NBER WORKING PAPER SERIES

RETURN ON RETURNS:
BUILDING SCIENTIFIC CAPACITY IN AIDS ENDEMIC COUNTRIES

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Working Paper 31374
http://www.nber.org/papers/w31374

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 2023

We appreciate comments from Tom Vogl. We acknowledge NIH Fogarty International Center staff, US principal investigators and staff involved with the AITRP program, as well as a number of Fogarty trainees and African scientists for providing input into the research question and assisting in the interpretation of the results. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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June 2023
JEL No. F22,J61,O1,O3

ABSTRACT

We estimate spillovers from public funding for health research in the context of the NIH's Fogarty International Center's AIDS International Training and Research Program, which aims to strengthen scientific capacity in AIDS endemic countries by providing African researchers with training opportunities in the U.S. We use an event study difference-and-differences framework with information on scientists who participated in the program and the outcomes of African scientists working in the same scientific fields at their home institutions. Compared to control groups of similar scientists, our results show that scientists exposed to a returned trainee increase their publication output, particularly those with international coauthors. They also increase their grant funding and publish more HIV and WHO policy documents, showing that the Fogarty program impacted health policy related to the HIV/AIDS epidemic in African countries.

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1 Introduction

Public investments in research and development are key to addressing challenges to human health. In the U.S. alone, over $45 billion was spent in 2022 on medical research through the National Institutes of Health (NIH), with over 80% of the NIH budget funding research grants to extramural researchers.[1] Yet quantifying the impacts of public funding for research in terms of knowledge production and progress on public health issues is challenging. Existing evidence from the U.S. shows negligible impacts of NIH grants on researcher productivity on the margin, likely due to the large amount of alternative sources of funding available to researchers working in biomedical research in the U.S. (Jacob and Lefgren 2011).

In other contexts, particularly in settings where there are lower funding levels, recent evidence finds that the impacts of research funding are much larger, suggesting that the marginal dollars in these cases can have higher impacts on science. For example, after the end of the USSR, grants for researchers led to large increases in publications and scientists staying in the science sector during an economic crisis (Ganguli 2017). Moreover, looking beyond the direct recipient of a grant is an important step in ascertaining the returns to public funding. Even in the U.S., impacts of public research grants show large impacts on spillovers in terms of patenting (Azoulay et al 2019; Myers and Lanahan 2022).

In this paper, we estimate the impact of research funding in the context of the NIH's Fogarty International Center's AIDS International Training and Research Program (AITRP). Started in 1988, the goal of the program was to strengthen scientific capacity in AIDS endemic countries by providing African researchers with training opportunities in the U.S., with the hope that this would help to contain the global epidemic. While Fry (2022) shows that the African trainees returning back to African institutions have an impact on global networks, it lends itself to the question of whether this kind of research funding meets its goals of increasing scientific capacity in Africa across a variety of dimensions, and in a cost-effective manner.

To estimate the impact of this program, we examine measures reflecting an improvement in the scientific capacity of African countries and progress in combatting the HIV/AIDS epidemic. In our empirical strategy, we focus on the local African researchers who work in HIV-related areas before and after a Fogarty grantee participates in the program and returns to home. We measure both traditionally measured spillovers on the publications of local researchers, as well as impacts on research funding and HIV and WHO health policy documents.

We would expect larger effects of research funding programs in African countries compared to U.S. contexts that are typically the focus of innovation literature. Macro models point to the importance of

[1] https://www.nih.gov/about-nih/what-we-do/budget

scientific progress as a key driver of economic growth (Schumpeter 1942; Solow 1957; Abramovitz 1986; Romer 1990; Jones 1995). Yet the production of scientific knowledge is dominated by a handful of countries, and many African countries in particular are lagging far behind in terms of scientific output. Despite being home to over one billion people, in 2020, sub-Saharan Africa (excluding South Africa) accounted for less than 0.5% of global scientific publications, and gross domestic expenditure on research and development in the region is well below 0.5% of GDP (UNESCO fact sheet).[2] In the history of the Nobel prize, no one born or living in these countries has ever been awarded the prize in science.[3] It is surprising therefore that the nature of scientific knowledge production in many African countries, which have faced persistent challenges in achieving economic growth and severe health crises such as HIV and Ebola, has received relatively little attention in the innovation literature (Fry 2021).

Impacts of research funding and their spillovers are hard to trace, and obtaining data on African science is particularly challenging, particularly as few institutions or governments in Africa have websites with lists of researchers. Drawing on the AITRP program provides us with an opportunity to study the impact of the return home to Africa of the American trained scientists who participated in AITRP masters or Ph.D programs in America, and explore the extent to which their return home results in any changes in the production of knowledge by other researchers in Africa. We combine longitudinal information on the trainees with bibliometric information culled from publications, grant funding, clinical trials, and policy documents to measure these impacts.

Our approach compares the outcomes of scientists at African institutions who were "treated" by a scientist returning to their institution after participating in the AITRP program, and control groups of scientists who were not treated, to measure whether the training program leads to spillovers. Specifically, we use an event study difference-in-differences (DD) approach to estimate the causal effects of the return home of the American trained scientists. We use two control groups of peer scientists to measure the causal impact of the program: (1) scientists affiliated with African institutions that do not receive a returning FIC AITRP trainee but working in a similar area (neglected tropical diseases, NTD), and (2) scientists working in a different area - those who did not publish in NTD related research - but who are also affiliated with return institutions.

We focus on several main outcome measures that are particularly important in measuring scientific capacity in the African context. First, we use publication data, which are commonly used as measures of scientific productivity. Second, we use information on grant funding received from international sources, including the US National Institutes of Health (NIH) and the UK's Wellcome Trust. Third, a novel contri-

[2] For reference, in 2017 the global average share of GDP devoted to research and development was 1.7%, and the regional average for North America and Western Europe was 2.5% of GDP.

[3] The four countries with the most Nobel Prize winners are: the United States, the United Kingdom, Germany and France

bution of our work is showing the policy impacts of AITRP using information on health policy documents from the WHO and those dealing with HIV.

Our main results show evidence of spillovers from the AITRP. We show that scientists at institutions returned trainee had an increase in publications, particularly those in HIV-related research and those with international coauthors. There is very little difference between publication outcomes coauthored with the returned trainee and without, suggesting that the returnee is more likely to be facilitating introductions between African- and American-based scientists, as opposed to adding Africans to their own publications. They also have increased grant funding and published HIV and WHO policy documents, showing that the Fogarty program significantly impact health policy in African countries. A back-of-the envelope calculation shows that the cost per publication amongst local African scientists is approximately USD $9,195, which is relatively low given estimates from other contexts. For example, one estimate of the cost of one publication in the United States is around USD $1.7million (Jacob and Lefgren 2011).

