Emigration and performance of developing countries

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Table of Contents

1. Introduction

Over the last decades, the economic aspects of emigration have been abundantly investigated by the economists. Indeed, the relationship between emigration and development is crucial to understand some of the disparities across countries. In addition, this relationship is bidirectional in the sense that development affects the emigration patterns and emigration affects the economic development of countries. In the literature, these bidirectional links have mainly been investigated separately. The strand that focuses on the determinants of emigration state that income level, employment probability and growth perspectives in the country of destination constitute the main incentives for potential migrants (Docquier *et al.*, 2014). In addition, Dao *et al.* (2018) argue that emigration increases with the economic development and then decreases after a certain point of development. Therefore, developing countries are most likely to be the countries with the highest emigration rates. This theory was first depicted by Zelinsky (1971). Indeed, he observed an inverted U-shaped relationship between emigration rates and economic development in cross-sectional data. This U-shaped curve is usually referred to as the *migration transition curve.* The strand that focuses on the effect of emigration on economic development claim that college graduates tend to be more mobile than the less skilled individuals and thus more prone to migrate towards countries that highly rewards skilled individuals (Docquier and Rapoport, 2012). Moreover, this positive selection rate decreases with the economic development (Docquier, 2018). Therefore, emigration tends to reduce the human capital stocks (brain drain) in the countries of origin that are considered as low income countries.

Based on these facts, we see that the developing countries were identified by the literature as being the countries with the highest emigration rates and thus, are more likely to suffer the loss of their high-skilled individuals on their economic development. Therefore, the aim of this study is to assess the effect of emigration on development in terms of income per capita and identify the implications for the developing countries. For that, we will use a database extracted by Docquier (2018) and use a Development Accounting model *à la* Jones (2014) based on a CES specification to quantify the output per capita for each country and to simulate the no-migration output per capita for each country. To assess the effect of emigration, we start with a scenario that mainly highlights the detrimental aspects of skill-biased emigration. We will see that under this scenario, emigration is prejudicial for almost all the countries. To this configuration, we will add one by one the main compensating mechanisms that are identified by the literature. They consist of the

remittances, the endogenized education decisions (brain gain due to the migration prospects) and the diaspora externalities which stimulate trade and Foreign Direct Investment (FDI). After including these three compensating mechanisms, we will see that a large amount of countries gain from a skill-biased emigration, especially the developing the ones, despite some remaining countries who still suffer losses in terms of income per capita.

The structure of this study is organized as following. Section 2 reviews the economic literature concerning the empirical and theoretical aspects underlying the topic of this study. Section 3 provides the main stylized facts about skill-biased emigration and presents the data that were used for the simulations. Section 4 presents the Developing Accounting model and its variants to reflect the effect of skilled-biased emigration under each scenario. Section 4 explains as well the calibration of the different variants of the parameters of the CES specification and defines the different elasticities encountered. Section 5 analyzes the results of each scenario's simulations. Section 6 draws the main conclusions about this study and mentions the main limitations about it.

2. Literature review

In this section, we review the literature concerning (i) the empirical part of this study in order to apprehend what kind of modelling and concepts are needed when we focus on a development accounting approach; and (ii) the theoretical part of this study in order to apprehend the current economic view on emigration and its main mechanisms.

The first part is devoted to the methodology and concepts that are used in this study in order to empirically assess the effect of emigration on the economic development of the countries in our sample. The second part is devoted to the literature concerning the evolution of the economic view about the emigration and its effect of the development; and to the literature concerning the three compensating mechanisms mentioned earlier.

2.1. The Development Accounting and framework

As mentioned in the introduction part, this study focuses on the economic implications that are implied by emigration. Development accounting models are used in order to assess the sources of income disparities across countries so that we can compare them. For this case, we focus on the economic disparities that are linked to the skill-biased emigration. These development accounting models will be used in order to quantify the effect of skill-biased emigration, i.e. the high-skilled migrants and the low-skilled migrants, on the income per capita for a country i. The model variants will then be calibrated, in a further section, depending on the observed characteristics for each country and other elasticities of substitution that will be fixed for each country.

2.1.A. The Constant Elasticity of Substitution (CES) specification

Concerning the model that will allow us to quantify the output of a country i, we follow the model based on Docquier (2018). It is a Constant Elasticity Substitution (CES) production function. This type of framework is a typical neoclassical production function widely used to account for economic growth. Docquier *et al.* (2013), construct a simple aggregate model, based on the CES framework, of an economy where the workers are differentiated by their place of birth (native versus foreign born) as well as their education (skill) levels in order to quantify the effect of migration flows on the labor markets of the OECD countries during the 1990s.

They highlight the fact that the CES framework allows them to assess the wage and employment effects of immigration of foreign workers into the country and of emigration of native workers to other countries. They explain that these movements alter the relative composition of workers of different education levels in a country. They argue that the CES framework shows that the main effects of migration patterns on employment and on wages of non-migrant natives depend crucially on the size and educational composition of immigrants and emigrants relative to non-migrants, as well as on the parameters of the model. Therefore, the CES framework helps explaining the wage disparities across workers with different education attainment. Typically, the factors of production used in this type of framework are labor and capital. However, for this study, we consider the two factors of production as being qualified workers and less qualified workers. The concept of elasticity of substitution is a measure of the ease with which the varying factor can be substituted for others (Hicks, 1932). This type of production function that we know today was presented by Arrow, Chenery, Minhas and Solow (1961) based on the seminal contribution of Solow (1956) where he first established the theoretical and econometric foundation of the CES production function. Over the years, numerous variants of the CES production functions have been used in the literature. Klump and Preissler (2000) identified four of them. The specification of Arrow *et al.* (1961) is represented by:

$$Y = C\left[\alpha K^{\frac{\sigma-1}{\sigma}} + (1-\alpha)L^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

Where C is an efficiency parameter, α is a restricted distribution parameter, K is the capital factor, L is the labor factor and σ is the elasticity of substitution between the two factors of production (Klump and Preissler, 2000). De La Grandville (1989) introduced a normalized version of the CES production function:

$$Y = C(\sigma)\left[\alpha(\sigma)K^{\frac{\sigma-1}{\sigma}} + (1-\alpha(\sigma))L^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

This normalized version aims at highlighting the common point of tangency between the various specifications of production functions. Klump and Preissler (2000) argue that by changing the value of σ (0,1 or ∞), we can retrieve the specification of other types of production functions such as the Cobb-Douglas production function (i.e. $\sigma = 1$), among others.

2.1.B. The Total Factor Productivity (TFP)

Besides the elasticity of substitution mentioned above, there is another parameter that is crucial in the neoclassical growth models. This is the Total Factor Productivity (TFP). In the specification mentioned earlier, this corresponds to the parameter C. However, in the following, we will refer to this parameter as "A_i". We thus consider that each country has a different TFP. This was proven by Prescott (1998). Unlike Caselli and Coleman (2006), we don't allow for A to vary between the two skilled-biased groups. As defined by Comin (2006), the Total Factor Productivity (TFP) is the portion of output not explained by the amount of inputs used in production. Therefore, this concept of TFP refers to the magnitude of efficiency and intensity as to how the different countries exploit their factors of production in the aggregate production, Y_i. Concerning its role in explaining the disparities in terms of income per capita, it turns out to be crucial. The literature over economic growth has extensively investigated the sources of these disparities. In a traditional production function, as the CES specification, the two main factors of production are the capital factor (K) and the labor factor (L). In his paper, Jones (2015) accounts for the contribution of the capital factor, labor factor and the TFP in the differences of income per worker between a set of countries, using the Penn World Tables data. He compares the GDP per worker of Mexico to the GDP per worker of the USA, which is approximately about one third of the USA's GDP per worker. He finds out that the share of the capital factor in explaining the economic disparity is little. The share of the human capital helps explaining a bit more the reason of the difference between the Mexican and American GDP per worker. However, the Total Factor Productivity is the largest explaining factor when we account for income differences across countries. We find similar results concerning the role of physical capital and human capital in Prescott (1998). Besides, he states that the neoclassical growth model accounts for differences across countries only if Total Factor Productivity differs across countries.

2.1.C. The role of human capital

As mentioned in the previous sub-section, we have seen in the literature that the contribution of the human capital is larger than the contribution of the physical capital in explaining the differences in terms of income per capita. To that, we can mention the contributions of Mincer (1981, 1984) and Barro and Sala-i-Martin (1992) who showed the major role of the accumulation of human capital in the economic growth. Therefore, it is important to investigate through to the literature related to this topic in order to identify how the accumulation of human capital affects

the economic growth. In his paper, Jones (2011) introduces a "generalized division of labor" aggregator which allows human capital stocks to be calculated with relatively little aggregation structure. This methodology allows for human capital stocks to be a central contributor in explaining the disparities across countries in terms of income per capita. Thanks to his estimate of human capital stocks, he no longer needs the TFP variation in order to account for cross-country variation in terms of income per capita. TFP is often presented as reflected the "ideas and/or institutions" of a country. Therefore, his view might be considered as an attempt to diminish the importance of the TFP in the economic growth. This is not the case if we consider that (i) the ideas are embodied in the factors of production and that (ii) this process of embodiment is influenced by the institutions themselves. In conclusion, the contribution of his paper lies in emphasizing the role of human capital in economic growth with respect to the role of the ideas and the institutions, captured by the TFP.

Benhabib and Spiegel (1994) investigate the role of human capital in economic development. They first use a traditional Cobb-Douglas production function with physical capital and human capital as being the two factors of production. First, they find out that the role of the human capital is insignificant in explaining per capita income growth. These results are inconsistent with the economic theory that claims that the accumulation of human capital is a prerequisite for growth. This inconsistency in their results is explained by Nelson and Phelps (1966). For them, treating the human capital as a simple factor of production is a source of mistake since we would be misspecifying its role by doing so. Benhabib and Spiegel (1994) use an alternative method to account for human capital in economic growth. For that, they use a model in which the human capital levels directly affect the TFP through two channels. The first channel is identified by Romer (1990a) which considers that the levels of human capital may directly influence the capacity of countries to innovate new technologies suited to domestic production. The second channel, identified by Nelson and Phelps (1966),who state that the levels of human capital affects the speed of adoption of technology from abroad and its diffusion. Therefore, Benhabib and Spiegel (1994) assume that the ability of a nation to adopt and implement new technology from abroad is a function of its domestic human capital stock. With this alternative way to take into account the role of human capital in economic growth, they reach three significant results. First, differences in the levels of human capital stocks influence the economic growth rates of countries for a long time. Second, a country which runs behind the technological leader but which

possesses a higher stock of human capital will eventually catch up and overtake the leader in a finite time period and, third, a country maintains its leadership over the time as long as its level of human capital stock remains the highest. However, more recently Deuster and Docquier (2018) found evidence that the effect of international migration on high level human capital accumulation is much smaller than the effects identified in the literature. They claim that on average, the net effect on human capital accumulation is very small in developing countries[1]. Therefore, we see that the contribution of human capital accumulation is variable according to the empirical method that is used.

2.2. The economic perspective about the effect of emigration

As mentioned in the introduction, this study focuses only on the effect of emigration on the economic development of countries. Therefore, in this section, we are going to review the literature concerning this strand of the economic theory. We start by presenting the evolution of the literature concerning the effect of emigration over the years. We then present a channel through which emigration could be beneficial for the developing countries but that is not included in our framework as a compensating mechanism.

2.2.A. Evolution of the economic research about the brain drain

Docquier and Rapoport (2012) survey about four decades of literature concerning the different views about the economic effect of brain drain. The first contributions to the economic literature about the phenomenon of brain drain go back to the late 1960s. The first publications on this topic concluded that the global effect of the skill-biased emigration was mainly neutral and that the free migration was positive for the world economy. These conclusions were explained by the fact that high-skilled migrants left some of their assets in their countries of origin, which balances the share of high-skilled and low-skilled work force in the resident population. In the 1970s, the second wave of publications concerning the effect of emigration broke off with the view stating that skill-biased emigration has a globally positive effect on the economic development. This new wave was mainly driven by Jagdish Bhagwati. He came out with a series of new models in order to assess the effect of brain drain on welfare. Authors, such as Bhagwati and Hamada (1974) and McCulloch and Yellen (1977), introduced domestic labor markets rigidities, informational imperfections, as well as scale and other types of externalities in order to highlight the

[1] Countries with low-income and middle-income

detrimental consequences induced by brain drain. Under this pessimistic view, high-skilled individuals' emigration was considered as increasing the economic disparities around the world. In this configuration, they estimate that rich countries get richer at the expense of poor countries since the richest drain out the college educated. Finally, the third wave of publications appeared in the late 1990s. Until then, both positive and negative effects of skill biased emigration on the countries of origin were identified in the literature. Therefore, the aim was to determine under which conditions does brain drain lead to a positive position or to a negative position in terms of development and global welfare in the countries of origin.

