Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Can lower remittance costs improve human capital accumulation in Africa?

Maroula Khraiche a, *, James Boudreau b

a University of Texas Rio Grande Valley, Department of Economics and Finance, 1201 West University Drive, Edinburg, TX 78539, United States
b Kennesaw State University, Department of Economics, Finance, and Quantitative Analysis, 560 Parliament Garden Way, Kennesaw, GA 30144, United States

Received 9 November 2019; received in revised form 20 March 2020; accepted 23 April 2020
Available online 15 June 2020

Abstract

To evaluate gains in human capital accumulation from reduction in remittance prices, this study constructs a general equilibrium model in which the choices to invest in human capital and to migrate are endogenous. The model is calibrated for a group of eight African economies which offer student loans, and the effect on human capital accumulation of decreasing the remittance price to the level recommended by the United Nations (3%) is numerically derived. It is found that reduction in remittance prices alters the decisions of households, leading in the aggregate to a decrease in interest rates, a curbing of the desire to migrate, and an increase human capital. Hence, the study offers the policy prescription that governments, both in nations where remittances originate and in those to which funds are sent, must continue to lower remittance prices, by, for example, improving access to mobile banking, especially since such policies are relatively immune to economic shocks.

© 2020 The Society for Policy Modeling. Published by Elsevier Inc. All rights reserved.

JEL classifications: F22; E2; D91

Keywords: Migration; Credit; Human Capital; Brain drain; Brain gain
1. Introduction

International labor migration from developing to developed countries has increased three-fold over the past 40 years. Skilled labor emigration has been rising at an even faster rate (Docquier & Rapoport, 2012). In 2000, immigrants with tertiary education constituted 31.4% of African immigrants, 27.6% of Latin American immigrants, and 43f.5% of Asian immigrants (Docquier & Marfouk, 2004). This level of skilled migration can be alarming given that the proportion of highly skilled workers in the labor force was only 3.6% in African countries and 6% and 11.8% in Asian and Latin and Caribbean countries, respectively. The emigration of skilled labor from developing economies is typically labeled brain drain and can raise vital concerns for governments in developing countries as they design programs that finance higher education. Factors that alleviate the problem of brain drain are remittances and brain gain (when workers acquire more education in hopes of migration to a higher wage labor market). This study demonstrates that policymakers can mitigate the negative impact of brain drain and extract more benefit from brain gain by lowering the price of remittances, aligning it with the UN’s Sustainable Development Goals.

A general equilibrium model is built in which a worker can choose to migrate and then send remittances home if the utility from migration to a labor market with higher wages exceeds that from staying. However, of those who desire to migrate, only a fraction succeeds (brain drain). Those whose migration plans do not materialize accumulate more human capital, earn higher incomes, and accrue more savings, than they would have in the absence of migration possibilities (brain gain). Remittances further increase the incomes and savings of stayers. However, there is the possibility of a harmful secondary effect: as individuals borrow to finance their education, aggregate borrowing increases, which puts upward pressure on interest rates, making it prohibitive to invest in higher education. The model is calibrated for a set of eight African countries for which some data on student loans is available, and numerical results derived. It is shown that if policymakers successfully reduce the price of remittances, the harm from the secondary effect is mitigated, and the brain gain channel is strengthened, skilled migration rates fall, and human capital increases.

This study builds on earlier research by Beine, Docquier, and Rapoport (2008); Galor and Zeira (1993); Cai (2020); Djadjic, Docquier, and Michael (2019); Mesnard (2004) and Antunes, Cavalcanti, and Villamil (2008), that documents the impact of migration on human capital accumulation and investment while taking into account credit market dynamics. However, this work is novel in that it calculates the benefits of a reduction in remittance prices explicitly while taking into account the effect of this reduction on interest rates and migration decision.

Remittance prices are the transfer costs migrants must pay in order to send funds home, calculated as the transaction fee relative to the value sent. The World Bank estimates that with a reduction in the remittance price to 5%, developing countries would receive over $16 billion additional funds a year. Given the importance of remittances for the receiving economies, one of the UN Sustainable Development Goals is the reduction of remittance prices from its worldwide average of 7% to less than 3% and the elimination of remittance corridors with costs higher than 5%. The importance of reducing remittance prices has been recognized by policymakers for

---

1 Small countries such as Suriname, Guyana, Haiti, and Jamaica, are typically more affected, with skilled emigrants accounting for around 80% of the educated workforce.

2 Current estimates indicate that remittance transactions costs can add up to an average of 10% of the amount sent and a large variance across countries.
over a decade. Leaders at the 2009 G-8 meeting and the 2014 G-20 meeting pledged to reduce remittance prices as well. Increasing access to banking services, particularly mobile banking, increasing competition between money transfer agencies, and improving information for migrants on costs at these agencies, are simple steps to reduce the costs of transferring funds (Yang, 2011). Additionally, governments can reevaluate their range of regulations to improve transparency of international transaction if these increase migrants’ costs of transferring money home (Beck & Peria, 2011).

The remainder of the paper is organized as follows. The next section describes the related literature. The sections that follow introduce the model and describe the equilibrium. It is succeeded by discussion of the calibration strategy and presentation of the numerical findings. The last two sections respectively, discuss the policy implications of the findings and present the study’s conclusion.

2. Related literature

Early literature on brain drain suggested that the migration of skilled labor made those left behind worse off (Bhagwati and Hamada, 1974; Miyagiwa, 1991; Wong and Yip, 1999), leading some economist to advocate taxing emigrants. However, later literature concluded that when workers are faced with a probability of migration to a labor market with a higher wage than prevalent at home, they accumulate more human capital levels than in the absence of migration so that the unsuccessful migrants boost the nation’s stock of human capital in net (Stark, Helmenstein, & Prskawetz, 1998; Vidal, 1998). The positive effect that the prospect of migration can have on human capital accumulation is typically labeled “brain gain”. Empirically, evidence of brain gain is mixed. Beine, Docquier, and Rapoport (2001) and Beine et al. (2008) find evidence of brain gain effect whereas Faini (2003) fails to find such an effect.

Migration can also increase human capital through the effect of remittances. The impact of remittances on human and physical capital, and, in turn, growth, typically depends on the extent to which households use these funds for investment versus consumption. Many studies find that remittances are used for human capital investment: Adams and Cuecuecha (2013) find evidence of this in Ghana, Yang (2008) finds similar patterns for the Philippines, and Hines and Simpson (2019) find the same for Kenya. Also, evidence of the use of that remittances for physical capital investment has been document by Adams (1998) for rural Pakistan, Jena (2018) for Kenya, and Taylor, Rozelle, and de Brauw (2003)) for China.

Although some studies have found that remittances are spent on consumption smoothing rather than investment, there is ample evidence of the contribution of remittances to economic growth and productivity (Annen, Batu, & Kosempel, 2016; Gupta, Pattillo, & Wagh, 2009; Imai, Gaiha, Ali, & Kaicker, 2014; Kapri & Ghimire, 2020), which points to their importance in financing investment.5

---

3 Mountford (1997) and Stark and Zakharenko (2012) go on to show that the migration possibilities of particular skilled workers can improve productivity, and Katz and Rapoport (2005) show that with migration, higher variance in the home country’s return to education compared to that of the foreign country increases human capital.

