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Losing Our Minds? New Research Directions on Skilled Migration and Development

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ABSTRACT

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This paper critiques the last decade of research on the effects of high-skill emigration from developing countries, and proposes six new directions for fruitful research. The study singles out a core assumption underlying much of the recent literature, calling it the *Lump of Learning* model of human capital and development, and describes five ways that research has come to challenge that assumption. It assesses the usefulness of the Lump of Learning model in the face of accumulating evidence. The axioms of the Lump of Learning model have shaped research priorities in this literature, but many of those axioms do not have a clear empirical basis. Future research proceeding from established facts would set different priorities, and would devote more attention to measuring the effects of migration on skilled-migrant households, rigorously estimating human capital externalities, gathering microdata beyond censuses, and carefully considering optimal policy – among others. The recent literature has pursued a series of extensions to the Lump of Learning model. This study urges discarding the Lump of Learning model, pointing toward a new paradigm for research on skilled migration and development.

JEL Classification: F22, J24, O15

Keywords: brain drain, skill flow, development, migration, human capital, education

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1 Introduction

Research on skilled migration and development is in crisis. Economists have studied the development effects of skilled migration for many years within a single paradigm. That paradigm's core assumption is that the clearest and most direct effect of skilled migration on development is to substantially harm development. From there, the literature has pursued two courses: first, to explore indirect effects of skilled migration that might partially offset its direct harm, and second—if that offset is not deemed sufficient—to explore policies to tax or restrict skilled migration. But that paradigm has accumulated an increasing load of anomalies that it cannot accommodate. It may be time for the literature to move forward resting on a new set of axioms.

This paper argues that there was never a good reason to believe—in the best available data—that skilled emigration is an important mechanical determinant of the large human capital shortages in developing countries. To the contrary, the literature has accumulated various theoretical and empirical reasons to believe that skilled migration is part and parcel of the development process by which countries achieve prosperity, security, and the accumulation of human capital. This study highlights the assumptions whose usefulness may have run its course. It argues that a research agenda for the future should explore the direct harms of limiting skilled migration, and require proof of the little-questioned axiom that limiting skilled migration has social benefits.

The paper begins by pointing out a core assumption of much of the most influential research on skilled migration and development, an assumption that it terms the *Lump of Learning model*. It then presents five challenges to the Lump of Learning model—two where the literature has made notable progress, one that is an area of active research, and two where there has been little progress. It concludes by specifying six fruitful directions for future research, and advocating a shift in perspective that yields fresh research questions.

2 The Lump of Learning model of development

Many of the most-cited economics papers on high-skill emigration and development take a dim view of skilled emigration. In these works, skilled emigration is a "loss to those left behind" (Bhagwati and Rodríguez 1975). Unless its harm is somehow offset, the effect of skilled emigration on development is said to be "undoubtedly detrimental" (Beine et al. 2001) and in particular, "extremely detrimental in…Africa" (Beine et al. 2008). In poor countries, for this influential strand of research, skilled migration is clearly above optimal levels; indeed, for the poorest countries the optimal level is zero (Docquier and Rapoport 2012, p. 722).

All of these studies reach that conclusion starting from a specific set of assumptions about how skilled workers affect development. These are, 1) that stocks of human capital inside the country mechanistically produce development; 2) that the marginal effect of skilled workers becomes greater as they are scarcer; and 3) that emigration of skilled workers directly and mechanically tends to harm development by shrinking that beneficent stock. These papers contain some form of the Lump of Learning production function

$$y = \theta \cdot \left(h - h^*\right)^{\alpha}, \tag{1}$$

where y is a development outcome such as Gross Domestic Product per capita, h is the global stock of human capital per capita produced by the country, h^* is human capital outside the country (thus $h - h^*$ is human capital inside the country), θ is total factor productivity and $0 \leqslant \alpha < 1$ reflects scarcity in other, unmodeled inputs that are imperfect substitutes for h.

Assuming the Lump of Learning production function builds inquiry around the axiom that skilled migration mechanically harms development $\left(\frac{\partial y}{\partial h^*} < 0\right)$. Theoretical and empirical research centers on the question of *how bad* it really is—demanding existence-proofs for hypothetical forces that might offset the direct harm. This paradigm is so influential that the research literature commonly defines the prevalence of skilled migration as the rate of "brain drain", a pejorative rhyme invented by sensationalist British newspapers to denounce emigration by scientists (Winters 2009). The Lump of Learning production function accepts as axiom the notion that skilled workers have the highest marginal product where they are scarcest

$\left(\frac{\partial^2 y}{\partial (h-h^*)^2} < 0\right)$.

Under these assumptions, it is a short step to policy: if reducing skilled emigration h^* improves development outcome y, then development policy should reduce skilled emigration from the poorest countries as much as possible. For example, Collier (2013, pp. 218, 257) argues for coercive restrictions or "ceilings" on the ability of skilled workers from countries like Haiti to migrate to rich countries. These quotas, motivated by "compassion", are conceived and intended to produce development by obstructing skilled workers' departure.

3 Five challenges to the Lump of Learning model

The Lump of Learning model is currently in crisis, strained by a number of empirical and theoretical anomalies. Collectively these anomalies suggest that the Lump of Learning production function has outlived its usefulness, and a new paradigm—a new set of axioms—is needed as the basis for future research and more thoughtful policy recommendations in this area. These anomalies challenge equation (1) by exploring ways that it can be misspecified.

3.1 Data and causation

For decades, economists could not quantify the extent of high-skill emigration from developing countries. There were simply no reliable statistics. That changed a decade ago, when pioneering statistical work by Dumont and Lemaître (2005) and Docquier and Marfouk (2006) produced the first systematic data on the number of high-skill workers born in developing countries who live in high-income countries.

The authors of these initial studies profess agnosticism about the effects of skilled migration. Both studies present statistics on the prevalence of skilled migration from different developing countries, but no data regarding its effects on human capital stocks or development outcomes. They nevertheless make unmistakeable claims about those effects. First, they assume that the departure of skilled migrants has the net effect of reducing skill stocks in the country of origin: Docquier and Marfouk (2006, p. 174, 186–187) describe emigration rates as reflecting the

"net impact" of skilled migration on skill stocks, and countries with higher emigration rates are more "strongly affected". Second, they use language that strictly rules out net benefits from skilled emigration: the countries that skilled migrants leave are "losers", the countries they go to are "winners", and countries with skilled emigration rates of two percent are described as experiencing "a brain loss of two percent". Dumont and Lemaître (2005, p. 17–18) recommend exclusively policy interventions to reduce skilled migration and its "adverse" effects, but none to increase skilled migration.

All of this rhetoric would be incoherent without the underlying assumptions that skilled migration has substantial net negative effects on skill stocks and substantial net negative effects on development. But these are assumptions that researchers have brought to the data; they have not been demonstrated by the data. To see why the language of these studies requires assumptions of net harm, imagine calling people who purchase bonds "losers" because they experience a loss of cash today in exchange for far-off and perhaps uncertain benefits, or discussing the bond market in terms of policy interventions exclusively to reduce the purchase of bonds. Such rhetoric would be odd indeed unless we began with the assumption that the costs of bonds exceed their benefits, or simply choose to discuss exclusively the proximate costs.

