. For each treated and control scientist we consider the first treatment in

their career in the instance that there are multiple treatments over time.[2] Carrying out this procedure gives 3,179 scientists treated by an OWSD fellow in the home organization at some point in their career, and 1,917 control scientists affiliated with the home organization of an unsuccessful applicant. The treated and control scientists are located across 80 organizations in 18 countries in Africa and Asia (Appendix B, Table B-1). A number of fellows (and applicants) drop out of the sample if their home organization is unidentifiable in the Elsevier Scopus database or there are no spillover scientists, leaving 64 fellows, and 63 unsuccessful applicants considered in the main analysis. On average, each fellow impacts 50 non-migrants, and each unsuccessful applicant impacts 30 non-migrants in the sample (Figure 5). We match each treated and control non-migrant scientists with their full publication record and generate annual variables on their collaborative patterns and publication outcomes for the three years before and six years after the fellowship (or unsuccessful application). This observation window is sufficiently long to enable us to measure both pre-fellowship trends, which allows us to check whether the parallel trends assumption holds, and to observe the post-fellowship impact on researchers' networks. It is important to note that because fellowships are for doctoral students, few applicants participate in research networks four or more years prior to their application.

Ascertaining Non-Migrant Gender

For each non-migrant scientist who has a first name in the Elsevier Scopus database we attempt to estimate the gender of the scientist using a commercial database obtained from the company, Ethnic Technologies, of first names, which is mapped to our database of treated and control scientists. The main challenge of assigning gender given first names is assigning less common names. The strength of the database obtained from Ethnic Technologies is the identification of gender from first names from a broad range of names that are uncommon and tied to distinct ethnic groups.

Overall, this approach enables us to assign a gender to 32% of the non-migrant sample. 58% of the sample of non-migrants did not have a first name in the Elsevier Scopus database, and so gender assignment was possible. Out of the remaining 42% of the sample, 10% were un-assigned

[2] Multiple treatments to the same non-migrant are rare. Around 6% of the sample experience more than one fellow/applicant in their organization/field within the 6 year follow-up period after the first fellow/applicant event.

gender due to ambiguity in the gender of the name. Overall, the sample of non-migrants with assigned gender contained 34% female, 66% male[3].

Measurement

Dependent variables.

We use a number of outcome measures, all of which we generate using the publication record of the non-migrant developing country scientists. Our central outcome variables are measures of the collaboration patterns of the non-migrant scientists affiliated with the fellow's home organization and publishing in the same scientific field. Specifically, we measure:

- the number of publications with coauthors from the fellow's (or unsuccessful applicant's) host organization and the number of new coauthoring relationships with scientists from the host organization in each year;
- the number of publications with coauthors from the fellow's (or unsuccessful applicant's) host country and the number of new coauthoring relationships with scientists from the host country;
- the number of publications with coauthors from foreign countries in the Global South[4] and the number of new coauthoring relationships with scientists from foreign countries in the Global South;
- the number of publications with coauthors from the fellow's (or unsuccessful applicant's) home organization and the number of new coauthoring relationships with scientists from the home organization; and
- the number of publications with coauthors from the fellow's (or unsuccessful applicant's) home country and the number of new coauthoring relationships with scientists from the home country.

Independent variables

[3] The high level of scientists with no assigned gender in the sample has implications for the generation of the variables associated with female representation in the organizations. However, given that we use the proportion (see the description of how the measures are created later in this section) we do not consider this a concern for our measurement if we expect that the numbers of unassigned men and women is proportional across institutions.

[4] OWSD posts the list of Global South countries that appear in this study at the following URL: https://owsd.net/sites/default/files/OWSD%20138%20Countries%20-%20Global%20South.pdf

The main independent variable in the study is based on the organizational affiliation of non-migrant scientists, and their field of research at the time of the fellowship (or unsuccessful application). The method we use to ascertain treated and control scientists using publication data is described above. In addition, we theorize about variation in the impact of the fellowship on the outcomes of non-migrants by home and host country level features, and characteristics of the broker/non-migrant relationship.

Country level gender parity

We incorporate measures of gender inequality at the home and host country level in the year of fellowship (or unsuccessful application) using the Gender Development Index (GDI) from the United National Development Programme. The index covers 162 countries from 1995 to 2019. The index measures gender inequality in three main ways – health, measured by female and male life expectancy at birth; education, measured by female and male expected years of schooling for children and female and male mean years of schooling for adults ages 25 years and older; and command over economic resources, measured by female and male estimated earned income. The further the value of the GDI from 100, the more disparity between males and females in the country in the year. We incorporate the definition of a high parity country from the UNDP, and classify countries as having low equality between men and women if they have an absolute deviation from gender parity of more than 10%. Due to the fact that the data is only available for some observation years we interpolate the data at the country level for years that there is no observation. For robustness, we also use a measure of the absolute inequality index measure. The HDR Technical Report contains details on how the index is developed and the definitions of high gender parity countries.

We use additional measures of gender inequality in the home country in the year of the fellowship (or unsuccessful application). In an alternative specification we employ the HDR Gender Inequality Index, which is an index that measures gender inequality in a country in three ways: reproductive health, measured by maternal mortality ratio and adolescent birth rates; empowerment, measured by proportion of parliamentary seats occupied by females and proportion of adult females and males aged 25 years and older with at least some secondary education; and economic status, expressed as labor market participation and measured by labor

force participation rate of female and male populations aged 15 years and older. We also use a UN Global Parity Index measure of the ratio of girls to boys in secondary education each home country year, and a measure of the share of parliamentary seats held by women in each home country year, data from IPU.

Descriptive Statistics

Fellows and Applicants

The home and host location of fellows and applicants is provided in Figure 5.

We report descriptive statistics for the sample of 127 fellows and applicants used in the main analysis in Table 1. Unsuccessful applicants and successful applicants, i.e., OWSD Fellows, are statistically similar on each dimension of the data we utilize in the analysis, with the exception that unsuccessful applicants applied, on average, one year later than did successful applicants. The fact that winners appear, on average, one year earlier in the sample reflects the growing popularity of the program in its later years, though we do not believe that this biases our results. Successful and unsuccessful applicants do differ in a number of ways that are not statistically significant. For example, a higher fraction of successful applicants apply for shorter-term sandwich fellowships than do unsuccessful applicants (52% vs. 38%). We examine results for sandwich fellowships separately in our robustness checks, but in the main sample this difference would likely bias the analysis against finding differences in the impact of successful and unsuccessful applicants on network sharing, as sandwich fellowships are shorter than full fellowships and afford grantees less time to develop international networks. Successful applicants experience slightly higher levels of success in publication prior to applicant, including a slightly longer average time period between first publication and application (0.8 years vs. 0.3 years), a higher probability of any publication before application (14% vs. 6.3%), and a higher average number of publications in the year of application (14% vs. 3.2%). Successful applicants also experience slightly lower gender parity in their home countries prior to application (0.09 vs. 0.19). Although none of these differences is statistically significant, they nonetheless suggest caution when we interpret our results. On the remainder of the dimensions relevant for the hypotheses, successful and unsuccessful applicants look quite similar. For example, gender parity is similar in both groups' selection of host countries, as is the size of their home

organizations, and their continent of origin, as more than 88% of all applicants' home countries are in Africa.

Non-Migrants

The descriptive statistics in Table 2 describe the set of 5,096 treated and control scientists. Of these, our gender names database classifies approximately 8% of non-migrant scientists as female, 25% as male, and does not identify a gender for the remaining two-thirds of scientists. Table 3 documents that the control and treated groups are similar with respect to gender and field. Variables reporting information on publications, collaborations, and gender representation are measured in the year of the application to the fellowship. There are several notable similarities between the treated and control groups. For example, the distribution of male and female scientists and subject area is roughly the same. In addition, country-level features are similar for treated and control scientists. Overall, just 11% of the sample years are in what considered to be a high parity country and the probability that a non-migrant is in a high gender parity country at the time of the fellowship application is identical for treated and control scientists.

There are, however, some important differences amongst the treated and control scientists. On average, treated scientists have higher scientific productivity, have more extensive global networks, and are in larger organizations. While the levels of publication outcomes and collaborative patterns are different across treated and control scientists, the trends leading up to the fellowship application year are similar (Figure 6). This is consistent with the parallel trends assumption and enables us to provide consistent estimates of the effect of the fellowship given that our approach compares outcomes within an individual before and after the fellowship (or unsuccessful application). The key identifying assumption in this approach is that the treated scientists exhibit the same pattern or trend up until the point of treatment as the control scientists – and would continue to do so were it not for the treatment. The next section provides more details on our approach and the assumptions made. In addition, robustness checks verify whether these level differences are driving any observed effects.

Section 5. Results

Econometric Framework

In order to evaluate the impact of the fellowship on non-migrant collaboration patterns in the home country organization, we compare a non-migrant scientist's outcomes after the fellowship is awarded to a researcher in their organization relative to before, using a scientist fixed effects specification. The estimating equation (equation 1) relates non-migrant scientist *i*'s outcomes in year *t* to the fellowship award to a scientist in their organization:

$$Y_{it} = \beta_0 + \beta_1 \text{Post\_Fellowship}_{it} * \text{OWSD\_Organization} + \beta_2 \text{Post\_Fellowship}_{it} + f(\text{AGE}) + \partial_\tau + \gamma_i + \varepsilon_{it} \quad [1]$$

where *y* reflects the outcome measure. In the majority of our analyses, the outcome of interest reflects the number of collaborative publications, i.e., the number of scientists' publications that involve co-authorship with individuals of particular types, e.g., individuals from the fellow's host country. Post_Fellowship denotes an indicator variable that takes the value of one beginning in the year after the scholar applies for the OWSD fellowship (thus incorporating a one year lag between fellowship application and associated publication outcomes). OWSD_Organization is an indicator variable equal to one for treated scientists, i.e., those in organizations with a winning applicant. The function, f(AGE), specifies a flexible function of the non-migrant scientist's career age, which includes calendar year fixed effects and non-migrant scientist fixed effects. We do not include an OWSD_Organization fixed effect, as this is codetermined with the scientist fixed effect. In light of these fixed effects, the coefficient β_1 can be interpreted as the increment (or decrement) to the outcome variable associated with in each of our analyses, we cluster standard errors at the level of the fellow (or unsuccessful applicant), reflecting the correlation among repeated observations among individuals in the sample. The central assumption in our approach is that the collaboration trajectory of researchers in the migrant scientists' home institution would have persisted along the pre-migration path if that focal scientist did not win an OWSD grant.