4 Some work on the effect of remittances on human capital has focused on the educational attainment of the children left behind (see Amuedo-Dorantes and Pozo (2010); Jamel Bouoiyour (2015), and Salas (2014); Bansak and Chezum (2009), and Edwards and Ureta (2003).

5 Additionally, Abbas, Masood, and Sakhawat, (2017)) and Opperman and Adjasi (2019) show that loans can substitute for remittances.
This study is also related to papers that have explored the forces that can shape the brain gain effect. For example, Chen (2009) incorporates fertility choice in an endogenous growth model and shows that while an increase in skilled migrants’ probability of successful migration leads to brain drain in the long run, an increase in the probability of migration of low skilled migrants can lead to brain gain. Stark, Helmenstein, and Prskawetz (1997) and Chau and Stark (1999) identify return migration as a channel through which migration can lead to brain gain.

This study demonstrates that brain gain can be strengthened by the lowering of remittance prices, and that this lowering can lead households to invest more in human capital, save more, and migrate less.

3. The model

The model employed is a heterogeneous-agent overlapping generations model with each individual living for three periods. In the first period individuals choose whether they will borrow to finance human capital as in the work by Croix and Michel (2007); in the second period individuals make their migration choices as in the work by Faini (1996). However, not everyone is successful in their attempt to migrate as in the work by Stark et al. (1997) and Beine et al. (2001). The probability of actually migrating is given by $0 < l < 1$. The inclusion of uncertainty in an individual’s migration outcome in the model is motivated by real-world features such as border restrictions and visa procedures set by receiving countries.

Those who do migrate work abroad at a higher wage and do not return. Those who stay home work at the prevailing domestic wage, pay back their loans and make their savings decision. In the last period agents retire and consume savings.

3.1. Households ability and home preference distribution

Individuals are heterogeneous along two dimensions, ability denoted by $z$ and indexed by $j$ and preference for staying at home denoted by $\theta$ and indexed by $i$. Heterogeneity in ability (represented by $z_{ij}$) is uniformly distributed between $[0,1]$ following Mayr and Peri (2008). And following Faini (1996), preference for living in the home country (represented by $\theta_i$) is distributed according to a Pareto function such that,

$$f(\theta) = \frac{\varepsilon}{\theta^{\varepsilon+1}}, \quad F(\theta) = 1 - \frac{1}{\theta^{\varepsilon}}, \quad \theta \in [1, \infty), \quad \varepsilon > 0 \quad (1)$$

where $\varepsilon$ is a parameter of the Pareto distribution. If an individual lives at home, their utility is augmented by an idiosyncratic $\theta_i > 1$, but they receive no such augmentation if they migrate. The lower utility of living abroad represents social and psychological costs that come with adapting to a new environment (Faini, 1996).

3.2. Human capital evolution

Individual ($i$, $j$) is born in $t-1$, borrows $b_{ij,t-1}$, and accumulate human capital $h_{ij,t}$. Human capital accumulated by each individual depends on their borrowing $b_{ij,t-1}$ and on the aggregate

---

6 Mayr and Peri (2008) assume that ability follows a uniform distribution so they can derive closed form solutions for their model.
level of the previous generation’s human capital, $H_{t-1}$, and is governed by the following function as in the paper by Croix and Michel (2007),

$$h_{ij,t} = b_{ij,t-1}^{\lambda} H_{t-1}^{1-\lambda}$$

where $0 < \lambda < 1$ determines the elasticity of human capital to borrowing.

### 3.3. Household types

Individuals with high enough ability $z_j$ invest in human capital. Individuals with high enough $\theta_i$ stay at home, earn returns on their human capital at home and invest their savings at home; individuals with low enough $\theta_i$ plan to migrate. After the migration outcome is revealed, the individual, in period $t$, decides on his optimal savings for retirement in period. The threshold of $z_j$ above which households invest in education is derived in section (4.3), and the threshold of $\theta$ above which individuals will stay home is derived in Appendix A.

Therefore, three types of individuals exist in each generation: stayers who invest in human capital, those who wish to migrate, and those who do not invest in human capital. The optimization problems and optimal levels of human capital, borrowing, and savings for those types are derived next.

#### 3.3.1. Household type I: stayers

An individual $(i,j)$ living in the origin country $(o)$ who does not wish to migrate but invests in human capital is referred to as a stayer. Stayers maximize the following utility function,

$$U_{ij}^o = \ln \left( \theta_i c_{ij,t}^o \right) + \delta \ln \left( \theta_i c_{ij,t+1}^o \right)$$

subject to human capital accumulation function (2) and the following budget constraints,

$$c_{ij,t}^o = z_j h_{ij,t}^o - s_{ij,t}^o - R_{t-1} b_{ij,t-1}^o$$

$$c_{ij,t+1}^o = s_{ij,t}^o R_t$$

where $\delta$ is the discount rate, and $R_{t-1}$ and $R_t$ are the relevant interest rates. Ability ($z_j$) augments earning from human capital so that if two workers have the same level of human capital, the higher ability worker with higher $z_j$ would earn a higher income. $s_{ij,t}^o$ is savings for stayers who invest in human capital and $z_j h_{ij,t}^o - R_{t-1} b_{ij,t-1}^o$ is life-cycle income for stayer $i$.

The optimal levels of borrowing, human capital, and savings implied by the above maximization problem are,

$$b_{ij,t-1}^o = \left( \frac{z_j}{R_{t-1}} \right)^{\frac{1}{1-\lambda}} H_{t-1}$$

$$h_{ij,t}^o = \left( \frac{z_j}{R_{t-1}} \right)^{\frac{\lambda}{1-\lambda}} H_{t-1}$$

---

7 The superscript $o_1$ is used to distinguish domestic savings and earnings of stayers who never wanted to migrate, and the domestic savings and earnings of stayers who would have liked to migrate but failed and are denoted by the superscript $o^2$. 
Similarly, where subject 3.3.2. developing expected emigration which and migrant in leaving family members, whom a emigration utility private constant Skilled Stayers’ Note, An Possible how number of private education, Khraiche, 2011. Possible as much, to loans it is so that 1 and 2 detail has the enter in. This contract dictates that those who successfully migrate remit a portion of their income back to those who remain behind. The remittances contract is discussed in more detail in section 3.3.3.

Possible migrants choose how much to borrow and invest in human capital \( b_{ij,t-1}^d \) and \( \delta_{ij,t-1} \), and how much to save if they migrate or if they stay home \( s_{ij,t}^d \) and \( s_{ij,t}^p \) to maximize the following expected utility function,

\[
U_{ij,t}^d = I \{ \ln \left( c_{ij,t}^d \right) + \delta \ln \left( c_{ij,t+1}^d \right) \} + (1 - I) \{ \ln \theta_i \left( c_{ij,t}^p \right) + \delta \ln \theta_i \left( c_{ij,t+1}^p \right) \} \]

subject to the human capital accumulation function (2) and the following budget constraints,

\[
c_{ij,t}^d = (1 - \tau) x z_j h_{ij,t}^d - s_{ij,t}^d \]
\[
c_{ij,t+1}^d = s_{ij,t} R^d \]
\[
c_{ij,t}^p = z_j h_{ij,t}^p - s_{ij,t}^p - R_{ij,t-1} b_{ij,t-1}^d + (1 - p) T \]
\[
c_{ij,t+1}^p = s_{ij,t}^p R_t \]

where \( x > 1 \) represents the higher earnings abroad and \( R^d \) represents the foreign interest rate, which is unchanged by migration. \( 0 < \tau < 1 \) is the portion of income a migrant remits to other family members, while \( T \) is the amount of remittances received and \( p \) is the remittance price defined as the cost of sending funds home.