In fact, the data we have suggest that skilled migration overall is not an important mechanical determinant of skill stocks in migrant-origin countries. To see why, consider plotting skill stocks *inside* each country against skill stocks *outside* each country. Figure 1 schematically shows one way to do this. A country might move in this space, say between 1990 and 2000, as the stocks of skilled workers inside and outside evolve over time. Any such change could be decomposed in principle into two effects. The direct effect is that having one more worker outside the country mechanically implies one less worker inside the country: this can only represent movement along the dotted line of slope –1. The indirect effect comprises all other forces that can shape skill stocks inside and outside—including all the forces that can affect both stocks inside and stocks outside at the same time, such as a growth spurt or a famine, as well as reverse effects of skilled emigration on incentives to acquire human capital at the origin. The net effect, the black arrow, is the composition of this direct effect and indirect effect. Which matters more?

Empirically, indirect effects swamp the direct effect. The best data we have are shown, in the same format, in Figure 2. The vertical axis shows the fraction of adults inside each country with a tertiary degree. The horizontal axis shows the fraction of each country's adults who got a tertiary degree in that country and later moved to an OECD country. Each black arrow shows how one country moved between 1990 and 2000. Panel (a) shows all developing countries where data are available; panel (b) shows the same data 'zoomed in' on the clump of countries with low emigration rates. (The dotted line in panel [b] retains slope –1; the horizontal axis is stretched.) The data do not cover the year 2010 because currently-available estimates of skilled migration for that year are by country of birth, not country of training.

Countries should move 'southeast' in this graph, roughly paralleling the dotted line of slope –1, if the direct effect dominates. That would imply something close to a one-for-one tradeoff between skilled workers leaving and skilled workers inside. But the data look nothing like that. The vast majority of countries either moved to the left (skill stocks abroad fell) or they moved to the right *and up*, with positive slope (87 of the 100 in Figure 2). Skill stocks inside developing countries are primarily shaped by other forces, separate from the direct effect.

This remains true in more recent data. Figure 3 shows stocks of tertiary graduates inside and outside all developing countries in 2010—this time by country of birth, not country of training. Developing countries are divided into terciles by the fraction of the adult population with a tertiary degree, where the first tercile is the lowest. On the vertical axis, the light area shows the average tertiary graduates per adult *inside* countries in that tercile. The dark area shows average tertiary graduates per adult *outside*, that is, living in an OECD country in 2010 but born in the origin country. (The fraction *trained* in the country of origin is much smaller.) The overall height of the bar, light and dark, thus shows the hypothetical stock of tertiary graduates that each tercile would have if—somehow—*all* emigrants with tertiary degrees were suddenly obliged to return to their countries of birth. The horizontal dotted line shows the average stock of tertiary graduates in advanced economies.

Again we see that skilled emigration does little to explain low stocks of human capital in developing countries. The gap in graduate density between poor countries and rich countries would be little affected even by the draconian measure of obliging 100% return of all tertiary-

educated people born in poor countries, even if they grew up and acquired skills abroad. A more moderate but still drastic policy of obliged return for, say, half of skilled emigrants who acquired their skills at home—a limited subset of skilled emigrants—would change home-country human capital stocks by a small sliver of the dark bars in Figure 3. Human capital shortages in poor countries would be barely affected, even mechanically. Put differently, by far the most important reason that there are few physicians and scientists in Niger and Laos is that those countries have few physicians and scientists *anywhere*, not that those people move from one place to the other.

The global data have a clear message. Extraordinary attention to isolating causal relationships is required by the low magnitude of the direct effect relative to confounding indirect effects. Even if equation (1) is strictly correct, the story is so incomplete that we do not learn much about development from the causal relationship it represents. If we want to know why the poorest countries have little human capital, the data do not suggest looking for the cause in skilled migration. And if migration is not an important reason that human capital stocks are low, it likewise cannot be an important reason why development outcomes are poor.

The literature has made some progress in recognizing that equation (1) is inadequate. The following section describes the area where the most progress has been made. The three sections thereafter describe problems with the Lump of Learning model where much less progress has been made.

3.2 Mechanisms in the labor market

Why is it difficult to detect any causal relationship between rising skill stocks abroad and falling skill stocks at home? Researchers have made the most progress in correcting one form of misspecification in equation (1): Perhaps the very opportunity to emigrate raises investment in skill. That is, perhaps

$$y = \theta \cdot \left(h(h^*) - h^*\right)^{\alpha}, \tag{2}$$

where the existence of skilled emigration tends to raise skill stocks at home $\left(\frac{\partial h}{\partial h^*} > 0\right)$. Under this assumption, the net effect of skilled migration on human capital stocks at home, and on

development outcomes, is no longer clear.

Such an effect could arise simply because the possibility of working at high wages abroad raises the expected return to investment in skill (Mountford 1997; Stark et al. 1997). It could arise more subtly because volatility at the origin causes risk-averse investors to shift investment from less-mobile capital like a restaurant to more-mobile capital like skills (Katz and Rapoport 2005). Another possible channel is that emigration by one skilled migrant could raise the educational aspirations of non-migrant family members, even within the home labor market (Böhme 2015).

The most internally-valid evidence for these effects comes from natural quasi-experiments in single countries, with circumscribed external validity. Batista et al. (2012) find that the success of skilled emigrants from Cape Verde, as determined by exogenous economic shocks in migrant-destination countries, substantially raises demand for secondary schooling by other family members. Böhme (2015) likewise uses destination-country economic shocks to identify the effect of migration on educational aspirations of children in Moldova. Chand and Clemens (2008) find that a large and sudden skilled emigration from Fiji, due to a shock specific to one ethnic group, caused offsetting investment in tertiary education by only that ethnic group. This evidence suggests that even very large and sudden emigration by skilled workers can, in some settings, cause human capital investment that offsets the departure.

A number of studies have attempted to establish the effect of emigration prospects on human capital investment in cross-country data. This approach seeks greater external validity, but the internal validity of such estimates to date remains dubious. Human capital investment and skilled emigration can be associated for many reasons, and isolating the pure effect of skilled emigration prospects on the demand for skill is difficult. Increases in the skill acquisition can cause skilled emigration, as when publicly-subsidized universities flood domestic labor markets with graduates it cannot absorb.

Perhaps more importantly, third factors can cause both skill acquisition and high-skill emigration, such as conflict and recession. In particular, high-skill emigration rates can proxy for poor conditions at home that would tend to reduce human capital acquisition: high-skill em-

igration to the United States rose under odious political regimes such as Ethiopia's Mengistu, Nigeria's Obasanjo, and Zimbabwe's Mugabe (Clemens 2014). This and other related forces would tend to produce spurious correlations between high-skill emigration and low human capital stocks or poor development outcomes at home. Early work largely sidestepped these issues (Beine et al. 2001).