Our results highlight the large impacts public investments in health research can have particularly in countries where funding levels are low. The results also show how training for scientists from developing countries abroad are also a channel to bring in 'ideas' which underlie models for sustained economic growth. Closely related papers show that returnees encourage the flow of knowledge between countries (Filatotchev et al 2011; Kogut and Macpherson 2011; Kenny et al 2013; Kahn and MacGarvie 2016; Bahar et al 2019) but few have shown the impact in terms of productivity spillovers on other local researchers, particularly on the health policy impacts. Ganguli and Wang (2022) use the Chinese Thousand Talents program to show that the colleagues of Chinese scholars who return to China show an increase in publications with international coauthors, but that the effects are limited to lower-ranked institutions as most higher-ranked institutions were already connected to international communities. Fry (2022) studies the same AITRP program but focuses on publications and the role of scientific networks, showing how returnees act as brokers in global knowledge networks for local researchers who have limited prior international connections. In this paper, we focus on the broader impacts of the AITRP program by looking at the wider set of colleagues who benefit from the program and not just in terms of publications, but also in terms of their contributions to grants and health policy documents. This finding has broad implications for cost benefit calculations of scientific capacity building programs, and for organizations in low and middle income countries seeking to improve knowledge production.

2 Setting, Data and Empirical Approach

2.1 The Fogarty International AIDS Training Program

Established in 1968, the National Institutes of Health Fogarty International Center (NIH FIC) funds research and training projects across American and foreign universities. One of the largest programs in the NIH FIC is the AIDS International Training and Research Program (AITRP) (now known as the HIV Research Training Program). Started in 1988 the goal of the program was to strengthen scientific capacity in AIDS endemic countries, with the hope that this would help to contain the global epidemic.

> *'But it really changed with the AIDS epidemic, and the realization that to address this particular epidemic we had to change our style of conducting research internationally. We had to overtly move away from the 'colonial' research, or the 'parachute' approach, and really get into collaborative research and capacity building on site.'* Gerald Keusch, MD, Director of FIC 1998-2003

Principal investigators (PIs) in American universities can apply to train researchers from low and middle income country (LMIC) sites (universities, hospitals and research centers). If successful, the American-based PIs receive grants in five year cycles, of around USD $500,000 a year, renewable upon re-competition. The PI can offer short or long-term training, usually with a combination of American and field site location, although the long-term degree level (Ph.D and masters) training at the American university is generally the focus of the program.

Following long-term training at the American institution, trainees are encouraged to return home to their country of origin through a variety of carrot and stick incentives including re-entry funding, visa restrictions, formal return agreements and strategic selection of trainees. A survey carried out by FIC in 2002 found that a return rate of over 80% at that time, taking up variety of positions ranging from academic positions to roles in government and multilateral organizations.[4]

2.2 Sample

2.2.1 The Returning Trainees

The returning trainees in the dataset are African scientists who participated in long-term FIC AITRP supported training at American institutions between 1988 and 2014 inclusive (see Fry (2022) for more

[4]https://www.fic.nih.gov/News/GlobalHealthMatters/july-august-2012/Pages/hiv-aids-aitrp-program-anniversary.aspx last accessed 10-8-19

information on the trainees themselves). Names and graduation dates of African trainees participating in FIC AITRP long term programs are gathered directly from the records of United States institutions involved. The names of the trainees are then matched with publication data, if any, using the Elsevier Scopus publication database, and information on institution of return for each trainee is gathered based on publication affiliations post graduation. Out of 426 African researchers who took part in long term training in the United States over the full time period (1988-2014), 244 trainees in the sample are affiliated with their home country and continue as publishing scientists following their training, hereon considered returnees. On return to their home country, the trainees take up a variety of positions across academic, government and non-profit institutions.

2.2.2 Treated Peer Scientists

The goal of our analysis is to measure the impact of AITRP trained scientists participating and then returning to African institutions. Therefore we focus on scientists working in the institutions in Africa at the time of return of the FIC AITRP trainee. Using the Elsevier Scopus publication database, we first generate a full sample of scientists affiliated with African institutions and publishing in health, biomedical or social sciences and have published at least three times and in last or first author position at least once between 1988 and 2014 in each of the 15 countries to which FIC AITRP trainees return. From this sample we extract those scientists affiliated with the institutions that the FIC AITRP trainees move (back) to in the 3 years before the FIC AITRP trainee graduates, meaning that they published in at least one of the three years prior to the graduation (and assumed immediate return) of the FIC trainee and identified their affiliation as that of the FIC AITRP returning institution. This process gives us 6,400 scientists, 50 percent of whom (3,235 scientists) publish in neglected tropical disease (NTD) related research prior to the return event, hereby considered 'treated' scientists. We chose to consider scientists who publish in NTD prior to the return event as treated scientists because HIV is an NTD, and scientists in Africa who publish in HIV tend to also publish in other NTD's such as tuberculosis and malaria. Returnees who cannot be linked with publishing peer scientists (because their institutions are too small, or there are no scientists publishing in NTD related research in their return institution) drop out of the sample, leaving 179 returnees in our sample for whom we measure the impact on their peers at home.

2.2.3 Control Group Scientists

The main analysis in the paper compares the outcomes of the "treated peers" described above to outcomes of similar scientists affiliated with institutions that don't have a returning FIC AITRP trainee. We refer to this control group as “Non-returnee Institution Scientists” or control group A.

Similar scientists affiliated with non-return institutions are identified from the entire corpus of remaining scientists after the treated scientists were extracted from the sample using a matching procedure. Specifically, we match scientists in return institutions with those in non-return institutions using a coarsened exact matching (CEM) procedure to ensure that career age and the total number of publications in each of the five years leading up to the return event are similar. In some instances, several matches are found for one return institution scientist, and unmatched scientists are discarded.[5] Each matched non-return institution scientist is given a counterfactual return year based on the return year of their return institution scientist counterpart. This procedure leaves 5,500 return institution scientists (or an average of 31 scientists publishing in biomedical sciences per trainee) and 105,813 non-return institution scientists.