2.2.B. The temporary migration

Docquier and Rapoport (2012) mention a beneficial aspect of emigration that is not frequently investigated in the literature. This channel concerns temporary high-skilled migrants, which they call "returnees". They assert that temporary high-skill emigration is beneficial for the countries of origin in some cases. For instance, this temporary high-skilled emigration can be positive if a substantial amount of additional skills are accumulated abroad, if the returnees are directly or indirectly involved in the diffusion of new technologies in their countries of origin and if the perspective of temporary migration foster education investments ex-ante. Therefore, a positive contribution of temporary migration is likely to occur if the amount of time spent abroad is sufficiently short enough and if the differential in terms of productivity with the country of destination is neither too large nor too small.

Based on the recent literature about returnees, Docquier and Rapoport (2012) mention that, generally, return rates among high-skilled individuals tend to increase with home country skill prices and growth prospects. For instance, this is observed in the case of foreign students based in the USA (Kwok and Leland, 1982; Rosenzweig, 2008) and for students on abroad originally from the UK (Dustmann and Weiss, 2007). Another example is given by Mayr and Peri (2009) concerning the high-skilled individuals originally from Eastern Europe. They find that the human capital acquired by them while studying in Western European countries involves a higher premium when they are back in their countries of origin. Consequently, this increases the positive selection in return migration.

2.3. The compensating mechanisms

We now present the three main compensating mechanisms that will be developed in this study. Over the last decades, we saw that the literature has been considering that emigration and brain drain could have both positive and detrimental effects upon the economic development of origin countries. Therefore, it is crucial to identify through which channels brain drain could be offset or, even, overcome. For that matter, we are going to present the three main mechanisms that are developed in the existing literature.

2.3.A. The remittances

The remittances of emigrants is surely the main compensating mechanism for the loss of college graduates in a country of origin (Docquier, 2018). Adam JR and Page (2005) state that the international remittances sent back home by these migrant workers have a profound impact on the developing countries of Asia, Africa, Latin America, and the Middle East. In addition and according to the Global Development Finance (World Bank, 2004), official international remittances sent home by migrant workers represent the second most important source of external funding in developing countries.

Therefore, the role of remittances in the development of those countries is indisputable. Recently, scholars have claimed that the remittances from college graduates are supposed to replenish the loss of human capital stocks due to the brain drain (Docquier and Rapoport, 2012). Therefore, it is interesting to understand the remitting behavior of the high-skilled workers in a country of destination and also to determine if the amount of remittances is used to invest in acquiring education. Docquier and Rapoport (2012) ask the question whether high-skilled emigrants remit more than the low-skilled. We should expect to respond positively to this question for several reasons. Indeed, we can consider than these highly-skilled individuals have access to better-paid jobs, to a bank account and they are not illegal emigrants. To that, we can add the fact they are likely to repay their loans (to their families in the country of origin) via remittances. However, due to other reasons, we could also expect that high-skilled individuals remit less. For instance, we can consider that college graduates come from richer families and that they migrate with their entire families. These two aspects could lower the need for the high-skilled to remit money to their countries of origin. As a result, it is difficult to determine with certainty if the high-skilled remit less or more, on average. Concerning the use of these remittances, evidence from recent literature show that remittances potentially help in relaxing the credit constraints of the

households on physical and human capital investments. These results hold for remittances from both high-skilled and low-skilled individuals. Therefore, remittances sent by high-skill individuals may help to overcome liquidity constraints, stimulate education investments and reduce poverty at origin (Docquier and Rapoport, 2012; Adam JR and Page, 2005). Furthermore, the size of the effect depends on the amounts transferred and on their distributional impact as proven by Docquier and Rapoport (2012).

Concerning the evidence of whether the high-skilled remit less or more and the use of these remittances, several authors have investigated these questions. At a macro level, Faini (2007) finds out that the amount of remittances tends to decrease with the proportion of high-skilled individuals among a group of emigrants in a country of destination. Niimi *et al.* (2010) reach the same conclusion concerning the remitting behavior of the high-skilled. Therefore, in the light of these results, the negative aspect of brain drain cannot be offset by higher amounts of remittances (Faini, 2007). Furthermore, it is important to stress out the fact that these results were obtained with data on emigration to the OECD countries while the data on the amounts of remittances concerns all the countries where emigrants are, which could be a source of bias in the results. At the micro level, we can mention Bollard *et al.* (2011) who find out an unclear relationship between the education attainment and the possibility of remitting and a strong positive relationship between education and the amount remitted conditional on remitting. Overall, education is most likely to affect positively the remitting behavior of the emigrants.

In another publication, Docquier and Rapoport (2006) investigate the economics of the remittances. Their research is divided in a microeconomic and macroeconomic point of view. The microeconomic analysis focuses on the determinants of remitting whereas the macroeconomic analysis focuses on the growth effect of the remittances. Concerning the motivations (micro level), they identify a combination of (i) individualistic motives, such as the willingness to be altruistic and to exchange, and of (ii) familial motives, such as investing and insurance, for remitting. As far as the growth effect of remittances is concerned (macro level), they identify beneficial implications since remittances encourage access to self-employment and increase investment in small businesses. In addition and as stated earlier by Docquier and Rapoport (2012), they already highlighted the role of remittances in promoting higher educational attainment of children who are part of a household whose contains migrant members. They also investigate the effect of remittances on economic disparities. They find out that remittances tend

to lower the economic inequalities in communities with a long migration tradition. However, remittances tend to increase these inequalities among the communities when they are at the beginning of the migration process.

Concerning the growth effect of remittances, we can mention the results of Adam JR and Page (2005). They investigated the emigration and remitting behaviors, among others, from 71 developing countries to the USA and European countries that are part of the OECD. Their main finding is that migration and remittances have a strong and statistically significant impact on reducing poverty in the developing countries. Concerning the remittances and after instrumenting for the possible endogeneity of international remittances, they argue that a 10% increase in the amount of international remittances will lead to a decline of around 3.5% in the share of people living in poverty.

2.3.B. The brain gain

As defined by Beine *et al*. (2008), the term "brain drain" designates the international transfer of resources in the form of human capital and mainly applies to the migration of relatively highly educated individuals from developing to developed countries. With the brain gain mechanism, we consider the pre-migration human capital stock to be endogenous to the prospect and realization of migration (Docquier and Rapoport, 2012). Therefore, this compensating mechanism is significant since the prospect of emigration may induce potential migrants to invest more in education in order to benefit from the higher wages in the countries that valuate high-skilled workers. This is explained by Docquier and Rapoport (2012) where the high-skilled workers have a probability p to emigrate while the low-skilled workers have a probability normalized to zero. Furthermore, they argue that there are two conditions for a beneficial brain drain (BBD). First, the wage ratio (wage level in the destination country and wage level in the country of origin) should be low enough to generate strong incentive effects, but not so low that liquidity constraints on education investment become strongly binding. Second, the probability p to emigrate of high-skilled workers should be sufficiently low.

Beine *et al.* (2001) focus on the impact of migration prospects on human capital formation and growth, using cross-section data for 37 developing countries. Their findings at the macro level suggest that there are two impacts implied by migration opportunities. The first impact, potentially beneficial, is the "brain effect". This situation is characterized by the fact that migration opportunities encourage investment in education since it gives access to higher

expected return when the economy is open to migrations. The second impact, certainly detrimental, is the "drain effect". This situation is characterized by the fact that migration opportunities drain out a large share of the college educated individuals. Therefore, the impact of the migration opportunities depends on which of these two effects prevail. In addition, they identified the conditions for a BBD, i.e. when the "brain effect" dominates the "drain effect". First, a BBD would occur when the economy is originally closed to an underdevelopment trap and that migration probabilities are not too high. Second, a BBD would occur when the economy already exhibits a relatively high growth performance and that migration probabilities take intermediate values.

In another publication at macro level, Beine *et al.* (2008) use new data on emigration rates by education level to examine the impact of skill-biased emigration on the human capital accumulation in developing countries. Based on cross-section data of 127 developing countries, they estimate the net effect of the brain drain using counterfactual simulations for each country. Concerning the results, they find evidence of a positive effect of skilled-biased emigration prospects on the pre-migration human capital stocks in the sample of 127 developing countries. They find that the countries that beneficiate from the brain drain are characterized by low levels of human capital and by low-skilled emigration rates. While the countries that don't experience a BBD are characterized by high levels of human capital and by high-skilled emigration rates. It also appears that there are more losers due to the brain drain than winners and also the losses outcome the gains. Countries associated with losses in terms of income per capita are mainly small countries in Sub-Saharan Africa and Central America. Conversely, countries associated with gains in terms of income per capita tend to be highly populated and fast growth countries such as China, India and Brazil. Eventually, they find that the gains outweigh the losses, once the results are translated into numbers. As a result, they claim that there is an overall gain for developing countries as a whole. Based on their findings, they draw two conclusions concerning the brain drain and its impacts on the development of countries. First, brain drain involves an increase in the number of high-skilled workers in the labor force of the developing countries. This suggests empirical evidence against the pessimistic view concerning the impacts of brain drain at an aggregate level. Second, the brain drain involves major distributional effects among developing countries.

At the micro level, Deuster and Docquier (2018) state there is also a positive impact of emigration on the net stock of human capital in the countries of origin. To prove that, they mention several studies that investigate this relation at the micro level. For instance, we find that the prospect of migration induce an increase in the human capital stocks among certain minorities in some countries. We find evidence of that in Chand and Clemens (2008) on Fiji, Gibson and McKenzie (2011) on Tonga and Papua New Guinea, Batista *et al*. (2012) on Cape Verde, Shrestha (2017) on Nepal, and Theoharides (2017) on the Philippines. In order to identify the causal effects, these studies exploit survey data on education choices and migration intentions, micro data on education and exposition to migration by region, or quasi-natural experimental methods.

2.3.C. The diaspora externalities

We will now introduce the last compensating mechanism identified in the literature about the effect of emigration on development. In short, this part of the literature section focuses on the potential for migrants to reduce international transaction costs and to facilitate the flow of goods, factors and knowledge between the countries of destination and the countries of origin of emigrants (Docquier and Rapoport, 2012). Concerning the contribution of diaspora networks, sociological literature has investigated this topic as well. In particular, Gaillard and Gaillard (1997) and Meyer (2001) mentioned the role of high-skilled individuals in the diffusion of knowledge and technology across the world. As far as the term 'network' is concerned, Beine *et al.* (2011) define this term in those words: "stock of immigrants of own national background already resident in a given destination". From an economic point of view, many recent publications have investigated the link between migration and trade and Foreign Direct Investment (FDI). Evidence concerning the externalities of diaspora networks on the pattern of FDI have been showed. These externalities are mainly driven by the high-skilled individuals, especially for the case of FDI (Docquier and Rapoport, 2012). Therefore, Docquier and Rapoport (2012) sum up by stating that diasporas of high-skilled migrants in a country of destination reduce international transaction costs and facilitate the diffusion of knowledge and ideas. Furthermore, they promote technology diffusion, stimulate trade and FDI and contribute to improving domestic institutions. However, it is unclear whether these externalities mentioned before rely on the share of college graduates or on the absolute number of them among a diaspora in a country of destination.

Concerning the evidence at a macro level, Docquier and Rapoport (2012) report several publications that investigated the effect of migration and trade creation. These publications enhance the fact that diaspora networks are important to overcome informal trade barriers but without considering the contribution of the high-skilled individuals. Felbermayr and Jung (2009) use data on trade volumes and migration by education level. They find a positive relationship between bilateral migration and bilateral trade. However, they don't find significant differences across the different education groups. Next, Docquier and Rapoport (2012) investigate if migration and FDI are substitutes or complements. For that, they mention Aroca and Maloney (2005) who studied the flows of migrants between the border states of Mexico and USA. They found a negative relationship between low-skilled migration and FDI between the two countries. Docquier and Rapoport (2012) report another example with the study of Tong (2005). In this study, the author finds a positive relationship between ethnic Chinese networks and FDI in the South-East Asian countries and beyond, especially where the institutional quality is relatively high. Kugler and Rapoport (2007) use data on bilateral FDI and migration to investigate the relationship between migration and FDI for the USA with the rest of the world flows during the 1990s. They find a negative relationship between manufacturing FDI and current low-skilled migration, towards a given country. Concerning the high-skilled migration, they find a positive correlation between FDI in both the service and manufacturing sectors with the high-skilled individuals stocks in the USA.

Concerning the evidence at a macro level, Docquier and Rapoport (2012) report the publication of Foley and Kerr (2008). They quantify the links between high-skilled migrants in the USA and the FDI from the USA to countries of origin. For that, they use US data at firm-level on FDI and on patenting by ethnicity of the investors. They find clear evidence that the US firms with a significant proportion of workers from a certain ethnicity, who have been active in the patenting process, encourage FDI to the countries of origin of these workers.

