The impact of remittances on savings, capital and economic growth in small emerging countries

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Abstract

This paper uses an OLG model in order to capture the economic and demographic effects of remittances in small open economies. We describe household decisions on education and savings, where elderly people receive remittances and domestic transfers from their children. Due to a boost in returns from human capital investments as well as higher levels of productivity elsewhere, remittances increase education at the expense of domestic savings. A significant negative correlation is thus found between domestic savings and remittances in a large set of countries. The model also predicts inverted U-shaped curves between remittances and economic growth because of this substitution effect. Furthermore, we conduct a counterfactual analysis on five Caribbean islands, which shows that different strategies regarding domestic transfers and remittances may be successful in fostering growth, depending on the scale of migration or the transfer rate.[1]

Keywords: Migration, Capital Stock, Endogenous Fertility, Overlapping Generations Model, Caribbean, Small Island Developing States, Development Economics.
JEL classification: F63, F24, J24, J11, O11, O15, O54.

Highlights

- Consumption by elderly people depends on future remittances from their offspring.
- Migration increases human & physical capital stocks and economic growth.
- Migration induces a substitution effect between savings & human capital.
- Economic growth may be enhanced through remittance or domestic transfers controls.

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1. Introduction

Between 2016 and 2017, the worldwide stock of 250 million international migrants generated more than $600 billion in remittance flows–defined as transfers of money between migrants and their family in a domestic area–about three-quarters of which benefited developing and emerging economies (KOMAD, 2016; Clemens, 2017). This is due to the fact that 70% of the international migrant stock comes from these countries. Although there are definite effects of remittances on recipient countries, the literature has failed to reach a consensus regarding their magnitude or net effect. On the one hand, remittances can provide funding for economic development in the form of increased investment in human capital or relaxed credit constraints for further physical capital accumulation. On the other hand, several studies have found insignificant or even adverse effects–*e.g.,* the Dutch disease (Acosta et al., 2009), increased informality (Brown et al., 2013; Opperman and Adjasi, 2019; Raza and Jawaid, 2014), or high capital volatility (Imai et al., 2014; Nyamongo et al., 2012).

This paper focuses on the key features of the interactions among remittances, savings, education spending and economic growth. We address two main issues. First, the literature provides comprehensive insights into the relationship between remittances and financial development or human capital accumulation. Nevertheless, these insights are insufficient with respect to agent behavior in migration-sending countries. Indeed, if remittances are to be considered a benefit from migration in those areas, they could affect relative trade-offs for domestic savings–and thus potential investments–for a household. Second, while there are several empirical studies, there is only a handful of papers based on a theoretical analysis of the incentives created by remittances, and even then, they do not scrutinize the savings channel, and focus instead on education spending (Marchiori et al., 2008; Mountford and Rapoport, 2011).

The main goal of this work is therefore to fill the gaps in the relationship between remittances and domestic savings by answering the following crucial questions. What are the impacts of remittances on savings in the sending area? Do remittances promote economic growth?

To achieve this objective, we formulate a theoretical framework designed to assess the impact of migration on savings as well as on education–*e.g.,* because it changes the potential remuneration of human capital. The overlapping generations (OLG) models are well-suited to address the dynamics of capital accumulation, economic growth and demographic structures affected by intergenerational choices, such as education spending (Del Rey and Lopez-Garcia, 2016; Docquier et al., 2007; Schoonbroodt and Tertilt, 2014). Moreover, they are often used in the study of migration and remittances (Beine et al., 2001; Delogu et al., 2018; Docquier et al., 2008; Marchiori et al., 2008).

The proposed OLG model is kept as tractable as possible to underscore its main results. First, it provides clear insights into household choices in terms of savings and education, knowing that migration is considered as a family strategy (Beine et al., 2011, Mountford and Rapoport, 2011). In our model, parents set their education investment schedule based on expected returns from intergenerational transfers when they grow into old age. As a result, there is no direct link tying remittances to domestic savings in the model. Nevertheless, the positive effects that remittances have on human capital can accelerate capital stock accumulation through the income effect from which the household benefits. The model also describes the dual intertemporal tradeoff on household consumption schedules and pensions through capital investment or expected remittances from offspring.

Our model is then checked against the data on a large array of countries to test its main findings on the interactions between remittances and savings. The next step of our analysis is then to focus on a smaller set of countries from the Caribbean to refine our analysis further. Five Caribbean islands–Barbados, the Dominican Republic, Haiti, Jamaica, and Trinidad and Tobago–are scrutinized because of their characteristics. First, they exhibit a substantially large share of highly educated individuals in their migration, according to KOMAD (2016).[2] Second, demographics in the Caribbean have been characterized by a negative migration balance, while remittances represent a large share of the region's GDP relative to other developing and emerging economies. We conduct a counterfactual analysis to study the impact of migration policies on the remittances and the migration rate. Some of these policies have been originally implemented in sending countries with a high level of migration and remittances–*e.g.,* in Asian countries (Athukorala, 1993b,a; Desai et al., 2004).

Owing to the theoretical model laid out in this paper, we find that migration has a positive impact on education expenditure, human capital stock and production *per capita*. This result is in line with those of Beine et al. (2006) and Docquier et al. (2008). Nevertheless, there is a strong substitution effect induced by migration gains between returns from domestic savings and those of investments in human capital. Consequently, migration can adversely affect physical capital accumulation when the substitution effect induced by remittances dominates over the income effect in the economy. As a result, migration can lead to a smaller investment in physical capital, which affects output in the long run. Consequently, one should expect a negative correlation between remittances and domestic savings but not necessarily between the former and capital stock. This mechanism could explain why the effect of remittances on financial development and on economic growth in general is so difficult to characterize through the analysis of the data. Thanks to the analytical exercise, we are able to define three conditions, on the scale of migration, the net gain from migration as well as the level of family transfers to define which effect will be higher: the negative effect through the substitution of savings by education spendings, or the positive one with the increase in human capital in the economy and potentially ins physical capital.

The empirical evidence corroborates the predictions described earlier. We report a statistically significant negative correlation between domestic savings and remittances after controlling for a large array of factors. Further, we apply a counterfactual analysis to

[2]Individuals with a tertiary education account for 48% to 75% of their migration outflows.

make predictions as to how policymakers can regulate migration and flows of remittances to achieve their policy objectives in a reduced sample. This numerical analysis shows that the Dominican Republic, Haiti and Jamaica have developed a migration strategy that leads to a higher stock of units of efficient labor, while Barbados and Trinidad and Tobago invest more in physical capital because the gains from migration are comparatively smaller. We find that countries with high emigration rates or high potential gains from migration are so dependent on incoming flows of remittances that they have only two paths to increase their long-term economic growth. They would either rely exclusively on foreign intergenerational remittances, or reduce their emigration rate enough to reverse the substitution effect in favor of capital accumulation. When these countries become fully dependent on remittances while decreasing domestic intergenerational transfers, they should not capture all of the diaspora income because of the negative effects from substitution among domestic savings and education expenditures. The second case is when they can decrease their emigration rate to reduce the substitution effect, though that may hamper their economic growth. Among all three countries, specialization in migration is high enough that they would lose all other development opportunities, should they maintain their current migration structure. In other countries where migration incentives are not high enough, the reverse is true. International transfers do not generate an income effect, and policymakers should increase domestic intergenerational transfers while capturing as much of the diaspora remitted income as possible.

Consequently, the contribution to the literature is threefold in our paper. First of all, we participate to the debate over effects of remittances on economic growth, and outline conditions for migration in order to benefit from those transfers. Second, by using an OLG model, we are able to describe the incentives induced by remittances on domestic savings as well as on physical capital stock. The literature has indeed explored such a dynamic for education spendings and human capital (see Docquier and Rapoport (2012) for a literature review). This allows to describe in a tractable manner the mechanisms at play in the interactions between remittances and savings. To the best of our knowledge explicit characterization of this interaction is not done as yet. Finally, we are able to test potential gains measured in economic growth that stem from policies on remittances for suitable countries, thanks to numerical simulations.

The remainder of this paper is structured as follows. Section 2 presents the related literature on remittances. Section 3 introduces the modified OLG model. Section 4 highlights key results through equilibrium analysis, while Section 5 describes empirical relations related to the model conclusions. Section 6 discusses the array of migration policies Caribbean SIDS policymakers can pursue to boost economic growth.

2. Related literature

In this section, we present a compendium of literature on remittances. Their importance cannot be overstated, since they account for a third of all international capital flows, and represent the second-largest flows of capital across the world (Yang, 2011). Subsequently, a growing body of literature has focused on the impact they have on economic development and, more particularly, on capital markets in receiving countries. However, the mostly empirical literature has yet to reach a clear-cut consensus on the magnitude of this impact.

Indeed, numerous papers find that remittances have positive effects on economic growth through direct or indirect impacts. Remittances can be used directly to fund the economy or to relax the credit constraint in the domestic country (Adams and Cuecuecha, 2010; Giuliano and Ruiz-Arranz, 2009; Osili, 2007; Poirine, 1997; Woodruff and Zenteno, 2007; Yang, 2008). Furthermore, reductions in poverty (Adams and Page, 2005; Anyanwu and Erhijakpor, 2010; Gupta et al., 2009) or in inequalities (Bang et al., 2016; Li and Zhou, 2013) are observed in high-recipient countries. In addition, by relaxing the budget constraint, further resources can be brought to bear for funding education expenditure (Acharya and Leon-Gonzalez, 2014; Adams and Cuecuecha, 2010; Alcaraz et al., 2012; Azizi, 2018; Bansak and Chezum, 2009; Calero et al., 2009; Salas, 2014) or in health spending (Amuedo-Dorantes and Pozo, 2011; Azizi, 2018). As a result, remittances can enhance labor productivity (Mamun et al., 2015) and thus result in improvements in economic growth.

