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ARTICLE

A Benefit-Cost Analysis of Increased International Migration of Skilled Labor in Africa and the World

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Abstract

Greater labor migration can establish more channels for information flows, directly contributing to faster economic growth and improved innovation and work. It can also expand international remittances, which can be invested by recipient households in home countries in education, entrepreneurship, and improved and sustainable agricultural technologies. At the same time, however, increased emigration of medical professionals and technical workers from poor countries can reduce quality of local services, innovation, health status, and productivity. This analysis attempts to quantify the economic benefits and costs of permitting an immediate 10% increase in the bilateral migration of skilled workers (physicians, engineers or science, engineering, technology, and mathematics workers, and other persons with advanced educations) among the nations of the African Continental Free Trade Area and, more broadly, among 25 global regions. Economic benefits include higher migrant incomes abroad, welfare gains in destination countries associated with higher economic efficiency, spillover productivity gains, and an improved ability of the younger and more skilled working force to support the needs of the wider population, resulting in higher national production. Benefits in source countries include productivity enhancements from two sources: (*a*) greater access to knowledge associated with more bilateral trade and investment and (*b*) the ability of local households to invest remittances in productivity-enhancing activities. Welfare losses in source nations include static efficiency reductions and a worsened demographic support capability. In Africa, the benefit-cost ratios range from 3.7 to 6.9; in the global analysis, 17 to 38.

1. Introduction and policy context

The United Nations Sustainable Development Goals (SDGs) are comprehensive, seeking as much as possible to eliminate extreme poverty and hunger, improve health and education, and reduce gender and economic inequalities, while also increasing economic growth and addressing climate change. There are 17 broad SDGs, with each comprising a series of targets. Many of these targets may be addressed in some fashion through the subject matter of this paper, which is focused on the benefits and costs of higher international mobility of skilled labor. For example, greater labor migration can establish more channels for information flows, directly contributing to faster economic growth (Goal 8) and improved innovation and work (Goal 9). It can also expand international remittances, which can be invested by recipient households in home countries in education (Goal 4), entrepreneurship (Goal 9), and improved and sustainable agricultural technologies (Goal 12). At the same time, increased emigration of medical professionals and technical workers from poor countries can reduce quality of local services, innovation, health status, and productivity. There are numerous economic tradeoffs, making the issue of global migration an important subject for benefit-cost analyses.

Skilled migrants move across borders largely to achieve higher incomes, assuming they get to work in their chosen professions (Grogger & Hanson, 2011). Salary increases and improved living standards are the primary benefit to these migrants and their families. Moreover, skilled migration can expand innovation and economic opportunities in destination countries, which is well established by studies of developed economies (Hunt & Gauthier-Loiselle, 2010; Kerr, 2013). They also relieve critical labor shortages in technical and professional fields. These outcomes, in turn, color the debate in such countries about immigration policy, which tends to favor higher-skilled immigrants over the less skilled. Scholarship about developing countries focuses heavily on the potentially negative economic implications of the brain drain from outward migration (Docquier & Rapoport, 2012). Less studied are the effects of skilled migration from poorer to richer nations on reverse productivity gains because emigrants also establish additional channels for trade, investment, and production networks, which can enhance productivity gains in their home countries (Elo, 2015).

Such considerations underlie the analysis in this report, which is aimed at answering this question: What would be the economic benefits and costs of permitting an immediate increase in the bilateral migration of skilled workers among the 54 nations of the African Continental Free Trade Area (AfCFTA) and, more broadly, among all regions of the world? The impetus for studying Africa arises from a growing interest in greater labor mobility among African nations. The members of the African Union (AU) adopted a Free Movement Protocol in 2018 as a component of Africa Agenda 2063.[1] Its objective is to "provide for the progressive implementation of free movement of persons, right of residence, and right of establishment in Africa." These rights, along with the market-opening measures of AfCFTA, are seen as essential for the economic integration of the continent and a driver of future economic development.[2] While to date relatively little migration policy reform has happened in national capitals, interest in greater movement of skilled persons remains high, as expressed in a recent framework draft.[3]

While potentially important in Africa, the gains from skilled-labor migration on a global scale are likely magnitudes higher. From the standpoint of economic growth and poverty reduction across the developing world, therefore, an extended analysis of a marginal increase

[1] Protocol to the Treaty Establishing the African Economic Community Relating to Free Movement of Persons, Right of Residence, and Right of Establishment, https://au.int/en/treaties/protocol-treaty-establishing-african-economic-community-relating-free-movement-persons.

[2] See the extensive analysis of the potential impacts of AfCFTA performed by the World Bank (2020), which projects growth in real GDP of 7% by 2035 across the continent. Such gains would be enhanced by increased international labor mobility.

[3] The Revised Migration Policy Framework for Africa and Plan of Action (2018–2027), an update of earlier frameworks, was adopted in 2018 by the African Union members. Labor migration is one of nine thematic areas discussed in the context of international and domestic migration policies.

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in global labor integration is in order. Moreover, despite some political reservations, pressures are building that will raise the demand for international movement of skilled labor. This is true for several reasons but arises especially due to demographic trends. Richer and higher-income emerging economies continue to experience sharp declines in their fertility rates and are aging rapidly, raising the need for skilled workers from abroad in such advanced occupations as medical care, finance, information technologies, and other knowledge-intensive industries.

Thus, the present analysis builds spreadsheet models of the key impacts of greater international flows of skilled workers in various categories (physicians, engineers or science, engineering, technology, and mathematics (STEM) workers, and other persons with advanced educations), both across Africa and 25 global regions. *The benchmark change is a 10% increase in the bilateral migrant stocks of skilled workers, using 2020 data but implemented in 2022, considered to be permanent migration over the workers' careers abroad of 25 years on average.* The computations build on constructed bilateral matrices of 2020 migrant stocks among 12 countries and regions in Africa and 25 regions across the globe. Data on some variables and relationships are scarce, forcing several assumptions to be made to construct these matrices.

Skilled international migrants are defined as movers that have completed an advanced education, using UNESCO's ISCED categorization. Specifically, the included categories are those with a tertiary education (Groups 5 and 6), an MA degree or equivalent (Group 7), and a doctoral degree or equivalent (Group 8). The analysis deploys separate data inputs for the prevalence of physicians in the population and those with degrees in STEM, in order to break out those types of skills. This is important, given the significance of losing their services in source countries while gaining them in destination countries. Quantifiable economic benefits arise for three actors in the model. First, there are higher migrant incomes abroad, which are substantial in the case of migration from low-income to high-income economies. Second, there are welfare gains in destination countries associated with higher economic efficiency, spillover productivity gains, and an improved ability of the younger and more skilled working force to support the needs of the wider population, resulting in higher national production. Benefits in source countries include productivity enhancements from two sources: (*a*) greater access to knowledge associated with more bilateral trade and investment and (*b*) the ability of local households to invest remittances in productivity-enhancing activities. Welfare losses in source nations include static efficiency reductions and a worsened demographic support capability. Benefits and costs are discounted at an 8% rate to compute their net present values.

1.1. Initial summary of results

Table 1 summarizes the aggregated results for the African and global models. Detailed results broken down by region are presented later in the report. The broader the skill classification, the greater are the volumes of benefits and costs because there are more migrants involved. There are notable variations in the benefit-cost ratios (BCRs) across skill categories. In Africa, the BCRs range from 3.71 for the broadest skill class (labeled "other skilled labor") to 6.87 for greater migration of physicians and 4.37 for STEM workers. The gains for the latter two highly skilled categories largely arise from higher wages earned by those who migrate, the gains from investing remittances sent back to source countries, and better demographic ratios in the destination nations. STEM migration involves large positive technology spillovers. The origin countries suffer their largest losses in diminished demographic support ratios. Notably, if

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Table 1. *Overview of B/C ratios.*

A. African case			
Policy	Benefit	Cost	B/C ratio
10% rise in bilateral physician migration	194	28	6.87
10% rise in bilateral STEM migration	1,466	335	4.37
10% rise in other skilled labor migration	4,696	1,258	3.71
10% rise in all bilateral skilled migration	6,356	1,621	3.92
10% rise in bilateral physician + STEM migration	1,660	363	4.57
B. Global case			
Policy			
10% rise in bilateral physician migration	83,993	2,193	38.29
10% rise in bilateral STEM migration	299,642	17,127	17.50
10% rise in other skilled labor migration	710,383	67,692	10.49
10% rise in all bilateral skilled migration	1,094,019	87,012	12.57
10% rise in bilateral physician + STEM migration	383,635	19,320	19.86

Note: In millions of dollars at an 8% discount rate.

migration were limited to physicians and STEM workers, the BCR would be 4.57, markedly higher than that for other skilled labor categories.

These BCRs are well above unity, suggesting that perhaps four or five dollars would be returned per dollar of cost. However, they are relatively small compared to those from global migration, shown in the second panel of Table 1. A primary reason for the low BCRs is that within-Africa skilled migrants do not receive large gains in wages abroad, given the relatively narrow range in salaries across nations. Further, as noted later, some African regions experience relatively large losses from lower demographic support capabilities. Nonetheless, the estimated BCRs suggest that there are substantive net gains available to African countries through a marginal increase in skilled labor on the continent.

There are far larger volumes of migration in the global model, of course. The major point at this stage is that the BCRs are considerably higher, achieving levels above 10, suggesting truly notable potential net gains. These ratios are over 38 for physician migration and 17 for STEM workers, reaching 20 for the combination of those flows. There are four primary reasons for the markedly higher growth in benefits over costs between Africa and the world analysis. First, migrants from lower-income to higher-income economies receive considerably higher wage gains in the global model. Second, these gains generate significantly higher remittances back to source nations, which may be used by residents there to invest in productivity-increasing activities, such as more education and entrepreneurship. Third, there are greater positive productivity spillovers associated largely with migration from richer to poorer countries.[4] Fourth, the arrival of skilled immigrants generates relatively large demographic support gains in destination economies.

[4] As explained later, there are such movers in the data. The model posits that they retain their home-country salaries, meaning they would not migrate to low-wage nations and accept diminished compensation. They do, however, generate local spillovers.

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This policy would permit a 10% increase in bilateral skilled migrant stocks through migration according to 2020 estimated skilled migrant stock shares. Workers would work abroad for 25 years.

1.2. Theory and model

I develop spreadsheet-based models that capture important welfare impacts of a marginal increase in skilled-labor mobility within Africa and across the globe. In principle, workers can move in any direction, but to discipline the analysis, I tie the migration changes to estimates of existing bilateral stocks of skilled migrants, using 2020 figures for Africa and the world. The models are virtually identical in structure, save for the treatment of international productivity spillovers.

The models are constructed and calibrated to aggregate data, to estimate key economic impacts of a 10% rise in bilateral migrants of physicians, STEM workers (each broken down separately), and other skilled labor. In total, skilled labor is defined as those aged 15–64 who have completed an advanced education, ranging from short-cycle tertiary to doctoral degrees.