The majority of the dependent variables of interest are skewed and non-negative. Due to the large number of zeroes in the dataset, we estimate most specifications using ordinary least squares regression with inverse hyperbolic sine transformed outcome variables.[5]

Impact of Fellowship on Non-Migrants

Average effects

Table 3 reports results estimating the specification presented in Equation 1. The results document that, on average, the migration of an individual from a non-migrant's organization results in the formation of new international relationships, particularly among scientists from the host country of the migrant and other scientists from the Global South. Specifically, having a successful fellow in their organization increases the number of collaborative publications with foreign scientists in the Global South by 4.8%, and increases the number of new collaborative relationships with foreign scientists in the Global South by 7.1%. We explore the dynamics of these effects in Figure 7, where we estimate a specification in which the treatment effect is interacted with a set of indicator variables corresponding to a particular year before or after the fellowship application. The effects do not appear to be transitory, and they do not appear to be growing significantly prior to the fellowship. One OWSD fellow that we spoke to described these spillover benefits to their experience abroad, saying:

> *"The effect of collaboration is like a ripple effect. Everyone gets to benefit from it… your university, even your nation."*

The remainder of the analysis explores heterogeneity according to country level and organizational level characteristics, with a focus on the outcome: collaborations with the host country.

The moderating role of country level gender parity

Table 4 explores heterogeneity in the effect of the fellowship through separating the sample of treated and control scientists into two groups: those in countries with low levels of gender parity, and those in countries with higher levels of gender parity. We interact the main independent

[5] Analyses that explore the robustness of these choices are available in Appendix D.

variable of interest (Post fellowship x OWSD organization) with a dummy variable for whether the host country of the fellow has high levels of gender parity. The results support the theoretical expectations of the paper, namely that non-migrants in countries with high levels of gender parity are more likely to become connected to the fellow's host country (Table 4, columns 2 and 6). In fact, following the fellowship award, non-migrants in high gender parity countries produce 10% more collaborative publications with the fellow's host country scientists than those in lower gender parity countries, and generate 15% more collaborative relationships with scientists in the host country of the fellow, which amounts to just over 0.2 additional relationships in a 6-year period following the fellowship award.

In general any additional benefit from the fellow going to a host country with high gender parity is statistically insignificant (Table 4, columns 3 and 7). However, for non-migrants in countries with high levels of gender parity, host country gender parity also influences the extent to which they are connected with the host country (Table 4, columns 4 and 8). Overall, these findings imply that home and host country gender parity are complements rather than substitutes.

Mechanisms

Perceived legitimacy of female migrants as brokers

We argue that home and host country gender parity affects a female migrant's ability to share her international connections through a mechanism of perceived legitimacy. Specifically, we propose that women in high gender parity countries are better able to share their networks because of more trust in them as a broker, and because they are more likely to be in a better position to share their network.

While it is difficult to test the former directly, we explore whether alternative mechanisms that confer legitimacy on women are a substitute to country level gender parity, which gives some supporting evidence in the existence of receptiveness to the women as a broker as a mechanism driving the results.

A large literature explores the role of female representation within an organization in establishing the roles and norms around women in an organization, and thus, women's workplace experiences. In other words, the level of female representation in an organization is likely to play a role in the expectations for women in the organization. Since Kanter's (1997) seminal work on tokenism, researchers have argued that more equal representation of women in an organization, particularly in positions of authority, is associated with decreased stereotyped role encapsulation for women (Lockheed 1985; Ely 1995). Higher female representation of women in an organization can also result in more role models or mentors in senior positions in an organization for other women (Ibarra 1992), making it easier for the female migrant to adopt a senior position themselves or position of authority.

To the extent that the country level of gender parity affects whether female migrants are perceived as more legitimate brokers, then we would expect that legitimacy gained from being from an organization with higher levels of female representation would be more useful for scientists in countries with lower levels of gender parity. In other words, we would expect that legitimacy conferred by country level characteristics and by organizational level characteristics to be substitutes.

We test this contingency by using publication records at the level of the home and host organization of the fellow (or unsuccessful applicant) to generate a measure of the average proportion of women (as compared to men) affiliated with the home and host organization of the fellow (or unsuccessful applicant) in the three years prior to the fellowship (or unsuccessful application). We interact the main variable of interest (Post fellowship x OWSD organization), and the main interaction of interest (Post fellowship x OWSD organization x high gender parity home country) with the proportion of female scientists in a non-migrant's organization in Table 5. The results reveal that, although not statistically significant, as a result of the large standard errors, non-migrants in an organization with higher levels female representation have a higher likelihood of collaborating with host country scientists (Table 5, columns 2, 4). In addition, compared to the impact of being in an organization with higher levels of female representation for non-migrants in countries with higher levels of gender parity, the impact of the fellowship is positively related to the proportion of women in their organization for non-migrants in countries

with lower levels of gender parity. This also suggests that organizational-level characteristics are a substitute to rather than a complement for country-level characteristics.

We next explore whether female migrants in high gender parity home and host countries are more likely to be in an optimal position for sharing their network by examining any heterogeneity in the women's formal position and collaborative networks.

We find that out of 33 fellows for whom we could source information on their role in the six years after their fellowship, 50 percent in high parity countries were considered to be in senior positions (i.e. they had senior in their job title, or were professors or directors), whilst 44 percent were in senior positions in low gender parity home countries. In Table 7 we report the results of a regression analysis that examines the rate of home and host country collaborations as a function of the fellows' countries' gender parity. Although the results are not statistically significant, again as a result of the large standard errors, we document that female migrants from high gender parity home countries have more home country collaborators (column 2), and female migrants going to high gender parity host countries have more host country collaborators (column 7). The lack of a positive relationship between home country gender parity and host country collaborators (and vice versa) suggests that the gender parity in the home and host country does not affect overall collaboration rates, but rather plays a specific role in the formation of collaboration networks in that country. This result is consistent with previous studies that find that women in some countries are less likely to be in a position to communicate with other members of their organization. For example, Etzkowitz et al (2000) describe female scientists in Turkey in the 1980s, saying *"women report that they tend to be excluded from informal sources of communication"* (p. 205).

While we interpret these findings as giving evidence for a legitimacy mechanism, we explore the viability of some other plausible mechanisms that could be driving these heterogeneous effects.

Variation in the Fellow's Impact by Non-migrant Gender

An alternative possible mechanism that could explain the observed results is a mechanical correlation between a possible elevated effect of a female migrant on female non-migrants and

higher proportions of female scientists in organizations in countries with higher levels of gender parity.

Specifically, might expect that female non-migrants would benefit more from the migration of another female from their institution. Plenty of research suggests that individuals benefit from mentors and role models of the same gender (Ragins and Cotton 1993; Gaule and Piacentini 2018). Following this logic, it is plausible to think that institutions in higher gender parity countries might have more women in them, and therefore female migrants might have a larger average impact in these institutions. We explore whether this is driving our result by exploring whether the level of sharing of host country connections differs for male or female non-migrants in the home country organization in Table 6. We find that not only do the female migrants have a lower impact on female non-migrants (column 2), but there is no additional benefit to female non-migrants in high gender parity countries. This implies that the majority of the benefit is being accrued by male non-migrants in high gender parity countries.

Fellow Quality

Supply side explanations are often given to explain variation in women's outcomes across different contexts. Supply side arguments follow the logic that individual attributes determine outcomes, and any variation in outcomes across genders or contexts is attributable to variation in education, effort and choice. In our setting, insofar as the results could be explained by differences in supply side factors, we would expect women in low gender parity countries to be less well prepared for their doctorate, go to worse host institutions, or have lower effort or general performance during and after their doctoral studies.

We find no support for these hypotheses. To start, the fellows from low gender parity countries tend to apply with more publications, as opposed to fewer. On average, applicants to the fellowship from high gender parity have on average 0.1 publications at the time of application, whereas applicants from low gender parity countries have 0.24 publications. Applicants from high gender parity countries also tend to apply to lower ranked host institutions than applicants from low gender parity countries. The average rank of a host institution for an applicant from a

high gender parity country is 517, whereas the average rank of a host institution for an applicant from a low gender parity country is 436.

We assess whether fellows from high gender parity countries put in more effort to their scientific career, or have more innate ability or higher performance in the six years after their fellowship application. The results in Table 7 reveal that fellows from high gender parity countries are no more productive after the start of the fellowship than those from low gender parity countries, suggesting that variation in fellow quality or effort is not driving the observed results.

Fellow location

We also explore whether the country characteristics affect the organizational affiliation of the fellow (i.e. whether the fellow continues to be affiliated with the home institution during the fellowship), which could affect the extent to which they connect home and host organization scientists, and the extent to which the fellow collaborates with the host organization, which affects their position in the network as a broker.

The cross-sectional regression results in Table 7 reveal that on average, home country gender parity does not affect the fellow's probability to be affiliated with the home organization. However, we do observe that the fellow is less likely to be affiliated with their home country if the host country has high levels of gender parity (Table 7, column 2).

Insofar as we might expect that gender parity of their home country might affect the likelihood of the fellow to carry out a sandwich fellowship, or remain in their home country, which could also impact their brokerage ability, we assess whether the effects are more salient for sandwich or full-time fellows. We present the results in Appendix C. The analysis finds no statistically significant difference in the effects of a full-time fellowship versus a sandwich fellowships. That said, although the variation by home country gender parity remains robust, we do observe that full time fellows have a slightly larger impact than sandwich fellows in the period after the fellowship. This could be because a longer duration abroad enables deeper relationships with the host country researchers. We also find the effect is stronger among the small number of fellows

who are known to return after their fellowship to high parity home countries. These results lend themselves to several follow-on research questions, one of which regards the costs and benefits of alternative migration 'modes,' which, we hope, will be explored in future research.

Alternative Explanations and Robustness Checks

We explore the robustness of our core findings to a number of possible alternative explanations and statistical approaches. One alternate explanation that could account for the heterogeneous relationship between country characteristics and the likelihood that migrants share their international connections is that high gender parity countries may simply be more advanced economically or scientifically, therefore enhancing brokerage possibilities of the migrant. We assess the validity of this concern in Table 9 by including an interaction of measures of economic or scientific advancement of the home country in a specification together with the interaction of home country gender parity. Insofar as these alternative measures of economic or scientific advancement are driving the observed relationship between gender parity and brokering ability, the inclusion of the interactions should result in a drop in the main coefficient.

