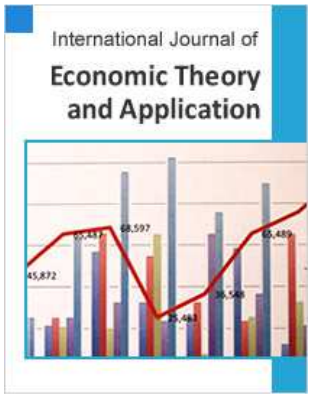
International Journal of Economic Theory and Application
2015; 2(5): 40-55
Published online September 20, 2015 (http://www.aascit.org/journal/ijeta)
ISSN: 2375-298X



Keywords
Ex-Ante Multiple Equilibria,
Ex-Post Multiple Equilibria,
Take-Off,
Technology Adoption,
Technology Absorption,
Knowledge Externalities,
Diaspora,
Comparative Development

Received: August 25, 2015
Revised: September 3, 2015
Accepted: September 4, 2015

Comparative Economic Development, Brain Drain and Modern Growth

Diana Loubaki[1, 2]

[1]Department of Fundamental Analysis in Economics, University Marien N'Gouabi, Brazzaville, Congo
[2]Centre d'Economie du Développement et de la Soutenabilité de la Croissance, Clamart, France

Email address
dloubaki@yahoo.fr, diana.loubaki@laposte.net

Citation
Diana Loubaki. Comparative Economic Development, Brain Drain and Modern Growth. *International Journal of Economic Theory and Application*. Vol. 2, No. 5, 2015, pp. 40-55.

Abstract
This article is a global economic development theory built on a mixture of historical observation, scientific results as well as modern growth and the brain drain theories interaction. The results found are: ex-ante and ex-post multiple equibria define multiple take-off locus over time. Once the dynamical paths converge toward a given locus, thus joins the convergence club in economic performance level. Finally, comparative development presents three main economic performance levels where the highest is shared among Western countries, between the highest and the world threshold is the one shared by the Asian emerging countries, Latin American countries settled on the threshold and African countries remain at the bottom. Therefore, a theory is provided to lift the lowest dynamical path toward the equilibrium on the basis of the capacity to innovate through R&D, knowledge externalities, adoption and absorption of new innovations in production sector. Consequently, the model provides theoretical foundations of the empirically observed emerging countries in economic globalization context fact the theory couldn't explain until now.

1. Introduction

Development began in 18th century in England first and spread all over Western countries, despite of that, development theory didn't exist but increasing returns and scale economies were recognized to be the engine of economic performance (Smith, 1776; Say, 1817) so that reflections in growth theory continues with Young (1928) and the influential work of Marshall during the 1930s. Between the 1940s and the 1970s something happened to economics, a rise in the standards of rigor and logic which yields to a much improved level of understanding of some things through the emergence of methods in social science i.e numerical examples and mathematical models. Nonetheless, in the early 20th century economic analysis becomes more mathematical, but up to the post war 2, most of the countries were developing (Bardhan, 1993) which can be noticed through the planning models like Harrod (1939) and Domar (1948). During the 20th century, the country's economic performance was classified among industrialized countries or non industrialized countries i.e developing countries. But in the 21th century, the economic performances of the countries in development level are divided in three categories which are: industrial countries, emerging countries and developing countries and each country's category follow a specific development path according to the data. In order to model that evidence and provide tools able to explain those recent mutations, a framework is build to provide mechanisms of economic

development which have made knowledge jumps from one configuration to another on the basis of the growth and the brain drain literatures. The proof is given in two steps, the first explains emerging countries' existence and the second provides remedies for the least developed countries to reach their development frontier (Acemoglu, 2005)

The classical economy of the 17th, 18th and early 19th century were all development economics and economists were writing about the Great Britain industrialization process (Bardhan, 1993) which was the first to reach the take-off denoted D_1* while the other countries didn't reach it yet, so that equilibrium were multiple at that time also qualified as ex-ante multiple equilibria. Then after the post war 2, when Japan as well as United States already described long-run growth, development spread nearly all over the whole Western countries through knowledge, enhancing their industrialization though the capacity to innovate, a by-product of R&D and to absorb as well as to adapt new technology in the production sector highlights for example by *"the Concorde"*, a high technology plane invented by the French Engineers after the post war 2. Thus, between the years 1945s and 1970s, the world industrialized economies reached *their economic growth golden age* which began to fluctuate with the oil shocks of 1973 and 1979 then growth began to decrease. In parallel, with the forthcoming event of liberalization of some countries in Asia, Latin America and Africa in the years 1960s under the more developed countries' power, their growth perspectives became to be discussed first by Roseinstein-Rodan (1943) [1] and other development economists pioneers[2]. After the 1960s with the independence event of those countries under the Western countries influence i.e Asian countries as well as Latin American and African countries, a specific development economics field emerges and became new under developed regions. Despite of that fact, some countries keeps growing while some others couldn't, so that accounting differences in development terms among countries in order to explain why it is so became a central issue in comparative economic development field. Therefore raised the famous question of Robert Lucas, Jr (1988) i.e "*is there some action a government of India could take that would lead the Indian economy to grow like Indonesia's or Egypt's? If so,* what, *exactly? If not, what is the "nature of India" that makes it so? The consequences for human welfare involved in questions like these are simply staggering: Once one starts to think about them, it is hard to think about anything else"* thus highlights the importance of economic growth in the world debate.

Therefore, according to Barro and Sala-i-Martin (2004)[3], the real per capita gross domestic product (GDP) in the United States grew by a factor of 10 from $3340 in 1870 to $33,330 in 2000, all measured in 1996 dollars. This increase in per capita GDP corresponds to a growth rate of 1.8 percent per year. This performance gave the United States the second-highest level of per capita GDP in the world in 2000 (after Luxembourg, a country with a population of only about 400,000). Some Asian countries like South Corea, Singapoor, Hong-Kong, and Taiwan high and sudden economic performance around 2000 and China in the years 2010, yield ex-ante multiple equilibria toward a single one denoted, the second take-off locus, D_2* on the space while others countries in Africa and Latin American were left under developed. Those Asian countries economics paths had jumped on the dynamical system of the developed countries over the time, whereas, the Latin American economies had jumped on the threshold or on the average world development level according to data provided by the studies on comparative economic development and African countries remain under developed where some of them exhibit negative growth rate (DRC[4]).

The comparison of levels of real per capita GDP over a century involves multiples as high as 20; for example, Japan's per capita GDP in 1990 was about 20 times that in 1890. Comparisons of levels of per capita GDP across countries at a point in time exhibit even greater multiples. Figure1 shows a histogram for the log of real per capita GDP for 113 countries (those with the available data) in 1960. The mean value corresponds to a per capita GDP of $3390 (1996 U.S. dollars). The standard deviation of the log of real per capita GDP (a measure of the proportionate dispersion of real per capita GDP) was 0.89. This number means that a 1-standard-deviation band around the mean encompassed a range from 0.41 of the mean to 2.4 times the mean. The highest per capita GDP of $14,980 for Switzerland was 39 times the lowest value of $381 for Tanzania. The United States was second with a value of $12,270. The figure shows representative countries for each range of per capita GDP. The broad picture is that the richest countries included the OECD and a few places in Latin America, such as Argentina and Venezuela. Most of Latin America was in a middle range of per capita GDP. The poorer countries were a mixture of African and Asian countries, but some Asian countries were in a middle range of per capita GDP.