The impacts modeled and quantified include the following.[5]

- The number of new migrants in each bilateral direction, plus the totals of skilled emigrants and immigrants by country or region.
- The implied changes in wages of skilled workers in these categories in source and destination countries, allowing for some convergence over time in wages between low-wage countries and high-wage countries. Pre-migration salaries for physicians and STEM workers are taken from an online global survey source, while proportionate wage premia for other skilled workers are assumed the same across regions.
- The gains in wage income for migrants, which depend on wage differences between source and destination and the ability (productivity) of immigrants, which determines the portion of the post-migration destination wage they earn over time after migrating. Because the migrants are skilled, a relatively rapid convergence of their salaries to destination levels is modeled. I assume migrants will not accept a lower wage in a destination country than they earned at home. These gains in migrant incomes over 25 years are a benefit in the model.
- The increase in remittances paid by the skilled migrants to their families remaining in the source countries. Remittances *per se* are not a welfare gain; rather, they are a transfer from migrants to home locations. However, they support investments, as noted below.
- The losses in static economic efficiency in source countries as skilled emigrants leave and the gains in static economic efficiency in destination nations as skilled immigrants arrive. These elements are in the welfare calculations. Note that these are welfare triangles in the standard economic sense. Even small changes in source-country and destination-country wages generate large aggregate compensation changes for remaining (source) and native (destination) workers. However, these changes are welfare rectangles that reflect income transfers between workers and capital owners or other factors and are not included in the welfare computations.

[5] These factors largely follow those discussed in Bossavie *et al.* (2022) regarding the impacts of skilled migration in Europe. A consideration of the impacts of changes in demographic support ratios on GDP has been added, following Marchiori *et al.* (2013).

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- The international migration of skilled workers brings positive productivity spillovers to their destination regions that arise from greater diversity in teams, more innovation and creativity, and improved techniques (Ortega & Peri, 2014). These are modeled simply and counted as destination benefits.
- There are similar productivity spillover benefits for source regions associated with the expansion of bilateral or multilateral trade and investment flows and greater production networks within cross-border migration associated with people from similar regional origins.
- Next, there are source-region welfare gains associated with increased inflows of labor remittances from skilled emigrants. The gains arise from the ability of source households and firms to invest a portion of these remittances in education, health, and entrepreneurship. The overall returns to such investments are high in developing countries.
- Finally, migration of skilled workers has important demographic effects, exemplified by the improvement (deterioration) of health status in destination (source) regions associated with physician migration. More broadly, skilled workers embody a higher ability to support the needs of the population through fiscal transfers and other processes than do unskilled workers. In principle, one could attempt to model these impacts within each skill category, accounting for the dynamic costs and benefits among regions with varying demographic profiles. The data required for this purpose are scarce, while projections of such needs are inherently difficult. Thus, I adapt the dynamic estimates in Marchiori *et al.* (2013) of the impacts of a considerably larger hypothesized increase in skilled emigration on the long-term labor support ratios in aggregated regions of emerging and developing source regions. These ratios are translated into declines in per-capita GDP, taken as a welfare loss. However, there are corresponding improvements in these ratios in destination regions.

To clarify, this final element is an effort to capture an important dimension of the "brain drain" of skilled emigration in source regions and the corresponding immigration benefits in addressing the evolving skilled labor shortages in recipient nations. Migrating physicians, for example, likely generate larger gains in rich countries with aging populations and low birth rates. As Marchiori *et al.* (2013) point out, there are additional impacts, including the potential for "brain gain" as remaining young people in source countries choose to invest in human capital as their prospective wages rise over time. I leave those effects aside.

With that overview, certain elements of the model parameters and equations, as listed in Appendix A, can be considered. The matrices of bilateral immigration and emigration shares are constructed from existing estimates of international migrant stocks, described in the data section below. The benchmark labor-demand elasticities in both destination and source regions are set at –0.5, which is close to the upper end of the confidence interval established in an extensive meta-analysis of published estimates of this parameter (Lichter *et al.,* 2014). The role of these parameters in the model is to compute the implied rise in source wages and drop in destination wages due to the migration of different skill classes. Note that higher elasticities would expand these wage impacts, with offsetting effects on benefits and costs. Specifically, for a given increase in migration, the lower destination wage would reduce the net wage gains of migrants and diminish remittances, even as it raises the destination net efficiency gains. Experimentation with higher demand elasticities had little impact on the ultimate BCRs.

There is little systematic information on the age at which the typical skilled migrant leaves one country to work abroad. Because a focus of this report is the effects of skilled migration

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on lower-income economies, I chose to calibrate the foreign career roughly to the anticipated foreign career of an African-trained doctor or engineer. Emigrant African doctors tend to complete their degrees in their early 30s and work for a few years at home before going abroad at perhaps 35 years of age. Given lower life expectancies in Africa, the typical retirement age is around 60. Thus, an emigrant would deprive the source country of the fruits of its educational investment for perhaps 25 years. To be sure, retirement ages are higher in richer destination countries, meaning this procedure underestimates the investment and productivity benefits available to those locations.

The next parameter, an annual macroeconomic wage convergence factor, attempts to capture the fact that, for the last few decades, real wages have tended to rise faster in poor and emerging economies than in richer ones, associated with such elements as technology diffusion and offshoring. Failure to account for this factor would overstate the time-related wage gains to migrants. Based on evidence from the convergence literature, I set this catch-up parameter conservatively at 2% (0.02) per year.[6]

More consequential for the model are estimates of how quickly the wages (via productivity) of immigrants catch up to native wages of similar professionals. There is a large literature on this issue, which finds, for example, that even lower-skilled immigrants into the USA and Europe tend to catch up within a relatively short portion of their working life, conditional on the quality and substitutability of their training and skills.[7] It is likely that such convergence is relatively quick for physicians and STEM workers, while somewhat slower for other skilled labor. Thus, I permit the convergence factors to rise linearly from 80% to 100% in 3 years for the former and in 5 years for the latter.

The next parameter is the rate at which the additional skilled migrants might be expected to remit back to source countries a share of their income gains. In 2020, personal remittances in the world amounted to US$ 425 billion, which came to around US$ 1600 per person, given the total international migrant stock estimate from the United Nations Department of Economic and Social Affairs (UN DESA) of 265.6 million. It is likely that skilled migrants remit more per person but at a lower rate, which is consistent with the fact that, on average, migrants in Organization for Economic Cooperation and Development (OECD) countries remitted 4.7% of their gross incomes (measured as GDP per capita), compared to 15.3% in non-OECD nations.[8] The rate chosen here is 7.5% (0.075) of wage gains (rather than gross wages or GDP per capita) by the skilled migrants, which is consistent with the weighted average of these OECD versus non-OECD rates.

The succeeding set of parameters relate to potential productivity spillovers in destination countries from international migration of skilled workers. Numerous channels have been identified in the economics literature for such effects. First, as noted above, skilled immigration has a positive causal impact on real productivity per capita in a wide range of countries and is associated with intellectual diversity and high innovation propensities (Ortega & Peri, 2014). Second, such migration can stimulate growth in trade and inward foreign direct investment (FDI). These flows are, to some degree, channels for transferring advanced technologies to advantageous production locations (Markusen, 2002). Thus, there are significant productivity spillovers from inward FDI and technology licensing, emerging

[6] See Baldwin (2016) on convergence.

[7] See, for example, Blau and Mackie (2017) for the USA.

[8] Data from the World Bank, https://data.worldbank.org/indicator/BX.TRF.PWKR.DT.GD.ZS.

through multiple channels, including implementation of higher quality standards, demonstration effects, and local business startups (Keller, 2010).

The question here is the extent to which an increase in skilled immigration would support such technology spillovers and result in real GDP gains in destination countries. There are few reliable direct estimates of how flows of skilled workers generate such impacts. Rather, the influences are indirectly measured through trade, FDI, patenting, and the like. In this context, I make the following assumptions. First, suppose that each dollar of high-technology imports, FDI, and licensing is capable of raising local total factor productivity by US$ 0.03, a conservative estimate (Coe *et al.,* 1997; Keller, 2010). Second, assume that increased flows of skilled workers facilitate additional inward technology transactions sufficient to capture half this impact, or US$ 0.015. Because these externalities must be measured in USD terms, I apply the associated parameters to the income gains earned (adjusted for productivity differentials) by movers at the destination because these gains are the appropriate measure of increased human capital. Specifically, for movers from lower-wage to higher-wage locations the destination GDP gain is the relevant spillover parameter times the adjusted wage differential multiplied by the number of movers. For movers from higher-wage to lower-wage locations, the GDP impact is just the spillover rate times the source wage multiplied by the number of movers. Put simply, for each US$ 1 billion in wages earned by skilled immigrants there is a spillover of US$ 15 million real GDP gains at the destination.[9]

It is reasonable to assume that the effective spillover rates would vary depending on whether the migration is North–North, North–South, South–North, or South–South, where North refers to high-income economies and South to lower-income developing and emerging countries. Thus, I scale the North–North parameter at 0.015 as the benchmark. Presumably, North–South migrants embody greater differences in knowledge, and I take that parameter to be 0.06. In contrast, I set the South–North spillover at half the benchmark, or 0.0075. Finally, there is certainly information content in South–South labor flows, and I set the parameter to be 0.04, reflecting the rapid learning that takes place in countries with lagging technologies.[10] These spillovers are counted as real GDP gains in the welfare calculations.

The next parametric questions concern potential gains in source nations from similar productivity spillovers arising from skilled emigration on the one hand and domestic investment of remittances on the other. Regarding the former, I simply replicate the benchmark spillover parameter of 1.5% (0.015) discussed above. As for the latter, two additional parameters matter along with the remittances rate determined above. First, what proportion of incoming remittances are invested productively in education, health status, and the like? I could find no information on this question and simply take the parameter to be 25% (0.25). One justification is that remittances on permanent wage gains abroad presumably reflect a permanent increase in income for the recipient households in source countries. As such, we would expect a significant share going to investment activities. Second, what are the returns to such investments in terms of real productivity gains? Here, I appeal to a recent review of studies of returns to education in over 100 countries, typically performed using a Mincerian approach, which finds an average social plus private return to education of 32%

[9] The report by the African Union (2019) finds somewhat higher spillover impacts on manufacturing value added on both the immigration and emigration side. However, manufacturing is a relatively small share of GDP in Africa, suggesting smaller values are in order.

[10] These spillover parameters are the same as those I used in an earlier analysis of innovation zones within the Western Hemisphere (Maskus, 2014).

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(Patrinos & Psacharapoulos, 2020). Thus, I assign a parameter of 30% (0.3) as the return on investment of incoming remittances in source countries.

Turning to the model equations, they are generally straightforward implementations of the logical steps described above. Two points should be emphasized, however. First, the database begins with extensive estimates from UN DESA of bilateral migrant stocks across countries, which does not have a breakdown by skill categories. These migrants may have arrived in destination locations at any time in the past and therefore do not necessarily reflect current pressures for migration. Nonetheless, as described in the next section, I apply estimates of each region's labor forces (also essentially stock estimates) in the three skill categories to total emigrant stocks to approximate the propensity to move abroad. In turn, these propensities are used to predict the distribution of where the 10% additional skilled migrants will locate. In brief, I assume that the existing bilateral migrant shares determine the allocation of the flows of new skilled migrants. Second, as mentioned earlier, there are substantial numbers of migrants in the UN DESA data who have resettled from higher-wage economies in lower-wage locations, which could happen for numerous reasons. In terms of economic pressures, however, it is unlikely that skilled professionals would choose to do so and accept lower wages abroad. Thus, I implement the assumption that physicians, STEM workers, and other skilled workers moving abroad keep their home wages rather than accept lower destination wages.

In principle, of course, workers could accept lower wages abroad under at least two important circumstances. One is that they gain altruistic benefits that make them better off but are essentially unmeasurable. Another is that real wages may be higher abroad due to lower costs of living. Indeed, comparisons of GDP per capita made with purchasing power parity (PPP) adjustments generally show that the gaps in real living standards between rich and poor countries are smaller than nominal wages would suggest. Such adjustments rarely reverse real income comparisons, meaning that migrants from high-wage economies presumably wish to retain their higher living standards associated with higher home wages, making this assumption reasonable. However, using PPP adjustments would reduce the real wage gains accruing to migrants and lower the computed BCRs somewhat.