As mentioned before, the diaspora externalities include the diffusion of knowledge and technology and also have an effect on the institutional quality and governance around the globe. For that, Docquier and Rapoport (2012) mention the publication of Kerr (2008) as evidence. He uses data on patent citation to investigate the transfer of knowledge from the USA to the countries of origin of the diaspora networks in the USA. He finds that there is a positive relationship between migration and technology in the countries of origin of these USA based

diaspora networks and mainly in the high-tech sector. The main findings that are reported in Docquier and Rapoport (2012) concerning the institutional governance aspect are the following. First, Li and McHale (2009) find that high-skilled individuals positively affect the political institutions in their countries of origin. However, they seem to affect negatively the economic institutions. The second main finding is from Spilimbergo (2009). He finds that migrant individuals promote democracy in their countries of origin if their foreign education was obtained in a democratic country. Indeed, the presence of foreign trained individuals in their countries of origin makes it difficult for authoritarian regimes to carry on since they have access to external media and foreign governments.

In their publication, Beine *et al.* (2011) focus particularly on the impact of diaspora on the composition and concentration of the future flows of migrants. Therefore, the emphasis does not directly concern the effect of these networks on development but concerns rather the characteristics of the upcoming migrants. However, the results of Beine *et al.* (2011) are important in order to understand which features attract more high-skilled individuals since they are those who impact more positively the development in their countries of origin. Beine *et al.* (2011) argue that the externalities of networks in a country of destination have an effect on the migration patterns such as the flow size, the skill composition and the concentration. These externalities operate through their effect on bilateral migration costs via two channels. The first one concerns the reduced costs in terms of assimilation and information for the newcomers. The second one concerns the family reunion programs which attract new migrants and lower the barriers of legal migration. Their results are obtained with the data of Docquier, Lowell and Marfouk (2009). Concerning the results, they explain that if the effects of networks are different according to the skill group then the size of the current diaspora in a country of destination will also determine the selection effects in terms of human capital levels. They show that assimilation and information costs constitute sources of positive selection since they diminish with human capital levels. So any factor that lowers these migrations costs will help increasing the flows of low-skilled migrants. In addition, they argue that when the size of the diaspora in the country of origin gets bigger, it causes that migrants rely less on an economic migration program and rely more on the family reunion programs. Therefore, the fact of being a high-skilled individual will be less relevant when the country of destination already hosts a significant diaspora from the same country of origin. As a result, they emphasize on the idea that countries with larger diaspora

will be more likely to attract low-skilled individuals than high-skilled individuals. Concerning the concentration of skill groups in countries of destination, it is more likely that unskilled migrants decide to migrate to fewer countries but in large number. As a result, countries of destination with large diaspora will tend to be more concentrated in terms of low-skilled individuals, with respect to the high-skilled individuals.

McKenzie and Rapoport (2010) investigate the role migration networks concerning the self-selection patterns of migration between the USA and Mexico. Their findings are in line with those of Beine *et al.* (2011). Indeed, they explain that as migration networks get larger, the share of low-skilled individuals in migration flows will tend to be higher than the share of high-skilled individuals. Conversely, small migration networks are associated with rather positive or neutral self-selection of migrants based on their educational level. This is due to the high costs of migration. Thus, larger migration networks are associated with lower costs of migration and induce negative selection since they attract low-skilled individuals.

3. Emigration by skill group: stylized facts

Before going through the stylized facts about emigration, we must present the data that were considered for this study. The data that were used for this study originally come from Artuç *et al*. (2015) for the year 1990 and from the **D**atabase on **I**mmigrants in **O**E**C**D (DIOC) described in Arslan *et al.* (2014) for the years 2000 and 2010. The aim of the DIOC is to provide useful data on migrants by country of origin that can be compared internationally. The DIOC 10/11 is the most up-to-date version of this database initiative, covering the 33 destination countries[2] that were part of the OECD in 2010. However, the simulations were done using the database of Docquier (2018). In this publication, he combined the two sources of data mentioned above in order to characterize the evolution of emigration rates between 1990 and 2010. In this database, we find data about 194 countries concerning the income level per capita, data on emigration and skill specific wage ratio.

Concerning the skill-biased migration rate, it is obtained with the following expression (Docquier, 2018):

$$m_i^s = \frac{M_i^s}{M_i^s + L_i^s}$$

Where m_i^s is the skill-specific emigration rate of country i, M_i^s is the number of migrants in the OECD destinations from country i and L_i^s is the number of the resident population in country i. M_i^s and L_i^s are extracted by Docquier (2018) based on the data from Artuç *et al*. (2015) and from Arslan *et al.* (2014).

The study focuses only on emigration to the OECD countries and on emigrants who are aged 25 and over. Based on the definition of Docquier and Marfouk (2006), a high-skilled individual is defined as "a foreign-born individual, aged 25 or more, holding an academic or professional degree beyond high-school (i.e., a "college graduate") at the census or survey date". Concerning the simulation part, only the data for the year 2010 were considered.

The data from Artuç *et al.* (2015) and from Arslan *et al.* (2014) were used to construct **Table 2.2** as in Docquier (2018). This table provides the aggregate stock of migrants and the skill groups' emigration rates classified by income group, by country size and by region for the years 1990, 2000 and 2010.

[2] 36 countries in 2018 (Source : OECD)

First, we can see that the total stock of migrants more than doubled between 1990 and 2010. We find the highest stocks in countries with upper-middle income, in highly populated countries and in Western Europe. This region accounts, by itself, for 18% of the emigration to the OECD countries in 2010 while North America (USA and Canada) accounts for 2%.

Concerning the skill-specific emigration, we notice that high-skill migration rate, m_h, increased in low-income countries and low populated countries. The latter feature is illustrated by the high-skilled migration rate of the Caribbean countries and Pacific islands where the rates were, respectively, of 32.7% and 27.5% in 2010. However, these rates both declined since 1990. As for low-skilled migration rate, it increases in high-income countries and low populated countries. Caribbean countries and Central America have the highest rates of low-skilled migration of approximately 14%. Based on these figures, we can say that high-skilled migrants are more mobile than the low-skilled ones.

Worldwide, college graduates migrate three times more than the less educated. This brain drain is exacerbated mostly in low-income countries where the selection rate is around 18. This means that in low income countries, the college graduates are prone to migrate around 18 times more than the low-skilled individuals.

In addition, if the migration rate of college graduates globally decreased in the world between 1990 and 2010, we observe the opposite pattern concerning the less educated people since it increased for all classifications (by income group and by country size) and for almost all of the regions (except Western Europe).

Table 2.2 - Emigration stocks and rates to OECD destination countries

	Total stock (x 1000)			Rate low-skill (As %)			Rate high-skill (As %)		
Year	1990	2000	2010	1990	2000	2010	1990	2000	2010
World	40,717	58,585	81,449	1.3	1.5	1.7	5.2	4.7	5.1
By income group									
High-income	19,570	22,369	26,286	2.7	3.0	3.0	3.9	3.3	3.7
Upper-middle	11,708	20,238	30,229	0.9	1.3	1.6	6.4	5.5	5.1
Lower-middle	8,791	14,739	22,679	0.9	1.1	1.3	8.5	8.4	8.1
Low-income	649	1,240	2,255	0.5	0.8	1.1	16.4	16.2	18.0
By country size									
High pop	25,603	37,997	52,565	0.9	1.1	1.2	4.0	3.8	4.2
Upper-middle	6,919	9,714	14,204	2.9	3.6	4.3	10.2	8.8	9.4
Lower-middle	6,683	8,880	12,064	4.7	5.5	6.2	12.1	10.5	10.4
Low-pop	1,511	1,994	2,617	8.0	9.3	9.9	28.2	24.5	22.1
By region									
Africa									
Northern	2,016	3,274	4,687	3.1	3.6	4.0	10.8	10.7	9.2
Sub-Saharan	1,375	2,414	4,250	0.5	0.7	0.9	14.1	13.0	11.9
Americas									
Caribbean	1,951	3,055	3,926	9.3	13.2	13.8	43.6	34.6	32.7
Central	3,484	8,166	12,221	6.8	12.2	13.8	13.6	9.4	10.2
South	1,628	3,100	5,214	0.8	1.4	1.9	4.8	4.0	4.5
USA & Can	1,428	1,660	1,905	0.6	0.9	0.7	1.0	0.8	0.9
Asia									
Eastern	1,288	2,248	3,399	0.1	0.1	0.2	2.0	2.4	2.3
South-Cent	1,726	3,302	6,353	0.2	0.3	0.4	3.2	4.4	5.2
South-East	2,583	4,207	5,979	0.8	1.1	1.2	10.8	7.4	6.2
Middle East	2,760	3,840	5,230	2.6	2.8	2.7	10.4	7.4	6.4
Europe									
Eastern	6,644	8,558	12,488	4.3	5.4	7.4	9.5	9.5	11.6
Western	13,304	13,972	14,742	4.5	4.4	4.1	8.4	7.4	7.1
Oceania									
Australia & NZ	397	565	753	2.6	3.4	3.4	4.3	4.3	5.2
Pacific islands	133	223	303	4.1	5.5	5.6	47.2	39.7	27.5

Note: Table 2.2 focuses on emigration to OECD countries only. For income groups[3] and regions, we use the World Bank classification. For country size, I distinguish between countries with population above 25 million (High-pop), between 10 and 25 million (Upper-middle), between 2.5 and 10 millions (Lower-middle), and below 2.5 million (Low-pop).

[3] High income: >12,056$
Upper-middle: 3,896$-12,055$
Lower-middle: 996-3,895$
Low-income: <995$
(Source: World Bank)

4. A development accounting model

4.1. The variants of the model

In order to assess the effect of skilled-biased emigration in terms of income per capita in the countries of our sample, we need a framework that allows us to quantify the output per capita. As presented in the literature review, the model used in this study is based on a CES (Constant Elasticity Substitution) production framework as developed in Docquier (2018). This type of framework allows comparing countries in terms of macroeconomic performances and wage inequality for each skill groups. In addition, a rise of human capital in this type of framework will be followed by an increase in the average output per capita since high-skilled workers are more productive that the low-skilled ones. We first start by presenting the general model (Eq.1). We then present the different variants of this model in order to reflect the specificities of each scenario (the common and pessimistic views) and to take into account the contributions of each compensating mechanism. The parameters A_i and θ_i, which will be defined shortly after, will bear different values throughout the different variants due to the different scenarios and compensating mechanisms. Their calibrations will be presented in the next section (4.2).

The following CES technology describes the level of income per capita (y_i) and the wage rate for each skill group (w_i^s) in country i as a function of the skill composition of its own population.

$$y_i = y_i(h_i^L) = A_i \left[\theta_i (h_i^L)^{\frac{\sigma-1}{\sigma}} + (1-\theta_i)(1-h_i^L)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \quad (1)$$

$$\frac{w_i^h}{w_i^l} = \frac{\theta_i}{1-\theta_i}\left(\frac{h_i^L}{1-h_i^L}\right)^{\frac{-1}{\sigma}} \quad (2)$$

Where h_i^L denotes the share of college graduates in the resident labor force, A_i represents the Total Factor Productivity (TFP), θ_i denotes the preference of firms for high-skilled workers and the parameter σ stands for the elasticity of substitution between high-skilled and low-skilled workers. This last parameter will be further detailed in the next section concerning the calibration of the parameters.

In order to assess the effect of emigration on income per capita, we need to know the actual share of college graduates in the resident labor force (h_i^L). This share depends on two figures: (i) the share of college graduates in the native population (h_i^N) and on (ii) the migration rates of each

skill group (m_i^s). h_i^N is found in the database of Docquier (2018) we have on the countries and m_i^s is detailed in the previous section.

Therefore we have:

$$h_i^L = \frac{h_i^N(1-m_i^h)}{h_i^N\left(1-m_i^h\right)+(1-h_i^N)(1-m_i^l)} \tag{3}$$

We can now use Eq. (1) to simulate the situation in terms of income per capita in country i with no emigration (y_i^{cf})[4]. To do that, we use the share of college graduates in the native population (h_i^N) instead of the share of college graduates in the resident labor force (h_i^L):

$$y_i^{cf} = y_i(h_i^N) = A_i\left[\theta_i(h_i^N)^{\frac{\sigma-1}{\sigma}} + (1-\theta_i)(1-h_i^N)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{4}$$

We then compare this no-migration counterfactual level of income per capita, $y_i(h_i^N)$, to the actual level of income per capita, $y_i(h_i^L)$. We can express the difference between the no-migration situation and the actual one in percentage *à la* Jones (2014):

$$\Delta_i = \frac{y_i(h_i^L) - y_i(h_i^N)}{y_i(h_i^N)} = \frac{y_i - y_i^{cf}}{y_i^{cf}} \tag{5}$$

The interpretation of the result is straightforward. A positive result stands for an improvement of the level of income per capita. Thus, emigration has an overall positive effect in country i. While a negative result stands for a deterioration of the level of income per capita. Thus, emigration has an overall negative effect in country i.