For the 38 sub-Saharan African countries with data, the mean growth rate from 1960 to 2000 was only 0.6 percent per year. Hence, the typical country in sub-Saharan Africa

1 This article focused on under development regions of south and eastern Europe only

2 Those authors dispute over the nature of the policies that might be required to break a country out of a low-level trap. Rosenstein-Rodan and others appeared to imply that a coordinated, broadly based investment program -- the Big Push would be required. Hirschman disagreed, arguing that a policy of promoting a few key sectors with strong linkages, then moving on to other sectors to correct the disequilibrium generated by these investments, and so on, was actually the right approach. Arthur Lewis's famous "Economic development with unlimited supplies of labor" emphasized dualism among modern and traditional sectors of good production which causes under development, thus the absorption of low skilled workers from traditional sector into modern sector was the right approach leading to development. Fleming (1954), argued that owing to the role of intermediate goods in production was the way to develop faster a given country.

3 Economic Growth, 2004, book published by the *MIT Press*

4 Democratic Republic of Congo

increased its per capita GDP by a factor of only 1.3 over 40 years. Just above the African growth rates came a few slow-growing countries in Latin America, including Bolivia, Peru, and Argentina. As a rough generalization for regional growth experiences, we can say that sub-Saharan Africa started relatively poor in 1960 and grew at the lowest rate, so it ended up by far the poorest area in 2000. Asia started only slightly above Africa in many cases but grew rapidly and ended up mostly in the middle. Latin America started in the mid to high range, grew somewhat below average, and therefore ended up mostly in the middle along with Asia. Finally, the OECD countries started highest in 1960, grew in a middle range or better, and therefore ended up still the richest. Therefore, both some Asian countries as well as Latin American countries share sometimes the middle path and sometime other time, the highest levels in economic performance close to the OECD countries that we models through knowledge which allowed so, as a jumping function (Chen, 2006, 2008)

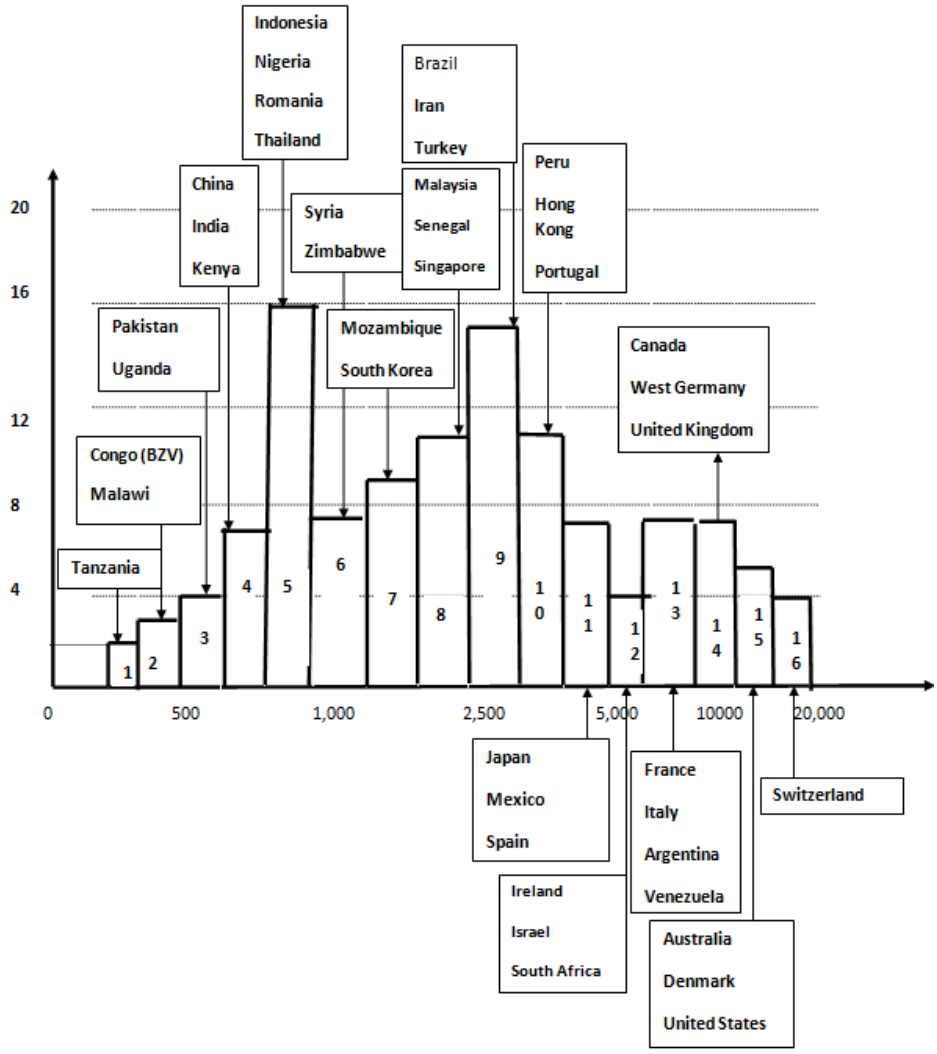


Figure 1. *Histogram for growth rate of per capita GDP in 1960.*

Source: Barro and Sala-i-Martin, 2004, Economic Growth, the MIT Press

The conclusion which can be given is that, economic growth led to substantial reductions in the world's poverty rates and head counts over the last thirty years. As mentioned earlier, this outcome was not inevitable: if aggregate growth had been accompanied by substantial increases in income inequality, it would have been possible for the mean of the income distribution to increase but also for the fraction of the distribution below a specified poverty threshold to also increase.

Sala-i-Martin (2003a) shows that, even though this result is theoretically possible, the world did not behave this way over the last thirty years. Moreover, he also shows that world income inequality actually declined slightly between 1980 and 2000. This conclusion holds whether inequality is measured by the Gini coefficient, the Theil Index, the mean logarithmic deviation, various Atkinson indexes, the variance of log-income, or the coefficient of variation. Sala-i-Martin

