

# Brain Drain or Brain Gain? Effects of High-Skilled International Emigration on Origin Countries

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# Enhanced Abstract

## Background

Emigration rates of highly skilled individuals like top academics, inventors and scientists, engineers, and medical professionals from many lower-income and smaller countries are in the range of 10 to 50%. There has long been a concern that this “brain drain” harms origin economies. However, high-skilled migration can also enhance human capital at home through “brain gain” effects on incentives to invest in education, remittances, and return migration. Additionally, it can have other beneficial impacts on well-being in the origin country through trade and business development, innovation, and transmitting knowledge and positive norms from the destination (see summary figure).

[Summary Fig. 1 about here.]

## Advances

Much of the debate around brain drain and brain gain has relied on theoretical arguments, anecdotes, and non-causal empirical associations. Recent research has used modern experimental and non-experimental methods to establish causal evidence on these different channels.

We now have empirical validation of the theoretical argument that new high-skilled migration opportunities can increase, rather than decrease, the overall stock of educated workers in a country. Exogenous changes in U.S. immigration policies resulted in more Filipinos training as nurses and Indians acquiring computer science skills than emigrating, raising the total number with these skills at home. Human capital at the origin also increases through remittances funding education, and from migrants returning with education and work experience acquired abroad. Whether the net effect is a “brain drain” or a “brain gain” will depend on fundamental factors such as how quickly universities and training institutes can adjust to produce skilled workers demanded abroad given the regulatory environment for private education, or the conditions governing investments at home.

Other impacts on home economies vary with the time frame, type of skill migrating, and country context. There can be short-run negative consequences on firms and scientific innovation in origin countries when skilled workers depart, but over time, these emigrants build trade and FDI networks, and act as conduits for knowledge transfer. This can spur the creation of new industries, as has occurred in the IT sector in several countries. Migrants also tend to transfer political attitudes and social norms of their destination countries, which can boost support for democracy, improve population health, and enhance female decision-making power at home when migrants go to more liberal and democratic destinations.

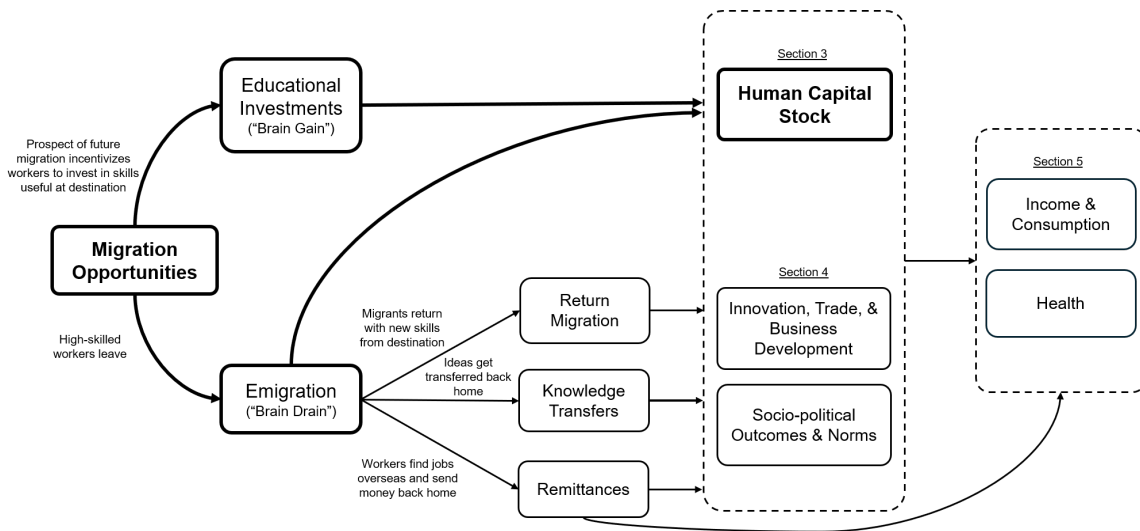
The largest welfare impacts are on the high-skilled emigrants themselves, who often more than double their incomes by migrating. Migration also produces much broader positive impacts on origin

communities. Benefits accrue not only to other household members left behind by the migrant, but also to entire regions through the investment, trade, entrepreneurship and innovation channels described above. Despite fears of medical brain drain, the weight of the evidence indicates that population health at home improves with emigration, due to improved norms, remittances, knowledge transfers, and return migration of skilled health professionals.

## **Outlook**

Rising education levels worldwide, international competition for talent, and a preference for high-skilled migrants in many destination-country migration policies are all likely to ensure the flow of high-skilled migrants from poor to rich countries will continue to grow. Recent literature should provide some reassurance to those concerned about “brain drain”, because it demonstrates many potential ways origin countries gain from the outflow.

However, the evidence base remains limited, and there are many opportunities for new causal research. Much of the literature focuses on impacts in a few large middle-income countries such as India, the Philippines, and Mexico, whereas many of these mechanisms can apply differently in more fragile, and poorer countries that have fewer opportunities for skill acquisition and for productive home investments. Most research looks at impacts of all types of skilled migration combined, or pools together educated and less educated migrants, whereas many impacts will vary depending on the type of skill departing. The biggest research gap lies in understanding effective policy responses in sending regions. Comprehensive policy analysis requires a consideration of the full range of direct and indirect “general equilibrium effects” of emigration on all relevant labor markets, and any external benefits accruing to population health and well-being through new innovations and business creation.



**Summary Fig. 1. Conceptual framework: Effects of high-skilled emigration on origin economy.**

## Abstract

Many highly educated citizens of low-income countries emigrate to high-income countries. How does such high-skilled emigration affect the economy of the origin country? The direct effect of such emigration is “brain drain”: a direct decrease in the origin country’s human capital stock. However, there may be a variety of indirect “brain gain” effects through incentives to invest in education, remittances, technology transfer, or return migration. This review identifies various mechanisms that may lead to brain drain, gain, or brain circulation, and summarizes the evidence that uses causal inference methods to shed light on the empirical relevance of these mechanisms. The weight of the evidence suggests that migration opportunities often *increase* human capital stock in origin countries, and produce downstream beneficial effects through remittances, foreign direct investment and trade linkages, transfers of knowledge, technology and norms, and return migration. We conclude by describing potential future research paths.