The final element is the adaptation of Marchiori *et al.*'s (2013) dynamic estimates of changes in support ratios. Their policy experiment is a series of increases in skilled migration of 20% each decade over 50 years. Their definition of skilled labor corresponds to the broadest category here: those workers with at least a secondary education. This experiment is first scaled downward to reflect the smaller size of skilled migration envisioned in the present analysis. Next, their estimates of changes in support ratios over the first 25 years of their projection period are taken to indicate what might happen in the timeframe considered here. These impacts vary across the seven regions in their analysis due to differences in demographic profiles, emigration propensities, and other factors. I apply these scaled parameters by region to corresponding regions in the African and global models here, assigning the smallest impacts in the high-income regions in order to be conservative on the benefits side regarding high-wage destinations. This vector of regional impacts on per-capita GDP losses is then translated into dollar-based impacts in source and destination regions using population data for 2020.

1.3. Data sources

As noted, the benchmark data matrix is built from bilateral estimates of migrant stocks in 2020 from UN DESA. African countries are aggregated into the 12 regions and individual countries (see Appendix B) and nearly all countries of the world into the 25 global regions (including India as a single country) in Appendix C. Note that in the UN DESA data for Africa, regional categories are defined differently from those in the AU. For example, Zambia and Zimbabwe are placed in Eastern Africa by the UN but in Southern Africa by the AU. For consistency with the migration data, I use the UN definition, but this element should be kept in mind as results are examined. The list of countries assigned to UN regions in the global model is comprehensive. However, some very small nations and territories were excluded, as were North Korea, and Taiwan, China Province because the UN matrix did not report migration data for them.

Organizing the raw data in this way, the basic matrix accounted for 256.6 million individuals among bilateral migrant stocks. The full UN DESA matrix claims there were 280.6 million migrants. The difference of around 24 million was either from UN "other" sources, which were undefined, or from the excluded small countries and non-reporters. The benchmark matrix in the model therefore contains 91% of the estimated global migrant stocks.

This matrix was then scaled in steps to achieve a reasonable estimate of the matrix of bilateral stocks of skilled migrants. First, the raw matrix was reduced by 30% to reflect the fact that about that percentage of migrants are outside the working age range of 15–64 years, which is the definition used in this analysis. Second, estimates of the proportion of each source country's population with an advanced degree were developed, as described next. I applied these proportions to the bilateral cells in the working-age matrix, assuming that emigrants among advanced workers had the same share of the source labor force as domestic advanced labor. These adjustments resulted in an estimated 23.8 million migrants with advanced education or 13.9% of working-age migrants. Approximately 14.7 million are located in OECD countries. However, the World Economic Forum estimates that there are 25.2 million educated migrants in OECD countries, or 42% more than accounted for so far. Further, the AU estimates suggest that there were about 29% more skilled migrants in African countries than the 1.01 million found (African Union, 2019). Therefore, to be consistent with available independent estimates, the figures in the OECD destination cells were adjusted upward by 42%, and those for non-OECD countries were raised by 29%. These procedures produced a global bilateral matrix totaling 36.7 million migrants with advanced education. That matrix is reproduced in Table 2.

Similar procedures were applied to compute the estimated bilateral matrix of migrant stocks in Africa, which is given in Table 3. There were an estimated 1.479 million migrants with advanced education, which is consistent with AU estimates. In both tables, it is evident that migration decisions are driven to a large degree by gravity-based factors: there is a strong geographical concentration of migration between regions (and within regions) in close proximity and between regions of larger size. However, some regions display lower immigrant stocks than such factors would suggest, indicating their relative closure to labor mobility.

The next task was to estimate the numbers of physicians, STEM workers, and other skilled laborers who make up these bilateral cells of migrants with advanced education. That is, of the educated workers from, say, low-income Southeast Asia, who reside in Australia and New Zealand, how many can be reasonably assigned to each of the three skill classes? For this purpose, estimates of the domestic labor forces in each country with advanced education were compiled, along with estimates of the number of doctors and STEM workers. For the first estimation, I relied on the Barro and Lee (2013) dataset of educational

Table 2. Final estimated matrix of global bilateral migrant stocks with advanced education in persons: 2020.

	Source												
Destination	ANZD	CCAM	CNAS	CHNM	EAFR	EEUR	HIEA	HISEA	HIWA	INDIA	LISEA	LIWA	MAFR
ANZD	s	4273	725	49,588	8158	57,904	119,789	58,752	10,963	63,370	72,744	30,868	521
CCAM	392	171,366	2	2100	16	2380	4230	41	986	935	533	343	21
CNAS	25	0	48,821	120	1	981,588	8798	3	0	42	6	13,818	0
CHNM	999	0	23	529	0	1243	94,221	760	0	478	23,425	20	0
EAFR	87	6	0	343	107,498	90	121	10	0	2543	64	0	51,191
EEUR	1325	1062	564,806	6006	202	2,400,289	4130	397	5372	1323	5891	172,280	193
HIEA	11,079	410	7994	248,685	0	4852	173,221	8861	0	5499	120,635	0	0
HISEA	7292	0	0	27,273	151	0	31,224	274,785	0	26,767	161,029	146	0
HIWA	1930	403	5615	134	3621	146,465	30	16	124	1910	598	18,051	154
INDIA	890	0	44	5005	1884	278	468	7165	0	0	3477	66	0
LISEA	4737	42	0	11,435	7	114	23,235	5184	160	4235	214,954	1374	31
LIWA	1102	39	5378	1192	238	187,172	978	150	4922	557	1600	575,517	6
MAFR	2	60	0	58	11,806	601	58	0	5	0	0	306	70,094
MOIL	0	0	0	0	7897	0	0	0	0	647,028	247,656	146,219	350
NOAM	57,884	3,249,693	19,432	178,533	47,487	661,941	686,778	32,181	64,231	311,031	404,594	121,927	11,048
NAFR	316	120	454	260	16,853	4698	856	2091	195	553	1640	27,896	6456
NEUR	76,313	42,522	5733	18,906	46,351	833,168	78,877	32,191	29,344	84,289	38,011	96,244	4457
OSAM	528	10,904	4	2682	6	2833	5304	27	528	221	78	1943	17
OSAS	171	4	664	8471	1	33	3964	33,709	75	144,047	70,079	5133	0
PACI	4149	0	0	173	1	6	292	37	0	114	1347	0	0
SAFR	2468	456	4	703	49,212	7012	1615	354	2792	2482	304	250	8370
SEUR	21,579	107,339	7176	26,809	9003	966,828	10,179	710	10,663	21,228	19,550	39,028	16,763
SSAM	321	41,279	10	2553	82	7342	22,356	77	774	82	157	2442	584
WAFR	10	868	216	249	227	336	347	153	396	178	36	401	6545
WEUR	18,950	42,394	178,577	25,779	29,355	2,092,834	56,493	6874	16,279	24,491	69,834	474,544	32,213
TOTALS	428,586	3,673,237	845,677	617,584	340,056	8,360,009	1,327,564	464,529	147,808	1,343,403	1,458,241	1,728,816	209,014

	MOIL	NOAM	NAFR	NEUR	OSAM	OSAS	PACI	SAFR	SEUR	SSAM	WAFR	WEUR	TOTALS
ANZD	7705	83,377	13,912	483,896	10,897	56,765	6497	36,894	118,629	14,134	3669	72,174	1,602,241
CCAM	37	302,141	145	6225	73,005	108	0	57	9749	4816	140	9650	589,416

Table 2. *Continued*

	MOIL	NOAM	NAFR	NEUR	OSAM	OSAS	PACI	SAFR	SEUR	SSAM	WAFR	WEUR	TOTALS
CNAS	5	88	17	2409	0	1260	0	0	0	0	2	1770	1,058,770
CHNM	0	7830	0	1500	1497	857	0	0	3	4929	0	48	138,362
EAFR	0	1082	14,943	3833	0	1109	0	6579	825	0	1200	2433	193,957
EEUR	814	18,137	3079	114,238	898	2820	12	277	46,435	678	919	75,725	3,427,309
HIEA	0	68,236	340	13,550	9382	18,992	0	287	1841	23,817	852	7326	725,857
HISEA	0	7833	0	3815	0	140,720	0	0	0	0	0	68	681,102
HIWA	142	32,809	46,685	19,639	1079	7149	0	2172	7062	6460	47	17,873	320,169
INDIA	8861	10,208	0	2300	0	339,852	13	0	47	0	79	626	381,263
LISEA	612	18,945	488	9504	129	4056	2	86	718	42	35	3246	303,369
LIWA	2298	6677	29,755	10,205	37	21,065	0	56	42,087	77	159	72,693	963,961
MAFR	0	808	52,167	66	0	0	0	722	1321	0	47,626	7681	193,382
MOIL	22,919	7355	441,312	12,814	0	720,427	0	0	0	0	2313	5528	2,261,816
NOAM	35,227	399,507	139,211	448,267	540,647	222,535	3497	22,386	324,346	110,288	125,820	268,780	8,487,269
NAFR	10,277	6597	24,863	3549	14	526	0	118	3879	58	3511	12,864	128,645
NEUR	15,527	145,981	34,886	528,177	25,514	151,168	222	36,672	191,857	17,054	54,440	184,813	2,772,716
OSAM	241	34,047	225	3527	642,688	70	0	43	34,548	31,607	39	9250	781,359
OSAS	4853	12,733	27	10,160	0	361,977	0	26	784	1252	0	273	658,437
PACI	0	1759	331	475	0	305	619	0	88	0	0	10,665	20,362
SAFR	184	4729	1602	19,642	246	2659	2	35,878	8846	682	4763	10,229	165,486
SEUR	1410	79,439	287,617	166,937	386,654	59,850	27	4173	627,578	108,480	82,662	330,738	3,392,419
SSAM	86	13,274	742	2895	429,914	673	3	220	82,902	54,653	1377	12,992	677,789
WAFR	986	1514	4250	478	361	62	31	200	1142	319	592,311	3925	615,541
WEUR	4917	147,795	696,311	219,554	89,058	109,525	52	8266	1,072,286	39,293	96,348	601,390	6,153,411
TOTALS	117,100	1,412,900	1,792,908	2,087,653	2,212,020	2,224,528	10,976	155,113	2,576,972	418,638	1,018,313	1,722,760	36,694,407

ANZD, Australia and New Zealand; CCAM, Caribbean and Central America; CNAS, Central Asia; CHNM, China and Mongolia; EAFR, Eastern Africa; HIEA, High-Income East Asia; HISEA, High-Income Southeast Asia; HIWA, High-Income West Asia; INDIA, India; LISEA, Low-Income Southeast Asia; LIWA, Low-Income West Asia; MAFR, Middle Africa; MOIL, Mid-Eastern Oil Producers; NOAM, North America; NAFR, Northern Africa; NEUR, Northern Europe; OSAM, Other South America; OSAS, Other South Asia; PACI, Pacific Islands; SAFR, Southern Africa; SEUR, Southern Europe; SSAM, Southern South America; WAFR, Western Africa; WEUR, Western Europe.