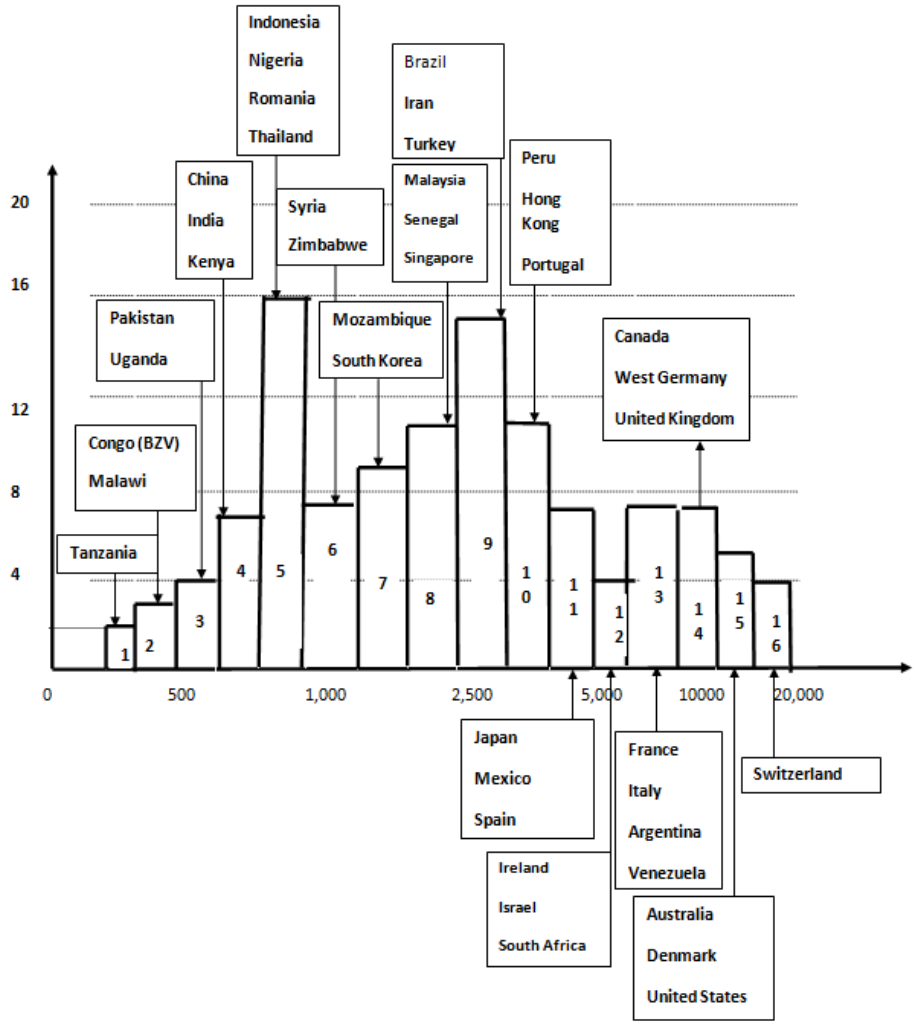


Figure 2. *Histogram for growth rate of per capita GDP in 2000.*

Source: Barro and Sala-i-Martin, 2004, Economic Growth, the MIT Press

(2003a) decomposes the world into regions and notes that poverty eradication has been most pronounced in the regions where growth has been the largest. Poverty rates for the poorest regions of the world: East Asia, South Asia, Latin America, Africa, the Middle East and North Africa, as well as Eastern Europe and Central Asia. In 1970, three of these regions had poverty rates close to or above 30 percent. In modern development economy, poverty reduction is a central issue of the policy conducted by World Organization and UN pointed out Millennium goal to achieve from 2000 to 2015 which is cutting poverty in half and for instance as I know this purpose is not reached yet. Therefore, this analysis aim is to explain comparative economic development evolution and mutations over time first and provide explanations and discussions on the way the countries left behind can overcome their backwardness over time, specifically sub Saharan African countries which development path still far from their frontier.

The other region in Africa has witnessed a dramatic increase in poverty rates over the last thirty years caused by food crisis and HIV/AIDS pandemic introduction. We also know that per capita growth rates have been negative or close to zero for most countries in Africa. Latin America and North America have both experienced reductions in poverty rates. Latin America witnessed dramatic gains in the 1970s, when growth rates were substantial, but suffered a setback during the 1980s Poverty rates in Latin America stabilized during the 1990s. Poverty rates declined slightly between 1970 and 1975. The decline was very large during the high-growth decade that followed the oil shocks and then stabilized when aggregate growth stopped. Finally, Eastern Europe and Central Asia (a region that includes the former Soviet Union) started off with very small poverty rates. The rates multiplied by a factor of 10. Actually, mostly because of financial crisis in 21th century, growth in high-income countries remains weak, with their GDP expanding only 1.3 percent in 2012 and expected to remain low at an identical 1.3 percent in 2013. In the Euro Area, growth is now projected to only

return to positive territory in 2014, with GDP expected to contract by 0.1 percent in 2013, before edging up to 0.9 percent in 2014 and 1.4 percent in 2015 between 1989 and 2000 (World Bank Weekly Update, January 3, 2013), whereas, in Eastern Europe and Central Asia, poverty rates increased dramatically in contrast to growth rate which increases spectacularly but still income distribution matters among the population. One is the huge increase in inequality that followed the collapse of the communist system leading to the liberalism of most of the country in the whole world and the second factor is the dismal aggregate growth performance of these countries. Indeed, according to those observations, the world countries can be classified such as displayed by the figure 3

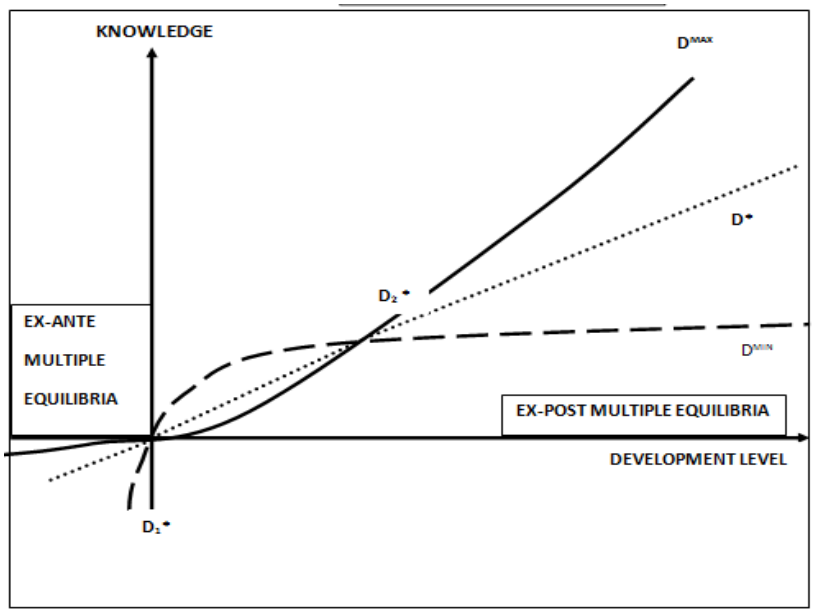


Figure 3. *Describes the historical Evolution of World Comparative Development as a summary.*

The article is organized as follow, section 2 models comparative economic development of the whole world in order to provide a new classification in which emerging countries is introduced like a special entity that the theory couldn't explain yet. Section 3 exposes comparative modern growth and the brain literatures in order to provide tools able to make the least developed countries achieve their development frontier i.e African countries like it is the case for other countries' category i.e Western Countries, some Asian Countries and Latin American. Section 4 presents the results associated and the article ends up with section 5 with the unified development theory in order to present the new development approach i.e efficient theory able to lead the least developed countries, specifically African countries toward development like it is the case for the other countries. Finally, section 6 concludes on the study.

2. Analytical Modeling of Comparative Development

Following Lucas (1988), we assume N countries indexed by i where $i=1,2,3,...,N$ the production function of each country is of Cobb Douglas and can be written such that:

$$Y^i(t) = A^i K^i(t)^{\alpha} H^i(t)^{1-\alpha} h_a{}^i(t)^{\gamma} \quad (1)$$

Where A^i is technological level already absorbed and adapted in the production sector, K^i is the stock of capital used in the production process, H^i is the stock of human capital used in the production, h_a captures the external effects of human capital and α and γ are positive parameters and we have: $Y^1(t) < Y^2(t) < ... < Y^N(t)$;. $A^1(t) < A^2(t) < ... < A^N(t)$; $H^1(t) < H^2(t) < ... < H^N(t)$; $K^1(t) < K^2(t) < ... < K^N(t)$; $h_a{}^1(t) < h_a{}^2(t) < ... < h_a{}^N(t)$ such that i can be classified in three similar groups $n<m<l$ thus $i=\{min,*,max\}$