From this sample, all scientists in return and non-return institutions who had a publication in NTD related research in the three years prior to the return event (or counterfactual) are extracted for the main analysis. This primary analysis sample comprises 2,519 treated scientists and 33,016 control scientists.

A secondary analysis compares the treated peers described above to a second control group of scientists who did not publish in a NTD prior to the return event and who are also affiliated with return institutions (control B). We refer to group as “Returnee Institution Scientists, no prior NTD”. These are scientists in return institutions who are publishing in areas different from NTD, such as maternal health, cardiovascular health, nutrition, amongst others. In the event that returnee institutions are improving at a rate faster than non-returnee institutions, independent of the return event, this additional analysis accounts for these time-varying changes.

Table 1 shows that there are some differences in the levels of pre-return outcomes between treated and untreated non-migrants. For example, treated scientists tend to have more internationally collaborative publications than scientists in returnee institutions, but with no prior NTD experience (control group B). While the levels of publication outcomes and collaborative patterns are different across treated and control scientists, the trends even in the raw data leading up to the fellowship application year are similar (Figure 1a). This is consistent with the parallel trends assumption and allows us to estimate the effect of the return event using an approach that compares the outcomes within a non-migrant scientist before and after the return home.

[5] It is important to note that because of the relatively small population of scientists in African countries, it is difficult to identify exact control matches for each returnee scientist.

2.2.4 Measurement

For every scientist in the sample, we collect data on publications, contributions to policy documents, awarded grants and clinical trials participated in and generate a number of annual variables as outcomes.

Publication data: The full publication history for each treated and control scientist in the sample is gathered from the Elsevier Scopus publication database, and the following variables are generated:

- **Publication counts**: The number of publications each year on which the scientist is a contributing author. An alternative measure adjusts the number of publications. by each publication's source normalized journal impact factor, a measure of the average number of citations per publication in the journal. Publications in HIV are identified using a key word search of the title/abstract/key of each publication.
- **Last authored publications**: The number of publications each year on which the scientist is the last author. In science, last authors are typically the principal investigator contributing intellectual oversight as well as funding to the research.
- **Average team size**: The average number of authors across all publications on which the scientist is a contributing author each year.
- **Internationally collaborative publications**: The number of publications each year on which the scientist is a contributing author and on which collaborators based in foreign countries are also listed as contributing authors.

Policy documents: Using the Altmetrics database, we gather data on policy documents that reference publications authored by sample scientists, and generate the following variables:

- **Policy document count**: The number of policy documents each year referencing publications on which the scientist is a contributing author. Documents in HIV are identified using a key word search of the title of each policy document. Documents authored by the World Health Organization (WHO) and African policy makers are also identified.

Grants: Data on all National Institutes of Health (NIH) and Wellcome Trust grants committed to Africa based recipients are gathered from the grant awarding organization websites. The NIH is the United States government research grant awarding entity, and the Wellcome Trust is a foundation in the United Kingdom and is one of the largest research funders in Africa. We then match grants to our sample scientists using the names of principal investigators and co-principal investigators in the grant documentation, and generate the following variables:

- **NIH grants awarded**: The number of NIH grants awarded on which the scientist is a principal or co-principal investigator each year.
- **Wellcome Trust grants awarded**: The number of Wellcome Trust grants awarded on which the scientist is a principal or co-principal investigator each year.

2.3 Estimation Approach

In order to identify the effect of the program, we use an event study differences-in-differences approach, where we compare local researchers' outcomes after a trainee returns relative to before, and relative to the change in local researchers' outcomes who did not have a trainee return, using a scientist fixed effect specification. There are two potential concerns regarding selection that could have implications for the interpretation of our results: the selection of trainees who show particular potential for home country impact, and the selection of particularly promising return institutions by the trainee. To address both of these issues, we focus our analysis on the home country colleagues of program trainees, and we exploit the timing of the return home of the trainees. Our use of scientist level fixed effects allows us to account for between non-migrant scientist and between institution time-invariant heterogeneity, and the contribution of the control group scientists in the analysis is that it identifies calendar year and cohort effects.

The estimating equation (equation 1) relates scientist *i*'s outcomes in year *t* to their institution and timing.

$$
\begin{aligned}
E\left[y_{it}|X_{it}\right] = exp\Big[&\beta_0 + \beta_1 AFTER\_RETURN_t \times RETURN\_INSTITUTION_i \\
&+ f(AGE_{it}) + \delta_t + \gamma_i\Big]
\end{aligned}
\tag{1}
$$

Where *y* is the outcome measure, AFTER_RETURN denotes an indicator variable that switches to one the year the return event. RETURN_INSTITUTION denotes an indicator for if the scientist is affiliated with an institution receiving a returning FIC AITRP trainee. f(age) corresponds to a flexible function of the scientist's career age as is standard to include in studies of scientist productivity (Levin and Stephan 1991) and δ_t stands for a full set of calendar year indicator variables to account for the fact that aggregate research activities may vary over time. γ_i correspond to scientist fixed effects. Regression models include weights at the individual level assigned by the coarsened exact matching procedure. Standard errors are clustered at the level of the institution of the individual scientist.

Analysis using control group B replaces RETURN_INSTITUTION with Prior_NTD_experience and the sample is limited to just scientists based in returnee institutions at the time of the return event.

3 Results

We present effects of the returnee scientists on four main outcomes of knowledge generation: peers' publications, policy documents and NIH funding.

3.1 Graphical Results

We first show the effects graphically in Figure 1a (additional outcomes represented in appendix figures A-1 and A-2). The figure shows the average number of publications per scientist by year relative to the return of a trainee scientist. The small dashed line represents outcomes for the treated scientists - those in the same institution, who had previously published in NTD areas. The solid line is control group A, or those scientists in non-returnee institutions also with prior NTD experience. The graph shows that prior to the return of the trainee, both groups follow a similar publication trend. After the return of a trainee, publications for the treated peer scientists working in the same institution and in NTD rise more than for the other control groups.[6] While all groups experience a decline after the initial bump in year 0, the average publications for treated peers is higher than the control group and this effect persists for 5 years after the return. We attribute the immediate increase in publications to the fact that the publication cycle in biomedical sciences is typically very short, and African-based scientists may be joining projects nearer to the end of the project (possibly after the grant is obtained and field work is taking place).