Note that migrants default on debt when they leave their country of origin. To motivate this assumption, it is observed that bankers in small countries have expressed reluctance to make student loans given the uncertainty of debt repayment in light of the established patterns of skilled emigration (Khraiche, 2011). Similarly, Kenya, which does provide students loans to cover public and private education, has historically faced difficulty in collecting repayment partly because of emigration and poor record keeping and enforcement (Otieno, 2004). The phenomenon of debtors leaving a country and avoiding debt repayment was also a serious concern in Dubai in 2009, as

\[ s_{ij,t}^d = \frac{\delta}{1 + \delta} \left( z_j h_{ij,t}^d - R_{ij,t-1} b_{ij,t-1}^d \right) \]

(8)

Stayers’ human capital is negatively related to interest charged on debt, and their savings are a constant fraction of income. Using optimal levels of borrowing and human capital for stayers given by (6) and (7), the life-cycle income can be rewritten as \( (1 - \lambda) z_j h_{ij,t}^d \). Hence, the indirect utility of the individual staying in the origin country is given by,

\[
V_{ij,t}^a = \ln \left( \theta_i^{1+\delta} \left( \frac{1}{1+\delta} \right)^{1+\delta} R^d \left( (1 - \lambda) z_j h_{ij,t}^d \right)^{1+\delta} \right) \]

(9)

3.3.2. Household type II: those who desire to migrate

An individual \( (i, j) \) who wishes to migrate and live in the destination country \( (d) \) is referred to as a possible migrant. Before knowing whether he will successfully migrate or not, the possible migrant enters into a remittances contract with other possible migrants of the same type with whom he has familial ties. This contract dictates that those who successfully migrate remit a portion of their income back to those who remain behind. The remittances contract is discussed in more detail in section 3.3.3.

Skilled emigrants account for around 30% of the educated workforce in Lebanon, where the article was published. This number is likely to be underestimated since it ignores migration of skilled workers to the Gulf countries and other developing countries (Docquier & Marfouk, 2004).
indebted expatriates made unemployed by the financial crisis began leaving the country, debts unpaid (Worth, 2009).\footnote{Despite including the assumption of defaulting migrants, a positive relationship between human capital accumulation and migration is still found.}

To find an analytical solution, $\phi$ is defined as the portion of migrant income accruing to a single individual at home. Since remittances by a single individual can be distributed over several family members who stay, it is possible that $\tau \neq \phi$.\footnote{For example, if there are two family members, one migrates while the other stays, then. On the other hand, if there are 3 family members, one migrates and two stay, then.} In this case, $T$ in terms of $\phi$ is defined as,

$$T = \Phi z_j h_{i,j,t}^d$$

On average, if the family size is $F$, then $IF$ fraction of the family migrates, and $(1 - I)F$ stays. Therefore, remittances sent by migrant family members of type $(\theta_i, z_j)$ equal $IF(\tau x z_j h_{i,j,t}^d)$, which would be distributed over $(1 - I)F$ stayers and each receives $T = IF(\tau x z_j h_{i,j,t}^d)/((1 - I)F)$. Therefore, $\Phi = l\tau x_f/(1 - l)$.

The solution to the maximization problem of possible migrants yields,

$$b_{i,j,t}^d = \left(\frac{\Phi z_j \lambda^\delta}{KR_{rt-1}}\right)^{\frac{1}{\delta}} H_{i-1}$$

$$h_{i,j,t}^d = \left(\frac{\Phi z_j \lambda^\delta}{KR_{rt-1}}\right)^{\frac{1}{\delta}} H_{i-1}$$

$$s_{i,j,t}^d = \frac{\delta}{1 + \delta} (1 - \tau) x z_j h_{i,j,t}^d$$

$$s_{i,j,t}^{\alpha} = \frac{\delta}{1 + \delta} \left(1 + (1 - p) \phi - \frac{\Phi}{K}\right) z_j h_{i,j,t}^d$$

where $b_{i,j,t}^d$, $h_{i,j,t}^d$, and $s_{i,j,t}^d$ are the optimal levels of borrowing, human capital accumulation, and savings of an individual who wish to migrate but fails. $K = (1 - l + \lambda)$ and $\Phi = 1 + (1 - p) \phi l$ are defined for simplicity of exposition and also because these two expression summarize the effect of the possibility of migration and remittances on human capital decisions of those who stay.

A comparison of the expressions for the human capital of stayers and migrants given, respectively, by (7) and (17), makes clear that those who wish to migrate accumulate more human capital ($h_{i,j,t}^{\alpha} < h_{i,j,t}^d$) by a factor of $\left(\frac{\Phi}{K}\right)^{\frac{1}{\delta}} > 1$. There are two reason for the higher level of human capital accumulated by migrants. First, the possibility of migrating to a labor market with higher wages and defaulting on repayment augments human capital accumulation by a factor of $\left(\frac{1}{K}\right)^{\frac{1}{\delta}} > 1$. The second reason is the presence of remittances, which augments human capital by a factor of $(\Phi)^{\frac{1}{\delta}} > 1$. A person who wanted to migrate and default, and now has to pay back the debt and stay home, can use remittances to pay back some of the debt and therefore accumulates more human capital to begin with (compared to the case where the worker receives no remittances). Therefore, migration boosts some individuals’ human capital (brain gain). However, aggregate human can rise or fall depending the fraction of the population that migrates and no longer works at home (brain drain).
Eq. (19), describes the savings rates for possible migrants who fail to migrate. These individuals save a fraction \( \frac{\delta}{1 + \delta} (1 + (1 - p) \Phi - \lambda \frac{\Phi}{K}) \) of their income. Remittances boost savings of possible migrants who stay by increasing the fraction saved.

If a possible migrant successfully migrates, then the indirect utility of the migrant can be obtained by substituting (17) and (18) into the budget constraints, yielding

\[
V^d_{ij,t} = \ln \left( \frac{1}{1 + \delta} \delta^\delta R^\delta \left( (1 - \tau) x z j h^d_{ij,t} \right)^{1 + \delta} \right)
\] (20)

If a possible migrant stays home instead of migrating, then the indirect utility of the migrant can then be obtained by substituting (17) and (19) into the budget constraints, yielding

\[
V^\omega_{ij,t} = \ln \left( \phi^1_{i} \delta^\delta R^\delta \left( 1 + (1 - p) \Phi - \lambda \frac{\Phi}{K} \right) z j h^\omega_{ij,t} \right)^{1 + \delta} \right)
\] (21)

3.3.3. Remittances contract

An individual enters into a remittances contract in period \( t - 1 \) only if, a priori, the expected lifetime indirect utility of paying remittances is bigger than or equal to the expected lifetime utility of not paying remittances. Formally, an individual will enter in an enforceable remittances contract if,

\[
\left( lV^d_{ij,t} \right) + \left( 1 - l \right) V^\omega_{ij,t} \geq \left( lV^{d, NR}_{ij,t} \right) + \left( 1 - l \right) V^{\omega, NR}_{ij,t}
\] (22)

where \( V^d_{ij,t} \) (given by Eq. (20)) is the lifetime utility of migrant in a remittances contract. And \( V^\omega_{ij,t} \) (given by Eq. (21)) is the lifetime utility of the individual in a remittances contract but fails to migrate. \( V^{d, NR}_{ij,t} \) and \( V^{\omega, NR}_{ij,t} \) are the lifetime utilities for a migrant and a stayer who would have liked to migrate, without a remittances contract. To find \( V^{\omega, NR}_{ij,t} \), \( V^{d, NR}_{ij,t} \), \( V^d_{ij,t} \) and \( V^\omega_{ij,t} \) are evaluated at \( \tau = 0 \) and \( \Phi = 0 \).

