The effects of migration and remittances on development and capital in Caribbean Small Island Developing States

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Abstract

This paper adapts an OLG model framework in order to capture the economic and demographic effects of migration in countries such as the Caribbean islands. We describe household decision-making on education spending, consumption and savings where the elderly receives remittances and domestic transfers from the active generation. In a given economy, the model predicts that migration boosts education spending at the expense of physical capital accumulation. Furthermore, numerical simulations of the model predict that households in Jamaica, Haiti and Dominican Republic invest more in education and exhibit higher fertility rates. As a result, their economic growth is labor-driven. By contrast, Trinidad and Tobago as well as Barbados generate their economic growth through physical capital accumulation. This is due to the fact that benefits from human capital accumulation are lower in Barbados because of a low migration premium, while remittances in Trinidad are too low to trigger additional education expenditure.

Keywords: Migration, Capital Markets, Endogenous Fertility, Overlapping Generations Model, Caribbean, Small Island Developing States, Development Economics.

JEL classification: F63, F24, J24, J11, O11, O15, O54.

1. Introduction

Welfare and development are affected by myriad of factors, ranging from social and economic status, to education, health and environment. The literature seeks to account for the impact of socio-demographic variables on economic growth by formulating models that include one or several aspects of the issue at hand. In particular, Overlapping Generations (OLG) models literature encompasses several studies dealing with the link between economic growth and the demographic structure – *i.e.* fertility, human capital, longevity, etc. – (Cardia and Michel, 2004; Del Rey and Lopez-Garcia, 2016; Docquier et al., 2007; Schoonbroodt and Tertilt, 2014). Due to their structural characteristics, these issues have been particularly relevant for Caribbean Small Islands Developing States (SIDS). Indeed, the United Nations (UN) defines the Caribbean SIDS as a group of developing countries facing specific social, economic and environmental vulnerabilities (UN-OHRLLS, 2015).[1]

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[1]There are 16 countries in this group: Antigua and Barbuda, Bahamas, Barbados, Belize, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Saint-Kitts and Nevis, Saint-Lucia,

There is also a strong consensus in the literature that SIDS countries exhibit a higher degree of economic vulnerability compared with other developing economies (Adrianto and Matsuda, 2004; Briguglio, 2003; Briguglio, 1998; Briguglio, 1995; Briguglio and Galea, 2003; Briguglio et al., 2009; Guillaumont, 2010; van der Velde et al., 2007). This is explained, among other things, by structural challenges such as their small size – which makes it difficult to achieve economies of scale in the production chain – and their limited access to natural resources – which forces them to import most of the raw materials.

This paper provides an analysis of the demographic dynamics in Caribbean SIDS and their effects on physical and human capital accumulation, through a theoretical model and numerical simulations. The first part of our work for these Caribbean SIDS is to link economic growth to demographic dynamics, which depends strongly on migration. Indeed, despite some heterogeneity among these countries, we report two broad features: first, demographics in the Caribbean have been characterized by rapid demographic transition, and second, most of them exhibit a negative migration balance. According to **?**, demographic transition represents an economic opportunity for the region, thanks to the increase in productive capital *per capita*. The high emigration is expected to have a positive economic impact since it amplifies the effects of the demographic transition and leads to additional economic returns. However migration alters the determinants of fertility or education – *e.g.* the cost of raising children or the potential remuneration of human capital, etc. – and thus can change strongly the demographic dynamics.

Several authors such as Connell and Conway (2000) or Thomas-Hope (1992) study the impact of migration, however a debate on its effects for the developing economies remains. First, recent contributions by Beine et al. (2006) or Docquier et al. (2008) defend the idea that migration could enhance economic development through an increase in average human capital in the domestic country. Moreover, remittances – defined as transfers of money between migrants and their family in the domestic area – can finance economic development. These cash transfers promote economic growth especially if they are used to increase investments in human capital or release the credit constraints. Nonetheless, in many cases, remittances are used to fund consumption or unproductive investments.

Given the magnitude of global flows in remittances – they are the second-largest flows of capital across the world and the third of all international capital flows (Yang, 2011) – a growing literature focuses on their impacts for economic development and more particularly for the capital markets. However there is no consensus in the literature, which is mostly empirical. Indeed, while Alcaraz et al. (2012), Bansak and Chezum (2009), Osili (2007), Poirine (1997), Woodruff and Zenteno (2007) and Yang (2008) find that remittances have positive effects on economic growth, through increases in education

Saint Vincent and the Grenadines, Suriname as well as Trinidad and Tobago. Note, that Guyana and Suriname are not islands but continental countries, however they have the main characteristics of the SIDS.

There are seven non-independent territories: Anguilla, Aruba, British Virgin Islands, Montserrat, Netherlands Antilles, Puerto Rico and United States Virgin Islands.

expenditures or entrepreneurship in the domestic country. Others find that they only fund household's consumption or increase the stability of the family's revenue (Brown and Ahlburg, 1999; Combes and Ebeke, 2011; Durand et al., 1996). By contrast, another body of literature argues that it is not possible to rely on them to trigger economic development (Frucht, 1968, Hill (1977)). Besides, two other empirical studies focus on the impact of remittances in the independent states of the Caribbean and both conclude that although these transfers boost long-term consumption growth, they do not seem to have a significant impact on long-term growth (Lim and Simmons, 2015; Mishra, 2007). In addition, some authors qualify the positive effects of remittances according to specific conditions. Sobiech (2019) shows that remittances can increase economic growth in the early stages of development, when the financial sector is small, otherwise a substitution between capital market and remittances is possible. While Combes and Ebeke (2011) find that remittances must not exceed 6% of the receiving country's GDP in order to keep its stabilyzing effect. In the first part of our work we focus on the remittances channel to link demographic dynamics to economic growth, with a direct contribution to the literature on remittances' effects. Moreover, we use a theoretical approach in order to describe the potential economic mechanisms involved in the relation between remittances, capital market and growth. Then we calibrate the model and thanks to numerical simulations we study five islands' specificities in terms of migration.

The second part of our paper is devoted to the effects of capital market distorsions in the context of high-migration countries. We argue that Caribbean SIDS face imperfect capital market structures in the form of a wedge between interest rates and marginal returns of capital. This wedge may account for imbalances in the dynamics of human and physical capital accumulation among those economies that show significant levels of migration. The existence of such distortions in the capital market can have repercussions on growth and capital accumulation, both in the short and long run. We equate this capital wedge with the existence of capital adjustments costs, the kind that has been described in particular in Hayashi (1982) and Wang and Wen (2012). In our work, we introduce a simple fixed cost of adjustment on the capital market and we test the effects of a variation of this cost, knowing that there is an interaction between Caribbean islands' demographic features and the domestic capital supply, *i.e.* savings.

Our contribution to the literature resides in linking economic growth, migration and demographic dynamics on the one hand, and the impact of remittances on capital accumulation on the other hand. There is a lack of literature on this particular issue we seek to address, and to do so, we develop a two-stage approach. The first step is to build an OLG model of a closed-economy, in order to study how domestic production and remittances impact economic growth. This tractable model provides us with some insights on households' choices in terms of savings, fertility and education.[2] On the one hand we highlight the usual trade-off between present and future consumption. On the other hand, we show

[2]The model is kept as simple as possible in order to drive clear intuitions on the capital dynamics in the domestic area, thus we develop a model of a closed-economy only open to migration.

that the decision schedule for financing consumption during old-age through natality and education, is influenced by expected remittances from the next generation. Indeed in our model, parents decide their education investment schedule on the basis of expected return from the intergenerational transfers. In certain conditions, we find a positive impact of migration on education investments, natality, human capital stock and production, in line with Beine et al. (2006) or Docquier et al. (2008). However, there is a substitution effect between savings and fertility and/or education expenditures induced by the migration. Therefore migration can lead to a decline in physical capital investments that results in a decline in production in some cases. To complete the analytical results, careful numerical simulations are conducted for five islands – Barbados, Dominican Republic, Haiti, Jamaica as well as Trinidad and Tobago. We find that 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 gain from migration are reduced.

Secondly, we observe in the data that there is a wedge in capital markets, *i.e.* that interest rates are not equal to marginal returns of capital. We use this empirical result to incorporate capital market distortions in our model, then proceed to evaluate their impact on capital accumulation as well as economic growth. Following a numerical simulation analysis on our set of islands – Barbados, Dominican Republic, Haiti, Jamaica as well as Trinidad and Tobago – we find that the capital wedge has a significant impact on the dynamics of capital accumulation, though at different levels depending on the benchmark economy, and in different directions for short and long-run time frames. More specifically, all selected countries exhibit a growth trade-off, with a negative effect in the short-run, and a positive one in the long run if the wedge is reduced. As for capital, there are country-specific levels of distortions for which the economy is indifferent between short and long-run capital accumulation.

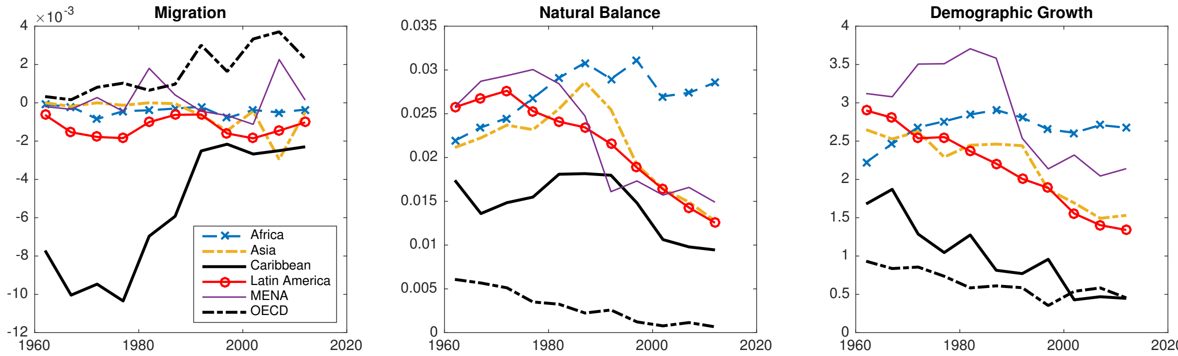
The paper is structured as follows. Section 2 describes the stylized facts related to the demographic features of Caribbean SIDS. Next, section 3 introduces the modified OLG model. Section 4 highlights key results through equilibrium analysis, while section 5 presents results from numerical simulations for the distortion-free model. On the basis of empirical evidence, section 6 introduces distorsions in the capital market, and describes the trade-offs in growth and capital accumulation both in the short and long-run. Finally the last section draws conclusions and defines a roadmap for future research work.

2. Stylized Facts

This section highlights the demographic and capital market features of Caribbean islands and their particular properties. First we show that migration is an important demographic feature for Caribbean islands even compared to other low and middle income countries. Secondly, we will focus on the effect of migration, through remittances and their impact on fertility as well as savings. Using data from the World bank's World Development Indicators (WDI), Figure 1 plots migration balance, natural balance and population growth in Africa, Asia, Caribbean, Latin America, the Middle-East and North

Africa (MENA) as well as the countries of the Organisation for Economic Co-operation and Development (OECD), which are retained throughout the paper as our benchmark for comparative purposes. The Caribbean countries show a strong negative migration balance, which is compensated by a positive natural balance. The extent of migration flows is quite significant for this regional group, the highest among emerging economies in our country sample.[3] As a result, population growth in the Caribbean is close to OECD levels, which are quite low compared to the other groups' levels. This figure shows that the biggest specificity of Caribbean islands is the migratory component of their demographic dynamics. Therefore it is crucial to study this phenomenon, especially by taking into account the economic impact of migration.

Figure 1: Demographic features by region

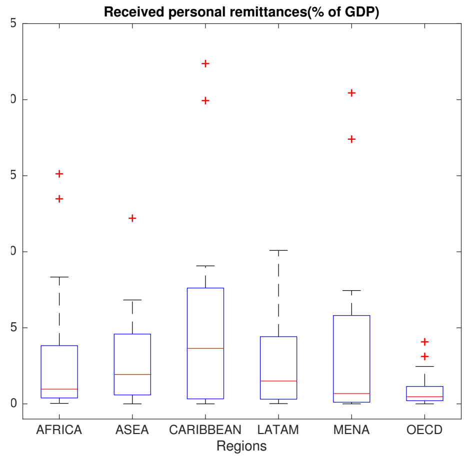


We compare the percentage of received personal remittances relative to GDP across regional groups for the period 1961-2014. Figure 2 shows that there are a couple of outliers with high levels of remittances relative to GDP in Sub-Sahara Africa, South Asia, the Caribbean, MENA and to a lesser extent, the OECD. Median remittances appear to be higher among the Caribbean compared to other regional groups, and they also exhibit the highest levels of outliers ; even when compared to Latin America, whose own remittances have been documented in the literature as representing a significant fraction of their respective GDPs. The figure also shows that the Caribbean regional group exhibits the highest median share at 3.65% of GDP, followed by South Asia and Pacific, as well as Central Europe and Balkans at 1.93% and 1.63% of GDP respectively. The distribution of remittances relative to GDP across each regional group suggests that there are significant differences, and we conclude that the Caribbean SIDS countries exhibit the highest level among developing and emerging economies. We argue in this paper that there are incentives for individuals living in Caribbean countries to invest in human capital and have their offspring immigrate. High levels of migrations are expected to yield substantial remittances from the diaspora relative to produced wealth in their home country.