Moreover, those are also supposed to improve financial development (Aggarwal et al., 2011; Chowdhury, 2011; Demirgüç-Kunt et al., 2011; Gupta et al., 2009; Fromentin, 2017). Indeed, improvements in the financial system of developing countries are required to address increasing capital flows. As a result, remittances are positively correlated with the number of banking agents and bank accounts per inhabitant in some developing countries. In turn, these indicators of financial development are positively correlated with economic growth and development.

Nevertheless, the numerous identification issues surrounding the determinants of economic growth, set another body of literature on quantifiying the positive effects of remittances according to a specific set of conditions. Sobiech (2019) in particular finds that remittances bolster economic growth during the early stages of financial development. As the financial sector expands and gains in complexity a substitution effect between capital markets and remittances is possible. For instance, Combes and Ebeke (2011) find that remittances - expressed as a percentage of GDP- provide macroeconomic stabilization to the receiving country, up to 6%. There is a more recent body of literature which focused on the relationship between investment and remittances. In addition to Sobiech (2019) and the index for financial development which she developed to assess the effects of remittances on economic growth, Rao and Hassan (2011) are skeptical that remittances exert significant effects on economic growth, though they exclude investment as a possible channel. By contrast, Clemens and McKenzie (2018) raise methodological issues with measurement of remittance and their effects on economic growth.

We focus in our paper on the interactions between remittances and economic growth, and how the accumulation of physical and human capital affects their interplay. However, instead of an empirical approach as in the papers described above, we adopt a theoretical perspective. In this context, our work is related to theoretical analysis, and more specifically to OLG models, that study migration and remittances. Since the seminal work of Miyagiwa (1991) and Mountford (1997), to the more recent papers by Marchiori et al. (2008), Marchiori et al. (2010) or Mountford and Rapoport (2011), general equilibrium models and more specifically OLG models have been used to describe the consequences of the migration (as a family strategy) on the brain drain. In these papers several stylized models are developed in order to study the interactions between migration and economic growth. These models are then calibrated, in order to predict household preferences in terms of education and child-rearing, subject to potentiel effects from remittances and migration dynamics. The simulated outcome seeks to check whether the household decision-making is affected as a result. For instance Marchiori et al. (2008) studies the interplay between education expenditure and the remittances. He finds that remittances enhance human capital accumulation and economic growth if the cost of children is high enough in order to observe increases in human capital instead of fertility. While Mountford and Rapoport (2011) conducts a similar analysis for a two countries model. He finds in that case, that skilled migration was likely to increase the divergence between developed and developing countries for the income. While our paper embraces a similar topic, we adopt a narrower perspective, one that look at the tradeoff between domestic savings–and thus, investment through physical capital accumulation–and education spending. In contrast to the literature mentioned above, we cast aside considerations on fertility and demographics, and focus on a more tractable framework. We focus on a particular aspect of the relationship between remittances and economic growth, through human and physical capital accumulation.

3. The Model

This section presents an OLG model, with discrete time indexed by $t = 0, 1, 2, ..., +\infty$. OLG models are described extensively in de la Croix and Michel (2002) and are convenient for studying intergenerational transfers. In this paper, we use a tractable model in which we focus on household behavior with respect to savings, consumption and children education.

3.1. Firm behavior

The production of the composite good is carried out by a representative firm in our economy. Output is produced according to a constant returns-to-scale technology:

$$Y_t = AK_t^{\alpha} (L_t h_t)^{1-\alpha} \tag{1}$$

where K_t is the aggregate stock of physical capital, $L_t h_t$ is the aggregate efficient labor stock, $A > 0$ measures the technology level, and $\alpha \in (0, 1)$ is the share of physical capital in the production. Defining $y_t \equiv \frac{Y_t}{L_t h_t}$ and $k_t \equiv \frac{K_t}{L_t h_t}$, respectively, as the production and the capital to units of efficient labor ratio, we write the following:

$$y_t = Ak_t^{\alpha} \tag{2}$$

The firm profit is as follows:

$$\Pi_t = AK_t^{\alpha}\left(L_t h_t\right)^{1-\alpha} - w_t h_t L_t - R_t K_t \tag{3}$$

where w_t is the wage for one unit of efficient labor and $R_t \equiv 1 + r_t$ is the return factor of capital.

Assuming that the capital fully depreciates in one period, the factor prices are as follows:

$$w_t = A(1-\alpha)K_t^{\alpha}\left(L_t h_t\right)^{-\alpha} = A(1-\alpha)k_t^{\alpha} \tag{4}$$
$$R_t = A\alpha K_t^{\alpha-1}\left(L_t h_t\right)^{1-\alpha} = A\alpha k_t^{\alpha-1} \tag{5}$$

3.2. Family behavior

The representative household lives through three periods: childhood, adulthood, and old age. At t, a new generation of nN_t homogenous agents is born, where n is the exogenous number of children per household. We denote the emigration rate by $\rho \in [0, 1[$. Migration implies that only $(1-\rho)nN_t$ children stay in the domestic country after childhood. The other $\rho n_t N_t$ children migrate to countries where wages are greater. The evolution of the size of the adult generation is given by the following equation:

$$N_{t+1} = nN_t(1-\rho) \tag{6}$$

Individuals born in $t-1$ care about their adult consumption level c_t and their old-age consumption level d_{t+1}, according to the psychological discount factor β. Agents' preferences are represented by the following utility function:

$$U(c_t, d_{t+1}) = \ln(c_t) + \beta \ln(d_{t+1}) \tag{7}$$

During childhood, individuals are reared by their parents and do not make any decisions. If they remain in their home country as adults, they supply one inelastic unit of labor, remunerated at wage w_t, per unit of human capital h_t. Adults transfer a fraction γ of their revenue to their parents, regardless of their country of residence. They allocate the rest of their income to consumption, c_t, savings, s_t and children's education ne_t. Adults who have migrated also transfer the same share γ of their revenue to their parents. However, they can claim a higher wage in their country of residence, which we posit is proportional to the domestic wage, such that $w_t^F \equiv \varepsilon w_t$, where $\varepsilon > 1$ denotes the net gain from migration. In our economy, incoming cash flows from migrants are remittances, while transfers from domestic workers are simply intergenerational transfers. We assume that the migrants are not economically active in the domestic country, except for the remittances sent to their parents. Therefore, we only study the parents' tradeoff between savings and investments in children (through education and fertility), knowing that a fraction ρ of the new generation will leave the country and will transfer a larger cash amount. The budget constraint in the first period is given by the following:

$$c_t + s_t + ne_t = w_t h_t(1-\gamma) \tag{8}$$

When they are old, agents only consume their savings remunerated at the return factor R_{t+1} and the intergenerational transfers sent by their children, wherever they live. That said, there are two tradeoffs in this model; the first one concerns present versus future consumption. In addition, they must choose between savings or transfers–through human capital investments–to finance their consumption when old. The budget constraint in the second period is written as follows:

$$d_{t+1} = s_t R_{t+1} + n\gamma(1-\rho)w_{t+1}h_{t+1} + n\gamma\rho\varepsilon w_{t+1}h_{t+1} \tag{9}$$

We denote $\Lambda_h \equiv \gamma(1-\rho+\rho\varepsilon)$ as the share of income transferred to the elderly parents. It is positively correlated to ε, ρ and γ which denote respectively the net gain from migration, the emigration rate and the intergenerational transfers rate.

Finally, human capital per child, h_{t+1}, depends on education expenditures per child, e_t, and on parents' human capital h_t:

$$h_{t+1} = \theta h_t^{1-\mu} e_t^{\mu} \tag{10}$$

where $\theta > 0$ is the efficiency of human capital accumulation and $0 < \mu < 1$ represents the efficiency of education. Note that, here, corner solutions are possible since there are two different forms of investments. However, we choose not to pay attention to them because $e_t = 0$ would bring the stock of human capital to 0; thus, we set the following condition: $e_t > 0$.

Some elements deserve a further discussion in our model. First, the demographic structure in the economy is given, and the household focuses only on consumption, education expenditure and savings. It is therefore possible to conclude that the household faces a mandatory substitution tradeoff between remittances and the savings. In addition, a positive effect from the migration on the capital stock can be observed, thanks to an increase in the human capital. Second, the countries our model seeks to describe are small, open economies. However, in order to focus on the substitution effects between human and physical capital accumulation, we abstract all aspects related to foreign trade, as well as capital flows other than remittances. Finally, we introduce an equality between the relative proportion in the revenue of the intergenerational transfers from the migrants and non-migrants. Indeed, for the sake of simplicity, we assume that the proportion of revenue sent to parents is the same, regardless of the children's location. This assumption allows us to formulate tractable analytical results on the impact of intergenerational transfers. Nevertheless, we also test the impact of differentiated γ according to the location of the children in the section devoted to numerical analysis.