Rewriting equation (1) in intensive form where, $k^i(t) = K^i(t)/H^i(t)$, $y^i(t) = Y^i(t)/H^i(t)$, it yields equation (2) such that:

$$y^i(t) = A^i k^i(t)^{\alpha} h_a{}^i(t)^{\gamma} \quad (2)$$

Where $y^{\min}(t) < y^*(t) < y^{\max}(t)$

The dynamical evolutions of physical capital and human capital are respectively given by equations (3) and (4) such that:

$$\overset{\circ}{K}{}^i(t) = B^i K^i(t)^{\beta} h_a{}^i(t)^{1-\beta} \quad (3)$$

$$\overset{\circ}{H}{}^i(t) = D^i H^i(t)^{\mu} h_a{}^i(t)^{1-\mu} \quad (4)$$

Where B^i and D^i are the respective productivity parameters of physical capital and human capital evolutions over time

Rewriting (3) and (4) in intensive form, it yields their respective growth rates over time

$$g_k^{\,i}(t) = B^i k^i(t)^{\beta} \tag{5}$$

$$g_h^{\,i}(t) = D^i h^i(t)^{\mu} \tag{6}$$

Where: $g_k^{\,i}$ is physical capital growth rate, $g_h^{\,i}$ is human capital stock growth rate, h^i is external effects of per-unit of human capital stock and k^i is external effects of per-capita unit of physical capital. We also have: $g_k^{\min}(t) < g_k^*(t) < g_k^{\max}(t)$ and $g_h^{\min}(t) < g_h^*(t) < g_h^{\max}(t)$

Since

$$\mathrm{h}^{\mathrm{i}}(t) = h_a^{\,i}(t) / H^i(t);$$

$$g_k^{\,i}(t) = K(t)/K(t),\ g_h^{\,i}(t) = H(t)/H(t)$$

and $k^i(t) = h_a(t)/K^i(t)$,

$$1<i<N$$

Both per-capita physical capital, knowledge and production depends on external effect which acts differently according to the environment in touch with the country, a kind of market shared together which raises external benefit for the whole, therefore defines several similarities groups leading to classification of the countries and establishes a kind of convergence in development levels among some given countries.

Definition 1; Ex-ante multiple equilibria is defined by several vectors composed of per-capita income, $y^i(t)$, $i=1,2,...,N$ per-capita growth rates in technology, $g_k^{\,i}(t)$ and knowledge, $g_h^{\,i}(t)$ where exist both the maximum, $Max\{y^i(t), g_k^{\,i}(t), g_h^{\,i}(t)\}$ and the minimum, $Min\{y^i(t), g_k^{\,i}(t), g_h^{\,i}(t)\}$ the whole expressed like a vector of three components i.e

$$(y^i(t), g_k^i(t), g_h^i(t))_{1<i<N} \tag{7}$$

Assumption 1: for each given country indexed by i where $h^i(t) = h_a^{\,i}(t)$ i.e external effects are fully captured.

According to the observation, countries differ in their levels of knowledge and technology which also explain their differences in economic performance. The equilibrium is defined by the compute of optimal values according to the optimal control theory in solving the program $\underset{g_k^i, g_h^i}{Max}\left(y^i(t)\right)_{1<i<N}$ (see equations (2), (5) and (6)) which yields to the Hamiltonian

$$\mathrm{H}^i = y^i(t) + \lambda_1^{\,i} g_k^i(t) + \lambda_2^{\,i} g_h^i(t) \tag{8}$$

$$1<i<N$$

The first order conditions subjected to $\lambda_1^{\,i} = \lambda_2^{\,i}$ yields the steady states in technology and in knowledge as well as in growth rate i.e:

$$k^{i*} = \left[\left(\frac{D^i\mu}{A^i\gamma}\right)\left(\frac{\alpha A^i}{\beta B^i}\right)^{1/\gamma}\right]^{\gamma/\alpha(\gamma-1)+\beta} \tag{9}$$

$$h^{i*} = \left(\frac{D^i\mu}{A^i\gamma}\right)^{\gamma/\alpha(\gamma-1)+\beta}\left(\frac{\alpha A^i}{\beta B^i}\right)^{1/\gamma(1+\gamma/\alpha(\gamma-1)+\beta)} \tag{10}$$

$$g_k^{\,i*} = B^i\left[\left(\frac{D^i\mu}{A^i\gamma}\right)\left(\frac{\alpha A^i}{\beta B^i}\right)^{1/\gamma}\right]^{\gamma\beta/\alpha(\gamma-1)+\beta} \tag{11}$$

$$g_h^{\,i*} = D^i\left(\frac{D^i\mu}{A^i\gamma}\right)^{\gamma\mu/\alpha(\gamma-1)+\beta}\left(\frac{\alpha A^i}{\beta B^i}\right)^{\mu/\gamma(1+\gamma/\alpha(\gamma-1)+\beta)} \tag{12}$$

Lemma1: *the multiple dynamical paths* $\left(y^i(t), g_k^i(t), g_h^i(t)\right)_{1<i<N}$ *admit a upper,* $\left(k^{\max}, h^{\max}, g_h^{\max}, g_k^{\max}\right)$ *and a lower bounds,* $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ *where* $k^{\min} < k^* < k^{\max}$ *;* $h^{\min} < h^* < h^{\max}$ *;* $g_k^{\min} < g_k^{\,*} < g_k^{\max}$ *and* $g_h^{\min} < g_h^{\,*} < g_h^{\max}$

Proof:

Let I=(1,2,…,N) the number of existing countries in the whole world such that 1≤2≤…≤N for all i∈N, given Γ_i the set of upper values in economic performance of the countries, then $(k^i(t), h^i(t), g_k^i(t), g_h^i(t)) \in G$ the set of comparative economic growth is an increasing function and Since the variables are defined in a compact and convex set, E there exist i_0 and i_1 such that $\underset{i_0}{Min}\left\{k^i, h^i, g_k^i, g_h^i\right\} = \left(k^{\min}, h^{\min}, g_k^{\min}, g_h^{\min}\right)$ and $\underset{i1}{Max}\left\{k^i, h^i, g_k^i, g_h^i\right\} = \left(k^{\max}, h^{\max}, g_k^{\max}, g_h^{\max}\right)$ exist, indeed, the first order conditions have only provided thresholds in economic performance such that: $k^{i*} = \bar{k} = k^*$; $h^{i*} = \bar{h} = h^*$; $g_k^{\,i} = \bar{g}_k = g_k^*$ and $g_h^{\,i} = \bar{g}_h = g_h^*$, therefore we have: $k^{\min} < k^* < k^{\max}$; $h^{\min} < h^* < h^{\max}$; $g_k^{\min} < g_k^{\,*} < g_k^{\max}$ *and* $g_h^{\min} < g_h^{\,*} < g_h^{\max}$

Proposition1: the comparative economic development is an escalator continuous function in countries such that: $\left[k^{\min}, h^{\min}\right]$ expresses African countries economic performance team; $\left[k^*, h^*\right]$ expresses Latin American countries economic performance club; $\left[k^{\max}, \infty\right[\cup \left[h^{\max}, \infty\right[$ *expresses Western Countries economic performance team, whereas the intermediary*

between $]k^{\max}, h^{\max}[$ *and* $[k^*, h^*]$ *expresses Asian countries economic performance club*