Recently, the standard strategy in cross-country studies is to seek valid instrumental variables for high-skill emigration. But the quest for valid cross-country instruments is often much more difficult than meets the eye. For example, Beine et al. (2008) and Di Maria and Lazarova (2012) regress human capital stocks in a cross-section of countries on the rate of skilled emigration, instrumented by 1) population size and 2) lagged rates of emigration (or equivalently, human capital stocks abroad). The strength of such instruments can arise merely by construction, because both the current and lagged rates of skilled migration have population size in the denominator (see e.g. Kronmal 1993). For example, if one defines for each country i some $x_{i,t}$ that consists of *pure white noise* divided by population size, $x_{i,t}$ will be correlated with both population size and with $x_{i,t-1}$ because population size is a component of all three variables. But the correlation contains no economic information.

Furthermore, the validity of these instruments is unknown at best. At worst, the broader literature suggests that they are not valid. Bazzi and Clemens (2013) point out that numerous cross-country studies have used country size to instrument for everything from trade and investment to foreign aid receipts, as determinants of economic growth. Economic growth has large effects on human capital investment (Bils and Klenow 2000). Because such regressions do not control for the growth or level of GDP per capita—nor for trade, investment, foreign aid, and other channels—then if country size is a valid instrument in any of those growth studies, it is an invalid instrument for skilled migration as a determinant of human capital stocks. All of these channels by which country size can affect human capital investment end up in the error term, which can thus be correlated with country size, biasing all of the coefficient estimates from two-stage least squares. And the second instrument, lagged human capital investment, can be caused by any of the omitted country-traits or country-specific shocks that cause current human capital investment—invalidating that instrument as well.

All of this suggests that we cannot treat the coefficient estimates in regressions of this kind as causal parameters, and the current evidence does not justify strong causal claims that any country in the sample "suffers lower growth as a consequence of skilled migration" (Di Maria and Lazarova 2012).

It is inadequate to simply state that no better instruments exist, and proceed to strong claims of having isolated causal relationships with dubious instruments. If sound instruments are not available, strong causal claims are not appropriate. Much more evidence about causal relationships must precede further causal claims, an imperative that has gained more ground in other subfields of economics (Angrist and Pischke 2010) than in this one. Future efforts should focus on gathering internally-valid causal estimates from a greater variety of settings. Natural experiments remain much more promising than low-quality instruments.

3.3 Mechanisms outside the labor market

The literature has recognized a further problem with the Lump of Learning model: skilled migration can affect total factor productivity. Economists have made some progress on theorizing channels for this effect, but much empirical work remains to be done (Lodigiani et al. 2015). That is, it could be that

$$y = \theta(h^*) \cdot \left(h - h^*\right)^{\alpha}, \tag{3}$$

where skilled emigration tends to raise the productivity of all factors of production including skilled workers themselves $\left(\frac{\partial \theta}{\partial h^*} > 0\right)$. This assumption, too, is sufficient for the net effect of skilled migration on development outcomes to be ambiguous, even if skilled emigration causes a net decrease in skill stocks at home.

One way to approach this literature is to look back at Figure 3. A remarkable pattern in these data escaped mention above: development typically goes hand-in-hand with *greater* skilled migration and *larger* human capital stocks abroad. Developing countries in the second tercile of human capital stocks at home have much larger stocks abroad than the poorest countries. The typical developing country that has begun to build important stocks of human capital at home does so while *doubling* the stock of human capital abroad.

The latest research suggests that this pattern may not be coincidence, but may reflect something about the emigration of skilled workers into diasporas that feeds—and is fed by—the development process.

- *Technology transfer.* Skilled migrants are known to act as conduits for the transfer of new technologies to their countries of origin. Kerr (2008) shows that when patents filed in developing countries cite a patent filed in the United States, the patent filed in the United States is more likely to have been filed by a researcher whose ethnicity corresponds to the developing country. For example, US patents cited by researchers filing a patent in India are relatively more likely to have been filed in the US by ethnically-Indian researchers. Comin et al. (2012) find that person-to-person interactions have been an important channel of technology diffusion among nations over the last 140 years. Bahar and Rapoport (2015) show that developing countries with larger stocks of skilled emigrants in a country that produces a certain good are more likely to subsequently begin producing and exporting that good themselves. That is, skilled emigration may be involved in changing the comparative advantage of nations and the complexity of their production capabilities—which is a strong predictor of subsequent development (Hidalgo and Hausmann 2009).

- *Capital flows.* The share of foreign direct investment that developing countries receive from the United States is strongly associated with the stock of college graduates from that country present in the United States (Kugler and Rapoport 2007; Docquier and Lodigiani 2010; Javorcik et al. 2011). This relationship is stronger for high-skill migrant stocks than for low-skill migrant stocks, thus it signifies something beyond the bonds of migration in general. Constant and Tien (2010) find that African countries whose leaders studied abroad attract more Foreign Direct Investment. High-skill migrants also tend to remit more cash to their countries of origin than low-skill migrants (Bollard et al. 2011).

- *Trade.* A similar pattern holds for trade flows: It has been known for some time that the more migrants from developing countries live in rich countries, the more trade occurs between those countries (Rauch 1999). In recent research it has become clear that this relationship, too, is stronger for high-skill migrants than for low-skill migrants (Felbermayr and Toubal 2012; Aleksynska and Peri 2014).

- *Formal and informal institutions.* An intriguing recent literature, reviewed by Ivus and Naghavi (2014), finds that migrants from developing countries are involved in the transfer of institutional norms to their countries of origin. These include informal norms such as social conventions on fertility (Beine et al. 2013). Here again there appears to be a special role for high-skill migrants in particular. Spilimbergo (2009) finds that developing countries with more students abroad in democratic countries tend to become more democratic themselves. Beine and Sekkat (2013) find a relationship between the lagged extent of high-skill emigration from developing countries and later improvements in governance quality in the country of origin, while Mercier (2013) finds that African leaders with foreign education govern more democratically.

These channels are the subject of active research, and much more investigation is required to determine whether or not some of these correlations reflect causal relationships. Innovative research design can accomplish this, even in cross-country data, as Kerr (2008) has shown. But we cannot yet be confident about the extent to which, or the conditions under which, skilled emigration might foster development through many of these channels.

This research is nevertheless damning of the Lump of Learning model (1) as an adequate description of the relationship between human capital and development. While many in this literature have justified efforts to limit high-skill emigration by the need for an unspecified "critical mass" of human capital at home (e.g. Dumont and Lemaître 2005, p. 14), this recent work suggests that a "critical mass" of human capital *abroad* may play an important role in development. There is abundant qualitative evidence that high-skill diasporas could only foster development in India and China when they reached a certain size (Saxenian 2006; Wei and Balasubramanyam 2006).