The consumer program is summarized by the following:

$$\begin{array}{lrcl} & \max\limits_{s_t,e_t} U(c_t, d_{t+1}) & = & \ln(c_t) + \beta \ln(d_{t+1}) \\ s.t & c_t + s_t + ne_t & = & w_t h_t (1-\gamma) \\ & d_{t+1} & = & s_t R_{t+1} + n\gamma(1-\rho)w_{t+1}h_{t+1} + n\gamma\rho\varepsilon w_{t+1}h_{t+1} \\ & h_{t+1} & = & \theta h_t^{1-\mu} e_t^{\mu} \end{array}$$

The first-order conditions (FOCs) are given by the following equations:

$$\frac{1}{c_t} = \frac{\mu n \beta w_{t+1} h_{t+1} \gamma (1-\rho+\rho\varepsilon)}{d_{t+1} e_t} \quad (11)$$

$$\frac{1}{c_t} = \frac{\beta R_{t+1}}{d_{t+1}} \quad (12)$$

The optimality condition for education is derived by equating both first order conditions stated above. The optimal level of education expenditure is such that the household is indifferent between future returns from transfers–domestic and remittances–which are commensurate to future wages $w_{t+1}h_{t+1}$ and returns from investment, denoted R_{t+1}.

$$e_t^\star = \frac{\mu\gamma(1-\rho+\rho\varepsilon) w_{t+1} h_{t+1}}{R_{t+1}} \quad (13)$$

Introducing the optimal education choice, as well as the budget constraints in the FOC with respect to the savings (equation (12)) gives directly the household optimal choice in terms of savings.

$$s_t^\star = \frac{1}{1+\beta}\left[w_t h_t \beta (1-\gamma) - (1+\beta\mu) \frac{n\gamma(1-\rho+\rho\varepsilon) w_{t+1} h_{t+1}}{R_{t+1}} \right] \quad (14)$$

The analysis of the individual choices are quite simple. Indeed, here it appears that education is positively correlated to the migration rate, the net gain from migration and the intergenerational transfer rate. Moreover, education spendings increase with the efficiency of education. On the contrary, optimal savings decrease in the opportunity cost of education expenditure, which depends on wages collected by future generations and all the parameters in Λ_h, while savings are increasing in wages net of intergenerational transfers γ.

4. Equilibrium

4.1. Intertemporal equilibrium

The Market Clearing Conditions (MCC) for capital and the efficient units of labor are given, respectively, by equation (15) and (16).

$$K_{t+1} = s_t N_t \quad (15)$$

$$N_{t+1} h_{t+1} = n N_t \theta h_t^(1-\mu) e_t^\mu \quad (16)$$

The values of the household's optimal choices s_t^* and e_t^* are given in equations (14) and (13). The wage and return factor on capital correspond, respectively, to (4) and (5). After some computations, we can rewrite the choices made by the household as:

$$e_t^\star = \frac{1}{n} \frac{\beta\mu\Lambda_h(1-\alpha)}{\alpha(1-\rho)(1+\beta) + \Lambda_h(1-\alpha)(1+\beta\mu)} (1-\gamma) w_t h_t \quad (17)$$

$$s_t^\star = \frac{\beta\alpha(1-\rho)}{\alpha(1-\rho)(1+\beta) + \Lambda_h(1-\alpha)(1+\beta\mu)} (1-\gamma) w_t h_t \quad (18)$$

At this point, it is worth mentioning that any substitution effect mentioned earlier is largely offset by an income effect, captured by $(1-\gamma)w_t h_t$. The larger the income share transferred to the elderly, the smaller available income for spending for active adults.

Proposition 1. *Given the initial conditions $K_0 > 0$, $N_0 > 0$ and $h_0 > 0$, the intertemporal equilibrium is the sequence (K_t, N_t and h_t) that satisfies the following system $t \geq 0$:*

$$\begin{cases} K_{t+1} &= \Psi\alpha(1-\rho)K_t^{\alpha}(L_t h_t)^{1-\alpha} \\ N_{t+1}h_{t+1} &= n^{1-\mu}(1-\rho)\theta[\Psi\mu\Lambda_h(1-\alpha)]^{\mu}K_t^{\alpha\mu}(L_t h_t)^{1-\alpha\mu} \end{cases} \tag{19}$$

where $\Psi \equiv \left[\frac{\beta A(1-\alpha)(1-\gamma)}{[\alpha(1-\rho)(1+\beta)+\Lambda_h(1-\alpha)(1+\beta\mu)]}\right]$

Therefore, the capital to efficient units of labor ratio k_t can be defined as follows:

$$k_{t+1} \equiv \frac{K_{t+1}}{N_{t+1}h_{t+1}} = \alpha\theta(\mu\Lambda_h)^{\mu}(n\Psi)^{1-\mu}k_t^{\alpha(1-\mu)} \tag{20}$$

We define g_t^{Nh} and g_t^{K}, respectively, as the growth of the stocks of efficient units of labor and physical capital in this economy.

$$g_t^{Nh} = \frac{N_{t+1}h_{t+1}}{N_t h_t} \tag{21}$$

$$g_t^{K} = \frac{K_{t+1}}{K_t} \tag{22}$$

Because of the accumulation of human capital, there is no steady state in this economy but a balanced growth path (BGP).

Proposition 2. *On the BGP, the system satisfies the* ***Proposition 1*** *and the stock of physical and efficient units of labor grows at the same constant rate $g_{BGP} = g_t^K = g_t^{Nh}$; therefore, $k_t = k_{BGP}$ is constant. There is a unique locally stable equilibrium for which the values of k and g are as follows:*

$$k_{BGP} = \left[\frac{\alpha}{\theta[\mu\Lambda_h(1-\alpha)]^{\mu}}\left(\frac{\Psi}{n}\right)^{1-\mu}\right]^{\frac{1}{1-\alpha(1-\mu)}} \tag{23}$$

$$g_{BGP} = \Psi\alpha(1-\rho)k_{BGP}^{\alpha-1} \tag{24}$$

Proof of the stability of the equilibrium. See Appendix A. □

We introduce a new variable which is the growth rate of the production per inhabitant ($\hat{g}_{BGP}$). This variable is related to the long term growth rate of the consumption per inhabitant and thus to the gain in terms of utility. Therefore, we have:

$$\frac{Y_{t+1}}{nN_{t+1}+N_{t+1}+N_t}\frac{nN_t+N_t+N_{t-1}}{Y_t} \equiv \frac{g_{BGP}}{n(1-\rho)} \tag{25}$$

where $nN_{t+1}+N_{t+1}+N_t$ is the total population at the period $t+1$ and $nN_t+N_t+N_{t-1}$ is the population at the period t.

Finally, we conduct a comparative statics analysis to evaluate the effect of the different parameters on the ratio of capital to units of efficient labor, the growth rate of the economy as well as the growth rate of the consumption. First, we consider the effects of the different parameters on the capital to units of efficient labor ratio, k_{BGP}, which is given by the equation (23).

Proposition 3. *On the BGP, there is a negative correlation between k_{BGP} and the net gain from migration, ε, and the intergenerational transfer rate, γ. The technological factor, A, and the psychological discount factor, β, have a positive effect on k_{BGP}. Finally, the effect of the migration rate, ρ, is ambiguous.*

Positive effects from A and β result, respectively, from the increase in production due to a better productivity and from the increase in savings due to a higher preference for the future. The net gain from migration, ε and γ can be observed directly in the term Ψ in equation (19). They have negative effect on capital stock which come from the substitution effect between education and savings that leads to an increase in education expenditures at the expense of the savings. In that context, human capital increases faster than the capital stock and the economy becomes more intensive in units of efficient labor. Finally, the ambiguous effect from the migration rate which is demonstrated in the Appendix B.1, is due to the decrease in population size that occurs with a higher migration. Therefore, even if education expenditures increase with a higher migration, and thus lead to a higher human capital, the reduction in population might lead to an increase in the capital per unit of efficient labor.

Second, we investigate how the growth of the economy, g_{BGP}–given by equation (24)– responds to a change in the different parameters of the model.

Proposition 4. *On the BGP, the economic growth, g_{BGP}, is positively impacted by the technology factor, A, the preference for the future, β, the efficiency of human capital accumulation, θ, and the population growth rate. The effect of the other parameters, ρ, γ and ε are ambiguous.*

Analytical expressions of the conditions are given in the Appendix B.2. First, there are some intuitive results that are in line with the literature. A rise in the technological factor, A, or in the efficiency of human capital accumulation, θ, increases the efficiency of the economy and thus leads to stronger economic growth on the BGP. An increase in β, the preference for the future, results in higher investments in the future through human capital or savings and subsequently to an increase in economic growth. Second, the effect of migration are quite difficult to distinguish analytically. Indeed, the growth rate of the economy will increase with migration features, if the increase in human capital is large enough to compensate the reduction in capital per units of efficient labor. Moreover, if the migration rate is higher, the size of the economy is reduced, because the population decreases.

Finally, the growth rate of the production per inhabitant, $\hat{g}_{BGP}$, is studied according to the number of children per household and the emigration rate–the impact of the other parameters are the same than for the economic growth. The growth of the production *per capita* will be reduced if the number of children per household is higher. While the effect of the migration rate is still ambiguous, however it is more likely to be positive, because migration reduces the growth of the population size.

In conclusion, in these economies, if our findings hold, it is possible to have a negative impact on economic growth from remittances because of the effect on the capital market. Indeed, in some cases, the investments in intergenerational transfers induced by migration or remittances can be too high and thus lead to a strong substitution to domestic savings. Thus, the next step of our analysis is to test these intuitions, which constitute key elements to draw a conclusion on the growth impact of migration.

5. Empirical evidence

The theoretical analysis laid out above shows that remittances have an ambiguous effect on migration. In this section, we formulate a specification designed to check the empirical basis of the tradeoff between remittances and domestic savings. Indeed, several papers such as Acosta (2011), Adams and Klobodu (2016), Coulibaly (2015) and Rao and Hassan (2011) show that the effects of remittances are either very small or statistically insignificant. In this section we intent to give a first insight of an empirical analysis of the effects described in the model. To that effect, we use data from the World Bank's World Development Indicator (WDI) as well as the Groningen Growth and Development Centre database (PWT) to build a sample set of 141 countries. Their long-run averages are computed for the period 1961-2014 or any available data points within that time period. The specification in equation 26 describes domestic savings as a function of the variables that are relevant for the model. The specification is written as follows:

$$S_i^d = \alpha_0 + \alpha_1 Remitt_i + \alpha_2 HC_i + \alpha_3 Kap_i + X_i'\delta + \varepsilon_i \tag{26}$$

Domestic savings S^d are regressed on remittances (expressed in logged real 2005 \$), the human capital index, physical capital stock (in logged terms), and additional explanatory variables in vector X_i'. This vector incorporates variables for relative wealth measured through the GDP ratio of each country in the sample set relative to average OECD real GDP *per capita*, foreign capital flows, and demographic indicators–*i.e.* migration scale and flows–whether it is immigration or emigration. All specifications account for a substantial share of variance in the savings among the sample set: the adjusted R^2 values range from 0.906 to 0.926. The balance effect of migration is captured by the dummy variable "Sign", which takes the value of 1 if the migration balance is negative and 0 otherwise. The monetary variables are all expressed in logarithmic terms.