***Table 3.** Final estimated matrix of African bilateral migrant stocks with advanced education in person: 2020.*

	Source												
Destination	Other EA	MA	Other NA	Other SA	Other WA	Kenya	Tanzania	Uganda	Egypt	South Africa	Nigeria	Ghana	Total
Other EA	116,743	48,902	98,613	2456	362	2018	1295	19,103	1269	7527	1792	22	300,101
MA	23,437	107,318	62,805	1146	15,907	0	0	462	9	132	38,078	649	249,943
Other NA	70,553	9834	37,917	0	812	198	4	141	10,244	102	4436	67	134,307
Other SA	5616	3315	117	618	31	120	28	88	42	4765	416	32	15,188
Other WA	170	4285	9728	14	226,831	99	14	0	259	297	62,022	23,088	326,807
Kenya	32,738	2978	1554	8	0	0	461	22,544	0	16	0	0	60,298
Tanzania	13,810	6432	0	164	0	1230	0	336	0	94	0	0	22,065
Uganda	64,953	27,171	9810	0	3	1735	271	0	0	0	0	0	103,943
Egypt	4112	51	10,622	48	106	7	2	0	0	33	150	24	15,154
South Africa	69,990	9,500	913	58,517	339	1008	153	454	1290	0	6658	816	149,637
Nigeria	0	5723	0	0	41,404	0	0	0	0	0	0	24,264	71,391
Ghana	26	12	6	0	15,401	1	0	0	10	0	14,829	0	30,286
TOTALS	402,148	225,521	232,084	62,972	301,196	6416	2227	43,127	13,122	12,966	128,381	48,962	1,479,120

Other NA, Other Northern Africa; Other SA, Other Southern Africa; Other WA, Other Western Africa.

attainment, which lists for most countries of the world figures capturing the proportion of the population over age 25 that have completed secondary and tertiary education.[11] These data exist at 5-year intervals, with the latest year being 2015. Thus, the figures for tertiary education rates in each country from 2010 and 2015 were extrapolated forward to estimate 2020 rates, making appropriate adjustments where there were unreasonably large jumps or reductions in prior attainment. These rates were then multiplied by the 2020 total population ages 15–64 to approximate the labor force with advanced education. Note that the Barro-Lee definition of tertiary completion is somewhat broader than the UNESCO definition of advanced education, but this is the best approximation method available.

The estimate of the number of physicians in each country was straightforward. Data for many countries on the number of doctors per 1000 people in the population are available in the World Bank's World Development Indicators Database.[12] For developing and emerging economies, the data are reported erratically by year, and the most recent estimate available after 2015 was used. Most such ratios were from 2019 or 2020. Again, applying these rates to total population generated estimates for total physicians in domestic labor forces.

The procedure for STEM workers was similar but less direct because there are no systematic international estimates of their proportional representation in national workforces. However, the UNESCO UIS database reports annual percentages of graduates from science, technology, engineering, and mathematics programs in tertiary education.[13] The original goal was to focus on engineers alone in the migration study, but the UIS data include engineering students in a broad category including manufacturing and construction, too extensive a category for the purposes here. However, all STEM workers are potential contributors to growth, innovation, and spillovers, making them an appropriate aggregated category to study. Again, the most recent proportions available were used, most of which were for 2019 or 2020 for countries with such data. I then multiplied these STEM rates by the Barro-Lee rates of tertiary education in the working-age population to attain estimates of the numbers of STEM workers in each country with data. Finally, the category of other skilled labor is just the difference between workers with advanced education and the sum of physicians and STEM workers.

To allocate skilled workers to bilateral migrant status, I followed these steps. First, under the assumption that current (2020) labor forces with an advanced education are as likely to emigrate as past labor forces, I computed their propensity to emigrate as the ratio of each region's total skilled migrants abroad to its 2020 total skilled labor. This propensity was applied also to doctors, STEM workers, and other skilled labor to estimate foreign emigrant stocks of those categories. Finally, using the final matrix of bilateral skilled migrant stocks described above, each category was assigned to cells of skill-specific migration matrices according to the bilateral emigration shares between each region pair, that is, I assume that overall skilled bilateral migrant stocks determine the same shares in each category of skilled migration.

Armed with these estimates for domestic and foreign emigration propensities among skill categories, it was next necessary to compute salaries in source and destination countries. In the African model, a simple rule, which seemed to capture rough estimates of wage premia

[11] The dataset is available at http://www.barrolee.com/, and the methods underlying it are described in Barro and Lee (2013).

[12] https://databank.worldbank.org/source/world-development-indicators.

[13] http://data.uis.unesco.org/.

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by skill category, was applied. Specifically, the wage of skilled workers was taken to be 1.6 times GDP per capita, reflecting the low end of the skill premia reported by the World Bank (2020) in their analysis of AfCFTA. To capture the higher ranges, the wage of STEM workers was set at 2.75 times GDP per capita and of physicians at 7.5 times GDP per capita.

While this approach produced reasonable figures for African skilled wages by category, it proved untenable for the global model, especially in richer countries. For example, 7.5 times 2020 per-capita GDP in the USA and Germany yielded figures for the average physician salary far larger than survey-based estimates. Thus, I collected data on average physician and engineer salaries available online from a private firm offering information to potential professional migrants about compensation rates in nearly all countries.[14] These 2022 data are reported in local currencies, requiring conversion with market exchange rates in that year, which were downloaded from the IMF International Financial Statistics, using period-average rates across the first three quarters. These to 2020 prices were deflated using country consumer price indexes from the WDI, which currently extend only through 2021. Finally, salaries for other skilled workers were computed as engineering salaries divided by 1.724, based on an inspection of some other, less-skilled, categories of educated workers in the salary survey. These national salary figures were applied to all countries in the global model, including in Africa. It should be noted that these salaries are pre-tax and, in principle, should be adjusted in each region to an after-tax basis. However, available data on statutory personal-income tax rates are not universal, and they can be misleading given the large range of exemptions and deductions across nations. Thus, the model relies on pre-tax wage differences to compute wage gains. It is likely that such gains would be somewhat lower on an after-tax basis.

Finally, as anticipated, many of the variables mentioned were unavailable, or unreliably reported, in numerous countries, especially smaller economies and developing regions. This is one reason, beyond simple tractability, for conducting the benefit-cost analysis at the regional level, rather than on a cross-country basis. Thus, variables involving rates or ratios were aggregated to the regional level, using weights for countries with reliable data based either on population measures or GDP as the situation suggested. This weighting scheme permitted filling in the data requirements for both the African and global models.

1.4. Results for the African model

Again, the policy analyzed here is a one-time, 10% increase in bilateral skilled migration, relative to 2020 levels, across the countries and regions of Africa, beginning in 2022. This could be considered the result of a mutual decision among AU members to relax their immigration restrictions against foreign skilled workers based on prior migration patterns. Alternatively, one could imagine a 10% relaxation in overall barriers and the response mirrors past migration patterns, which could reflect underlying equilibrium conditions. The model assumes that the higher limits are met with immediate increases in bilateral migration, so that none of the permitted increases go unfilled.

[14] http://www.salaryexplorer.com/salary-survey.php. It is worth noting that across all countries the ratio of physician to engineering salaries ranged in a narrow band around 2.65, not far from the 2.7 factor between them when using the GDP per capita rule of thumb.

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Implementing the model with the data for African countries and regions generates the welfare results presented in Table 4 through Table 7. Per guidelines of the Copenhagen Consensus Project, future benefits and costs are discounted at 8%. In this context, recall that the program period is 25 years after the initial increase in skilled migration. Specifically, the migrants move to foreign locations and work the bulk of their careers there, earning destination-level incomes if wages there are higher or source-level incomes otherwise.

The model predicts an overall gain in physician migrant salaries (see Table 4) of US$ 98.473 million, which may seem modest in light of the scope of the policy change. There are three primary reasons for this. First, the initial migrant stocks in this category were small and a 10% increase amounts to just 2531 doctors overall. Second, the salary gaps between regions are relatively modest, generating small gains to migrants.[15] Third, a considerable amount of migration happens within regions. For example, 29% of the new physician migrants move within Other Eastern Africa, Middle Africa, Other Northern Africa, and Other Southern Africa. Because only one wage for physicians is defined within a region, these migrants generate no income gains. Nonetheless, the average salary increase for migrants in the model is US$ 38,271, a notable gain on source levels. Carrying through Table 4, the efficiency gain in destination countries is just over US$ 1 million, while productivity spillovers amount to US$ 9.7 million. The largest source of welfare gains in the destination countries and regions is the GDP gain from improved demographic support ratios, amounting to about US$ 77 million. Total destination benefits amount to US$ 87.7 million. In contrast, source countries suffer a small efficiency loss of US$ 925,000 and a significant demographic loss of US$ 27.3 million. Offsetting these losses somewhat are gains from diaspora-related network effects and the ability to invest a portion of inward remittances. Together these benefits total around US$ 8 million.

Across the continent, the BCR from physician migration is 6.87, a notable ratio in the context of development policy. However, these BCRs vary widely across countries and regions. The smallest are in Egypt, Ghana, Nigeria, and Other North Africa. In the cases of Egypt and Nigeria, this is due to a small increase in predicted immigration. Within the three regions, there are larger migrant flows, but no scope for wage increases due to the single regional wage. Thus, to some extent, the distribution of costs and benefits is an artifact of the model, in that within-region migrants presumably would gain some compensation increases. In contrast, larger net benefits are predicted for Kenya and South Africa, which attract large numbers of immigrant physicians and enjoy large GDP gains from improved support ratios. This finding highlights the substantial benefit from being a destination country for highly skilled professionals. Finally, the largest BCRs are registered for Other Eastern Africa and Other Southern Africa, both of which saw large out-migrations of physicians to other countries where they earned significantly higher wages.

There are more STEM migrants than physicians, resulting in a larger scope of benefits and costs, but the costs rise faster, resulting in a lower BCR of 4.37 for Africa overall. Again, there are small BCRs in some countries (Other North Africa, Egypt, Nigeria, Ghana, and Other West Africa) for similar reasons. In addition to South Africa and Other Southern

[15] To clarify, the reason that the emigrants from some countries have small wage gains is because the destination wages can be lower than source wages. In South Africa's case, its home wages are the highest in the continent and its emigrants experience no wage increase, nor do they send back remittances in the model.

Table 4. *Benefits and costs of a 10% increase in bilateral physician migration in Africa.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F			
Other EA	62,770	93	1489	2174	172	2913	1832	1366	62,770	3755	3198	3085	69,723	3085	22.60
MA	2961	163	1340	2437	16	2199	211	64	2961	3940	275	2214	7177	2214	3.24
Other NA	1510	20	1049	2462	74	4255	754	33	1510	3532	787	4329	5828	4329	1.35
Other SA	10,320	23	206	85	259	354	603	225	10,320	314	828	614	11,462	614	18.68
Other WA	7528	346	1900	2338	220	2155	985	164	7528	4583	1148	2375	13,260	2375	5.58
Kenya	164	57	346	9906	0	1054	8	4	164	10,309	11	1054	10,485	1054	9.95
Tanzania	551	1	54	7124	0	719	27	12	551	7179	39	719	7770	719	10.80
Uganda	4079	45	269	953	20	395	173	89	4079	1267	262	415	5608	415	13.50
Egypt	246	1	162	4797	0	4154	61	5	246	4960	67	4154	5273	4154	1.27
South Africa	0	140	2206	41,568	3	3602	82	0	0	43,915	82	3604	43,996	3604	12.21
Nigeria	8208	5	344	2631	146	4731	1018	179	8208	2980	1197	4877	12,385	4877	2.54
Ghana	136	110	325	486	15	786	72	3	136	921	75	801	1,132	801	1.41
TOTALS	98,473	1004	9691	76,962	925	27,317	5825	2143	98,473	87,657	7968	28,241	194,098	28,241	6.87

Note: In US$ thousands at an 8% discount rate.

Other EA, Other Eastern Africa; MA, Middle Africa; Other NA, Other Northern Africa; Other SA, Other Southern Africa; Other WA, Other Western Africa.