4.1.1. The common view

Based on these expressions, the counterfactual with no migration's economy production under the common view is described by:

$$\mathrm{y}_i^C = y_i(h_i^N) = A_i\left[\theta_i(h_i^N)^{\frac{\sigma-1}{\sigma}} + (1-\theta_i)(1-h_i^N)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{6}$$

And the effect of emigration in terms of income per capita is given by:

$$\Delta_i^C = \frac{y_i - \mathrm{y}_i^C}{\mathrm{y}_i^C} \tag{7}$$

[4] « cf » stands for counterfactual.

4.1.2. The pessimistic view

Based on the CES framework of Eq.4, we now assume two schooling externalities in order to take into account the pessimistic view of the brain drain.

$$A_{P,i} = A_{0i}\left(\frac{h_i^L}{1-h_i^L}\right)^{\epsilon} \tag{8}$$

$$\frac{\theta_{P,i}}{1-\theta_{P,i}} = R_{0i}\left(\frac{h_i^L}{1-h_i^L}\right)^{\kappa} \tag{9}$$

Equation (8) corresponds to a simple Lucas-type, aggregate externality (Docquier, 2018; Lucas, 1988). We assume that the scale of total factor productivity (TFP), A_i, is a concave function of the skill-ratio in the resident labor force, h_i^L. This externality captures the idea that college educated workers tend to smooth the technological innovation and the adoption of advanced technologies (Benhabib and Spiegel, 1994; Caselli and Coleman, 2006; Ciccone and Papaioannou, 2009; Docquier, 2018).

Equation (9) corresponds to the skill-biased technical change that affects the relative productivity of high-skilled workers (Acemoglu, 2002; Docquier, 2018; Restuccia and Vandenbroucke, 2013).

Therefore, the counterfactual with no migration's economy production under the pessimistic view is described by:

$$\mathrm{y}_i^P = y_i(h_i^N) = A_{P,i}^{NE}\left[\theta_{P,i}^{NE}(h_i^N)^{\frac{\sigma-1}{\sigma}} + (1-\theta_{P,i}^{NE})(1-h_i^N)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{10}$$

And the effect of emigration in terms of income per capita is given by:

$$\Delta_i^P = \frac{y_i - \mathrm{y}_i^P}{\mathrm{y}_i^P} \tag{11}$$

4.1.3. The remittances

To take into account the effect of the remittances on the income per capita, we simply add the share of the remittances in the GNP of each country to the result obtained in the pessimistic view. It is important to note that we consider now the national income since we included transfers from abroad in the ouptput. Therefore, the effect of emigration in terms of income per capita is given by:

$$\Delta_i^{Rem} = \frac{y_i - \mathrm{y}_i^P}{\mathrm{y}_i^P} + \frac{Rem._i}{Y_i} \tag{12}$$

Where $Rem._i$ stands for the amount of remittances perceived by the country i in \$.

4.1.4. Endogenized education decisions (Brain gain)

For this compensating mechanism, we need to derive an alternative no-migration counterfactual level of human capital, h_i^N, before migration. This counterfactual involves a smaller pre-migration human capital level. We find the no-migration counterfactual level of human capital, h_i^N, expression in Beine *et al*. (2008):

$$h_{N,i} = h_i^{N_0} \left(\frac{m_H}{m_L}\right)^{\eta} \tag{13}$$

The counterfactual with no migration's economy production including the effect of the brain gain under the pessimistic view is described by:

$$y_i^{BG} = y_i(h_{N,i}^{NE}) = A_{BG,i}^{NE} \left[\theta_{BG,i}^{NE}(h_{N,i}^{NE})^{\frac{\sigma-1}{\sigma}} + (1-\theta_{BG,i}^{NE})(1-h_{N,i}^{NE})^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{14}$$

And the effect of emigration in terms of income per capita is given by:

$$\Delta_i^{BG} = \frac{y_i - y_i^{BG}}{y_i^{BG}} + \frac{Rem.}{y_i} \tag{15}$$

4.1.5. The diaspora externalities

For the last compensating mechanism, we consider that the business links, trade and FDI induced by a diaspora network in a country d, directly affects positively the Total Factor Productivity (TFP), A_i, in the country of origin i.

This effect is extracted from Docquier (2018) and is described by:

$$A_i^D = A_{0,i}\left(\frac{h_i^L}{1-h_i^L}\right)^{\epsilon}(1+\rho m_i) \tag{16}$$

The counterfactual with no migration's economy production including the effect of the diaspora externalities under the pessimistic view is described by:

$$y_i^{BG} = y_i(h_{N,i}^{NE}) = A_{D,i}^{NE} \left[\theta_{BG,i}^{NE}(h_{N,i}^{NE})^{\frac{\sigma-1}{\sigma}} + (1-\theta_{BG,i}^{NE})(1-h_{N,i}^{NE})^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{17}$$

This externality is directly included in the previous result in this way:

$$\Delta_i^D = \frac{y_i - y_i^{BG}}{y_i^{BG}} + \rho m_i \quad (18)$$

4.2. The calibration

In this section, we will present how the different parameters and elasticities introduced in the section 4.1 were calibrated in order to assess the implications under each scenario based on the schooling externalities and the compensating mechanisms that will serve for the simulations.

For each scenario, we first start by defining the elasticities that were mentioned in the expressions of the previous section and that will be mentioned hereafter. We then present how the parameters were calibrated with reference to the model variant considered.

4.2.1. The common view

The main elasticity that we encountered is the elasticity of substitution between college-educated and less educated workers, σ. We find in the labor market literature that the value of σ varies between 1.5 and 3 (Ottaviano and Peri, 2012; Angrist, 1995). For this study, we fixed the value of σ = 2 in line with Docquier (2018).

In what follows, we calibrate the parameters of Eq.(6). In this scenario, we consider the different parameters as exogenous. For the calibration of θ_i, the preference of firms for college graduates workers, based on equation (2), we have that σ is fixed. So θ_i has to match the wage inequality level (w_i^h/w_i^l)[5].

Therefore:

$$\theta_i = \frac{(w_i^h/w_i^l).SRL_i^{\frac{1}{\sigma}}}{1 + (w_i^h/w_i^l).SRL_i^{\frac{1}{\sigma}}}$$

Where:

$$SRL_i = \left(\frac{h_i^L}{1 - h_i^L}\right)$$

Now that the expression of θ_i is determined, we can turn to the calibration of the Total Factor Productivity (TFP), A_i. For that, we use equation (1) so that A_i matches the level of income per capita, y_i:

[5] Data on returns to skills are taken from Hendriks (2004).

$$A_i = \frac{y_i}{Q_i}$$

Where,

$$Q_i = \left[\theta_i (h_i^L)^{\frac{\sigma-1}{\sigma}} + (1-\theta_i)(1-h_i^L)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}}$$

4.2.2. The pessimistic view

For the pessimistic scenario, we encounter two new elasticities. The first one is the elasticity between the TFP and the skill ratio (SRL_i), ε, and the second one is the elasticity between the skill bias and the skill ratio, κ. For the first one, Docquier (2018) finds that the correlation between the calibrated TFP level and the skill ratio is equal to 0.89. Moreover, Docquier (2018) finds that the elasticity between the TFP and the skill ratio, ε, is close to 0.4. He states that given the bidirectional causation relationship between productivity/income and education decisions, the elasticity is considered as an upper bound for the aggregate externality. He assumes that half of the correlation between the TFP and the skill ratio is due to the technological externality. Therefore, this elasticity is fixed at ε = 0.2 in line with Docquier (2018). For the second elasticity encountered in the pessimistic scenario, Docquier (2018) finds that the correlation between the calibrated skill bias and the skill ratio is equal to 0.91 and that the elasticity between the skill bias and the skill ratio, κ, is close to 0.2. He states that given the bidirectional causation relationship between the skill bias and education decisions, the elasticity is considered as an upper bound for the skill-bias externality. He assumes that half of the correlation between the skill bias and the skill ratio is due to the skill bias externality. Therefore, this elasticity is fixed at κ = 0.1 in line with Docquier (2018).

In what follows, we calibrate the parameters of Eq.10. We have assumed that both θ_i and A_i are now endogenous since we consider schooling externalities in the framework.

To calibrate these two parameters based on Eq.8 and Eq.9 and use them to calculate the no-migration counterfactual, we have to consider two situations: the situation that we observe (*E*), with emigration, and the counterfactual without emigration (*NE*). In the next expressions, we are going to use the log-linearization method on the expressions and then apply the exponential function in order to retrieve an expression in level.

We start with Eq.9. For θ_i, we have:

$$ln\left(\frac{\theta_i^{NE}}{1-\theta^{NE}}\right) = ln(R_{0,i}) + \kappa.ln(SRL_i^{NE}) \quad (19)$$

$$ln\left(\frac{\theta_i^{E}}{1-\theta_i^{E}}\right) = \ln(R_{0,i}) + \kappa.ln(SRL_i^{E}) \quad (20)$$

We extract $\ln(R_{0,i})$ from (20):

$$\ln(R_{0,i}) = ln\left(\frac{\theta_i^{E}}{1-\theta_i^{E}}\right) - \kappa.\ln(SRL_i^{E}) \quad (21)$$

We then insert (21) in (19):

$$ln\left(\frac{\theta_i^{NE}}{1-\theta_i^{NE}}\right) = ln\left(\frac{\theta_i^{E}}{1-\theta_i^{E}}\right) + \kappa.\ln\left(\frac{SRL_i^{NE}}{SRL_i^{E}}\right)$$

$$\frac{\theta_i^{NE}}{1-\theta_i^{NE}} = exp\left[ln\left(\frac{\theta_i^{E}}{1-\theta_i^{E}}\right) + \kappa.\ln\left(\frac{SRL_i^{NE}}{SRL_i^{E}}\right)\right]$$

$$\theta_i^{NE} = \frac{exp\left[ln\left(\frac{\theta_i^{E}}{1-\theta_i^{E}}\right) + \kappa.\ln\left(\frac{SRL_i^{NE}}{SRL_i^{E}}\right)\right]}{1+exp\left[ln\left(\frac{\theta_i^{E}}{1-\theta_i^{E}}\right) + \kappa.\ln\left(\frac{SRL_i^{NE}}{SRL_i^{E}}\right)\right]} \quad (22)$$

We apply the same methodology for A_i:

$$\ln\left(A_i^{E}\right) = \ln(A_{0,i}) + \epsilon.\left(SRL_i^{E}\right) \quad (23)$$

$$\ln\left(A_i^{NE}\right) = \ln(A_{0,i}) + \epsilon.\left(SRL_i^{NE}\right) \quad (24)$$

We extract $\ln(A_0)$ from (23):

$$\ln(A_0) = ln(A_i^{E}) - \epsilon.ln(SRL_i^{E}) \quad (25)$$

We insert (25) in (24):

$$\ln(A_i^{NE}) = \ln(A_i^{E}) + \epsilon.ln\left(\frac{SRL_i^{NE}}{SRL_i^{E}}\right)$$

$$A_i^{NE} = exp\left[ln(A_i^{E}) + \epsilon.ln\left(\frac{SRL_i^{NE}}{SRL_i^{E}}\right)\right] \quad (26)$$

4.2.3. The remittances

For this compensating mechanism, there is no new parameter to calibrate since we simply added the share of remittances to the result simulated under the pessimistic view, where we assume schooling externalities. The values of the shares of remittances in the GNP are taken from World Development Indicators (World Bank, 2017).

4.2.4. Endogenized education decisions (Brain gain)

For the scenario in which we add the contribution of the endogenized education decisions (brain gain), Docquier (2018) assumes that the share of college graduates in the native population, h_i^N, depends on skilled-biased migration prospects, given by m_i^h/m_i^l. In line with Beine *et al.* (2008), the elasticity between h_i^N and m_i^h/m_i^l is fixed at η = 0.0454.