All specifications (1) through (5) show that remittances and domestic savings are negatively correlated, which is in line with our model's predictions. The estimated coefficients vary slightly from one specification to the other, but they remain statistically significant: in real terms, a 1% increase in remittances expressed is associated with a decline in savings ranging from -2.2% to -6.1%. Such an explanation is further bolstered by the estimated coefficient for human capital–the index correlates negatively with domestic savings. The higher the returns from human capital are, the lower the incentive to save.

In contrast, there is a positive relationship between domestic savings and physical capital stock. The estimated coefficient is positive and fits well with our predictions that higher capital stock correlates with higher levels of domestic savings. The estimated coefficient declines significantly–without losing its statistical robustness–in specifications (3) through (5), which means that the capital stock is affected by other explanatory variables in these specifications. Physical capital elasticity depends on the specification, as it ranges from 0.56 to 1.38. The interaction effect between physical and human capital is positive and statistically significant. This lends credence to the underlying assumption of increasing returns to physical capital per capita, owing to the education effects on human capital.

Relative GDP is computed as the ratio of real GDP to OECD-wide average real output. There are decreasing returns in domestic savings. The estimated coefficient remains statistically significant and robust to all three specifications (3) through (5). Finally, the demographic indicators also generate predicted results. Positive net migration–relative to the total population–means that the country receives more than it sends in population flows. This is mainly associated with developed economies whose domestic savings per capita are higher, with all things being equal.

Table 1: Domestic savings: 1961-2014

Variable	(1)	(2)	(3)	(4)	(5)
Remittances	-3.354***	-3.262***	-2.241**	-4.741***	-6.103***
	(1.127)	(1.114)	(1.074)	(1.380)	(2.219)
Human Capital Index	-0.124	-1.515**	-3.193***	-2.314***	-2.314***
	(0.115)	(0.678)	(0.750)	(0.768)	(0.793)
Physical Capital Stock	1.389***	1.134***	0.570***	0.565***	0.571***
	(0.059)	(0.136)	(0.184)	(0.179)	(0.179)
H.C x P.C		0.138**	0.306***	0.230***	0.216***
		(0.066)	(0.074)	(0.075)	(0.077)
Relative GDP			-0.016***	-0.017***	-0.017***
			(0.004)	(0.004)	(0.004)
FDI					0.001
					(0.001)
Net Migration (% Population)				6.189**	7.711***
				(2.399)	(3.089)
Net Migration (sign)				-0.217*	-0.188***
				(0.129)	(0.134)
Intercept	-6.275***	-3.782***	1.955	1.938	1833
	(0.412)	(1.266)	(1.800)	(1.736)	(1.744)
Count	133	133	133	133	133
R2	0.908	0.911	0.922	0.930	0.930
R2 Adjusted	0.906	0.909	0.919	0.926	0.926
RSS	41.567	40.208	35.210	31.633	31.477
RMSE	0.568	0.560	0.527	0.503	0.503
Fisher	426.530	329.227	302.024	238.360	207.999
Log-Likelihood	-111.376	-109.166	-100.339	-93.216	-92.886

Note: WDI and PWT databases. Nonweighted averages are computed over the period 1961-2014 or any available data points within the time period.
Legend: p-value *** p $\leq$ 1%, ** 5% and * 10%.

6. An application to Caribbean SIDS: Numerical analysis

In this section, we discuss the array of migration policies that Caribbean SIDS policymakers can pursue through counterfactual analysis. Policy instruments are defined on a two-dimensional plane, namely, the scale of migration and the amount of received remittances–*i.e.* the values of ρ and γ, respectively. For instance, investing in education can improve emigration since it contributes positively to human capital accumulation and the remuneration abroad. Furthermore, SIDS policymakers can facilitate emigration through stronger diplomatic ties to host countries, facilitate electoral participation of the diaspora, etc. These *emigration* policies have been described comprehensively by Pedroza and Palop-García (2017). In contrast, it is also possible to reduce the net migration rate instead through facilitated return migration due to fiscal deductions and write-offs when foreign funds are repatriated. To increase the flow of received remittances, some countries hold their nationals liable for taxation on their income regardless of their country of residence or subject them to mandatory contributions to the domestic pension system (Athukorala, 1993b,a; Desai et al., 2004). Between the 1970s and 1990s, countries such as the Philippines or India have implemented macroeconomic policies that hinged on labor migration in their bid to enhance economic growth. The stated purpose of such policies was to harness the significant flows in remittances stemming from the large diaspora to accelerate their economic development. Since the 1990s, the diaspora strategy has been studied as a new policy tool in political geography.

Indeed, De Haas (2010) argues that migration in a self-implemented phenomenon by individuals could be inefficient. Therefore, increases in migration gains could be obtained due to public transnational policies based on coordination and cooperation with the diaspora (Agunias and Newland, 2012; De Haas, 2010; Faist, 2008; Mullings, 2012, Pedroza and Palop-García, 2017; Ragazzi, 2014).

In this work, we do not study the implementation of these policies but rather their effects on the long-term growth rate, g_{BGP}. Therefore, in the rest of this section, it will be assumed that these policies are attainable, especially changes in remittance rate and domestic intergenerational transfers. Before changing these parameters, we will study the initial conditions and the different strategies that have been implemented by the five studied islands.

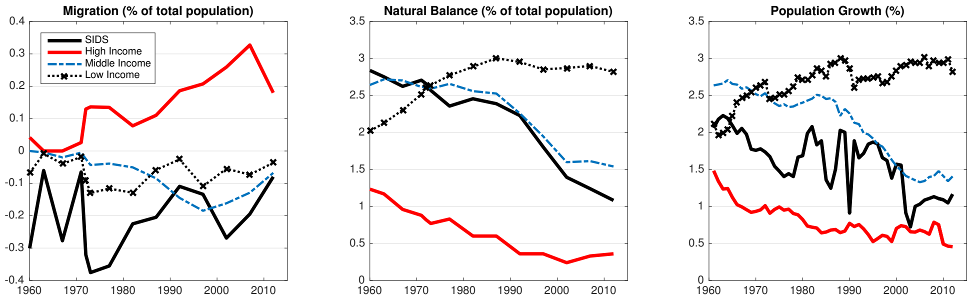
6.1. Caribbean Islands - Features

The theoretical results described in earlier sections highlight the influence of demographics of high-migration countries on their long-run development trend. This section delineates some stylized facts to show that SIDS represent a good benchmark of the economy described in this model and are thus relevant to the migration policies we seek to evaluate. We use data from the World Bank's WDI with a sample of 176 countries over available data points between 1960 and 2014. Figure 1 plots the migration balance, natural balance and population growth in low-income countries, middle-income countries and high-income countries.[3] The demographic features in middle-income countries and SIDS appear to differ widely, while they are the closest in our sample in terms of economic attainments. The islands show a strong negative migration balance, which is almost lower than the net migration from the other groups. This emigration is compensated by a positive natural balance close to the middle-income countries. As a result, population growth in the SIDS is closer to that of high-income countries, which are quite low compared to that of other groups. This figure shows that the migratory component of their demographic dynamics is significant enough to change the population evolution, especially in the last 30 years.

Using a slightly smaller sample set of 149 countries, we then compare received personal

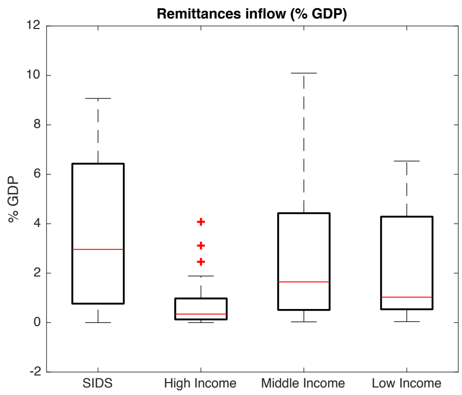
[3] The sample set is broken into three income-based categories using the World bank's ATLAS method. SIDS countries are abstracted from each income bracket, while upper-intermediate and lower-intermediate income groups are consolidated into one category.

Figure 1: Demographic features: SIDS vs. income groups



remittances (relative to GDP) across income groups and SIDS for the period 1961-2014. Figure 2 shows that the islands group exhibits the highest median share at 3% of GDP, followed by middle-income countries and low-income countries at 1.9% and 1% of GDP, respectively. The median of the inflows of remittances in the high income-countries is almost close to 0% of GDP.

Figure 2: Remittances in percentage of GDP: SIDS vs income groups



Due to quality of data issues and to simplify comparisons between the different strategies, not all the SIDS are studied here; rather, only the Caribbean SIDS are studied. Taking the Caribbean islands as a case study here presents several benefits. First, the main difference in their demographic features come from their migration level, knowing that they are all high-emigration countries. Second, they present a stronger homogeneity in terms of diplomatic connections, receiving countries and political statuses compared to the entire group of islands. Third, there are 38 to 58 SIDS according to the United Nations Organization, and half of them are in the Caribbean. Finally, the paper of Pedroza and Palop-García (2017) builds an index of emigration policies for Latin American and Caribbean countries, which shows that, in this region, emigration is a crucial subject of public policy.