Africa, large BCRs are recorded for Uganda, Tanzania, Kenya, and Other East Africa, pointing to substantial increases in migration to and from those locations. Again, Ghana and Nigeria stand out as places where there are limited productivity spillovers and relatively high losses from reduced support ratios due to emigration (Table 5).

The other tables may be read analogously. The scale of migration of other skilled workers is considerably larger but the overall continental BCR of 3.73 is lower than that of STEM migration (Table 6). This is true also when all three types of migration are combined in Table 7. Total program benefits rise to US$ 6.36 billion and total costs to US$ 1.62 billion.

There are at least four lessons to be drawn from this African exercise. First, the primary beneficiaries of emigration are the migrants themselves who earn higher foreign wages even within Africa. Second, the limited data available for many countries, which forced them to be included in broad regions with single professional wages, mask some of the benefits that would exist in a more finely grained approach. In that context, the analysis understates somewhat the true BCRs for migrants from those countries. Third, despite that shortcoming, it is reasonable to infer that more open migration policies within Africa, while beneficial for each region overall, are not likely to be major sources of net development benefits in the smaller and poorer countries. They tend to be sources of net emigration, thereby losing on the demographic side and not acquiring many spillovers from immigration. Fourth, the largest net beneficiaries among individual countries in the data tend to be those with significant increases in net immigration, such as South Africa and Kenya.

1.5. Results for the global model

Although an important question in its own right, a global analysis of skilled migration is useful because of the shortcoming noted in the African model. Regional aggregation of data into single measures of investment costs and wages considerably limited the scope for net benefits to migration from poor countries, especially within regions. A global model offers scope for more regions with highly varying cost and salary conditions, along with greater scope for technology spillovers from technologically advanced countries to developing economies.

Therefore, turning to the results of the global model, presented in Table 8 through Table 11, again, the policy experiment is an immediate 10% increase in bilateral migration of three types of skilled labor, which could reflect a marginal relaxation of global migration barriers. Obviously, the far larger scale of global migration generates much greater program benefits and costs. Overall, benefits from all types of migration, shown in Table 11, amount to US$ 1.094 trillion, while costs come to US$ 87 billion. The essential point is the substantial rise in the BCR, from 3.92 in Africa to 12.57 in the global model for all categories combined. Indeed, this ratio rises to 38.29 for the migration of physicians. This expansion of opportunities for skilled migration to the world scale therefore qualifies as a highly effective policy choice for increasing global incomes.

The primary reason for the larger growth in benefits than in costs is that many skilled migrants from lower-income and middle-income economies are now permitted to move to richer countries, where physician, STEM, and other salaries are far higher than in their source nations. Thus, for example, in the calculations for physicians in Table 8, income gains to migrants come to US$ 72 billion, or 86% of total program benefits. Combining all three

Table 5. *Benefits and costs of a 10% increase in bilateral stem worker migration in Africa.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F			
Other EA	298,808	437	7027	26,343	820	35,300	8711	6502	298,808	33,807	15,212	36,121	347,827	36,121	9.63
MA	27,683	374	5805	29,529	146	26,644	1975	602	27,683	35,708	2577	26,790	65,969	26,790	2.46
Other NA	7786	87	4921	29,839	380	51,562	3896	169	7786	34,847	4065	51,942	46,698	51,942	0.90
Other SA	51,962	73	781	1036	1313	4294	3048	1131	51,962	1889	4178	5607	58,029	5607	10.35
Other WA	33,582	1155	6944	28,330	978	26,109	4383	731	33,582	36,428	5114	27,087	75,124	27,087	2.77
Kenya	2390	44	1169	120,035	1	12,771	115	52	2390	121,248	167	12,772	123,805	12,772	9.69
Tanzania	654	19	301	86,331	0	8713	32	14	654	86,651	47	8713	87,352	8713	10.03
Uganda	6650	791	1463	11,545	32	4790	281	145	6650	13,799	425	4822	20,874	4822	4.33
Egypt	790	6	811	58,130	1	50,333	197	17	790	58,947	214	50,334	59,950	50,334	1.19
South Africa	0	1116	10,347	503,707	7	43,646	226	0	0	515,170	226	43,653	515,396	43,653	11.81
Nigeria	19,932	60	1812	31,881	351	57,331	2461	434	19,932	33,753	2894	57,682	56,579	57,682	0.98
Ghana	1105	129	1009	5888	125	9519	583	24	1105	7026	607	9644	8738	9644	0.91
TOTALS	451,342	4289	42,391	932,592	4154	331,013	25,907	9821	451,342	979,272	35,727	335,168	1,466,342	335,168	4.37

Note: In US$ thousands at an 8% discount rate.
Other EA, Other Eastern Africa; MA, Middle Africa; Other NA, Other Northern Africa; Other SA, Other Southern Africa; Other WA, Other Western Africa.

Table 6. *Benefits and costs of a 10% increase in bilateral other skilled worker migration in Africa.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F			
Other EA	626,525	994	14,089	99,360	1763	133,147	18,742	13,534	626,525	114,443	32,276	134,910	773,245	134,910	5.73
MA	98,117	550	11,812	111,379	532	100,496	7189	2120	98,117	123,741	9309	101,028	231,166	101,028	2.29
Other NA	12,525	237	10,075	112,549	626	194,485	6,425	271	12,525	122,861	6696	195,110	142,082	195,110	0.73
Other SA	122,926	186	1,856	3906	3180	16,196	7387	2655	122,926	5948	10,042	19,377	138,916	19,377	7.17
Other WA	64,306	2,240	13,357	106,855	1919	98,481	8602	1389	64,306	122,452	9991	100,399	196,749	100,399	1.96
Kenya	4894	174	3102	452,752	2	48,171	242	106	4894	456,027	348	48,173	461,269	48,173	9.58
Tanzania	1233	61	715	325,628	0	32,864	63	27	1233	326,404	89	32,865	327,726	32,865	9.97
Uganda	35,052	814	3308	43,545	175	18,067	1517	757	35,052	47,667	2274	18,242	84,993	18,242	4.66
Egypt	3490	4	1331	219,258	4	189,850	892	75	3490	220,592	967	189,854	225,050	189,854	1.19
South Africa	0	2393	21,980	1,899,903	18	164,626	558	0	0	1,924,276	558	164,644	1,924,835	164,644	11.69
Nigeria	31,051	221	4107	120,249	559	216,243	3921	671	31,051	124,577	4592	216,802	160,220	216,802	0.74
Ghana	3629	120	1652	22,209	421	35,904	1961	78	3629	23,981	2039	36,325	29,649	36,325	0.82
TOTALS	1,003,748	7993	87,383	3,517,593	9199	1,248,530	57,499	21,683	1,003,748	3,612,969	79,182	1,257,729	4,695,900	1,257,729	3.73

Notes: In US$ thousands at an 8% discount rate.

Other EA, Other Eastern Africa; MA, Middle Africa; Other NA, Other Northern Africa; Other SA, Other Southern Africa; Other WA, Other Western Africa.

Table 7. *Benefits and costs of a 10% increase in bilateral all categories of skilled migration in Africa.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F			
Other EA	988,103	1524	22,605	127,877	2756	171,360	29,284	21,402	988,103	152,005	50,686	174,116	1,190,795	174,116	6.84
MA	128,761	1087	18,957	143,345	694	129,339	9375	2786	128,761	163,389	12,161	130,033	304,312	130,033	2.34
Other NA	21,821	344	16,045	144,850	1079	250,302	11,075	473	21,821	161,239	11,548	251,381	194,608	251,381	0.77
Other SA	185,208	281	2843	5027	4752	20,845	11,038	4011	185,208	8152	15,048	25,597	208,408	25,597	8.14
Other WA	105,416	3740	22,201	137,522	3,116	126,745	13,969	2284	105,416	163,463	16,253	129,861	285,132	129,861	2.20
Kenya	7449	274	4618	582,692	3	61,996	365	161	7449	587,584	526	61,999	595,559	61,999	9.61
Tanzania	2438	81	1070	419,083	1	42,297	122	53	2438	420,234	175	42,297	422,848	42,297	10.00
Uganda	45,781	1650	5040	56,043	227	23,253	1970	991	45,781	62,733	2961	23,480	111,474	23,480	4.75
Egypt	4526	10	2304	282,185	5	244,337	1150	98	4526	284,499	1248	244,342	290,273	244,342	1.19
South Africa	0	3649	34,534	2,445,178	28	211,873	866	0	0	2,483,361	866	211,901	2,484,227	211,901	11.72
Nigeria	59,190	286	6263	154,761	1056	278,304	7400	1283	59,190	161,310	8683	279,360	229,184	279,360	0.82
Ghana	4870	360	2986	28,583	562	46,208	2615	105	4870	31,928	2721	46,770	39,519	46,770	0.84
TOTALS	1,553,563	13,286	139,465	4,527,147	14,278	1,606,860	89,231	33,646	1,553,563	4,679,898	122,877	1,621,138	6,356,339	1,621,138	3.92

Note: In US$ thousands at an 8% discount rate.

Other EA, Other Eastern Africa; MA, Middle Africa; Other NA, Other Northern Africa; Other SA, Other Southern Africa; Other WA, Other Western Africa.

Table 8. *Benefits and costs of a 10% increase in bilateral physician migration globally.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
ANZD	122.3	91.3	123.0	133.1	3.8	31.4	27.0	2.8	122	347	30	35	499	35	14.17	10.70
CCAM	26,223.2	0.3	92.2	11.7	42.3	75.3	599.5	594.4	26,223	104	1194	118	27,521	118	234.00	11.04
CNAS	1912.7	1.1	21.5	13.3	2.1	10.9	42.4	43.4	1913	36	86	13	2034	13	157.63	9.43
CHNM	1112.3	0.0	17.3	82.7	1.5	430.8	85.4	25.2	1112	100	111	432	1323	432	3.06	0.49
EAFR	526.1	0.1	6.0	3.5	0.2	6.2	11.0	11.9	526	10	23	6	559	6	86.97	5.06
EEUR	11,862.1	10.3	274.9	26.3	42.3	64.2	345.6	268.9	11,862	311	614	106	12,788	106	120.11	8.70
HIEA	1164.5	3.6	29.8	80.6	2.3	143.4	55.0	26.4	1164	114	81	146	1360	146	9.33	1.34
HISEA	197.9	3.8	10.7	19.7	1.2	14.2	10.2	4.5	198	34	15	15	247	15	16.09	3.19
HIWA	207.4	5.1	13.8	19.0	1.6	8.8	13.7	4.7	207	38	18	10	264	10	25.31	5.40
INDIA	3095.8	0.0	11.2	12.5	0.2	46.9	61.2	70.2	3096	24	131	47	3251	47	69.06	3.30
LISEA	2001.8	0.1	22.0	14.8	1.0	70.0	47.2	45.4	2002	37	93	71	2131	71	30.01	1.82
LIWA	3214.1	2.6	86.0	8.7	7.9	15.3	86.4	72.8	3214	97	159	23	3471	23	149.59	11.06
MAFR	95.6	0.1	6.4	2.7	0.0	2.8	2.3	2.2	96	9	4	3	109	3	38.08	4.75
MOIL	93.0	43.4	47.1	58.7	0.2	3.0	6.3	2.1	93	149	8	3	251	3	77.93	49.01
NOAM	0.0	543.1	660.7	2928.0	2.4	460.4	43.3	0.0	0	4132	43	463	4175	463	9.02	9.02
NAFR	2829.6	0.0	14.9	0.8	2.7	10.9	63.3	64.1	2830	16	127	14	2973	14	218.23	10.51
NEUR	509.8	64.4	202.5	131.6	55.9	99.2	210.3	11.6	510	399	222	155	1130	155	7.29	4.00

Table 8. *Continued*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
OSAM	2847.0	1.2	54.4	12.5	7.4	35.3	83.1	64.5	2847	68	148	43	3063	43	71.71	5.05
OSAS	3179.8	0.1	19.9	5.6	1.2	18.4	67.5	72.1	3180	26	140	20	3345	20	170.65	8.43
PACI	22.4	0.2	6.6	1.8	0.0	0.9	0.5	0.5	22	9	1	1	32	1	36.28	10.93
SAFR	310.9	0.6	26.0	5.9	0.5	5.4	8.9	7.0	311	32	16	6	359	6	61.49	8.29
SEUR	6349.3	38.5	158.8	101.6	64.5	78.1	333.1	143.9	6349	299	477	143	7125	143	49.96	5.44
SSAM	1452.3	0.7	55.4	155.9	0.6	94.3	40.6	32.9	1452	212	73	95	1738	95	18.33	3.01
WAFR	1094.4	0.4	8.4	6.2	1.2	10.2	23.1	24.8	1094	15	48	11	1157	11	102.13	5.56
WEUR	1590.6	152.1	469.2	645.4	27.0	187.3	194.4	36.1	1591	1267	230	214	3088	214	14.41	6.99
TOTALS	72,014.9	963.1	2438.7	4482.7	269.7	1923.7	2461.4	1632.2	72,015	7884	4094	2193	83,993	2193	38.29	5.46

Note: In US$ millions at an 8% discount rate.