Many beneficial interactions with the high-skill diaspora would have been extremely difficult to foresee and deliberately create. In fact, well-intended policy might have eliminated them. It is hard to imagine how Sudanese officials working to reduce high-skill emigration could have predicted the development effects of Mohammed Ibrahim. He quit his job as a technician at Sudan's telecommunications administration and emigrated; several years thereafter he brought billions of dollars in investment and technology transfer to Sudan and 13 other

African countries with his firm Celtel. It is hard to imagine that Beninois officials limiting skilled migration could have predicted the development effects of Léonard Wantchékon. He emigrated from Benin with its top tertiary qualifications in mathematics and physics, and recently founded the highly-regarded African School of Economics in Cotonou. It is hard to imagine how Indian officials condemning the "drain" of high-skill engineers could have predicted the development effects of Vivek Paul. He emigrated after becoming a highly-trained engineer, and would later return to transform the Indian firm Wipro into a multibillion-dollar global company and an engine of technology transfer to India.

Economists would not find it easy to measure what these people would have accomplished if they had been obliged to remain permanently in the countries where they became tertiary graduates. But there is compelling qualitative evidence that it was precisely their experiences abroad that allowed them to become transformative figures at home (e.g. Saxenian 2006, p. 281). Their effects on development constitute further anomalies placing the Lump of Learning model in crisis.

The literature is making progress in this area, and as it does, more anomalies are likely to arise. The next two sections address areas where, in contrast, the literature has made little progress on the shortcomings of the Lump of Learning model.

3.4 Human capital and growth

The Lump of Learning model in (1) has intuitive appeal. It appears to build on the long tradition of production functions familiar to economists in all fields, such as the Solow-Swan growth model and the Hecksher-Ohlin trade model (Snowdon 2015). It embodies the assumptions that 1) more human capital causes development *ceteris paribus*, 2) the marginal effect is largest where human capital is scarce, and 3) additional human capital has positive external effects on the marginal product of all other factors, such as low-skill workers and capital (here lumped into θ).

But in the last 15 years of the growth-and-development literature, this mechanistic view of the relationship between human capital and development has been progressively discredited.

The migration-and-development literature has not caught up. Recent literature on growth and human capital suggests that the relationship might be driven by third factors and reverse causation rather than by positive externalities from human capital stocks. That is, perhaps

$$y = \theta(x) \cdot \Big(h(x,y) - h^*(x,y)\Big)^{\alpha}, \tag{4}$$

where x is some third factor. In this setting we can observe a positive relationship between countries' human capital stocks and development with or without a substantial positive effect on development from the presence of human capital *per se*—the only thing that is mechanically affected by high-skill migration.

This sea-change has been underway for some time. Hall and Jones (1999, p. 92) decompose the difference in output per worker between the five richest countries on earth and the five poorest. They find that even if the poorest had the same levels of human capital as the richest—but nothing else changed—93% of the output gap would remain. This is not compatible with a large pure effect of human capital on development, but is compatible with a large effect on human capital accumulation from other forces that do cause development.[1] Bils and Klenow (2000) find that most of the cross-country relationship between growth and human capital can be explained by the fact that expected future growth causes investment in human capital.

In particular, economists have been simply unable to detect the large human capital externalities that are assumed by the Lump of Learning model. The existance of substantial externalities of this type remains conjectural. Pritchett (2001) finds that even very large increases in poor countries' human capital stocks in the late twentieth century had no positive external effects that can be detected in macroeconomic development. Rigorous identification strategies proposed by Acemoğlu and Angrist (2000) and Ciccone and Peri (2006) detect no externalities at all. Reviewing this large literature, Lange and Topel (2006) conclude, "There is no evidence from this literature that social returns are smaller than private ones, yet neither is there much to suggest that they are larger." More recently, Acemoğlu et al. (2014) conclude that "existing evidence does not support human capital externalities of any significant magnitude."

[1] Of these other forces, Hall and Jones find that the most important are institutions and government policy, which they call "social infrastructure". Docquier et al. (2014) find no evidence that skilled emigration causes declines in the quality of governance.

Why might this be the case—in developing countries specifically? First, a recent literature suggests that much more of cross-country differences in development can be accounted for by measures of human capital that are adjusted for the quality of learning (Hanushek and Woessmann 2008; Jones 2014; Manuelli and Seshadri 2014). But far from supporting the Lump of Learning model, this undermines it. When a skilled worker emigrates from a poor country, the worker leaves with that country's particular quality of human capital. If that quality is low in the poorest countries, skilled emigration from the poorest countries would have the *smallest* marginal effect on development.

Second, an important strand of the growth literature suggests nonlinearities in the production function (e.g. Durlauf et al. 2005). If skilled labor requires other skilled labor to be productive, production could exhibit increasing returns to scale in human capital over a substantial range. This is the case, for example, in the 'O-ring' production function due to Kremer (1993)—compared in Figure 4 to the decreasing-returns form assumed by (1) and to a linear form. Increasing returns imply that the positive external effects of a marginal skilled worker would be very small in the poorest countries. Given that even blocking most skilled emigration would little affect human capital scarcity in the poorest countries (Figure 3), there is little reason to believe that even draconian restrictions on high-skill migration would push poor countries to the inflection point where skilled emigration has large effects.

Critics of increasing returns to education often highlight one clear pattern in the data: the positive cross-sectional relationship between earnings and schooling is typically greater in countries with low average schooling (Psacharopoulos and Patrinos 2004). But this does not at all imply that the *returns* to investment in schooling are typically higher in countries with less schooling. Heckman et al. (2006) explain in detail why not, concluding that "cross-sections are no longer useful guides to the life cycle earnings or schooling returns of any particular individual." Among other things they stress the importance of heterogeneity and uncertainty in the true returns, which can make the true return to education much lower than the observed relationship between education and earnings. This remains true even when the factors responsible for heterogeneous returns are observable and 'controlled for' with fixed effects.[2]

[2]To see why, suppose there are two ethnic groups: the dominant group *A*, a 10% minority, persecutes group *B*. Civil-service jobs for people with secondary education go to *A*'s, who therefore earn 50% more, not to *B*s. Everyone knows this, so *A*'s get secondary education and *B*'s do not. A cross-sectional study would find that people with

The problem arises most of all in developing countries, where structural heterogeneity in labor-market returns to schooling can arise from social hierarchies, gender bias, malnutrition, and many other forces.

This literature presents a serious challenge to the Lump of Learning model, a challenge that migration-and-development research has barely begun to address. This literature suggests that a reasonable null hypothesis for empirical work is that skilled emigration has no direct effect on development in the poorest countries—either at the margin or on average. This is counterintuitive because we so often observe things missing in the poorest countries that skilled workers from those countries are able to do easily in other countries, such as create innovation and enterprise. But this does not begin to imply that the same workers could do many of the same things in their countries of origin, a necessary belief if we are to attribute the lack of development to their absence.

