Emigration Prospects and Human Capital in the Developing Countries: The Possibility of the Qualitative Brain Gain

Kouni, Mohamed

Faculté des Sciences Economiques et de Gestion, UNiversity of Tunis El Manar

17 September 2010

Emigration Prospects and Human Capital in the Developing Countries: The Possibility of the Qualitative Brain Gain

Mohamed KOUNI [1] [2] [3]

Abstract: In this paper we study the net effect of high-skilled emigration. Hence, we elaborate a simple theoretical model that studies the net effect of high-skilled emigration. The result showed that the emigration in the case where the fraction of human capital that emigrates is inferior to the critical level (equal to the difference between one and the elasticity of brain gain with respect to emigration), as well as in the case of the strong selectivity adopted, the emigration has the possibility to create a quantitative and qualitative brain gain. Indeed, to determine the net effect of brain drain we propose a new method that decomposes the gross investment of human capital into two components: the net domestic incentive effect and the net quantitative brain drain effect. Through This decomposition we can determine the net quantitative effect that arrives from the interior situation and the one arriving from the prospects effect. Finally, we tempt to define the indicator of the qualitative effect of this phenomenon. The empirical results showed that the emigration has an important effect on the human capital investment. Thus, the majority of countries have the possibility to register a net quantitative gain. Nevertheless, little of countries only have the possibility to record a qualitative brain gain.

JEL Classifications: F22, J24, O15.
Keywords: Brain drain, human capital, development.

[1] Dr. in Economics: Search Unit: « Labor Market, Commerce and Economic Policy »: Faculté des Sciences Economiques et de Gestion: University of Tunis ELmanar, Tunisia, and Consultant at the Embassy of the Republic of Korea in Tunis.

[2] **Email**: kouni.mo@gmail.com

[3] The author wants to thank Professor Mongi BOUGHZALA, for helpful comments and suggestions. Any remaining errors are the sole responsibility of the author.

1. Introduction

The international migration of skilled workers has augmented since the nineties. In fact, the emergence of the new literature of brain drain reviewed the old results, while showing that this phenomenon is more complex than a simple flight. Stark et al. (1997); Stark et al. (1998); Stark and Wang (2002); Beine et al. (2001, 2003, 2008) and Docquier and Rapoport (2004, 2007) sustain that the emigration prospects modify the structures of investment in education of the residents. Motivated by a more high remuneration, the residents multiply their education efforts to have emigrated finally. In presence of very selective policies all skilled workers cannot emigrate. Except a minority that emigrate. The rest of workers remain in their source country, consequently this quantity is qualified as a brain gain. However, the result of the new brain drain literature is not confirmed by some studies. Among these works the one of Schiff (2005) that finds that the brain gain is small or negative. It's clear that a new debate on the consequences on source countries is translated by the recent studies.

However, some critics can be addressed to these studies. First, the majority of these studies elaborate certain of models that study the individual behavior. Thus, they aggregate these analyses for the global society. Second, these models are not incorporating the negative effect represented by the human capital flight. Third, they don't achieve any comparison between the incentive effects generated by the internal conditions in the source countries and the effects of the emigration perspectives.

Starting from these remarks, we elaborate a simple theoretical model basically inspired from the Solow model and it referred to the works of Boulila (1997) and Docquier and Rapoport (2007). Indeed, we aim to study the net effect of high skilled emigration. Thus, we incorporate the double effects: negative and positive effects equally. The negative effect is the quantity (rate) of skilled individuals that emigrates and the positive effect is the quantity (rate) that remains in its source country in the long term. Indeed, to determine the net effect of brain drain we propose a new method to decompose the gross investment of human capital into two components: the net domestic incentive effect and the net quantitative brain drain effect. Through This decomposition we can determine the net quantitative effect that arrives from the interior situation and the one that coming from the prospects effect. Beine et al. (2008) determine the net effect of skilled-emigration and show that some countries have a net brain gain, but others have a negative brain drain effect. It’s important to signal that the works study the brain drain effects without resorting to decomposition, but it is essential to distinguish between the two effects. Finally, we tend to define the possibility to have a qualitative effect of this phenomenon.

The principal contribution in this paper can be summarized as follows:

- The incorporation of the two effects of brain drain (negative and positive) in the theoretical model.
- The measurement of two new indicators (human capital indicator, and indicator of emigration prospects)
- The decomposition of gross investment into two elements; the net domestic incentive effect and the net quantitative brain drain effect.
- Finally, this paper showed the possibility to register a qualitative effect.

The rest of this paper is organized as follows: in section two we describe the theoretical model. In section three we illustrate the method to define and measure the net effect of brain drain. In the last section we conclude.

2. The model : The net theoretical effect of brain drain

We study in this section the situation of a small economy. The production is determined by two factors: the labour (L) and the human capital (H):

$$Y = F(H, L) = H^{\alpha}(AL)^{1-\alpha} \quad (1)$$

With Y H L A and $0 < \alpha < 1$ are respectively the output level, the human capital, the all active population, the labour productivity and the elasticity of the production with respect to human capital.

The output per efficiency unit is as follows:

$$y = h^{\alpha} \quad (2)$$

h is the human capital by head. We suppose, indeed, on the base of the work of Docquier and Rapoport (2007) that h is superior to one, for the simple reason that the unskilled part of population have a human capital index equal to one. The accumulation of this factor is provided in following a public and private effort denoted (s) (fraction of national income). This accumulation is decreased by ($\delta + \varepsilon$) that signify respectively; the depreciation rate and the fraction of the human capital that emigrate. ε can be defined as the report between the emigrant human capital (h_M) and the resident human capital (h) : $\varepsilon = {h_M}/{h}$.

Moreover, L increase at the natural rate (n) and decrease by the emigration rate (m). Also, the productivity increases with a constant rate noted (g).

The high-skilled emigration rate is defined by two factors, the differential incomes and institutional factors set. It takes the following standard form:

$$m = a(\log y^{*} - \log y) - I \quad (3)$$

This rate is positively correlated with the differential incomes $(y^{*} - y)$ and negatively correlated with the institutional factors (I).

At the initial period, economy registers a flight of a number of high-skilled workers. Also, on the basis of the model of Schiff (2005) we consider that the economy cannot recuperate the human capital loss in short and medium terms. Schiff suggests that there is a transition period formed after emigration. Through this period, number of individuals, affected by emigration prospects, decides to invest in education. Indeed, in the medium term there's not brain gain. Economy can register a positive effect in the long term when this period is over. At this stage there are two effects realised; a positive effect engendering an investment superior to the number of emigrants, and negative effect measured by a high-skilled workers that emigrate. We assume that each skilled emigrant takes on average with him a fraction of human capital measured by $((\varepsilon H / L) = \varepsilon h)$ [4]; with ε is the part of stock of human capital that emigrated, defined as preceding ($\varepsilon > 1$, because $h > 1$ for all skilled-emigrants)[5] and (H / L) is the human capital by head. Moreover, the economy has obtained a new number of high skills that it is superior or inferior to the emigrated number. Consequently, the quantitative gain is inferior or superior to brain loss. We assume, therefore, that the individual fraction of gain noted by q and defined by the ratio: ($q = Q / L$, where Q, represents the new skills that

[4] $(\varepsilon(H / L) = (h_M / h) * h = h_M$, this is the human capital taken by an emigrant on average.

