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RCT IDEAS FOR SCIENCE IN LOW- AND MIDDLE-INCOME COUNTRIES

Research on science in low- and middle-income countries (LMICs) across fields of study is relatively nascent. Thus far, the field has primarily focused on the relationship between access to networks in high-income countries and scientific discoveries or innovation in LMICs. In this review, I propose possible randomized control trials (RCTs) that could help expand our understanding of how scientific discovery may be accelerated in LMICs, including how to address gaps in research on network connections to high-income countries and new potential avenues for supporting this expansion.

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This document was prepared by Elizabeth Lyons in coordination with J-PAL's Science for Progress Initiative. It is not an exhaustive review of all the evidence on this topic.

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1. BACKGROUND

1.1 NETWORKS, TRAINING, AND LOCAL SCIENTIFIC PROGRESS

A positive relationship between scientific productivity in LMICs and access to diaspora members and research collaborators in high-income countries has been repeatedly demonstrated.[1] Fry (2022) makes progress on providing causal evidence of this relationship by analyzing the impact of returning foreign-trained African scientists on the productivity of home country scientists in the institutions they return to. Compared to African scientists in similar institutions, the colleagues of foreign-trained scientists significantly increased their publication output after the foreign-trained scientists returned to their institution. Fry & Ganguli (2023) demonstrate that the same training program for African scientists increased scientific publications, grant funding, and policy document publications in returnee institutions. Similarly, Fry (2023) finds that increases in collaborations between West African scientists and OECD scientists in response to Ebola outbreaks increased the productivity of West African scientists with prior infectious disease research experience.

Notably, while return migration may benefit scientific productivity among non-migrants in LMICs[2], existing evidence suggests the productivity of the scientists who immigrate back is reduced. Kahn and MacGarvie (2016)[b] find that foreign-born, U.S.-educated scientists who return to lower-income countries have significantly lower research productivity than those who return to high-income countries.

Access to networks in high-income countries may play a role in accelerating science in LMICs. A small body of literature considers the impact of education and training programs on science and innovation outcomes. One such training program is the Fogarty International Center's Scholars and Fellows Program which funds 1-year training opportunities for LMIC postdocs and trainees at LMIC research centers. In addition to training on global health research, the program provides opportunities for participants to present research to and network with scholars from around the world. Survey evidence has shown that the program increases the likelihood that LMIC scholars pursue careers in global health research (Heimburger et al, 2015) and that scholars' research influences policy in their respective countries (Bennett et al, 2013).

Another ambitious training program is The Structural Transformation of African Agriculture and Rural Spaces (STARS) program which pairs junior scholars in Africa with research mentors at Cornell University who support and guide the junior scholars through a research program. Training and networking opportunities are also provided. Early evidence suggests that the research produced through

[1] For example, Agrawal et al (2011) study the citation patterns of USPTO by inventors located in India and find these patents are more likely to cite patents filed by inventors with Indian last names not located in India than patents filed by inventors with non-Indian last names who are not located in India. However, they also find that, on average, these estimated within-ethnicity knowledge spillovers are smaller than knowledge spillovers between those living in the same country. These results suggest that emigration of scientists from India likely reduces inventive performance in aggregate. In contrast, Naghavi & Strozzi (2015) find a positive association between emigration and LMIC inventiveness, particularly when emigrant native countries have relatively strong intellectual property protections. Fry & Furman (2023) provide evidence that institutional environments may affect whether researchers in the diaspora can facilitate cross-country connections. Specifically, they find that female scientists who emigrate from LMICs are more likely to create connections between researchers in their home country and those in their adopted country when they both have relatively high gender equality.

[2] Also demonstrated by Kahn and MacGarvie (2016)a

this program had higher citations than research produced by similar program applicants without compromising research quantity (Abay et al, 2025).

Throughout LMICs and high-income countries, efforts to promote and equalize access to STEM education are ubiquitous and have been going on for decades (e.g. Zymelman, 1990) though evidence on how they impact science and innovation outcomes are limited.[3] Systematic investigations of the effects of STEM education are especially critical given evidence that without labor market demand for STEM workers, STEM-focused education can worsen career outcomes for students (Muriithi & Musili, 2021).