ANZD, Australia and New Zealand; CCAM, Caribbean and Central America; CNAS, Central Asia; CHNM, China and Mongolia; EAFR, Eastern Africa; HIEA, High-Income East Asia; HISEA, High-Income Southeast Asia; HIWA, High-Income West Asia; INDIA, India; LISEA, Low-Income Southeast Asia; LIWA, Low-Income West Asia; MAFR, Middle Africa; MOIL, Mid-Eastern Oil Producers; NOAM, North America; NAFR, Northern Africa; NEUR, Northern Europe; OSAM, Other South America; OSAS, Other South Asia; PACI, Pacific Islands; SAFR, Southern Africa; SEUR, Southern Europe; SSAM, Southern South America; WAFR, Western Africa; WEUR, Western Europe.

skill types, migrant income gains account for 75% of global benefits.[16] Clearly, such migration opportunities can generate wage gains in massive proportions. Moreover, these increases favor skilled workers from poor countries where migration opportunities would expand considerably. Consider, for example, the gains to physicians from the Caribbean and Central America (CCAM), most of whom would migrate to North America. Those doctors would gain US$ 26.2 billion in income. Furthermore, those income gains would support more investable remittances and network spillovers, generating significant net welfare gains in the CCAM source countries. Similar results pertain in India, Other Southern Asia (OSAS), Low-Income Western Asia (LIWA), Eastern Europe, and Northern Africa (NAFR), among others. Including the gains to their net emigrants, these regions register BCRs in excess of 30 and go far higher (Tables 8–10).

Some additional findings stand out. There are exceptionally high BCR ratios from the increase in STEM migration in the cases of India, low-income Southeast Asia (LISEA), other South Asia, Eastern Africa (EAFR), and Southern Africa (SAFR), among others. Again, these are largely income gains to emigrants, but this fact generates enough spillovers and remittance-based investment gains to give the source regions considerable net welfare gains. In Table 11, incorporating all types of skilled-labor movements, BCRs of 15 or higher exist in each of the African regions and some other developing regions, including the Pacific Islands, accounting for income gains to migrants. While the sources of these net gains vary, it seems the spillover benefits as destinations and the investment gains as sources dominate the reduced support-ratio demographic problems as skilled workers emigrate. This common finding in the tables challenges the conventional wisdom that skilled emigration is harmful through brain-drain effects.

To highlight the dominance in the results of migrant income gains the final column in Table 8 through Table 11 reports BCRs for regions, excluding the benefits to migrants. While these are not measures of overall program effects, which appear in the primary BCR columns, they do indicate the balance of benefits and costs for specific regions as net recipients or net senders of skilled workers. While these ratios are much smaller, they remain well above one and some are notably high.[17] For example, among developing regions, there are high ratios in the case of physicians for the CCAM, Eastern Europe, and the Pacific Islands (PACI), among others. Other regions are prominent in this context in the case of STEM migration, while several developing regions stand out when all three skill categories are permitted to migrate. In brief, for developing countries the major impact of greater opportunities for skilled labor mobility is to raise emigrant incomes considerably in their destinations. However, the other gains, arising from productivity spillovers, network effects, and additional investment resources arriving through remittances, are sufficient to more than overcome the losses from diminished support ratios, leaving substantive net benefits.

The computed impacts for developed regions, such as North America (NOAM), Western Europe (WEUR), and Northern Europe (NEUR), are quite different. Because they send relatively few migrants abroad and those workers do not gain much foreign income, the overall BCRs in those rows are generally smaller than those for developing regions, although

[16] The fact that these potential wage gains, just for skilled migrants, are estimated to be $816 billion recalls the comment that international migration barriers amount to "leaving trillion-dollar bills on the sidewalk" (Clemens, 2011).

[17] The exception is China and Mongolia (CHNM), where the flows of emigration and immigration are small in comparison with the region's size.

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Table 9. *Benefits and costs of a 10% increase in bilateral STEM worker migration globally.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
ANZD	367.6	305.5	387.2	1134.0	12.7	267.9	88.8	8.3	368	1827	97	281	2291	281	8.17	6.86
CCAM	53,221.2	1.8	431.7	100.1	81.5	642.0	1204.0	1206.3	53,221	534	2410	724	56,165	724	77.63	4.07
CNAS	4831.7	8.1	93.7	113.4	5.5	92.5	108.5	109.5	4832	215	218	98	5265	98	53.71	4.42
CHNM	3362.5	0.1	126.7	704.9	4.9	3671.2	267.3	76.2	3362	832	344	3676	4538	3676	1.23	0.32
EAFR	1834.8	0.2	18.9	30.1	0.7	52.9	39.8	41.6	1835	49	81	54	1966	54	36.62	2.43
EEUR	52,908.4	31.0	904.0	224.1	191.1	546.7	1549.8	1199.2	52,908	1159	2749	738	56,816	738	77.01	5.30
HIEA	10,934.3	6.5	131.8	687.0	19.1	1222.1	474.4	247.8	10,934	825	722	1241	12,482	1241	10.06	1.25
HISEA	2211.5	17.0	76.2	168.3	12.1	120.8	109.0	50.1	2211	261	159	133	2632	133	19.80	3.16
HIWA	281.6	30.8	59.6	161.9	6.6	75.1	43.3	6.4	282	252	50	82	584	82	7.14	3.69
INDIA	20,784.4	0.1	52.0	106.7	1.4	399.7	418.5	471.1	20,784	159	890	401	21,833	401	54.44	2.61
LISEA	11,953.8	0.3	99.5	126.3	5.5	596.6	277.1	270.9	11,954	226	548	602	12,728	602	21.14	1.29
LIWA	8152.4	7.9	208.8	74.5	19.4	130.5	217.1	184.8	8152	291	402	150	8845	150	59.01	4.62
MAFR	502.5	0.3	19.5	22.9	0.3	24.0	12.1	11.4	502	43	24	24	569	24	23.41	2.73
MOIL	443.5	282.8	246.9	500.2	0.8	25.9	28.2	10.1	444	1030	38	27	1512	27	56.62	40.01
NOAM	0.0	795.3	2034.7	24,951.3	13.8	3923.3	249.9	0.0	0	27,781	250	3937	28,031	3937	7.12	7.12
NAFR	14,196.8	0.1	45.6	6.8	13.0	93.2	316.1	321.8	14,197	52	638	106	14,887	106	140.16	6.50
NEUR	2163.5	262.0	611.4	1121.8	141.6	845.2	560.8	49.0	2163	1995	610	987	4768	987	4.83	2.64
OSAM	10,905.2	3.7	182.0	106.8	28.9	301.2	321.2	247.2	10,905	293	568	330	11,766	330	35.64	2.61

***Table 9.** Continued*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
OSAS	17,269.3	0.7	89.7	47.3	6.4	156.8	366.8	391.4	17,269	138	758	163	18,165	163	111.34	5.49
PACI	79.2	0.5	17.2	15.2	0.0	7.4	1.8	1.8	79	33	4	7	116	7	15.55	4.91
SAFR	912.8	2.0	73.0	50.1	1.3	45.8	26.8	20.7	913	125	47	47	1085	47	23.01	3.66
SEUR	10,483.0	190.4	405.5	865.9	103.6	665.9	540.2	237.6	10,483	1462	778	770	12,723	770	16.53	2.91
SSAM	2403.2	3.2	131.5	1328.1	0.8	803.3	64.9	54.5	2403	1463	119	804	3985	804	4.96	1.97
WAFR	3815.1	1.5	27.2	52.5	4.0	86.7	80.7	86.5	3815	81	167	91	4063	91	44.79	2.74
WEUR	4028.6	594.6	1179.9	5499.6	58.7	1595.9	432.5	91.3	4029	7274	524	1655	11,827	1655	7.15	4.71
TOTALS	238,046.9	2546.3	7654.3	38,200.0	733.8	16,392.9	7799.6	5395.4	238,047	48,401	13,195	17,127	299,642	17,127	17.50	3.60

Note: In US$ millions at an 8% discount rate.

ANZD, Australia and New Zealand; CCAM, Caribbean and Central America; CNAS, Central Asia; CHNM, China and Mongolia; EAFR, Eastern Africa; HIEA, High-Income East Asia; HISEA, High-Income Southeast Asia; HIWA, High-Income West Asia; INDIA, India; LISEA, Low-Income Southeast Asia; LIWA, Low-Income West Asia; MAFR, Middle Africa; MOIL, Mid-Eastern Oil Producers; NOAM, North America; NAFR, Northern Africa; NEUR, Northern Europe; OSAM, Other South America; OSAS, Other South Asia; PACI, Pacific Islands; SAFR, Southern Africa; SEUR, Southern Europe; SSAM, Southern South America; WAFR, Western Africa; WEUR, Western Europe.