The constraint in (22) amounts to a participation constraint that defines a threshold level of, \( \hat{\tau} \) below which an individual would be better off participating in the remittances contract when he is still not sure whether he will migrate or not. Simplifying (22), \( \hat{\tau} \) is found as follows,

\[
\hat{\tau} \leq 1 - \left[ \frac{1 - \lambda / K}{1 + (1 - p) \Phi - \lambda \Phi / K} \right] \left( \frac{\lambda / K}{\Phi} \right)^{1 - \frac{1}{\tau}} < 1
\] (23)

Eq. (23) is not an explicit function of \( \tau \) since \( \Phi \) and \( \Phi \) vary with \( \tau \). However, Eq. (23) shows that there exists a positive level of remittances that would make the possible migrant enter into a remittances contract. It is assumed that the level of \( \tau \) satisfies the constraint given by (23) and that all migrants enter into a remittances contract and honor their commitment.

3.3.4. Household type III: least skilled

The next worker whose problem is formalized is the one with very low ability \( z_j \), who finds it optimal not to invest in human capital and is labeled as least skilled. The least skilled earns an income \( a \) in period \( t \), some of which is saved for period \( t + 1 \). The least skilled are excluded from the credit markets, and therefore do not receive a return on their savings. The implications of excluding the least skilled from capital markets are discussed in section (4).
Therefore, an individual \((i, j)\) living in the origin country \((o)\) who does not wish to migrate or invest in human capital (referred to as a least skilled individual) maximizes the following utility function,

\[
U_{ij,t}^n = \ln \left( \theta_i c_{ij,t}^n \right) + \delta \ln \left( \theta_i c_{ij,t+1}^n \right)
\]  

(24)

subject to the following budget constraints,

\[
c_{ij,t}^n = a - s_{ij,t}^n \tag{25}
\]

\[
c_{ij,t+1}^n = s_{ij,t}^n \tag{26}
\]

The solution to the least skilled optimization problem is the following optimal savings function

\[
s_{ij,t}^n = \frac{\delta}{1 + \delta} a \tag{27}
\]

and the indirect utility is given by,

\[
V_{ij,t}^n = \ln \left( \theta_i \frac{1 + \delta}{1 + \delta} \left( \frac{1}{1 + \delta} \right)^{1+\delta} \delta^\delta a^{1+\delta} \right) \tag{28}
\]

4. Aggregation

Now that the decision processes of individuals have been formalized, the next section proceeds to find the fraction of the population that will invest in human capital. The fraction of the population that wants to migrate is derived in Appendix A. This is followed by derivations of aggregate human capital, savings, and borrowing levels.

4.1. Human capital investment decision threshold

Although it has been assumed that the least skilled will not migrate,\(^{11}\) the decision to invest in human capital is endogenous for stayers. Those who do not wish to migrate will only invest in human capital if and only if \(V_{ij,t}^o \geq V_{ij,t}^n\) which implies that the utility of investing in human capital and staying home is larger than the utility of not investing in human capital and simply earning income \(a\). This inequality gives rise to a threshold of ability, \(\hat{z}\), above which the individual will invest in human capital. Formally, anyone with ability \(z_i\) above the threshold \(\hat{z}\) given below will invest in human capital,

\[
\hat{z} = \frac{1}{(1 - \lambda)^{(1-\lambda)} \lambda^\lambda \left( \frac{a}{H_{t-1}} \right)^{1-\lambda} \frac{R_{t-1}^{\lambda - 1}}{R_t^{\lambda - 1}}} \tag{29}
\]

\(^{11}\) Mayr and Peri (2008) make a similar assumption when calibrating their model in order to guarantee that some population will remain home regardless of migration restrictions. This assumption is further discussed in the Appendix B.
4.2. Aggregate human capital

The fraction of the population that would like to migrate, since its preference for staying at home (θi) is low enough to ensure that its utility from migration is higher than that from staying, is defined as mi. The full expression for mi is in Appendix A. Since mi is the desired migration rate and only l migrate successfully, then lmí as the realized migration rate. Aggregate human capital for a generation is given by\(^{12}\)

\[ H_t = \int _\mathcal{z}^1 \left\{ (1 - m_t) h_{j,t}^o + m_t (1 - l) h_{j,t}^d \right\} f(z) \, dz \]  

(30)

From the expressions for the human capital of stayers and of those who would prefer to migrate, given respectively by (7) and (17), the aggregate level of human capital in the country of origin becomes,

\[ H_t = \int _\mathcal{z}^1 \left\{ \left( \frac{z_j \lambda}{R_{t-1}} \right)^{\frac{1}{\gamma}} \left[ 1 + m_t \left( \left( \frac{\Phi}{K} \right)^{\frac{1}{\gamma}} - 1 \right) \right] \right\} H_{t-1} f(z) \, dz \]  

(31)

\[ = (1 - \lambda) \left( 1 - \mathcal{z}^{\frac{1}{\gamma}} \right) \left( \frac{\lambda}{R_{t-1}} \right)^{\frac{1}{\gamma}} \left[ 1 + m_t \left( \left( \frac{\Phi}{K} \right)^{\frac{1}{\gamma}} - 1 \right) \right] H_{t-1} \]  

(32)

Note that remittance prices have an impact on aggregate human capital through their effect on individuals’ human capital decision, their effect on interest rates, and their effect on migration decisions.

4.3. Aggregate borrowing and savings

The aggregate level of savings for a generation, St, is given by,

\[ S_t = \int _\mathcal{z}^1 \left\{ (1 - m_t) s_{j,t}^{o1} + m_t (1 - l) s_{j,t}^{o2} \right\} f(z) \, dz. \]  

(33)

And aggregate borrowing is given by,

\[ B_{t-1} = \int _\mathcal{z}^1 \left\{ (1 - m_t) b_{j,t-1}^p + m_t b_{j,t-1}^d \right\} f(z) \, dz \]  

(34)

The assumption of excluding the least skilled individuals from the credit markets does not change the expression for aggregate borrowing in the model. This is because borrowing is exclusively used for education. If the least skilled were able to invest their savings, the level of savings they would accumulate would still be given by \(\frac{\delta}{1+\delta} a\), since they save a fraction of their income determined by the discount rate \(\delta\). Therefore, the aggregate savings function would be given

\[ S_t = \int _\mathcal{z}^1 [(1 - m_t) s_{j,t}^{o1} + m_t (1 - l) s_{j,t}^{o2}] f(z) \, dz + \int _0^{\mathcal{z}} \frac{\delta}{1+\delta} a f(z) \, dz, \] where the first integral sums over the savings of those who accumulate human capital and the second integral sums over those who do not (the least skilled). Examining this expression reveals that the savings of the least skilled can only impact the aggregate savings function \(S_t\) through changes in \(\mathcal{z}\), since \(a\) and \(\delta\) are

\(^{12}\) The i subscript is dropped since optimal human capital does not depend on \(\theta_i\).
constants. However, even without considering the savings of the least skilled, changes in $\hat{z}$ are already taken into account as they change the aggregate savings of those who accumulate human capital (by changing the limits of the first integral).