3.2 Regression Estimates

3.2.1 Publications

We turn to regression estimates of these differences-in-differences and present the results in Tables 2-4. In each table, we show the difference in differences estimates using each control group (different institution + NTD experience and same institution + no prior NTD pubs). Table 2 shows the estimates for publication outcomes. As evident in Figure 1a, we see significant effects on a number of publication outcomes. Focusing on the analysis with control group A in Panel A, column 1 shows that publications of treated peer scientists overall increase by 5.3% (from a mean of 0.73 publications). This amounts to approximately 0.039 additional publications per scientist per year, or 0.19 publications in a 5 year period following the return of the American trained scientist. While this may not sound like much, given the low baseline rate of production, a 5% increase on the mean represents a significant productivity shift. Furthermore, given that

[6]The jump in year 0 for all scientists is an artefact of the data collection procedure - scientists are most likely to have published in year 0 as we define inclusion in the sample of treated or control as having a publication in the years leading up to the return event, which is mechanically most likely in year 0 (considering career age and annual trends).

each returning trainee impacts more than 14 treated colleagues on average, this implies that each returnee contributes around 2.7 spillover publications in a five year window after their return.

Accounting for quality of the publications by weighting by the journal impact factor in Column 2, we see large increases of almost 30%. In Column 3, we show that most of the increase comes from HIV-related publications, which is where we would expect the knowledge spillovers to be happening given the training program's focus on HIV.

We don't see any impact on non-HIV publications or last-authored publications specifically. We see in Column 6 that the treated peers are working in larger teams and in Column 7 that there are significant increases in the number of publications with an international coauthor, with these publications increasing by 8.6% from a mean of 0.38.[7]

Column 9 shows very little difference between results of publication outcomes coauthored with the returned trainee and without. In fact, very few non-migrants (just 1 percent of the non-migrant sample) coauthor publications with the returning scientist after their return home. This implies that the returnee is more likely to be facilitating introductions between African- and American-based scientists, as opposed to adding non-migrants to their own publications.

Panel B, which reports the results of analysis using control group B as the comparison group (same institution and no prior NTD pubs), overall shows similar results, with a few differences, including positive effects on non-HIV publications. This is plausible as this control group worked on non-NTD areas prior to the return of the trainee. Since the HIV publications also increase for this group, this means that these scientists are also shifting the direction of their research towards HIV in response. We also see an increase in last authored publications and domestic publications when using this control group.

Figure 1b shows the difference in differences estimates with control group A graphically. Each bar represents the coefficient from a regression interacting dummies for each year before and after the return of a trainee and a dummy for a treated peer scientist. The effect of the return of a trainee on peer publications is clear beginning 1 year after the return of the trainee, and the impact appears persistent.

3.2.2 Policy Documents

We present the estimate for contributions to policy documents in Table 3. In panel A with control group A, Column 1 we see that the arrival of a trainee leads to an overall increase in contributions to policy documents of around 5%. Columns 2-4 separate the documents into the type of documents. The

[7]These results are robust to accounting for variation in treatment timing and multiple time periods using the Callaway and Sant'Anna (2021) difference-in-difference estimation (see online appendices).

results show that the increases are coming from HIV and WHO policy documents rather than African policy documents. Column 5 has a binary dependent variable of any policy documents or not, showing that treated peer scientists are 5 percentage points more likely to contribute to a policy document after a trainee arrives. Column 6 shows that the proportion of a scientist's publications that are mentioned in policy documents also increases significantly.

3.2.3 Grants

Finally, we turn to impacts on grants in Table 4. As was evident in Figure 1d, Column 1 shows that the likelihood of getting any NIH grant increases by 0.1.5% as well as the amount received. Although see that there is also an increase in getting a Wellcome Trust grant and in the amount received, the magnitude of this increase is much smaller than that of the NIH grants, which is consistent with the idea that the returning trainees are bringing back US specific knowledge and connections.

4 Conclusion and Discussion

This paper offers a new perspective on the returns to public investments in research on health. We estimate the impact of the return home of African scientists after participating an NIH training program in the United States on local scientists working in the institutions they return to and in the same fields, and find that the publication rates of these researchers increase. Going beyond publications, we show that there are also spillovers to the program in terms of grants and policy documents.

We show that unlike in the U.S., the impacts of research funding can be large, suggesting that the marginal dollars in these cases can have higher impacts on science. The findings also inform the topical debate on immigration and mobility, in particular the impact of migration of high-skilled individuals in and out of developing countries. To date, much research on this topic has focused on the mobile individual themselves. The spillovers gained from return migration documented in this paper should be an important consideration of future research and program design aimed to promote scientific capacity in developing countries.

Our results have broad implications for cost benefit calculations of scientific capacity building programs, and for organizations in low and middle income countries seeking to improve their ideas production. A back-of-the envelope calculation shows that the return on investment in the program is approximately USD $9,195 per publication in the five years after the return of the trainee.[8] Estimates of the cost per publication in other contexts vary widely. But given that one estimate of the cost of one publication in the United States is around USD $1.7million (Jacob and Lefgren 2011), we tentatively conclude that the gains from supporting returning trainees far outweigh the cost, and programs such as AITRP provide significant bang for their buck.

[8] We interviewed several principal investigators in the program and asked them the cost per returnee (including travel costs, any benefits, stipend and tuition) and the average estimate of returnees in our sample (a combination of masters and PhD students, assuming each trainee spends on average one year in the United States as part of their training) is approximately USD $80,000 per returnee. On average each returnee produces six publications in the five year period following their return home (online appendices Figure A-3), and 2.7 'spillover' publications, or publications authored by local peers of the returnee after their return, totaling contributions to 8.7 publications overall.