[5] Many studies showed that the emigrant human capital is superior to the resident human capital. Therefore we assume, for the reason of the high selectivity, that $h_M > h$. In this case , $\varepsilon > 1$.

obtained their diploma under the emigration incentives) is inferior or superior to m. Thus, (q) is positively correlated with (m) because the brain gain is the result of the evolution of emigration prospects. In fact, we assume that $(\partial q / \partial m) > 0$ and $(\partial^2 q / \partial m^2) < 0$. Finally, in spite of many studies showed that the brain drain is superior to brain gain; we cannot assume that $q < m$. Therefore, we take in our analysis the two cases: $q < m$ and $q > m$.

The accumulation function in this case, can be written as follows:

$$\dot{h} = sh^{\alpha} - h[\ (g + n + \delta) - m(1 - \varepsilon) - q\ ] \tag{4}$$

Therefore, the growth rate of human capital per efficiency unit equal to:

$$g_h = \dot{h}/h = sh^{\alpha - 1} - [\ (n + g + \delta) - m(1 - \varepsilon) - q\ ] \tag{5}$$

Our principal objective in this paper is the verification of the gain or the loss in term of human capital in the case of equilibrium with emigration (this equilibrium is defined by the equality: $sh^{\alpha-1} = [\ (n + g + \delta) - m(1 - \varepsilon) - q\ ]$). Indeed, to attain this objective, it's important to compare between the curve of human capital depreciation in the case of closed economy ($C = (n + g + \delta)$) (the Solow model) and the one in our equilibrium ($[\ (n + g + \delta) - m(1 - \varepsilon) - q\ ] = C_1$). If $(C) > (C_1)$, the new equilibrium is located below the (C). This means that this equilibrium associate a human capital level which is superior to the one associated in the absence of high-skilled emigration (brain gain). On the contrary, economy registers a brain loss.

2.1 The characteristics of (C_1):

To visualize the pace of this curve, we tend to determine the derivative of his equation with respect to (h) as follows:

$$\partial C_1 / \partial h = -(\partial m / \partial h)[\ (1 - \varepsilon) + (\partial q / \partial m)\ ] \prec or \succ 0 \tag{6}$$

This derivative is negative when $\varepsilon > [\ ((\partial q / \partial m) + 1) = b + 1\ ]$, because $(\partial m / \partial h) < 0$[6], and $\varepsilon > 1$. In this case (C_1) is decreased with (h). If ($\varepsilon < b + 1$), this curve is increased with respect to (h).

The second derivative takes the following form:

$$\partial^2 C_1 / \partial h^2 = (\partial^2 m / \partial h^2)\left[(\varepsilon - 1) - (\partial q / \partial m)\right] - \left[(\partial^2 q / \partial m^2)(\partial m / \partial h)^2\right] \tag{7}$$

It's clear that this derivative is positive when ($\varepsilon > b + 1$). Indeed, in this case (C_1) is convex. However, if ($\varepsilon < b + 1$) the sign of this derivative is not clear, therefore (C_1) can be convex or concave.

We assume, also that $0 < m < 1$ and $0 < q < 1$. Thus, we define the following condition[7]:

[6] See equations (2) and (3).

Equilibrium condition

For $\varepsilon = \varepsilon^* = 1+b$, (C) is equal to ($C_1$) and the equilibrium is located on (C) (this equilibrium is equivalent at the one of Solow).

For $\varepsilon < \varepsilon^* = 1+b$, (C) is superior to ($C_1$) and the equilibrium is located under (C).

For $\varepsilon > \varepsilon^* = 1+b$, (C) is inferior to ($C_1$) and the equilibrium is located above (C).

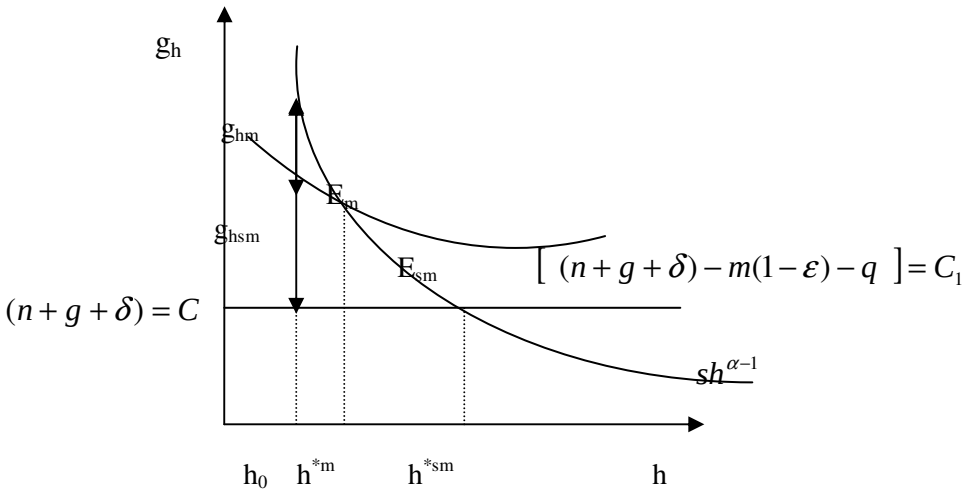
2.2 The long term dynamic transition: The case of high-skilled emigration:

In this subsection we treat the different possibilities of equilibrium. According to previous condition, we can characterize two possibilities of equilibrium with emigration:

- **Equilibrium in the case where $\varepsilon > \varepsilon^* = 1+b$:**

In this case, (C) is inferior to (C_1), so the equilibrium is located above (C). The following graphic illustrate this case:

Graphic 1: *The long term dynamic transition: The case where $\varepsilon > \varepsilon^* = 1+b$*



From this graphic, it's clear that the equilibrium with emigration associate a human capital level (h^{*m}) which is inferior to the one associated by the equilibrium without emigration (h^{*sm}). In the same way, the growth rate in the case of emigration (g_{hm}) is lower than the one of economy without emigration (g_{hsm}). In spite of registering a quantitative gain, the economy cannot recuperate the qualitative loss when the emigrated part of human capital is superior to critical level ($\varepsilon > \varepsilon^* = 1+b$).