3.5 Public policy

The literature has likewise made little progress on the public economics of regulating high-skill migration. Forget for a moment all of the preceding challenges to the Lump of Learning model, and suppose that high-skill migration affects development precisely as in equation (1). How then should policy respond? That is, suppose

$$y = \theta \cdot \Big(h - h^*(p)\Big)^{\alpha}, \tag{5}$$

where p is some policy intervention to regulate skilled migration. What is the optimal p?

The standard response has been to impose some type of Pigouvian tax or quota on skilled migration to correct for the negative externality that skilled migrants thus impose on those left behind (e.g. Bhagwati and Rodríguez 1975; Collier 2013). The economics literature has spent

a secondary degree earn 50% more than those who do not. But the real return to secondary education for the average person is only $\big(0.1 \times 50\%\big) + \big(0.9 \times 0\%\big) = 5\%$. This problem is not solved simply by the observability of ethnicity: The bias survives the addition of ethnicity fixed-effects, as long as at least one B is able to get secondary education and a civil-service job, but very few are. Suppose that the population is 1,000 and only three members of B acquire secondary education and get the 50% earnings increase of a civil-service job. A regression with ethnicity fixed-effects would still put the "return" to secondary schooling at exactly 50%. But the true average return for an individual would be $\big(0.103 \times 50\%\big) + \big(0.897 \times 0\%\big) \approx 5\%$.

decades debating the merits of a 'Bhagwati tax' on skilled migrants, a debate that appears to have ended with Bhagwati himself renouncing almost all of the justifications that have been advanced over the years (Clemens 2014). But the literature has produced few alternative policy ideas, and support for tax-like policies to raise the cost of skilled migration—such as limits on the recruitment of skilled workers from developing countries—remains strong in policy circles.

The problem with any Pigovian tax or quota is that, as Coase (1960) showed long ago, the existence of a negative externality cannot be sufficient to justify any particular Pigouvian tax or quota on efficiency grounds. Coase proved that, when transactions costs prevent two parties to an externality from negotiating directly, efficient policy requires that the entitlement to exert the externality rest with the party that has the highest mitigation cost. In the case of skilled migration, the party with the highest mitigation cost is typically the migrant.

For example, suppose a publicly-trained Malawian nurse wishes to leave Malawi for a rich country. There are two ways to mitigate any negative externality that might arise from that departure. One is for the right to exert a negative externality to rest with the Malawian state, which could mitigate the externality by preventing the nurse's departure. This costs the nurse hundreds of thousands of dollars of foregone future income. The other way is for the right to exert a negative externality to rest with the nurse, who could then migrate without restriction. This would cost the Malawian state several thousand dollars to train a replacement. Because the nurse's mitigation cost is much higher, vesting the state with the entitlement makes the world much worse off than vesting the nurse with the entitlement (Clemens 2014). The simple, intuitive Pigouvian tax or quota is generally inefficient.

If transactions costs were low enough for the nurse and the government to negotiate, both parties would prefer a solution other than simply vesting the government with the right to impose costs on the migrant with quotas or taxes. Both would be better off if they could negotiate a way for the nurse to migrate and for either the nurse or the destination country to pay for the nurse's training or pay to train a replacement. New institutions would be necessary to bring transactions costs low enough for bargains of this kind to occur. Such policy mechanisms have barely been explored in the literature (Clemens 2015), though related policy experiments exist

(Clemens et al. 2015).

Other justifications have been advanced for taxes and quotas on skilled migration, justifications based not on efficiency but on equity or ethics. Such arguments are weakened by the fact that they require pure assertion of the axiom that countries of birth hold inherent property rights in the brains of people born in those countries. Without this axiom, coercive taxes or quotas applied to poor countries' skilled emigrants on equity grounds would equally apply to *all* skilled workers in rich countries. For example, if equity dictates that a Malawian nurse in London may be taxed because he is better off than Malawians, the same concern would dictate that most Londoners should be taxed for the same reason. This would not justify a tax on skilled migrants in particular (Clemens 2014).

Likewise, if ethics dictate that a Malawian nurse be obliged to live in Malawi because his skills are needed there, the same concern would dictate that nearly any skilled Londoner be required to live in Malawi—since it is likely that their skills are needed as well. Here, ethics justifying a quota on how many Malawians may live in London rather than Malawi would require a quota on how many Londoners of any origin may live in London rather than Malawi. That is, it would require deporting a variety of skilled Londoners to Malawi. These problems are resolved if we simply accept the axiom that Malawians have special obligations to Malawi by accident of birth. Since that axiom absolves the rich-country enforcers of migration barriers from responsibility for personally assisting Malawi, it may come as no surprise that it receives broad and unexamined acceptance. But the axiom precedes, and does not emerge from, economic theory or empirical data.

4 New research directions

Empirical research on skilled migration and development got off on the wrong foot. It began with the assumption that skilled migration does large social harm, a claim often considered too obvious to require proof. The field seems to have captured researchers' interest only to the extent that they could demonstrate some counterintuitive force to mitigate the unquestioned harm. The burden of proof in all empirical work has rested on those who would claim any

benefits at all, particularly in the poorest countries. Few researchers have demanded transparently identified empirics to demonstrate that skilled emigration substantially *causes* the low human capital stocks and poverty observed in poor countries. To say the same thing differently, few researchers have demanded evidence that obstructing skilled migration, all else equal, would substantially ameliorate low human capital stocks and deficient development outcomes in poor countries.

The research priorities of the field would look different under different assumptions. Suppose researchers in the field began by assuming what is unmistakably observable: that obstructing skilled migration does tremendous harm to skilled workers from poor countries. For many such workers, obstructing their migration equates to a tax of 60–95% on their real earnings (Clemens 2014), with numerous consequences for their health, their children's opportunities, and so on. The research questions might then center on proving that large social benefits, net of negative side effects, justify the direct and present harm to migrants. For example, large human capital externalities would not be simply assumed but would demand to be proven.

The literature looks little like this now. Here are a few research directions that would open up under a fresh set of assumptions:

- *Effects on migrants.* We know little about the extent of the benefits that migration causes for skilled workers—which is to say, the harm done to them by obstructing migration—other than the fact that the benefits are large. This reflects the priorities of a literature that has modeled skilled workers largely as national property rather than as agents with welfare of their own. For example, Docquier et al. (2009) express numerous concerns about the effects of emigration by high-skill women on children and economic growth at the origin, with the effects on female migrants themselves unmeasured and mentioned only in passing. Naghsh Nejad and Young (2014), in contrast, consider the migrants: they find that skilled women tend to emigrate when they can thereby secure a greater improvement in rights and freedoms at the destination relative to the origin—provided they have sufficient rights to access education and migration opportunities in the first place. The former approach encourages us to think of limiting skilled women's migration as socially responsible; the latter approach encourages us to gravely ponder the

consequences of limiting skilled women's access to freedom and basic human rights. Only a handful of studies have tried to measure the effects of high-skill migration on migrants and their families (e.g. Clemens 2013).