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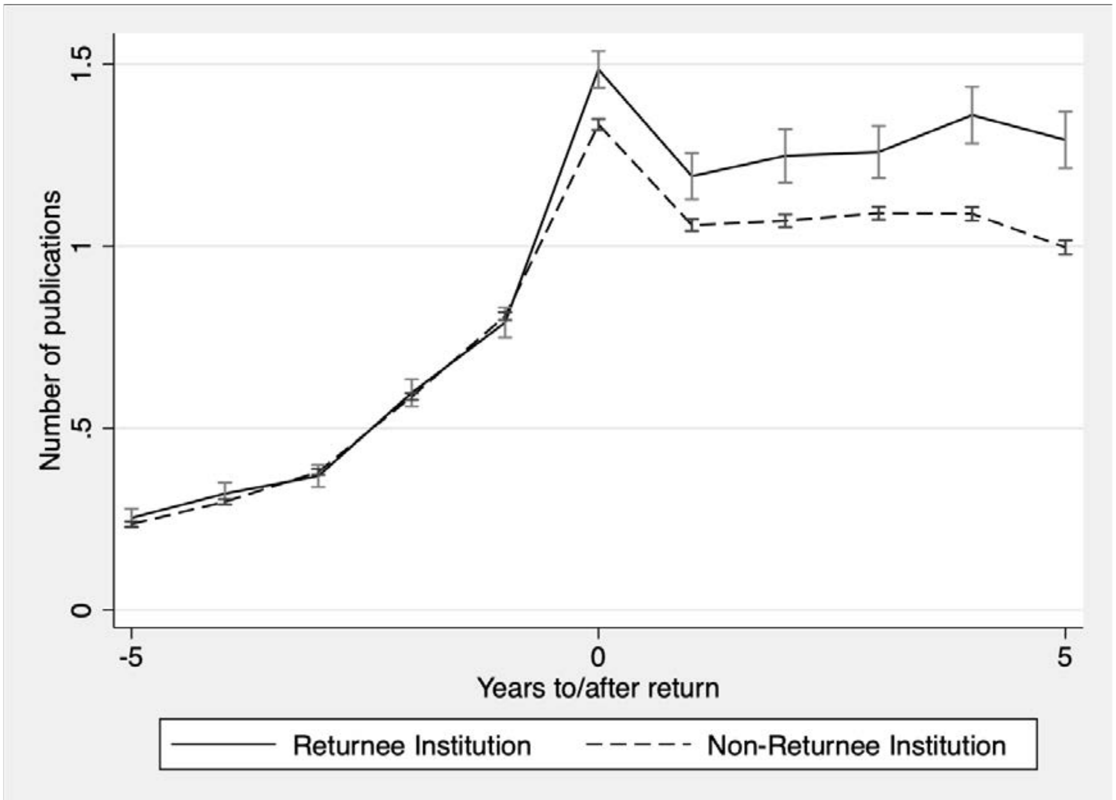
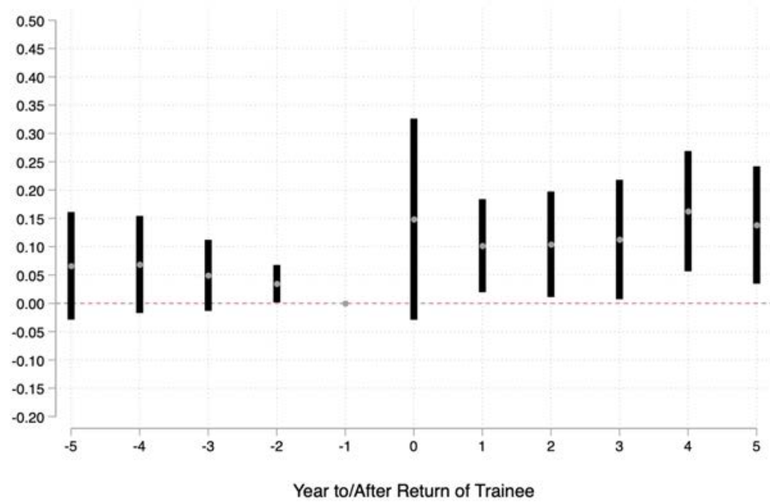
Tables and Figures

Figure 1: Impact of the Return of an American Trained Scientist on Non-Migrant's Publication Outcomes



(a) Raw data plot



(b) Regression coefficients

Notes: Raw trends of average publication output per non-migrant for the are plotted for the five years before and after return of the US trained scientist in panel (a). In panel (b), coefficient estimates stemming from conditional (scientist) fixed effects ordinary least squares specifications in which inverse hyperbolic sine publication output is regressed onto year effects, article age effects, as well as 10 interaction terms between treatment status and the number of years before/after the return of a trainee (the indicator variable for treatment status interacted with the year of return is omitted). The 90% confidence interval robust standard errors clustered around the institution is plotted with light blue bars.

Table 1: Statistics for Non-Migrant African Study Scientists the Year Before the Return of a Trainee

	Returnee Institution, Prior NTD Experience Treated Scientists (N = 2,519) (1)		Non-Returnee Institution, Prior NTD Experience Control Group A (N = 33,016) (2)		Returnee Institution, No Prior NTD Experience Control Group B (N = 2,981) (3)		(2)-(1)	(3)-(1)
	mean	std. dev.	mean	std. dev.	mean	std. dev.	mean (std. dev.)	
Career age	4.52	6.70	4.26	6.24	5.00	7.30	0.26	-0.48
							(0.14)	(0.19)
Number of publications	0.79	1.06	0.81	0.98	0.58	0.89	-0.018	0.21
							(0.21)	(0.026)
Number of source normalized impact per paper (SNIP) weighted publications	658	1141	593	980	386	825	66	272
							(21.35)	(26.60)
Number HIV publications	0.31	0.64	0.30	0.63	0	0	0.012	0.31
							(0.014)	(0.012)
Number international collaborative publications	0.44	0.81	0.39	0.73	0.20	0.54	0.051	0.23
							(0.016)	(0.018)

Notes: This matched study sample consists of African scientists who were actively publishing in biomedical, health or social related research at the time of the return (or counterfactual return) of a FIC AITRP trainee. All variables are measured using scientist level data gathered from the Elsevier Scopus database, and measurements are made the year before the return year, and weighted by an individual's matching weight, unless stated otherwise.

Table 2: The Impact of Returnees on Non-Migrants' Publication Outcomes

	Number of Publications	Impact Factor Weighted Publications	Number of HIV Publications	Number of non-HIV Publications	Any Last Authored Publication	Average Team Size	Internationally Collaborative Publications	Domestic Publications	Number of Publications, Excl. Returnee Coauthor
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Control Group A different institution, NTD experience									
Returnee institution × after return	0.0534**	0.2930***	0.0871***	-0.0212	-0.0026	0.1373***	0.0864***	-0.0267	0.0507**
	(0.024)	(0.103)	(0.021)	(0.018)	(0.006)	(0.034)	(0.026)	(0.016)	(0.024)
Total Observations	390886	390886	390886	390886	390886	390886	390886	390886	390886
Mean of Dep. Variable	0.7330	586.7453	0.2282	0.5048	0.0981	3.4085	0.3803	0.3527	0.7279
Control Group B same institution, no NTD experience									
Prior NTD experience × after return	0.1534***	0.7031***	0.1082***	0.0672***	0.0132***	0.2674***	0.1529***	0.0187**	0.1521***
	(0.024)	(0.131)	(0.025)	(0.017)	(0.005)	(0.046)	(0.022)	(0.009)	(0.023)
Total Observations	60500	60500	60500	60500	60500	60500	60500	60500	60500
Mean of Dep. Variable	0.7540	640.0847	0.1898	0.5642	0.1163	2.6310	0.4053	0.3487	0.7422
Author FE	X	X	X	X	X	X	X	X	X
Year FE	X	X	X	X	X	X	X	X	X
Career Age FE	X	X	X	X	X	X	X	X	X