Specifically, we examine in column 2 whether the main coefficient is affected by the propensity for high gender parity countries to be English speaking, as this could be important for building global scientific networks. In columns 3 and 4, we investigate whether the core result is affected by national scientific capacity, measured as the number of publications per country. We construct this measure as the count of publications in the Elsevier Scopus publication database of which at least one author is affiliated with the focal country, i.e., total number of publications with an author from that country not fractional publications weighted by author location. Lastly, we ask in column 5 whether GDP per capita affects the core result. The results are robust to the inclusion of these measures of economic and scientific advancement, i.e., the relationship between gender parity in the home country and brokering remain stable. We interpret these analyses as suggesting there is something particular about gender parity that explains the variation in the effect of the female migrant.

One additional potential explanation that we have not yet pursued is the prospect that non-migrants in high gender parity countries may also be based in better organizations and that this

fact, rather than gender parity, explains the results. To explore this we run the main analysis with a sample that excludes non-migrants in organizations in the top 75th percentile in terms of number of researchers (Table 10, column 4), in the bottom 25th percentile (Table 10, column 5), and excluding non-migrants in organizations that never have a successful fellow (Table 10, column 7). The results remain robust to this modification of the analysis. Because gender parity is positively correlated with the passing of time, we also explore whether the results simply reflect improvements in brokerage over time. In Table 10 column 3 we limit the sample of non-migrants to those who are associated with a fellow or applicant after 2010. The results remain robust.

We probe the robustness of the results to a number of other variants of the sample, and measures of key independent variables. For example, because more than half of the sample of non-migrants is from Nigeria, we run the analysis without Nigerian non-migrants (Table 10, column 2), and we run the analysis without non-migrants who had a collaborative record with host country researchers before the fellowship application (Table 10, column 6). The results are robust to these alternative samples.

Finally, we test the robustness of the results to alternative measures of country gender parity in Appendix A. We assess whether the results are similar if we use a continuous measure of gender parity, an alternative measure of gender parity (the Gender Inequality Index), and a country level measure of the ratio of women to men in secondary school education. We find a very similar dynamic to the main results.

Section 6. Discussion

In this paper we examine the extent to which female migrants connect individuals across their home and host institutions. In so doing, we develop a contextualized view of second-hand brokerage that takes into account the role of institutional context in the success of the broker as a global network builder. The empirical results document that, in the context of the OWSD Fellowship Program, female migrant scientists are more likely to share international connections

if their home countries have high levels of gender parity and if their host country also has high levels of gender parity. These results are consistent with an interpretation in which female migrant scientists share their connections in institutional environments whose conditions confer legitimacy upon their roles as brokers.

We attempt to make several contributions in this paper. First, we highlight an under-recognized challenge in the spillover benefits from migration. Prior literature has focused on the challenges that migrants face in transferring knowledge back home (Wang 2015). We complement this work by highlighting the role of migrants in connecting individuals across organizational and national borders and by documenting the role that the institutional contexts that the home and host locations play in facilitating this role. We use data from a novel setting of South-South migration, which illustrates the roles of both the home and host location institutional context.

Second, we contribute to an emerging literature that separates the structural and functional definitions of a broker. While recent work suggests that the broker's advantage depends on their cultural and organizational context (Xaio and Tsui 2007; Vasudeva et a; 2013; Wang 2015), we show that in order to facilitate relationship building between previously disconnected actors, the context in which each of the potential new partners is in matters.

We should note a number of limitations associated with this study and potential extensions to address them. First, we use publication records and collaborations to infer relationships between scientists. Future research should, ideally, explore alternative measures of relationships and connections that are not conditioned on success of the partnership. Second, a key boundary of the study is that we examine static rather than dynamic effects. Future research to better understand the inter-generational implications of these kinds of migration events is important.

Despite these limitations, we believe that the findings have important implications for our understanding of the role of institutional context on the spillover benefits from migration. More practically, the results suggest that organizations and managers seeking to benefit from employees visiting other organizations or countries should work towards conferring legitimacy upon these migrants, in order to support their ability to build global networks, achieve resource

and knowledge flows, and, ultimately, performance improvements. As the rate of migration between organizations and countries continues to rise, future research should further examine how to fully leverage the benefits associated with the global networks that migrants generate.

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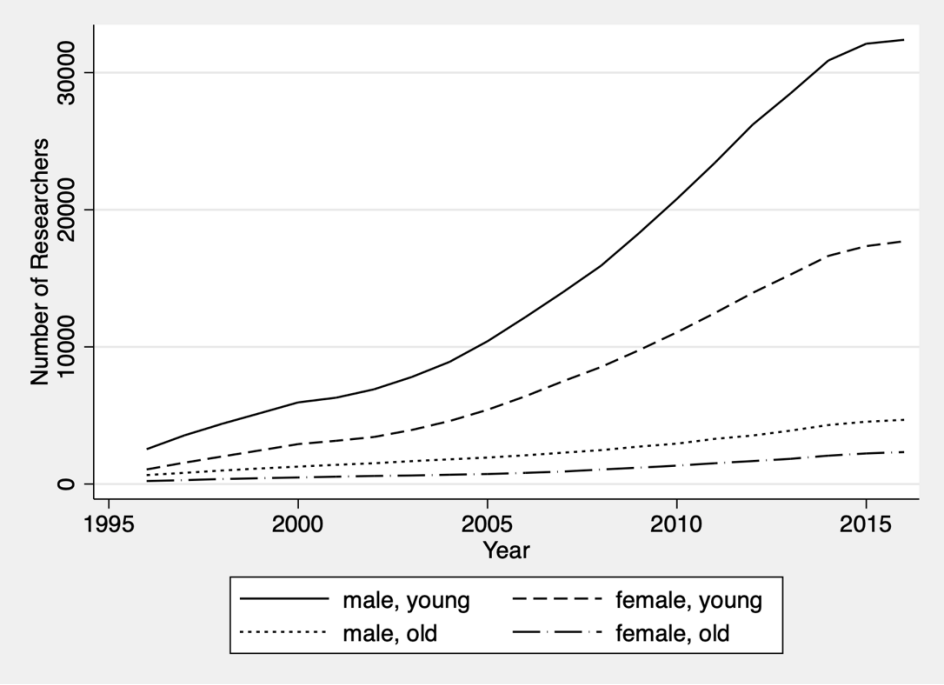
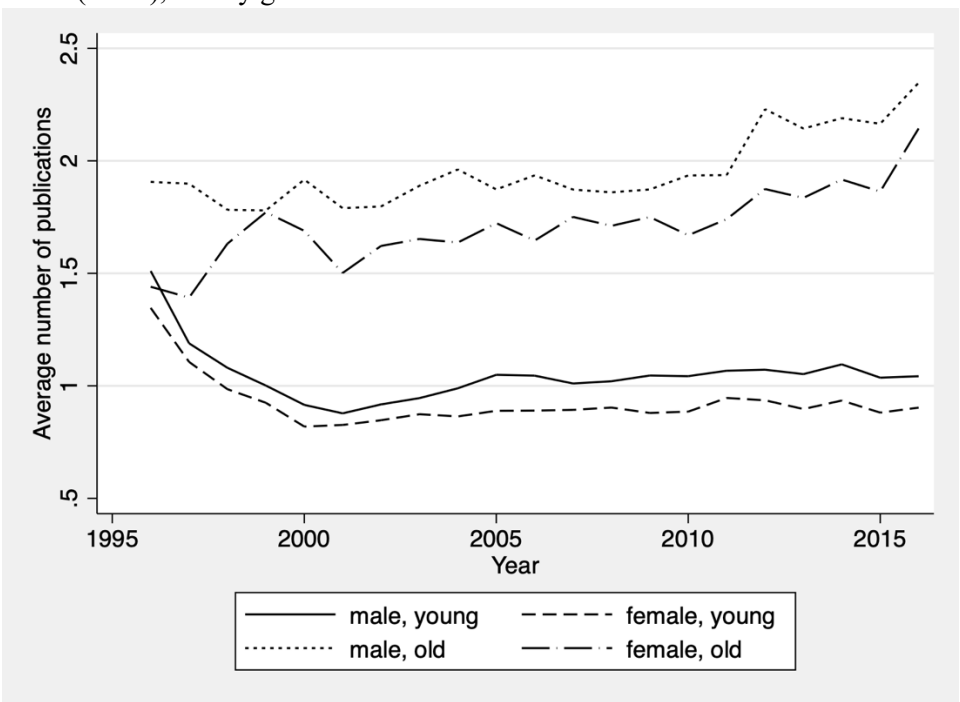
Figures and Tables

Figure 1. Trends in the number and productivity of researchers by gender over time

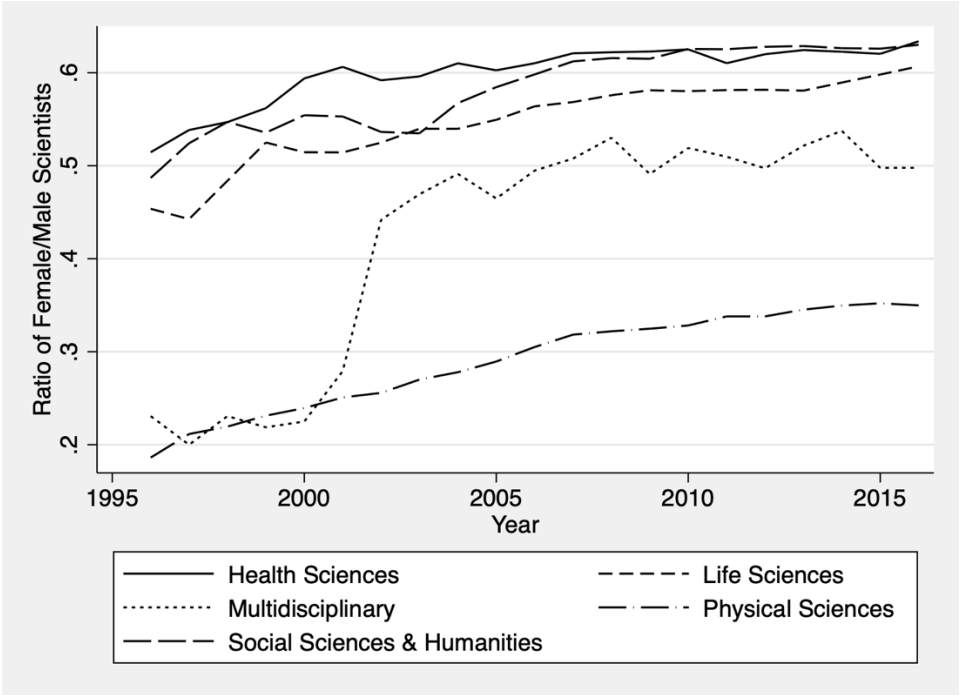


a. We identify the number of unique researchers in each year across all sample countries, by gender and separate into those who have been publishing for less than 10 years ("young"), and the remainder ("old"), and by gender.