Although the model presented in this paper is focused on a couple of Caribbean SIDS

[3] In the 1970's migration was especially high. This is due to the migration policies in the receiving countries especially in United Kingdom and in United States of America.

Figure 2: Remittances in percentage of GDP by region



countries, we seek to ground its results in empirical facts. To that effect, we formulate a specification to explain fertility – as measured by the average number of children per woman of procreation age. We select a number of variables that can be used as proxies for determinants of fertility. These variables are all relevant to the model – the proposed specifications seek to offer empirical validation of some of the model's intuitions and results. We use data from WDI and the University of Pennsylvania World Table (PWT) datasets 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 benchmark specification writes:

$$FERT_i = \alpha_0 + \alpha_1 GDP_i + \alpha_2 HC_i + X_i' \delta + \varepsilon_i \tag{1}$$

For each country i, $FERT$ denotes fertility – measured as the average number women of procreation age are likely to bear in their lifetime. GDP refers to real GDP *per capita*, and HC to the human capital index developed by Barro and Lee (2013). X' is a vector with the additional controls we incorporate in the specifications we formulate in Table 1. The controls we add to the benchmark specification are all derived from the model presented in this paper. Namely, we incorporate net migration relative to total population, as well as remittances, computed in their real monetary value in *per capita* terms. Following the model's predictions and the literature's main findings, we expect both GDP and Human Capital to have a negative impact on fertility. On the other hand, negative net migration and remittances are likely to correlate positively with fertility. In addition, we also incorporate a factor variable that seeks to capture the regional effect. Using the OECD country group as the baseline category, we incorporate a dummy variable that seeks to capture group effects in the sample set. The 141 countries are broken down according to their respective geographical areas: Sub-Sahara Africa, South Asia and Pacific, the Caribbean, Central-Eastern Europe and Balkans, Latin American and Middle East and North Africa. The regional dummy seeks to capture category-specific heterogenous effects. Odd-numbered specifications incorporate the regional dummy effects, while even-numbered ones do not. Table 1 reports the estimated coefficients α_i, other controls δ as well as summary statistics that offer a broader picture of each specification's reliability.

Specifications (1) and (2) regress fertility on real GDP and Human capital index. Specifications (3) and (4) incorporate an interaction term, one that takes into account the covariates between human capital and real GDP *per capita.* For all intents and purposes, the interaction effect between real GDP and human capital seeks to filter out separate estimates for both variables and their influence on fertility. Specifications (5) to (8) incorporate further controls: (5) and (6) take into account the migration effects on fertility by using net migration relative to total population as a proxy. Finally, specifications (7) and (8) add remittances expressed in *per capita* terms and logged values. All specifications account for a substantial share of variance in the fertility rate among the sample set: the adjusted R^2 values range from 0.781 to 0.870, which is a significant result and *prima facie* case that our model is grounded in empirical facts.

Real GDP *per capita* and the Human capital index exhibit a negative and statistically significant relationship with fertility. This is an expected result, since the literature has produced a wealth of evidence that as countries become wealthier and more intensive in human capital, one would expect a secular decline in fertility. With increasing levels of wealth and human capital, households adjust their natality by reducing the number of children in order to spread more resources across their progeny. The same can be reported for human capital: as households become more knowledgeable, they have fewer children, and transmit a larger human capital stock per child to future generations. Note that the estimated coefficients for both variables for all specifications (1) through (8) are negative and statistically significant. Furthermore, looking at specifications (1) and (2), there does not seem to be large regional dummy effect on the covariate between real GDP *per capita* and fertility, as the estimated coefficient does not changes significantly, and retains its high degree of statistical significance. By contrast, there are important changes for the estimated coefficient of human capital – it is more than doubled when the regional dummy effect is taken into account, even as it remains statistically significant. This suggests that there is a region-specific characteristic for human capital and fertility, which is observed in almost all regional groups relative to the OECD. The Caribbean regional group in particular exhibit a statistically significant higher fertility rate relative to the OECD, though not as high as observed in other regional groups of emerging economies. Specifications (3) and (4) alter slightly the estimated coefficients for GDP and human capital index, as they take into account the interaction effect between GDP and the human capital index. Note that although the estimated coefficient is not statistically significant, it does suggest that there is a higher than expected human capital effect on fertility than specifications (1) and (2) let on. Such a result is also reported for specifications (5) and (6), where net migration is taken into account.

Large flows of immigration – measured as net migration relative to total population – are associated with high fertility, the estimated coefficient is statistically significant. This is due to the fact that fertility is higher in poorer countries, and that a substantial share of migrants worldwide come from those countries. As a result, the estimated coefficient for net migration will be positive, as the host country benefits from a higher migrant fertility. Nevertheless, note that the coefficient changes significantly whether the regional dummy effect is taken into account – specification (5) more than doubles the estimated coefficient when the regional dummy is taken out in specification (6). The regional effect is significant in specification (7) when remittances *per capita* – in log terms – are incorporated in the benchmark specification. In particular, (8) is relevant to the model as it fits well with its predictions. Although we expect fertility to fall as countries become wealthier and more intensive in human capital, an interaction effect of both correlates positively with fertility, as measured by the interaction terms. Furthermore, wealth and human capital are significantly correlated with fertility in our sample set, though there is a definite regional effect to be taken into account, as we compare the adjusted R^2 for specifications (1) and (2).

The interaction variable between Human capital index and real GDP *per capita* is positive but statistically not significant, except for specification (8). In this case, the influence of net migration and remittances *per capita* is such that the interaction effect between human capital and GDP is positively correlated with fertility. We argue that this result lends an empirical validation to the model we describe in the next section. High human capital stock translates into monetary present and future gains: a more human capital-intensive education means that expected wage gains from migration increase, which boosts net migration to other countries. As a result, domestic households have an incentive to raise more children and educate them, since they can emigrate and get higher wages abroad. Parents then benefit later on with higher levels of remittances *per capita*. Given the empirical results derived from the large sample set discussed above, we are confident that results predicted in the model are grounded in empirical facts. In particular, we expect fertility to decrease with wealth and human capital. In addition, gains from a higher accumulation of human capital through eduction take the form of higher wages domestically and abroad. Given that individuals from Caribbean SIDS emigrate to OECD-type countries, wage gains are higher, which provides additional incentives to have more children. Parents expect their progeny to then send back remittances, which are increasing in their wages and human capital. We are aware of the fact that countries with a negative net migration flow relative to total population should exhibit a higher fertility rate. However, we argue that that the dominant effect will be the positive impact of emigration from poor to rich countries on the fertility in the latter. As a result, fertility is positively correlated with net migration and remittances. Even though the remittances' impact on fertility lines up with the predicts in our model, we note that the most largest effects on fertility in absolute value remain human capital and net migration. Their estimated coefficients are large and statistically significant, which suggests that they have an important role in determining fertility as far as the sample set goes.

Table 1: Fertility - number of children per woman: 1961-2014.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Real GDP *per capita*	-0.409***	-0.384***	-0.606***	-0.587***	-0.656***	-0.753***	-0.887***	-0.909***
	(0.084)	(0.086)	(0.178)	(0.188)	(0.178)	(0.167)	(0.18)	(0.157)
Human Capital Index	-0.592***	-1.608***	-1.437	-2.385***	-1.334*	-2.261***	-1.847***	-2.501***
	(0.202)	(0.194)	(0.902)	(0.738)	(0.879)	(0.688)	(0.837)	(0.63)
Human Capital Index x GDP			0.104	0.097	0.093	0.107	0.141	0.126*
			(0.097)	(0.083)	(0.095)	(0.076)	(0.091)	(0.07)
Net Migration (% Population)					3.804**	8.426***	1.109	5.674***
					(1.759)	(1.259)	(2.065)	(1.671)
Log Remittances *per capita*							0.152***	0.157***
							(0.054)	(0.048)
Intercept	7.745***	10.478***	9.181***	12.035***	9.655***	12.908***	11.349***	13.866***
	(0.753)	(0.381)	(1.515)	(1.383)	(1.5)	(1.245)	(1.451)	(1.162)
Count	141	141	141	141	141	141	137	137
R2	0.868	0.783	0.87	0.785	0.874	0.809	0.886	0.828
Adjusted R2	0.86	0.78	0.861	0.781	0.864	0.804	0.876	0.822
RSS	57.395	94.588	56.666	93.471	55.062	83.063	49.251	74.176
RMSE	0.659	0.828	0.658	0.826	0.651	0.782	0.628	0.752
Fisher	179.053	356.065	175.288	276.66	170.372	232.106	150.34	190.889
Log-Likelihood	-136.705	-171.925	-135.803	-171.087	-133.779	-162.764	-124.315	-152.367
Regional Dummy	YES	NO	YES	NO	YES	NO	YES	NO

Note: Dataset built using WDI and PWT databases. Non-weighted averages are computed over the period 1961-2014 or any available data points within the time period. Specifications (7) and (8) drop 4 countries from the sample set due to data points unavailable for remittances. Dummy regional variables refer to unweighted five regional groups in addition to the OECD baseline. Estimated coefficients of the regional dummy effect refer to regional mean group difference with respect to OECD group. Estimated results are reported with standard errors in parenthesis. Levels of significance are referred to with stars.
Legend *** p $\leq$ 1%, ** 5% and * 10%.

The specification in equation 1 is augmented to describe domestic savings as a function of similar explanatory variables. The second specification writes:

$$S_i^d = \alpha_0 + \alpha_1 Remitt_i + \alpha_2 HC_i + \alpha_3 Kap_i + X_i' \delta + \varepsilon_i \tag{2}$$

In the standard specification domestic savings S^d, are a function of remittances (expressed in real 2005 $), the Human Capital index, physical capital stock, and additional explanatory variables in vector X_i'. This vector incorporates variables for relative wealth, foreign capital flows, and demographic indicators – *i.e.* migration scale and 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.

All specifications (1) through (5) show that remittances and domestic savings are negatively correlated, a result that is in line with the model we present in this paper. Due to remittances received from abroad, domestic agents prefer to reduce their savings – thus funding for physical capital – and instead spend resources on educating their offspring. Although the estimated coefficient changes according to each specification, changes are not large, and the estimated coefficient remains statistically significant. A 1% increase in remittances expressed in real Dollars is associated with a decline in savings ranging from -2.2% to -4.7%. Such an explanation is further bolstered by the estimated coefficient for human capital – the index correlates negatively with domestic savings. This can be explained as the higher the returns from human capital – measured with the Barro-Lee index – the lower the incentive to save.

By contrast, there is a positive relationship between domestic savings on the one hand, 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 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 thanks to the education effects on human capital.

Relative GDP is computed as the average percentage of real GDP relative to mean OECD's GDP. 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 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, all things being equal. The balance effect is captured by the dummy variable 'Sign', which takes 1 if the migration balance is negative and 0 otherwise. This means that sending countries exhibit lower domestic savings.

The specification reported in table 2 does not incorporate regional dummies in contrast with table 1. Some regional groups exhibit a statistically significant effect, but the Caribbean group does not appear to differ statistically from the OECD benchmark group. Nevertheless, we find that the estimated coefficients in table 2 conform with our expectations of what the model predicts regarding the interaction between remittances and savings.

Table 2: 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)
FDIs					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: Dataset built out of WDI and PWT databases. Non-weighted averages are computed over the period 1961-2014 or any available data points within the time period. Logged savings are expressed in real Dollars and regressed over explanatory variables. Remittances, Physical capital stock and foreign direct investment (FDIs) are all expressed in logged real 2005 Dollars. Sign for net migration is a dummy variable which takes 1 if net migration relative to population is negative, 0 otherwise. The sample set of 133 countries is smaller than that used in table 1 due to data availability for the selected indicators. Estimated results are reported with standard errors in parenthesis. Levels of significance are referred to with stars.
Legend *** p $\leq$ 1%, ** 5% and * 10%.

3. The Model

This section presents an overlapping generations (OLG) model, with discrete time indexed by $t = 0, 1, 2, ..., +\infty$. OLG models are extensively described in de la Croix and Michel (2002) and are convenient to study intergenerational transfers as in Del Rey and Lopez-Garcia (2016) or Thibault (2008). They are widely used in the studying of migration and remittances (Beine et al., 2001; de la Croix et al., 2007; Docquier et al., 2008; Marchiori et al., 2008). In the present work we use a simple model in which we focus on households' behavior toward savings, consumption and education.