1.2 FINANCIAL CAPITAL AND INCENTIVE DESIGN

As in any research ecosystem, the financial support and incentives LMIC scientists face impact their scientific performance, and weak investment or incentives in LMICs may contribute to low overall scientific output.[4] As an example of how financial investments in science can alter subsequent outcomes, Fry & Blomfield (2025) find that African scientists who worked on clinical research trials funded by governments are more likely to work on non-government funded clinical research trials subsequently relative to scientists who did not work on government-funded trials. These results are driven by scientists with no prior clinical research trial experience, suggesting the government funding increased researcher capacity for clinical trial implementation.[5]

Beyond the potential importance of aggregate financial support, well-designed institutions and incentives can impact research productivity in LMICs. For example, Fry et al (2023) find that the introduction of a nationwide researcher ranking system based on publications in Indonesia is associated with a significant increase in peer-reviewed publications, including in high-impact international journals. However, opportunities to publish in international journals may be lower for LMIC researchers than those in countries where these journals are headquartered. Dumlao & Teplitskiy (2025) find that journal reviewers are more likely to accept papers from authors from their own countries. Given that a handful of countries are over-represented in reviewer pools, submissions from countries less represented in reviewer pools are penalized. Peng et al (2021) find similar patterns of ethnic preferences among top journal editors in biology but do not find evidence of preferences for same-ethnicity authors among reviewers.

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[3] Bound et al (2015) find that Indian students who pursue computer science or engineering in a US college have better outcomes in the US IT job market than those educated elsewhere. However, the authors highlight that this may be due to more favorable immigration rules for US-educated workers rather than differential education quality. There is anecdotal evidence that the IIT system in India has promoted a culture of innovation in country; however, evidence that the IIT system has increased the rate and quality of scientific discovery in the country is, to my knowledge, still unavailable (see Nayar (2011) for some possible reasons for why they have not).

[4] Sub-saharan African (SSA) countries on average spend 0.4% of GDP on research, compared to 1.9% in East Asia and the Pacific and 2.4% in North America and Western Europe (Atickem et al, 2019). Similarly, Africa accounts for only 1.1% of global R&D investments and that close to 66% of these investments come from only three countries in the continent (Simpkin et al, 2019).

[5] More generally, grant funding in resource constrained settings is associated with increases in research productivity. As summarized above, Fry (2023) and Fry & Ganguli (2023) find that an NIH program that funds African scholar training and research positively impacts home country science. Ganguli (2017) finds a significantly positive impact of a grant program introduced shortly after the fall of the Soviet Union to support Soviet scientists on recipient scientific performance and on the likelihood that they continued in research careers. She notes that a probable condition for this type of program to be successful is the pre-existing scientific human capital that exceeds available financial capital for research.

Providing financial incentives after research is completed likely also matters for innovative performance. Kremer & Williams (2010) demonstrate the potential for well-designed innovation prizes to spur innovation in LMICs where intellectual property rights (IPRs) are limited or for problems for which the costs of IPRs are particularly high.[6]

2. POSSIBLE RCT DESIGNS TO EXAMINE SCIENCE IN LMICS

There are countless unanswered questions about the impact of science undertaken or not undertaken in LMICs. These include big-picture questions such as how global economic development is affected by low scientific participation from many LMICs and how low research & development (R&D) investments in LMICs impact local economic development. They also include microeconomic questions such as how foreign grant funding for LMIC researchers impacts individual researcher output. In this section, I describe two RCT designs that could begin to answer some of the most pressing questions in the field. These designs are ideas that can be modified and pursued by readers of this post. Alternatively, they may serve as catalysts for additional ideas about how we can better understand science in LMICs.

2.1 GRADUATE SCHOOL MENTORSHIP, LMIC SCIENTISTS, AND LOCAL SCIENCE DEVELOPMENT

Research Questions

1. Does mentorship on applications from high-income country scientists increase the likelihood that LMIC junior scientists are accepted into and complete graduate school and/or post-docs in high-income countries?
2. Does attending graduate school in high-income countries impact home-country science differently than attending graduate school in home countries? Does this depend on the scientists' research focus?
3. Does attending graduate school in high-income countries increase the scientific output and impact of LMIC scientists? If so, which countries benefit most from this improved research output?