The dynamics of individual Caribbean countries are built around numerical values assigned to the model's structural parameters, which go beyond demographic and human capital formation. We calibrate numerical values for each country using macroeconomic data from PWT and WDI datasets. Long-run averages and ratios allow us to specify individual sets of numerical values. We focus on five Caribbean island countries: Barbados, the Dominican Republic, Haiti, Jamaica, and Trinidad and Tobago.

Table 2 reports the model's structural economic parameters, their respective economic interpretations, the support range for credible values and the method used to compute them. The method to calibrate these values is given in Appendix C.

Table 2: Calibrated values for structural parameters - SIDS Caribbean countries.

Parameters	Range	**BRB**	**DOM**	**HTI**	**JAM**	**TTO**
Preference factor for the future	$\beta \in [0,1[$	0.940	0.898	0.894	0.944	0.938
Capital intensity in production	$\alpha \in [0,1]$	0.340	0.361	0.225	0.312	0.208
Technology level	$A > 0$	1.034	1.014	1	1.014	1.038
Population growth	$n > 1$	1.227	2.018	1.929	1.718	1.535
Efficiency - education	$\mu \in [0,1]$	0.130	0.145	0.082	0.162	0.191
Efficiency - HC* accumulation	$\theta > 0$	5.025	5.301	3.863	4.898	4.861
Emigration rate	$\rho \in [0,1]$	0.107	0.159	0.159	0.374	0.218
Net gain from migration	$\varepsilon > 1$	1.91	9.68	51.00	6.58	3.030
Share of income remitted	$\gamma \in [0,1]$	0.121	0.130	0.098	0.200	0.018
Capital stock	K_0	0.021	0.279	0.143	0.335	0.115
Human capital stock	h_0	1.367	0.817	0.631	1.083	1.102
Labor	L_0	0.006	0.092	0.169	0.051	0.028

Note: calibrated values for individual countries use available data points for the period 1961-2014. Initial values for capital stock and labor are given with a factor of 10^6
(*) HC: human capital.
Legend: **BRB:** Barbados. **DOM:** the Dominican Republic, **HTI:** Haiti, **JAM:** Jamaica, and **TTO:** Trinidad and Tobago

6.2. Results

Table 3 reports expressions for capital and growth rate per efficient unit of labor, as well as economic growth at the aggregate level, denoted respectively k_{BGP}, g_{BGP}, and $\hat{g}_{BGP}$. The model predicts that all five economies are driven by the amount of physical capital in the economy as well as the number of units of efficient labor. The respective contributions of these two factors is given by a combination of the structural parameters in the equilibrium equation (equation (20)). In our model, increases in units of efficient labor stock come from higher levels of human capital, the population growth being exogenous. Results reported on table 3 should therefore be interpreted as follows: if k_{BGP} is high, it means that capital accumulation is high as well, when compared to the other islands. If g_{BGP} is high, while k_{BGP} is comparatively small, this means that economic growth is driven during the transitional dynamics by human capital. Finally, if the growth rate *per capita* is much lower than the growth rate of the economy as a whole, it means that most of the latter comes from demographic growth. Consequently, physical and human capital accumulation are too low to make up for population growth.

Table 3 shows that a strategy built around rapid accumulation of human capital yields different outcomes across all five islands. Two countries, Barbados and Trinidad and

Table 3: Values of capital to units of efficient labor ratio and growth on the BGP

	BRB	**DOM**	**HTI**	**JAM**	**TTO**
k_{BGP}	0.036	0.013	0.010	0.015	0.158
g_{BGP}	2.298	3.323	4.086	2.165	1.608
$\hat{g}_{BGP}$	2.097	1.958	2.519	2.013	1.339

Legend: **BRB:** Barbados. **DOM:** the Dominican Republic, **HTI:** Haiti, **JAM:** Jamaica, and **TTO:** Trinidad and Tobago

Tobago, have a significantly higher level of k_{BGP}. Yet the former shows a higher level of economic growth *per capita* than the latter. This is due to the fact that in Trinidad and Tobago, the incentive to invest in human capital is lower than in the other countries, due to lower levels of intergenerational transfer ($\gamma = 0.018$) and comparatively low levels of net gain from migration ($\varepsilon = 3.030$). In Barbados, intergenerational transfer share is high and creates a strong enough incentive to invest in human capital, even if the net gain from migration is the lowest among all five islands ($\varepsilon = 1.91$). By contrast, countries with a higher level of emigration rate exhibit small figures for capital per units of efficient labor. Indeed, there is a high substitution effect in these countries between on the one hand, education spendings and on the other hand, domestic savings, which leads to tower physical capital accumulation relative to the accumulation of human capital. Although growth rates are very high in Haiti and the Dominican Republic, a large part of it is accounted for by population growth, which is respectively $n = 1.929$ and $n = 2.018$. Thus there are significant differences between the growth rate and the growth rate of the variables *per capita*. This is not the case in Jamaica, where the population growth is limited by the high emigration rate which is the highest of the sample with $\rho = 0.374$.

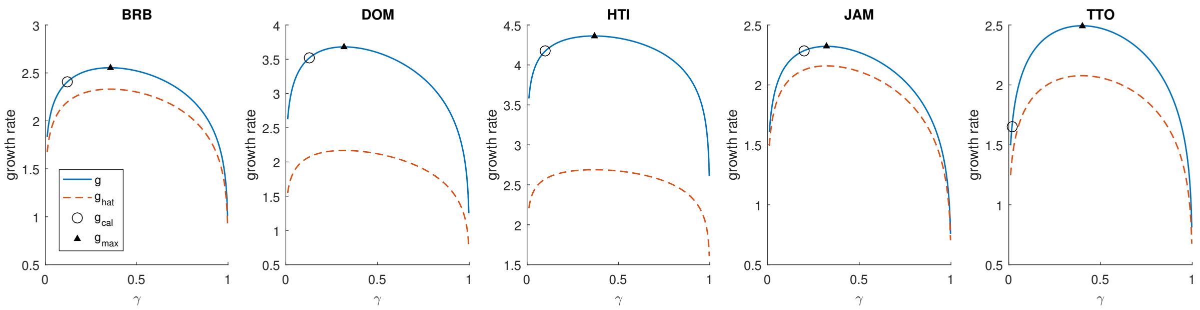
6.3. Counterfactual analysis

We conduct a counterfactual analysis on intergenerational transfers and their impact on economic growth. To that effect, we compute BGP levels of economic growth and *per capita* production growth over all possible values for these parameters and study their impact *ceteris paribus* on economic growth on the BGP.

Figure 3 reports the expected impacts of changes in the value of intergenerational transfers γ regardless of the country of evidence for young adults. All five SIDS countries exhibit the inverted U-shaped curve between intergenerational transfers and economic growth, with different levels of economic growth and curvatures. For small values of γ, there are increasing and concave returns, up to the point where the curve reaches its extremum and then declines to zero as γ gets closer to unity. Though all countries benefit from increasing their economic growth thanks to higher γ parameter values, Trinidad and Tobago stands to benefit the most from an increase in γ. This is mostly due to the latter exhibiting a comparatively lower level of intergenerational transfer rate, and thus a smaller share allocated to education spending and human capital.

Notwithstanding the potential benefits from increasing share of intergenerational trans-

Figure 3: Analysis of the effect of the migration policy on the intergenerational transfers on g^{BGP}: γ



Legend: **BRB:** Barbados. **DOM:** the Dominican Republic, **HTI:** Haiti, **JAM:** Jamaica, **TTO:** Trinidad and Tobago, Opt: optimal value, and Cal: calibrated value.

fers γ to its growth-maximizing level, these results might be misleading. Indeed, parameter γ induces a negative income effect for the adults–since they have to allocate a fraction of their current income to the elderly. The parameter also influences the inter-temporal substitution effect between domestic savings, and education spending. Finally, γ exerts a positive income effect when future human capital is enhanced in the domestic economy. In order to disentangle the three effects, it might be interesting to isolate remittances from domestic intergenerational transfers. Therefore, we take our counterfactual exercise a step further, this time with differentiated values for intergenerational transfers according to the location of the children. We denote γ_d for transfers from the children in the home country and γ_f for remittances. We re-write accordingly the expressions for household optimal choices in the canonical model (equations (17) and (18)). As a result, we obtain the following expressions for the education and the savings (denoted respectively $\bar{e}_t^\star$ and $\bar{s}_t^\star$):

$$\bar{s}_t^* = \frac{\beta\alpha(1-\rho)(1-\gamma_d)}{\alpha(1-\rho)(1+\beta)(1-\alpha)(1+\beta\mu)[\gamma_d(1-\rho)+\varepsilon\rho\gamma_f]} w_t h_t \quad (27)$$

$$\bar{e}_t^* = \frac{1}{n}\frac{\beta\mu(1-\gamma_d)(1-\alpha)[\gamma_d(1-\rho)+\rho\varepsilon\gamma_f]}{\alpha(1-\rho)(1+\beta)+(1-\alpha)(1+\beta\mu)[\gamma_d(1-\rho)+\varepsilon\rho\gamma_f]} w_t h_t \quad (28)$$

Therefore, the equilibrium is modified according to the equations below:

$$\bar{k}_{BGP} = \left[\frac{\alpha}{\theta[\mu\bar{\Lambda}_h(1-\alpha)]^\mu}\left(\frac{\bar{\Psi}}{n}\right)^{1-\mu}\right]^{\frac{1}{1-\alpha(1-\mu)}} \quad (29)$$

$$\bar{g}_{BGP} = \bar{\Psi}\alpha(1-\rho)\bar{k}_{BGP}^{\alpha-1} = n^{1-\mu}(1-\rho)\theta[\bar{\Psi}\mu\bar{\Lambda}_h(1-\alpha)]^\mu \bar{k}_{BGP}^{\alpha\mu} \quad (30)$$

$$\bar{\hat{g}}_{BGP} = \frac{\bar{g}_{BGP}}{n(1-\rho)} \quad (31)$$

where $\bar{\Lambda}_h \equiv [\gamma_d(1-\rho)+\varepsilon\rho\gamma_f]$ is the new share of the children income received by their parents and $\bar{\Psi} \equiv \left[\frac{\beta A(1-\alpha)(1-\gamma_d)}{[\alpha(1-\rho)(1+\beta)+(1-\alpha)(1+\beta\mu)\bar{\Lambda}_h}\right]$.