3.1. Firm's behavior

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

$$Y_t = AK_t^{\alpha} (L_t h_t)^{1-\alpha} \tag{3}$$

where K_t is the aggregate stock of physical capital, L_t is the aggregate labor supply to production, h_t is the mean human capital, $A > 0$ 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 efficient units of labor ratio, we write:

$$y_t = Ak_t^{\alpha} \tag{4}$$

The firm profit is:

$$\Pi_t = AK_t^{\alpha} (L_t h_t)^{1-\alpha} - w_t h_t L_t - R_t K_t \tag{5}$$

where w_t is the wage for an unit of efficient labor and $R_t \equiv 1 + r_t$ the interest rate of capital.

Assuming that the capital fully depreciates in one period, factors prices are:

$$w_t = A(1-\alpha)K_t^{\alpha} (L_t h_t)^{-\alpha} = A(1-\alpha)k_t^{\alpha} \tag{6}$$

$$R_t = A\alpha K_t^{\alpha-1} (L_t h_t)^{1-\alpha} = A\alpha k_t^{\alpha-1} \tag{7}$$

3.2. Family's behavior

Households live three periods, childhood, adulthood, and old age. At $t + 1$, a new generation of $n_t N_t$ homogenous agents is born, where n_t is the growth rate of the adult generation between period t and $t + 1$. As in de la Croix and Doepke (2003) the value of n_t is chosen by the adults of period t, knowing that raising n_t children takes a fraction σn_t of time, with $\sigma \in (0, 1)$. We denote the probability of migration by $\rho \in [0, 1[$. Migration implies that only $(1 - \rho)n_t N_t$ children stay in the domestic country after childhood, the others $\rho n_t N_t$ children migrate to countries where wages are greater. The evolution of the size of the adult generation is represented by this equation:

$$N_{t+1} = n_t N_t (1 - \rho) \tag{8}$$

And we note the population growth[4] as:

$$g^N = \frac{N_{t+1} - N_t}{N_t} = n_t(1-\rho) - 1 \tag{9}$$

Individuals born in $t-1$ care about their adult consumption level c_t, their old-age consumption level d_{t+1}. The preferences of the agents are represented by this utility function:

$$U(c_t, d_{t+1}) = \ln(c_t) + \beta \ln(d_{t+1}) \tag{10}$$

During childhood, individuals are reared by their parents and do not make any decisions. When adult, if they stay in the domestic territory, they supply inelastically one unit of labor remunerated at wage w_t per unit of human capital h_t. They allocate their income to consumption c_t, savings s_t and children education $n_t e_t$. Besides, they transfer a part γ of their revenue to their parents. Agents who have migrated send the same part γ of their revenue to their parents, but they can have a higher wage abroad which is proportional to the domestic one: $w_t^F \equiv \varepsilon w_t$, where $\varepsilon > 1$ is the net gain from migration. Cashflows from the migrants are remittances in our economy, 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 in this paper, we do not study the decision of migration by the children or the remittances level, but only the parents trade-off between savings and children education, knowing that a part of the children will leave the country with a probability ρ and will remit more. The budget constraint in the first period is given by:

$$c_t + s_t + n_t e_t = w_t h_t (1 - \gamma - \sigma n_t) \tag{11}$$

When old, agents only consume their savings remunerated at the rate R_{t+1} and the intergenerational transfers sent by their children, wherever they live. That said, there are two trade-offs in this model, the first one with regard to present versus future consumption. In addition, they have to choose between savings or transfers – through human capital investments and the number of children – to finance their consumption when old. The budget constraint in the second period writes:

$$d_{t+1} = s_t R_{t+1} + n_t \gamma (1-\rho) w_{t+1} h_{t+1} + n_t \gamma \rho \varepsilon w_{t+1} h_{t+1} \tag{12}$$

Human capital of the child h_{t+1} depends on the total investments in education e_t and on the parents' human capital h_t:

$$h_{t+1} = \theta h_t^{1-\mu} e_t^{\mu} \tag{13}$$

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

[4] Note that there is population growth only if $n_t(1-\rho) > 1$

two different forms of investments. But 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 condition: $e_t > 0$.

Three elements in our model must be discussed. First, there is no altruism towards the children even if the fertility is endogenous, consequently there is no direct utility gain from having children. This specification implied implicitly that the only reason to have children is to invest for old-age consumption. We are well aware that this is a strict assumption, but, according to the literature, budget constraints and economic optimization motives explain a part of the fertility choices. Moreover in developing countries this type of model seems to be adequate as in Zhang and Nishimura (1993). Our analysis focuses on migration and family related factors and their respective impacts on fertility. Additionally, a model with altruistic motives towards the children has also been tested in Appendix B, but the conclusions of the model for the migration impacts do not change, while the interpretation of the analytical results is more complicated.

Secondly, islands here are small closed economies only open to emigration, there are no imports, exports or capital flows between the rest of the world and the domestic economy. It is clear that these countries present a significant degree of economic openness. Nevertheless the current model offers a tool to study the domestic savings and the impact of migration on domestic production. Indeed our idea is to study the investments in the domestic area and their evolution in a context of high emigration and with remittances recipients. The comportments of this latter in terms of savings can be modified thanks to the possibility to receive intergenerational transfers. Therefore we do not attempt to solve everything in this paper but only to characterize the trade-offs between savings and intergenerational transfers to fund old-age consumption, as well as their impacts on capital accumulation. Nonetheless, a model with imports to insure consumption during old-age has been tested in Appendix C to test this hypothesis. It appears that the trade-offs between savings and intergenerational transfers to fund the elderly's consumption is orthogonal to trade openness. While the economic growth can be impacted by the imports cost structures. Therefore the conclusions of the model for the migration impacts do not change, especially our explanation towards the capital stocks, while the interpretation of the analytical results is much more complicated in a specification with imports.

The third element concerns the equality between the relative proportion in the revenue of the intergenerational transfers from the migrants and the non-migrants. Indeed, for the sake of simplicity, we suppose that the proportion of revenue sent to the parents is the same, regardless of the location of the children. The amount and the motives of remittances from migrants are well-studied in the economic literature. However, to the best of our knowledge, there are no studies that allow us to evaluate the amount of intergenerational solidarity in Caribbean islands knowing that there are several forms of solidarity. Nonetheless, one should finally note that in developing states, family solidarity is an important characteristic and can replace the access to credits through cash flows that help to finance education or consumption during old age. Moreover, solidarity can take the form of spending more time for long-term care for instance (Mizushima, 2009). Even if migration is not significant – such is the case in Trinidad and Tobago – intergenerational transfers can still occur and matter in the decision-making schedule on savings, education expenditure and natality. Thus, we make the assumption, that the term γ include remittances for migrants and cash transfers or time for non-migrants.

The consumer program is summarized by:

$$
\begin{aligned}
\max_{s_t,e_t,n_t} U(c_t, d_{t+1}) &= \ln(c_t) + \beta \ln(d_{t+1}) \\
s.t \qquad c_t + s_t + n_t e_t &= w_t h_t (1 - \gamma - \sigma n_t) \\
d_{t+1} &= s_t R_{t+1} + n_t \gamma (1-\rho) w_{t+1} h_{t+1} + n_t \gamma \rho \varepsilon w_{t+1} h_{t+1} \\
h_{t+1} &= \theta h_t^{1-\mu} e_t^{\mu}
\end{aligned}
$$

The combination of the First Order Conditions (FOC) leads to the optimal choice of education – which is just a part $\frac{\mu\sigma}{1-\mu}$ of the income – and to a relation between the future prices of production factors:

$$e_t^* = \frac{\mu \sigma w_t h_t}{1-\mu} \tag{14}$$

$$R_{t+1} = \frac{\gamma(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma} \frac{w_{t+1} h_{t+1}}{w_t h_t} \tag{15}$$

The income allocated to future consumption is denoted x_t. Its value differs from d_{t+1}, the consumption when old, because it does not include the remitted share of the children income and the remuneration of the savings. Therefore, x_t is the part of the first period income which is invested to fund future consumption, whether it is through savings or human capital investments. According to the value of education given by equation (14) we write:

$$x_t = s_t + \frac{\sigma w_t h_t}{1-\mu} n_t \tag{16}$$

Using equations (15) and (14) as well as the budget constrains, we obtain a second equation for x_t:

$$x_t = \frac{\beta(1-\gamma)}{1+\beta} w_t h_t \tag{17}$$

At this point, the respective shares of investments in human capital or savings in the funding of the future consumption are undetermined. Therefore, we need to introduce the market clearing conditions (MCC) – given by equations (18) to (20) – and the factor prices – given by equations (6) to (7) – in order to determine the household's optimal choices in terms of savings and natality.

$$K_{t+1} = s_t N_t \tag{18}$$

$$L_{t+1} = N_{t+1} = n_t N_t (1-\rho) \tag{19}$$

$$h_{t+1} = \theta e_t^{\mu} h_t^{1-\mu} = \theta \left(\frac{\mu w_t \sigma}{1-\mu} \right)^{\mu} h_t \tag{20}$$

Using the MCC, we find the equation (21) and combining equation (15) and the factor prices, we write the equation (22):

$$k_{t+1} = \frac{K_{t+1}}{h_{t+1}N_{t+1}} = \frac{s_t}{(1-\rho)n_t h_{t+1}} \tag{21}$$

$$k_{t+1} = \frac{\alpha w_t h_t \sigma}{h_{t+1}(1-\alpha)(1-\mu)\gamma(1-\rho+\rho\varepsilon)} \tag{22}$$

Finally we find the optimal choices for savings and natality by introducing in x_t the relation between s_t and n_t that appears when equations (21) and (22) combine:

$$s_t^* = \frac{\beta\alpha(1-\rho)(1-\gamma)}{(1+\beta)[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} w_t h_t \tag{23}$$

$$n_t^* = \frac{\beta\gamma(1-\gamma)(1-\alpha)(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma(1+\beta)[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} \tag{24}$$

As said earlier there are several trade-offs in this model. The first one is between adult and old-age consumptions – *i.e.* c_t and x_t –, the second one introduces a choice between human capital investments and savings to fund old-age consumption. Finally, the third trade-off is between quantity and quality of children to maximize the intergenerational transfers.

For the first trade-off, as said earlier, x_t, is the share of the present income allocated to future consumption. This share increases with β, the time preference factor, and decreases with γ, the intergenerational transfer rate. Indeed, a high γ creates a negative income effect which reduces both c_t and x_t. However, the effect of γ on consumption when old is not necessarily negative because, as γ increases it is less necessary to invest to rise d_{t+1} thanks to the larger intergenerational transfers which are received in the next period.

Secondly the trade-off between human capital investments and savings depends on the net gain from migration, ε, the emigration rate, ρ and γ. Indeed these parameters increase the gain from migration and thus the human capital investments. Therefore they all lead to a reduction of savings in order to increase the income share devoted to education or natality.

Finally, households choose to invest more in education than in natality if the value of the efficiency of education, μ, or the opportunity cost of raising children, σ, increase. Moreover two elements must be noted. First, the number of children per household is constant over time. Second, because of the competition between the income effect and the substitution effect between savings and human capital, the impact of γ on n_t is ambiguous and depends on the condition bellow:

$$\gamma < \frac{\sqrt{\alpha(1-\rho)}\left[\sqrt{\alpha(1-\rho)+4(1-\alpha)(1-\rho+\rho\varepsilon)} - \sqrt{\alpha(1-\rho)}\right]}{2(1-\alpha)(1-\rho+\rho\varepsilon)} \tag{25}$$

The growth of the adult generation – *i.e.* the labor force – is given by equation (9) and is increased by all the parameters which are positively correlated to n_t, except for ρ which has an ambiguous effect on demographic growth. Indeed, ρ boosts the natality and thus increases the number of children, however it also results in a decrease in the number of adults who stay in the domestic area at the next period. These are two competing effects, and thus in some cases an increase in migration could lead to a growth of the population size, if the increase in the number of children is higher than the decrease in the number of adults through migration. The direction of the impact of ρ depends on the following condition:

$$\frac{\partial g^N}{\partial \rho} > 0 \iff \frac{1-p}{1-p+p\varepsilon} > \frac{\alpha(\varepsilon-1)}{\gamma(1-\alpha)} \tag{26}$$

4. Equilibrium

4.1. Intertemporal equilibrium

The MCC for capital and the efficient units of labor were given respectively by the equation (18) and the combination of equations (19) and (20). The values of the households' optimal choices s_t^*, n_t^* and e_t^* are given in equations (23), (24) and (14). Wage and interest rate correspond respectively to (6) and (7). After some computations, we can deduce the intertemporal equilibrium.