$^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$

Notes: [a] Estimates stem from fixed effects ordinary least squares specifications in which dependent variables in columns 1-4, and 6-9 are inverse hyperbolic sine transformed counts of outcomes per scientist in a given year, and in column 5 the dependent variable is a dummy variable which takes the value of 1 if the focal scientist has a publication of that type in a given year. All models incorporate a full suite of calendar year, career age and scientist fixed effects.
[b] Heteroskedastic robust standard errors, clustered at the institution, are given in parentheses.

Table 3: The Impact of Returnees on Non-Migrants' Contributions to Policy Documents

	Number of Policy Documents	Number of HIV Policy Documents	Number of WHO Policy Documents	Number of African Policy Documents	Any Policy Documents	Proportion of Publications in Policy Documents
	(1)	(2)	(3)	(4)	(5)	(6)
Control Group A different institution, NTD experience						
Returnee institution × after return	0.0506***	0.0253***	0.0398***	-0.0004	0.0366***	0.0367**
	(0.016)	(0.010)	(0.012)	(0.000)	(0.011)	(0.016)
Total Observations	390885	390885	390885	390885	390885	159504
Mean of Dep. Variable	0.1014	0.0138	0.0707	0.0006	0.0631	0.0974
Control Group B same institution, no NTD experience						
Prior NTD experience × after return	0.1047***	0.0407***	0.1016***	-0.0013**	0.0790***	0.0742***
	(0.013)	(0.009)	(0.011)	(0.000)	(0.010)	(0.013)
Total Observations	60500	60500	60500	60500	60500	23894
Mean of Dep. Variable	0.0955	0.0195	0.0627	0.0011	0.0574	0.0908
Author FE	X	X	X	X	X	X
Year FE	X	X	X	X	X	X
Career Age FE	X	X	X	X	X	X

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Notes: [a] Estimates stem from fixed effects ordinary least squares specifications in which dependent variables in columns 1-4, and 6 are inverse hyperbolic sine transformed counts of outcomes per scientist in a given year, and in column 5 the dependent variable is a dummy variable which takes the value of 1 if the focal scientist has a publication of that type in a given year.

[b] Heteroskedastic robust standard errors, clustered at the institution, are given in parentheses.

Table 4: The Impact of Returnees on Non-Migrants' Grants

	Any NIH grant	NIH USD granted	Any Wellcome Trust grant	Wellcome Trust USD granted
	(1)	(2)	(3)	(4)
Control Group A different institution, NTD experience				
Returnee institution × after return	0.0015**	0.0679***	0.0009**	0.0133**
	(0.001)	(0.020)	(0.000)	(0.006)
Total Observations	390885	390885	390885	390885
Mean of Dep. Variable	0.0010	9606.2813	0.0010	1069.7935
Control Group B same institution, no NTD experience				
Prior NTD experience × after return	0.0014**	0.0675***	0.0004	0.0065
	(0.001)	(0.024)	(0.000)	(0.005)
Total Observations	60500	60500	60500	60500
Mean of Dep. Variable	0.0011	11997.4659	0.0007	635.6659
Author FE	X	X	X	X
Year FE	X	X	X	X
Career Age FE	X	X	X	X

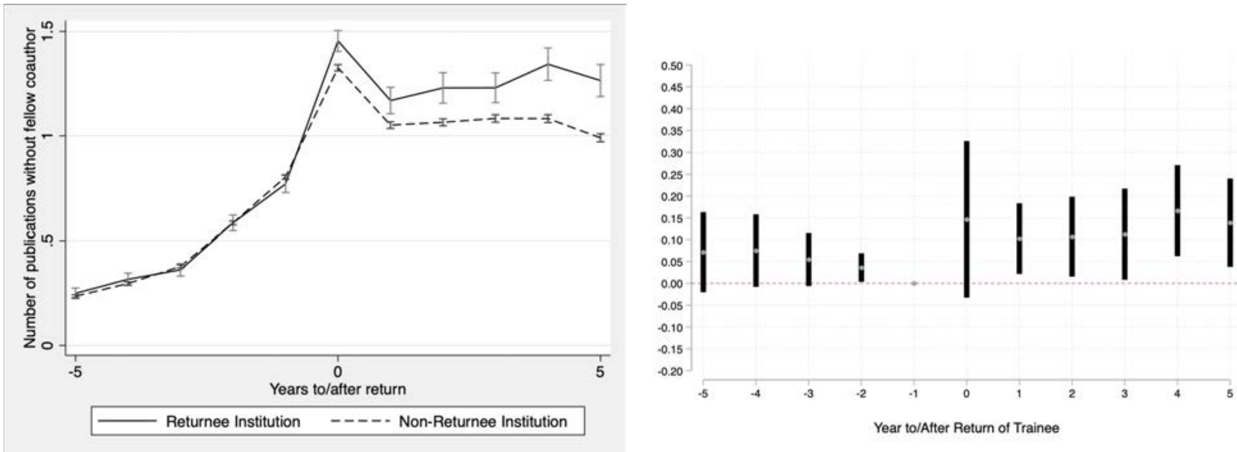
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Notes: Notes: [a] Estimates stem from fixed effects ordinary least squares specifications in which dependent variables are inverse hyperbolic sine transformed counts of outcomes per scientist in a given year. All models incorporate a full suite of calendar year, career age and scientist fixed effects.
[b] Heteroskedastic robust standard errors, clustered at the institution, are given in parentheses.