For example, if a parameter (other than $\delta$ or $a$) change caused $\hat{z}$ to increase, this would mean that a higher threshold of ability must be attained in order for a worker to invest in human capital, increasing the proportion of least skilled workers in the economy and decreasing the number of skilled workers. This in turn would increase the contributions of the least skilled to aggregate savings (if their savings were included in aggregate savings), but reduce the contributions of those who accumulate human capital. The key, however, is that those who accumulate human capital would have a higher level of savings than the least skilled, implying that aggregate savings would fall as threshold $\hat{z}$ increased. Qualitatively, the model still predicts that aggregate savings would fall with a higher $\hat{z}$ even if the least skilled were excluded from capital markets and their contributions to aggregate savings were ignored.

5. Equilibrium

Equilibrium in the asset market requires that,

$$B_{t-1} = S_{t-1},$$

which in turn determines the equilibrium interest rate in the origin country, $R_{t-1}$. Using the optimal levels of borrowing derived for individuals who live in the origin country and the expressions for aggregate savings and borrowing, the interest rate which clears the asset market is given by

$$R_{t-1} = R_{t-2} \left( \frac{1 + \delta}{\delta} \right) \frac{1 + m_t \left( \frac{\Phi}{\lambda} \right)^{\frac{1}{1 - \lambda}} - 1}{\left( 1 - \lambda \right) + m_{t-1} \left( 1 + \left( 1 - p \right) \Phi - \lambda \frac{\Phi}{\lambda} \right) (\frac{\Phi}{\lambda})^{\frac{1}{1 - \lambda}} - \left( 1 - \lambda \right)} \right)^{1 - \lambda}. \quad (36)$$

5.1. Steady state

To find the origin country’s steady state interest rate, the equalities $R_{t-2} = R_{t-1} = R_t = R$ and $m_{t-1} = m_t = m$ are imposed. This yields the following expression for the steady state interest rate, $R$:

$$R = \left( \frac{1 + \delta}{\delta} \right) \frac{1 + m \left( \frac{\Phi}{\lambda} \right)^{\frac{1}{1 - \lambda}} - 1}{\left( 1 - \lambda \right) + m \left( 1 + \left( 1 - p \right) \Phi - \lambda \frac{\Phi}{\lambda} \right) (\frac{\Phi}{\lambda})^{\frac{1}{1 - \lambda}} - \left( 1 - \lambda \right)} \right)^{1 - \lambda}. \quad (37)$$

The existence of the equilibrium is discussed in Appendix D. Note that the interest rate is a function of remittances and remittance prices. More remittances and lower remittance prices increase savings directly as more funds arrive, and indirectly through their effect on human capital accumulation, borrowing, and desired migration ($m$). Next, numerical results are turned to in the
next section to estimate the degree to which remittance price reduction can change the interest rate and the migration rate, and in turn, human capital.

6. Numerical results from policy experiment

In this section, the effects of reducing remittance prices upon the growth of human capital accumulation, interest rates, and desired migration rates, as implied by the model, are estimated. To do so, the model is calibrated to match data from developing countries from which emigrants depart, and developed economies, the migrants’ destination.

6.1. Calibration strategy

First, the traditional parameters of the model are calibrated. The variable \( x \), which captures the differences in productivity between developing and developed countries, is assumed to equal 2, as in the paper by Mayr and Peri (2008). The discount rate, \( \delta \), is set to 0.5. Eq. (15), which defines \( \phi = T / \sum_{j} h_{i,j}^{d} \), where \( T \) is remittances received and \( z_{j} h_{i,j}^{d} \) is income earned, is used to calibrate \( \phi \). Therefore, the World Bank’s estimates of remittances received by the host country as a percent of its GDP is taken for the value of \( \phi \).

Since detailed data on student loans in developing economies is not available, structural estimation of the nontraditional parameters of the model is not possible. Therefore, a simple calibration strategy is employed to calculate \( \lambda, l, \) and \( \varepsilon \) for a set of eight African countries for which data on student loan interest rates and borrowing levels are available for the year 2005. The countries are Burkina Faso, Ethiopia, Ghana, Kenya, Namibia, Nigeria, Rwanda, and South Africa. Their pertinent data are listed in Table 1. Although developing economies have historically offered free public education, this trend has seen changes as some countries have opted for cost sharing programs whereby some education expenses (such as boarding, program fees, tuition) are charged to students (Woodhall, 2007). As such cost sharing increased, student loans were introduced to help students deal with paying their share of the expenses. In 2003, after cost sharing was introduced, Ethiopia established a loan program in which students borrow to cover food, lodging and 15% of tuition cost. The loans required repayment to start a year after degree completion (Johnstone & Aemero, 2001; Yizengaw, 2007). Similarly, Ghana also offers students loans with a subsidized interest rate (Atuahene, 2008). Recently, Strathmore University (a private institution in Kenya), the World Banks’ International Finance Corporation, and the Commercial Bank of Africa Ltd established a loan program for students enrolled in the University. Similarly, South Africa and Nigeria, have student loan programs. The First Bank of Nigeria Ltd offers student loans for those seeking private education.  

The parameters, \( l, \varepsilon, \) and initial value of \( m \), are simultaneously calibrated using three equations: the equilibrium interest rate equation given by (37), the equilibrium desired migration rate given by (40), and \( lm \) set equal to each country’s emigration rate among those with tertiary education, retrieved from the IAB Brain Drain Dataset, published by the German Institute for Employment Research (Brucker, Capuano, & Marfouk, 2013). Using a value of \( R \) equal the student loan interest rates (listed in Table 1) and the aforementioned equations, a nonlinear equation solver enabled solving for \( l, \varepsilon, \) and \( m \). The computed values of the parameters for each country are listed in Table 2.

---

13 This information along with more examples have been accumulated by The International Comparative Higher Education Finance and Accessibility Project.
Table 1  
Data used for calibration.

| Country     | Borrowing limits | Repayment period | Unit cost of tertiary education | Interest rate on student loans | Skilled migration rate (lm) | Remittances Rate (¥) |
|-------------|------------------|------------------|---------------------------------|-------------------------------|---------------------------|----------------------|
| Burkina Faso | $998             | 6 years          | $1364                           | 3%                            | 1.75%                     | 3.70%                |
| Ethiopia    | $1,290–$1,814    | 15 years         | $389–$888                       | Average bank rates while the student is in school | 15.81%                   | 1.00%                |
| Ghana       | $1380            | 15 years         | $1083–$1806                     | 10.25% compounded annually plus 4% | 23.46%                   | 5.40%                |
| Kenya       | $2032            | Short repayment horizon | $3387                           | 4%                            | 23.74%                     | 3.10%                |
| Namibia     | NSR400 per student | Short repayment horizon | $1643                           | Interest equal to half of prime rate, no compounded | 8.13%                     | 0.60%                |
| Nigeria     | 14,300 Naira     | 10 years         | 14300 Naira                     | 7%                            | 13.16%                     | 6.10%                |
|             | $6445–$8057      |                  | $2846–US$7116                   | 5% Compounded from loan origination | 12.09%                   | 2.70%                |
| Rwanda      |                 |                  |                                 |                               |                          |                      |
| South Africa| $516–$8397       |                  | $5263–$8010                     | Inflation plus an additional 2% | 10.34%                    | 0.30%                |
| Data Source | Experton and Fevre (2010) | Experton and Fevre (2010) | Experton and Fevre (2010)       | IAB (2010, 5 year average)    | WDI (2017)               |                      |