# 1. Introduction

One-third of Ghana’s doctors have emigrated (1), and its nurses were leaving the country at the rate of 500 per month in 2022 (2). 91% of Ethiopian Ph.D. holders (3) and 62% of the country-wide top 100 scorers on the entrance exams for the Indian Institutes of Technology (IIT) are abroad (4), as are two-thirds of software engineering graduates from top Canadian universities (5). Across Sub-Saharan Africa, the Caribbean, and the Pacific, people with tertiary education are 30 times more likely to emigrate than those who are less educated (6). 18% of all individuals from low-income countries with bachelor’s degrees are living in OECD countries (7).

Skilled individuals, such as those highlighted above, tend to out-migrate from poorer and smaller countries at higher rates. They migrate in pursuit of educational and career goals. Conflicts or natural disasters tend to accelerate that process. Top academic achievers from five countries earned an average of USD 35,000-79,000 per year more after migrating, equivalent to a 53-600% increase (8).

[Figure 1 about here.]

Fig. 1 shows that high-skilled emigration rates can vary substantially by country and skill categories. A natural concern is that such high rates represent a significant loss of human capital in sending countries — colloquially referred to as “brain drain”. Public health officials fear that it can create healthcare worker shortages in poor countries, leading the World Health Organization to list 55 countries where health worker recruitment should be subject to additional safeguards (9). Sociologists have characterized these flows as a form of exploitation, and a cause of underdevelopment (10). Political scientists lament the exit of individuals who could have led political change at home (11). Economists have worried about fiscal and other externalities of losing skilled human capital (12, 13).

However, simply observing out-migration does not necessarily imply a net loss in human capital in origin countries, since migration opportunities can also create new human capital. Migrants can fund educational investment at home through remittances, or bring back new knowledge and skills to create “brain circulation” (14). The *prospect* of migration can cause more people to invest in acquiring skills at home, or “brain gain” (15, 16, 17). More broadly, emigration does not necessarily imply a net welfare loss for the origin country. High-skilled emigration can improve income, health, and well-being for citizens left behind.

This review will discuss various mechanisms by which high-skilled emigration affects origin-country outcomes, either positively or negatively, and summarize the recent empirical evidence. While this topic has been the subject of considerable research over decades in many disciplines, recent economics research has used modern empirical methods such as instrumental variables (IV), regression discontinuity, difference-in-differences (DID), and natural or randomized policy experiments to highlight the *causal*

effects of emigration. Box 1 provides a methodological overview. We begin with a conceptual framework to outline the possible mechanisms through which high-skilled emigration could affect the origin economy.

### **Box 1. Identifying Causal Impacts of High-Skilled Migration**

One of the difficulties in determining the effects of high-skilled migration on origin countries is that individuals choose whether to migrate. This decision is almost certainly correlated with many other characteristics of the individual. These characteristics may also determine outcomes, generating an omitted variable bias issue. As a result, empirical strategies that attempt to determine the effects of high-skilled migration by comparing migrant outcomes to non-migrant outcomes or countries with high migration rates to countries with limited migration likely suffer from omitted variable bias. Recent research has employed a variety of experimental and quasi-experimental methods that enable researchers to obtain causal estimates of the effects of high-skilled migration:

1. *Random Assignment (RA)*: RA randomly allocates individuals into treatment and control groups. This overcomes selection and other omitted variable problems since random assignment implies that the outcomes of the treatment and control groups are similar in expectation in the absence of the treatment. In large samples, random assignment allows estimating causal effects by simply comparing average outcomes in the treatment group to average outcomes in the control group. For example, we can compare Indian IT workers who migrated to the U.S. as a result of winning a visa lottery to the losers of the lottery (treatment versus control) to determine how earnings change with high-skilled migration (18).
2. *Difference-in-Differences (DID)*: This quasi-experimental method compares two groups of individuals, one treated and one untreated, before and after a policy change. Treatment is not randomly assigned in this case, but rather, DID assumes that in the absence of the policy treatment, outcomes for the two groups would evolve similarly over time (“parallel trends”). For example, we can compare the educational outcomes of Gurkha (treatment) to non-Gurkha (control) Nepalese before and after changes to the educational requirements for Gurkhas to migrate and join the British Army were implemented (19).
3. *Regression Discontinuity (RD)*: Another quasi-experimental method, RD, is used in settings where a cutoff point along some dimension determines who receives a treatment and who does not. RD assumes that in the absence of the treatment, outcomes are continuous over the cutoff. As such, people just below the cutoff are similar to those above it on all dimensions except for the treatment. Comparing those just below to those just above, therefore, provides an estimate of the treatment effect. For example, to migrate to Korea from the Philippines, individuals must achieve a language test score above a fixed cutoff (20). Hence, we can compare individuals just above versus below the cutoff score to determine the effects of migration on origin households.
4. *Shift Share Instrumental Variables (SSIV)*: SSIV is another quasi-experimental method that uses his-

torical variation in conditions across regions (“shares”) — e.g., which is the dominant industry — in combination with shocks (“shifts”) that affect different regions differentially due to these variations in conditions. For example, we can exploit differences across regions in Italy in the proportions of migrants that they send to each destination country (shares), as well as exogenous shocks (shifts) in the economic conditions of those destination countries which lead to some regions having more emigration than others, to create an exogenous “shift-share” instrument (21). In particular, we can use this variable as an “instrument” for endogenous, regional out-migration rates of the young, skilled population in Italy.

## 2. Conceptual Framework

An immediate effect of the emigration of a skilled worker is that her human capital is no longer available in the sending country after she moves abroad. This is the primary concern with a skilled migrant’s exit, colloquially referred to as “brain drain”. But careful economic reasoning reveals other indirect channels through which this initial trip can affect human capital in the sending economy, such that new migration opportunities can — on net — either increase or decrease the aggregate human capital stock of the developing country that migrants leave behind. We summarize these direct and indirect channels in Fig. 2.

First, the appearance of the migration opportunity may itself have induced that emigrant to invest in acquiring skills that have high returns in the destination labor market; human capital that she might otherwise not possess had that opportunity never existed. If Canada provides visas to trained Filipino nurses, then more young Filipinos may now enroll in nursing school. Unless every graduate of those nursing programs receives a Canadian visa and exits, the Philippines may end up with *more* nurses at home than they otherwise would, absent that migration opportunity. This effect is labeled “Brain Gain” in Fig. 2.