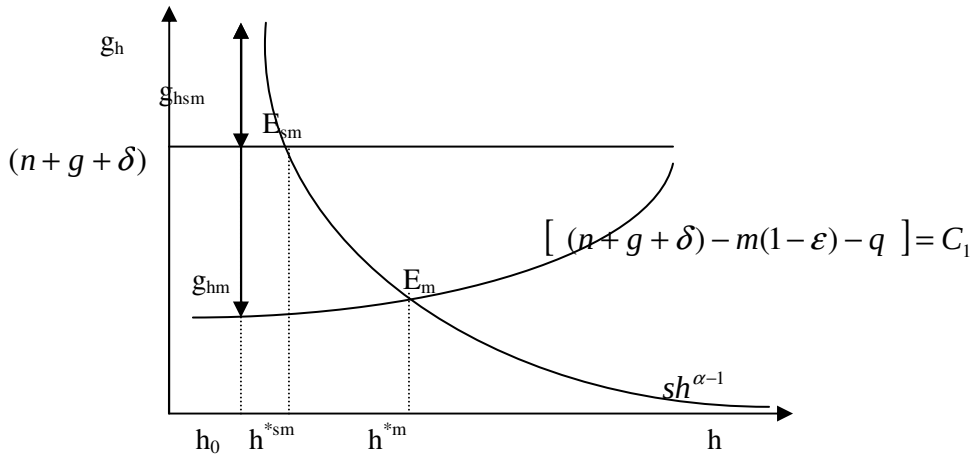
---

[7] See the proof and graphics that demonstrate this condition, thus the different forms of the curve of human capital depreciation in the appendices

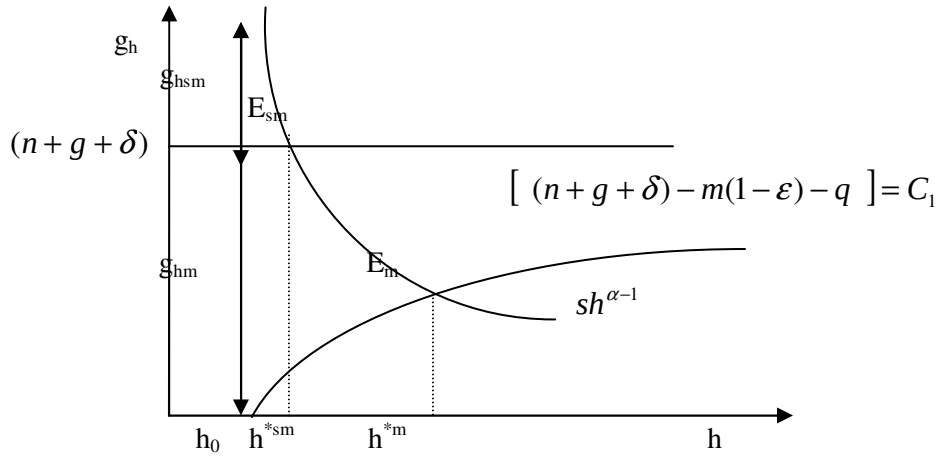
- **Equilibrium in the case where $\varepsilon < \varepsilon^* = 1 + b$:**

Now (C) is superior to (C_1), thus the equilibrium is located under (C). The following graphics illustrate this case:

Graphic: 2: ***The long term dynamic transition: The case where $\varepsilon < \varepsilon^* = 1 + b$ and C_1 is convex***



Graphic: 3: ***The long term dynamic transition: The case where $\varepsilon < \varepsilon^* = 1 + b$ and C_1 is concave***



In spite of marking a qualitative loss, the economy succeeded in realizing a net gain in terms of human capital. This gain can be interpreted as follows: the high-skilled emigration, through the incentive mechanism, encourages the individuals to invest in education. Finally the economy obtains a human capital quantity bigger than the one that emigrated. We can, now, ask the question: how does the economy recuperate the qualitative loss (especially that the human capital quality that emigrated is superior to the one of resident human capital) in order to produce a bigger quantity of human capital? Once this is attained, we assume that **the gain is the result, also, of the amelioration of the human capital quality**. This means that in the presence of high-selective immigration policies, the emigration prospects create a competitive environment between the investors. Individuals incited by the emigration know, in advance, that a small part among the candidates can emigrate; therefore, they search to

ameliorate the level and the quality of their skills. Finally, just a part, among these competitive investors, that emigrates. Other part remains in his source country. Consequently, the source country has the possibility to register amelioration in the human capital quality.

2.3 The effect of an increase in ε on the variables of the stationary state:

In this part we study the impact of an increase of ε on the level and rate of human capital. For obtain this result we effectuate the derivative of h^* [8] and g_h with respect to ε.

$$\partial h^* / \partial \varepsilon = \frac{1}{1-\alpha}\left[\frac{s}{((n+g+\delta)-m(1-\varepsilon)-q)}\right]^{\frac{\alpha}{1-\alpha}}\left[\frac{-ms}{((n+g+\delta)-m(1-\varepsilon)-q)^2}\right] < 0 \quad (8)$$

Thus:

$$\partial g_h / \partial \varepsilon = -m < 0 \quad (9)$$

It's clear that an increase of ε, decreases the equilibrium level of human capital. In spite of that in the long run the economy registers a human capital level bigger than the one initially obtained. Therefore, the qualitative loss (increase of ε) reduces the level and the growth rate of this factor. Thus, even if economy obtain at equilibrium a net quantitative gain as well as, gross qualitative gain, an increase of the fraction of human capital, decreases the level and the growth of human capital.

Graphically, this problem can be represented by the movement of C_1. Consequently, when ε increases C_1 moves upwards because $\partial C_1 / \partial \varepsilon = m > 0$. Note, that for all ε, this curve moves upwards. Indeed, for three graphics (1, 2, 3) and for $\varepsilon < \varepsilon^* = 1+b$ or $\varepsilon > \varepsilon^* = 1+b$, this movement permits the movement of the equilibrium towards the left with respect to equilibrium with emigration E_m ($sh^{\alpha-1}$ no affected).

- **The effect of an increase of m on the variables of the stationary state:**

The effect of an increase of m can be schematized as follows:

$$\partial h^* / \partial m = \frac{1}{1-\alpha}\left[\frac{s}{((n+g+\delta)-m(1-\varepsilon)-q)}\right]^{\frac{\alpha}{1-\alpha}}\left[\frac{s(1-\varepsilon+(\partial q/\partial m))}{((n+g+\delta)-m(1-\varepsilon)-q)^2}\right] \quad (10)$$

Indeed;

$$\partial g_h / \partial m = (1-\varepsilon) + \left[\frac{\partial q}{\partial m}\right] \quad (11)$$

The sign of the two equations is not clear. It's determined by the level of ε, if $\varepsilon > \varepsilon^* = 1+b$, equations (10) and (11) are negative and if $\varepsilon < \varepsilon^* = 1+b$, these equations are positive. Therefore, an increase of emigration rate (m) can improve the level and the growth rate of human capital when $\varepsilon < \varepsilon^* = 1+b$. This means that an increase of (m) create the incentive effects by the evolution of the emigration prospects. This situation leads the economy towards the new equilibrium where the human capital is so superior to the previous equilibrium. Geometrically, this problem can be appreciated by the movement of the curve of human capital depreciation (C_1). The derivative of (C_1) with respect to (m) can be written as follows:

---

[8] $h^* = \left[\frac{s}{((n+g+\delta)-m(1-\varepsilon)-q)}\right]^{1/1-\alpha}$

$$\partial C_1 / \partial m = \varepsilon - 1 - (\partial q / \partial m) \quad (12)$$

This result is positive when $\varepsilon > \varepsilon^* = 1 + b$ and is negative when $\varepsilon < \varepsilon^* = 1 + b$. It's clear that if $\varepsilon < \varepsilon^* = 1 + b$, ($C_1$) moves downwards and if $\varepsilon > \varepsilon^* = 1 + b$ this curve moves upwards. In the case where $\varepsilon < \varepsilon^* = 1 + b$, the economy registers a brain gain. In the other case ($\varepsilon > \varepsilon^* = 1 + b$), an increase of (m) decreases the level and the growth rate of human capital. Therefore, the equilibrium is located at the right (left) with respect to equilibrium with emigration E_m, when $\varepsilon < \varepsilon^* = 1 + b$ (when $\varepsilon > \varepsilon^* = 1 + b$), while giving a level of bigger (weaker) human capital.
To summarize this section we adopt the following proposition:

Proposition:

For all $0 < m < 1$, $\varepsilon > 1$, ***and***

- *If* $\varepsilon < \varepsilon^* = 1 + b$, *the emigration prospects can generate:*
  1. *A net quantitative human capital gain.*
  2. *The possibility to obtain a qualitative human capital gain.*
  3. *An increase of the human capital fraction that emigrated* (ε) *reduces the growth rate and the level of human capital.*
  4. *An increase of the emigration rate (m) improves the growth rate and the level of human capital.*
- *If* $\varepsilon > \varepsilon^* = 1 + b$, *the emigration prospects can generate:*
  1. *The economy realizes a net qualitative brain loss and the equilibrium generate a human capital level inferior to the one given by the equilibrium without emigration.*
  2. *An increase of the* (ε) *and / or of the (m) decreases the growth rate and the level of human capital.*

Proof

When $\varepsilon < \varepsilon^* = 1 + b$, $C_1 < C$, consequently the equilibrium with emigration is located below C. thus, the economy registers, always in this case, a human capital gain.
When $\varepsilon > \varepsilon^* = 1 + b$, $C_1 > C$, therefore, this equilibrium is located above C and the economy registers, always in this case, a net qualitative and quantitative loss in term of human capital.
In the other hand, in spite of that the quality of the human capital gotten following the emigration is lower to the one of the emigrants, the economy registers an important human capital gain (a net quantitative gain) and in presence of the high selective policies, the emigration prospects create a competitive environment between investors. Therefore, these investors tend to improve the quality of their human capital. Finally, one part emigrates and the rest of the gained human capital registers an improvement of his quality.

3. The empirical study

3.1. The model

In our empirical part, and after define and measure some new indicators, we estimate the equation adopted by Beine et al. (2008) and we use the Docquier and Marfouk data base (2006). This equation is based on the Solow model with β convergence and this is conforming to our model presented in previous section. In fact, this specification can be written as follows:

$$\ln(h_{moy,00}/h_{moy,90}) = c_0 + c_1(\ln h_{moy,90}) + c_2(\ln gmp_{H,90}) + c_3(\ln gdp_{90}) + c_4(\ln d\_pop_{90}) + c_5(RM_{90}) + \varepsilon \quad (13)$$

Where, $\ln(h_{moy,00}/h_{moy,90})$, $\ln h_{moy,90}$, $\ln gmp_{H,90}$, $\ln gdp_{90}$, $\ln d\_pop_{90}$, RM_{90} et ε are respectively the gross human capital investment, the human capital in 1990, the emigration prospects indicator, the gross domestic product , the population density, the ratio of international remittances on GDP and the error term.

It should be noted that the negative sign of the coefficient c_1 translates the convergence of the model. Moreover, following our theoretical model and the new brain drain literature, c_2 is positive. The per capita GDP is Proxy of the individual liquidity which has a positive coefficient. However, the sign associated to the coefficient of the population density is negative. This variable is Proxy of education cost. Moreover, the remittances have a positive effect on the investment in human capital (the sign of its coefficient is positive).

Moreover, the sample of countries chosen for our empirical work comprises 58 middle-income countries.

For the reason that the data of various variables concerning the skilled emigration were available only on very limited period we choose to adopt a cross section analysis. Although the data of skilled emigrants exist only for the two years 1990 and 2000 (according to the DM database (2006)), all works adopted this type of modeling (Beine and Al (2001, 2003, 2007, 2008); Lucas (2005), Docquier et al. (2007, 2008)…).

The tests results showed the existence of two problems: the heteroscedasticity and the endogeneity of the two variables, $\ln gmp_{H,90}$ and $\ln gdp_{90}$. To remove the first problem we adopted the method of White. However, to surmount the second problem we use the method of the instrumental variables (IV).

3.2 The human capital indicator

As we already mentioned, we repeat the estimation of equation (13) while adopting new measures of some indicators: the human capital and the emigration prospects indicators. Concerning the human capital indicator, Beine et al. (2008) adopt the ratio of the skilled population on the total population as a measure of human capital. Nevertheless, this measure cannot reflect efficiently this variable for some reasons. First, this ratio reveals the share of skilled population but not the education level. This means that it hasn't mentioned on the number of years for each education level. Second, this share ranging between zero and one, does not make it possible to realize a good comparison between countries, as well as its average is about the same for all. Therefore, it does not make it possible to guarantee the disparity between countries. Third, because it is ranging between zero and one, this measure

cannot satisfy our theoretical hypothesis ($h > 1$). For all these reasons we adopt the following human capital measure by the next system of equations:

$$h_{t,L}^{j} = (q_{t,L}^{j} * (4/18)) + ((q_{t,M}^{j} + q_{t,H}^{j}) * (8/18)) + 1 \quad (14)$$

$$h_{t,M}^{j} = (q_{t,M}^{j} * (10.5/18)) + (q_{t,H}^{j} * (12/18)) + 1 \quad (15)$$

$$h_{t,H}^{j} = (q_{t,H}^{j} * (15.5/18)) + 1 \quad (16)$$

Where $h_{t,L}^{j}$, $h_{t,M}^{j}$ and $h_{t,H}^{j}$ are respectively the lowest (L), the middle (M) and the highest (H) levels of individual human capital. Moreover, $q_{t,L}^{j}$, $q_{t,M}^{j}$ and $q_{t,H}^{j}$ designed the lowest , the middle and the highest shares skilled population defined by Docquier and Marfouk (2006) as follows:

$$q_{t,s}^{j} = \left(R_{t,s}^{j} + M_{t,s}^{j} \right) \Big/ \left(\sum_{s} R_{t,s}^{j} + \sum_{s} M_{t,s}^{j} \right) \quad (17)$$

With $R_{t,s}^{j}$ and $M_{t,s}^{j}$ are respectively the resident population which has a skills level, equal to s ($s = L, M, H$), and the one which emigrated and it has the same skills level.