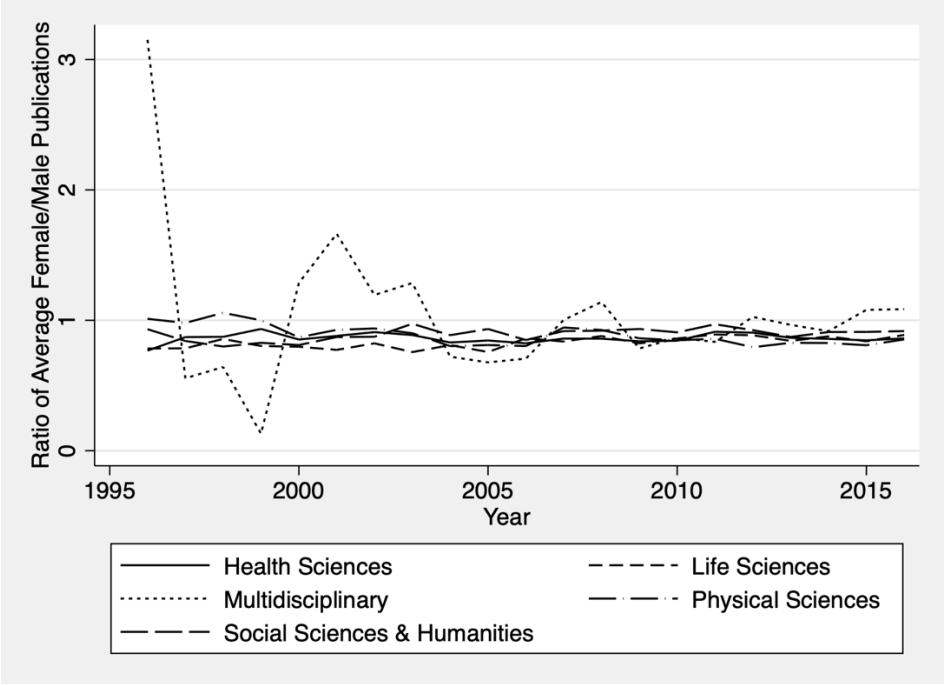


b. We estimate the average number publications per unique researcher in each year across all sample countries, by gender and separate into those who have been publishing for less than 10 years ("young"), and the remainder ("old"), and by gender.

Figure 2. Trends in the number and productivity of researchers by gender in different scientific fields

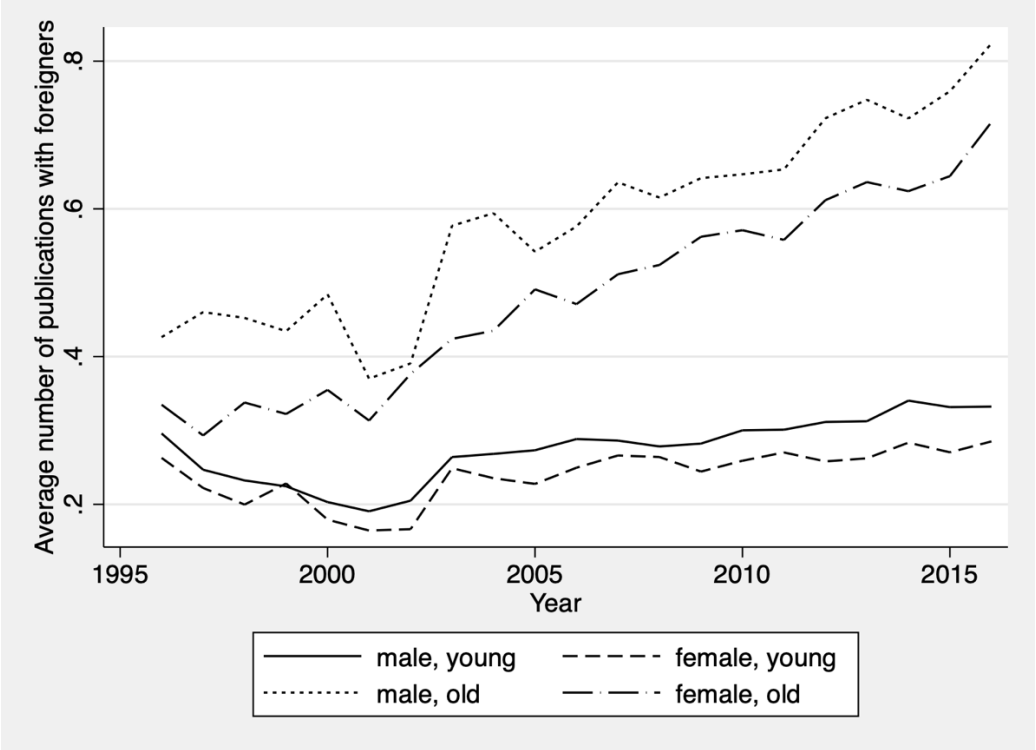


a. We identify the ratio of unique female to male researchers in each year across all sample countries in a given scientific field.

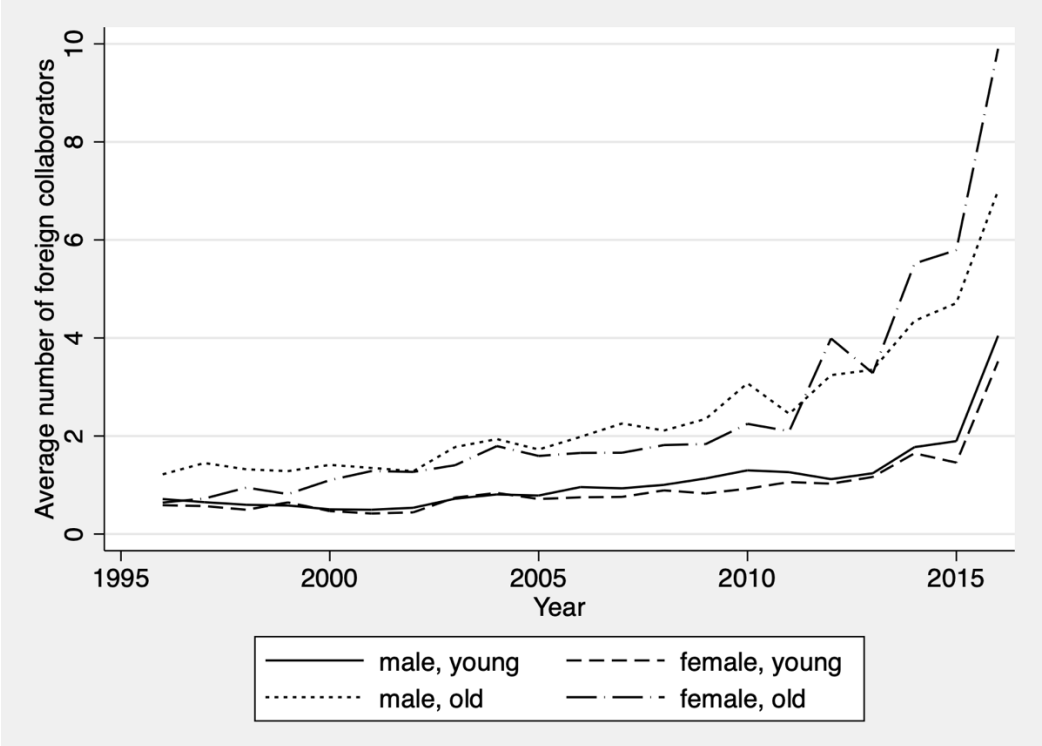


b. We identify the ratio of the average number of publications of female to male researchers in each year across all sample countries in a given scientific field.

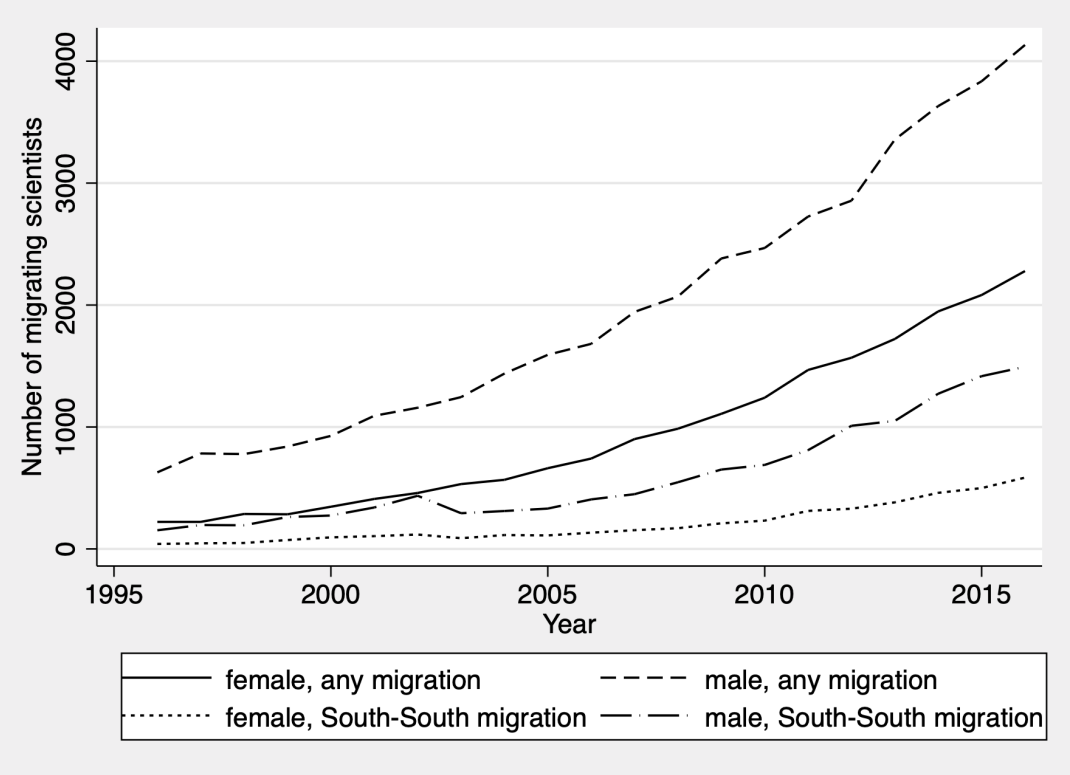
Figure 3. Trends in the international network of researchers by gender



a. We identify the average number of publications with international collaborators of female and male researchers in each year across all sample countries.