In what follows, we calibrate the parameters of Eq.14. We first calibrate the new no-migration counterfactual of pre-migration level of human capital from Eq.13. Again, we start with the "with migration" situation and the "no-migration" situation.

$$h_{N,i}^{NE} = h_i^{N_0}\left(\frac{m_{i,H}^{NE}}{m_{i,L}^{NE}}\right)^{\eta}$$

$$h_{N,i}^{E} = h_i^{N_0}\left(\frac{m_{i,H}^{E}}{m_{i,L}^{E}}\right)^{\eta}$$

After log-linearizing these two expressions and substituting, we obtain a new no-migration counterfactual for the level of human capital:

$$h_{N,i}^{NE} = \exp\left[\ln\left(h_{N_0,i}^{E}\right) - \eta.\ln\left(\frac{m_{i,H}^{E}}{m_{i,L}^{E}}\right)\right] \tag{27}$$

Since we have a new no-migration counterfactual for the level of human capital, we have to take this modification into account for the expressions of θ_i^{NE} and A_i^{NE}. Therefore, we have:

$$\theta_{BG,i}^{NE} = \frac{exp\left[ln\left(\frac{\theta_i^E}{1-\theta_i^E}\right) + \kappa.\ln\left(\frac{SRL_{BG,i}^{NE}}{SRL_i^E}\right)\right]}{1 + exp\left[ln\left(\frac{\theta_i^E}{1-\theta_i^E}\right) + \kappa.\ln\left(\frac{SRL_{BG,i}^{NE}}{SRL_i^E}\right)\right]}$$

$$A_{BG,i}^{NE} = exp\left[\ln(A_i^E) + \epsilon.ln\left(\frac{SRL_{BG,i}^{NE}}{SRL_i^E}\right)\right]$$

Where,

$$SRL_{BG,i}^{NE} = \left(\frac{h_{N,i}^{NE}}{1 - h_{N,i}^{NE}}\right)$$

4.2.5. The diaspora externalities

For the last scenario under which we add the effect of the diaspora externalities, Docquier (2018) mentions a strand of the literature that identifies the elasticity between migration and trade and FDI at 0.1 and 0.2 (Iranzo and Peri, 2009; Felbermayr *et al.*, 2010; Parsons and Vezina, 2017; Kugler and Rapoport, 2007; Javorcik *et al.*, 2011). In addition, he mentions another strand of the literature that identifies the elasticity between trade and FDI and TFP at 0.3 and 0.01 (Anderson *et al.*, 2016; Feyrer, 2009). He then combines these findings which give a conservative elasticity of TFP to emigration around 0.03. This elasticity is given by $\rho m/(1 + \rho m)$. Since the elasticity is fixed at 0.03 and that, on average, we have 3% of migrants around the globe, Docquier (2018) fixes the value of $\rho = 0.618$.

For this last compensating mechanism, there is no new parameter to calibrate since we simply introduce a new expression of the TFP that takes directly into account the effect of the diaspora externalities.

To sum up the different calibration results that we just introduced, **Table 4.1** contains the fixed values of the different elasticities that are used in the previous expressions. **Table 4.2** contains the calibrated parameters that vary for each country and the mean and standard deviations of these parameters as well. The sources of these different elasticities and parameters are again mentioned in the table.

Table 4.1 - Fixed values of the elasticities

Parameter	Description	Baseline	Source
σ	Elast. subst. btw high-skilled and low-skilled workers	2	Docquier (2018)
ε	Elast. subst. btw the TFP and the skill ratio	0.2	Docquier (2018)
κ	Elast. subst. btw the skill bias and the skill ratio	0.1	Docquier (2018)
η	Elast. subst. btw between h_i^N and m_i^h/m_i^l	0.045	Beine *et al*. (2008)
ρ	Elast. subst. btw TFP and migration rate	0.618	Docquier (2018)

Table 4.2 – Calibrated parameter values

Parameter	Description	Mean	S.d.	Source
θ_i	Firms preferences for high-skilled workers	0.415	0.113	Docquier (2018)
A_i	Total Factor Productivity	19401.392	20117.08	Docquier (2018)
θ_i^{NE}	Firms pref. for high-skilled workers (Pessimistic view)	0.42	0.11	Docquier (2018)
A_i^{NE}	Total Factor Productivity (Pessimistic view)	20087.49	20524.102	Docquier (2018)
Y_i	Gross National Product	9049.893	9755.514	World Bank (2017)
$Rem._i/Y_i$	Share of remittances in the GNP	0.041	0.064	World Bank (2017)
$h_{N,i}^{NE}$	Share of college educated (Brain gain)	0.088	0.073	Arslan *et al.* (2014)
$\theta_{BG,i}^{NE}$	Firms preferences for high-skilled workers (Brain gain)	0.418	0.11	Docquier (2018)
$A_{BG,i}^{NE}$	Total Factor Productivity (Brain gain)	19824.744	20321.286	Docquier (2018)

5. The results

In this section, we will analyze the results of the mains views existing in the literature – the common view and the pessimistic view - on income per capita based on the models (Eq.6 and 10) presented earlier. We will, then, assess the effects of the three compensating mechanisms reviewed in the literature section. For that, we will start with the results of the simulations based on the common view configuration followed by the results of the pessimistic view configuration, concerning the effect of emigration on income per capita(Δ_i). Afterwards, we will progressively take into account the effects of the remittances, the endogenized education decisions (brain gain) and the diaspora effects on income per capita. To assess the effect of emigration on income per capita, we will first analyze the relations between the income differential (Δ_i) and the income, y_i, (in logs), the income differential (Δ_i) and the selection rate (in logs), the income differential (Δ_i) and the migration rate. Afterwards, we will list the top ten winners/top ten losers in order to identify the main features of the countries that win/lose from emigration. Last, in this analysis, we mention the values for some specific variables of specific countries. These variables and their values for all the countries of the sample can be found in **Table 8.1** in the Appendix section.

5.1. The common view

For this first scenario, we assume neither schooling externalities nor compensating mechanisms. The simulations were obtained with the minimalist model (Eq.6).

The effect of emigration on income per capita in percentage, Δ_i^C(Eq.7), is depicted in the **Figures 5.1.1-5.1.3**. In the first figure where we compare the effect of emigration to the income level by country, we can see that the effect of emigration is detrimental for almost all of the countries listed in the database for the year 2010. This is depicted by the trendline (in red) which captures the average effect of emigration on the countries. The largest loss of income per capita is up to almost 10% of the national gross product per capita while only two countries gain from emigration. The largest losses of income are mostly observed for the countries with an income per capita comprised between 1000-8000$, so mostly the developing countries. The poorest countries with an income per capita >1000$ and richest countries with an income per capita <12,000$ are less affected by their emigration.

In the second figure, we compare the effect of emigration to the selection rate. We can observe that the loss of income per capita diminishes as the selection rate increases. Therefore, the countries with low selection rates, i.e. where high-skilled emigration is not particularly larger than the low-skilled migration, suffer more losses of income per capita than those with high selection rates. Nonetheless, all the countries lose income per capita from emigration even those with high selection rates, except two countries which possess very low selection rates (<1). This is shown by the trendline (in red) on the graph which is under zero.

In the third figure, we compare the effect of emigration to the migration rate (in percentage). Here, the negative correlation between the effect of emigration on income per capita and migration rate is obvious. We can see that countries with high mmigration rates are those whose income losses per capita are the most important.

On these 3 figures, we have seen the main tendencies concerning all the countries. We can now turn to the analysis of the countries that gain and lose the most under this scenario. On **Table 5.1.1**, we find the top ten winners and top ten losers countries along with their income per capita (y_i), gain/loss of income (Δ_i^C), migration rate (m_i) and selection rate in logs (Selec).

On the left hand part of the table, we have the top ten winners in terms of income per capita. We can now identify these two countries mentioned above as the only two countries who gain in terms of income per capita. This is Mexico (+2%) and Greece (+0.1%). So these two countries have higher income per capita with emigration (the actual situation) than if all their college graduates were part of the resident labor force. This interesting result is explained by the fact that their low-skill migration is larger than their high-skilled migration. In other words, they lose more workers with low productivity (the low-skilled) than workers with high productivity (the high-skilled). Concerning the eight other winners, we have countries with contained losses around 1% of income per capita. All these countries have similar features; they have upper-middle to high-income per capita, low to mid selection rates and low migration rates for most of them.

On the right hand side of the table, we now have the top ten losers in terms of income per capita. We can identify Jamaica as being the country that encounters the largest loss of income due to its emigration, which is of approximately 10% of income per capita. Alongside with the rest of the top ten losers, Jamaica is characterized by middle income per capita, relatively high migration

rate (above 30%) and low selection rate. These are obviously the features we identify based on the three figures above of the countries that lose the most income per capita.

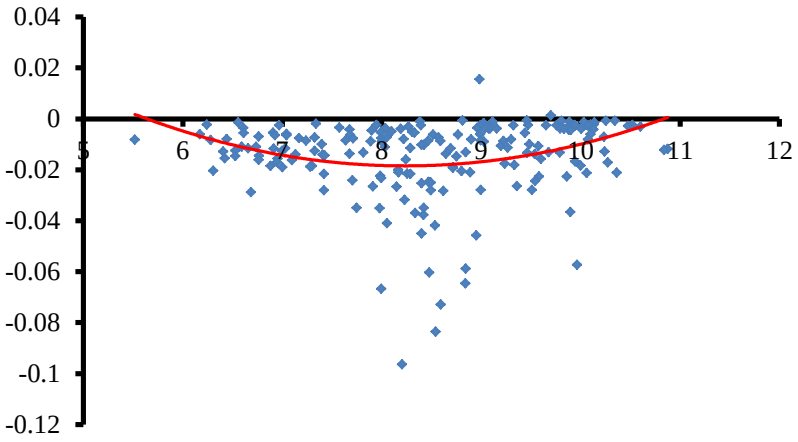

Figure 5.1.1 - The common view (Δ_i^C and ln y_i)

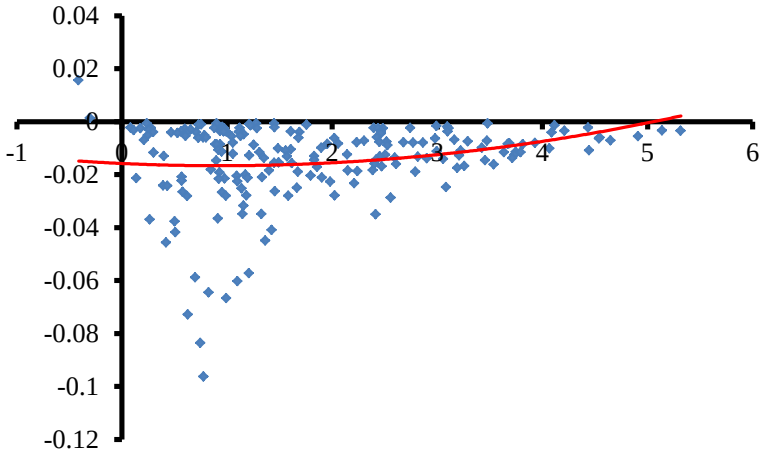

Figure 5.1.2 - The common view (Δ_i^C and ln Selec)

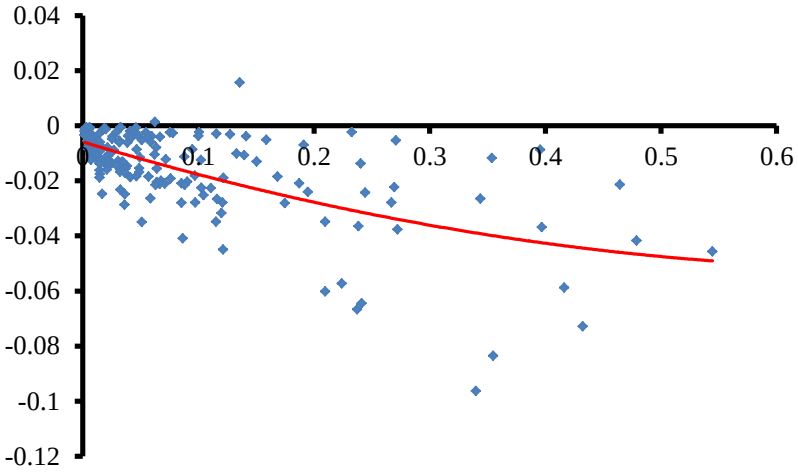

Figure 5.1.3 – The common view (Δ_i^C and m_i)

Table 5.1.1 – Winners and losers from emigration in the common view

Country	y_i	Δ_i^C	m_i	Selec	Country	y_i	Δ_i^C	m_i	Selec
Top 10 winners					**Top 10 losers**				
Mexico	7978.799	0.016	0.136	-0.412	Jamaica	3668.331	-0.096	0.340	0.776
Greece	16361.840	0.001	0.062	-0.304	St Vincent	5141.807	-0.084	0.355	0.746
China	6724.780	-0.001	0.003	3.480	Grenada	5410.208	-0.073	0.432	0.628
Czech Rep.	12867.933	-0.001	0.033	1.451	Fiji	2970.696	-0.067	0.237	0.994
United States	31177.722	-0.001	0.006	0.901	Saint Lucia	6936.656	-0.065	0.241	0.827
Slovenia	18170.444	-0.001	0.046	0.237	Palau	4812.528	-0.060	0.210	1.099
Norway	28499.564	-0.001	0.032	1.279	Saint Kitts&Nevis	6953.690	-0.059	0.416	0.699
Turkmenistan	4382.895	-0.001	0.002	1.212	Trinidad&Tobago	21314.379	-0.057	0.224	1.209
Russia	9111.164	-0.001	0.019	0.755	Dominica	7742.391	-0.046	0.544	0.421
Spain	19706.256	-0.001	0.018	0.731	Lebanon	4452.735	-0.045	0.121	1.364

Notes: Data from Docquier (2018).