Data Source: Experton and Fevre (2010)
To calculate $\lambda$ for each of the eight countries, the fact that $\lambda$ is the elasticity of human capital with respect to debt, and therefore, can be written as $\frac{\delta H_{t-1}}{\delta b_{ij,t-1}}$, is exploited. $\frac{\delta H_{t-1}}{\delta b_{ij,t-1}}$ is scaled so that the interest rate in the model lies between 0 and 1. Finally, interpretation of $b_{ij,t-1}$ and $H_{t-1}$ as the dollar amount borrowed and the dollar cost of education enables calculation of $\lambda$. Utilized data on the ratio of borrowing to the cost of education enables calculation of $\lambda$. Utilized data on the ratio of borrowing to the cost of education enables calculation of $\lambda$.

Finally, remittance prices for the sample of countries are retrieved from the World Bank’s Remittance Prices Worldwide database. Table 3 shows the average transaction costs of sending remittances to these countries. The highest remittance price in the sample stands at over 19.5% for Namibia. Indeed, some African countries have the highest costs of sending funds home (KNOMAD, 2017). Even so, Africans are found to remit twice as much on average as migrants from other developing countries (Bollard, McKenzie, & Morten, 2010).

### 6.2. Policy experiment

This section documents the extent to which a decrease in remittance prices ($p$ in the model) to 3% can affect human capital accumulation in developing economies experiencing brain drain. 3% is chosen since the UN Sustainable Development Goals is to reduce remittance prices to this percentage.
6.2.1. Computational method

To measure the impact of reduction in the remittance price to 3% upon human capital accumulation, the new desired migration rate and the interest rate that clears the asset market under the new remittance price are simultaneously calculated.\textsuperscript{14} The subsequent change in human capital is calculated using Eq. (31). Some studies document that remittances respond to changes in costs. Freund and Spatafora (2008) find a negative correlation between remittance prices and remittances, and Ashraf, Aycinena, Martinez, and Yang (2010) demonstrate that this could be substantial for migrants from El Salvador. Similarly, using survey hypotheticals of Tongan migrants in New Zealand, Gibson, Mckenzie, and Rohorua (2006) estimate a high elasticity of remittances to changes in cost. The elasticity of remittances to their price for this study’s sample of 8 African countries is calculated to be $-0.13$ based on taking each country’s remittance rate and remittance price as individual points along a demand curve. Therefore, the simulations assume that the remittance rate increases by 0.13% for each 1% reduction in the remittance price.

6.2.2. Results

The results are presented in Fig. 1. It is found that for the sample countries, human capital increases following a remittance price reduction. The increases are detailed in Table 4.

The gains in human capital from reduction in the remittance price come mainly from lower interest rates and lower migration rates (see Figs. 2 and 3). The market clearing interest rate

\textsuperscript{14} Technically, the interest rate that clears the asset under the condition given by equation (35) is found such that the migration rate is given by equation (40).
Fig. 2. Change in migration rate.

Fig. 3. Change in interest rate.

decreases as the remittance price decreases since saving increases faster than borrowing. The increase in saving comes directly from the receipt of more remittances as their transaction cost decreases. The additional remitted funds also enable households to increase human capital (brain gain) without increasing borrowing, which enables them to earn more income and increase saving. Also, as the interest rate decreases, the threshold of ability above which households invest in human capital ($z$) decreases. So, with a reduction in the remittance price, households which would have ordinarily decided not to invest in human capital, reverse that decision.

Additionally, the desired migration rate ($m$) decreases as the remittance price falls. This implies that, as emigrated family members can send more funds home, fewer households desire to migrate. Therefore, reduction in the remittance price, by reducing migration, further increases human capital at home by curbing brain drain.

Human capital gains from the reduction in the remittance price are larger for countries with a high probability of success in migration ($l$). In other words, in economies in which it is easy to migrate, the increase in human capital from reducing the remittance price is more pronounced. One reason for this effect is that households plan their human capital accumulation decision before their migration outcome is revealed. A benefit of human capital accumulation is higher earnings and remittances sent home, upon successful emigration of a family member. A decrease in the price of remittances would increase this benefit, and it stands to reason that this increase shall be more pronounced the higher the probability of emigration.
Unsurprisingly, reduction of remittance price to 3% tends to induce a bigger increase in human capital in countries in which this price was higher to begin with, as may be seen in Fig. 4.

7. Policy discussion

This study contends that the lowering of the prices of remittances is a potential policy tool for increasing brain gain and reducing brain drain towards raising the levels of human capital in developing economies. Beck and Peria (2011) hold that remittance prices may be reduced by such measures as improving access to bank, increasing competition between providers of remittance services, and reevaluating the level of regulation for governing these providers.

As is well known, the introduction of mobile banking has improved access to financial services in general, particularly in developing economies. Therefore, increasing access to mobile phones and investing in communication infrastructure may significantly lower remittance prices. Additionally, improving consumer information about the charges of the various providers can foster competition between them leading to lower costs. The World Bank has calculated the average cost of sending remittance via the cheapest service providers and has found that migrants often pay more than this. This suggests that dissemination of information about the lowest cost providers could bring down the cost.

Given these various means of bringing down the prices of remittances, lowering these to 3% may well be within reach. However, certain obstacles remain. U.S. regulations against money-laundering have prevented many Western banks from dealing with African remittance providers, occasionally these providers fly banknotes on airplanes to their agents in Africa, a method severely interrupted by the coronavirus pandemic as planes were grounded in many locations (The Economist, 2020). In the interest of human capital accumulation, hence economic development, in developing economies, the U.S. might consider relaxing its international funds transfer regulations, per the argument of this paper.
8. Conclusion

In order evaluate gains in human capital accumulation from reduction in remittance prices, this study builds a general equilibrium model in which the choices to invest in human capital and migrate are endogenous. To decide whether or not to migrate, individuals weigh the gains from the chance to earn a higher lifetime income abroad and send remittances home against their idiosyncratic preferences for consumption at home. Their migration decision then affects their borrowing and savings in the asset market, and therefore, the domestic interest rate.

Since human capital is better rewarded abroad, those who wish to migrate borrow more to accumulate more human capital in preparation (brain gain). This increased borrowing puts upward pressure on the domestic interest rate in the origin country. On the other hand, more human capital accumulation by potential migrants leads to higher earnings at home and abroad and greater remittances home, all of which has the effect of lowering interest rates. The model in this study is calibrated for a group of eight African economies which has provision for student loans, and the effect upon human capital accumulation of decreasing remittance prices to 3% is numerically derived. It is found that interest rates decrease, the desire to migrate decreases, and human capital growth rate increases.

Policymakers have already directed efforts to reduce remittance costs in the past. This study’s policy recommendation is that continue to do so by for example, increasing access to mobile banking.