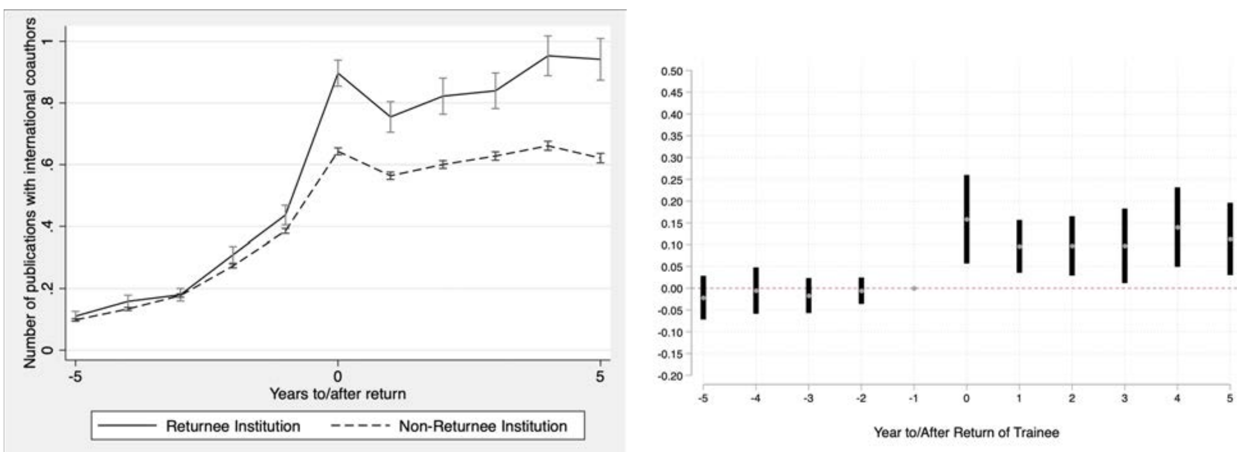
Online Appendices

Appendix A: Additional Figures and Alternative Specifications

Figure A1: Additional Publication Outcomes for Non-Migrant Scientists Before and After the Return of an American Trained Scientist

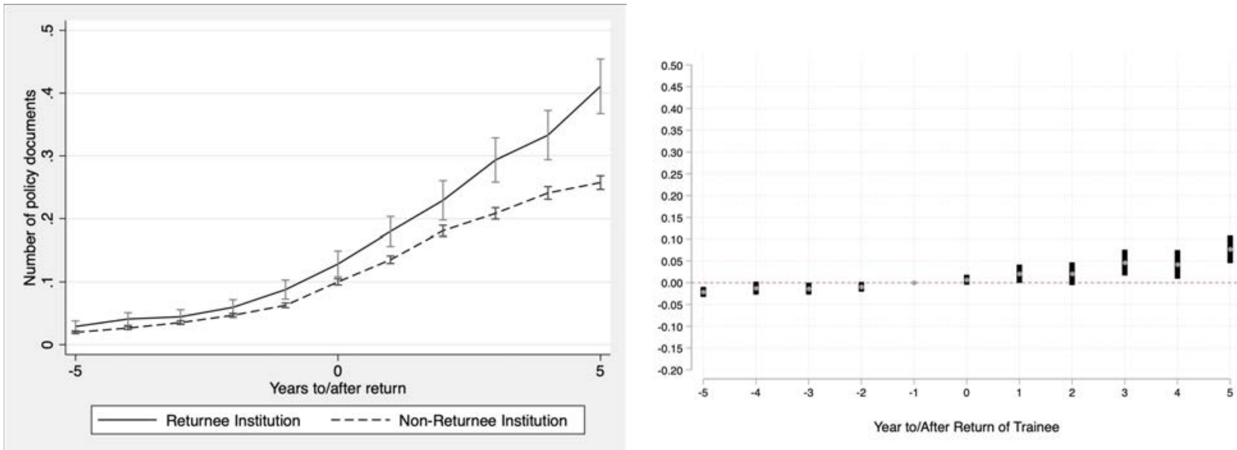


(a) Number of publications without returnee

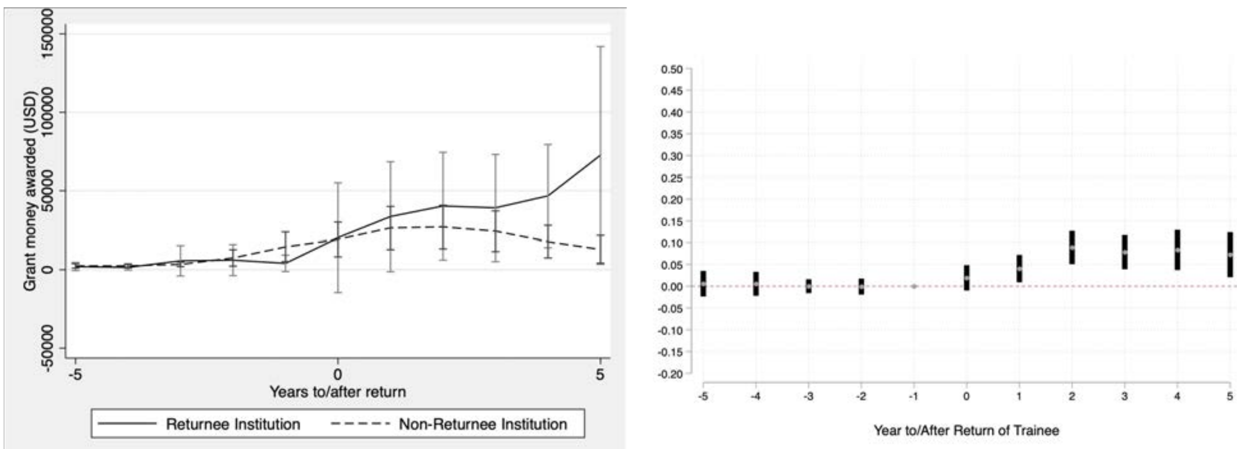


(b) Number of internationally collaborative publications

Figure A2: Policy Document Contributions and Grant Funding for Non-Migrant Scientists Before and After the Return of an American Trained Scientist