Second, migrants typically earn higher incomes abroad, some of which is remitted to the sending country. Remittance recipients may use some fraction of that windfall to invest in education and skills. The box labeled “Remittances” in Fig. 2 can thus increase the aggregate stock of human capital in the sending country. We examine empirical research on the net effects on human capital in Section 3.

Third, many developing country citizens migrate abroad specifically to attend universities and acquire training not available locally, which directly increases the number of educated individuals born in an origin country. Many of them then return home with this education. Some of the most popular global migration corridors involve richer countries in the Middle East and East Asia offering *temporary* work opportunities to citizens of the Global South, on short-term renewable contracts. These contracts do not offer a path to citizenship. Many of those migrants, therefore, return to their country of birth after the contract expires, bringing back with them the work experience and skills acquired abroad. They may



also bring back specialized frontier knowledge from rich countries, all of which can increase innovation, entrepreneurship, and even change social norms and political behaviors at home. There could also be negative externalities if the departure of scientists reduces local innovation, medical worker exit undermines health, or the departure of educated elites reduces political accountability. Empirical research on these channels is discussed in Section 4.

The factors discussed above can either increase or decrease the human capital stock in a migrant-sending developing country when a new migration opportunity arises for skilled workers. The relative importance of these different channels will determine the net effect on income, consumption, and health in the origin country, and we review these effects in Section 5. The relevance of any such factor may be a function of the type of migration opportunity, the specifics of destination country migration policies, and the characteristics of the home country's labor market and education system. Economic theory can provide further guidance on the conditions under which any of these channels is likely to be more or less important.

For example, whether migration directly results in a large loss of human capital depends crucially on whether destination countries demand high-skilled or low-skilled workers (22). Given the excess supply of workers in some skill categories in labor-abundant, migrant-sending nations, demand for agricultural or home-care workers does not necessarily pose much of a "brain drain" concern. And even if the foreign work opportunities are in medicine, IT, or engineering, the net effect on domestic human capital will depend on how quickly training institutes in the source country can produce new graduates. That supply elasticity is itself a function of government policy, such as the nature of regulation in the higher education sector. Source-country governments could respond to the foreign demand for its skilled labor by deregulating, and permitting the private sector to produce skilled graduates more quickly.

Another critical factor is the domestic labor market's capacity to absorb the newly skilled workers. As a simple example, if emigrants acquire English or French language skills to be more productive in destination labor markets, those language skills can probably be productively used at home even if the visa never comes through, or re-used when migrants return home. Some other language skills may be less portable.

The importance of the remittance channel will depend on how remittance funds are spent at home. If recipients invest those funds in skill acquisition or entrepreneurial ventures, emigration is more likely to lead to a "brain gain", on net. If remittance funds are mostly consumed or invested in real estate, we may not see as much gain in human capital, but it may improve welfare in other ways. The source country is more likely to benefit in the long run if returning migrants and their families combine their new ideas, innovations, and capital to create novel enterprises at home. This, in turn, crucially depends on the investment climate, political stability, and investor protections at home. Finally, skilled workers and elites' propensity to depart will depend on how well their physical and intellectual property is protected

at home. Scientists tend to leave when the returns to innovation are low in the home market.

In summary, to understand the *net* effect of new migration opportunities on the human capital stock in source countries for any given context (source-destination pair) and sector, we need to review the empirical evidence on all channels by which home-country skill acquisition and retention may be affected, as well as the underlying factors that determine the importance of each channel. We begin in Section 3 by discussing the effects of high-skilled migration on the human capital stock.

[Figure 2 about here.]

### 3. Effects on the human capital stock

Some recent papers in economics use causal identification methods that exploit policy changes and plausibly exogenous shocks (see Box 1) to provide compelling evidence for the “brain gain” channel, whereby a new migration opportunity *increases* the stock of educated workers in the origin economy. For example, a DID analysis shows that a sudden exogenous change in U.S. visa availability for Filipino nurses increased not only the number of tertiary-educated nurses in the Philippines, but also the overall stock of tertiary-educated labor (23). For each new nurse that moved abroad, 9 new nurses were licensed in the Philippines. Similarly, when the H1-B visa cap was relaxed in the U.S., increasing Indian IT workers’ likelihood of migrating there, Indian students and workers acquired computer science skills at higher rates (24). A migration-induced increase in the earnings of Indians in the U.S. by 10% *raised* IT employment in India by 5.8%. Fig. 3 illustrates how enrollment in nursing in the Philippines or engineering in India closely tracked the expansion and contraction in visa availability. As these papers carefully and rigorously establish, it would be difficult to explain away the evident close correlations between enrollment fluctuations and the sudden changes in the visa caps using some other omitted factor.

[Figure 3 about here.]

A DID analysis from Fiji shows that when a coup d’etat increased discrimination against Fijians of South Asian origin, that group increased their educational investments to increase their chances of migrating (25). Their enhanced schooling investments outweighed the direct brain drain effect of skilled worker out-migration, such that the human capital stock in Fiji *increased* on net. Overall, the fraction of the tertiary-educated Indian workforce in Fiji tripled following the coup. Similarly, the British Army instituting an education requirement for Nepali Gurkhas to join increased the average years of education in that population by over 20% (19), and new migration opportunities led to increases in middle school enrollment in Cape Verde (26).

Substantial brain gain can only occur if the origin country has adequate training infrastructure. In the Philippines, U.S. visa opportunities caused the supply of nursing programs, especially at existing private institutions, to expand to accommodate increased demand (23). Enrollment increased more in places with a larger supply of private institutions without pre-existing nursing programs. Unsurprisingly, pass rates on the Philippine nursing licensure exam fell, but the number of licensed nurses still increased because so many more individuals sat for the exam.

Migration opportunities also change the skill composition of the labor force. If skills demanded abroad differ from what is needed in the domestic labor market, this could lead to a skills mismatch. This was not a concern in the Philippines, as more nurses were employed at home (23). In theory, there could be shortages if, say, doctors chase migration opportunities and pursue geriatric or surgical specializations when there is a greater need for tropical medicine or pediatrics at home. Such mismatch effects are likely to be relatively small because most types of skills migrants acquire can be redeployed.