Definition 1. *Given the initial conditions $K_0 \geq 0$, $L_0 \geq 0$ and $h_0 \geq 0$, the intertemporal equilibrium is the sequence (K_t, L_t and h_t) such that the following system is satisfied for all $t \geq 0$:*

$$\begin{cases} K_{t+1} &= \frac{\alpha\beta A(1-\alpha)(1-\gamma)(1-\rho)}{(1+\beta)[\alpha(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)]} K_t^{\alpha} L_t^{1-\alpha} h_t^{1-\alpha} \\ L_{t+1}h_{t+1} &= \frac{\beta\gamma(1-\gamma)(1-\alpha)(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma(1+\beta)[\alpha(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)]}\theta \left[\frac{\mu A\sigma(1-\alpha)}{1-\mu}\right]^{\mu} K_t^{\alpha\mu} L_t^{1-\alpha\mu} h_t^{1-\alpha\mu} \end{cases} \tag{27}$$

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

$$k_{t+1} = \frac{\alpha(A\sigma)^{1-\mu}}{\theta\gamma[\mu(1-\alpha)]^{\mu}(1-\mu)^{1-\mu}(1-\rho+\rho\varepsilon)} k_t^{\alpha(1-\mu)} \tag{28}$$

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

$$g_t^{Lh} = \frac{L_{t+1}h_{t+1}}{L_t h_t} \tag{29}$$

$$g_t^{K} = \frac{K_{t+1}}{K_t} \tag{30}$$

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

Definition 2. *A BGP is an equilibrium satisfying* ***Definition 1*** *and where the stock of physical and efficient units of labor grow at the same constant rate $g_{BGP} = g_t^K = g_t^{Lh}$. On the balanced growth path, $k_t = k_{BGP}$ is constant.*

Proposition 1. *According to the* ***Definition*** *2 there is a unique locally stable equilibrium, for which the values of k and g are:*

$$k_{BGP} = \left[\frac{\alpha(A\sigma)^{1-\mu}}{\theta\gamma[\mu(1-\alpha)]^{\mu}(1-\mu)^{1-\mu}(1-\rho+\rho\varepsilon)}\right]^{\frac{1}{1-\alpha(1-\mu)}} \tag{31}$$

$$g_{BGP} = \frac{\alpha\beta A(1-\alpha)(1-\gamma)(1-\rho)}{(1+\beta)\left[\alpha(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)\right]} \times \left[\frac{\alpha(A\sigma)^{1-\mu}}{\theta\gamma[\mu(1-\alpha)]^{\mu}(1-\mu)^{1-\mu}(1-\rho+\rho\varepsilon)}\right]^{\frac{1}{1-\alpha(1-\mu)}} \tag{32}$$

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. □

Finally, we conduct a comparative statics analysis in order to evaluate the effect of the different parameters on the growth rate and the ratio of capital to unit of efficient labor. First, we investigate how the growth of the economy, g_{BGP}, responds to a change in the different parameters of the model.

Proposition 2. *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 under the following conditions by the net gain from migration ε, the level of intergenerational transfers γ and the probability to migrate ρ.*

$$\frac{\partial g_{BGP}}{\partial \varepsilon} > 0 \iff \varepsilon < \frac{(1-\rho)(1-\gamma)}{\gamma\rho}$$

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

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

First of all there are some intuitive results which 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 a stronger economic growth on the BGP. An increase in β, the preference for the future, results in higher investments for the future through human capital or savings and subsequently to an increase in the economic growth.

Moreover, the model gives us some insights on the effects of the parameters on the demographic features described by the choice of natality and the human capital investments. First, the effect of ε, the net gain from migration, is not intuitive. There is a positive economic effect of ε according to a condition which is negatively correlated to the probability of migration, ρ, and the intergenerational transfer, γ ; despite the fact, that these three parameters enhance the gain from human capital investments for the parents. That means, that when the parameters that control the gain from migration – *i.e.* γ or ρ – are high the condition for a positive effect of ε on the economic growth is more restrictive. This comes from the substitution effect. Indeed, an increase in ε in a context where the incentive to invest in human capital is already high, leads to a too strong reduction in the savings and consequently to a decrease in the physical capital in the economy. In this context, the economic growth is hampered by the effect of ε. Otherwise, if migration or transfers are not too large, tha range of ε that leads to a gain for the domestic economy is wider.

The impact of the probability of emigration for the children is complicated because it results from different effects, especially on natality, the amount of savings and the adult population size. Indeed, an increase in the probability to emigrate creates an incentive to have more children through the effect of the net gain from migration. However, because there are more adults who leave the territory at the next period it can lead to a decrease in the number of units of efficient labor and thus to a reduction of the economic growth. Therefore, the migration effect on the capital stock is three-fold. First, by increasing the number of children, there is a rise in the rearing expenditures and thus a decrease in the savings. Second in some cases, there is the negative effect from the reduction of the population size and consequently from the smaller number of contributors to the capital stock. However, in other cases, migration could lead to an augmentation of the number of units of efficient labor – thanks to the stronger natality – and thus the capital stock can rise. Finally, by increasing the gain from migration income in the domestic area can be improved. Consequently, in a wealthier economy even if the share of savings is reduced, the capital stock is enhanced.

In conclusion, the positive effects from the parameters, γ, ε and ρ on the stock of units of efficient labor or the domestic income are higher than their negative impacts on physical capital, if they respect the conditions described in Proposition 5. Otherwise, the accumulation of productive capital is too slow and the economic growth is lessened on the BGP.

Now, we consider the effects of the different parameters on the capital to units of efficient labor ratio, k_{BGP}.

Proposition 3. *On the BGP, there is a negative correlation between k_{BGP} and all the parameters, except A and σ which have a positive effect on k_{BGP}.*

The positive effects of A and σ result respectively from the increase in the production and from the decrease in the number of children due to the extra cost – *i.e.* the decrease in the next generation size. The negative impact of the other parameters is explained by the increase in the number of units of efficient labor in the economy – with respect to ε, θ, γ. The effects of ρ are two-fold, first the substitution effect on savings and second the effect on economic growth which is negative for certain values of ρ.

In conclusion, it is clear that in these economies, it is possible to have a migration rate which has a negative impact on the economic growth because of the effect on capital market. Indeed, in some cases, investments in intergenerational transfers induced by migration can be too high and thus lead to a strong substitute to domestic savings. In this case, a special focus should be on capital market evolution and on the first periods of development. Indeed Caribbean states are developing or emerging economies. Thus it is necessary to scrutinize the path that leads to the BGP which describes the long-run behavior of the economy. Moreover the interpretation of the conditions of Propositions 5 and 3 is not simple. Therefore an numerical analysis is conducted for different Caribbean islands. We have two objectives, first we aim to characterize more precisely the BGP values for k^{BGP} and g^{BGP} according to the effect of the parameters. Secondly we try to describe the paths that lead to the BGP and to evaluate the accuracy of the model to describe the reality in selected islands.

5. Numerical analysis

This section deals with the transitional dynamics of five Caribbean SIDS: Barbados, Dominican Republic, Haiti, Jamaica as well as Trinidad and Tobago. The proposed theoretical analysis underlines the importance of the demographic characteristics of these countries to study the long-run development. Prior to this, in order to evaluate the use of this model toward economic development we need to study the first periods of the simulation. This model establishes a link between fertility on the one hand, and received remittances on the other. As such, it is well-suited as an analytical framework for Caribbean SIDS, given that these countries exhibit large flows in migration and remittances. In order to describe the dynamics of individual Caribbean countries, we need to assign specific numerical values to the model structural parameters in every aspect, and not just demographic dynamics 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.

Table 3 below reports the model's structural economic parameters, their respective economic interpretations, the support range for credible values as well as the calculation methods. We use data from the World Bank (2018) World Development Indicators (WDI) as well as the University of Pennsylvania World Table (PWT). The dataset is comprised of demographic and macroeconomic variables, which are then computed in ratios and steady-state expressions in order to match the empirical values of the model's structural parameters. For instance, we use real interest rates as provided by the WDI World Bank dataset to calibrate values for the discount factor β, while data on capital stock and productivity is compiled for the PWT dataset to provide numerical values for the technology level A and capital share of output α. We also use WDI to extract information needed to compute the emigration rate from natural birth rates and demographic growth rates. The section below discusses in details the methods by which we calibrate the numerical values of our model's structural parameters.

Table 3: Model structural parameters

Economic Parameters	**Range**	Method	Data source
Preference factor for the future	$\beta \in [0, 1[$	Calibration	WDI
Capital intensity in production	$\alpha \in [0, 1]$	*idem*	WDI & PWT
Technology level	$A > 0$	*idem*	PWT
Emigration rate	$\rho \in [0, 1]$	*idem*	WDI
Net gain from migration	$\varepsilon > 1$	*idem*	*idem*
Share of income remitted	$\gamma \in [0, 1]$	*idem*	*idem*
Efficiency - education	$\mu \in [0, 1]$	Estimation	WDI & PWT
Efficiency - human capital accumulation	$\theta > 0$	*idem*	*idem*
Cost of child-rearing	$\sigma \in [0, 1]$	Calibration	*idem*

5.1. Structural parameter values estimation and calibration

In order to take the proposed model to the data, we need to put forward a set of credible values for its structural parameters. The purpose of the calibration exercise is two fold: first, calibration ensures that the model performs credibly well for each parameter value with respect to the economies whose features we seek to replicate. Second, when the model proves to be able to match defining moments for the benchmark economy, it provides an adequate analytical framework, and thus predicts a set of relevant outcomes with respect to policy changes and instruments. As such, proper calibration can yield useful results for policymaking. Nonetheless, credible values for structural parameters are contingent upon available data. This is particularly the case for small emerging economies, such as the Caribbean islands.

Kydland and Prescott (1991) provide a comprehensive framework for discussing calibration in general equilibrium models. They insist on discipline as to how one chooses benchmark values for the structural parameters. They insist for instance that for agent behaviour, values should be drawn from panel studies on households and firms, or by using long-run averages as a proxy for the steady-state. Finally, they also argue that econometric estimation of optimality conditions can provide suitable alternatives. 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 use only macroeconomic variables for calibration. We are left with econometric estimations of structural parameters, with all the challenges involved, as delineated in Favero (2001). As mentioned before in Kydland and Prescott (1991), a naive econometric specification may yield statistically robust but incoherent estimates for structural parameters. 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 correspondant to the year 1970. The same constraints apply as to the number of SIDS countries to be included in our sample set. 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 other structural parameters of our model are calibrated and/or estimated using the following steps:

- 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 (13), in order to define human capital elasticity to education expenditure as follows:
$$\varepsilon^h(\mu) = \frac{\partial h_{t+1}}{\partial e_t}\frac{e_t}{h_t}$$
We regress logged future human capital h_{t+1} on education expenditure in logs 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 expenditure 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 households' 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. By contrast, Cooley and Prescott (1995) compute an alternative expression for the discount factor β, one that calls for additional parameters. Using the Euler equation at the steady-state, and assuming no growth in consumption, they calibrate a value of β that is function of capital share of output α, capital depreciation δ and the capital-to-output ratio k/y at the steady state. We retain the previous method as it is parsimonious in its use of data, and use the long-run interest rate averages for each country in our sample set. These 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 capita*l 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). Both countries have a comparatively higher level of human capital, and their respective economies, so any relevant comparison within our SIDS sample set needs to correct for differences in human capital. We obtain credible values for parameter α when we compute the output-to-capital ratio relative to human capital.

- 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 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 rolling average ratio of changes in the population that are not accounted for by births and deaths. This means that for each country in our sample set, we compute the rolling average of the following expression:

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

- 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 – in the total population. This allows us to compute the fraction of remittances that benefit the elderly in the recipient economy.

- σ is the individual cost of child-rearing, whose value is computed to match calibrated values for the parameters listed above, as well as those parameters μ, θ estimated using a mix of OLS regression and calibration. Recall that at the steady-state, n is exogenous, and is computed as the natural balance. Using the stead-state expression of equation (24), parameter σ writes:

$$\sigma = \frac{\beta(1-\mu)(1-\gamma)\gamma(1-\alpha)(1-\rho+\rho\varepsilon)}{(1+\beta)n\left[\alpha(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)\right]}$$

  We use the calibrated values for the other parameters, as well as the average 30-year rolling geometric mean over the 1970-2014 period for n. In this case, n is treated as an exogenous component in order to make use of empirical data from the WDI dataset.

Similar adjustments are carried out for the initial values for capital as well as output and efficient units of labor. Output is normalized to unity in 1970, and the capital stock is computed using capital-to-output ratio for the same year. The figures in Table 4 report harmonised initial values for physical capital for comparison purposes. The same calibration is computed for efficient units of labor, which are derived from normalized output and capital. We use the Cobb-Douglas equation (3) to deduce $L_0 h_0$ for a given K_0 and $y_0 = 1$. Finally, given that human capital is reported as an index in PWT, we retain the 1970 value for all five economies. We report all the economic parameters in Table 4 below:

5.2. Results

First of all, we conduct an analysis of the effect of the different parameters related to migration on economic growth. To do so, numerical simulations with different values of the studied parameter are computed ceteris paribus. The results are given in the Figures

Table 4: Calibrated values for structural parameters - SIDS Caribbean countries.