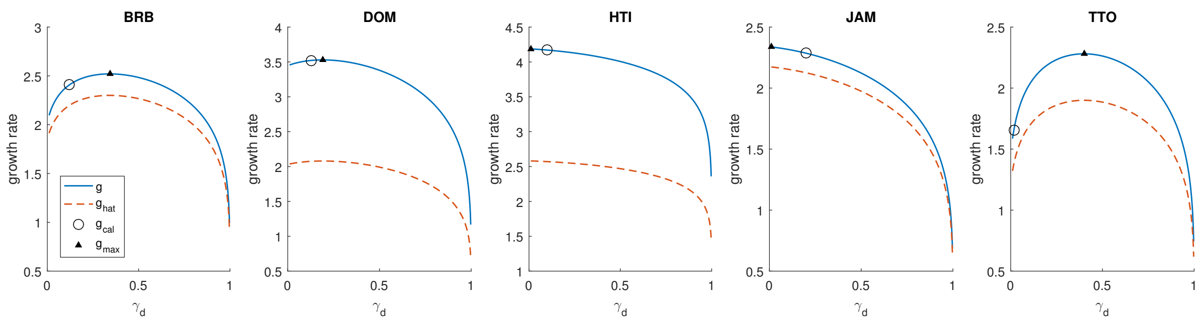
Figures 4 and 5 depict economic growth rate as a function of two levels of intergenerational transfers; namely, domestic γ_d and foreign γ_f[4]. We can ascribe the same three

[4]Note that we fix the other component of intergenerational transfers to the previous value for γ. As

effects discussed earlier to the local intergenerational transfer rate γ_d, namely, a negative income effect as a mandatory transfer to their parents during adulthood, a positive substitution effect in favor of education spending, and a positive income effect for high levels of human capital. Nevertheless, the substitution and positive income effects that run through human capital accumulation will be lower than in the canonical case, whereas the negative income effect will be exactly the same. An increase in γ_d will not reduce as strongly the incentives to invest in physical capital, though it does not encourage a higher accumulation in human capital, neither. By contrast, γ_f generates solely a substitution and positive income effect, both stemming from the increase in human capital, It is worthwhile to point out that the relative weights of these two effects depend directly on gains from migration ε, as well as the scale of migration, denoted by ρ.

We focus first on the impact of γ_d on economic growth. Countries with a high level of emigration–such as Jamaica or Haiti–will gain from a reduction of this rate to zero. This allows for these countries to mitigate the negative income effect from γ_d while benefiting from large flows of remittances from abroad. This would be possible for large enough values of γ_f, ρ and ε. However, this also implies that they become fully dependent on remittances and savings to support and enhance their economic growth. Other countries may not experience large gains from migration, due to lower levels of emigration or a smaller wealth gap with developed economies, as captured by parameter ε. As a result, the optimal value of γ_d depends on tradeoffs between the negative income effect and economic gains induced by the incentive to invest in human capital.[5] Consequently, countries such as Barbados or Trinidad and Tobago will gain from an increase in their intergenerational transfers, due to benefits stemming from increases in human capital accumulation. This means that the positive income effect from a higher human capital largely offsets the negative income effect on the adults income and than the substitution effect between education spendings and savings.

Figure 4: Analysis of the effect of γ_d on the growth rates



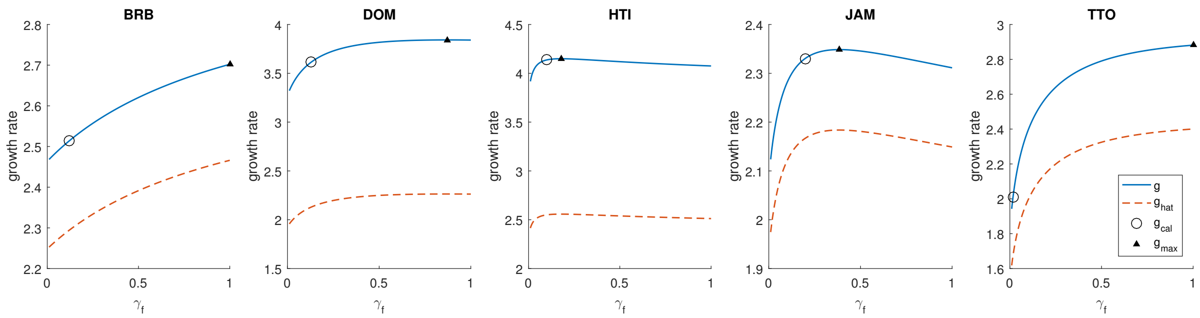
Legend: **BRB:** Barbados. **DOM:** Dominican Republic, **HTI:** Haiti, **JAM:** Jamaica, **TTO:** Trinidad and Tobago, Opt: optimal value, Cal: calibrated value

a result, only one γ at a time is varied across its support. Another solution is to keep constant the other value for γ to 0, though it is also necessary to introduce the following condition $\gamma_d + \gamma_f > 0$

[5]The substitution effect is still active with an increase in γ_d; however, its impact is lower on domestic intergenerational transfer.

Second, the effects of intergenerational transfers from abroad are almost always positive for Barbados and Trinidad and Tobago, while its effect is lower for the other countries. Indeed, the negative impact from parameter γ_f is only due to the substitution effect on domestic savings, which can lead to a permanent reduction in physical capital accumulation. This occurs only if the reduction in savings is large enough, so any gains from increased human capital are wiped away by losses in physical capital. Figure 5 shows that an increase in γ_f is always positively correlated with the growth rate for all countries, except Jamaica and Haiti, where there is a strong emigration specialization. In those two countries, the substitution effect from remittances is large enough to induce a permanent reduction in physical capital accumulation for large γ_f values. Moreover, the values that maximize the growth rates are quite low for these countries, compared to the other countries of the sample.

Figure 5: Analysis of the effect of γ_f on the growth rates

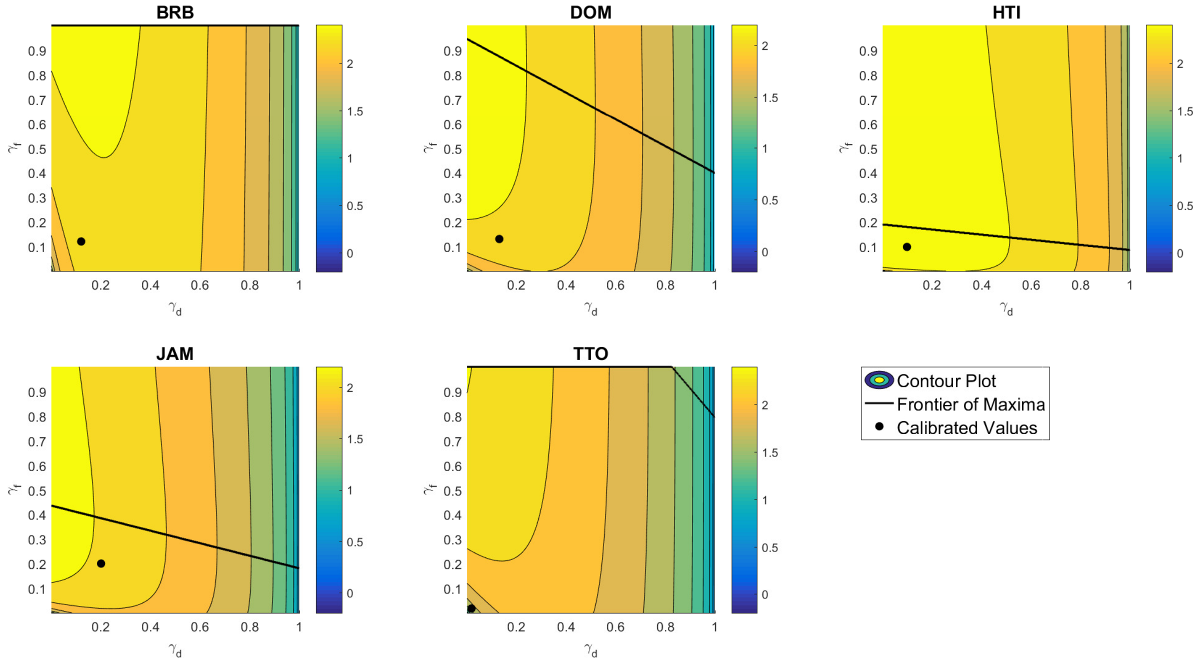


Legend: **BRB:** Barbados. **DOM:** Dominican Republic, **HTI:** Haiti, **JAM:** Jamaica, **TTO:** Trinidad and Tobago, Opt: optimal value, Cal: calibrated value

Finally, we consider a policy that would implement the optimal combination of domestic intergenerational transfer rate and remittances rate. Figure 6 reports the joint effects of optimal policy for output growth *per capita*.[6] Simultaneous changes in γ_d and γ_f, when coupled with a higher gain from migration ε generate a steeper substitution effect, which hurts growth. Indeed, for countries such as Jamaica and Haiti, the optimal values of remittances should not exceed 0.45 and 0.2 respectively. This means that in those countries, the substitution effect is very strong, especially in Haiti where the net gain from migration is comparatively high. On the contrary, Barbados will always experiment an increase in economic growth with the remittances–*i.e.* it is always optimal to capture the entirety of the diaspora income. This is due to the fact its GDP is closer to the OECD average than other SIDS countries in our sample set. A substitution effect from remittances is possible in Trinidad and Tobago, though only if the domestic intergenerational transfer rate γ_d is very high. In that case, the combination of the negative income effect induced by γ_d and the reduction in physical capital accumulation are too large.