Migrant remittances may increase educational investments in the long run (20, 27, 28, 29, 30, 31, 32). This could prompt a virtuous cycle leading to more high-skilled migration in the future, which in turn raises incomes and education levels (33).

Finally, many migrate for the explicit purpose of acquiring skills. Globally, the number of international students rose from about 2 to 6.4 million in 2000 to 2021 (34). Much of the growth in the number of students was from large countries like China and India (35), but for many smaller countries, a large fraction may be educated abroad. For instance, in Tonga and Micronesia, 100% of migrants had received their bachelors education abroad, as there were limited opportunities at home (8). Returnees may bring back academic knowledge, as evidenced by returning Fulbright Fellows (36), but may be less likely to find employment if they lack local work experience (37).

## **4. Effects on Innovation, Entrepreneurship, and Norms**

### **4.1 Business Development, FDI, Trade, and Entrepreneurship**

Skilled migrants can benefit others in their origin country by creating and growing businesses. These businesses provide jobs and new goods and services valued by consumers, and influence the productivity of other firms through supply chains and knowledge spillovers. Migrants contribute by financing capital, sharing ideas and knowledge, or via trade linkages. One study uses a shift-share IV design on historical data to show that U.S. counties with larger migrant networks send more foreign direct investment (FDI) to the migrants' origin country (38). Cross-country analysis suggests that FDI has a strong association with the stock of tertiary-educated migrants (39). A DID analysis using a 1990 U.S. immigration reform that changed the number of high-skilled scientists and engineers from some origin countries but not

others shows that a 10% increase in the migrant ethnic network increases manufacturing output in the sending country by 3% (40).

Migrants also facilitate connections between exporters and importers across borders. This enables firms to access new markets abroad while offering consumers a wider array of lower-cost products. Natural experiments derived from Vietnamese refugee resettlement in the U.S. (41) and Japanese ethnic networks formed during World War II imprisonments (42) provide convincing causal evidence on the links between migration and trade. Skilled migrants generate even further productivity benefits: Immigrant IT sector workers who returned home to India after their U.S. H1-B work visas expired spurred the subsequent off-shoring of IT production from the U.S. to India (24).

The effect of migration on business development should vary with the type of migrant, the time frame for adjustment, and on economic conditions at the origin. Skilled human capital departing from small countries with limited domestic markets, or fleeing conflict, recession, or political repression are less likely to invest in firms at home. In these cases, the direct loss of skilled labor may be the dominant effect. For example, evidence from a shift-share IV design shows a one standard deviation increase in the emigration rate of young, skilled migrants after a recession reduced new firm creation by 4.8% in Italy (21).

The effects of emigration are more likely to be negative in the short run, before economies have time to adjust. A staggered DID analysis based on variation across countries-of-origin and industries in the timing of when workers could enter the European labor market finds that as tertiary-educated workers emigrated from Eastern European countries during the first few years after they joined the European Union, labor costs increased by 7% and productivity fell by 6% in home markets. But these negative effects dissipate over time as firms adjust (43).

Migration of academics, scientists, and medical professionals is less likely to affect business development than the migration of entrepreneurs and inventors. A survey of academic high achievers from Ghana, New Zealand, Tonga, Micronesia, and Papua New Guinea reveals that it is extremely uncommon for this group to help firms make trade deals, facilitate knowledge transfers to businesses, or provide the capital needed to start new businesses, regardless of the individual's migration status (8). These types of migrants, therefore, do not affect business development much. In contrast, migrant information technology (IT) workers from India, China, Israel, and Taiwan provided venture capital, knowledge, and network connections to help spur the creation and growth of the IT industry at home (44). The study of Indian computer scientists returning from the U.S. also finds that they increased the productivity of the IT sector in India (24). Skilled migrants returning home can also improve corporate governance. Leveraging the staggered roll-out of return migration incentives over time across different Chinese provinces, one study finds that return migration increased the valuation and productivity of the Chinese firms whose corporate boards return migrants joined (45).

## 4.2 Innovation and Scientific Development

Some skilled workers are inventors who generate external benefits to the broader economy (46). Technological innovation spurs positive local economic spillovers, especially when inventors develop general-purpose technologies that have a range of applications across industries and sectors. Furthermore, skilled migrants and returnees may import ideas, insights, and practices from abroad, and enhance the technical knowledge base at home. This diffusion of knowledge via migrant networks has been shown to increase patenting activity (40, 47, 48) and the productivity of academic research (36, 49, 50), and to transfer productive business knowledge and practices (45) back to migrant origin areas. Such knowledge transfers do not necessarily require return migration, as they may occur remotely via networks (51).

These papers leverage policy variation to establish causality. For instance, for every 1% increase in emigrants due to changes in European mobility laws, patent applications rise by 0.64% in the subsequent two years (48). When Chinese provinces attract returnees by providing incentives, resident companies that hire directors with foreign experience improve management practices and enjoy higher valuation and profits (45). Employees of a large Fortune 500 company in India who were assigned by their HR (in a manner uncorrelated with their baseline characteristics) to returnee managers filed more U.S. patents (47).

Conversely, losing potential innovators via brain drain can inhibit economic growth and innovation in sending countries (21, 52). Openness to migration can therefore create tradeoffs: potentially fewer innovators at home, but greater access to global knowledge that drives local innovation (53). These tensions underscore the delicate balance needed when promoting innovator emigration to maximize local innovation. Firm responses to changes in human capital further complicate optimal policy. Firms may respond to “brain gain” by investing in skilled labor-augmenting advanced technologies, or by dis-investing from labor-substituting technologies. An increase in the supply of workers dissuaded Italian firms from investing in productivity-enhancing technologies, as firms substituted away from capital towards the more abundant labor (54). Conversely, repatriation of migrants from South Africa back to Malawi catalyzed structural change as their capital financed new investments in non-farm physical and human capital, and rural workers shifted from farming to non-farm work (55).

Finally, emigration and return migration affect science and academic research in home countries via knowledge transfers. For instance, the Fulbright Fellowship program requires fellows to return to their home countries, and these returnees are more influential in their home countries, being cited 90% more than a control group (36). A study of top high school academic achievers from Pacific countries shows that while return migrants have no greater direct research impact than similar non-migrants, they are the main source of research knowledge transfers across borders (49). Return migration of a U.S.-trained African scientist increases their non-migrant scientist colleagues’ publication output by 12% through improved knowledge access and connections (50).