Parameters		**BRB**	**DOM**	**HTI**	**JAM**	**TTO**
Preference factor for the future	β	0.940	0.898	0.894	0.944	0.938
Capital intensity in production	α	0.340	0.361	0.225	0.312	0.208
Technology level	A	1.034	1.014	1	1.014	1.038
Education efficiency	μ	0.130	0.145	0.082	0.162	0.191
Efficiency of human capital accumulation	θ	5.025	5.301	3.863	4.898	4.861
Cost of rearing a child	σ	0.114	0.067	0.158	0.131	0.039
Emigration rate	ρ	0.370	0.183	0.160	0.490	0.374
net gain from migration	ε	1.91	9.68	51.00	6.58	3.030
Share of income remitted	γ	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
Labour	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 labour are given with a factor of 10^6

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

3 to 5. As expected inversed U-shaped curve are obtained for the scale of migration and the intergenerational transfer – *i.e.* ρ and γ. However, we find concave curves for the net gain from migration, ε, in all the islands except in Jamaica.

First, in Figure 3 for the net gain from migration, the calibrated values are smaller than the optimal values in terms of economic growth in Dominican Republic as well as Trinidad and Tobago. The value of ρ is almost optimal for Barbados and Haiti, while it is too high in Jamaica. Secondly, Figure 4 shows that the effect of ε was always positive on the studied interval except for Jamaica. Recall that the analytical results exhibit that ε has a positive impact on economic growth if its value is under a threshold which is negatively correlated to the values of the migration or intergenerational transfers. This is due among other things to the substitution effect between intergenerational transfers investments and savings which is too high if ρ or γ are large. The numerical simulations results show that the emigration rate and γ are not too high to have a large interval with positive effects from ε except in Jamaica where ρ is higher. Therefore, a high increase in ε will be profitable for all the studied countries except for Jamaica. Finally, the intergenerational transfer rate is almost at its optimum for the islands that has a strong emigration specialization while, the other countries could increase their economic growth with higher values of γ. This first analysis allow us to clarify some of the analytical results on the parameters effects for our studied countries. On a further step, we will study the trajectories of the economic development of the countries.

Economic results for the transitional period and the BGP are given respectively in

Figure 3: Analysis of the emigration rate: ρ

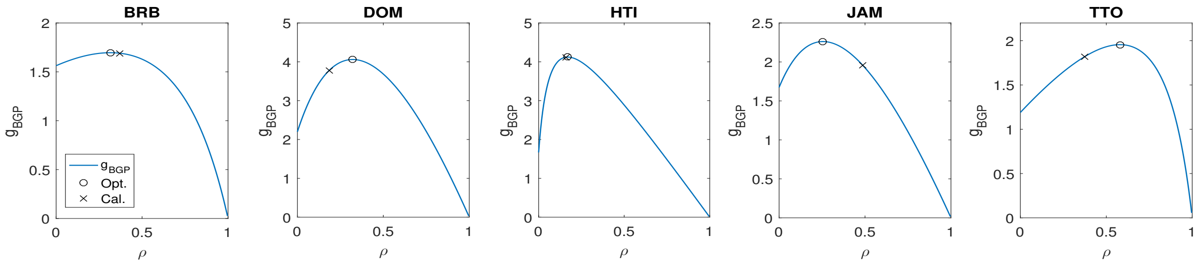


Figure 4: Analysis of the net gain from migration: ε

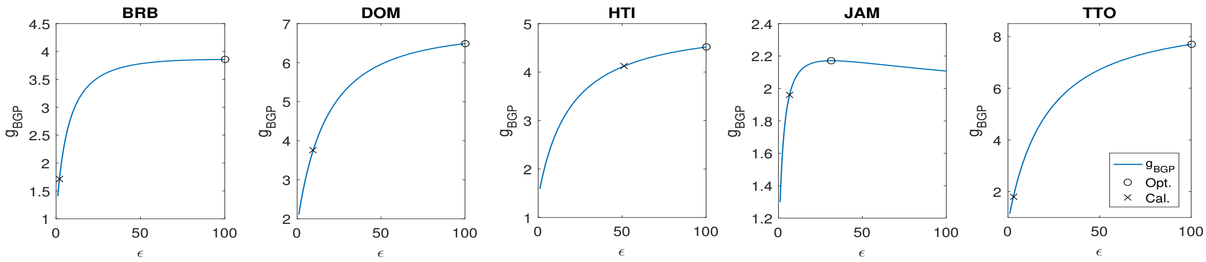
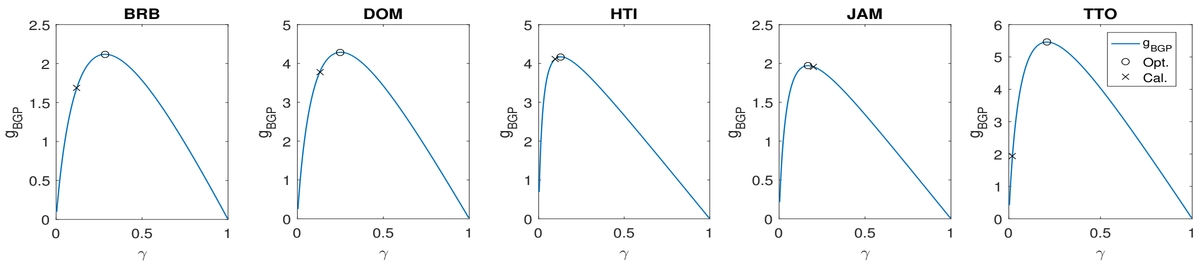


Figure 5: Analysis of the intergenerational transfers: γ



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

Figures 6 and 7 in logarithmic values and in the Table 5.[5] According to the model, the five economies are driven on the one hand by the amount of physical capital in the economy and on the other hand by the number of units of efficient labor. The respective weight of these two aspects will be given by the combination of the parameters in the equilibrium equation (equation (28)).

Table 5: Values of capital to units of efficient labor ratio and growth on the BGP

	BRB	**DOM**	**HTI**	**JAM**	**TTO**
k_{BGP}	0.018	0.003	0.004	0.003	0.039
g_{BGP}	1.691	3.772	4.119	1.958	1.819

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

First of all, the differences between the initial population size were important from the

[5]Each period is assumed to last twenty to thirty years

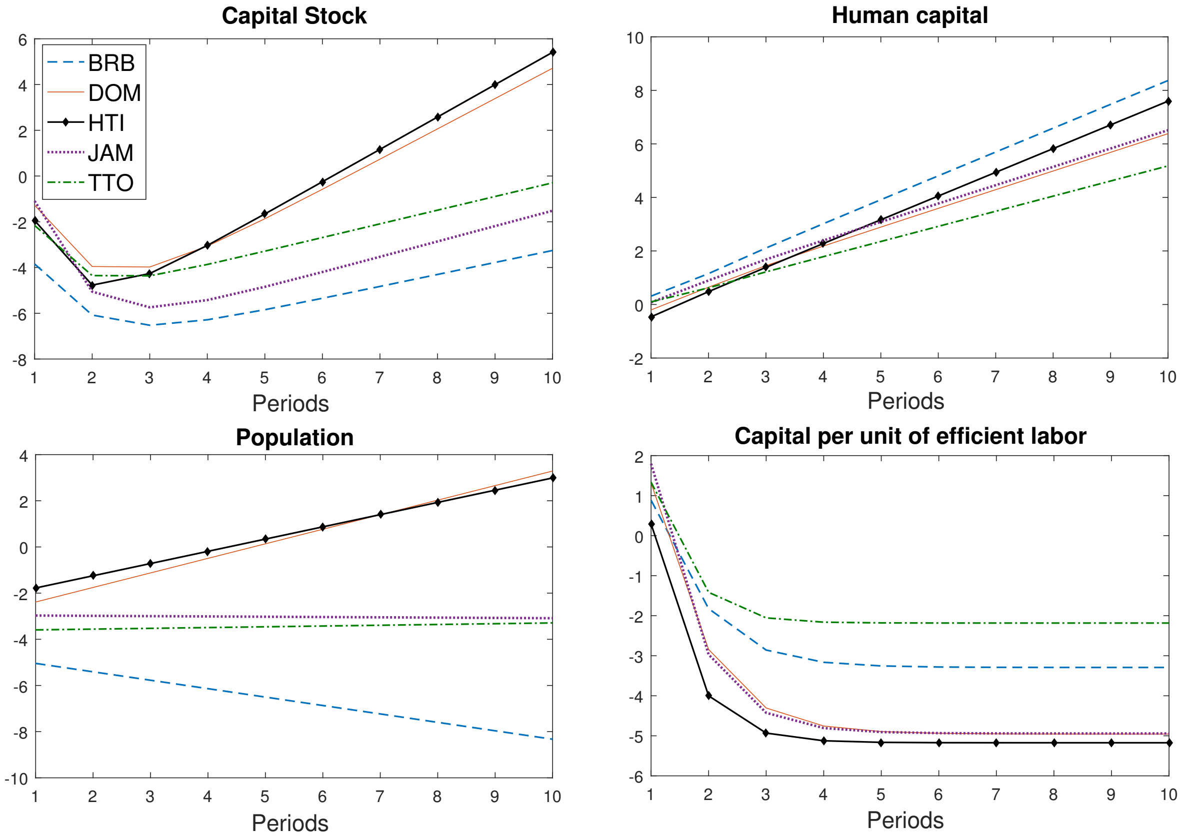
beginning and the calibration of σ has been set in order to reproduce the observed natality and the migration rate. Therefore it is more interesting to compare the human capital choices and the accumulation of physical capital, at a known level of population growth. It also appears that the strategy of human capital accumulation are different across all five islands. Indeed, in Barbados, the rhythm in human capital accumulation is very high, while in Trinidad and Tobago, human capital and its growth rate are smaller. Finally, Dominican Republic, Haiti and Jamaica converge to close level of human capital. For this first comparison, the model predicts that migration will act as an incentive to increase human capital in Jamaica, Haiti and Dominican Republic. In Trinidad and Tobago, where intergenerational transfers are smaller, human capital growth rate is lower.

Another explanation for the lower human capital accumulation in Trinidad could be the smaller cost for children-rearing compared to the other islands. Therefore, the trade-off between education and natality is decided by Trindidadian household in favour of having more children instead of investing in their education. In developing countries the effect of this trade-off could be explained by the theory developed in Becker (1981) which assumes that the fertility decline could occur only if the opportunity cost of raising children is stronger than the income effect from the children. The present model allow us to evaluate the stage of development in these economies in 1970. Here, even if the natality decreased since then, the Caribbean islands, and especially Trinidad and Tobago are not on a path that leads to an increase in the human capital in the domestic population according to the natality feature. In the other islands however, despite high natality, migration results in increasing education expenditure, creating an incentive to invest in human capital.

Finally, physical capital growth is reduced in the first periods, and is increased after the third period for the islands. The rank of the countries in terms of capital evolution changes significantly between the first periods and the last ones. Indeed, the countries where emigration is high and very profitable – such as Jamaica and Haiti – show a significant decline of capital growth in the first periods. We argue that the substitution effect induced by the migration between education or natality and savings may account for this feature in our model. This is well observed in the data for Haiti and Jamaica, both exhibit a larger share of remittances than savings in their GDP. The demographic features of these countries therefore lead to a larger increase in human capital or population size than physical capital. Moreover, in countries as Dominican Republic, or Haiti the physical capital stock increases after the fourth period, but this is due to the large population in these countries. Indeed, one should note that the population in Haiti or Dominican Republic is 5 or 10 times higher than the population size in Trinidad and Tobago of Barbados. Therefore, if we look at capital per units of efficient labor, Barbados and Trinidad and Tobago have much higher levels than Jamaica, Haiti or Dominican Republic. The demographic structure leads to a lower physical capital accumulation in countries dependent on remittances – *i.e.*, high levels of intergenerational transfer.

Barbados in particular is peculiar, because the emigration rate is quite high, however it does not create a strong incentive to migrate, because the net gain from migration, ε, is the smallest among the countries considered here and its γ value is average. Therefore even if emigration is an important feature of population growth, here it does not create a high incentive to substitute savings by education expenditures.