- *Separating correlation and causation.* This literature needs to worry much more than it does about biased estimates, for two reasons. First, observational estimates are not just biased, they are generally biased in a specific direction. Places where development conditions are poor for various reasons are places 1) that skilled migrants leave, and places 2) where there are adverse indicators—low human capital, poor development outcomes. This is both because skilled migrants leave places where development outcomes are poor, and because the same development conditions that cause a variety of adverse outcomes can also cause skilled emigration (corruption, ethnic favoritism, conflict, disease, and so on). Observational data, therefore, will systematically generate correlation between skilled migration and adverse conditions. Second, the mechanical effect of skilled migration on human capital stocks is much smaller than the other determinants of those stocks. Together, these mean that extraordinary attention is necessary to proving that skilled migration *causes* bad outcomes before making confident causal claims. The use of any instrumental variable at hand is not sufficient to solve this problem, especially in cross-country data. Much more promise lies in natural experiments, as argued by McKenzie and Yang (2010) and instantiated by Omar Mahmoud et al. (2014).

- *From censuses to surveys.* Too much empirical work in this area has relied upon census data. The advent of census-based estimates of skilled migration a decade ago was a major advance over the empirical dark ages that preceded it. But the limitations of such data are now apparent. Censuses contain essentially no microdata about skilled workers' interactions with their countries of origin, life before migration, circular movement, knowledge (quality of training, cognitive skill, talent, etc.), collaborations, networks, investments, or remittances. They contain very limited and indirect information about skilled emigrants' ethnicity, field of study, where they got their training, and who paid for it. In other words, censuses contain little information that can be used to directly study the questions in Subsections 3.2 to 3.5. It is hard work to conduct surveys that learn more about skilled migrants, but that work must be done. Recent work by Gibson and McKenzie (2012) exemplifies the way forward.

- *Creative empirics for indirect effects.* Theory runs far ahead of empirics to document and rigorously identify the indirect effects of skilled migration (Lodigiani et al. 2015). There is important suggestive evidence of large effects of skilled migration on human capital investment, both in quantity and kind, and on international linkages of various kinds: technology transfer, trade, investment, and the spread of norms and institutions. But all of these forces might coevolve with skilled migration over the course of the development process, and carefully establishing causality is elusive. Much progress can be made by innovatively merging rich new datasets, as Bahar and Rapoport (2015) merge product-level export data with skilled migration data to find that skilled emigration shapes the comparative advantage of developing countries. Further data advances will open up major new avenues for such work. Here, too, an agile search for natural experiments to establish the counterfactual remains more fruitful than rote application of instrumental variable methods without credible instruments, or calibrating theoretical models with harms of skilled migration built in by assumption.

- *Human capital externalities.* The most influential literature on skilled migration and development has been built around the assumption that human capital externalities are large, and that they are largest in the poorest countries. The evidence from the growth-and-development literature offers little support for that assumption (Subsection 3.4). If the research literature on skilled migration were built around what is known, it would assume large harm to skilled workers from limiting skilled migration, and proceed to explore whether proven positive externalities from limiting migration *per se* exceed that known harm plus proven negative externalities from limiting skilled migration *per se*. That is, both the positive and negative externalities of obstructing skilled emigration *per se* would require proof, and the burden of proving the existence of those externalities would be heaviest in the poorest countries. What has happened instead is that the literature has proceeded for over a decade without credible estimates of the externalities arising from skilled workers' pure presence in the poorest countries. A promising way forward lies in estimating externalities with microdata from interactions between workers (e.g. Mas and Moretti 2009).

- *Optimal policy.* The policy recommendations that have emerged from this literature are a further consequence of its founding assumptions. Under the assumption that skilled migration is a social bad like pollution, the intuitive policy is to impose taxes or caps.

Such recommendations have dominated the economics literature on this subject from the 1970s to present (Subsection 3.5). This literature would look quite different if it had begun with the known, present harm to skilled workers from limits on their mobility, and proceeded to explore regulations with theoretically clear and empirically demonstrated social benefits. The complexities of efficient, equitable, and ethical regulation in this area have barely been explored (Commander et al. 2004), and possible side-effects are poorly understood (e.g. Miyagiwa 1991). Taxes and restrictions on skilled migration have claimed nearly all the attention of the policy-relevant literature, while the creative design and evaluation of incentives for skilled workers to remain in poor countries has received extremely little attention. Recent work by Antwi and Phillips (2013) and Okeke (2013) is a rare exception, and offers a promising way forward.

5 Shifting the burden of proof

It is logically equivalent 1) to claim that skilled emigration has a substantial negative *effect* on development and 2) to claim that coercively preventing skilled emigration has a substantial positive effect on development. The first claim states that development would improve in the counterfactual case where the same country had less skilled emigration, *all else equal*; this is the definition of an *effect* in social science (e.g. Heckman 2005). "All else" includes the reasons that skilled migrants choose to leave. Migration is an action, and the only way that an agent's action can be changed by others without changing the agent's reasons for the decision is to coerce that person. If pay is the reason for migration, stopping migration without changing pay requires coercion; if migration is stopped *by* changing pay, then we are speaking of the effects of pay, not the effects of migration. The second claim is the dual of the first: an identical claim, stated differently.

The reason the two claims sound so different may be a quirk of brain function known to logicians as the Reduction Fallacy: we have a natural tendency to take one of numerous jointly-necessary conditions for an outcome, and describe that one necessary condition as "causing" the outcome. The phrase "wheels cause a car to move" sounds reasonable until we ponder whether or not placing wheels on a rusted-out wreck with no axles, engine, or ignition key

will produce movement.

Likewise, we do not have reliable evidence that changing the location of human capital is sufficient to cause development. But equation (1) assumes that blocking the exit of human capital by any means is *sufficient* to cause development. Collier (2013, p. 200) asserts to know that numerous poor countries "would benefit from emigration controls". But the belief that allowing migration harms development—that is, disallowing migration helps development—does not rest on evidence. Collier offers no case on earth in which blocking emigration from any town, region, or nation has produced development in those places to any extent.

These two ways of making the same claim have been treated very differently by the research literature on skilled migration and development. The claim that skilled emigration harms development has been taken as axiom, built into the workhorse models and considered beyond dispute. The identical claim that coercive limits on migration help development is often greeted with discomfort and disavowal, though it is precisely the same statement. Restating the core claim in this way reminds us that statements about a single cause are statements of sufficiency. It is certainly likely that the accumulation of human capital is a necessary condition for Haiti to become a rich country; but that is one of 100 necessary conditions. We should doubt the ability of far-off development planners regulating workers' physical mobility to provide the other 99 necessary conditions in the proper measure and at the proper time.

Restating the core claim in this way also clarifies where the burden of proof should rest: we should not believe that coercive restrictions on skilled emigration have benefits that offset their clear and present harm unless there is rigorous evidence to prove those benefits exist and substantially outweigh the harm. The research agenda for this field would sharply shift direction if this burden were recognized. There would be much more investigation of the harm that coercive migration restrictions inflict on skilled-migrant households, more investigation of the numerous indirect social sequelae of such restrictions, and more insistence on demonstrating the human capital externalities that—though recognized as unproven in the development literature—are accepted as sacred scripture in the migration literature.