Compared to non-migrants, migrants may also engage in more collaborations with cross-border research teams. A DID analysis leveraging a scholarship program for Chinese students shows that internationally mobile researchers had 7.3% more collaborators than their non-mobile counterparts (56). In contrast, other DID estimates based on EU expansion show that cross-border collaborations in new-EU countries actually fell as researchers with international linkages left their home countries (57). Thus, scientist migration has the potential to either increase or decrease cross-border collaborations.

### 4.3 Political and Social Norms and Outcomes

If skilled emigration leads to an exit of “agents of change” who would otherwise voice concerns, participate in politics, or hold leadership accountable, it can undermine domestic political accountability (11). But it is also possible for skilled emigration to *enhance* democracy if the diaspora uses their resources and connections to promote better political norms and accountability, or if return migrants exposed to democratic values abroad transmit those values locally upon their return. A cross-country study finds that sending international college students to study in high-quality democracies is associated with subsequent improvements in the quality of democracy in origin countries (58). Relatedly, areas of Cape Verde with more emigrants — particularly educated emigrants to the United States — displayed greater demand for better public services (59). Other non-experimental evidence also points to positive effects of emigration on the quality of political institutions, through both supply and demand channels (60, 61, 62, 63, 64).

Return migrants, or a diaspora that maintains contact with friends and family back home, might also transmit positive *social* norms regarding marriage, fertility, and gender. A randomized intervention to improve the integration of Cape Verdean immigrants in Portugal had a spillover effect on their closest contacts in Cape Verde, who increased support for gender equity in household decision-making by 4-6%, and electoral participation by 12%, relative to the contacts of migrants not offered the intervention (65). There were large improvements in female decision-making power within families of Bangladeshis who won a visa lottery to work in Malaysia, relative to those whose lottery entry was unsuccessful (66). Lottery winners’ wives were 148% more likely to be identified as the household head, and there was a 75% increase in females holding exclusive decision-making authority in those families. Conversely, migrants returning to Jordan from more conservative Arab countries return with more conservative gender norms (67).

Changes in gender norms can produce downstream benefits to child health and development. Lottery winners delayed marriage and childbirth in the Bangladesh study. Exposure to more liberalized reproductive health policies abroad results in lower fertility rates in origin areas, documented using a shift-share instrumental variable research design (68). Other studies also show that migrants adopt and transmit fertility norms from destination to origin countries (69, 70).

## 5. Impacts of High-Skilled Emigration on Origin Country Welfare

We care about human capital, entrepreneurship, innovation, and norms because they all contribute to the well-being and prosperity of origin countries. We, therefore, now turn to evidence on the effects of emigration on income, consumption, and health. Very few studies have managed to isolate the effects of high-skilled migration, so this section reviews some literature on the welfare impacts of low-skilled migration as well.

### 5.1 Income and Consumption

When economic migrants gain access to labor markets in richer countries, their incomes increase substantially (71). Random assignment of international migration opportunities not only yields significant income gains for migrants but also improves the well-being of their families remaining behind (66, 72, 73). Migrants are able to raise their incomes several-fold, gains that are many times larger than the estimated impacts of trade liberalization or capital mobility, or *in situ* development programs (74, 75). The spillover benefits accruing to household members remaining in the origin have been documented extensively using credible causal identification methods (20, 28, 29, 30, 66, 73, 76, 77, 78, 79, 80, 81, 82, 83).

Migration has even broader impacts on entire sending economies through the human capital, entrepreneurship, innovation, and business growth channels described above, all of which can create new employment opportunities for citizens remaining behind.

Two papers estimate area-wide impacts on migrant-sending areas of the Philippines. The first uses a difference-in-differences framework to analyze how removing Filipina women's ability to work in Japan as entertainers – a relatively lucrative occupation – affects area-wide economic outcomes (84). Moving from a province that was less dependent on these employment opportunities (at the 25th percentile) to a more dependent (75th percentile) province reduces mean household income by 0.5%, and raises the rate of child labor by 2.8%. The second study uses exchange rate shocks in Filipino migrants' overseas destinations – which changes their ability to remit money – on development outcomes in their origin provinces (33). Improved migrant income prospects make future migrants better-educated and more likely to work in high-skilled jobs. This is likely due to both reduced financial constraints (education funded by remittances) as well as changes in the perceived returns to education (since working internationally now pays better). Furthermore, a one standard deviation shock increases domestic income per capita by 1,349 Philippine pesos, and expenditure per capita by 1,224 Philippine pesos (real 2010 pesos, 0.12 standard deviation in each case) in Filipino-origin provinces. This is likely due to both investments of extra remittances in small enterprises and in education. The remittance shock creates a virtuous cycle

in which improved migrant income opportunities promote investment in education, which then leads to future migration in higher-skill, higher-wage occupations.

Even low-skilled migration of Malawians to South Africa benefited origin-area education and development in the long run (32, 55). Mexican migrant exposure to Great Recession shocks in the U.S. led to short-run declines in educational investment in origin areas (85). Estimates from microdata from 11 major destination countries suggest that more-educated migrants remit more to their origin countries (86).

## 5.2 Health

Emigration could undermine population health in origin countries if needed healthcare workers depart. But we have already seen that migration opportunities can lead to a ‘brain gain’ in healthcare on net (23). Indeed, across 53 African countries, larger emigration rates of physicians and nurses do *not* lead to substantial reductions in the number of physicians and nurses in the home country, as revealed in an instrumental variables analysis (87). The same study also cannot find evidence that physician and nurse emigration worsen population health in terms of infant mortality or disease prevalence. Undesirable living and working conditions for healthcare workers in underserved, remote, rural areas may be the limiting factor for population health, rather than the international emigration of those workers.

Remittance receipts from migrants might actually pay for better access to healthcare, improving population health. Healthcare spending in Mexican communities responds very strongly to remittance income, with a 6% marginal propensity to spend on healthcare out of remittance income (88). Another study finds that a 1 percentage point increase in households with return migrants led to a 13% decrease in the share of households without access to healthcare in Mexico, using variation in interior immigration enforcement policies across U.S. states as shift-share instruments for return migration from the U.S. to Mexico, (89).