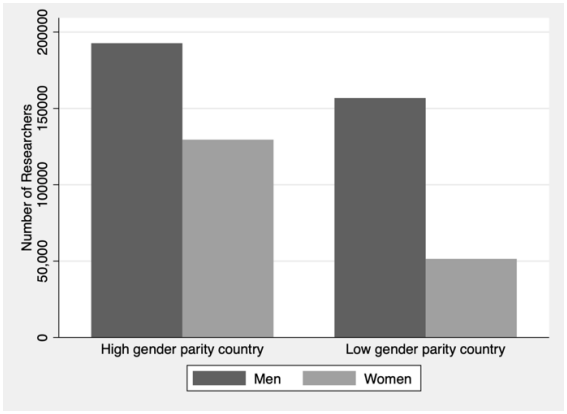


b. We identify the average number of unique foreign collaborators of female and male researchers in each year across all sample countries.

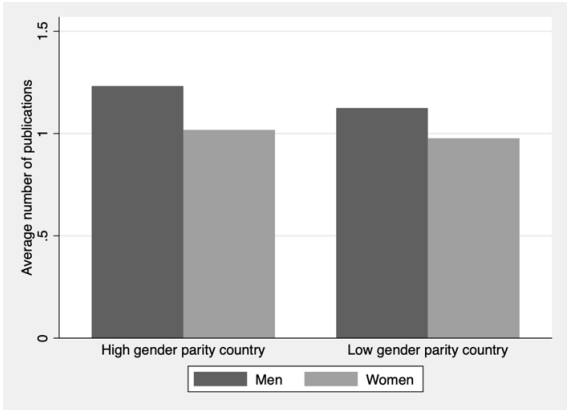


c. We identify the number of migrants across sample countries each year, defined as scientists who publish in the sample country and are then affiliated with a foreign country in a subsequent year. We plot just the first year of migration out of the sample country.

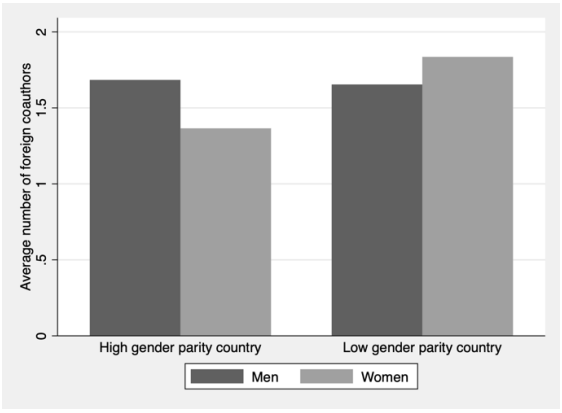
Figure 4. Association between country characteristics and the gender gap in science



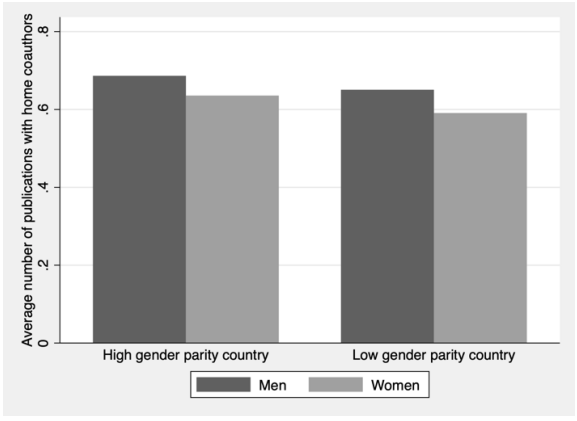
a. Number of researchers



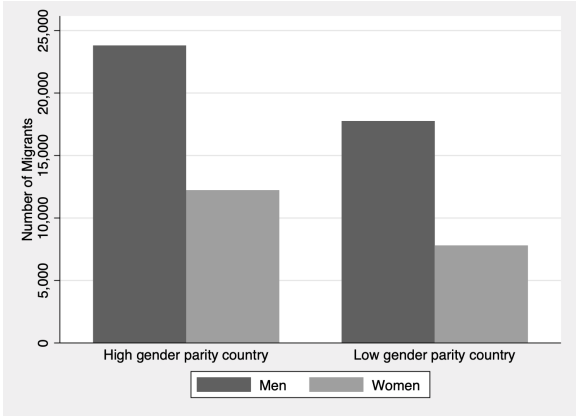
b. Average number of publications



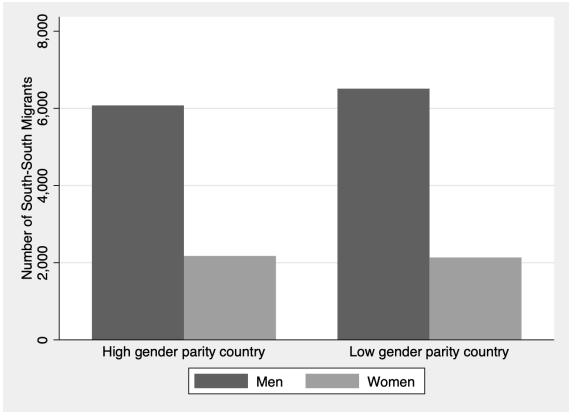
c. Average number of foreign collaborators



d. Average number of publications with home country collaborators



e. Number of migrants

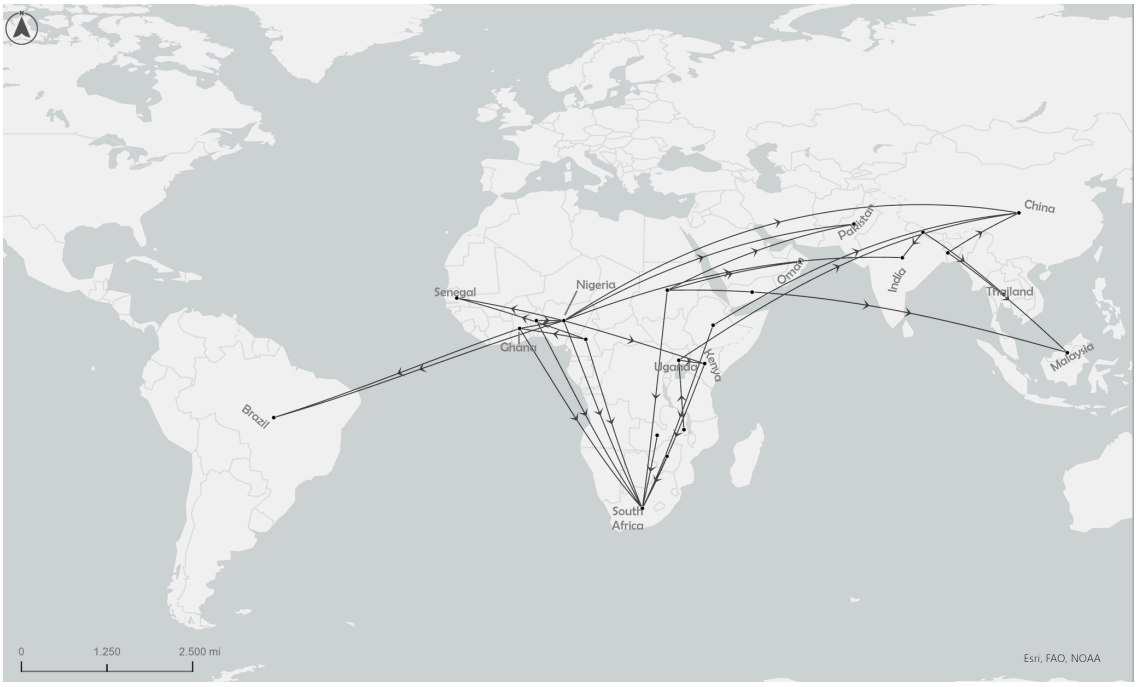


f. Number of South-South migrants

Notes: We estimate the average number of researchers across years 1996-2016 in panel (a), and average number of publications per scientist year (panel b), average number of unique foreign collaborators per scientist year (panel c), average number of publications with home country collaborators per scientist year (panel d), average number of migrants across years (panel e) and average number of South-South migrants (panel f) across all sample countries in higher gender parity countries and low gender parity countries. Gender parity is defined using the UNDP definition of low parity based on the distance of the inequality index from parity. Any country that has a deviation of more than 10% from parity is considered low parity.

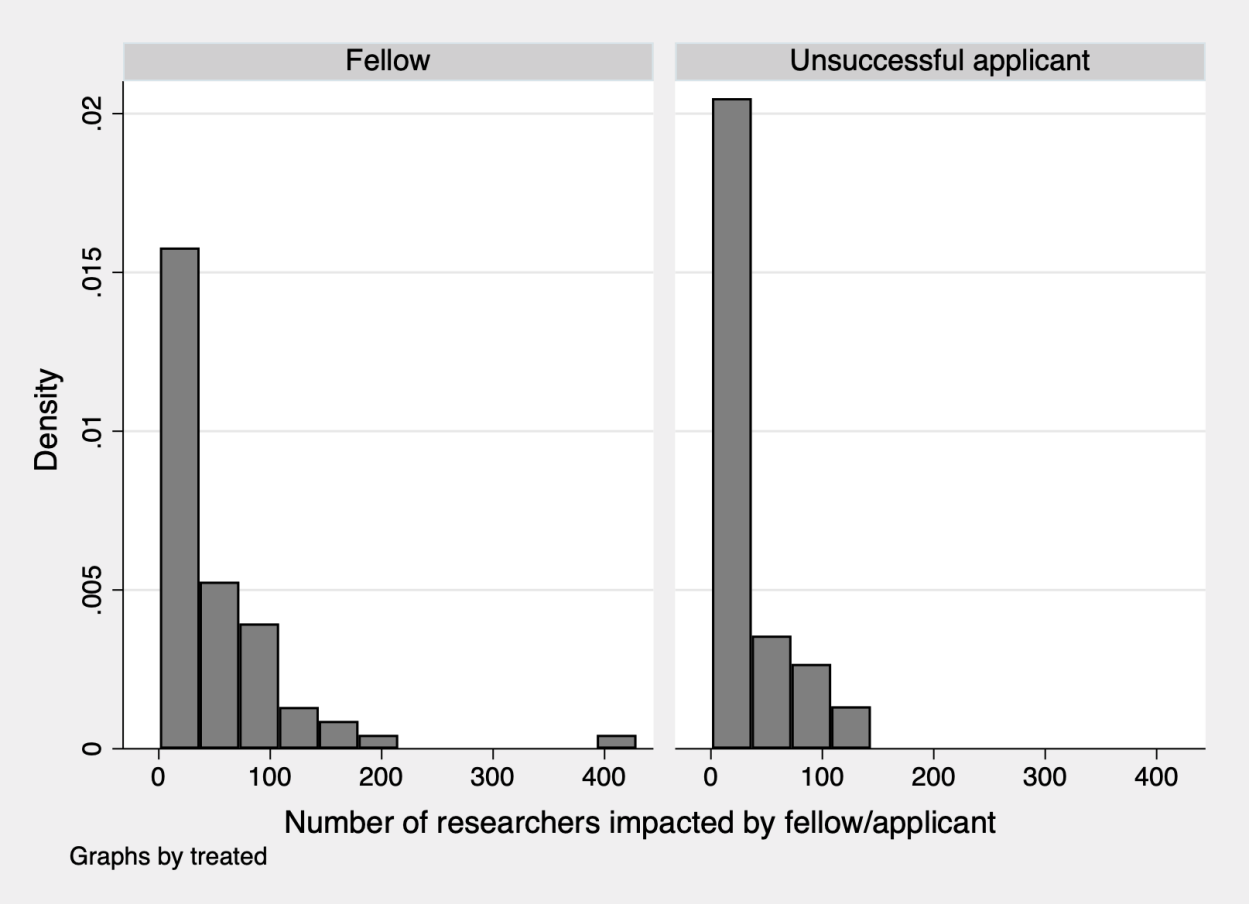
Figure 5. Map of home/host country of unsuccessful applicants and fellows