[6] Similar results are found for the economic growth but with higher level of economic growth.

Figure 6: Analysis of the effect of a combined migration policy on $\hat{\hat{g}}_{BGP}$: γ_f, ρ



BRB: Barbados, **DOM:** the Dominican Republic, **HTI:** Haiti, **JAM:** Jamaica, and **TTO:** Trinidad and Tobago

7. Conclusion

In this paper, we developed an overlapping generations model to explain the process of the interplay between economic growth and investment in human and physical capital in small island economies. The analytical results allowed us to bring out the role of migration to explain the choices of parents in terms of education and savings, knowing that intergenerational transfers were included in the budget constraint. These were a key feature of the investment/education tradeoff. Indeed, with the possibility of receiving transfers and especially remittances from migrants, there was a strong incentive to increase the education spending, at the expense of domestic savings, and thus investment in physical capital. Thanks to increased returns from human capital, the larger the incentive to invest in intergenerational transfer is, the lower the amount of savings, and thus the fewer units of capital were added to the economy. In some cases, there was a compensation effect from reduction of savings by a higher level of human capital. As a result, long-term economic growth per capita was sustained exclusively by the human capital accumulation. In other cases, this compensation did not occur, and output simply declined over time. Thus, we established three conditions under which it was possible to observe a tangible gain from migration in terms of economic development. These conditions concerned the probability of leaving the country, net gains from migration and the intergenerational transfers.

We developed a careful numerical analysis, with econometric estimation or calibration of structural parameters for five Caribbean islands: Barbados, the Dominican Republic, Haiti, Jamaica, and Trinidad and Tobago. This exercise allowed us to describe the productive capital accumulation according to their demographic features. Therefore, we observed three strategies of development. First, the Dominican Republic, Haiti and Jamaica had a high rate of human capital accumulation due to migration gains. Nevertheless, due to the strong incentive created by migration potential gains, savings on these islands were low. This resulted in a reduction of the accumulation of physical capital. Second, in Trinidad and Tobago, due to the small level of intergenerational transfers, savings were preferred to human capital investments to fund old-age consumption. Therefore, on this island, the accumulation of physical capital is higher due to the increase in savings. Finally, in Barbados, intergenerational transfers and migration were high; however, the net gain from migration was lower than in the other countries. Therefore, savings and education expenditures were equally important in that country. As a result, the two measures of productive capital stock increased at similar rates.

Further policymaking applications can be drawn from this paper. First, several structural parameters in this model can be made endogenous to the preferences of a benevolent social planner. For instance, the share of remittances to elderly people can be adjusted upward or downward, according to their welfare set of criteria. The government can also implement diaspora strategies designed to promote emigration to achieve a given welfare objective. However, in high-emigration countries such as the Caribbean SIDS, it is sometimes optimal to reduce migration because over-investment in human capital generates a permanent decline in their long-run economic growth per capita. This can be achieved by a generous policy for return migration. Governments in these economies can implement policies to create incentives for the household to increase savings and investments in physical capital instead.

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Appendix A. Stability of the Balanced Growth Path

Proof of the stability of the equilibrium. To prove the stability of the equilibrium we define the function $f(k_t) = k_{t+1}$.

$$\lim_{k_t \to 0} f'(k_t) = +\infty$$

$$\lim_{k_t \to +\infty} f'(k_t) = 0$$

$$\lim_{k_t \to +\infty} f(k_t) = +\infty$$

The function $f(k_t)$ is concave and there are two points such as $k_{t+1} = k_t$, which are $k_t = 0$ and $k_t = k_{BGP}$ satisfying $0 < f'(k_{BGP}) < 1$. Therefore, it exists a unique non-trivial equilibrium locally stable and the model shows a regular convergence. □

Appendix B. Comparative statics

Appendix B.1. Analysis of k_{BGP}

The equation of the BGP ratio of capital to efficient units of labor is given by the following:

$$k_{BGP} = \left[\frac{\alpha \left[\frac{\beta A(1-\alpha)(1-\gamma)}{\alpha(1-\rho)(1+\beta)+\gamma(1-\rho+\rho\varepsilon)(1+\beta\mu)(1-\alpha)} \right]^{1-\mu}}{\theta n^{1-\mu}[\mu\gamma(1-\rho+\rho\varepsilon)(1-\alpha)]^{\mu}} \right]^{\frac{1}{1-\alpha(1-\mu)}} \tag{B.1}$$

Without any calculations it appears that k_{BGP} is positively correlated to A and negatively correlated to n, γ and θ, respectively the population growth factor, the intergenerational transfer rate and the efficiency of human capital accumulation. The derivatives of k_{BGP} according to β and ρ are respectively:

$$\frac{\partial k_{BGP}}{\partial \beta} = k_{BGP} \frac{1-\mu}{1-\alpha(1-\mu)} \frac{\alpha(1-\rho) + \Lambda_h(1-\alpha)}{\beta[\alpha(1-\rho)(1+\beta) + \Lambda_h(1+\beta\mu)(1-\alpha)]} \tag{B.2}$$

$$\frac{\partial k_{BGP}}{\partial \rho} = \frac{-k_{BGP}}{1-\alpha(1-\mu)} \left[\frac{(1-\mu)[(1+\beta\mu)(1-\alpha)\gamma(\varepsilon-1) - \alpha(1+\beta)]}{\alpha(1-\rho)(1+\beta) + (1+\beta\mu)(1-\alpha)\Lambda_h} + \frac{\mu\gamma(\varepsilon-1)}{\Lambda_h} \right] \tag{B.3}$$

The expression (B.2) is always positive. While the derivative of k_{BGP} with respect to ρ (equation (B.3)) implies a condition for the effect of the migration rate. Indeed, migration is negatively correlated to the capital per unit of efficient labor if according to the following conditions:

$$\frac{\partial k_{BGP}}{\partial \rho} > 0 \iff \frac{(1-\mu)[\alpha(1+\beta)-(1+\beta\mu)(1-\alpha)\gamma(\varepsilon-1)]}{\alpha(1-\rho)(1+\beta)+(1+\beta\mu)(1-\alpha)\Lambda_h} > \frac{\mu\gamma(\varepsilon-1)}{\Lambda_h}$$

Appendix B.2. Analysis of g_{BGP}

The equation of the BGP growth rate of the economy is given by the following:

$$g_{BGP} = (1-\rho)\Bigg[\left[\frac{\alpha^\alpha \beta A(1-\alpha)(1-\gamma)}{\alpha(1-\rho)(1+\beta)+\gamma(1-\alpha)(1+\beta\mu)(1-\rho+\rho\varepsilon)}\right] \times [\theta n^{1-\mu}[\gamma\mu(1-\rho+\rho\varepsilon)(1-\alpha)]^\mu]^{1-\alpha}\Bigg]^{\frac{1}{1-\alpha(1-\mu)}} \quad \text{(B.4)}$$

Without any calculations it appears that g_{BGP} is positively correlated to A, θ, n. The derivatives of g_{BGP} according to β, ρ, γ, and ε are given by the following expressions:

$$\frac{\partial g_{BGP}}{\partial \beta} = g_{BGP}\frac{\mu}{1-\alpha(1-\mu)}\frac{\alpha(1-\rho)+\Lambda_h(1-\alpha)}{\beta[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]} \quad \text{(B.5)}$$

$$\frac{\partial g_{BGP}}{\partial \rho} = g_{BGP}\left[\frac{\alpha\mu\gamma(1+\beta)[\varepsilon-\alpha(\varepsilon-1)(1-\rho)]-\gamma\Lambda_h(\varepsilon-1)(1+\beta\mu)(1-\alpha)}{\Lambda_h(1-\alpha(1-\mu))[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]} - \frac{1}{1-\rho}\right] \quad \text{(B.6)}$$

$$\frac{\partial g_{BGP}}{\partial \gamma} = g_{BGP}\frac{\mu}{\gamma(1-\gamma)(1-\alpha(1-\mu))}\left[\frac{\alpha(1+\beta)(1-\rho)[(1-\alpha)(1-\gamma)-\gamma]}{[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]} - \frac{(1+\beta\mu)(1-\alpha)\Lambda_h[1-(1-\alpha)(1-\gamma)]}{[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]}\right] \quad \text{(B.7)}$$

$$\frac{\partial g_{BGP}}{\partial \varepsilon} = g_{BGP}\left[\frac{\alpha\mu\rho\gamma(1-\alpha)[(1+\beta)[1-\rho)(1+\beta)-\Lambda_h(1+\beta\mu)}{\Lambda_h(1-\alpha(1-\mu))[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]}\right] \quad \text{(B.8)}$$