There may also be positive knowledge and norms spillovers from destinations to origins in the healthcare sector, as in other knowledge sectors. Migration from Mexico to the U.S. increased birth weights and reduced infant mortality in origin households, partly due to improved medical knowledge (90). Migration-induced changes in social norms around reproductive health in the Philippines led to reduced origin-community fertility and lower infant mortality in a shift-share instrumental variables design (68).

In summary, while it is theoretically possible for emigration to worsen population health, the weight of the empirical evidence points towards migration improving healthcare at the origins. The evidence base we cite above draws from research on both high-skilled and less-skilled migrants. Whether high or low-skilled migration contributes more to health improvements is an open question. Effects on ability to pay for healthcare and on improvement in health knowledge may well be greater for households that



start out poorer and less educated at the origin. On the other hand, remittances that affect the ability to pay for healthcare at the origin may be larger amongst higher-skilled migrant categories. High-skilled migration may also produce technical innovations in the health sector, through impacts on inventions, diffusion of new medical technologies, and business development in the health sector, but there is no rigorous research on these topics.

## 6. Conclusion

Given the importance of human capital for a country's growth and development, it is natural to react to the large high-skilled emigration rates from developing countries highlighted in Fig. 1 with concerns about "brain drain", exploitation, and the prospect of economic stagnation in poorer countries. But carefully thinking through economic theory and examining modern empirical evidence on the full range of direct and indirect effects of emigration is reassuring that migration opportunities can *increase* human capital in origin economies and improve the well-being of the population *on net*. This is because emigration not only has a direct positive effect on the numerator of the rates reported in Fig. 1 (the number of educated individuals who depart), but also positive effects on the denominator (the total number of educated individuals in the origin country) through multiple channels.

Our review has focused on research that provides *causal* evidence on these channels, much of it produced by applied microeconomics. The weight of the evidence establishes that "brain gain" and "brain circulation" are not just theoretical possibilities, but also empirically relevant for many large migrant-origin countries. Skilled migrants foster business development, trade, and FDI linkages between destination and origin, contribute to their home economies through knowledge diffusion and remittances, and transmit norms about democracy and health. Many migrants return with skills acquired abroad. The overall impact of emigration on income and well-being in sending regions looks overwhelmingly positive – not only for the migrants and their families, but for the broader economy as well.

While this new literature should provide some reassurance to policymakers in developing countries concerned about "brain drain", the paucity of data on many skilled migration flows, coupled with the challenge of credibly identifying causal effects, still means that the evidence base for many theoretical mechanisms linking migration to human capital and welfare remains rather limited.

We see five important directions for future work. First, much of the literature has examined impacts on large, middle-income countries like India, the Philippines, and Mexico, where emigration is driven by more lucrative economic opportunities for skilled workers abroad. More work is needed on the extent to which impacts differ in more fragile and poorer countries where people left behind have more limited opportunities to invest in skill acquisition, and where domestic conditions preclude or discourage remittances and knowledge transfers from getting converted into actual investments. Second, the impacts

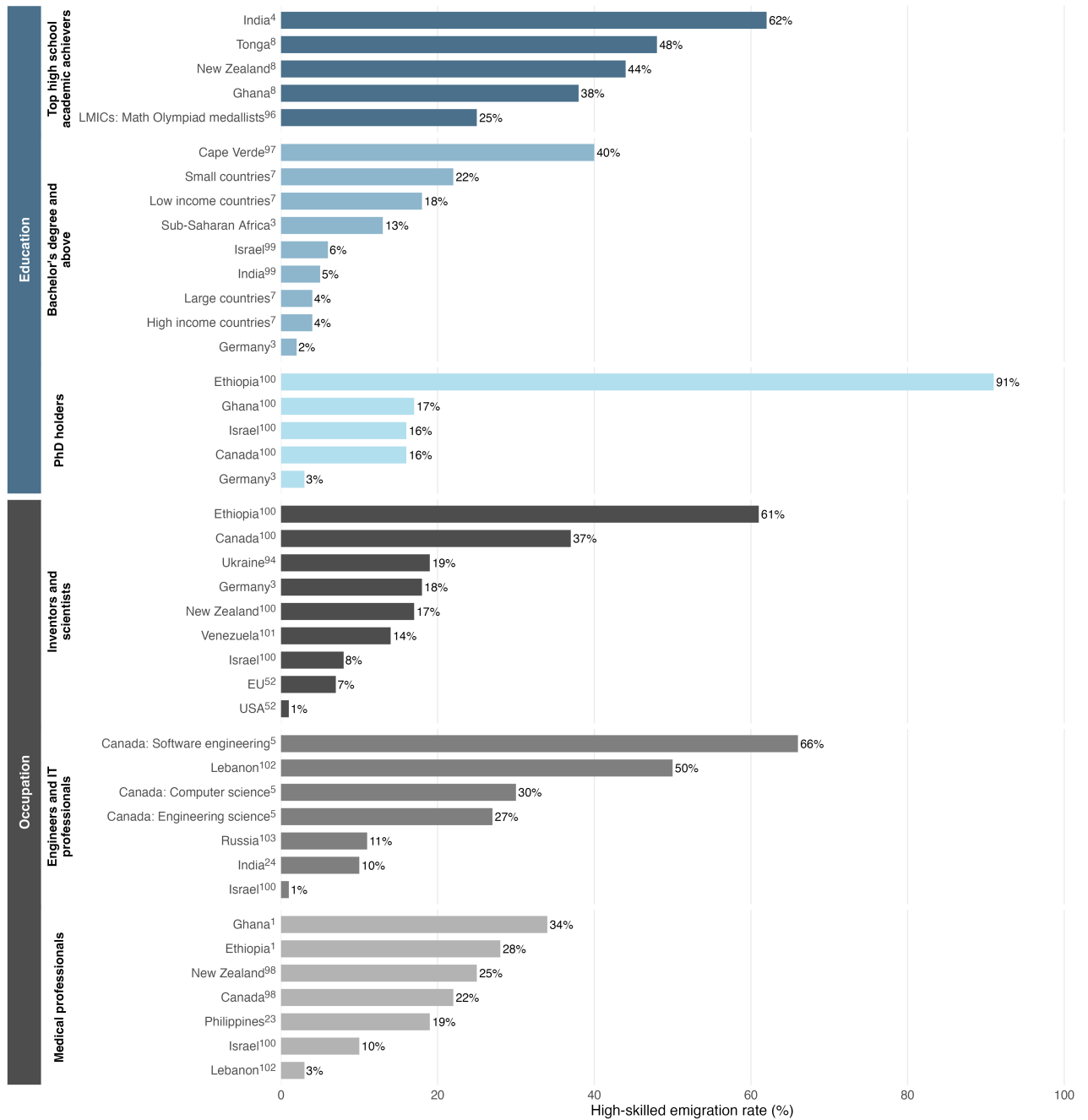
of high-skilled emigration are likely to vary substantially depending on the type of skill: an inventor, a doctor, a computer scientist, or a humanities professor leaving will not have the same effects on the home country. Yet, the existing literature typically lumps all migrants together or, at best, crudely disaggregates by tertiary or non-tertiary education. Third, most of the existing literature focuses on average effects, but there may be important distributional effects and heterogeneity across sub-groups in both sending and receiving countries. Fourth, more research is needed on the full range of direct and indirect “general equilibrium effects” of emigration, which is necessary for accurate policy analysis. For example, the fact that new North American migration opportunities for Filipino nurses or Indian IT workers produce more nurses and IT workers in the home countries is an interesting observation that addresses the *proximate* brain drain concerns, but by itself, it doesn’t answer the deeper, more relevant question of whether a larger number of nurses and IT workers are welfare-improving for the home economy. It is possible that chasing a US visa distorts young people’s decisions away from investing in skills (e.g., finance, law, medicine, or civil engineering) that are more needed in the origin economies, and instead produces a glut of nurses and IT professionals. Comprehensive policy analysis is only possible with serious consideration of the full range of effects of these human capital investment choices on all labor markets, on population well-being and health, and even on the potential creation of new products and markets through innovations. Relatedly, a fifth and final limitation of the literature is its heavy focus on documenting origin-country responses to migration shocks, as opposed to analysis that identifies effective policy actions with the potential to enhance the benefits and reduce the costs of high-skilled emigration. In addition to origin-country policies, better immigrant integration policies at destinations can also change the nature and scale of “brain gain”.