Table 10. *Benefits and costs of a 10% increase in bilateral other skilled worker migration globally.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
ANZD	1003.7	641.6	810.1	4518.8	38.7	1067.5	229.2	22.6	1004	5970	252	1106	7226	1106	6.53	5.62
CCAM	123,750.5	7.4	1152.3	398.9	285.8	2558.3	3047.1	2787.2	123,751	1559	5834	2844	131,143	2844	46.11	2.60
CNAS	8704.0	25.9	408.6	451.8	16.5	368.6	126.5	196.0	8704	886	323	385	9913	385	25.74	3.14
CHNM	3969.6	0.6	247.2	2809.0	12.9	14,628.6	364.4	89.4	3970	3057	454	14,641	7480	14,641	0.51	0.24
EAFR	5216.7	1.0	50.5	120.0	2.9	210.9	97.7	117.5	5217	171	215	214	5603	214	26.20	1.81
EEUR	98,219.6	95.0	1779.9	892.9	565.3	2178.3	1878.6	2212.2	98,220	2768	4091	2744	105,078	2744	38.30	2.50
HIEA	19,402.1	16.2	239.8	2737.5	54.1	4869.6	917.3	437.0	19,402	2993	1354	4924	23,750	4924	4.82	0.88
HISEA	3092.6	65.8	128.2	670.6	30.6	481.4	308.3	69.7	3093	865	378	512	4335	512	8.47	2.43
HIWA	592.4	100.0	131.1	645.1	21.3	299.4	89.5	13.3	592	876	103	321	1571	321	4.90	3.05
INDIA	33,233.1	0.3	120.6	425.2	3.8	1592.7	1341.6	748.5	33,233	546	2090	1597	35,869	1597	22.47	1.65
LISEA	28,904.8	0.8	221.7	503.4	19.1	2377.3	1000.7	651.0	28,905	726	1652	2396	31,282	2396	13.05	0.99
LIWA	21,670.7	22.9	510.4	296.8	73.7	520.0	411.7	488.1	21,671	830	900	594	23,401	594	39.41	2.91
MAFR	1717.3	1.0	42.7	91.4	1.2	95.8	23.2	38.7	1717	135	62	97	1914	97	19.74	2.03
MOIL	918.5	882.0	531.4	1993.1	2.4	103.4	82.6	20.7	919	3407	103	106	4428	106	41.87	33.19
NOAM	0.0	1881.9	4401.6	99,423.4	52.2	15,633.2	711.5	0.0	0	105,707	712	15,685	106,418	15,685	6.78	6.78
NAFR	35,546.7	0.2	104.9	27.1	46.4	371.6	452.2	800.6	35,547	132	1253	418	36,932	418	88.37	3.31
NEUR	4576.1	812.0	1002.1	4470.0	460.3	3367.8	1200.1	103.1	4576	6284	1303	3828	12,163	3828	3.18	1.98
OSAM	27,194.6	12.9	450.9	425.6	103.3	1200.1	753.7	612.5	27,195	889	1366	1303	29,450	1303	22.59	1.73
OSAS	37,024.4	1.8	216.6	188.5	20.4	624.7	2341.4	833.9	37,024	407	3175	645	40,607	645	62.94	5.55

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Table 10. *Continued*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
PACI	303.3	0.8	38.0	60.7	0.2	29.5	7.8	6.8	303	100	15	30	417	30	14.06	3.84
SAFR	2621.9	6.0	171.3	199.8	5.3	182.7	72.6	59.1	2622	377	132	188	3131	188	16.66	2.71
SEUR	22,814.6	616.1	872.8	3450.5	355.5	2653.5	607.9	513.8	22,815	4939	1122	3009	28,876	3009	9.60	2.01
SSAM	7083.1	9.0	435.1	5292.2	3.4	3200.8	170.5	159.5	7083	5736	330	3204	13,149	3204	4.10	1.89
WAFR	11,145.3	5.9	73.6	209.2	16.0	345.6	180.0	251.0	11,145	289	431	362	11,865	362	32.81	1.99
WEUR	7516.1	2295.6	1980.1	21,914.2	179.9	6359.2	504.5	169.3	7516	26,190	674	6539	34,380	6539	5.26	4.11
TOTALS	506,221.5	7502.6	16,121.6	152,215.4	2371.3	65,320.6	16,920.7	11,401.5	506,221	175,840	28,322	67,692	710,383	67,692	10.49	3.02

Note: In US$ millions at an 8% discount rate.

ANZD, Australia and New Zealand; CCAM, Caribbean and Central America; CNAS, Central Asia; CHNM, China and Mongolia; EAFR, Eastern Africa; HIEA, High-Income East Asia; HISEA, High-Income Southeast Asia; HIWA, High-Income West Asia; INDIA, India; LISEA, Low-Income Southeast Asia; LIWA, Low-Income West Asia; MAFR, Middle Africa; MOIL, Mid-Eastern Oil Producers; NOAM, North America; NAFR, Northern Africa; NEUR, Northern Europe; OSAM, Other South America; OSAS, Other South Asia; PACI, Pacific Islands; SAFR, Southern Africa; SEUR, Southern Europe; SSAM, Southern South America; WAFR, Western Africa; WEUR, Western Europe.

Table 11. *Benefits and costs of a 10% increase in bilateral all categories of skilled migration globally.*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
ANZD	1493.7	1038.3	1320.2	5785.9	55.2	1366.9	344.9	33.7	1494	8144	379	1422	10,017	1422	7.04	5.99
CCAM	203,195.0	9.5	1676.2	510.7	409.5	3275.7	4850.6	4587.8	203,195	2196	9438	3685	214,830	3685	58.30	3.16
CNAS	15,448.3	35.1	523.9	578.5	24.1	471.9	277.5	348.9	15,448	1137	626	496	17,212	496	34.70	3.56
CHNM	8444.4	0.7	391.1	3596.6	19.3	18,730.6	717.1	190.8	8444	3989	908	18,750	13,341	18,750	0.71	0.26
EAFR	7,577.6	1.3	75.3	153.6	3.9	270.0	148.6	171.0	7578	230	320	274	8127	274	29.67	2.01
EEUR	162,990.1	136.2	2958.7	1143.2	798.7	2789.2	3774.0	3680.2	162,990	4238	7454	3588	174,683	3588	48.69	3.26
HIEA	31,500.9	26.2	401.4	3505.1	75.6	6235.1	1446.7	711.2	31,501	3933	2158	6311	37,592	6311	5.96	0.97
HISEA	5501.9	86.6	215.2	858.6	43.9	616.4	427.4	124.3	5502	1160	552	660	7214	660	10.93	2.59
HIWA	1081.5	135.8	204.5	826.0	29.5	383.4	146.5	24.4	1081	1166	171	413	2419	413	5.86	3.24
INDIA	57,113.3	0.4	183.8	544.4	5.3	2039.3	1821.3	1289.8	57,113	729	3111	2045	60,953	2045	29.81	1.88
LISEA	42,860.3	1.2	343.2	644.6	25.7	3043.9	1325.0	967.3	42,860	989	2292	3070	46,142	3070	15.03	1.07
LIWA	33,037.1	33.4	805.3	380.0	101.0	665.8	715.2	745.7	33,037	1219	1461	767	35,717	767	46.58	3.49
MAFR	2315.4	1.4	68.7	117.0	1.5	122.7	37.6	52.2	2315	187	90	124	2592	124	20.89	2.23
MOIL	1455.0	1208.3	825.4	2552.0	3.3	132.4	117.1	32.8	1455	4586	150	136	6191	136	45.63	34.91
NOAM	0.0	3220.3	7097.0	127,302.6	68.3	20,016.9	1004.7	0.0	0	137,620	1005	20,085	138,625	20,085	6.90	6.90
NAFR	52,573.1	0.3	165.4	34.7	62.0	475.8	831.6	1186.5	52,573	200	2018	538	54,792	538	101.89	4.13
NEUR	7249.4	1138.4	1816.0	5723.4	657.8	4312.1	1971.1	163.7	7249	8678	2135	4970	18,062	4970	3.63	2.18
OSAM	40,946.8	17.8	687.3	545.0	139.6	1536.6	1158.0	924.2	40,947	1250	2082	1676	44,279	1676	26.42	1.99

Table 11. *Continued*

	Wage gains to migrants	Efficiency gain dest	Prod spillover immig dest	Demographic gain dest	Efficiency loss source	Demographic loss source	NW gain emig source	Inv prod gain emig source	Migrant benefits	Destination benefits	Source benefits	Source costs	Total benefits	Total costs	B/C ratio	B/C ratio excl migrant gains
	A	B	C	D	E	F	G	H	A	B + C + D	G + H	E + F				
OSAS	57,473.4	2.6	326.2	241.3	28.0	799.9	2775.7	1297.4	57,473	570	4073	828	62,117	828	75.03	5.61
PACI	404.8	1.6	61.8	77.7	0.3	37.7	10.1	9.1	405	141	19	38	565	38	14.86	4.22
SAFR	3845.6	8.6	270.3	255.8	7.1	233.9	108.3	86.8	3846	535	195	241	4575	241	18.99	3.03
SEUR	39,646.9	845.0	1437.1	4418.0	523.6	3397.6	1481.3	895.4	39,647	6700	2377	3921	48,724	3921	12.43	2.31
SSAM	10,938.5	12.9	622.0	6776.2	4.8	4098.4	275.9	246.9	10,939	7411	523	4103	18,872	4103	4.60	1.93
WAFR	16,054.9	7.8	109.3	267.9	21.2	442.6	283.8	362.3	16,055	385	646	464	17,086	464	36.84	2.22
WEUR	13,135.3	3042.3	3629.2	28,059.2	265.7	8142.4	1131.4	296.6	13,135	34,731	1428	8408	49,294	8408	5.86	4.30
TOTALS	816,283.2	11,012.0	26,214.5	194,898.1	3374.8	83,637.1	27,181.7	18,429.1	816,283	232,125	45,611	87,012	1,094,019	87,012	12.57	3.19

Note: In US$ millions at an 8% discount rate.

ANZD, Australia and New Zealand; CCAM, Caribbean and Central America; CNAS, Central Asia; CHNM, China and Mongolia; EAFR, Eastern Africa; HIEA, High-Income East Asia; HISEA, High-Income Southeast Asia; HIWA, High-Income West Asia; INDIA, India; LISEA, Low-Income Southeast Asia; LIWA, Low-Income West Asia; MAFR, Middle Africa; MOIL, Mid-Eastern Oil Producers; NOAM, North America; NAFR, Northern Africa; NEUR, Northern Europe; OSAM, Other South America; OSAS, Other South Asia; PACI, Pacific Islands; SAFR, Southern Africa; SEUR, Southern Europe; SSAM, Southern South America; WAFR, Western Africa; WEUR, Western Europe.

still high for NOAM and Australia-New Zealand (ANZD). However, removing the gains to migrants in the final column does not reduce the BCRs much, meaning some richer regions are sizeable net beneficiaries. This outcome is mostly due to improved demographic conditions, along with productivity spillovers from arriving migrants. These findings highlight the importance for richer countries of permitting more immigration of skilled labor, who can fill critical professional needs. The richest European region, Northern Europe (NEUR), however, registers relatively small BCRs. This is due largely to the fact that their emigrants, coming from high-salary regions, do not achieve much income gain in the model. Here is another case where the need for regional aggregation, forcing a single wage within an area of active intercountry professional migration, understates the potential net benefits. In contrast, the lower-income European regions, including Eastern Europe (EEUR) and Southern Europe (SEUR), capture significantly larger net benefits from an increase in skilled migration.

A final case is the set of Middle Eastern Oil Producers (MOIL), which register consistently high BCRs, including when gains to their emigrants are excluded. These are economies with relatively high salaries, so inward migrants gain substantial incomes there. Immigration of skilled labor generates notable benefits in terms of productivity gains and GDP increases associated with improved demographic support ratios.

1.6. Concluding remarks

The analysis in this report supports the following conclusions. First, the opportunity for higher international migration of physicians, STEM workers, and other skilled labor offers considerable scope for net global benefits. Accounting for all modeled benefits and costs, the BCRs range from around 4.6 in Africa to 20 on a global scale, and yet higher for physicians and STEM workers. Many individual regions, mostly made up of poor developing countries, register much higher BCRs.

Second, the primary source of these large gains is the higher incomes earned abroad by skilled emigrants. Their income gains are program benefits, even if they accrue only to the migrants. Thus, the substantial gains registered here refer largely to the fact that skilled immigrants from poor countries tend to earn much higher salaries abroad.

Third, skilled migrants do send to their home countries significant volumes of personal remittances. These are not welfare benefits *per se*; rather, they reflect decisions to transfer income gains abroad. However, remittances offer recipient households the wherewithal to invest in education, improved healthcare, entrepreneurship, and other activities that can permanently raise their productivity and incomes. This, along with spillover productivity gains learned from both immigrants and network effects abroad, is signal gains for poor countries from migration, especially of skilled labor. These gains, in virtually all cases modeled, are enough to overcome the demographic costs.