5.2. The pessimistic view

In this scenario, we assumed a pessimistic model with schooling externalities. These externalities are reflected in the production function by A_i^{NE}, the Total Factor Productivity (TFP), and by θ_i^{NE}, the preference of firms for college educated workers that are more productive. As a reminder, we assumed greater contributions of human capital to productivity (Docquier, 2018). The simulations were obtained with the pessimistic model (Eq.10).

The effect of emigration on income per capita in percentage, Δ_i^P (Eq.11), is depicted in the **Figures 5.2.1-5.2.3**. In the first figure where we compare the effect of emigration to the income level by country, we have again that the effect of emigration is negative for almost every countries. The only difference with the previous scenario is that both gains and losses are exacerbated due to the schooling externalities. Therefore, the brain drain will be the cause of greater losses in terms of income per capita since we consider human capital to have a more important role in productivity. So we can see that the largest loss of income per capita is now up to 40% (10% in the common view). In opposition, the very few countries who gain from emigration are now slightly better off compared to the previous scenario. Now, only the richest countries of the list are less affected by the emigration. Before, the poorest countries were also

among countries that were less affected by emigration while countries with middle income were the most affected. This is shown by the flattening of the left hand part of the trendline (in red).

In the second figure, we compare the effect of emigration to the selection rate. We now observe that the gap in terms of losses between the countries with high selection rates and low selection rates has narrowed. Therefore, countries with high selection rates, whose losses were contained previously, now lose almost as much income per capita than the others. Again, we observe these two countries with very low selection rates among those who gain from emigration.

In the third figure, we compare the effect of emigration to the migration rate (in percentage). Here, the situation remains the same. We still have this negative correlation between the effect of emigration on the income per capita and the migration rate.

Therefore, under the pessimistic view, the conclusions are very similar to those in the common view. The sole difference concerns the magnitude of the gains and the losses encountered by each country. On average, we observe deterioration for all the countries since the trendlines lie under zero in all these graphs.

On **Table 5.2.1**, we have the top ten winners and top ten losers countries along with their income per capita (y_i), gain/loss of income (Δ_i^P), migration rate (m_i) and selection rate in logs (Selec).

On the side of the winners, we have again Mexico and Greece as being the two countries who gained from emigration. Their gains in terms of income are now higher; +2.4% for Mexico (><+1.6% previously) and +0.5% for Greece (><+0.1% previously). Again, this is a consequence of their very low selection rates, under 1 ($m^l > m^h$). For the other "winners", we can see that their losses are more important and their features are the same as before. Concerning the losers, we now have Guyana which loses the most income per capita because of emigration, of around 40% of its income per capita. For Guyana and for the rest of the losers, we mostly have countries of the Caribbean with middle income, with relatively low selection rates, with relatively high migration rates but mostly with a high-skilled migration rate, often above 70%.

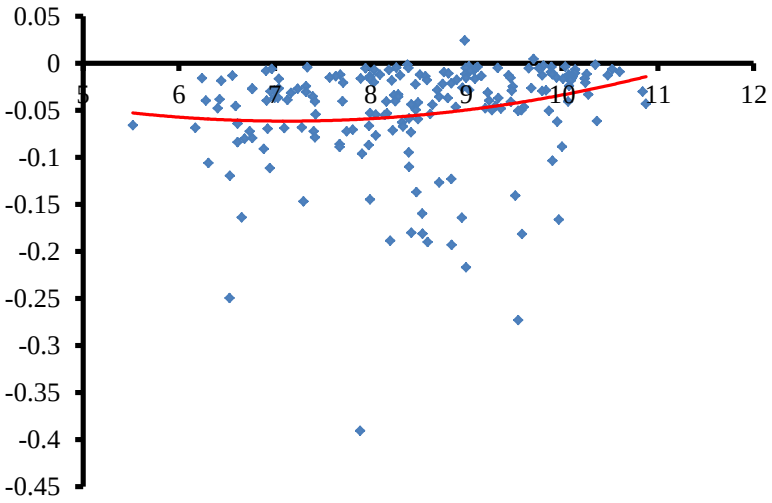

Figure 5.2.1 - The pessimistic view (Δ_i^P and ln y_i)

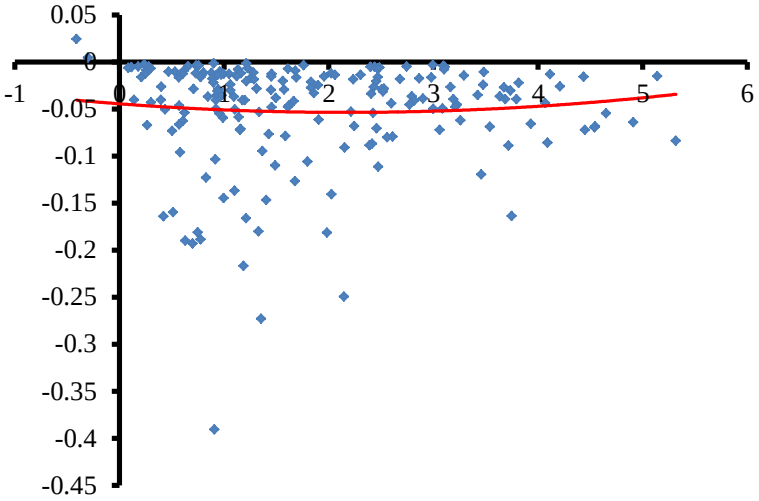

Figure 5.2.2 - The pessimistic view (Δ_i^P and ln Selec)

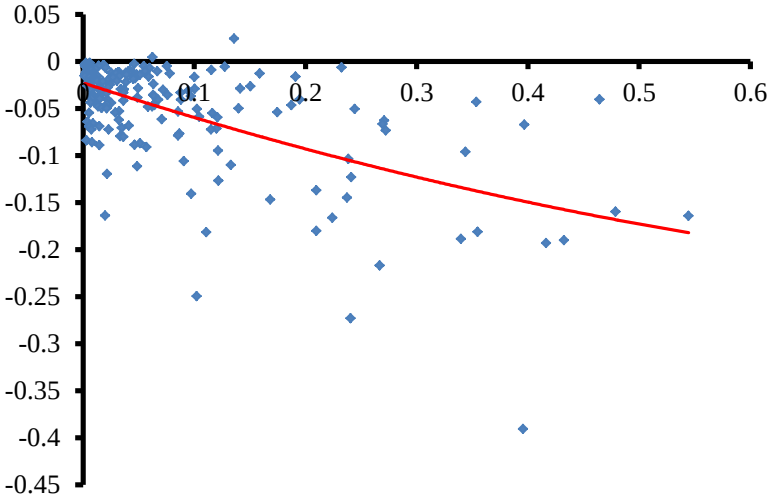

Figure 5.2.3 – The pessimistic view (Δ_i^P and m_i)

Table 5.2.1 - Winners and losers in the pessimistic view

Country	y_i	Δ_i^P	m_i	Selec	Country	y_i	Δ_i^P	m_i	Selec
Top 10 winners					**Top 10 losers**				
Mexico	7978.799	0.024	0.136	-0.412	Guyana	2676.874	-0.391	0.396	0.906
Greece	16361.840	0.005	0.062	-0.304	Barbados	13935.361	-0.273	0.240	1.351
Turkmenistan	4382.895	-0.002	0.002	1.212	Haiti	685.830	-0.249	0.102	2.145
United States	31177.722	-0.002	0.006	0.901	Antigua&Barbuda	8089.703	-0.217	0.267	1.186
Slovenia	18170.444	-0.003	0.046	0.237	Saint Kitts&&Nevis	6953.690	-0.193	0.416	0.699
Oman	8332.427	-0.003	0.002	2.994	Grenada	5410.208	-0.190	0.432	0.628
Japan	22815.513	-0.004	0.006	1.758	Jamaica	3668.331	-0.189	0.340	0.776
Spain	19706.256	-0.004	0.018	0.731	Mauritius	14529.242	-0.182	0.111	1.983
Russia	9111.164	-0.004	0.019	0.755	St Vincent&the Grenadines	5141.807	-0.181	0.355	0.746
Tajikistan	1540.488	-0.004	0.002	3.097	Belize	4567.695	-0.180	0.210	1.327

Notes: Data from Docquier (2018).

5.3. The remittances

As we have seen in the literature, there exist some mechanisms than can offset the loss of income per capita induced by the emigration and more precisely, the phenomenon of brain drain that heavily affects the productivity of the labor force in the countries of origin as we have seen in the pessimistic view.

The first compensating mechanism that we introduce is the remittances. As we have seen in the literature review, this is one of the most important mechanism to offset the loss of income per capita. On average, we have that remittances account for 4% of the GNP in 2010 (**Table 4.2**), based on the data of World Bank (2017).

To assess the effect of remittances on the income per capita, we added these values to the development accounting framework that we used in the pessimistic view.

The effect of emigration on income per capita in percentage, Δ_i^{Rem} (Eq.12), is depicted in the **Figures 5.3.1-5.3.3**. In the first figure where we compare the effect of emigration to the income level by country, we now have a very different situation. Indeed, we can see that many countries have significant gains due to the emigration when we take into consideration the remittances.

Four of them receive above of 20% more of income per capita. The trendline (in red) indicates that, on average, the remittances allow to offset the detrimental effect of brain drain since it is around 0, especially for middle income countries. However, based on the trendline, we see that the poorest and richest countries, on average, do not see their income per capita being offset by the remittances since it is below 0. Therefore, we have that more countries are losing income per capita due the emigration that the opposite. Also, the disparities among these countries are relatively important since we observe both large gains and large losses for them.

In the second figure, we compare the effect of emigration to the selection rate. When we include the remittances to the framework, the correlation between the effect of emigration on income per capita and the selection rate (in logs) disappears compared to the two previous cases. Indeed, the trendline (in red) on the graph completely flattened around zero. Therefore, we cannot draw any conclusions as to which countries gain or lose income per capita based on their selection rates.

In the third figure, we compare the effect of emigration to the migration rate (in percentage). We can see that the negative effect of migration rate on income per capita depicted earlier is divided by two when including the remittances to the framework.

On **Table 5.3.1**, we have the top ten winners and top ten losers countries along with their income per capita (y_i), gain/loss of income (Δ_i^{Rem}), migration rate (m_i) and selection rate in logs (Selec). As far as the winners are concerned, we now have a completely different list of winners compared to the previous scenarios. We now have Tajikistan, Lesotho and Moldova as the countries who gain the most from emigration in terms of income per capita. Tajikistan sees its income per capita to be higher by almost 40% comparing to a situation where all of its college graduates were part of the resident labor force. Although these countries have different profiles in terms of size population and geographic origins, they share some similar features; the three of them have middle income per capita, relatively low migration rates (<10%) but mostly they are the countries whose share of remittances in their GNP is the highest. The other countries share approximately the same features and mostly concerning the share of remittances in their income. Concerning the selection rate, we can see that it doesn't help to determine the profile of the winners since it ranges from a low rate (close to zero) to a high rate (above 5), in logs.

Concerning the losers, we have again small countries, mostly from the Caribbean, who lose from emigration. Except for Guyana, all these countries have a low share of remittances in their GNP. Indeed, all of them have a share way under 5% of the GNP. Concerning Guyana, its share of

remittances/GNP is around 16%. In addition, all these countries have in common middle to high income per capita and high migration rates. The country which is the most affected by emigration is Barbados with a loss of approximately 25% of income per capita.