## List of Figures

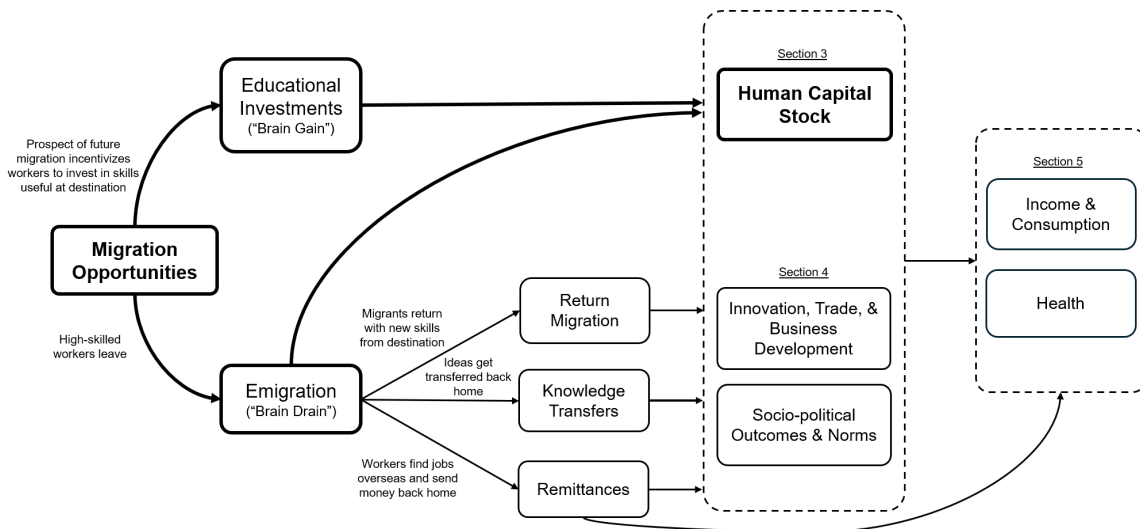
Figure 1: Estimates of high-skilled emigration rates across skill types and countries

Figure 2: Conceptual framework: Effects of high-skilled emigration on origin economy

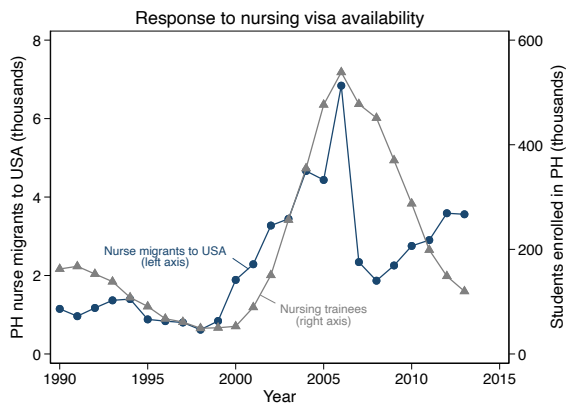
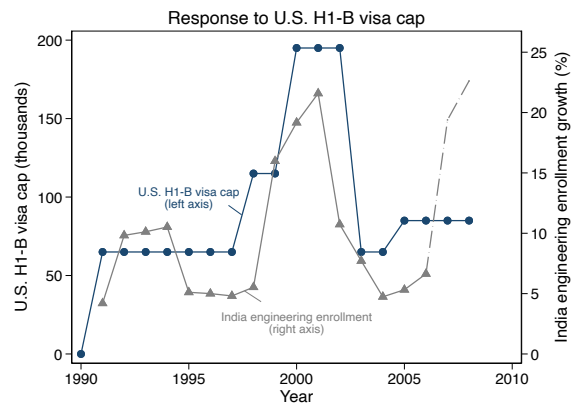
Figure 3: Enrollment response to migration prospects



**Fig. 1. Estimates of high-skilled emigration rates (percentage of the skilled population living overseas) across skill types and countries.** Refer to Appendix Table S1 for a description of the data sources and destination countries (mostly OECD countries). Vertical axis labels indicate the source country. Reference numbers in superscript.