Appendix A. Migration decision and migration rate

An individual considering his option to migrate in time \( t \) will stay at home if his preference for living at home exceeds the threshold \( \hat{\theta}_i \) defined by the condition \( V_{ij,t}^{o1} = V_{ij,t}^{d} \). Using this condition, the expression for \( \hat{\theta}_i \) is derive as,

\[
\hat{\theta}_i = \left( \frac{R_t}{R_d^t} \right)^{\frac{1}{1+\lambda}} x (1 - \tau) \left( \frac{\phi}{R} \right)^{\frac{1}{1+\tau}} \frac{(1 - \lambda)}{(1 - \lambda)} \] (38)

Therefore, anyone with home preference (\( \theta_i \)) above \( \hat{\theta}_i \), will have \( V_{ij,t}^{o1} > V_{ij,t}^{d} \), and will decide to stay home.

The probability that an individual’s \( \theta_i \) exceeds the aforementioned threshold in a generation will be equivalent to the portion of that generation staying home, which is denoted by \( 1 - m_t \), where \( m_t \) is the generation’s desired migration rate. Given that each \( \theta_i \) follows a Pareto distribution as in (1), then

\[
1 - m_t = P (\theta_i > \hat{\theta}_i) = \left( \frac{1}{\hat{\theta}_i} \right)^{\varepsilon} \] (39)

\[
1 - m_t = \left[ \left( \frac{R_t}{R_d} \right)^{\frac{1}{1+\lambda}} x (1 - \tau) \left( \frac{\phi}{R} \right)^{\frac{1}{1+\tau}} \frac{(1 - \lambda)}{(1 - \lambda)} \right]^{\varepsilon} \] (40)

The fraction of the population who would like to stay for a given generation \( 1 - m_t \) is increasing in the interest rate differential on savings between the origin country and abroad \( \left( \frac{R_t}{R_d} \right) \). It is decreasing in the excess return on human capital abroad, \( x \).
Appendix B. Assumption in section 4.3

In section (4.3), it was assumed that a worker whose ability is too low to make it worth investing in human capital while staying home, will also find it not worthwhile to invest and migrate. Formally, for a worker with \( z_j \) below \( \hat{z} \), \( V^n_{ij,t} \) is above \( V^d_{ij,t} \). In this appendix, an explicit condition is derived that guarantees that this assumption holds. To do so, a second threshold of \( \theta_i \), called \( \theta_{j,t} \), is derived, above which it is guaranteed that \( V^n_{ij,t} > V^d_{ij,t} \) for all those whose \( z_j < \hat{z} \). \( \theta_{j,t} \) is given by,

\[
\theta_{j,t} = \frac{1}{a R^{1/\tau}} (1 - \tau) x z_j h_{ij,t}^d, \forall z_j < \hat{z}.
\] (41)

The assumption in section (4.3) can now be rewritten as follows; a worker with low enough ability \( (z_j < \hat{z}) \), will have a \( \theta_i \) high enough to exceed \( \theta_{j,t} \).

Appendix C. Aggregation Details

Using the expression for optimal human capital and saving of stayers given by (7) and (8), and using the expression for optimal human capital and savings for those who wish to migrate given by (17) and (19), aggregate savings in (33) can be rewritten as,

\[
S_t = \int_{\hat{z}}^1 \left\{ \frac{1}{m} \left( \frac{\lambda}{R_{t-1}} \right)^{\frac{1}{1+\delta}} (1 - \lambda) + m_t \left( 1 - \lambda \right) \left( 1 + (1 - p) \phi - \lambda \frac{\Phi}{K} \right) \right. \left( \frac{\Phi}{K} \right)^{\frac{1}{1+\delta}} - (1 - \lambda) \right\} f(z) dz
\] (42)

Using the expressions for optimal borrowing of stayers given by (6), and for optimal borrowing for those who wish to migrate given by (16), aggregate borrowing in (34) can be rewritten as,

\[
B_{t-1} = \int_{\hat{z}}^1 \left\{ \left( \frac{z_j \lambda}{R_{t-1}} \right)^{\frac{1}{1+\delta}} \left( 1 + m_t \left( \frac{\Phi}{K} \right)^{\frac{1}{1+\delta}} - 1 \right) \right\} f(z) dz
\] (43)

Appendix D. Equilibrium Existence

Substituting \( R \) into the Eq. (40) that governs migration and imposing \( m_t = m \),

\[
1 - m = \alpha^\frac{f(m)}{[g(m)]^{\frac{1}{1+\delta}}} \] (44)

where \( \alpha = \left[ \frac{1}{(R^\delta)^{\frac{1}{1+\delta}} (1 - \lambda) \left( \frac{\Phi}{K} \right)^{\frac{1}{1+\delta}}} \right]. \)

Eq. (44) implicitly defines the steady state level of migration for the economy and depending on the values of \( \lambda, \phi \) and \( \delta \) in the range of \([0,1]\), the relevant range for \( m \). Evaluating \( f(m) \) at \( m = 1 \), it is evident that \( f(1) > 0 \). Therefore, at \( m = 1 \), \( f(m) \) is above \( 1 - m \). Therefore, if \( f(0) < 1 \), this would imply that that \( f(m) \) would start below \( (1 - m) \) and it would cross \( (1 - m) \) to reach the
point \( f(1) \) above \( (1 - m) \) and an equilibrium exists. The equilibrium would be unique since \( f(m) \) is monotonic given that \( g(m) \) is monotonic. Therefore, a sufficient and necessary condition for an equilibrium characterized by \( 0 < m < 1 \) to exist is for \( f(0) = \alpha e^{\frac{1+\delta}{\delta}} \left[ \frac{\lambda}{1-\lambda} \right]^{\frac{\lambda}{1+\delta}} < 1 \). A simple sketch of the proof can be seen in Figs. 5 and 6.

References

Abbas, F., Masood, A., & Sakhawat, A. (2017). What determine remittances to Pakistan? The role of macroeconomic, political and financial factors. Journal of Policy Modeling, 39(3), 519–531.

Adams, R. H. (1998). Remittances, investment, and rural asset accumulation in Pakistan. Economic Development and Cultural Change, 47(1), 155–173.
Adams, R. H., & Cuecuecha, A. (2013). The impact of remittances on investment and poverty in Ghana. World Development, 50, 24–40.

Amuedo-Dorantes, C., & Pozo, S. (2010). Accounting for remittance and migration effects on children’s schooling. World Development, 38(12), 1747–1759.

Ammen, K., Batu, M., & Kosempel, S. (2016). Macroeconomic effects of foreign aid and remittances: Implications for aid effectiveness studies. Journal of Policy Modeling, 38(6), 1136–1146.

Antunes, A., Cavalcanti, T., & Villamil, A. (2008). Computing general equilibrium models with occupational choice and financial frictions. Journal of Mathematical Economics, 44(July (7-8)), 553–568.

Ashraf, N., Aycinena, D., Martinez, C., & Yang, D. (2010). The impact of remittance fees on remittance flows: Evidence from a field experiment among salvadoran migrants. Working papers. University of Michigan mimeograph.

Atuahene, F. (2008). The challenge of financing higher education and the role of student loans scheme: An analysis of the student loan trust fund (slf) in Ghana. Higher Education, 56(4), 407–421.

Bank, W. The world bank, remittance prices worldwide, 2017, available at http://remittanceprices.worldbank.org.

Bansak, C., & Chezum, B. (2009). How do remittances affect human capital formation of schoolage boys and girls? The American Economic Review, 99(2), 145–148.