Setting and Randomization:

Existing programs provide mentorship to LMIC PhD-hopefuls and PhD students from high-income country scientists. For example, Graduate Applications International Network (GAIN) facilitates and oversees these connections for African scholars aiming to study economics and related fields in high-income countries. The Max Planck Institute's MPG: African Mentorship Program provides mentorship

[6] One class of these ex-post non-patent incentives is advanced market commitments (AMCs) that have been used in practice to incentivize new vaccine innovations (e.g. pneumococcal and COVID-19 vaccines). Kremer et al (2022) assess how various AMC design approaches may impact vaccine R&D but are agnostic about who undertakes the R&D. Graff Zivin & Lyons (2021) study an innovation prize among innovators in a middle-income country and find that more high-powered incentives increase the novelty of submissions to an innovation content in Mexico without reducing the quantity of output.

for African scientists hoping to start or in an existing graduate program (as well as recent PhD graduates) who aim to advance their scientific careers. Anecdotal evidence is consistent with programs like these positively impacting individual mentees, but robust causal evidence has not been produced. The mechanisms through which mentorship advances individual LMIC scientist career objectives are also unclear. Moreover, the spillovers from these types of programs to local science and their impacts on global knowledge are, to my knowledge, not known.

One approach to an RCT that explores graduate mentorship and LMIC scientist networks could be to randomize acceptance to mentorship programs for LMIC scientists preparing for graduate school or post-doc among top-scoring program applicants. If the sample of mentors is large enough, an RCT could also randomize accepted mentees into two different types of mentorship to try and test mechanisms through which information and networks may benefit LMIC scientists.

Outcomes:

With a sufficiently large sample size, the outcomes of interest from this design could be:

1. The direct effects of the program on whether mentees and the comparison group are admitted into and complete graduate school or a post-doc at a high-income country institute. This result would have implications for whether application requirements hinder high-quality LMIC student acceptance.
2. Depending on the sample of mentees, several longer-term research outcomes from the program could be tracked. For example, career outcomes, subsequent migration patterns, collaboration networks, and whether the scientists work on problems most relevant for their home countries or for high-income countries.

Needs:

1. A partnership with an existing LMIC emerging scientist mentorship program or a new program launch.
2. A sufficiently large mentor network for participation in the study. Multiple years of study may be necessary.
    a. To incentivize increased participation from mentors, the knowledge that they are both helping young scholars and helping to generate evidence on the effects of doing so may help.

2.2 RELAXING RESOURCE CONSTRAINTS FOR LMIC SCIENTISTS

Research Questions

1. Does alleviating time constraints without accompanying changes in research support result in an increase in LMIC scientists' research productivity? If so, how do changes in time investments in response to time constraint alleviations relate to their research output?
2. Does subsidizing LMIC scientist research without providing any guidance on what research they should pursue increase their productivity? How do they spend the subsidies?

Setting and Randomization:

Given limited research funding in many LMICs and the high teaching demands academics face in these settings (Mbithi & Guchu, 2023; Tumusiime, 2021), one potential reason that high-income country scientist networks improve research productivity for LMIC scientists is through access to resources like teaching assistants and funding. To test this possibility directly, a grant program could be set up to allocate funding for teaching assistants (TAs) and for research expense needs as defined by researchers. With the relatively low cost of graduate student labor in some LMICs,[7] grants valued at around $2,100 per recipient (either in TA time or cash transfers) could significantly enhance researcher productivity if insufficient time or finances limit their productivity. For example, a South African academic faculty survey found that faculty spend over half their work hours on teaching and a quarter or less on research (Botha & Swanepoel, 2015). Allocating around $2,000 to a teaching assistant for 10 hours per week of grading and lecture preparation assistance can more than double the amount of time these faculty have to spend on research over 3 months, or increase the annual research time of a researcher by 25 percent. A partnership with an existing grant program or a sufficiently large research project budget to set up a grant program could achieve the RCT design described below.

One approach to an RCT for testing the above research questions is to randomize 1) TA time and 2) research funding across grant applicants who meet the criteria for funding. The performance of awardees would be compared to the performance of qualified applicants not allocated awards. To ensure that information or incentive changes are not driving results, awards should not include any suggested changes to research plans, directives on how to spend funds, or feedback on grant applications. Similarly, it may be optimal from a design perspective for the grant to be open to any research topic within a broadly defined field so that applicants do not change their research direction in response to the incentives provided by the grant.

Outcomes:

With a sufficiently large sample size, the outcomes of interest from this design could be:

1. Research performance measured as the quantity, quality, and novelty of research output

[7] For example, at University of Nairobi, salary for TAs and RAs is approximately US$700/month.

2. Teaching performance measured with course evaluations and online student discussions when available
3. Time use measured with surveys and, to the extent possible, administrative data on course loads, conference and event attendance, etc.
4. Allocation of financial grants and use of TAs/research assistants (RAs) across tasks

Needs:

1. A partner grant organization or sufficient funding to launch a grant program
2. A sufficiently large pool of capable TAs or RAs to allocate to grant applicants randomized into the time constraint alleviation treatment

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