a. Unsuccessful applicant home and proposed host country



b. Fellow home and proposed host country

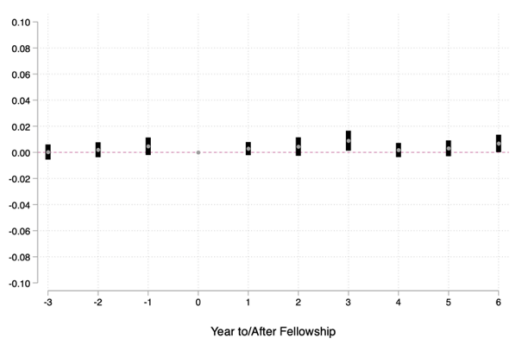
Figure 6. Histogram of the number of non-migrants each fellow/unsuccessful applicant impacts



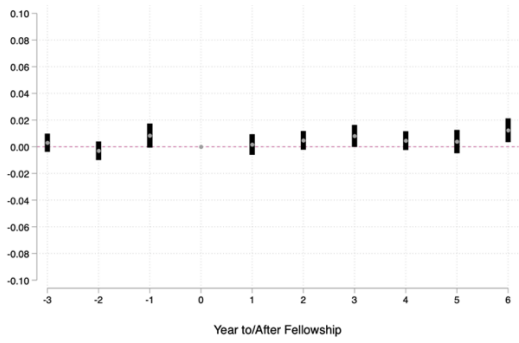
Notes: We compute the number of treated and control non-migrants in the sample affected by each fellow/unsuccessful applicant.

Figure 7. Event study diagrams

a. Host organization

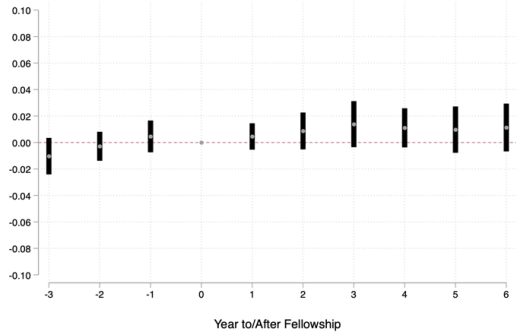


i. Number of collaborative publications

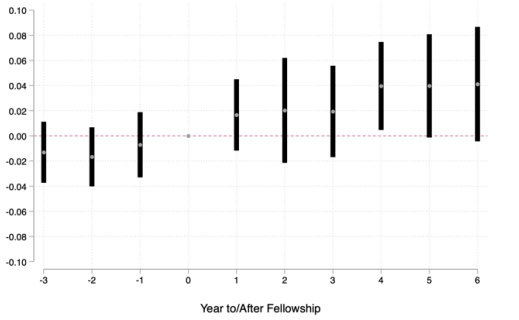


ii. Number of new coauthors

b. Host country

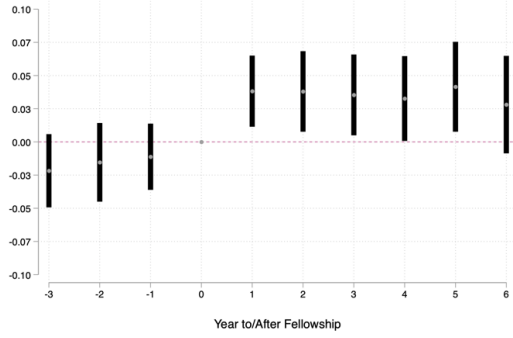


iii. Number of collaborative publications

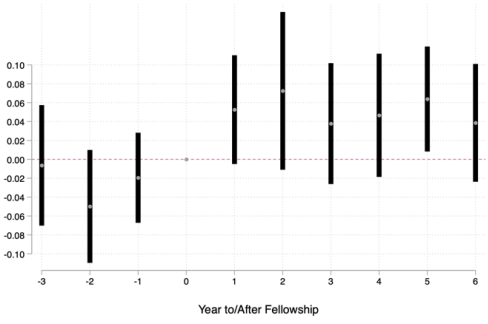


iv. Number of new coauthors

c. Global South



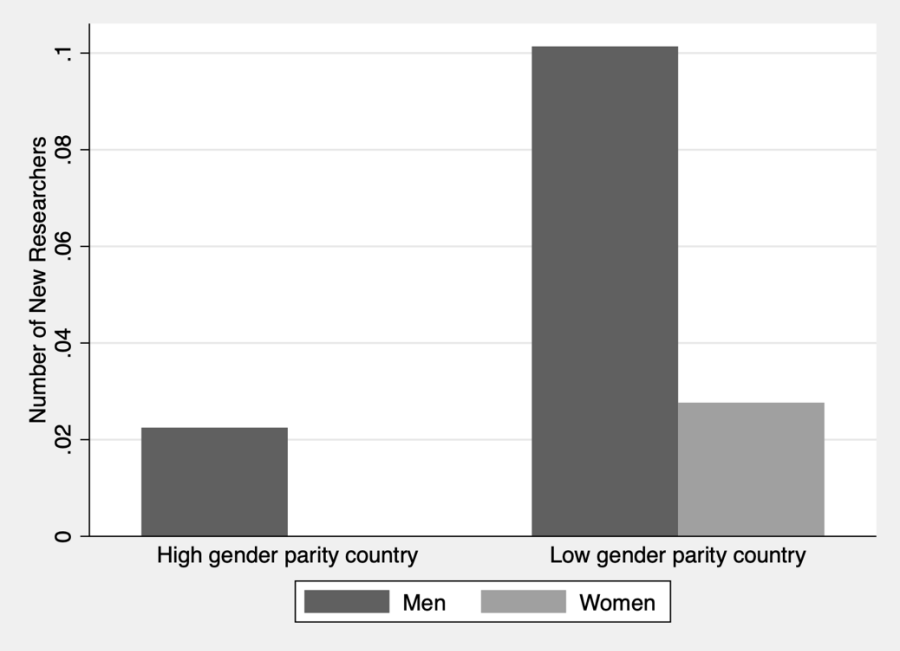
v. Number of collaborative publications



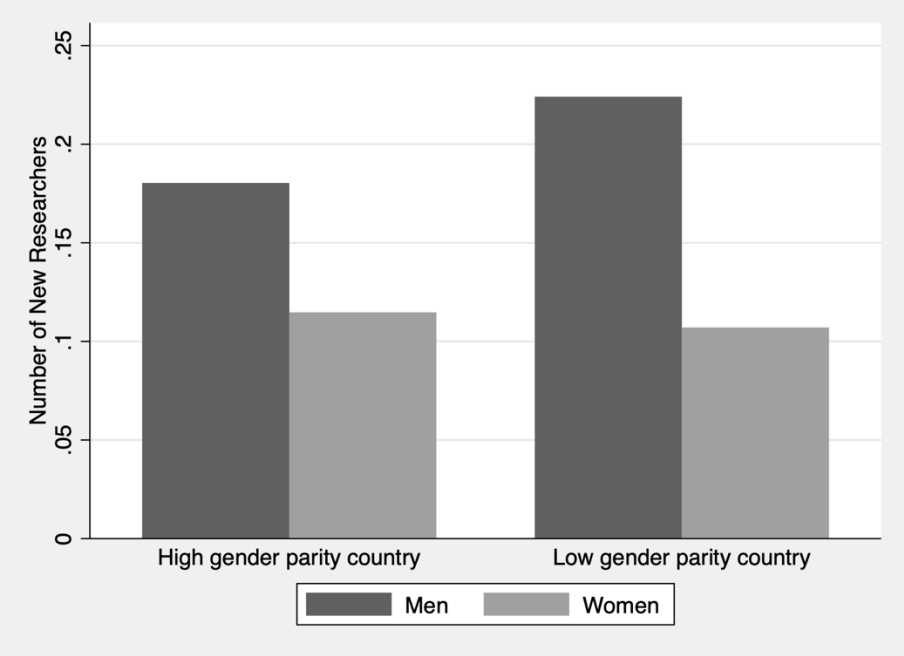
vi. Number of new coauthors

Notes: The solid dots in the above plots correspond to coefficient estimates stemming from ordinary least squares fixed effects specifications in which counts of outcomes per scientist in the year of observation are regressed onto year effects, career age effects, as well as interaction terms between treatment status and the number of years before/after the fellowship. All specifications also include a full set of lead and lag terms common to both the treated and control articles to fully account for transitory trends in collaborations around the time of the fellowship. The 90% confidence interval of the robust standard errors clustered at the institution level is plotted with black bars.

Figure 8. New researcher entry in the organization/scientific field of unsuccessful applicants versus fellows following the fellowship



a. Unsuccessful applicant organization/scientific field



b. Successful fellow organization/scientific field

Notes. The average number of new researchers per year who are identified as females and males in the data per organization/scientific field is calculated and plotted by whether the home country is classified as high gender parity or low gender parity.