While the effect of the intertemporal psychological preference factor appears to be positively correlated to the economic growth, the other parameters impact depend on conditions:

$$\frac{\partial g_{BGP}}{\partial \rho} > 0 \iff \frac{\alpha\mu\gamma(1+\beta)[\varepsilon-\alpha(\varepsilon-1)(1-\rho)]-\gamma\Lambda_h(\varepsilon-1)(1+\beta\mu)(1-\alpha)}{\Lambda_h(1-\alpha(1-\mu))[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]} > \frac{1}{1-\rho}$$

$$\frac{\partial g_{BGP}}{\partial \gamma} > 0 \iff \frac{(1-\alpha)(1-\gamma)-\gamma}{1-(1-\alpha)(1-\gamma)} > \frac{(1+\beta\mu)(1-\alpha)\Lambda_h}{\alpha(1-\rho)(1+\beta)}$$

$$\frac{\partial g_{BGP}}{\partial \varepsilon} > 0 \iff \frac{1+\beta}{1+\beta\mu} > \frac{\Lambda_h}{1-\rho}$$

Finally, we study the impact of the net migration rate on the production per capita growth, which is given by:

$$\hat{g}_{BGP} = \frac{g_{BGP}}{n(1-\rho)} \tag{B.9}$$

Note that the other parameters effects will remain the same than for the economic growth and that, without any calculations it appears that the effect of n, the number of children per household, will be negative.

$$\frac{\partial \hat{g}_{BGP}}{\partial \rho} = \hat{g}_{BGP}\frac{\mu}{1-\alpha(1-\mu)}\left[\frac{\Lambda_h(1+\beta\mu)(1-\alpha)[(1-\alpha)(\varepsilon-1)-1]}{(1-\rho+\rho\varepsilon)[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]}\right.$$
$$\left.+\frac{\alpha(1+\beta)[\varepsilon-\alpha(\varepsilon-1)(1-\rho)]}{(1-\rho+\rho\varepsilon)[\alpha(1-\rho)(1+\beta)+\Lambda_h(1+\beta\mu)(1-\alpha)]}\right] \tag{B.10}$$

The sign of this derivative depends on the following expression which is always positive if $\varepsilon > 1$.

$$\Lambda_h(1+\beta\mu)(1-\alpha)[(1-\alpha)(\varepsilon-1)-1]+\alpha(1+\beta)[\varepsilon-\alpha(\varepsilon-1)(1-\rho)] > 0$$

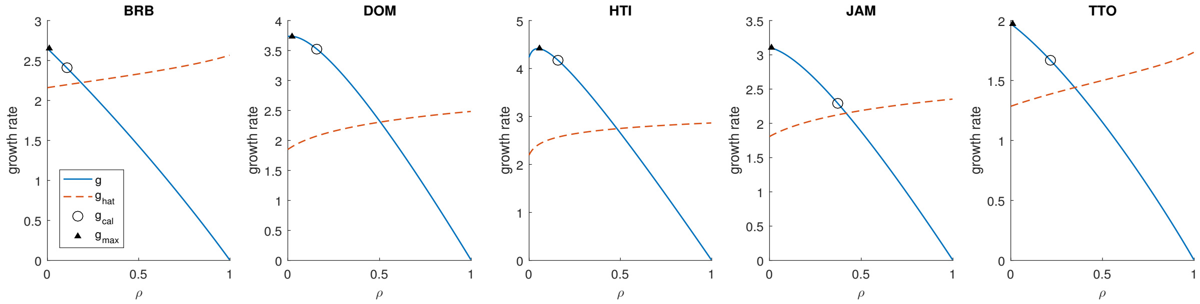
Therefore, while the effect of net migration on economic growth is ambiguous, it is always positive in terms of production *per capita*. This is confirmed by numerical analysis: in figure B.7 we represent the effects of a variation of ρ, the migration rate. While analytical results give ambiguous effects for the emigration rate, numerical results show that for a range of plausible values results remain the same. It shows that migration exerts a different effect depending on the growth rate rate considered. It has a negative effect on economic growth because it leads to a contraction in population numbers. Fertility being exogenous, it means that the labor force declines because of the departures of adults. By contrast, migration has a positive effect on production *per capita* growth rate. This is due to two effects, first the reduction in population, and second the increase in education thanks to the incentives created by migration. Note that this effect is observed because fertility levels do not react to the migration rate. Only countries with high levels of net gain from migration such as the Dominican Republic and Haiti might benefit from a positive migration rate at the aggregate level. However, in those cases, gains *per capita* are reduced. While countries with a relatively low output gap relative to the OECD –small ε– always benefit from an increase in migration rate at in *per capita* terms.

Appendix C. Numerical simulations

Appendix C.1. Calibration of the model

Kydland and Prescott (1991) provide a comprehensive framework for discussing calibration in general equilibrium models. They insist on the need for discipline in choosing

Figure B.7: Analysis of the effect of the migration policy on the emigration rate on g^{BGP}: ρ



benchmark values for the structural parameters.

Notwithstanding the usefulness of household and firm-panel studies, the dearth in micro-data in small open economies, such as SIDS in the Caribbean compels us to rely heavily on macroeconomic variables for calibration. We are left with econometric estimations of structural parameters, with all the challenges involved, as delineated in Favero (2001).

This is particularly the case for those parameters whose values are not well specified in the literature, or are specific to our model. As a result, we focus as much as possible on standard calibration, which relies on steady-state expressions of our model, and use long-run averages of variables in the dataset built for the sample of SIDS countries.

Most available data can be traced back to the 1970s, and we build a dataset for the time period 1970-2014. Numerical simulations will be then computed with initial values that march the year 1970. Because of data quality and availability, we focus on five countries with up-to-date and exhaustive data for our numerical analysis: Barbados, The Dominican Republic, Haiti, Jamaica and Trinidad & Tobago.

- The selected variable for Human Capital is derived from PWT which is an index computed on the basis of returns to education and years in schooling. Private spending is assumed to represent 20% of total education expenditure. Given the fact that we have no tangible indicator of human capital stock, we rely on a mixture of estimation and calibration in order to assign numerical values to parameters μ and θ. To that effect, we use equation (10), in order to define human capital elasticity to education expenditures as follows:

$$\varepsilon^h(\mu) = \frac{\partial h_{t+1}}{\partial e_t}\frac{e_t}{h_t}$$

  We estimate a logged regression of future human capital h_{t+1} on education expenditures in order to estimate its elasticity $\varepsilon^h(\mu)$. We also use $\Delta\bar{h}$ as the empirical long-run average change in human capital. This allows us to write an expression for parameter μ such:

$$\mu = \frac{\varepsilon^h(\mu)}{1 + \Delta\bar{h}}$$

The next step is to plug the numerical value μ for each country in order to calibrate for θ. Using long-run averages for the selected variables, we write:

$$\theta = \ln \frac{\Delta \bar{h}}{\mu(\bar{e} - \bar{h})}$$

Large numerical values for μ suggest that there is a higher elasticity of future human capital to education expenditures than to its present value. θ is a scale parameter that also measures the efficiency of present human capital and education expenditure.

- Parameter β which denotes preference for the future. The discount factor is usually calibrated using the risk-free interest rate in the United States at an annual rate of 4%. The calibrated value for the discount factor is computed as follows:

  $$\beta = \frac{1}{1 + \bar{r}}$$

  There is a large consensus in the literature that the interest rate is a good proxy for household's discounting factor (or preference for the future), though average long-run interest rates change significantly across countries. King and Rebelo (1999) compute values of 0.961 in annual terms, using the 3-months maturity for the United States Treasury Bills.

  Long-run interest rates for our SIDS sample range from about 6% in countries like Barbados, Jamaica as well as Trinidad and Tobago, to almost 12% for Dominican Republic and Haiti. As a result, values of parameter β range from 0.940 to 0.894.

- A similar approach is used to calibrate the capital share in output α at 1/3, which is the usual value used in the literature and derived from Solow (1957). The credible range of values has been set in Christiano and Fitzgerald (1998) using the interval [0.24; 0.43]. For advanced economies, Hairault (1995) and Hairault and Portier (1995) calibrate slightly higher values for the French economy, with $\alpha = 0.45$ on average. For small open economies and/or developing countries Schmitt-Grohé and Uribe (2003) prefer to calibrate a value for parameter α close to the consensus in the literature at 0.32. We calibrate the specific values for each SIDS in our country set using logged expressions of capital stock, out put per capital and productivity such that:

  $$\alpha = \frac{\ln y - \ln A - \ln n}{\ln k - \ln n}$$

  We obtain values close to 1/3 save for Barbados and Trinidad, both of which fall in the lower bound of the interval of credible values computed in Christiano and Fitzgerald (1998).

- The PWT dataset offers estimates of the Solow residual as a proxy for TFP productivity. It is computed as a percentage of productivity in the United States, and we use the long-run average real growth per capita at 2% as a benchmark. In order to compute the technology level of a given country in our sample set, we multiply the PWT 1970 value for TFP in each country as a percentage of that in the United States. For instance, the value for Jamaica is 1.014 translates into a long-run average TFP growth rate of 1.14% in 1970.

- Parameter n is the number of children per household. It is calibrated as the average 30-year rolling arithmetic mean over the 1970-2014 period.

- Parameter ρ is the probability of migration for a given individual. In order to provide a calibrated value for this parameter, we assume that the probability is the same for all individuals in each country in our sample set. This means that a fraction ρ of the population migrates over one period. The empirical equivalent of share ρ is computed as the 30-year average ratio of changes in the population that are not accounted for by birth or death figures. This means that for each country in our sample set, we compute the rolling average of the following expression:

$$\rho = \frac{nN_t - N_{t+1}}{N_t}$$

- ε is the premium wage individuals in SIDS economies expect to receive when they migrate. We assume that wages are proportional to GDP, therefore the long-run average ratio of real GDP per capita in the US over that of the simulated economy is a good proxy for the potential gains made from emigration.

- γ are remittances paid to the elderly and retired individuals in the economy. The WDI dataset provides remittances as a percentage of GDP. We compute γ by expressing remittances in monetary terms instead, and then multiply by the share of elderly individuals – aged 65 ans above – relative to total population. This allows us to compute the fraction of remittances that benefit the elderly in the recipient economy.