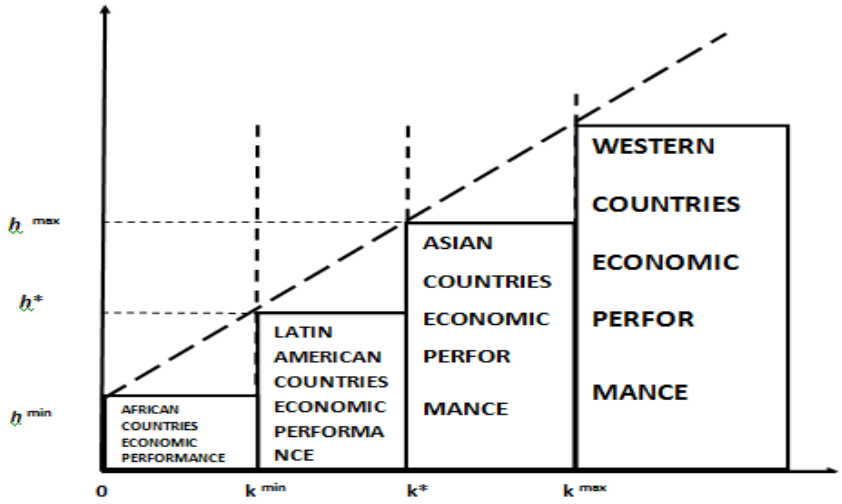


Figure 4. *Displays comparative development in knowledge performance among regional teams.*

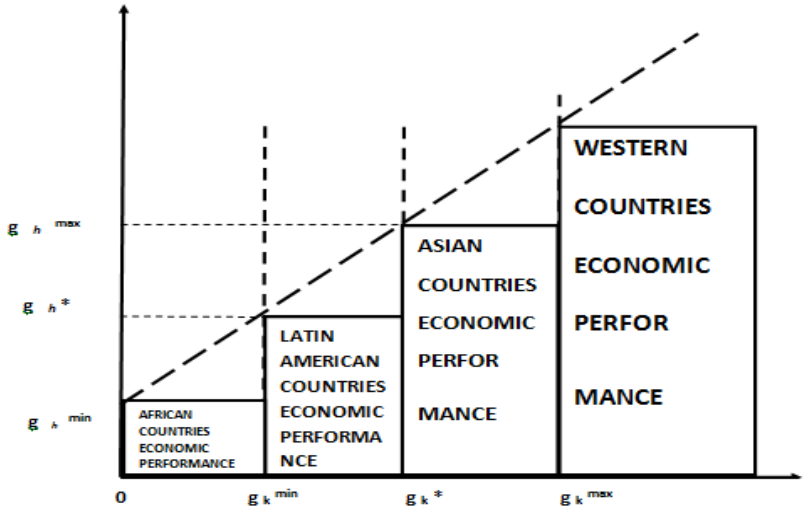


Figure 5. *Displays comparative development in growth rates among regional teams.*

See figures 4 and 5 for proof as well as the data presents in general introduction of the article

Proposition 2: *Economic Performance of countries in the world can be classified as teams which contain similarities in development economics levels over time*

Proof: relaying the history of comparative development, we can see that some countries grow faster than the others because of human capital investment as well as R&D investments differentials, long run growth as well as development frontiers differ according to the team in which belongs the country. Therefore, those differences are caused by geographical locations and the way external effects capture knowledge in the closest countries which make them converge faster or less fast toward their sustained growth

Proposition 3: *According to definition 1, up to the 18th century, the whole world dynamical paths exhibits ex-ante multiple equilibria, around the 18th century, the great Britain dynamical path reached,* $Max\{y^i(t), g_k^i(t), g_h^i(t)\} = (y^{\max}(t), g_k^{\max}(t), g_h^{\max}(t))$ *which accelerates knowledge spread among Western countries through external effects captured by* $h_a^i(t)$ *and create convergence of some Western countries dynamical paths indexed by i such that:*

$(y^i(t), g_k^i(t), g_h^i(t))_i$ *crossed the development take-off locus,* D_1^* *after the post war 2 and creates a convergence club toward the highest economic performance path and thus settled toward* $(y^{\max}(t), g_k^{\max}(t), g_h^{\max}(t))$ *due to the mixture of embodied knowledge,* h^* *and technology,* k^*

Proof: Before ex-ante multiple equilibria and the cross of D_1^* i.e up to the 18th century, economic development performance was multiple, after the 18th century, maximum and minimum levels in economic performance exist expressed by: $k^{\min} < k^* < k^{\max}$ for per-capita physical

capital; $h^{\min} < h^* < h^{\max}$ for per-capita human capital as well as $g_h^{\min} < g_h^* < g_h^{\max}$ and $g_k^{\min} < g_k^* < g_k^{\max}$ for the respective growth rates of physical and human capital, where each of those per-capita variables was composed of several countries indexed by *i*. Therefore, according to the empirical studies results, we can classify the variables in several categories which are: $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ for the lowest long run development path category i.e of the developing countries; $\left(k^*, h^*, g_h^*, g_k^*\right)$ is the average long run development path of the emerging countries and finally, $\left(k^{\max}, h^{\max}, g_h^{\max}, g_k^{\max}\right)$ is the highest long run development path shared by Western countries. Therefore, development g^* is the sum of the both growth rates in knowledge terms i.e $g^* = g_h^* + g_k^*$ where knowledge is the sum of the both capitals i.e $k^* + h^*$ (see figure 4)

The ex-post multiple equilibria is a process which emerged after the drop of the Berlin Wall in 1989 yielding first to the transition toward market based economies of Communism countries associated to the take-off of some Asian Countries in 2000. Consequently, the world development paths highlights fundamentally three of them such that the highest levels correspond to the Western Countries, the intermediary between the highest and the equilibrium part of global development contains Emerging Countries, whereas, Latin American countries dynamical paths fluctuate around the equilibrium or the world average levels. In contrast, the lowest development path levels caused by low economic performance are those shared by sub Saharan African Countries (See figures 1 to 4 given to prove proposition1)

Over time, $\left(k^*, h^*, g_h^*, g_k^*\right)$ when high, makes the emerging countries path jumps on the dynamical system of the developed countries and yields convergence in knowledge and technology terms as we can see for south Corea. Since over time beginning on the years 1960s $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ jumps on the upper dynamical system, then joined the average i.e $\left(k^*, h^*, g_h^*, g_k^*\right)$ path, thus describes Latin American countries. Finally, when it doesn't do so i.e $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ remains low, it describes the poorest countries in world mostly located in sub Saharan Africa. If averagely high, the path reaches the dynamics of the middle countries economic development, the reason of that stagnation is due to low human capital and technology adoption as well as R&D conduction absence, natural resources remain the main goods of those countries which face great fluctuations on the world market because their value still low for the country to departure from its poverty trap with low growth and development retard

Proposition 4: *After the post war2, the others countries in Latin America, Africa and Asia, show ex-post multiple equilibria, then around the 2000s some Asian Countries crossed the second take-off threshold and accelerate their economic performance in order to be located between the highest,* $\left(k^{\max}, h^{\max}, g_h^{\max}, g_k^{\max}\right)$ *and the threshold dynamical paths,* $\left(k^*, h^*, g_h^*, g_k^*\right)$ *whereas, some countries of Latin America converge around the threshold,* $\left(k^*, h^*, g_h^*, g_k^*\right)$. *In contrast, other countries of Africa as well as Asian countries still at the lowest economic performance dynamical path* $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$

Proof: according to the observations of comparative development related in the first section through figures (Barro, 2004), after the ex-ante multiple equilibria, the world economy exhibits finally three main dynamical paths which are the highest, the threshold and the lowest. Since around the years 2000s, some Asian countries in economic performance exhibits high growth including Russia which also reached a high economic performance position after the fall of the Berlin wall thus, converge toward the highest position, $\left(k^{\max}, h^{\max}, g_h^{\max}, g_k^{\max}\right)$ shared by Western countries, whereas Latin American countries' dynamical path settled at the middle position, $\left(k^*, h^*, g_h^*, g_k^*\right)$. In contrast, the poorest countries of some Asian countries and of Africa specifically sub Saharan Africa, remain at the lowest position, $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$

Therefore, the following sections deeply study what can be done for the poorest countries to achieve long-run growth and increase their economic performance. In order to understand what matters, we need to present the tools used in that context to learn more about the mechanisms in action and those causing under development. In order to do it, this article proposes the interaction between the literatures of modern growth and of the brain as a remedy before ending with the appropriate economic development theory.