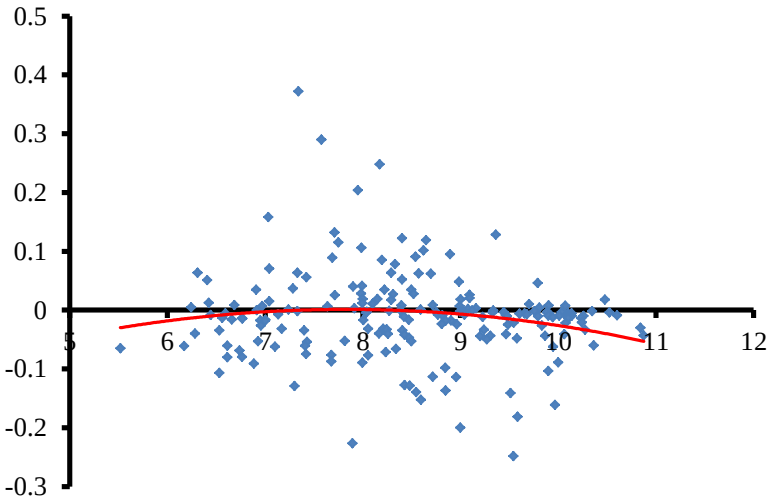

Figure 5.3.1 -T he remittances (Δ_i^{Rem} and ln y_i)

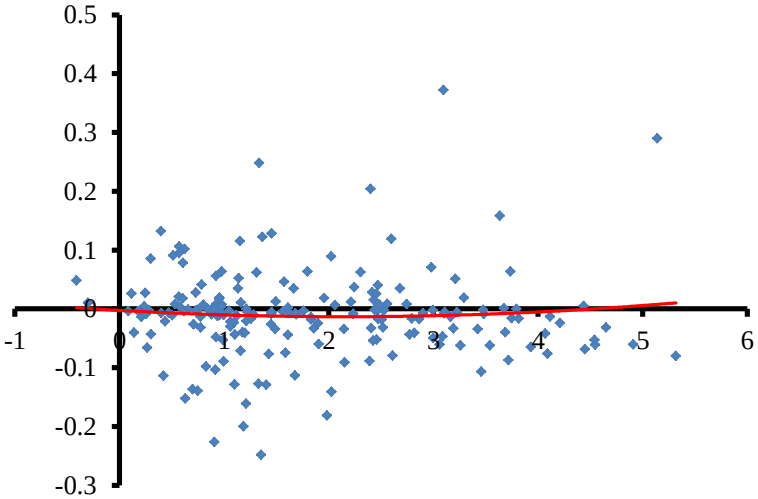

Figure 5.3.2 - The remittances (Δ_i^{Rem} and ln Selec)

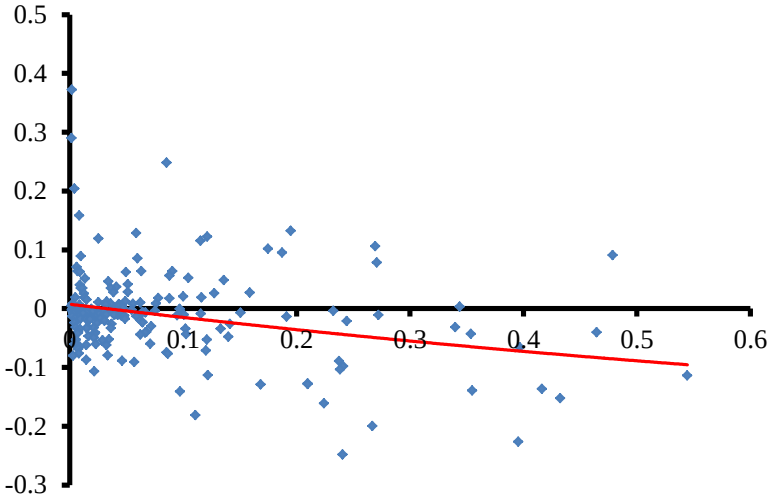

Figure 5.3.3 – The remittances (Δ_i^{Rem} and m_i)

Table 5.3.1 - Winners and losers after including the remittances

Country	y_i	Δ_i^{Rem}	m_i	Selec	Country	y_i	Δ_i^{Rem}	m_i	Selec
Top 10 winners					**Top 10 losers**				
Tajikistan	1540.488	0.372	0.002	3.097	Barbados	13935.361	-0.248	0.240	1.351
Lesotho	1951.903	0.290	0.001	5.138	Guyana	2676.874	-0.227	0.396	0.906
Moldova	3540.472	0.248	0.085	1.335	Antigua&Barbuda	8089.703	-0.200	0.267	1.186
Kyrgyzstan	2834.678	0.204	0.004	2.398	Mauritius	14529.242	-0.181	0.111	1.983
Nepal	1133.881	0.159	0.008	3.634	Trinidad&Tobago	21314.379	-0.161	0.224	1.209
Tuvalu	2228.022	0.132	0.195	0.394	Grenada	5410.208	-0.153	0.432	0.628
Armenia	11630.453	0.128	0.059	1.455	Bahamas	13511.609	-0.141	0.097	2.025
Lebanon	4452.735	0.123	0.121	1.364	Saint Vincent&the Grenadines	5141.807	-0.139	0.355	0.746
Jordan	5702.185	0.119	0.025	2.598	Saint Kitts&Nevis	6953.690	-0.137	0.416	0.699
Honduras	2323.110	0.115	0.115	1.149	Sao Tome&Principe	1484.154	-0.129	0.168	1.402

Notes: Data from Docquier (2018).

5.4. Endogenized education decisions (Brain gain)

We now introduce a second compensating mechanism into the framework. As explained in the literature review, the prospect of emigration tends to induce more people to invest in human capital. Therefore, by endogenizing education decisions, we assume that the no-migration counterfactual involves a smaller pre-migration level of human capital, h_i^N(Docquier, 2018). The simulations were obtained by using the model (14).

The effect of emigration on income per capita in percentage, Δ_i^{BG} (Eq.15), is depicted in the **Figures 5.4.1-5.4.3**. In the first figure where we compare the effect of emigration to the income level by country, we observe that the situation is very similar to the situation where the remittances are included to the framework. It appears that the gains of emigration for some countries slightly increase. Obviously, we see that the losses of income for some countries slightly decrease. Overall, we now have more countries that gain from emigration in terms of income per capita than the opposite. This is depicted by the trendline (in red) since on average the gains are now slightly above zero. However, the richest countries still lose income per capita, on average.

In the second figure, we compare the effect of emigration to the selection rate. Compared to the previous situation where we included the remittances to the framework, we now have a positive relationship between the effect of emigration and the selection rate. We see that countries that are associated with gains in terms of income per capita are those who possess a selection rate above 15 (in level); meaning that the college graduates tend to emigrate 15 times more than the less educated ones.

In the third figure, we compare the effect of emigration to the migration rate (in percentage). The relationship between the effect of emigration and migration rate is very similar to the previous case where the remittances were added. Compared to the framework that includes only the remittances, we can observe that high migration rates are associated with minor decreases in income per capita and low migration rates are associated with minor increases in income per capita.

On **Table 5.4.1**, we have the top ten winners and top ten losers countries along with their income per capita (y_i), gain/loss of income (Δ_i^{BG}), migration rate (m_i) and selection rate in logs (Selec). Overall, the table is very similar to the previous one. As stated before, the winners gain a bit more income per capita. For instance, Tajikistan has now two more points of percentage of income per capita when the education decisions are being endogenized. While most of the losers suffer a bit less from emigration since their losses have shrunk by less than a point of percentage. However, a few countries like Trinidad&Tobago and Grenada see their losses increasing by the same magnitude.

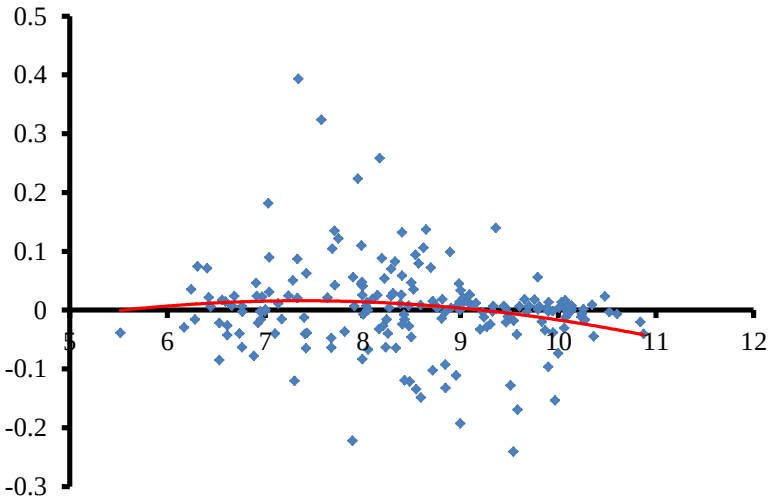

Figure 5.4.1 - The Brain Gain (Δ_i^{BG} and ln y_i)

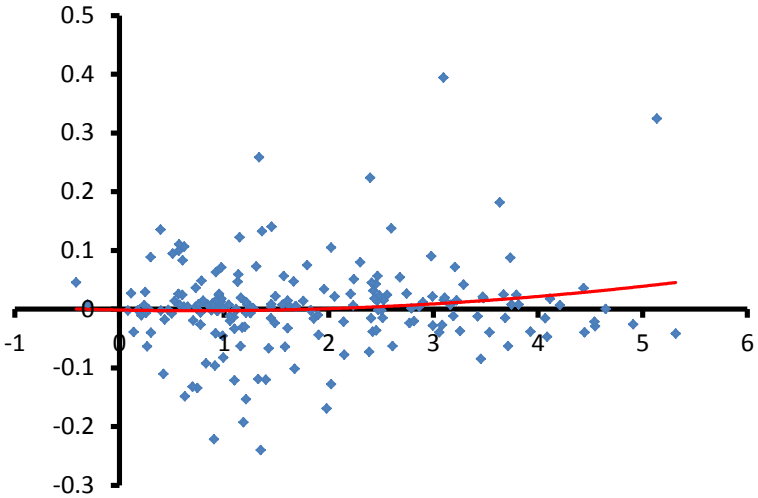

Figure 5.4.2 - The Brain Gain (Δ_i^{BG} and ln Selec)

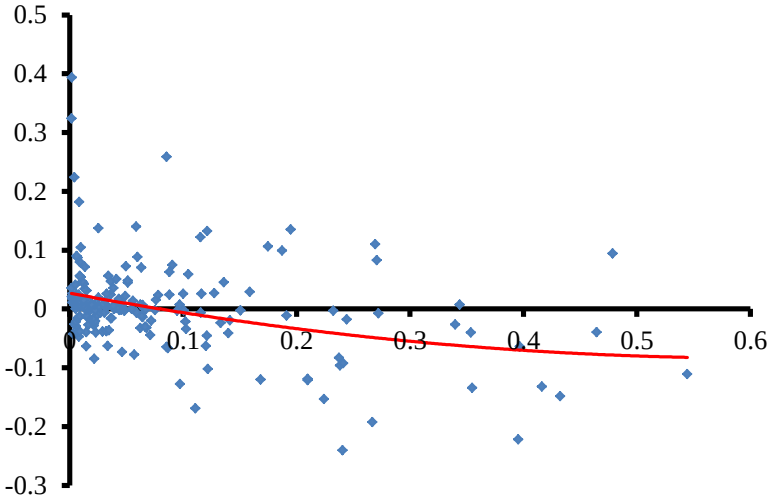

Figure 5.4.3 – The Brain Gain (Δ_i^{BG} and m_i)

Table 5.4.1 – Winners and losers after including the brain gain effect

Country	y_i	Δ_i^{BG}	m_i	Selec	Country	y_i	Δ_i^{BG}	m_i	Selecs
Top 10 winners					**Top 10 losers**				
Tajikistan	1540.488	0.394	0.002	3.097	Barbados	13935.361	-0.240	0.240	1.351
Lesotho	1951.903	0.324	0.001	5.138	Guyana	2676.874	-0.222	0.396	0.906
Moldova	3540.472	0.258	0.085	1.335	Antigua&Barbuda	8089.703	-0.193	0.267	1.186
Kyrgyzstan	2834.678	0.223	0.004	2.398	Mauritius	14529.242	-0.169	0.111	1.983
Nepal	1133.881	0.182	0.008	3.634	Trinidad&Tobago	21314.379	-0.154	0.224	1.209
Armenia	11630.453	0.140	0.059	1.455	Grenada	5410.208	-0.149	0.432	0.628
Jordan	5702.185	0.137	0.025	2.598	Saint Vincent&the Grenadines	5141.807	-0.135	0.355	0.746
Tuvalu	2228.022	0.135	0.195	0.394	Saint Kitts&Nevis	6953.690	-0.132	0.416	0.699
Lebanon	4452.735	0.132	0.121	1.364	Bahamas	13511.609	-0.128	0.097	2.025
Honduras	2323.110	0.122	0.115	1.149	Palau	4812.528	-0.122	0.210	1.099

Notes: Data from Docquier (2018).

5.5. The diaspora externalities

We now introduce the last compensating mechanism into the framework. The diaspora effect accounts for all the positive externalities due to the mass of emigrants from a country i in the destination country d. The literature on this topic has showed that the presence of migrants from a specific country helps to develop business links and stimulates trade and FDI with the destination country (Docquier, 2018). In our framework, we now have the schooling externalities, the remittances, the endogenized education decisions and the diaspora externalities. The simulations were obtained by using the model (Eq.17).