Table 1. Descriptive statistics of fellows/applicants in the year of the application

	Unsuccessful Applicants (N=63)			OWSD Fellows (N=64)		
	mean	**median**	**std.dev.**	**mean**	**median**	**std.dev.**
Application year	2008*	2010	3.84	2007	2009	4.82
Sandwich fellowship	0.38	0	0.49	0.52	1	0.50
Number of years since first publication (=0 if no prior publications)	0.33	0	1.76	0.81	0	1.98
Any prior publications	0.063	0	0.25	0.14	0	0.35
Number of publications in year of application	0.032	0	0.18	0.14	0	0.50
Number of publications with host country collaborators in year of application	0	0	0	0	0	0
Number of researchers in organization/field in year of application	8.30	2	15.42	7.39	4	14.84
Number of women in organization/field in year of application	0.46	0	1.10	0.56	0	1.46
High gender parity home country in year of application	0.19	0	0.40	0.094	0	0.29
High gender parity host country in year of application	0.86	1	0.35	0.77	1	0.43
African	0.94	1	0.25	0.88	1	0.33
Asian	0.063	0	0.25	0.13	0	0.33

Note. Variables are measured at the year of the application. Differences of means test compares mean values across unsuccessful and successful sample applicants in the year of the fellowship application. *, **, *** represent significance at the 0.1, 0.05 and 0.01 level respectively.

Table 2. Descriptive statistics for non-migrant study scientists the year of the application

	Control Scientists (N=1,917)			Treated Scientists (N=3,179)		
	mean	**median**	**std.dev.**	**mean**	**median**	**std.dev.**
Number of years since first publication at time of application (=0 if no prior publications)	6.60	4	7.35	8.22***	5	8.66
Female	0.080	0	0.27	0.087	0	0.28
Male	0.26*	0	0.42	0.25	0	0.43
Life sciences	0.63	1	0.48	0.65	1	0.48
Health and medical sciences	0.18	0	0.39	0.18	0	0.39
Physical sciences	0.18**	0	0.39	0.16	0	0.37
Number of publications	1.15	1	1.83	1.52***	1	2.20
Number of SNIP weighted publications in year of application	0.72	0	1.88	1.17***	0.40	2.78
Number of publications with home organization collaborators in year of application	0.78	0	1.19	0.97**	1	1.39
Number of new home organization collaborators in year of application	2.06	0	5.03	3.12***	0	7.11
Number of publications with host organization collaborators in year of application	0.00052	0	0.023	0.0047**	0	0.081
Number of new host organization collaborators in year of application	0.0031	0	0.12	0.014*	0	0.22
Number of publications with host country collaborators in year of application	0.023	0	0.24	0.045***	0	0.29
Number of new host country collaborators in year of application	0.17	0	2.10	0.29	0	2.56
Number of publications with Global South collaborators in year of application	0.23	0	0.76	0.26	0	0.82
Number new Global South collaborators in year of application	0.88	0	9.40	0.84	0	4.55
Number of researchers in the organization in year of application	191.33	120	183.88	285.95	222	182.51
Number of female researchers in the organization in year of application	26.58	14	32.18	40.66***	30	32.95
Inequality measure home country in year of application	0.87***	0.87	0.029	0.86	0.86	0.030
High gender parity home country in year of application	0.17***	0	0.38	0.089	0	0.27

Notes. Variables are measured at the year of the application. Differences of means test compares mean values across unsuccessful and successful sample applicants in the year of the fellowship application. *, **, *** represent significance at the 0.1, 0.05 and 0.01 level respectively.

Table 3. Impact of OWSD Fellowship on Fellow's Home Organization Non-Migrants' Collaboration Outcomes

Dependent Variable:	Number of collaborative publications			Number of new collaborative relationships		
	Host organization	Host country	Global South	Host organization	Host country	Global South
	(1)	(2)	(3)	(4)	(5)	(6)
Post fellowship x OWSD organization	0.0028	0.012	0.048***	0.0037	0.039**	0.071***
	(0.0018)	(0.0075)	(0.014)	(0.0029)	(0.017)	(0.027)
Mean of the dependent variable	0.0058	0.054	0.29	0.016	0.53	2.48
Number of scientists	5,096	5,096	5,096	5,096	5,096	5,096
Number of scientist x year observations	50,960	50,960	50,960	50,960	50,960	50,960
Number of fellows/applicants	127	127	127	127	127	127

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively. Coefficients can be interpreted as elasticities.

Table 4. Impact of OWSD Fellowship on Fellow's Home Organization Non-Migrants' Collaboration Outcomes by Home and Host Country Gender Parity

Dependent Variable:	Number of collaborative publications with host country				Number of new collaborative relationships with host country			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post fellowship x OWSD organization	0.012	0.0035	0.0025	-0.000034	0.031**	0.019*	0.011	0.0072
	(0.0075)	(0.0051)	(0.0065)	(0.0065)	(0.014)	(0.0099)	(0.014)	(0.014)
Post fellowship x OWSD organization x high gender parity home country		0.098***				0.14**		
		(0.020)				(0.067)		
Post fellowship x OWSD organization x high gender parity host country			0.011				0.024	
			(0.0076)				(0.016)	
Post fellowship x OWSD organization x (high gender parity home country & host country)				0.10***				0.15**
				(0.020)				(0.068)
Post fellowship x OWSD organization x (high gender parity home country & low gender parity host country)				-0.0078				-0.0037
				(0.0071)				(0.013)
Post fellowship x OWSD organization x (low gender parity home country & high gender parity host country)				0.0042				0.015
				(0.0061)				(0.014)
Mean of the dependent variable	0.023	0.023	0.023	0.023	0.27	0.27	0.27	0.27
Number of scientists	5,096	5,096	5,096	5,096	5,096	5,096	5,096	5,096
Number of scientist x year observations	50,960	50,960	50,960	50,960	50,960	50,960	50,960	50,960

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively. Coefficients can be interpreted as elasticities.

Table 5. The Role of Organizational Female Representation in the Impact of OWSD Fellowship on Fellow's Home Organization Non-Migrants' Collaboration Outcomes

Dependent Variable:	Number of collaborative publications with host country			Number of new collaborative relationships with host country		
	(1)	(2)	(3)	(4)	(5)	(6)
Post fellowship x OWSD organization	0.0035	0.0084	-0.00034	0.019*	0.026	0.0097
	(0.0051)	(0.0011)	(0.0075)	(0.0099)	(0.022)	(0.015)
Post fellowship x OWSD organization x high gender parity home country	0.098***		0.15***			0.33**
	(0.020)		(0.039)			(0.13)
Post fellowship x OWSD organization x proportion of women in home organization		0.011	0.012		0.014	0.029
		(0.019)	(0.013)		(0.037)	(0.029)
Post fellowship x OWSD organization x (high gender parity home country x proportion of women in home organization)			-0.16**			-0.56**
			(0.080)			(0.27)
Mean of the dependent variable	0.023	0.023	0.023	0.27	0.27	0.27
Number of scientists	5,096	5,096	5,096	5,096	5,096	5,096
Number of scientist x year observations	50,960	50,960	50,960	50,960	50,960	50,960

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively. Coefficients can be interpreted as elasticities.

Table 6. The Impact of Female Migrant on Non-Migrant Male Versus Female Non-Migrants

Dependent Variable:	Number of collaborative publications with host country			
	(1)	(2)	(3)	(4)
Post fellowship x OWSD organization	0.012	0.014*	0.0035	0.0053
	(0.0075)	(0.0077)	(0.0051)	(0.0051)
Post fellowship x OWSD organization x female non-migrant		-0.021**		-0.019**
		(0.0098)		(0.0090)
Post fellowship x OWSD organization x high gender parity home country			0.098***	0.098***
			(0.020)	(0.023)
Post fellowship x OWSD organization x high gender parity home country x female non-migrant				-0.012
				(0.060)
Mean of the dependent variable	0.023	0.023	0.023	0.023
Number of scientists	5,096	5,096	5,096	5,096
Number of scientist x year observations	50,960	50,960	50,960	50,960

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively. Coefficients can be interpreted as elasticities.

Table 7. Impact of OWSD Fellowship on Fellow's Collaboration Outcomes

Dependent variable	Number of collaborative relationships with home country researchers				Number of collaborative relationships with host country researchers			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fellow	0.086	0.065	0.24*	0.062	0.17***	0.16***	0.068	0.16***
	(0.055)	(0.056)	(0.13)	(0.056)	(0.056)	(0.060)	(0.061)	(0.060)
Fellow x high gender parity home country		0.19				0.036		
		(0.21)				(0.11)		
Fellow x high gender parity host country			-0.19				0.12	
			(0.13)				(0.074)	
Fellow x (high gender parity home country & host country)				0.23				0.059
				(0.23)				(0.12)
Mean of the dependent variable	0.64	0.64	0.64	0.64	0.41	0.41	0.41	0.41
Number of fellows/applicants	127	127	127	127	127	127	127	127
Number of fellows/applicants x year observations	889	889	889	889	889	889	889	889

Notes. Estimates stem from ordinary least square regressions with inverse hyperbolic sine transformed outcome variables. All models include a full suite of calendar year, career age (which incorporates whether they published before their application), scientific field and time since fellowship fixed effects, and a control for the number of researchers in their home organization/field, the number of publications they author in the three years prior to the application, whether they collaborate with the host organization in the three years prior to the application, and whether their fellowship was a sandwich fellowship or full-time. Standard errors are clustered at the level of the scientist. Coefficients can be interpreted as elasticities.

Table 8. Impact of OWSD Fellowship on Fellow's Location and Productivity

Dependent variable	Probability of being affiliated with home country					Number of publications		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Fellow	0.019 (0.022)	0.011 (0.022)	0.11** (0.048)	0.011 (0.022)	0.12*** (0.031)	0.11*** (0.032)	0.17*** (0.049)	0.11*** (0.033)
Fellow x high gender parity home country		0.072 (0.081)				0.073 (0.089)		
Fellow x high gender parity host country			-0.11** (0.046)				-0.062 (0.049)	
Fellow x (high gender parity home country & host country)				0.069 (0.089)				0.082 (0.094)
Mean of the dependent variable	0.099	0.099	0.099	0.099	2.09	2.09	2.09	2.09
Number of fellows/applicants	127	127	127	127	127	127	127	127
Number of fellows/applicants x year observations	889	889	889	889	889	889	889	889

Notes. Estimates stem from linear probability model regressions with outcomes taking the value of 1 if a scientist is affiliated with their home country in the observation year in columns 1-4 and their home institution in columns 5-8. All models include a full suite of calendar year, career age, scientific field and time since fellowship fixed effects, and a control for the number of researchers in their home organization/field, the number of publications they author in the three years prior to the application, whether they collaborate with the host organization in the three years prior to the application, and whether their fellowship was a sandwich fellowship or full-time. Standard errors are clustered at the level of the scientist. Coefficients can be interpreted as elasticities.