We follow Docquier and Marfouk (2006) and Barro and Lee (1993, 2000) to determine the various means of the schooling period for each skills level. In fact, we consider that the low skills level can be defined by 8 schooling years. The middle level can be measured by the interval between 9 and 12 years, and the high skills level can be expressed by the interval varied from 13 to 18 years. Moreover, 1 is the skills indicator of the unskilled population (Docquier and Rapoport (2004)). We assume that the unskilled individual has a minimum of skills generated from his life experience. Finally, we calculate the mean human capital for each country as follows:

$$h_{t,moy}^{j} = \left(h_{t,L}^{j} + h_{t,M}^{j} + h_{t,H}^{j} \right) \Big/ 3 \quad (18)$$

3.3 The indicator of the emigration prospects

The previous studies in this field have been based on the emigration rate to measure the emigration prospects. Nevertheless, this approximation suffers from some limits as follows:

- The emigration decision does not depend on the emigration probability only. It depends in really, on the emigration cost, the wages differential between areas and on the skills level of emigrant. Thus, the rational emigrant is called to make a calculation of expected benefits before deciding to emigrate. The probability cannot reflect exactly the emigration prospects in this case.
- Then, the economic and social changes can play a big role in the change of the choice of destination. Consequently the probability which is based on the emigration rate of the previous period can fall the determination of the emigration prospects effect.
- Finally, the emigration rate is a source of loss (the brain drain), whereas the authors considered it as a benefit source in the model. To calculate a net

benefit, the same authors used this rate as a Proxy of loss. A sort of contradiction appeared consequently.

For these reasons, we propose a new approximation of this indicator. Indeed, it takes account of several factors as the human capital, the international relative income, the probability and the emigration cost. Moreover, to calculate this indicator we adopt the equation that measures the expected benefits (critical threshold) for the high skilled emigration presented by Docquier and Rapoport (2004) as follows:

$$gmp_{t,H}^{j} = h_{t,H}^{j} - 1 + m_{t,H}^{j} * h_{t,H}^{j}\left[\Omega_{t}^{j} * (1 - (k_{t}^{j} / h_{t,H}^{j})) - 1\right] \quad (19)$$

Where, $gmp_{t,H}^{j}, m_{t,H}^{j}$, Ω_{t}^{j} and k_{t}^{j} are respectively the emigration prospects indicator, the emigration rate, the international relative income ($\Omega_{t}^{j} = w^{*} / w$), w^{*} and w are the wage of the host country and the one of the source country) and the emigration cost. Indeed, in this paper we approximate Ω_{t}^{j} by the ratio between the average of per capita GDP of thirty OECD countries and the per capita GDP of each source country. Moreover, to measure k_{t}^{j} we follow Docquier et al. (2007) which consider that the distance between countries constitute a veritable proxy for the emigration cost. In fact, as the authors we calculate this cost as the ratio of the distance between each source country and the average distance from the 4 OECD countries which are the United States, Australia, Japan and France, on the middle-income of the same countries (expected income).

3.4 The Results:

Our principal interest in this work consists to determine the effect of the emigration prospects on the gross investment in human capital. It's clear that the model is globally significant in all the regressions (Tables 1). The results postulate indeed, that the emigration prospects have a positive and highly significant effect. The coefficient of this variable appears positive in all the regressions. In the same way, it is significant at the level of 1% in all the regressions. The elasticities related at this variable vary from 0.017 to 0.02. Beine, Docquier and Rapoport (2008) obtained a coefficient of the emigration rate equal about 5%. It appears clear, consequently, that the result obtained by the authors is likely to be over-estimated.

Table 1: ***Effect of the emigration prospects on the human capital investment: Estimation Results by the method of the instrumental variables (GMM): Dependent variable:*** $\ln(h_{moy,00} / h_{moy,90})$ ***: Case of the middle-income countries.***

VARIABLES	(1)	(2)	(3)	(4)
Constante	-.2649721*** **(-7.80)**	-.2560155*** **(-7.14)**	-.2575489*** **(-6.89)**	-.2454228*** **(-6.49)**
ln $h_{moy, 90}$	-.0354986 **(-0.31)**	-.056723 **(-0.51)**	-	-
ln $gmp_{H, 90}$	.020211*** **(3.99)**	.0178549*** **(4.14)**	.0194425*** **(3.60)**	.0169077*** **(3.85)**
ln gdp_{90}	.0426197*** **(7.35)**	.0407222*** **(6.97)**	.0408208*** **(6.84)**	.0380247*** **(7.31)**
ln d_pop_{90}	-.0018432 **(-0.53)**	-	-.00186 **(-0.54)**	-
RM_{90}	.0036315*** **(4.78)**	.0035348*** **(4.61)**	.0035866*** **(4.60)**	.0034588*** **(4.35)**
chi2	**113.85**	**87.68**	**97.31**	**78.04**
Prob > chi2	**0.0000**	**0.0000**	**0.0000**	**0.0000**
R^2	**0.6058**	**0.6140**	**0.6082**	**0.6146**

*( ): The t-statistics. *, ** and ***: denote significance at respectively 10, 5 and 1% levels.*
Endogenous variables: ln $gmp_{H, 90}$ *and ln* gdp_{90}
Instruments: ln $h_{moy, 90}$*, ln_pop_90, ln_m_total_90, ln_gdp_80,* RM_{90} *, ln_*d_pop_{90}

Because the emigration rate is not the only variable which reflects the emigration prospects, its use as Proxy of the prospects is likely to especially inflate the source of estimation bias, necessary for the countries which have a high emigration rate and low-income. In total, the emigration prospects exert, as the literature of the new economy of the brain drain proves it, a positive and significant effect on the human capital investment in the middle-income countries.

The other variables have also an important effect on the human capital. The coefficient of GDP equal about to 0.04 in all the estimations and it is significant at the level of 1%. Thus, the income level constitutes the one among the principal determinants of the gross investment in human capital. This correlation supports indeed, the idea for which the emigration can encourage only people having an important financial capacity. Moreover, the population density appears statistically no significant, but with an awaited sign. The negative sign comes indeed, to confirm the opposite relation between the cost and the investment of education. The same result is obtained by Beine, Docquier and Rapoport (2008).

Finally, the remittances constitute one of main sources of the investment in human capital for the middle-income countries. In fact, their coefficient equal to 0.35%. Their coefficients are, consequently, significant with the threshold of 1%. Many works supported the positive effect of the remittances on the reduction of the education cost (the World Bank (2006)).

On the basis of the elasticities obtained from these estimations we calculate in the following subsection the net effect of emigration prospects on the human capital.