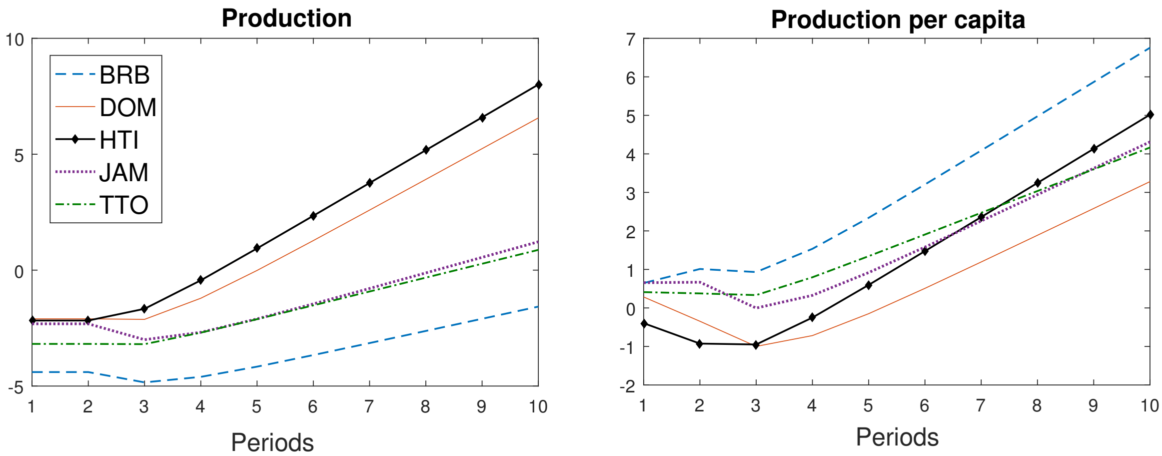
Figure 6: Evolution of the productive stocks



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

As we have assessed the impact of migration on the accumulation on productive stocks, it is possible now to analyse the economic growth on the short and long run. First of all, the level attained by the economies in terms of production depends significantly on the population size. Therefore, countries such as Haiti and Dominican Republic have a larger production stock, though it is due to a scale effect. When we look instead at production *per capita*, it is clear that Barbados as well as Trinidad and Tobago generate more production *per capita*. Second, in our model, Haiti shows a high level of production *per capita* on the long run. This is due to the smaller value of μ, the efficiency of education in the human capital dynamics. Indeed, in this case, the previous human capital impacts strongly the human capital dynamics. This induces a lower growth of human capital if h_t is small even if the education expenditures are significant. Nevertheless, on the long-run when the skills are high in the population, human capital increases almost by itself thanks to a smaller share of education expenditures in the process. Therefore, the long-run growth for Haiti is greater compared to the other countries. Note that this corresponds to cases without any depreciation of human capital. Third, while Jamaica and Dominican Republic were well ranked among our SIDS sample, they suffer from a stronger delay of economic growth in future periods, but not for the same reason. Indeed, as shown in the parameter analysis, migration is slightly to high in Jamaica, and that leads to a loss of economic growth. On the contrary, in Dominican Republic, the production *per capita* is lower because of the large size of the population. Indeed, this country is denoted by a smaller level of σ, the child-rearing cost. Therefore for this latter, migration leads to an incentive to increase the quantity of children instead of their human capital. Nevertheless, in the long-run, larger human capital or population size allow migration specialized countries to have a higher growth rate than the other islands. This is especially true if they are compared to Trinidad and Tobago, which has a lower economic growth on the long-run, while the short-run economic growth is higher. Finally, the demographic features of Barbados create a favourable economic environment that leads to an important gain in terms of human capital as well as physical capital and consequently in terms of production *per capita*.

Figure 7: Evolution of the production



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

In this model, we have explicitly assumed that market-clearing conditions on capital markets are acquired when interest rates are equated with the marginal returns of capital. We observe that in Caribbean countries with large migration flows, there is an incentive to invest in human capital, at the expense of physical capital. We now look into the implications of the existence of distortions on capital market.

6. Financial frictions - a simple setting

This section deals with capital markets and factors that may induce changes in physical and/or capital accumulation. If there are distortions on the capital market, its rental price will be affected. In particular, we assume that the interest rate return generated by adults in the first period is no longer equated to the marginal product of capital. Instead, we set a parameter φ as capital wedge, and write:

$$\tilde{R}_t = \varphi R_t \tag{33}$$

$$\tilde{R}_t = \varphi \frac{\partial Y_t}{\partial K_t} \tag{34}$$

Where $\varphi \in]0;1]$. This wedge corresponds to the effects described in Hayashi (1982) and Wang and Wen (2012), but it is introduced as an exogenous parameter. Therefore, we first start by checking if there is an empirical basis to this assumption by offering four econometric specifications. We write $R^\star$ the expected returns from the marginal productivity of capital and δ capital depreciation - static or time-variant. We list the proposed specifications as follows:

$$\tilde{R}_t = \varphi R^\star_t + \varepsilon_t \tag{35}$$

$$\tilde{R}_t = \varphi R^\star_t + \rho_r R^\star_{t-1} + \varepsilon_t \tag{36}$$

$$\tilde{R}_t = \varphi R^\star_t + \delta + \varepsilon_t \tag{37}$$

$$\tilde{R}_t = \varphi R^\star_t + \delta + \varepsilon_t \tag{38}$$

We then test for differences in estimated $\hat{\varphi}$, first as a statistically robust estimator for the capital wedge, and second, to test for regional differences by using the OECD group sample as the benchmark indicator.

Table 6: Regression results: ANOVA estimator of financial frictions.

Variable	(1)	(2)	(3)	(4)
Sub-Sahara Africa	-0.031	0.053	-0.034	-0.015
South Asia	-0.019	0.067	0.034	-0.013
Carribean	0.000	-0.059	-0.028	-0.184
E.Europe & Balkans	-0.013	0.129***	0.025	0.003
MENA	0.041	-0.091**	-0.091*	-0.147**
Latin America	-0.064***	0.070	-0.016	-0.024
Intercept	0.566***	0.415***	0.484***	0.513***
Sample size	123	123	123	123
R2	0.164	0.169	0.045	0.066
R2 Adjusted	0.12	0.126	-0.004	0.018
RMSE	0.063	0.148	0.196	0.215
RSS	0.467	2.548	4.436	5.364
Fisher	3.784	3.936	0.909	1.365
Log-Likelihood	168.185	63.894	29.803	18.116

Note: Mean groups are compared against OECD benchmark group. Coefficients reported in the table refer to mean differences. Legend: ***$\leq$1%, ** 5% and * 10%.

ANOVA regression results show that while the existence of financial frictions on capital markets is validated across all four specifications, the Caribbean sub-sample does not appear to exhibit statistically significant differences compared against the OECD benchmark regional group. Only Latin America and Eastern Europe & the Balkans appear to exhibit a statistically significant higher distortion on their respective capital markets. We interpret the result derived for our Caribbean sub-sample as both an empirical validation of our incorporation of financial frictions in our model, and the lack of differences with the OECD regional group as the size of financial frictions is not relevant in itself.

6.1. Theoretical analysis

Following this analysis, we have empirical evidence that distorsions in capital markets do exist, and proceed with incorporating them in our model. We introduce this distorsion $\varphi \in]0;1]$ in the maximization programs of the household and the firm to define the optimal choices and a new equilibrium. The firm profit writes:

$$\Pi_t = A\tilde{K}_t^{\alpha}(L_t h_t)^{1-\alpha} - w_t h_t L_t - \varphi R_t \tilde{K}_t = A\tilde{K}_t^{\alpha}(L_t h_t)^{1-\alpha} - w_t h_t L_t - \tilde{R}_t \tilde{K}_t \tag{39}$$

where $\tilde{R}_t$ is the interest rate of capital that includes the distorsion. Assuming that capital fully depreciates in one period, factor prices write as follows:

$$w_t = A(1-\alpha)\tilde{K}_t^{\alpha}(L_t h_t)^{-\alpha} \tag{40}$$

$$\tilde{R}_t = A\alpha\tilde{K}_t^{\alpha-1}(L_t h_t)^{1-\alpha} = A\alpha\varphi K_t^{\alpha-1}(L_t h_t)^{1-\alpha} \tag{41}$$

A relation between capital stock in the previous specification and in the new is:

$$\tilde{K}_t = \varphi^{\frac{1}{\alpha-1}} K_t \tag{42}$$

We suppose that the households have biased perceptions of the capital market and that they do not anticipate the distorsion. Their optimization program includes the interest rate without distorsion, R_{t+1}, subsequently FOC are not changed. However, when combined with factor prices in equations (40) and (41), we write:

$$\begin{aligned} R_{t+1} &= \frac{\gamma(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma}\frac{w_{t+1}h_{t+1}}{w_t h_t} \\ \Leftrightarrow A\alpha K_{t+1}^{\alpha-1}(L_{t+1}h_{t+1})^{1-\alpha} &= \frac{\gamma(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma}\frac{A(1-\alpha)\tilde{K}_{t+1}^{\alpha}(L_{t+1}h_{t+1})^{-\alpha}h_{t+1}}{w_t h_t} \end{aligned}$$

Replacing K_{t+1} and $\tilde{K}_{t+1}$ by their expressions in the precedent equation leads to the new optimal choices for the household:

$$s_t^* = \frac{\beta\alpha\varphi^{\frac{\alpha}{1-\alpha}}(1-\rho)(1-\gamma)}{(1+\beta)[\alpha\varphi^{\frac{\alpha}{1-\alpha}}(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]}w_t h_t \tag{43}$$

$$n_t^* = \frac{\beta(1-\gamma)(1-\alpha)(1-\mu)\gamma(1-\rho+\rho\varepsilon)}{\sigma(1+\beta)[\alpha\varphi^{\frac{\alpha}{1-\alpha}}(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} \tag{44}$$

Finally the MCC are not the same as in the previous specification since the distortion shows up on the future capital stock. We write the new dynamic conditions as follows:

Definition 3. *Given the initial conditions $K_0 \geq 0$, $L_0 \geq 0$ and $h_0 \geq 0$, the intertemporal equilibrium is the sequence (K_t, L_t, h_t) such that the following system is satisfied for all $t \geq 0$:*

$$\left\{ \begin{aligned} \tilde{K}_{t+1} &= \frac{\alpha\beta A\varphi^{-1}(1-\alpha)(1-\gamma)(1-\rho)}{(1+\beta)\left[\alpha\varphi^{\frac{\alpha}{1-\alpha}}(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)\right]}\tilde{K}_t^{\alpha}L_t^{1-\alpha}h_t^{1-\alpha} \\ L_{t+1}h_{t+1} &= \frac{\beta\gamma\theta(1-\gamma)(1-\alpha)(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma(1+\beta)\left[\alpha\varphi^{\frac{\alpha}{1-\alpha}}(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)\right]}\left[\frac{\mu A\sigma(1-\alpha)}{1-\mu}\right]^{\mu}\tilde{K}_t^{\alpha\mu}L_t^{1-\alpha\mu}h_t^{1-\alpha\mu} \end{aligned} \right. \tag{45}$$

The capital stock per unit of efficient labor is thus:

$$\tilde{k}_{t+1} = \frac{\alpha(A\sigma)^{1-\mu}\varphi^{-1}}{\theta\gamma(1-\rho+\rho\varepsilon)[\mu(1-\alpha)]^{\mu}(1-\mu)^{1-\mu}} k_t^{\alpha(1-\mu)} \tag{46}$$

Proposition 4. *According to the **Definition** 2 there is a unique locally stable equilibrium, for which the values of k and g are:*

$$\tilde{k}_{BGP} = \left[\frac{\alpha(A\sigma)^{1-\mu}\varphi^{-1}}{\theta\gamma(1-\rho+\rho\varepsilon)[\mu(1-\alpha)]^{\mu}(1-\mu)^{1-\mu}}\right]^{\frac{1}{1-\alpha(1-\mu)}} \tag{47}$$

$$\tilde{g}_{BGP} = \frac{\alpha\beta A\varphi^{-1}(1-\alpha)(1-\gamma)(1-\rho)}{(1+\beta)\left[\alpha\varphi^{\frac{\alpha}{1-\alpha}}(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)\right]} \times \left[\frac{\alpha(A\sigma)^{1-\mu}\varphi^{-1}}{\theta\gamma(1-\rho+\rho\varepsilon)[\mu(1-\alpha)]^{\mu}(1-\mu)^{1-\mu}}\right]^{\frac{\alpha-1}{1-\alpha(1-\mu)}} \tag{48}$$

According to these expressions a static comparative analysis is conducted in order to evaluate the effect of the capital market distortion φ on the BGP values for the capital per unit of efficient labor as well as the economic growth.

Proposition 5. *On the BGP, the capital per unit of efficient labor, $\tilde{k}_{BGP}$, and the economic growth, $\tilde{g}_{BGP}$, are negatively correlated to φ.*

Although the proposition above states that economic growth is positively correlated with capital market distortions – *i.e.* negatively correlated to φ – we should expect cross-country differences among the five Caribbean economies in our sample set. These differences can account for the dynamics of human and capital accumulation, and their respective incidences on growth. Moreover, because these countries are developing countries it is interesting to analyse the effects of the distorsion on the transitional dynamics. Therefore we conduct a numerical analysis.

6.2. Numerical analysis

The results for the numerical analysis are displayed in Figures 8 and 9. They show, that on the short-run, the distorsions on the capital market decrease the capital per efficient unit of labor and the economic growth, while on the long-run, the distorsion have a positive effect. We thus determine the value of φ for which economies are indifferent between long-run and short-run levels of capital per efficient unit of labor. We extract the estimated values for each of the five countries in our Caribbean sample from regressions run earlier. We then compare these empirical values for φ against those simulated "optimal" values of φ. The different values are reported on Table 7.

All countries share higher levels of simulated φ compared to their estimated values in the four specifications. This means that there are higher levels of distortions on capital markets than the model predicts. Nevertheless, the model predicts that if frictions are reduced, that is, each country increases its φ value closer to the optimal level, there is

Table 7: Capital market imperfections - estimated values for wedge parameter φ.