3. Brain Drain and Modern Growth Interaction

In this part, the article focuses on the analytical proof of the way sub Saharan Africa's Countries, can converge to its development frontier.

In a comparative development prospect, one need to know how does globalization affect development? Both the modern literature of endogenous growth and the brain drain, explain growth absence in developing countries by low knowledge investment. This paper provides some reflections given by both the modern growth and the brain drain theories, the last theory mostly focused on development of poorest countries' and explains low economic performance observed by high skilled labors stock absence due to migration from poor to rich countries. The central question raised by the link of the both theories is how to counterpart the brain drain for developing countries' to gain more knowledge?. In other words, how knowledge can be integrated in poor countries to enhance development, since we know that it is the main source of economic growth (Lucas, 1988), thus of poverty reduction (Sachs, 2005) and the whole yields development sustainability (Smulders, 1995). After having discussed the literature, we propose the way the problem of knowledge integration in

poorest countries can be solved.

The growth literature provides knowledge transfer possibility from rich to poor countries through two aspects. The first is the one contained in goods like books, physical capital, car, etc,.. Usually called technology, *k* in our case and diffused through international trade. The second aspect of knowledge is embodied on human being that is called human capital, *h*. The main difference among those two kinds of knowledge is their rivalry character. The rival aspect of knowledge means that, technology can be used without limit, but human capital belongs to someone once dead, knowledge is lost but the books written or the scientific production done by that person survive (Romer, 1990). The main link among knowledge is that, both of them result from an investment done by private agents or by the government i.e R&D. In use, technology and human capital are complementary, since buying a high tech innovation for good production for example, requires skills labors like engineers able to handle it like to adapt it in the production and allow it use in the creation of higher quality goods (Eicher, 1996). The adoption of foreign technologies requires individuals with strong technical and professional skills developed through secondary or specialized higher education, whereas innovation is research-based and requires the presence of high-level scientists and engineers. Other variables are also likely to impact productivity growth. Innovation depends on country characteristics such as public investments in R&D and in higher education, quality of governance, etc (Docquier-Rapoport, 2012). Indeed, knowledge adoption depends on subsidies to private R&D and the intensity of contacts and exchanges with leading countries. Therefore several questions raises such that, where and how high education should be acquired for new innovations to be adaptable?, What should be done to increase knowledge in order to possess high quality labor in non industrial countries?.

The natural answer some one is willing to give is why not training agents in a developed country to make sure that everything will work well? Or why not hire specialists in poor countries to work with high technology to develop industry? Because the second option will be too costly, thus not interesting enough for the long run growth to hold without government deficit increase indeed it might be gave up5. For the first question, unfortunately, the international migration literature answers, the country will face the brain drain i.e the non return of the high skilled labor trained abroad6 also called the diaspora. The policy will face eviction and leads to diaspora increase. Thus the poor country will only partly reach its goal in the concern of development perspective based on education acquisition abroad. Now, the same question turns out to be, how to make the endogenous growth which is R&D provider through human capital accumulation and the brain drain literatures meet in an international integration purpose achievement i.e for development take-off in sub Saharan Africa?. To answer this question, a new theory needs to be built both on the basis of modern endogenous growth and brain drain, respectively in the concern of goods transfer or international trade and skilled labor international mobility. Since the main mechanics proposed to slow the brain drain didn't work [7] (Bhagwati, 2009). Therefore, additional knowledge possessed by developing countries abroad or diaspora[8] whom presence at home would be useful to enhance development is absent, thus the economy can't increase its speed of convergence to its development frontier.

Consequently, through this reflection, the aim of the rest of this article is to provide a theory which indicates the way the brain drain can be eradicated and growth increased through knowledge integration in developing countries. The question asked now is:

What can be explicitly learned from the literatures of the brain drain and of the modern endogenous growth to support development? Since we know now, that, their link defines both a take-off and the stable long-run development equilibrium?

3.1. The Brain Drain Contribution to Economic Development

The brain drain literature begins in the late 1960s with the works of Grubel and Scott, (1966); Johnson, (1967); Berry and Soligo, (1969) just after the countries in Africa, Latin America and Asia under industrial countries' dependence such as France, England and Portugal obtained their political freedom, then migration didn't grow as much as it is today. Indeed, those contributions pioneers only conclude to a neutral impact of the brain drain on source countries. In the 1970s, as the migration phenomenon begins to grow, economists such as Bhagwati and Hamada, (1974); Kim, (1976); McCulloch and Yellen, (1977), qualify it as having negative consequences for those left behind. Then, the high-skilled labor migration from poor to rich countries begins to be viewed as contributing to increase inequality at the international level. Because it yields the rich countries

5 The contract to build the highest building in Brazzaville (Congo) with the French Engineers turns out to be too costly for the country and deserved to many credits. Actually, the Chinese are regularly hired in the country to build houses, buildings and other public needs cheaper than the Western countries' Engineers are.

6 According to the United Nations, the number of international migrants increased from 75 million in 1960 to 190 million in 2005, at about the same rate as the world population, meaning that the world migration rate increased only slightly, from 2.5 to 2.9 percent the immigrants-to-population ratio in the most developed countries has tripled since 1960 (and has doubled since 1985), and is increasingly skilled. Hence, while migration to the OECD area has increased at the same rate as trade, high-skill migration (or brain drain) from developing to developed countries has increased at a much faster race and can certainly be regarded as one of the major aspects of globalization.

7 The idea of introducing a "tax on brains" was first proposed in the 1970s by Jagdish Bhagwati, according to the following principles: i) it is an income tax paid by highly skilled emigrants on top of their regular income tax, the proceeds of which are transferred to the home country government; ii) the rationale for the tax is double: compensation (of those left behind, for the externality imposed on them, and of home country governments for their public funding of education), and equity (through re- distribution of the rents earned by highly skilled emigrants as a result of international restrictions on labor mobility); and iii) in its last version, the tax is basically a tax on retained citizenship (Bhagwati, 2009).