3.5 Emigration prospects versus domestic conditions : The net effect of emigration prospects: *Towards a new measures method*

3.5.1 The decomposition of gross investment of human capital

The principal question valorizing the high-skilled emigration effect is: what's the weight of emigration prospects in the all incentive effects? We assume in this case that there are two principal origins of incentive; one arriving from the emigration prospects and the other from the domestic conditions. The answer to this question permits to evaluate the importance of emigration effect. To reach this objective, we suggest a simple decomposition of gross investment of human capital in this section. Before we define this decomposition, we propose main definitions:

The gross investment can be defined by the difference between the actual human capital in the last stage and the one of the first stage thus:

$$I_h = \ln h^a_{H,2000} - \ln h^a_{H,1990} \quad (20)$$

Accordingly, to obtain a decomposition of gross investment of human capital it is necessary to determine the anticipated human capital that can be obtained following emigration. It is defined as:

Definition 1: The anticipated human capital

If in the first stage (stage 0), the economy registers an emigration rate of high-skilled individuals (m) while hoping to achieve to the last stage (stage 1) a gain in human capital term, the anticipated human capital in stage 1 equal to:

$$\ln h^E_{H,2000} = \ln h^a_{H,1990} + c_2 \ln gmp_{H,1990} - c_2 \ln m_{H,1990} \quad (21)$$

With $\ln h^E_{H,2000}$, $\ln h^a_{H,1990}$, $\ln gmp_{H,1990}$, $\ln m_{H,1990}$ and c_2 are respectively the anticipated human capital, the actual human capital in the stage 0, the indicator of emigration prospects in the stage 0 , the emigration rate in the stage 0 and the elasticity of the gross investment of human capital with respect to the emigration prospects. The equation (21) means that the anticipated human capital is determined by his actual level in the stage 0 plus the gross gain provided by the high-skilled emigration and reduced by the brain drain rate (the loss). Thus, we define this decomposition as follows:

Definition 2: The decomposition of gross investment of human capital

We assume there are two incentive effects of investment: the emigration prospects and the domestic conditions. The gross investment in human capital is already distributed between the two factors as follows:

- *The net domestic incentive effect (NDIE) equal to the difference between the actual level of human capital in last stage and the anticipated human capital:* $NDIE = \ln h^a_{H,2000} - \ln h^E_{H,2000}$
- *The net incentive quantitative effect of emigration prospects (NIQEEP) equal to the difference between the anticipated human capital and the actual level of human capital in the first stage:* $NIQEEP = \ln h^E_{H,2000} - \ln h^a_{H,1990}$

Proof

We can demonstrate this decomposition as:

$$NDIE = \ln h^a_{H,2000} - \ln h^E_{H,2000} = \ln h^a_{H,2000} - \ln h^a_{H,1990} - c_2 \ln gmp_{H,1990} + c_2 \ln m_{H,2000} \quad (22)$$

This means that the difference between the actual level of human capital in last stage and the anticipated human capital is equal to the difference between the gross investment and the net effect of emigration (loss or gain). Therefore, this difference corresponds to the net domestic incentive effect (NDIE).

If we reduce the anticipated human capital by the actual level of human capital in the first stage we obtain:

$$\ln h^{E}_{H,2000} - \ln h^{a}_{H,1990} = \ln h^{a}_{H,1990} + c_2 \ln gmp_{H,1990} - c_2 \ln m_{H,1990} - \ln h^{a}_{H,1990} = c_2 (\ln gmp_{H,1990} - \ln m_{H,1990}) \quad (23)$$

This result is similar to the net incentive quantitative effect of emigration prospects (NIQEEP).

The sum between the two effects is equal to the gross investment of human capital:

$$I_h = NIQEEP + NDIE \quad (24)$$

We have now three possibilities in the last stage: The emigration generates a net loss, or it creates an incentive gain smaller than the one generated by the domestic effect. Finally, it can exercise an incentive effect bigger than the one generated by the internal conditions in the source country. It is noteworthy that all the previous results could not be obtained without referring to the characteristics of the source country (the development level, the emigration rate, the poverty…).

If the anticipated human capital is inferior to the actual human capital in the first stage (the weak size of the emigration prospects), the domestic conditions generate the all incentive effects, but the emigration reduces the gross investment. However, if the anticipated human capital is superior to the actual human capital in the first stage, the emigration engenders the net incentive gain.

The calculation results can be exposed in the following table:

Table 2: *The decomposition of gross investment of human capital: Averages by countries groups*

Classification	Countries groups	I_h	*NDIE*	*NIQEEP*	$\ln h^{E,j}_{moy,2000}$
World Bank	**MIDDLE-INCOME COUNTRIES**	0.04868	0.02422	**0.02446**	0.19462
By interest group	**LATIN AMERICA**	0.03576	0.00910	**0.02667**	0.20804
	SUB-SAHARAN COUNTRIES	0.03287	0.01286	**0.02001**	0.16016
	MIDDLE EST AND NORTH AFRICA	0.03735	0.00601	**0.03134**	0.18875
	NORTH AND CENTRAL AMERICA	0.06673	0.05499	0.01175	0.20642
	EUROPE	0.03294	0.00526	**0.02768**	0.24665
	CENTRAL AND SOWTH ASIA	0.02590	-0.01253	**0.03843**	0.19230
	SOWTH EST ASIA	0.03700	0.00477	**0.03223**	0.20692
	OCEANIA	0.09530	0.06145	0.03385	0.16301

Table 2 shows that the *NIQEEP* is positive for all groups. Indeed, 6 among 8 groups register a net effect of emigration prospects superior than the net domestic effect (*NDIE*). This means, that the skilled emigration has a net positive effect on human capital investment.

3.5.2. The qualitative incentive effect of emigration prospects

On the basis of our theoretical model as well as the work of Docquier, Lohest and Marfouk (2007), we tend to propose a simple definition of qualitative effect of high-skilled emigration. This indicator can be defined as follows:

Definition 3: The qualitative incentive effect

The qualitative incentive effect can be defined as the ratio of the prospects intensity on the fraction of human capital that emigrates. If this indicator superior to one, we can conclude that the economy has a net qualitative brain gain. However, if this indicator is located between 0.5 and 1, we can say that the economy has the possibility to have a gross qualitative gain.

$$GQUA = IP / \varepsilon \tag{25}$$

Definition 4: The prospects intensity

The prospects intensity is equal to the ratio between the net incentive quantitative effect of emigration prospects (NIQEEP) and the gross investment in human capital: I_h.

$$IP = NIQEEP / I_h \tag{26}$$

Docquier, Lohest and Marfouk (2007), define a decomposition of the emigration rate into two components: The first component is the ratio of emigrants to natives: the average or total emigration rate of all types of individuals. It reflects the degree of openness of the sending country. The second component is the ratio of the proportion of skilled emigrants by the same proportion among natives. This ratio reflects the schooling gap between emigrants and natives. This ratio is always higher than one, indicating that emigrants are more educated than natives in all developing countries. We consider that the last ratio is equivalent to the fraction of human capital that emigrates (ε). This ratio is equal to the following equation:

$$\varepsilon = SG = \left[\frac{(M_{H,1} / \sum_s M_{s,1})}{((R_{H,1} + M_{H,1}) / \sum_s (R_{s,1} + M_{s,1}))} \right] \tag{27}$$

With $M_{H,1}$, $M_{s,1}$, $R_{H,1}$ and $R_{s,1}$ are respectively, the high-skilled emigrants stock, the stock of emigrants having the s qualification, the high-skilled natives and the stock of natives having the s qualification; s = low, middle or high qualification.