Countries	Estimated Values (1)	(2)	(3)	(4)	Optimal value
BRB	0.534	0.475	0.513	0.516	0.899
DOM	0.592	0.207	0.119	0.221	0.858
HTI	0.617	0.614	0.558	0.479	0.926
JAM	0.612	0.341	0.788	0.156	0.872
TTO	0.527	0.398	0.403	0.423	0.958

Figure 8: Long-run and short-run capital per unit of efficient labor

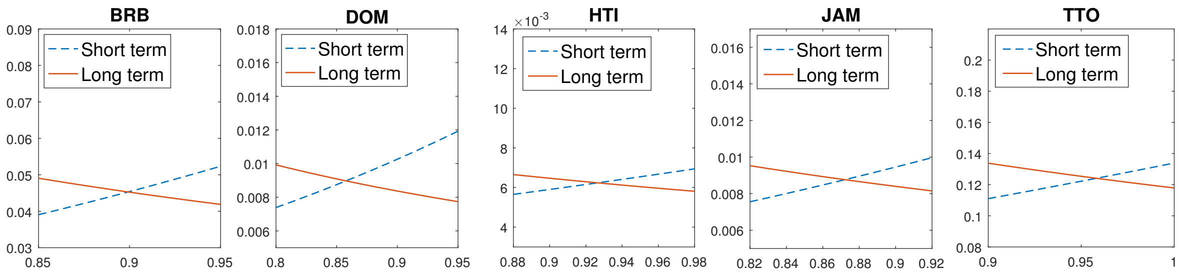
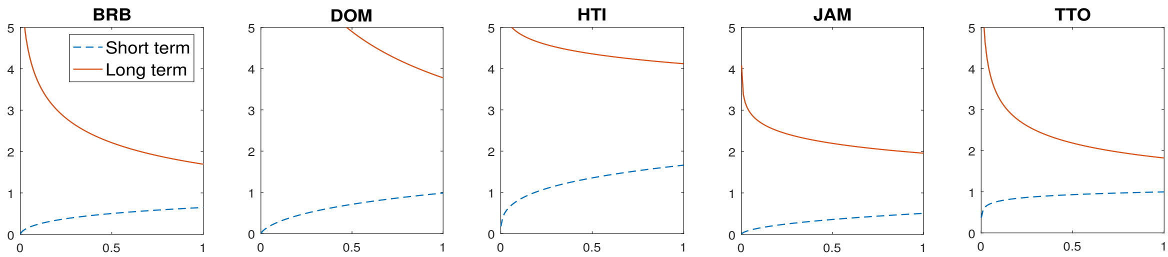


Figure 9: Long-run and short-run economic growth



NB: The value of φ is on the x-axis

a level of friction that leads to an indifference between long-run and short-run values of capital per unit of efficient labor. We also observe that there is a significant heterogeneity among estimated values for each country. Barbados and Trinidad & Tobago exhibit relatively robust estimators for φ, whereas the other countries exhibit significant differences, which suggests that the model does not account for all imperfections on capital markets in the other islands.

In the short-run, we observe that for all countries, a significant reduction in distortions would result in a lower level of capital per efficient unit of labor. It is worth pointing out that it does not mean necessarily that capital stock decreases because it is possible that human capital exhibits a higher growth rate, thus reducing the amount of capital per unit of efficient labor. However in that case, the is negative in terms of economic growth.

7. Conclusion

In this paper, we developed a simple overlapping generations model, to explain the process of the interplay between economic growth and investments in human and physical capital, according to the demographic structure of island economies. The analytical results allowed us to bring out the role of migration to explain choices of the parents in terms of natality, education and savings, knowing that intergenerational transfers were included in the budget constraint. These transfers were a key feature of our explanation of natality. Indeed, with the possibility to receive transfers and especially remittances from migrants, there was a strong incentive to have children. Thus, migration could have two opposite effect on the population size, a positive one through the higher number of children or a negative one because of the departures of the adults. These two opposite impacts could result in outcomes where the economic growth was increased but slower than the population size, which leads to a reduction of production *per capita*. Or on the contrary, a higher emigration rate could decrease the population size, but with an increasing production *per capita*. Indeed, the main mechanism resulted from the trade-off between savings and human capital investments, the larger was the incentive to invest in intergenerational transfer the lower was the amount of savings. In some cases, there was a compensation of the reduction in the savings by the size of the next adult generation which was the source of the capital stock. Then, the long-term economic growth *per capita* was sustained exclusively by the human capital accumulation or the population growth. In other cases, this compensation did not occur and the production was simply reduced. Thus, we established three conditions under which it was possible to have a gain from migration in terms of economic development. These conditions concerned the probability of leaving the country, the net gain from migration and the intergenerational transfers.

We developped a careful numerical analysis, with econometric estimation or calibration for the parameters for five islands, Barbados, Dominican Republic, Haiti, Jamaica as well as 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, islands as Dominican Republic, Haiti or Jamaica, had high rate of human capital accumulation and/or population growth in the first periods thanks to the migration. Nevertheless, due to the strong incentive created by migration potential gains, savings in these islands were low. This resulted in a reduction of the accumulation of physical capital in the short-run and in a negative effect on economic growth in the long-run for Jamaica. Second, in Trinidad and Tobago, due to the small level of intergenerational transfers, savings were prefered to human capital investments in order to fund old-age consumption. Moreover, the child rearing cost was smaller than in the other countries which resulted in a relatively high level of natality for the island. Therefore in this island the accumulation of physical capital is higher thanks to the increase in savings and the population growth. Finally, in Barbados, intergenerational transfers and migration were high, however the net gain from migration was lower than in the other countries. Therefore, in this country savings and education expenditures were important. In this situation the two productive capital stocks increased at similar rates.

The second part of this work was based on empirical evidence of a wedge on the capital market. Therefore, a distorsion linked to the inequality between the interest rate and the marginal returns to capital was introduced in the theoretical model and thus in the numerical analysis. In this section, we showed that the distorsion induced a trade-off between short and long-run growth and capital accumulation. Indeed, in the short-run the reduction of the distorsion led to an increase in these two variables for the five islands. While in the long-run, the distorsion led to a higher accumulation of capital and therefore to an increase in economic growth. Moreover we observed that the empirical value of the wedge was smaller that the optimal value, *i.e.* the value where the economies are indifferent between short and long-run capital per unit of efficient labor. Caribbean SIDS governments thus face a twin trade-off: on the one hand, long-run policies designed to reduce the effects of capital wedge generated a higher accumulation of physical capital, and had real-life applications as a selling point to attract Foreign Direct Investments (FDIs). On the other hand, there was a short-run cost to reducing human capital accumulation, thus affecting economic growth. Nevertheless, SIDS governments would benefit in the long-run from reducing the capital wedge at least up to the level where the economy is indifferent between short and long-run levels of capital per unit of efficient labor.

Relevant policymaking applications can be drawn from this paper. First, there are many structural parameters that can be made endogenous to the preferences of a benevolent social planner. For instance, the share of remittances to the elderly can be adjusted upward or downward. Similarly, the cost of child-rearing can be subsidized so as to maximize a given social welfare criterion set according to a Ramsey rule. With respect to developing and emerging countries such as Caribbean SIDS, institutional quality can also have a tremendous effect on natality, education and saving choices made by the household. Second, the government can also intervene in order to reduce the size of the capital wedge, either by improving capital markets, and/or subsidizing savings so as to reduce the distortionary effects of the said wedge. Finally, the government can also use taxation in order to achieve a given welfare objective. In this case, the social planner is willing to introduce distortions in order to achieve results that may contradict market-clearing conditions. We have seen that some Caribbean SIDS in our sample over-invest in human capital, which generates a long-run decline in their growth *per capita*. Governments in these economies can introduce distortions large enough to provide incentives for households to increase savings and investments in physical capital instead.

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Appendix A. The consumer's program

The consumer's program is summarized by equation (**??**). The first order condition (FOC) of the household's problem with respect to s_t shows the following standard relationship between adult consumption and old consumption:

$$\frac{1}{c_t} = \frac{\beta R_{t+1}}{d_{t+1}} \tag{A.1}$$

Similarly, the FOC of the household's problem with respect to education suggests that the remuneration from education and savings should be equal on the equilibrium, it leads to:

$$\frac{1}{c_t} = \frac{\beta\gamma\mu(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1}}{e_t d_{t+1}} \tag{A.2}$$

Finally, the FOC of the household's problem with respect to n_t the number of children leads to:

$$\frac{1}{c_t} = \frac{1}{\sigma w_t h_t + e_t}\frac{\beta\gamma(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1}}{d_{t+1}} \tag{A.3}$$

Combining equations (A.2) and (A.3) leads us to the optimal choice of education given by equation (14). Substituting education into equation (A.3) and combining with equation (A.1) leads to the relation between the future prices of the factors of production (15).

Defining x_t as the income allocated to future consumption and according to the value of education given by equation (14) we obtain:

$$x_t = s_t + \frac{\sigma w_t h_t}{1-\mu} n_t \tag{A.4}$$

Finally, using equations (15) and (14) we can rewrite the budget constraints as:

$$c_t = w_t h_t(1-\gamma) - x_t \tag{A.5}$$

$$d_{t+1} = x_t R_{t+1} \tag{A.6}$$

Replacing (A.5) and (B.6) in the FOC (A.1) we obtain a new expression of x_t:

$$x_t = \frac{\beta(1-\gamma)}{1+\beta} w_t h_t \tag{A.7}$$

Using the MCC, we deduce that:

$$k_{t+1} = \frac{K_{t+1}}{h_{t+1}N_{t+1}} = \frac{s_t}{(1-\rho)n_t h_{t+1}} \tag{A.8}$$

Moreover from equation (15) and the factor prices (equations (6) and (7)) we have:

$$k_{t+1} = \frac{\alpha w_t h_t \sigma}{h_{t+1}(1-\alpha)(1-\mu)\gamma(1-\rho+\rho\varepsilon)} \tag{A.9}$$

Therefore we can find a relationship between s_t and n_t:

$$n_t = s_t \frac{(1-\alpha)(1-\mu)\gamma(1-\rho+\rho\varepsilon)}{\alpha w_t h_t \sigma(1-\rho)} \tag{A.10}$$

Replacing expression (A.10) in x_t gives the optimal choices for savings and natality.

Appendix B. The impact of altruism on the household's choices

In this section, results are presented for a consumer program with altruism. This program is summarized by:

$$\begin{aligned}
\max_{c_t,s_t,e_t,n_t} U(c_t, d_{t+1}, n_t, w_{t+1}h_{t+1}) &= \ln(c_t) + \beta\left[\ln(d_{t+1}) + \xi \ln(n_t(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1})\right] \\
s.t \qquad c_t + s_t + n_t e_t &= w_t h_t(1-\gamma-\sigma n_t) \\
d_{t+1} &= s_t R_{t+1} + n_t\gamma(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1} \\
h_{t+1} &= \theta h_t^{1-\mu} e_t^{\mu}
\end{aligned}$$

where ξ is the altruism factor.

The first order condition (FOC) of the household's problem with respect to s_t does not change:

$$\frac{1}{c_t} = \frac{\beta R_{t+1}}{d_{t+1}} \tag{B.1}$$

The FOC of the household's problem with respect to education e_t includes now the altruism part:

$$\frac{1}{c_t} = \frac{\beta\mu}{e_t}\left[\frac{\gamma(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1}}{d_{t+1}} + \frac{\xi}{n_t}\right] \tag{B.2}$$

Finally, the FOC of the household's problem with respect to n_t, the fertility choice, becomes:

$$\frac{1}{c_t} = \frac{1}{\sigma w_t h_t + e_t}\left[\frac{\gamma(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1}}{d_{t+1}} + \frac{\xi}{n_t}\right] \tag{B.3}$$

Combining equations (B.2) and (B.3) leads to the optimal choice of education:

$$e_t^* = \frac{\mu\sigma}{1-\mu} w_t h_t N_t^{\delta} \tag{B.4}$$

Substituting the education choice into equation (B.3) and combining with equation (B.1) give a relation between the future prices of the production factors:

$$\frac{w_{t+1}h_{t+1}}{R_{t+1}} = \frac{\sigma w_t h_t}{\gamma(1-\mu)(1+\xi)(1-\rho+\rho\varepsilon)} + \frac{\xi}{\gamma(1+\xi)(1-\rho+\rho\varepsilon)}\frac{s_t}{n_t} \tag{B.5}$$

The FOC with respect to the savings gives:

$$s_t + n_t\frac{\sigma w_t h_t}{1-\mu} = \frac{\beta(1-\gamma)(1+\xi)}{1+\beta(1+\xi)} w_t h_t \tag{B.6}$$

At this point, the respective shares of investments in the children transfers or savings to fund old-age consumption are undetermined. Therefore, using the MCC (equations (18) to (20)) in the equation (B.5) allows to find a new relationship between s_t and n_t. Replacing this new expression in (B.6) gives the optimal choices of the household s_t^* and n_t^*:

$$s_t^* = \frac{\beta\alpha(1-\rho)(1-\gamma)}{(1+\beta(1+\xi))[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} w_t h_t \tag{B.7}$$

$$n_t^* = \frac{\beta(1-\gamma)(1-\mu)[\gamma(1-\alpha)(1+\xi)(1-\rho+\rho\varepsilon)+\xi\alpha(1-\rho)]}{\sigma(1+\beta(1+\xi))[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} \tag{B.8}$$

In this specification, if the altruism parameter ξ is equal to 0, the solutions are the same than in the canonical model. Second, a static comparative analysis shows that altruism impacts positively the fertility choice and negatively the savings. However, the sign of the derivatives of the savings or the fertility choices according to ε, ρ or γ are the same in the canonical model. Finally, the education expenditures are the same in the two models therefore, regarding to our topic it is not very useful to introduce altruism to study the migration impact even if is clear that the fertility choice cannot be reduced only to an economic bargain.