Developed economies are generally smaller net beneficiaries (in relative terms) from enhanced skilled migration. However, there are real gains arising from importing the services of skilled professionals who materially improve demographic support conditions while generating large spillover gains. These benefits are accentuated by the clear and growing need for more immigration as populations age in richer countries.

Combining these factors, enhanced migration of skilled workers should be seen as a win–win proposition among countries and the migrants themselves. Note that the income gains to

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migrants from lower-wage economies reflect the real productivity gains they achieve in destination locations, which raise global growth. The suggestion from this analysis is, therefore, to place a high priority on finding means to relax immigration barriers to international skilled-labor migration. This conclusion applies with considerable force in the case of physicians and STEM workers, the migration of which establishes the highest net benefits.

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A. Appendix A: Structure of the Global Model

Model parameters		Value	
Policy shock: percent increase in bilateral SM stocks	ν		0.1
Share of source *s* in destination *d* immigrant SM stock	α_{sd}	BL table	
Share of destination *d* in source *s* SM emigrant stock	α_{ds}		
SL demand elasticity in *d*	η_d		–0.5
SL demand elasticity in *s*	ηs		–0.5
Average duration of career abroad	T		25
Wage catch-up per year	θ		0.02
Productivity differential doctors and STEM	δ_P		0.8
Productivity differential other SM	δ		0.5
Remittance rate	ρ		0.075
Demographic support ratio adjustment factor	β		macro data
N-N productivity spillover in *dest* from incoming SK migrants	i_{NN}		0.015
N-S productivity spillover in *dest* from incoming SK migrants	i_{NS}		0.06
S-N productivity spillover in *dest* from incoming SK migrants	i_{SN}		0.0075
S-S productivity spillover in *dest* from incoming SK migrants	i_{SS}		0.04
Share of remittances in source household investments	λ		0.25
Private plus social returns to household investments	σ		0.3
Spillover network effects in source from emigration	φ		0.015
Model variables			
Bilateral skilled migrant stocks		M_{sd}	
Total initial skilled migrant stocks from *s* and in *d*		M_s^0, M_d^0	
Total initial physician migrant stocks from *s* and in *d*		P_s^0, P_d^0	
Total initial STEM migrant stocks from *s* and in *d*		G_s^0, G_d^0	
Total initial other skilled migrant stocks from *s* and in *d*		K_s^0, K_d^0	
Skilled labor forces in *s* and *d*		L_s, L_d	
Physician labor forces in *s* and *d*		L_{Ps}, L_{Pd}	
STEM labor forces in *s* and *d*		L_{Gs}, L_{Gd}	
Other skilled labor force in *s* and *d*		L_{Ks}, L_{Kd}	

Model parameters	Value
Bilateral physician, STEM and other SM flows	E_{Psd}, $E_{Gsd,}$ E_{Ksd}
Total physician, STEM and other skilled migrant inflows	E_{Pd}, E_{Gd}, E_{Kd}
Total physician, STEM and other skilled migrant outflows	E_{Ps}, $E_{Gs,}$ E_{Ks}
Wage income of skilled migrants	Y
Wages of physician natives in *s* and *d*	W_{Ps}, W_{Pd}
Wages of STEM natives in *s* and *d*	$W_{Gs,}$ W_{Gd}
Wages of other skilled natives in *s* and *d*	W_{Ks}, W_{Kd}
Bilateral remittances	R_{ds}
Efficiency loss source	B
Efficiency gain destination	D
Productivity spillover gains in destination	I_d
Productivity spillover gains in source	I_s
Network/Diaspora gains in source	H_s
Total populations in *s* and *d*	POP_s, POP_d
Per-capita GDP in *s* and *d*	$y_{s,}$ y_d
Model equations	
Growth bilateral skilled labor flows	$E_{sd} = \alpha_{sd}\nu M_d^0$
Growth bilateral physician flows	$E_{psd} = \alpha_{ds}\nu M_{Psd}^0$
Total physician emigrants from source	$E_{Ps} = \sum_d E_{Psd}$
Total physician immigrants to destination	$E_{pd} = \sum_s E_{Psd}$
Propensity to emigrate from *s*	$\Pi_s = M_s^0/(M_s^0 + L_S)$
Total physician emigration stock from *s*	$P_s^0 = \Pi s L_{Ps}^0/(1 - \Pi_s)$
Bilateral physician emigration stock	$M_{psd}^0 = \alpha_{ds} P_s^0$
Physician wage change in source	$W_{Ps}^1 = W_{Ps}^0(1 - \eta_s(E_{Ps}/L_{Ps}))$
Physician wage change in destination	$W_{Pd}^1 = W_{Pd}^0(1 + \eta_d(E_{Pd}/L_{pd}))$
Income gain to physician migrants over *T* years	$\Delta Y_{sPT} = \delta_P \sum_t \sum_d (E_{Psd}(W_{Pd}^1 - W_{Ps}^0)(1-\theta)^t)$ if $W_{Pd}^1 > W_{PS}^0$, 0 otherwise
Remittances changes over *T* years	$\Delta R_{sT} = \rho(\Delta Y_{PsT} + \Delta Y_{GsT} + \Delta Y_{KsT})$
Efficiency loss in source from physician emigration	$B = 0.5E_{Ps}(W_{sP}^1 - W_{sP}^0)$
Efficiency gain in destination from physician immigration	$D = 0.5E_{dP}(W_{dP}^0 - W_{dP}^1)$
N-N productivity spillover gain from physicians in destination	$I_d = i_{NN}\delta_P \sum_s W_d^1 E_{Pds}$ (if $W_{Pd}^1 > W_{PS}^0$) + $i_{NN}\sum_s W_s^0 E_{Pds}$ (otherwise)
N-S productivity spillover gain from physicians in destination	$I_d = i_{Ns}\delta_P \sum_s W_d^1 E_{Pds}$ (if $W_{Pd}^1 > W_{PS}^0$) + $i_{Ns}\sum_s W_s^0 E_{Pds}$ (otherwise)
S-N productivity spillover gain from physicians in destination	$I_d = i_{sN}\delta_P \sum_s W_d^1 E_{Pds}$ (if $W_{Pd}^1 > W_{PS}^0$) + $i_{sN}\sum_s W_s^0 E_{Pds}$ (otherwise)
S-S productivity spillover gain from physicians in destination	$I_d = i_{SS}\delta_P \sum_s W_d^1 E_{Pds}$ (if $W_{Pd}^1 > W_{PS}^0$) + $i_{SS}\sum_s W_s^0 E_{Pds}$ (otherwise)

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Model parameters	Value
Productivity gain in source from network effects abroad	$I_s = \varphi \sum_d W_d{}^1 E_{ds}$
Gain from household investments of remittances in source	$Hs = (\lambda \rho R_{ST})(1+\sigma)^T$
Income (GDP) loss due to lower support ratio in source from physician emigration	$\Delta N_{ps} = \beta y_s POP_s(E_{pS}/(E_{ps} + E_{gs} + E_{ks})$
Income (GDP) gain due to higher support ratio in destination from physician immigration	$\Delta N_d = \Delta N_s(E_d/E_s)$
Annual welfare gain to skilled migrants	$\Delta Q_M = \Delta Y_{PsT} + \Delta Y_{GsT} {}_{+} \Delta Y_{KsT}$
Annual welfare change in source	$\Delta Z_s = I_s + H_s - B - \Delta N_{Ps} - \Delta N_{Gs} - \Delta N_{Ks}$
Annual welfare change in destination	$\Delta Z_d = I_d + D + \Delta N_{Pd} + \Delta N_{Gd} + \Delta N_{Kd}$

B. Appendix B: Allocation of Countries to Regions in the Africa Model

Countries entering individually: Kenya, Tanzania, Uganda, Egypt, South Africa, Nigeria, Ghana

Regions:

- *Other East Africa*: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, Tanzania, Uganda, Zambia, Zimbabwe
- *Middle Africa:* Angola, Cameroon, Central African Republic, Chad, Congo Democratic Republic, Congo Republic, Equatorial Guinea, Gabon, Sao Tome & Principe
- *Other Northern Africa*: Algeria, Libya, Morocco, Sudan, Tunisia
- *Other Southern Africa*: Botswana, Eswatini, Lesotho, Namibia
- *Other Western Africa*: Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, The Gambia, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Senegal, Sierra Leone, Togo

C. Appendix C: Allocation of Countries to Regions in the Global Model

Region or country

1. *Northern Africa (NAFR)*: Algeria, Egypt, Libya, Morocco, Sudan, Tunisia
2. *Eastern Africa (EAFR)*: Burundi, Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Somalia, Sudan, Tanzania, Uganda, Zambia, Zimbabwe
3. *Middle Africa (MAFR)*: Angola, Cameroon, Central African Republic, Chad, Congo Democratic Republic, Congo Republic, Equatorial Guinea, Gabon, Sao Tome & Principe
4. *Southern Africa (SAFR)*: Botswana, Eswatini, Lesotho, Namibia, South Africa
5. *Western Africa (WAFR)*: Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo

6. *Central Asia (CNAS)*: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan
7. *China and Mongolia (CHNM)*: PR China, Mongolia
8. *High-Income East Asia (HIEA)*: China Hong Kong, Japan, Republic of Korea
9. *Low-Income Southeast Asia (LISEA):* Cambodia, Indonesia, Laos, Myanmar, Philippines, Thailand, Timor-Leste, Viet Nam
10. High-Income Southeast Asia (HISEA): Malaysia, Singapore, Brunei
11. India
12. *Other South Asia (OSAS)*: Afghanistan, Bangladesh, Bhutan, Iran, Maldives, Nepal, Pakistan, Sri Lanka
13. High-Income West Asia (HIWA): Cyprus, Israel
14. *Low-Income West Asia (LIWA)*: Armenia, Azerbaijan, Georgia, Iraq, Jordan, Lebanon, Syrian Arab Republic, Turkey, Yemen
15. *Middle Eastern Oil Producers (MOIL)*: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates
16. *Eastern Europe (EEUR)*: Belarus, Bulgaria, Czechia, Hungary, Poland, Moldova, Romania, Russian Federation, Slovakia, Ukraine
17. *Northern Europe (NEUR)*: Denmark, Estonia, Finland, Iceland, Ireland, Latvia, Lithuania, Norway, Sweden, United Kingdom
18. *Southern Europe (SEUR)*: Albania, Andorra, Bosnia and Herzegovina, Croatia, Greece, Italy, Malta, Montenegro, North Macedonia, Portugal, San Marino, Serbia, Slovenia, Spain
19. *Western Europe (WEUR)*: Austria, Belgium, France, Germany, Luxembourg, Netherlands, Switzerland
20. *Caribbean and Central America (CCAM)*: Antigua & Barbuda, Aruba, Bahamas, Barbados, Cayman Islands, Cuba, Curacao, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Puerto Rico, St Kitts & Nevis, Saint Lucia, Trinidad & Tobago, Turks & Caicos, Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama
21. *Southern South America (SSAM)*: Argentina, Brazil, Chile, Uruguay
22. *Other South America (OSAM):* Bolivia, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Venezuela
23. *North America (NOAM)*: Bermuda, Canada, United States
24. Australia and New Zealand (ANZD): Australia, New Zealand
25. *Pacific Islands (PACI):* Fiji, New Caledonia, Papua New Guinea, Solomon Islands, Vanuatu, Kiribati, Marshall Islands, Federated States of Micronesia, Nauru, Palau, French Polynesia, Samoa, Tonga, Tuvalu

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