The equation (27) reflects the part of the human capital rate that emigrates in the human capital rate of natives and emigrants.

This indicator of the qualitative effect of emigration permits to evaluate the participation of emigration in the production of human capital. If the gross investment is intensive in migratory effect, the report between the quantitative gain of the emigration and the gross investment is important. It is especially possible with the competition created by the strong selectivity to have a qualitative gain also. If this qualitative gain ratio passes the unit, this means that the human capital of the natives is superior to the one of emigrants and the developing economy recorded a net qualitative gain. The results can be presented in the following table:

Table 3: ***The qualitative incentive effect of emigration prospects: 1990-2000: Averages by countries groups***

Classification	Countries groups	IP	ε_00	GQUA
World Bank	**MIDDLE-INCOME COUNTRIES**	1.24775	4.38164	0.33536
By interest group	**LATIN AMERICA**	3.01558	2.99257	**0.73291**
	SUB-SAHARAN COUNTRIES	0.97874	8.75812	0.14147
	MIDDLE EST AND NORTH AFRICA	0.89969	3.21794	0.33916
	NORTH AND CENTRAL AMERICA	0.39710	2.12102	0.18613
	EUROPE	0.91634	2.26414	**0.57333**
	CENTRAL AND SOWTH ASIA	1.53993	9.09506	0.16582
	SOWTH EST ASIA	1.16427	4.58222	0.34399
	OCEANIA	1.16032	7.26351	0.11936

The results showed that if ε is higher than the unit in the majority of countries, which tends to support the assumption taken in our theoretical model (see table 3). Indeed, we showed in our model that in the case where $\varepsilon < \varepsilon^*$, the country has a possibility to register a net quantitative gain. Nevertheless, to know that ε is lower or higher than the critical threshold, requires a rather long set of data. Thus, it is extremely important to announce that in this work the data do not make it possible to achieve this objective. Therefore, we orient our attention toward a verification of the possibility to register a qualitative gain.

On average, the two groups of country of Latin America and Europe have a great possibility of recording an improvement in the quality of their human capital following the emigration. However, this improvement can be only gross. For the remainder, has not the possibility to have a qualitative gain.

4.5.1 Conclusion

In this paper we study the net effect of high-skilled emigration. Indeed, through the Solow model we elaborate a simple theoretical model that studies the net effect of high-skilled emigration. Thus, we incorporate the double effects: negative and positive effects. The negative effect is the quantity (rate) of skilled individuals that emigrates and the positive effect is the quantity (rate) that remains in his source country in long term. The result showed that emigration in the case where the fraction of human capital that emigrates is inferior to the critical level as well as in the case of strong selectivity adopted, the emigration has the possibility to create a quantitative and qualitative brain gain.

Moreover, to determine the net effect of brain drain, we propose a simple new method that decomposes the gross investment of human capital into two components: the net domestic incentive effect and the net quantitative brain drain effect. Through This decomposition we can determine: what is the net quantitative effect that arrives from the domestic economy and what is the one arriving from the prospects effect. Finally, we tend to define the indicator of

the qualitative effect of this phenomenon. The empirical results showed that the emigration has an important effect on the human capital investment. Thus, the majority of countries have the possibility to register a net quantitative gain. Nevertheless, little of countries only have the possibility to record a qualitative brain gain.

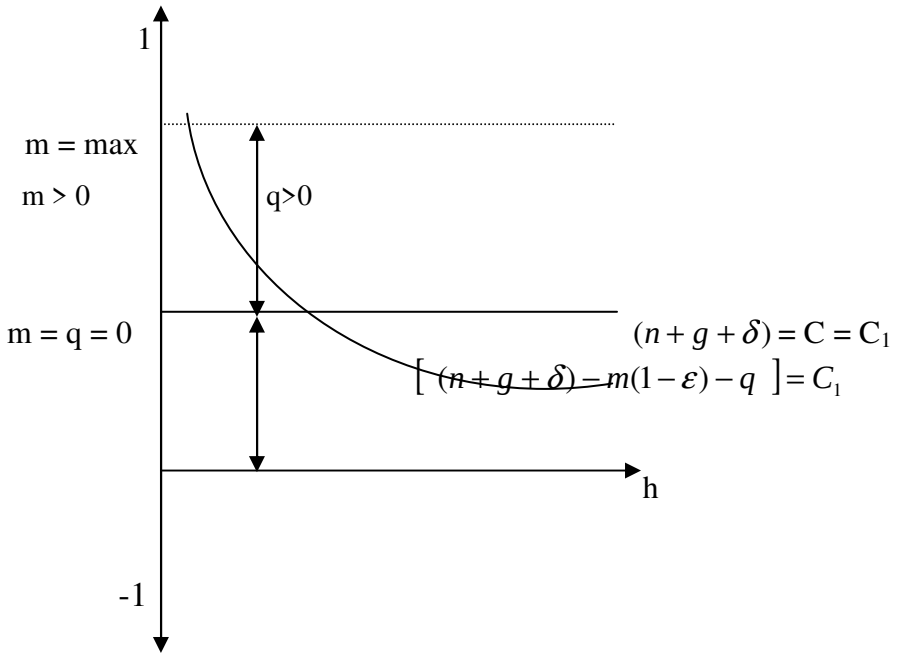
Appendices

A1: Proof of the equilibrium condition

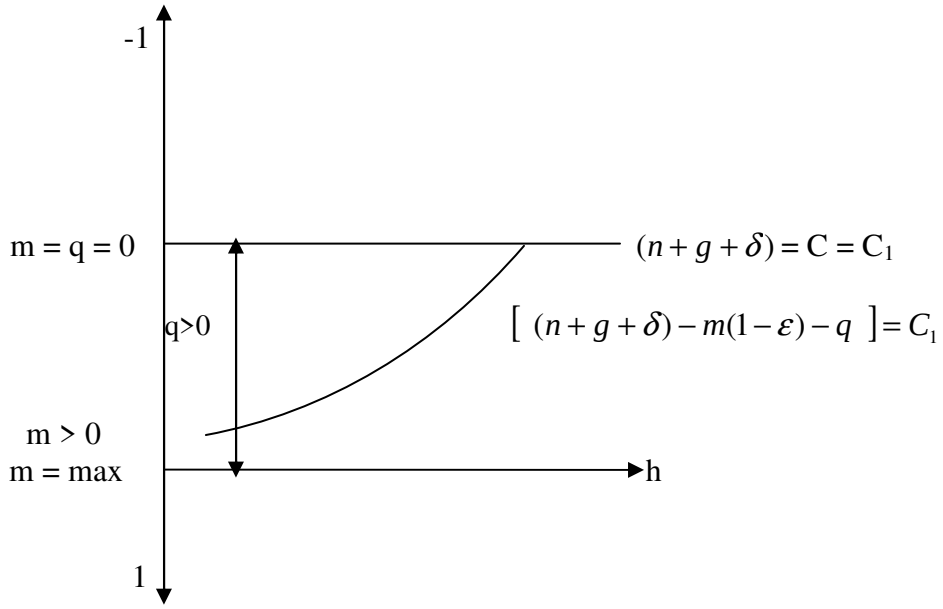
For all m = q = 0, C = C_1 and the equilibrium can be located on the C curve.
$-m(1-\varepsilon)-q=-m(1-\varepsilon)-bm \quad =m(\varepsilon-1-b)$, *for q = bm, with 0 <b <1, the quantity* $m(\varepsilon-1-b)$, *for given b, admits a solution* $\varepsilon^*=1+b$ *that is positive when* $\varepsilon^*>1+b$ *and finally, it is negative for* $\varepsilon^*<1+b$.