Appendix C. An economy with imports

In this section, results are presented for a consumer program with imports – noted m_{t+1}– in the utility, it is another consumption during old-age. It is not strictly an open economy because there are not price mechanisms, but it is a simple way to measure the potential impact of the main characteristics of Caribbean SIDS with respect to trade. Indeed, these economies are characterized by a high openness to trade but with a large negative trade balance. As stated earlier in this paper, a substantial share of remittances is used to fund consumption, here we introduce also the fact that a non-trivial fraction of household consumption is imported. However our aim is not to study the relative competitiveness of Caribbean SIDS compared to the rest of the world, but we attempt to give clear insights of the impact of remittances on capital dynamics if a share of the received amount is used to buy foreign products. Therefore in the present specification we introduce several assumptions. First, seniors choose between domestic consumption and imports according to a preference factor for local goods. Second, there is a complementarity between imports and local goods which comes from a preference for the variety. Finally, there is an extra cost for the imported goods.

Household's program is summarized by:

$$\begin{aligned}
\max_{c_t,s_t,e_t,n_t} U(c_t, d_{t+1}, m_{t+1}) &= \ln(c_t) + \beta\left[(1-\lambda_1)\ln(d_{t+1}) + \lambda_1 ln(m_{t+1})\right] \\
s.t \qquad c_t + s_t + n_t e_t &= w_t h_t(1-\gamma-\sigma n_t) \\
d_{t+1} &= s_t R_{t+1} + n_t\gamma(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1} - \lambda_2 m_{t+1}^{\lambda_3} \\
h_{t+1} &= \theta h_t^{1-\mu} e_t^{\mu}
\end{aligned}$$

where m_{t+1} is the consumption of imported goods, $\lambda_1 \in (0,1)$ is the preference for imported goods, $\lambda_2 > 1$ is the cost of these goods, and λ_3 a parameter that introduce a non-linearity in the cost structure for imported goods. Here we do not introduce any assumptions on the concavity or the convexity of the cost, in order to have a more general analysis. Moreover, in this specification we do not aim to study specifically importations in terms of preferences or costs, but simply to characterize their impacts on our main results.

By susbstitution, the utility function rewrites as :

$$U(e_t, s_t, n_t, m_{t+1}) = \ln[w_t h_t(1-\gamma) - n_t(w_t h_t \sigma + e_t) - s_t] + \\ \beta\left[(1-\lambda_1)\ln[s_t R_{t+1} + n_t \gamma w_{t+1} h_{t+1}(1-\rho+\rho\varepsilon) - \lambda_2 m_{t+1}^{\lambda_3}] + \lambda_1 \ln m_{t+1}\right] \quad \text{(C.1)}$$

The FOC of the household's problem with respect to s_t, n_t, e_t and m_t are:

$$\frac{\partial U(e_t, s_t, n_t, m_{t+1})}{\partial s_t} = -\frac{1}{c_t} + \frac{\beta(1-\lambda_1)R_{t+1}}{d_{t+1}} \quad \text{(C.2)}$$

$$\frac{\partial U(e_t, s_t, n_t, m_{t+1})}{\partial e_t} = -\frac{1}{c_t} + \frac{\beta\mu\gamma(1-\lambda_1)(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1}}{e_t d_{t+1}} \quad \text{(C.3)}$$

$$\frac{\partial U(e_t, s_t, n_t, m_{t+1})}{\partial n_t} = -\frac{1}{c_t} + \frac{\beta\gamma(1-\lambda_1)(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1}}{(\sigma w_t h_t + e_t)d_{t+1}} \quad \text{(C.4)}$$

$$\frac{\partial U(e_t, s_t, n_t, m_{t+1})}{\partial m_{t+1}} = -\frac{\beta(1-\lambda_1)\lambda_2\lambda_3 m_{t+1}^{\lambda_3}}{d_{t+1}m_{t+1}} + \frac{\beta\lambda_1}{m_{t+1}} \quad \text{(C.5)}$$

First of all, we study the trade-off between imports and domestic goods. It depends on the equation (C.5):

$$\frac{\beta(1-\lambda_1)\lambda_2\lambda_3 m_{t+1}^{\lambda_3}}{d_{t+1}m_{t+1}} = \frac{\beta\lambda_1}{m_{t+1}} \iff m_{t+1}^* = \left[\frac{\lambda_1 d_{t+1}}{(1-\lambda_1)\lambda_2\lambda_3}\right]^{\frac{1}{\lambda_3}} \quad \text{(C.6)}$$

Therefore, the elderly divide their revenue – which depends on their savings and the intergenerational transfers – between goods from the local industry and imports because of their complementarity. And the consumption of domestic goods d_{t+1} during old-age can be rewritten exclusively in terms of savings and transfers in the budget constraint:

$$d_{t+1} = \frac{\lambda_3(1-\lambda_1)}{\lambda_3(1-\lambda_1)+\lambda_1}\left[s_t R_{t+1} + n_t\gamma(1-\rho+\rho\varepsilon)w_{t+1}h_{t+1}\right] \quad \text{(C.7)}$$

Combining equations (C.3) and (C.4) leads to the optimal choice of education which is the same than in the precedent specifications:

$$e_t^* = \frac{\mu\sigma}{1-\mu} w_t h_t N_t^\delta \quad \text{(C.8)}$$

Substituting the education choice into equation (C.4) and combining with equation (C.2) give a relation between the future prices of the production factors:

$$R_{t+1} = \frac{\gamma(1-\mu)(1-\rho+\rho\varepsilon)}{w_t h_t \sigma} w_{t+1}h_{t+1} \quad \text{(C.9)}$$

From the FOC with respect to the savings and the new budget constraint given by the equation (C.7), we find a first relation between savings and natality:

$$s_t + n_t\frac{\sigma w_t h_t}{1-\mu} = \frac{\beta(1-\gamma)[\lambda_3(1-\lambda_1)+\lambda_1]}{\lambda_3 + \beta[\lambda_3(1-\lambda_1)+\lambda_1]} w_t h_t \quad \text{(C.10)}$$

At this point, the respective shares of investments in the children transfers or savings to fund old-age consumption are undetermined. Therefore, using the MCC (equations (18) to (20)) in the equation (C.9) as well as the price factors (equations (6) and (7)) allows to find a new relationship between s_t and n_t. Finally, combining this new expression with the equation (C.10) gives the optimal choices in terms of savings and natality:

$$s_t^* = \frac{\beta\alpha(1-\rho)(1-\gamma)[\lambda_3(1-\lambda_1)+\lambda_1]}{(1+\beta[\lambda_3(1-\lambda_1)+\lambda_1])[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} w_t h_t \quad \text{(C.11)}$$

$$n_t^* = \frac{\beta\gamma(1-\gamma)(1-\alpha)(1-\mu)(1-\rho+\rho\varepsilon)[\lambda_3(1-\lambda_1)+\lambda_1]}{\sigma(1+\beta[\lambda_3(1-\lambda_1)+\lambda_1])[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} \quad \text{(C.12)}$$

Consequently, according to the MCC, we can deduce the intertemporal dynamics and the equilibrium, knowing that the imports will change the savings and the natality in the same proportion according to the following quotient:

$$\Psi = \frac{[\lambda_3(1-\lambda_1)+\lambda_1]}{1+\beta[\lambda_3(1-\lambda_1)+\lambda_1]} \quad \text{(C.13)}$$

Definition 4. *Given the initial conditions $K_0 \geq 0$, $L_0 \geq 0$ and $h_0 \geq 0$, the intertemporal equilibrium is the sequence (K_t, L_t and h_t) such that the following system is satisfied for all $t \geq 0$:*

$$\begin{cases} K_{t+1} = \frac{\beta\alpha\Psi(1-\alpha)(1-\rho)(1-\gamma)}{[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} K_t^{\alpha} L_t^{1-\alpha} h_t^{1-\alpha} \\ L_{t+1}h_{t+1} = \frac{\beta\gamma\Psi(1-\gamma)(1-\alpha)(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma[\alpha(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)]}\theta \left[\frac{\mu A\sigma(1-\alpha)}{1-\mu}\right]^{\mu} K_t^{\alpha\mu} L_t^{1-\alpha\mu} h_t^{1-\alpha\mu} \end{cases} \quad \text{(C.14)}$$

In this specification, we can conclude that the introduction of imports does not change the capital to efficient units of labor ratio in the transition phase k_{t+1} or on the equilibirum k^{BGP} – these expressions are given respectively by the equations (28) and (31). However on the BGP and during the transition, the growth rates of the capital stock and the stock of efficient units of labor become respectively:

$$g^K = \frac{\beta\alpha\Psi(1-\alpha)(1-\rho)(1-\gamma)}{[\alpha(1-\rho)+(1-\alpha)\gamma(1-\rho+\rho\varepsilon)]} k_t^{\alpha-1} \quad \text{(C.15)}$$

$$g^{Lh} = \frac{\beta\gamma\theta\Psi(1-\gamma)(1-\alpha)(1-\mu)(1-\rho+\rho\varepsilon)}{\sigma\,[\alpha(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)]}\left[\frac{\mu A\sigma(1-\alpha)}{1-\mu}\right]^{\mu} k_t^{\alpha\mu} \quad \text{(C.16)}$$

Therefore we can deduce the growth rate on the BGP.

Proposition 6. *According to the **Definition** 2 there is a unique locally stable equilibrium, for which the growth rate expression is:*

$$g_{BGP} = \frac{\alpha\beta A\Psi(1-\alpha)(1-\gamma)(1-\rho)}{[\alpha(1-\rho)+\gamma(1-\alpha)(1-\rho+\rho\varepsilon)]} \times \left[\frac{\alpha(A\sigma)^{1-\mu}}{\theta\gamma[\mu(1-\alpha)]^{\mu}(1-\mu)^{1-\mu}(1-\rho+\rho\varepsilon)}\right]^{\frac{1}{1-\alpha(1-\mu)}} \quad \text{(C.17)}$$

In a static comparative analysis, we study the impact of the two factors λ_1 and λ_3 by studying the impact of the quotient given by the equation (C.13).

$$\frac{\partial \Psi}{\partial \lambda_3} = \frac{-\lambda_1}{[1+\beta[\lambda_3(1-\lambda_1)+\lambda_1]^2} \tag{C.18}$$

$$\frac{\partial \Psi}{\partial \lambda_1} = \frac{\lambda_3(1-\lambda_3)}{[1+\beta[\lambda_3(1-\lambda_1)+\lambda_1]]^2} \tag{C.19}$$

In conclusion, it is clear that that the introduction of imports does not change the trade-off between education or natality and savings, but changes the potential gain from the remittances for the domestic area in terms of growth. Therefore the capital to efficient units of labor ratio does not change in this specification and our explanations of the stronger accumulation of capital in some countries according to their demographic features remain the same.

Nonetheless, it is interesting to analyze the growth rate according to the cost structure of imports. Indeed, an increase in λ_3 leads in every cases to a decrease in g, however the positive impact of the weight of imports in the elderly preferences – *i.e.* λ_1 – depends on the costs characteristics. If they are concave (convex), an increase of the preference for imports will have a positive (negative) impact on the growth rate of physical or efficient units of labor stocks.

In consequence, taking into account the imports does not change our conclusions regarding the impact of migration and/or remittances on the evolution of the capital stock compared to the evolution of efficient units of labor. Here only the rythm of growth is modified because fewer resources stay in the domestic area, however all the decisions of the household are impacted in the same proportions by the imports structure, therefore the analysis is the same in an open or a closed economy.

Highlights

This paper adapts the standard OLG framework to model a small open economy with high migration. It describes household decision-making on education spending, consumption and savings where the elderly receives remittances and domestic transfers from the active generation. The paper analyzes the demographic dynamics in Caribbean SIDS and their effects on physical and human capital accumulation, through a theoretical model and numerical simulations. The model predicts the following:

- We show that the decision-making consumption schedule for the elderly is influenced by expected remittances from the next generation.
- Under specific conditions, we find a positive impact of migration on education investments, natality, human capital stock and production
- The substitution effect between savings and fertility and/or education expenditures induced by the migration is such that it may lead to a decline in physical capital accumulation.