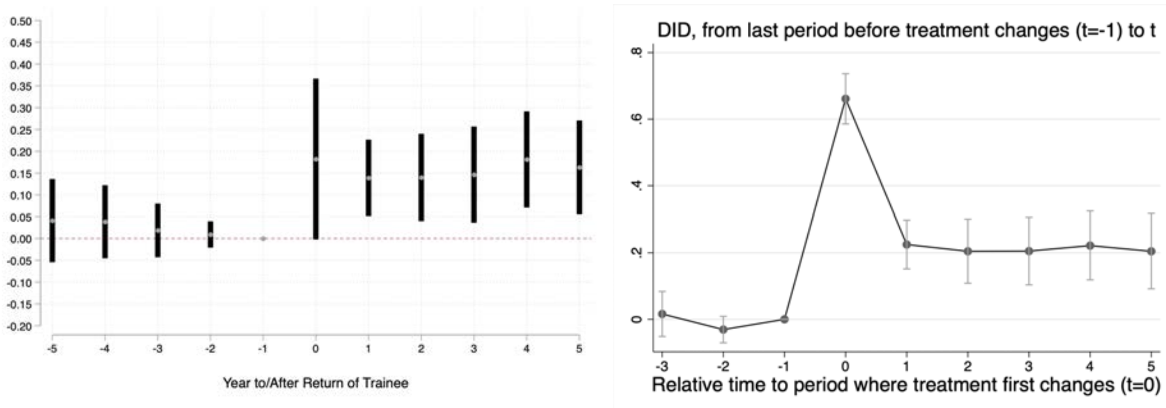
(a) Number of contributions to policy documents



(b) NIH grant money awarded

Notes: Raw trends of average outcome variables per non-migrant for the are plotted for the five years before and after return of the US trained scientist on the left hand side. On the right hand side, coefficient estimates stemming from conditional (scientist) fixed effects ordinary least squares specifications in which inverse hyperbolic sine outcomes are regressed onto year effects, article age effects, as well as 10 interaction terms between treatment status and the number of years before/after the return of a trainee (the indicator variable for treatment status interacted with the year of return is omitted). The 90% confidence interval robust standard errors clustered around the institution is plotted with light blue bars.

Figure A3: Modern Difference-in-Differences Method



(a) Unweighted event study estimates

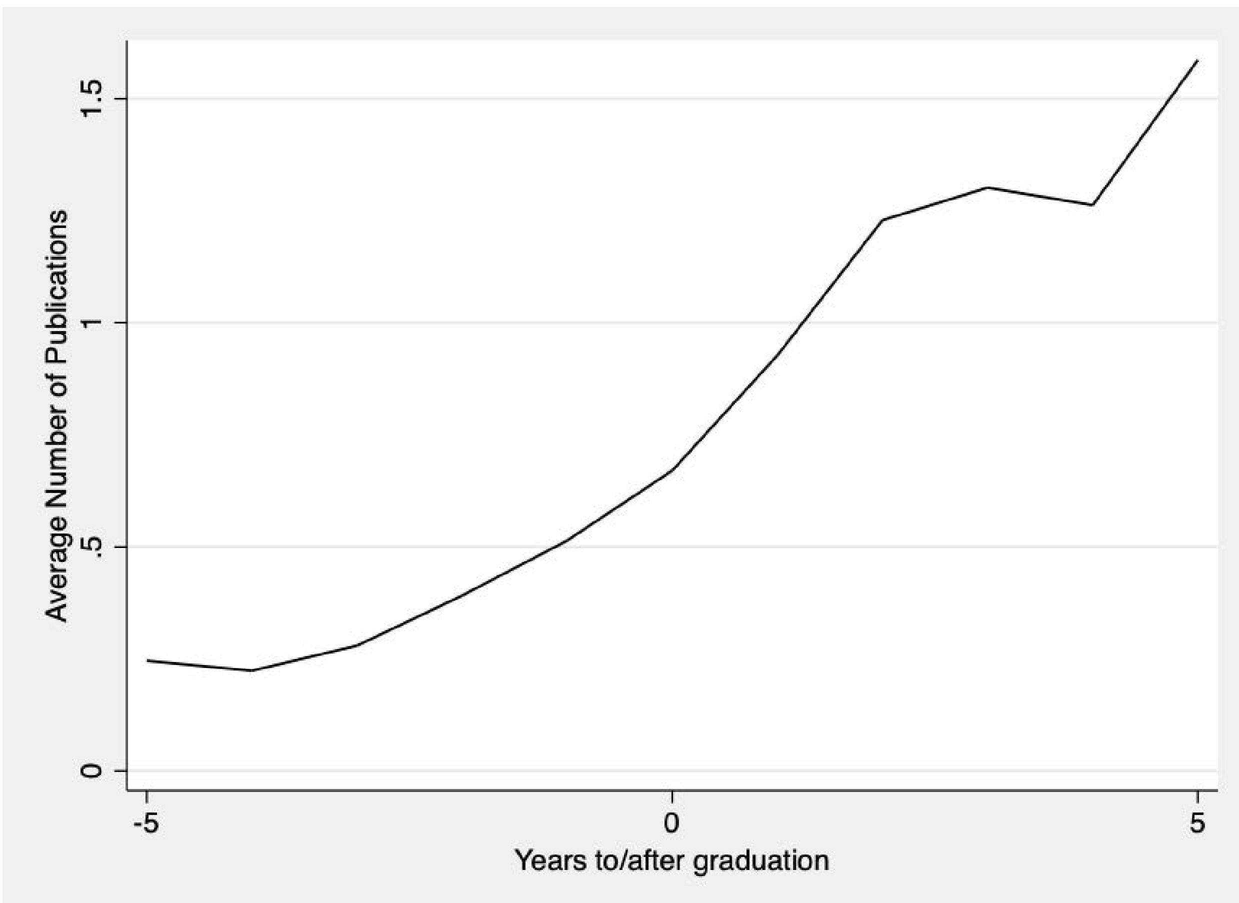
Notes: Event study estimates are generated using the De Chaisemartin and d'Haultfoeille (2020) procedure at the non-migrant year level and results are presented on the right hand side (event study estimates using unweighted samples using ordinary least squares are presented on the left hand side). All models include a control for career age trends and observations are unweighted. Figures show bootstrapped 95% confidence intervals. Standard errors are clustered at the level of the returnee.

Table A1: FIC AITRP Returnees by Country

Country	Number of Returnees
Kenya	73
Uganda	61
Zambia	36
Tanzania	20
Botswana	19
Malawi	9
Senegal	6
Nigeria	5
Mozambique	4
Rwanda	3
Zimbabwe	3
Ethiopia	2
Central African Republic	1
Burkina Faso	1
Lesotho	1

Note: This table provides details on the sample of 244 scientists who are trained in the United States in long-term training programs supported by the FIC AITRP and return home following their graduation (graduating between 1988 and 2014).

Figure A4: Returnee Publication Record



Notes: We plot the average number of publications authored by sample returnees in years before and after graduation from the FIC AITRP program.