In retrospect, widely-held views in economics have had influence on research and policy dis-

proportionate to the evidence base for them. The "Laffer curve", a normative theoretical concept for setting optimal tax policy, has proven difficult to measure quantitatively and to apply for informing real-world policy decisions (Tanzi 2014). To Varian (1993), the good economics of the Laffer curve is that its theory has helped structure debates; the bad economics "is that inference that because the Laffer effect can occur it does occur".

Likewise, the theoretical idea that high-skill migration can harm development is not evidence that it does so. The Lump of Learning model has helped structure debate, but we should now move past its assumptions and toward assumptions that do not presuppose what researchers seek to determine. Models that are truly agnostic about the effects of skilled migration would not simply place ancillary equations alongside the Lump of Learning production function, they would discard it. Better models would assign nonzero welfare to skilled workers regardless of their location; would include skilled workers as a productive asset regardless of their location; would ask the data where skilled workers are most productive; and would take seriously the many complements required for skilled workers to use their skills—allowing for the possibility that skilled workers have the lowest marginal private and social product where skills are most scarce, rather than assuming it away. Excising the unsupported axioms of positive externalities and strictly increasing returns means excising the Lump of Learning model itself.

As this literature proceeds, a good first step would be to drop the loaded, pejorative term "brain drain" that pervades journal articles as a synonym for high-skill mobility. Psychologists have shown that people believe statements to be more accurate merely because they rhyme (McGlone and Tofighbakhsh 2000), and rhyme is the only virtue of that tired locution. Calling skilled migration "brain drain" is just as appropriate for unbiased social science as it would be to describe female labor force participation as the "family abandonment rate". Female labor force participation is female labor force participation; skilled migration is skilled migration; sexist or nationalist terminological embellishments do nothing to help serious research and much to hinder it. The literature on skilled migration will be fruitful in years to come, and more so if researchers approach it with fresh eyes.

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Figure 1: *Direct and indirect determinants of the relationship between stocks of skilled workers abroad and at home*

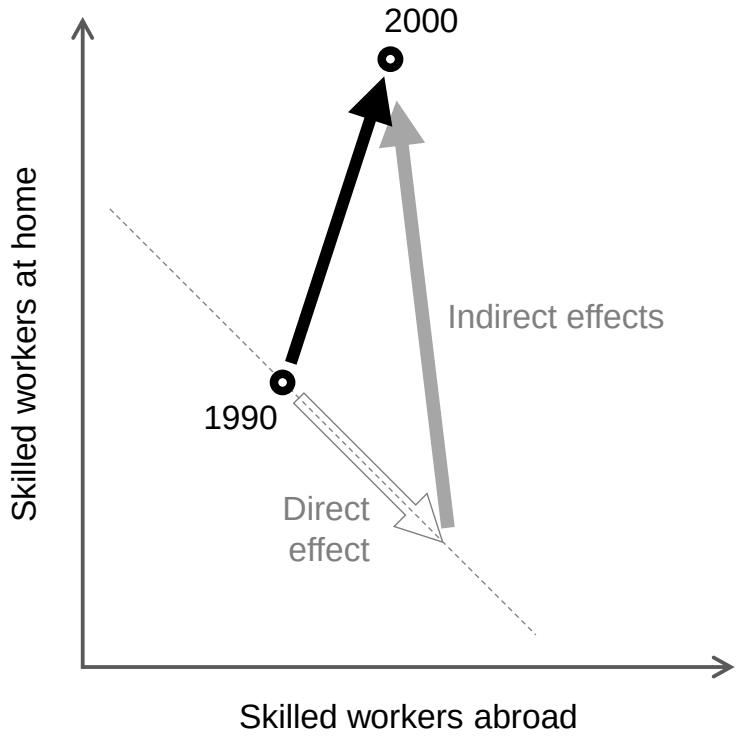
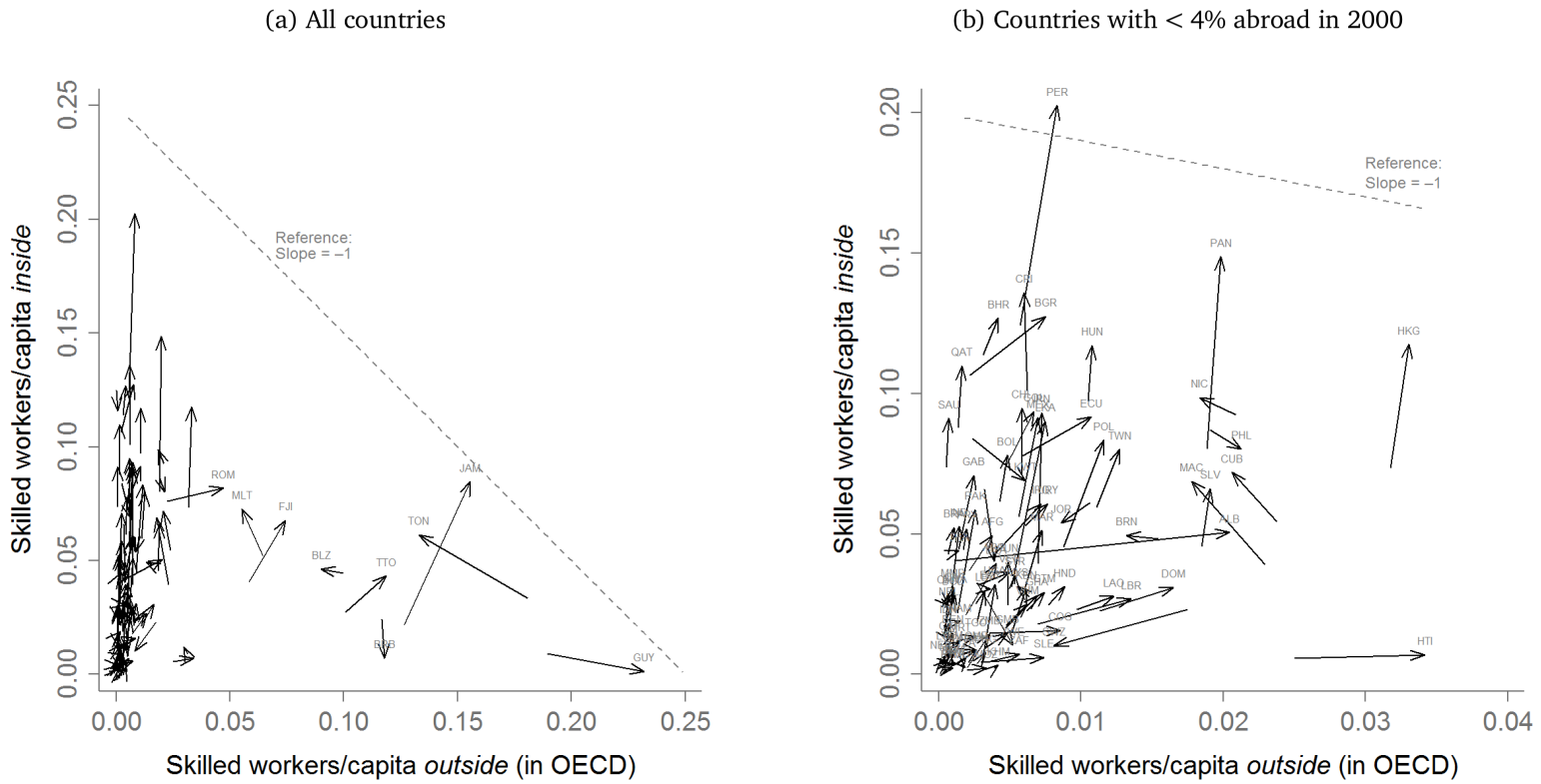
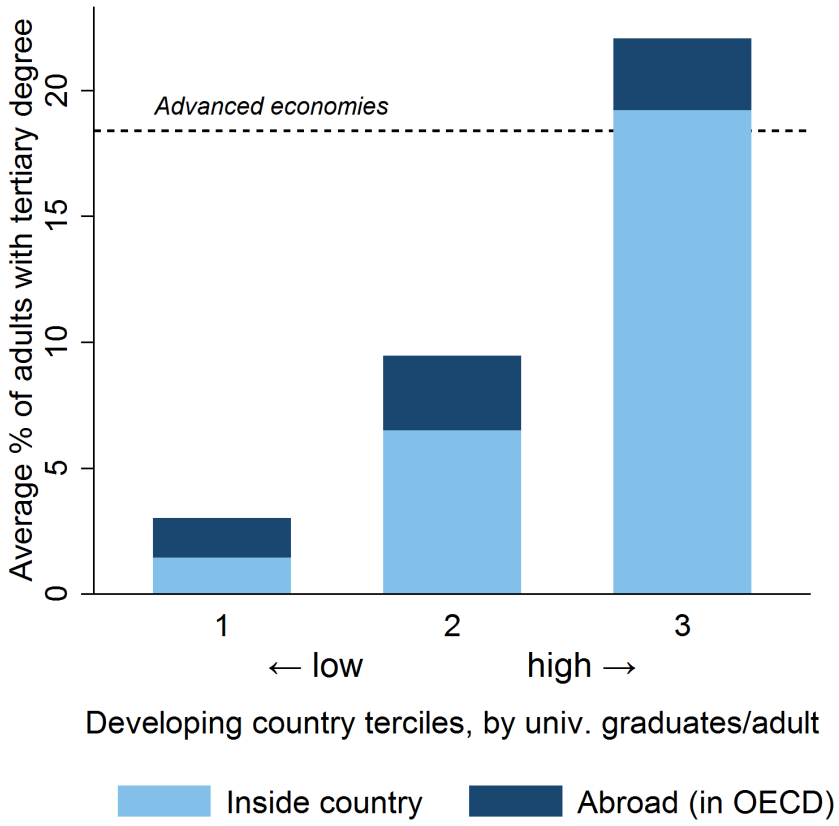