Table 9. Alternative explanations for home country gender parity effect

Dependent Variable:	Number of collaborative publications with host country				
	(1)	(2)	(3)	(4)	(5)
Post fellowship x OWSD organization	0.0035 (0.0051)	0.0035 (0.0069)	0.0026 (0.0068)	0.018* (0.010)	0.012 (0.0087)
Post fellowship x OWSD organization x high gender parity home country	0.098*** (0.020)	0.098*** (0.020)	0.098*** (0.020)	0.099*** (0.021)	0.094*** (0.020)
Post fellowship x OWSD organization x English first language home country		0.000097 (0.0063)			
Post fellowship x OWSD organization x total publications in home country			0.00000029 (0.0000012)		
Post fellowship x OWSD organization x total publications per capita in home country				-459.53 (301.22)	
Post fellowship x OWSD organization x log GDP per capita in home country					-0.0000046 (0.0000039)
Mean of the dependent variable	0.057	0.057	0.057	0.057	0.057
Number of scientists	5,096	5,096	5,096	5,096	5,096
Number of scientist x year observations	50,960	50,960	50,960	50,960	50,960

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively.

Table 10. Robustness checks

Dependent Variable:	Number of collaborative publications with host country								
Sample:	Full sample	Excluding Nigeria	Just post 2010	Excluding large organizations	Excluding small organizations	Excluding scientists with host country collaborations	Excluding never treated organizations	Excluding scientists with fellow collaborations	Placebo test
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Post fellowship x OWSD organization	0.0035	0.012**	-0.0015	0.0083	-0.0057	0.010**	-0.0021	0.0029	-0.0039
	(0.0051)	(0.0069)	(0.0066)	(0.0054)	(0.0071)	(0.0040)	(0.0065)	(0.0051)	(0.0044)
Post fellowship x OWSD organization x high gender parity home country	0.098***	0.098***	0.099***	0.097***	0.097***	0.18***	0.097***	0.096***	-0.048*
	(0.020)	(0.021)	(0.032)	(0.021)	(0.022)	(0.033)	(0.020)	(0.020)	(0.028)
Mean of the dependent variable	0.054	0.086	0.052	0.054	0.054	0.023	0.061	0.053	0.035
Number of scientists	5,096	2,413	3,382	3,888	3,913	4,770	4,080	5,050	5,096
Number of scientist x year observations	50,960	24,130	33,820	38,880	39,130	47,700	40,800	50,500	20,384
Number of fellows/applicants	127	81	74	109	62	126	93	127	127

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively. In column 4 we exclude non-migrants in the top 75th percentile in terms of number of researchers in their organization in the full sample, and in column 5 we exclude non-migrants in the bottom 25th percentile in terms of number of researchers in their organization in the full

sample. In column 8 we keep just pre-application data and run the specification with an event date two years prior to the actual event date. Coefficients can be interpreted as elasticities.

Appendix A.

Table A-1. Alternative inequality measures

Dependent Variable:	Number of collaborative publications with host country			
	(1)	(2)	(3)	(4)
Post fellowship x OWSD organization	0.0037 (0.0051)	0.36* (0.21)	-0.11* (0.062)	-0.016** (0.0081)
Post fellowship x OWSD organization x home country gender inequality (gender development index)	0.097*** (0.019)			
Post fellowship x OWSD organization x home country gender inequality (gender inequality index)		0.55 (0.33)		
Post fellowship x OWSD organization x home country female to male proportion of secondary school students			0.15* (0.078)	
Post fellowship x OWSD organization x home country share of parliamentary seats held by women				0.0017** (0.00073)
Mean of the dependent variable	0.13	0.086	0.061	0.050
Number of scientists	5,096	2,413	40,010	35,410
Number of scientist x year observations	50,960	24,130	4,001	3,541
Number of fellows/applicants	127	81	108	83

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively. Observation numbers vary across columns as some countries do not have measures for some independent variables. Coefficients can be interpreted as elasticities.

Appendix B.

Table B-1. Countries in Non-Migrant Sample

Country	Continent	Number of Control Non-migrants	Number of Treated Non-Migrants	Gender Inequality Index in 1996	GDP per capita in 1996
Bangladesh	Asia	144	234	0.72	395
Benin	Africa	0	242	0.74	387
Burkina Faso	Africa	87	87	0.72	249
Cameroon	Africa	180	675	0.88	753
Ethiopia	Africa	0	150	0.73	145
Ghana	Africa	1	43	0.84	397
Kenya	Africa	287	354	0.90	421
Madagascar	Africa	19	19	0.94	355
Malawi	Africa	8	10	0.88	228
Nepal	Asia	21	27	0.76	205
Nigeria	Africa	1,027	2,683	0.80	462
Rwanda	Africa	4	4	0.84	230
Sudan	Africa	103	190	0.77	301
Uganda	Africa	13	122	0.87	287
Yemen	Africa	1	7	0.62	374
Zambia	Africa	3	12	0.88	385
Zimbabwe	Africa	14	232	0.90	741
eSwatini	Africa	5	5	0.93	1695

Appendix C.

Table C-1. Impact of OWSD Fellowship by Fellowship Duration and Fellow Location

Dependent Variable:	Number of collaborative publications with host country							
Sample:	Full sample				Excluding 4 years of fellowship		Excluding fellows/applications not at home after graduation	
	Home Country Gender Inequality Index							
	Low parity		High parity				High parity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post fellowship x OWSD organization	-0.0029	-0.0022	0.13***	0.13***	0.14***	0.18***	0.29**	0.23***
	(0.0056)	(0.0082)	(0.016)	(0.013)	(0.028)	(0.020)	(0.066)	(0.60)
Post fellowship x OWSD organization x sandwich fellowship		-0.00097		-0.029		-0.021***		0.069
		(0.0072)		(0.084)		(0.027)		(0.065)
Mean of the dependent variable	0.034	0.034	0.21	0.21	0.18	0.18	0.23	0.23
Number of scientists	4,514	4,514	582	582	582	582	43	43
Number of scientist x year observations	45,140	45,140	5,820	5,820	3,492	3,492	430	430
Number of fellows/applicants	107	107	20	20	20	20	5	5

Notes. Estimates stem from ordinary least square regressions with inverse hyperbolic sine transformed outcome variables. All models include a full suite of calendar year, career age (which incorporates whether they published before their application), scientific field and time since fellowship fixed effects, and a control for the number of researchers in their home organization/field, the number of publications they author in the three years prior to the application, whether they collaborate with the host organization in the three years prior to the application, and whether their fellowship was a sandwich fellowship or full-time. Standard errors are clustered at the level of the scientist. Coefficients can be interpreted as elasticities.

Appendix D.

Table D-1. Alternative Functional Form

Dependent Variable:	Any collaborative publication with host country			
	(1)	(2)	(3)	(4)
Post fellowship x OWSD organization	0.0085*	0.0050	0.0036	0.0050
	(0.0047)	(0.041)	(0.0052)	(0.0041)
Post fellowship x OWSD organization x high gender parity home country		0.041**		
		(0.016)		
Post fellowship x OWSD organization x high gender parity host country			-0.0044	
			(0.0030)	
Post fellowship x OWSD organization x (high gender parity home country & host country)				0.041**
				(0.016)
Mean of the dependent variable	0.030	0.030	0.030	0.030
Number of scientists	5,096	5,096	5,096	5,096
Number of scientist x year observations	50,960	50,960	50,960	50,960

Notes. Estimates stem from fixed effects linear probability models in which dependent variables are a dummy variable that takes the value of 1 if a non-migrant has any collaborative publication with the host country researchers in a given year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively.

Table D-2. Results by Scientific Field

Dependent Variable: Number of collaborative publications with host country	Life Sciences				Physical and Social Sciences			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Post fellowship x OWSD organization	0.021**	0.0088*	0.012	0.0088*	-0.0040	-0.0057	-0.013	-0.0057
	(0.0096)	(0.0046)	(0.0077)	(0.0046)	(0.011)	(0.011)	(0.015)	(0.011)
Post fellowship x OWSD organization x high gender parity home country		0.093***				0.30***		
		(0.020)				(0.0094)		
Post fellowship x OWSD organization x high gender parity host country			0.012				0.010	
			(0.012)				(0.013)	
Post fellowship x OWSD organization x (high gender parity home country & host country)				0.094***				0.30***
				(0.020)				(0.0094)
Mean of the dependent variable	0.057	0.057	0.057	0.057	0.050	0.050	0.050	0.050
Number of scientists	3,295	3,295	3,295	3,295	1,801	1,801	1,801	1,801
Number of scientist x year observations	32,950	32,950	32,950	32,950	18,010	18,010	18,010	18,010

Notes. Estimates stem from fixed effects linear probability models in which dependent variables are a dummy variable that takes the value of 1 if a non-migrant has any collaborative publication with the host country researchers in a given year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively.

Table D-3. The Role of Organizational Female Representation at the Senior Level

Dependent Variable:	Number of collaborative publications with host country		
	(1)	(2)	(3)
Post fellowship x OWSD organization	0.0035	0.011	0.0019
	(0.0051)	(0.0087)	(0.0062)
Post fellowship x OWSD organization x high gender parity home country	0.098***		0.13*
	(0.020)		(0.070)
Post fellowship x OWSD organization x proportion of women in senior levels in home organization		0.0042	0.0067
		(0.015)	(0.011)
Post fellowship x OWSD organization x (high gender parity home country x proportion of women in senior levels in home organization)			-0.13
			(0.25)
Mean of the dependent variable	0.023	0.023	0.023
Number of scientists	5,096	5,096	5,096
Number of scientist x year observations	50,960	50,960	50,960

Notes. Estimates stem from ordinary least square regressions in which dependent variables are inverse hyperbolic sine transformed outcomes per scientist per year. All models include a full suite of calendar year, career age and scientist level fixed effects. Heteroskedastic robust standard errors, clustered at the fellow/applicant, are given in parentheses. *, **, *** denote statistical significance at p-values of 0.1, 0.05 and 0.01 respectively. Coefficients can be interpreted as elasticities. Senior level is defined as > 10 years of publication experience.