**Fig. 2. Conceptual framework: Effects of high-skilled emigration on origin economy.**

**A****B**

**Fig. 3. Enrollment response to migration prospects.** (A) Results reproduced from a study on Filipino nurses migrating to the U.S. (23). It shows the total number of nurse migrants to the U.S. (blue line, left axis) based on data from the Commission for Filipinos Overseas and postsecondary nursing program enrollment in the Philippines (gray line, right axis) from the Philippine Commission on Higher Education. (B) Results reproduced from a study on the migration of Indian IT workers to the U.S. (24). It shows the H-1B cap based on USCIS reports (blue line, left axis), and the year-on-year growth rate (in percentage terms) in engineering enrollment in India (gray line, right axis), from the Ministry of Human Resources and Development. The dotted line represents Engineering enrollment growth after the Indian tech boom took off in the mid-2000s.

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**Supplementary Appendix for  
“Brain Drain or Brain Gain? Effects of High-Skilled International  
Emigration on Origin Countries”  
For Online Publication Only**

**List of Supplementary Tables**

Table S1: Data sources for estimates of high-skilled emigration rates across skill types and countries (p. 38)

[Table S1 about here.]

Reference	Destination(s)	Definition of High-Skilled Emigration Rate	Dataset
(1)	22 OECD countries	Fraction of medical doctors trained in their origin country who were practicing abroad in 2014	World Health Organization data on doctors practicing in origin country; data on annual stocks of foreign-trained physicians by country of origin taken from censuses, public health ministries/institutes and medical associations' register data for the destination countries
(3)	Sub-Saharan African college graduates: OECD; German college graduates: U.S.; PhD holders and S&T researchers: U.S.	Fraction of college graduates born in the origin country who were living abroad in 2000; Share of PhD holders who were trained in the U.S. out of the total stock of those trained in the origin country and in the U.S., with flows averaged between 2002–2004; Fraction of researchers in Science & Technology employed in the U.S. out of the total stock employed in the U.S. and in the origin country in 2003	Data on high-skilled emigration rates taken from (91); data on PhD holders from SESTAT (NSF) and UNESCO; data on researchers in S&T based on SESTAT and OECD main S&T indicators
(4)	All	Fraction of 100 top scorers in IIT entrance exam 2010 who were living abroad at the time of data collection	Names and scores of IIT entrance exam takers scraped by programmer and made publicly available; all other data obtained via authors' own data collection using LinkedIn profiles, Github, ResearchGate and other sources
(5)	U.S.	Fraction of 2015–2016 graduates from select programs in 3 STEM-focused universities in Canada who were living abroad at the time of data collection	LinkedIn profile data (authors' own data collection)
(7)	OECD	Fraction of college graduates born in the origin country who were living abroad in 2010	(92); large countries defined as population size > 25 million and small countries defined as population size < 2.5 million
(8)	All	Fraction of top academic performers in national exams or in school graduating from high school between 1976–2004 who were aged 22+ years and living abroad at the time of data collection (2002–2004)	Author's own survey
(23)	All destinations with permanent migrants	Fraction of trained or professional nurses graduating in the Philippines between 2004–2006 who permanently migrated to the U.S. in that period	Administrative data on migration from Commission on Filipinos Overseas; reports on number of examinees and passers for the Philippine Nursing Licensure exam from Philippine Professional Regulation Commission
(24)	U.S.	Fraction of Indian-born college-educated workers who migrated to the U.S. after the age of 18 and were living abroad in 2012	Data on Indian-born college-educated workers from the India National Sample Survey 2012; Data on Indian migrants to the U.S. from the American Community Survey 2012
(52)	All	Fraction of patents filed between 2000–2010 by inventors with nationality in the origin country who resided abroad at the time of filing	Patent Cooperation Treaty (PCT) data from (93)
(94)	All	Fraction of scientists affiliated with a Ukrainian institution who left Ukraine since the start of the 2022 war with Russia	Authors' own survey

Reference	Destination(s)	Definition of High-Skilled Emigration Rate	Dataset
(95)	U.S.	Share of PhD holders who were trained in the U.S. out of the total stock of those trained in the origin country and in the U.S., with flows averaged between 2002–2004; Fraction of researchers in Science & Technology employed in the U.S. out of the total stock employed in the U.S. and in the origin country in 2003	Data on PhD holders from SESTAT (NSF) and UNESCO; data on researchers in S&T based on SESTAT and OECD main S&T indicators
(96)	U.S.	Fraction of International Mathematical Olympiad medallists representing their origin country between 1981–2000 who enrolled in an undergraduate institution abroad prior to 2016	Database of medallists from International Mathematical Olympiad’s website; data on education author’s own survey of medallists
(97)	All	Fraction of Cape Verdean university degree holders aged 25 and above who were residing abroad in 2001	Data on residents in Cape Verde from CSAE (University of Oxford) household survey (2005–2006); data on residents abroad from 2001 census wave of main destination countries.
(98)	18 OECD countries+South Africa	Fraction of physicians trained in the origin country who were living abroad in 2004	Data on trained physicians in origin countries from World Development Indicators; data on physicians living abroad from censuses, public health ministries/institutes and medical associations’ register data for the destination countries
(99)	20 OECD countries	Fraction of tertiary-educated (higher than high school leaving certificate or equivalent) individuals born in the origin country who were living abroad in 2010	Censuses and population register data for the destination countries
(100)	All	Fraction of native Israeli engineers/academics/medical professionals aged 30–40 (in 1995) who had been abroad for at least 365 consecutive days in 2004 and did not return for more than 90 days	1995 Israeli Census and emigration status in 2004 from Central Bureau of Statistics
(101)	All	Fraction of scientists with research works published in Venezuela who emigrated between 1960–2014	BIBLIOS publication database
(102)	All	Fraction of registered nurses in Lebanon who have moved abroad since the revolution on 17 October 2019; Fraction of registered engineers in Lebanon who were living abroad at the time of writing	Experts’ quotes
(103)	All	Fraction of open source software (OSS) developers residing in Russia and Belarus in February 2021, prior to the invasion of Ukraine in early 2022, who were living abroad by November 2022	Geographic distribution of OSS developers in February 2021 from Github as used in (104); author’s own data collection in June 2022 to revisit Github profiles of the same developers

**Fig. S1. Data sources for estimates of high-skilled emigration rates across skill types and countries.** The table shows the data sources and definitions used to construct Fig. 1.