Figure 2: *Changes in stocks of home-trained high-skill workers, 1990–2000*



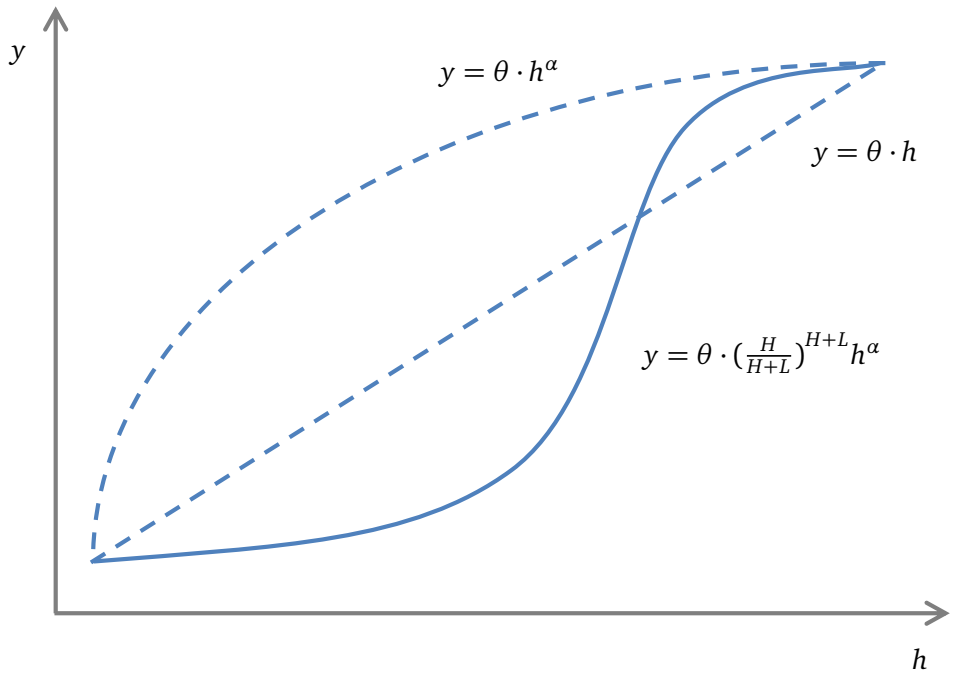
Here, 'skilled workers' are those with a tertiary degree *obtained in the country of origin*. Beginning of arrow shows 1990 value, pointed end of arrow shows 2000 value. Panel (a) shows all countries with available data for both years. Numerator and denominator are adults (age 25+) only. 'Outside' means living in one of 20 OECD countries in the year in question. Stocks of skilled adults in OECD countries from Brücker et al. (2013), stocks of skilled adults in home countries and total adult population from Barro and Lee (2013, version 2.0); fraction 'outside' is multiplied by the fraction of skilled emigrants who left at or after age 22, as a proxy for having been trained at home (from Beine et al. 2007). The Beine et al. estimates do not cover 2010, thus the figures above cover 1990–2000 only.

Figure 3: *Location of skilled workers, any country of training, developing countries in 2010*



2010 stocks of tertiary-educated workers *by country of birth, not training* from the OECD Database on Immigrants in OECD and non-OECD Countries: DIOC, 2010/11 edition, revision 2 (Arslan et al. 2014). 2010 stocks of skilled adults in home countries and total adult population from Barro and Lee (2013, version 2.0). Where Barro and Lee data are missing, filled in with values for number of adults age 25+ with tertiary education from the UNESCO (2015), in latest available year (circa 2010). Terciles defined by percentage of adults inside country with tertiary education: First tercile 0–3.385% ($N = 47$), second tercile 3.385–9.600% ($N = 47$), third tercile > 9.600% ($N = 47$). 'Advanced economies' defined by Barro and Lee as: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, UK, and USA.

Figure 4: *Alternative production functions*



H = number of high-skill workers, L = number of low-skill workers.