Beck, T., & Peria, M. S. M. (2011). What explains the price of remittances? An examination across 119 country corridors. The World Bank Economic Review, 25(1), 105–131.

Beine, M., Docquier, F., & Rapoport, H. (2001). Brain drain and economic growth: Theory and evidence. Journal of Development Economics, 64(Feburary (1)), 275–289.

Beine, M., Docquier, F., & Rapoport, H. (2008). Brain drain and human capital formation in developing countries: Winners and losers. The Economic Journal, 118(405(529)), 631–652.

Bhagwati, J., & Hamada, K. (1974). The brain drain, international integration of markets for professionals and unemployment: A theoretical analysis. Journal of Development Economics, 1(April(1)), 19–42.

Bolland, A., McKenzie, D., & Morten, M. (2010). The remitting patterns of African migrants in the OECD. Journal of African Economies, 19(07(5)), 605–634.

Brucker, H., Capuano, S., & Marfouk, A. (2013). Education, gender and international migration: Insights from a panel-dataset 1980-2010. Mimeo.

Cai, S. (2020). Migration under liquidity constraints: Evidence from randomized credit access in China. Journal of Development Economics, 142(C).

Chau, N. H., & Stark, O. (1999). Migration under asymmetric information and human capital formation. Review of International Economics, 7(3), 455–483.

Chen, H.-J. (2009). A brain gain or a brain drain? migration, endogenous fertility, and human capital formation. Economic Inquiry, 47(4), 766–782.

Croix, D., & Michel, P. (2007). Education and growth with endogenous debt constraints. Economic Theory, 33(December (3)), 599–530.

Djadic, S., Docquier, F., & Michael, M. S. (2019). Optimal education policy and human capital accumulation in the context of brain drain. JODE - Journal of Demographic Economics, 85(December (4)), 271–303.

Docquier, F., & Marfouk, A. (2004). Measuring the international mobility of skilled workers (1990-2000): Release 1.0. Policy Research Working Paper Series 3381. The World Bank, (Aug).

Docquier, F., & Rapoport, H. (2012). Globalization, brain drain, and development. Journal of Economic Literature, 50(September (3)), 681–730.

Edwards, A. C., & Ureta, M. (2003). International migration, remittances, and schooling: Evidence from El Salvador. Journal of Development Economics, 72(2), 429–461, 14th InterAmerican Seminar on Economics.

Fine, R. (1996). Increasing returns, migrations and convergence. Journal of Development Economics, 49(April (1)), 121–136.

Freund, C., & Spatafora, N. (2008). Remittances, transaction costs, and informality. Journal of Development Economics, 86(June (2)), 356–366.

Galer, O., & Zeira, J. (1993). Income distribution and macroeconomics. The Review of Economic Studies, 60(1), 35–52.

Gibson, J., Mckenzie, D., & Rohorua, H. (2006). How cost elastic are remittances? Estimates from tongan migrants in New Zealand. Pacific Economic Bulletin, 21(05).

Gupta, S., Pattillo, C. A., & Wagh, S. (2009). Effect of remittances on poverty and financial development in sub-saharan Africa. World Development, 37(1), 104–115.

Hines, A. L., & Simpson, N. B. (2019). Migration, remittances and human capital investment in Kenya. Economic Notes, 48(3), Article e12142.

Imai, K. S., Gaiha, R., Ali, A., & Kaecker, N. (2014). Remittances, growth and poverty: New evidence from Asian countries. Journal of Policy Modeling, 36(3), 524–538.
Jamal Bouoiyour, A. M. (2015). Migration, remittances and educational levels of household members left behind: Evidence from rural Morocco. European Journal of Comparative Economics, 12(July (1)), 21–40.

Jena, F. (2018). Migrant remittances and physical investment purchases: Evidence from Kenyan households. The Journal of Development Studies, 54(2), 312–326.

Johnstone, D. B., & Aemero, A. (2001). The applicability for developing countries of income contingent loans or graduate taxes, with special consideration of an Australian HECS-type income contingent loan program for Ethiopia. Mimeo.

Kapri, K., & Ghimire, S. (2020). Migration, remittance, and agricultural productivity: Evidence from the Nepal living standard survey. World Development Perspectives, Article 100198.

Katz, E., & Rapoport, H. (2005). On human capital payment with exit options. Journal of Population Economics, 18(06(2)), 267–274.

Khraiche, D. (2011). Students struggle to pay tuition fees despite facilities offered by banks. In The daily star. Retrieved from https://www.dailystar.com.lb/News/Lebanon-News/2011/Feb-21/61928-students-struggle-to-pay-tuition-fees-despite-facilities-offered-by-banks.ashx

KNOMAD. (2017). Migration and remittances: Recent developments and outlook. Migration and Development Brief, 28.

Mayr, K., & Peri, G. (2008). Return migration as a channel of brain gain. Working Paper 14039. National Bureau of Economic Research Bulletin on Aging and Health (May).

Mesnard, A. (2004). Temporary migration and capital market imperfections. Oxford Economic Papers, 56(April (2)), 242–262.

Miyagiwa, K. (1991). Scale economies in education and the brain drain problem. International Economic Review, 32(August (3)), 743–759.

Mountford, A. (1997). Can a brain drain be good for growth in the source economy? Journal of Development Economics, 53(August (2)), 287–303.

Opperman, P., & Adjasi, C. K. D. (2019). Remittance volatility and financial sector development in Sub-Saharan African countries. Journal of Policy Modeling, 41(2), 336–351.

Otiene, W. (2004). Student loans in Kenya: Past experiences, current hurdles, and opportunities for the future. Journal of Higher Education in Africa, 2(2).

Salas, V. B. (2014). International remittances and human capital formation. World Development, 59, 224–237.

Stark, O., Helmenstein, C., & Prskawetz, A. (1997). A brain gain with a brain drain. Economics Letters, 55(August (2)), 227–234.

Stark, O., Helmenstein, C., & Prskawetz, A. (1998). Human capital depletion, human capital formation, and migration: A blessing or a “curse”. Economics Letters, 60(September (3)), 363–367.

Stark, O., & Zakharenko, R. (2012). Differential migration prospects, skill formation, and welfare. Review of International Economics, 20(4), 657–673.

Taylor, J. E., Rozelle, S., & de Brauw, A. (2003). Migration and incomes in source communities: A new economics of migration perspective from China. Economic Development and Cultural Change, 52(October (1)), 75–101.

Vidal, J.-P. (1998). The effect of emigration on human capital formation. Journal of Population Economics, 11(4), 589–600.

Wong, K., & Yip, C. K. (1999). Education, economic growth, and brain drain. Journal of Economic Dynamics & Control, 23(5), 699–726.

Woodhall, M. (2007). Funding higher education: The contribution of economic thinking to debate and policy development. Education working paper series 8, The World Bank.

Worth, R. (2009). Laid-off foreigners flee as Dubai spirals down. The New York Times. Retrieved from https://www.nytimes.com/2009/02/12/world/middleeast/12dubai.html

Yang, D. (2008). International migration, remittances and household investment: Evidence from philippine migrants’ exchange rate shocks. The Economic Journal, 118(528), 591–630.

Yang, D. (2011). Migrant remittances. The Journal of Economic Perspectives, 25(September (3)), 129–152.

Yizengaw, T. (2007). Implementation of cost sharing in the ethiopian higher education landscape: Critical assessment and the way forward. Higher Education Quarterly, 61(2), 171–196.