8 The presence of highly educated Indians among the business, scientific and academic elites of England, the US, and other Western countries is impressive and has long been both a matter of national pride and of persistent concern

becoming richer at the expenses of poor countries which are the main funds providers in education investment of the former elites. Those arguments continue with the first papers which analyze the brain drain in an endogenous growth framework like Miyagiwa, (1991), Haque and Kim, (1995). Then, between the mid-1990s and the beginning of the 2000s as the phenomenon is highly known and detrimental for the source countries[9], the literature raised the idea that, high skilled labor migration could be beneficial to the source country (Mountford (1995, 1997), Stark et al. (1997, 1998), Vidal (1998), Docquier and Rapoport (1999), Beine et al. (2001), and Stark and Wang (2002)) and introduces education acquisition at home (Beine Docquier Rapoport (2008)) in the mid-2000s as well the fact that, the brain drain story does not necessarily need to hold (Docquier and Rapoport, 2007) because, in a developing economy closed to international migration, the returns to schooling are too low for investment in education to be high enough to lead to the brain gain, which effect introduces occupational choices, network effects (Kanbur and Rapoport, (2005)), fertility, education subsidies (Stark and Wang, 2002), and claim brain waste (Schiff, (2005); Docquier and Rapoport (2012)). Therefore, Garcia-Pires (2015) investigate the claim by Docquier and Rapoport (2012) on brain waste and finds that the brain drain scenario has several negative effects. For the origin country of migration, it reduces the incentives of individuals to acquire education and it weakens the possibility of brain gain to arise. For the destination country of migration, it undermines the chances of a positive self-selection of skilled migrants. Indeed emerges the diaspora10 concept to specify the high skilled labors from developing countries living in developed countries. But, return migrants knowledge and financial capital accumulation before returning may generate additional beneficial effects on technology adoption and productivity growth at home (Domingues Dos Santos and Postel-Vinay, 2003; Dustmann, Fadlon and Weiss (2008); Mayr and Peri (2009)), Stark et al. (1997) and Chen (2008) also elaborate the possibility of a brain gain associated with a brain drain in a context of migration, imperfect information and return through the following mechanism: in such a context, low-ability workers invest in education for the purpose of emigrating and are pooled with high-ability workers on the foreign job market. Once individual productivity is revealed, low-ability workers return home with the human capital they would not have acquired if it was not for the possibility of migration, hence the possibility of a brain gain with a brain drain emerge. Indeed, Agrawal, Kapur and McHale (2008) model innovation which depends on knowledge access and knowledge access partly depends on membership in both co-location and diaspora networks. A necessary condition for the movement of an innovator to the diaspora to increase access of the home country (India in their case) is the diaspora knowledge-access11. By reducing international transaction costs and favoring the diffusion of knowledge and ideas, highly-skilled diaspora settled in the developed countries facilitate technology diffusion, stimulate trade and contribute to improve domestic institutions. Kerr (2008) also uses patent citation data to examine the international transfer of knowledge between the US and the home countries of US-based on diaspora, with scientists being assigned to a particular diaspora by a recognition software. He finds strong evidence of knowledge diffusion along the ethnic diaspora channel, especially for the Chinese diaspora, and evidence that such transfer have a direct positive effect on manufacturing productivity in the home countries, especially in the high-tech sector.

3.2. The Modern Growth Theory Contribution to Economic Performance

From the beginning[12] until the mid-1980s, the literature of endogenous growth considered physical capital as the main growth engine. But, the hypothesis of diminishing returns of physical capital (Solow, 1956) yields to unobserved two facts which are, the poor country grow faster than the rich countries and may catch them and the sources of economic growth remain unknown since all inputs are remunerated at their margin productivity. Increasing returns[13] can't arise from that structure i.e competition to explain growth. Because of the technical difficulties presented by dynamic models it was difficult to take account of increasing returns inside those models, because the Euler law couldn't hold. Therefore, Arrow's (1962) paper on learning by doing, argued that increasing returns arise because new knowledge is discovered as investment while production is taking place but remains a public good not remunerated like the other inputs of production. The theory was blocked until the mid-1980s when Romer (1986), the first model to prove the existence of the equilibrium in the model of competition with

9 Developed countries such as France, begins to reject the application of permanent resident claim from foreign students specifically those natives of developing countries to make them going back home since studies done are ended and put pressure to the Congo republic to sell the building bought for his students in Paris in order to decrease incentives for foreign students to come to establish there on the basis of Education. Home higher education begins to be the first choice.

10 Immigrants represent 47 percent of PhD workers employed in the US science and engineering industry (and 24 percent of workers with bachelor education)

11 Buch et al. (2006) show that immigration can also attract FDI from the migrants home to host country; using regional differences for the origin-mix of immigrants to Germany, they show that the presence of immigrants from a given country significantly affects the spatial bilateral pattern of FDI to the German Lander.

12 The beginning of the growth theory can be established back to Smith (1776)

13Increasing returns are central to the explanation of long-run growth is at least as old as Adam Smith's story of the pin factory. With the introduction by Alfred Marshall of the distinction between internal and external economies, it appeared that this explanation could be given a consistent, competitive equilibrium interpre-tation. The most prominent such attempt was made by Allyn Young in his 1928 presidential address to the Economics and Statistics section of the British Association for the Advancement of Science

INCREASING RETURNS 1005 (Young 1969), Subsequent economists (e.g., Hicks 1960; Kaldor 1981) have credited Young with a fundamental insight about growth, but because of the verbal nature of his argument and the difficulty of formulating explicit dynamic models, no formal model embodying that insight was developed.

increasing returns through three elements: externalities, increasing returns in the production of output, and decreasing returns in the production of new knowledge combine to produce a well-specified competitive equilibrium model of growth. Despite the presence of increasing returns, a competitive equilibrium with externalities hold. The second problem raised by the literature, led Romer (1990)[14]; Lucas (1988); Aghion and Howitt (1992); Grossman and Helpman (1991a) [15] ; introduce human capital initiated by Becker and Schultz in the years 1960s for the demand of education inside the growth models to render them endogenous in the prospect of growth sources explanation. Now knowledge can be embodied in books, physical capital and called technology i.e *k* or in people called human capital i.e *h*. The difference among the two kinds of knowledge in models is highlighted by the fact that physical knowledge can grow without bound like in Rosen (1976), Heckman (1976) and Lucas (1988) but the embodied knowledge can't (Eicher, 1996). Consequently, as a non rival good, knowledge can't be kept secret and can be used by other countries, specifically where development needs to be increased (Azariadis-Drazen, 1990) to improve production methods and goods quality, since R&D generates innovations (Aghion-Howitt, 1996; Grossman and Helpman, 2015). Therefore in the concern of knowledge provided by goods through international trade, Helpman (1991a, ch. 8) and Young (1991) consider the opening of trade between two countries endowed with development levels differentials, leads to an inequality in gain since the leading country has a lower cost of innovation, which allows it to undertake more of this activity compare to the poorer country, thus autarky would be better for the last country. Those arguments contrast with those found by Samuelson, Hecksher and Ohlin for whom international trade yields equality in factor prices among the countries in action. Feenstra (1996) joins Helpman (1991a, ch. 8) and Young (1991) conclusion and evocates the risk of the increase of the existing gap between the poor and the rich countries. Peretto and Valente (2011) tell a similar story about resource abundance and their findings joins the Heckscher-Ohlin model. The given country must specializes in the resource the most abundant 16 it as relatively, thus in the creation of knowledge for industrial countries case and natural resources for the poor countries, then convergence will occur due to the equality in gains. Unfortunately, we also know from Prebish and Singer (1950) that exchange terms deteriorate when a country trade of goods is only or mostly based on natural resources, thus manufactured goods are those which improve gains in exchange trade and their production is a challenge for development purpose both in the concern of growth generated and of employment (Lewis, 1954). Therefore, Helpman (2004), Coe and Helpman (1995) Baldwin, Braconier, and Forslid (2005) and Keller (2010)[17], propose a country's bilateral trade volume with a particular partner to explain the extent to which R&D productivity in the country benefits from the partner's prior research experience. But international knowledge spillovers remain difficult to capture (Eaton and Kortum, 1999), otherwise it is able to establish integration of the world economy which thereby can raise knowledge stocks around the globe. Grossman and Helpman (2014)[18] R&D experience in some countries, conclude to productivity increase possibility elsewhere i.e in other countries. Tonetti, and Waugh (2014) propose a model with heterogeneous firms and trade costs which raise the relative profitability of high-productivity firms that exercise the opportunity to export relative to low productivity firms, that at best sell to the domestic market and face more intense competition there. Alvarez, Buera, and Lucas (2014) explore yet another mechanism that links globalization to diffusion in their model of idea flows. They start from the supposition that firms learn from those with whom they conduct business and find that trade is the vehicle for endogenous international knowledge spillovers. Unfortunately, in contrast with the brain drain theory, the mechanisms described in the modern growth literature presented still difficult to test empirically due to not accurate data collection as well as the methodology available (Grossman-Helpman, 2015).