The effect of emigration on income per capita in percentage, Δ_i^D (Eq.18), is depicted in the **Figures 5.5.1-5.5.3**. In the first figure where we compare the effect of emigration to the income level by country, it is very interesting to stress out the fact the observations are now completely different from the two first scenarios (common view and pessimistic view). Indeed, we now observe that countries with middle income per capita are now the main beneficiates of the emigration. In the common and pessimistic views, we observed that this specific range of countries was associated with the largest losses of income per capita due to emigration. This was

characterized by a U-shaped trendline. Now that we included all the compensating mechanisms, we obtain a proper inversed U-shaped trendline. The trendline indicates that, on average, countries with middle income per capita gain a bit less than 10% of income. However, some countries still lose income per capita despite the improvement for the majority of the countries of our sample.

In the second figure, we compare the effect of emigration to the selection rate. Again, the current situation completely differs from what we observed in the previous cases. While we still remark that the countries with high selection rates are associated with gains of income per capita, we notice that the countries with the lowest selection rates are now those who gain the most from emigration, on average as depicted by the trendline (in red).

In the third figure, we compare the effect of emigration to the migration rate (in percentage). Concerning this relationship, it is certainly the most interesting fact that we can observe after accounting for the effect of diaspora externalities. Indeed, for all the previous cases, we had a negative relationship between the effect of emigration on income per capita and the migration rate. Henceforth, the countries who gain the most from emigration in terms of income per capita are those who possess the largest migration rates. This result is explained by the different way we calibrated the Total Factor Productivity (TFP) to take into account the effect of the diaspora externalities which directly affects the TFP (Eq.26). In this expression, the magnitude of the diaspora externality is given by the product of the parameter ρ, that is a constant (see **Table 4.1** for its value), and of the migration rate, (m_i). Therefore, a higher migration rate will automatically induce an increase in the TFP, leading to a higher income per capita.

On **Table 5.5.1,** we have the top ten winners and the top ten losers countries along with their income per capita (y_i), gain/loss of income (Δ_i^D), migration rate (m_i) and selection rate in logs (Selec). On the side of the winners, we can notice that the composition has changed. If we still find Tajikistan, Lesotho and Moldova among the first countries who gain the most from emigration, we can see that the other winners have a different profile. These new winner countries are mainly characterized by high migration rates (>20%). We have explained earlier that countries with high migration rates will automatically beneficiate from the positive diaspora externalities. Concerning the remaining presence of Tajikistan, Lesotho and Moldova among the top winners in spite of their low migration rates, this is explained by the fact that they are the top three countries who receive the most remittances from abroad. On the side of the losers, we can

see that the composition has also changed drastically. Before, the top losers were mostly countries of the Caribbean. Now, except for the Barbados and the Bahamas, all the countries of this top ten are African countries. Most of these African countries are characterized by relatively low migration rates, hence their apparition in the top ten losers due to the emigration since they don't beneficiate from the diaspora externalities.

After all these compensating mechanisms being included to a framework that takes into account the schooling externalities, the remittances, the endogenized education decisions and diaspora externalities, we see that many countries are better off with emigration and that some countries' losses in terms of income per capita are offset by these three compensating mechanisms that we just introduced. However, some countries still remain on the side of losers from emigration since their emigration is detrimental to their economy, despite some of the positive externalities of the emigration. On the bright side, we can see that the gains in terms of income due to the emigration, if there are some, are larger in magnitude than the losses of income due the emigration.

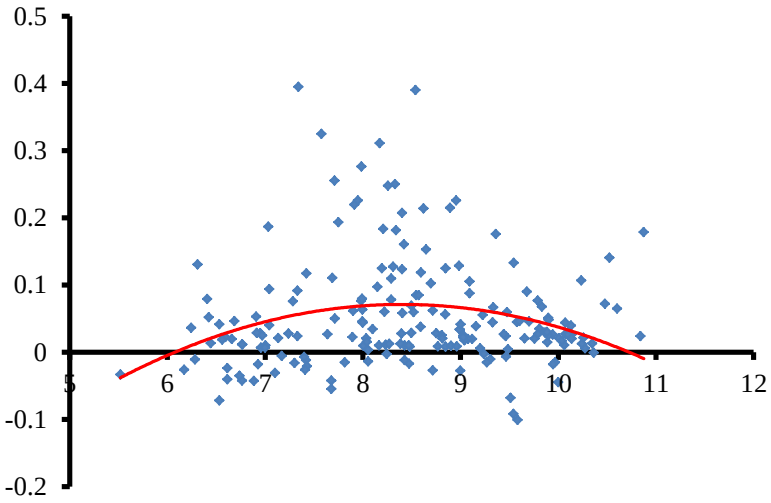

Figure 5.5.1 – The diaspora externalities (Δ_i^D and ln y_i)

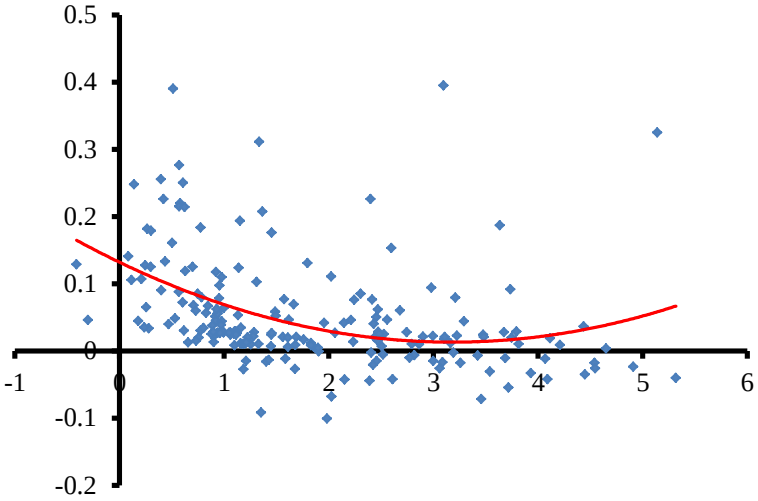

Figure 5.5.2 - The diaspora externalities (Δ_i^D and ln Selec)

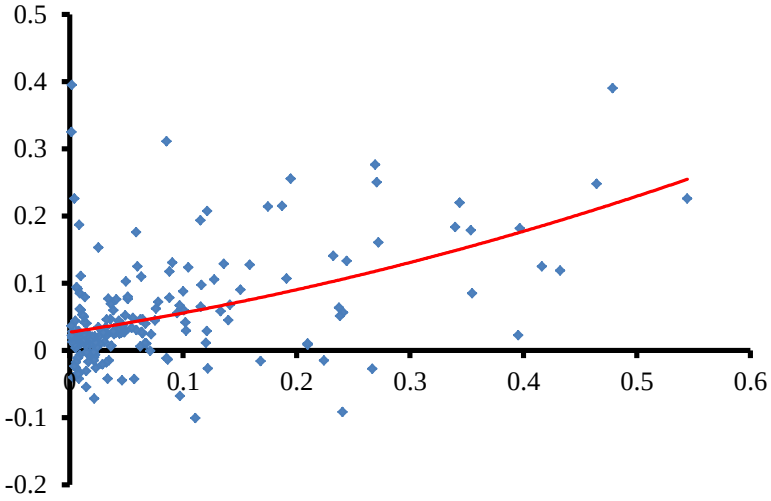

Figure 5.5.3 – The diaspora externalities (Δ_i^D and m_i)

Table 5.5.1 – Winners and losers after including the effect of diaspora

Country	y_i	Δ_i^D	m_i	Selec	Country	y_i	Δ_i^D	m_i	Selec
Top 10 winners					**Top 10 losers**				
Tajikistan	1540.488	0.395	0.002	3.097	Mauritius	14529.242	-0.101	0.111	1.983
Tonga	5109.597	0.390	0.479	0.510	Barbados	13935.361	-0.092	0.240	1.351
Lesotho	1951.903	0.325	0.001	5.138	Sierra Leone	686.442	-0.072	0.022	3.455
Moldova	3540.472	0.311	0.085	1.335	Bahamas	13511.609	-0.068	0.097	2.025
El Salvador	2940.419	0.276	0.269	0.570	The Congo	2159.021	-0.055	0.015	3.715
Tuvalu	2228.022	0.255	0.195	0.394	Equatorial Guinea	22048.506	-0.045	0.046	2.389
Albania	4148.936	0.250	0.271	0.605	Somalia	978.065	-0.043	0.057	2.149
Samoa	3861.905	0.248	0.465	0.138	Eritrea	867.004	-0.042	0.033	2.610
Dominica	7742.391	0.226	0.544	0.421	Mozambique	2159.767	-0.042	0.008	4.089
Kyrgyzstan	2834.678	0.226	0.004	2.398	Malawi	743.836	-0.040	0.003	5.317

Notes: Data from Docquier (2018).

6. Conclusion

This study focused globally on the effect of emigration on the development of countries in terms of income per capita. As established by the literature that focuses on the determinants of emigration, we find, on average, the highest emigration rates among the developing countries. Therefore, it appears that this range of countries would be the most afflicted by the effects of emigration in terms of income per capita. To refine the analysis, we chose an approach based on the skill-biased emigration in order to identify the loss due the emigration of the college graduates. We have seen in the literature about labor economics that these individuals tend to be more productive compared to the unskilled individuals, hence the major impact due to the brain drain. According to the recent literature, the brain drain could be beneficial or detrimental for countries. Indeed, the brain drain can be offset by some specific compensating mechanisms. Based on the literature, we identified three of them: the remittances, the endogenized education decisions (brain gain) and the diaspora externalities. Starting by the pessimistic view concerning the effect of emigration, which considers that brain drain can only affect negatively the countries, we built several variants of a development accounting model in order to assess the effect on income per capita for the different countries. This model is based on a Constant Elasticity of Substitution (CES) specification. This type of specification allows explaining the disparities in terms of performance between countries and the patterns of wage inequality between skill groups, on the aggregate level. Based on the data provided by Docquier (2018), we simulated a no-migration counterfactual of the economy for each country and for each different situation. We then expressed the difference between the level of income per capita that we observe and the no-migration counterfactual in terms of percentage.

Concerning the common and pessimistic views, we observe similar results. The emigration is detrimental for almost all the countries, in terms of income per capita. The gains (for only two countries) and losses are more important under the pessimistic view which consists of including schooling externalities to the CES framework. Concerning the developing countries, they are the most affect by the emigration in terms of income per capita. However, after including the three compensating mechanisms one by one, we observed that the situation has reversed for the developing countries. Indeed, when we include the remittances in the CES framework, we observe that developing countries become the main beneficiaries of brain gain. Their gains in terms of income per capita keep increasing as we add up the other compensating mechanisms to

the framework, i.e. the endogenized education decisions and the diaspora externalities. We also identified the main countries that lose and gain the most from emigration. On the side of the winners, we identify only developing countries after including all the compensating mechanisms. Their gains are mainly due to the amount of remittances they perceive and to the diaspora externalities. The effect of endogenized education decisions, however positive, is not as large compared to the two other compensating mechanisms' effect. Therefore, developing countries with a large share of remittances in the GNP and countries with high emigration rates, that influence positively the effects of diaspora externalities, constitute the winners. On the side of the losers, we identify all types of countries in terms of income per capita after including all the compensating mechanisms. Mainly, the losses of these countries are due to low emigration rates. Therefore, these countries do not beneficiate from the positive effect of diaspora externalities which are significant. Furthermore, 80% of these loser countries are from the African continent whereas before, the main losers were mainly small countries and often from the Caribbean.

Of course no study can perfectly reflect the reality of the economic disparities. For instance, in our framework, we allowed for the Total Factor Productivity (TFP) to vary only for countries. Nonetheless, we have seen in the literature that the TFP could also vary depending on the education level of the workers. This specification of the TFP would reflect a better assessment of the contributions of each skill group in terms of productivity. In addition, we have considered only emigration to the OECD countries, which could lead to some bias since the emigration to other countries is also significant. This is reflected by the case of Tajikistan that we identified as the main winner of emigration in terms of income per capita. Indeed, Tajikistan is the country that receives the largest share of remittances in its GNP. However, it is documented that a significant part of Tajik emigrants are located in Russia, which is not part of the OECD countries. This presence is due to the historical and cultural links between the two countries since Tajikistan was part of the Soviet Union until the 1990s. Therefore, we included in our model shares of remittances that did not come only from OECD countries. A new database able to identify the country of origin of the remittances would be a great contribution the development accounting exercise.

Last, we can say that, overall, the developing countries are better off with emigration since they benefit the most from it in terms of income per capita. However, the significant majority of winners due to emigration should not put the problematic of the losers under the rug since these

countries lost between 4-10% of income per capita in 2010, after all the three compensating mechanisms were included to the framework. We have seen that many countries suffer from brain drain since they see a tremendous amount of their college educated individuals leaving the countries. Many of these countries do not manage to offset these detrimental effects even when the compensating mechanisms are included. Eventually, this is mainly observed for African countries. In addition, around 50% of these African countries are still part of the poorest countries. Based on the theory of determinants of emigration, the economic development of these countries could foster the brain drain effect and lead to greater losses of income per capita.

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