Therefore C is superior to C_1 *when* $\varepsilon^*<1+b$. *This means that the equilibrium is located below the C. however, C is lower to* C_1 *when* $\varepsilon^*>1+b$ *and therefore the equilibrium is located over to the C. finally, if* $\varepsilon^*=1+b$, *C is equal to* C_1 *and the equilibrium corresponds to the one without emigration. It is clear, therefore, that when 0 <m <1, the position of the equilibrium is ambiguous; it can be below, to the over or on the C curve.*
For all -1 <m <0, q = 0, $\varepsilon>1$ *we have:* $-m+m\varepsilon<0$, *because,* $\left|\ m\varepsilon\ \right|>m$, *therefore C is always superior to* C_1, *so the equilibrium is situated below the C curve.*
We can schematize this problem as follows:

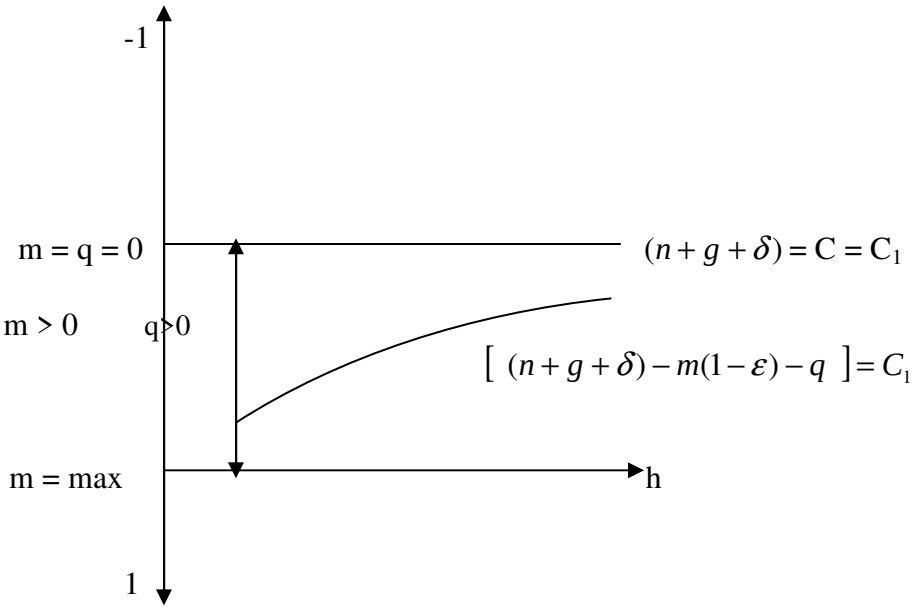
Graphic : 6 : the C_1 curve with respect to C: the case of : $\varepsilon>\varepsilon^*=1+b$ ***and*** $\varepsilon=\varepsilon^*=1+b$ ***for all 0 < m < 1.***



Graphic : 7-a : the C_1 curve with respect to C: the case of : $\varepsilon < \varepsilon^* = 1 + b$ ***and C_1 is convex for all 0 < m < 1 .***



Graphic : 7-b : the C_1 curve with respect to C: the case of: $\varepsilon < \varepsilon^* = 1 + b$ ***and C_1 is concave for all 0 < m < 1.***



Bibliography:

Barro R. J. and Sala-i-Martin X. (1995): "Economic Growth"; Mc Graw-hill; New York.

Beine M., Docquier F. and Rapoport H. (2001): « Brain drain and economic growth: theory and evidence » ; journal of Development Economics, vol 64.

Beine M., Docquier F. and Rapoport H. (2008) « Brain drain and human capital formation in developing countries: Winners and Losers››; The Economic Journal, vol 118

Boulila G. (1997) : " Migration, capital humain et croissance économique des pays en développement"; Revue Tunisienne d'Economie, n 8.

Carrington W. J. et Detragiache E. (1998): « How big is the Brain drain?" IMF, WP n° 102.

Cashin P. et Loayza N. (1995): « Paradise lost? Growth, convergence, and migration in the Sowth Pacific » ; IMF staff papers, vol 42 n 3.

Docquier, Lohest and Marfouk (2007): « Brain drain in developing countries »; the World Bank Economic Review, vol 21

Docquier F. and Marfouk A. (2004) : « Measuring the international mobility of skilled workers (1990-2000) » ;, World Bank WPS n 3381.

Docquier F. and Rapoport H. (2004) : « Skilled migration ; The perspective of developing countries » ; World Bank, WPS n 3382.

Haque N. U. and Kim S. (1995): "Human capital flight: Impact of migration on income and growth"; FMI, Staff Papers, vol 42 n 3.

Lucas B. (2001) : "Labour supply, migration, and long term development"; Open Economics Review, vol 12

Lucas R. (2005): "International migration to the high-income countries: Some consequences for economic development in the sending countries"; annual World Bank conference on development Economics, Europe; World Bank.

Lucas R. (1988): "On the Mechanics of economic development", Journal of Monetary Economic, 3-42

Mankiw, Romer and Weil (1992) : « A contribution to the empirics of economic growth » ; Quarterly journal of economics, vol 107, n 2

Mountford A. (1997) : " Can a brain drain be good for growth in the source economy?"; Journal of Development Economics, 53

Sciff M. (2005): "Brain grain: claims about its size and impact on welfare and growth are greatly exaggerated"; World Bank, W P S n° 3708

Schiff M. (1994) : “ How trade, aid, and remittances affect international migration”; World Bank, WPS n 1376

Solow (1956): “A contribution to the theory of economic growth” Quarterly Journal of Economics”, 65-94

Stark O. and Wang Y. (2002) : « Inducing human capital formation : migration as a substitute for subsidies » ; Journal of Public Economics, vol :86

World Bank (2006): “Economic Implications of Remittances and Migration”; in Global Economic prospects