4. Results of the Literatures Interaction

Proposition 5: *the both literatures evocated defines a development level equilibrium, D* as the intercept of knowledge, h* located on an increasing curve of growth performance, G(h) and BD(h), a decreasing brain drain curve in knowledge on the space*

14 Romer (1990) developed a model in which knowledge accumulated in the course of conducting

R&D raises the productivity of future innovation efforts

15 Grossman and Helpman (1991a) allowed for international knowledge flows, whereby either the knowledge stock that determines productivity in inventing new products reflects experience both at home *and abroad*, or else quality upgrading builds on past research successes in all countries. International knowledge spillovers tend to accelerate growth in all countries, as the cost of further innovation declines in every country with advances made elsewhere

16 This proposition was given first by Ricardo concept of equality in international exchange trade for which he was in favor

17 Coe and Helpman (1995) Baldwin and Robert-Nicoud (2008) consider an endogenous-growth model with heterogeneous firms and fixed costs of operation and of exporting, as in Melitz (2003). Then, a decline in trade costs raises the cutoff productivity level needed for a firm to survive and reduces the cutoff productivity level that leads it to participate in exporting. The resulting *selection* of more productive firms increases the intensity of competition in the world market.

18 Grossman and Helpman (2014) consider a world economy in which individuals differ in ability and successful innovators draw different technologies for producing their varieties. The model incorporates complementarities between the productivity of a technology and the ability of the workers that the firm employs. There are neither fixed costs of production nor of exporting. In this setting, the countervailing forces of scale and competition are quite clear: a reduction in trade costs in some country has no effect on the common rate of long-run growth in any of them. The extra profit opportunities that result from greater aggregate demand are exactly offset by the loss of market share to foreign producers.

Proof: according to the literatures of growth and of the brain drain in regard to knowledge provision in developing countries, modern growth is an increasing curve through knowledge and the brain drain is a decreasing curve of knowledge in developing countries. The curve displayed by figure 5 defines the equilibrium *(h*, D*)* in knowledge and development level terms generated according to the modern growth and the brain drain theories.

Proposition 6: *ex-post multiple development paths is located after the stable equilibrium D*, where high brain drain associated with low growth, leads the economy to development stability highlights sufficient knowledge to engage R&D and generates innovations. Thus leads the economy to the long run development path highlights by an increasing curve in knowledge which is a jumping function around the world average threshold dynamical path,* $\left(k^*, h^*, g_h^*, g_k^*\right)$

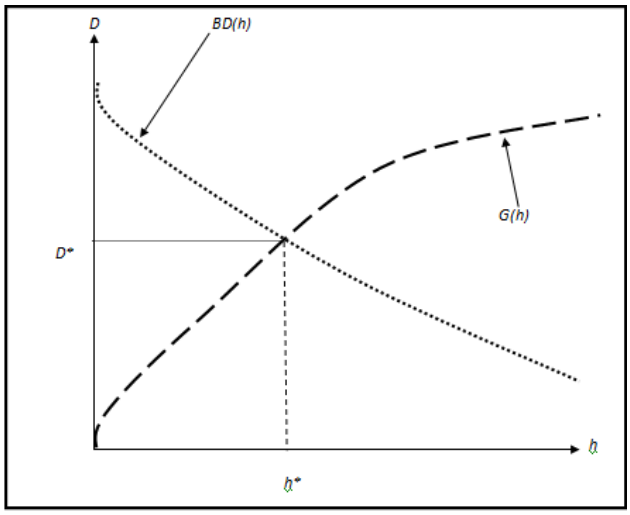


Figure 6. *Displays development take-off possibility according to the literatures applied to poorest countries.*

Proof: see figure 6 and the literature of the theories provided as well as comparative economic development related above. Figure 6 displays the fact that, since the equilibrium, D* is reached, the lowest dynamical path, $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ jumps on the world threshold dynamical path, $\left(k^*, h^*, g_h^*, g_k^*\right)$ through knowledge increase after the departure to the point, D^*

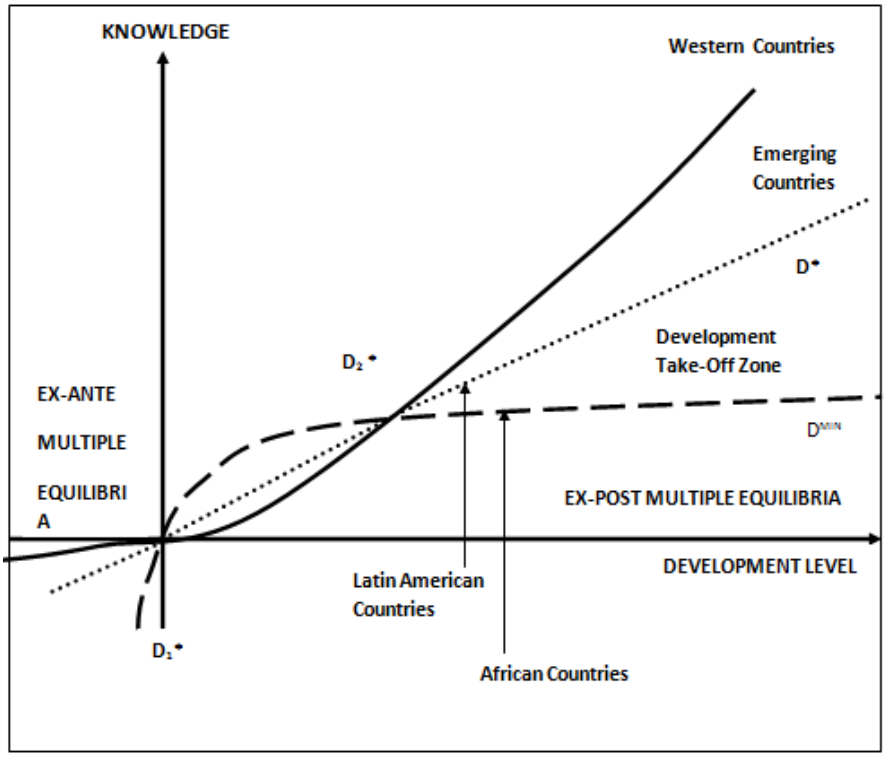


Figure 7. *Displays the existence of industrial, Emerging and developing countries economic performance paths after the application of the theory built.*

Table 1. *Presents both the structure and the link of the standard brain drain and modern endogenous growth literatures for poorest countries.*

Knowledge		**Diaspora (high developing country's skilled labor outside)**
Non rival good	Rival good	THE BRAIN DRAIN
International trade	Innovations through R&D	Home Brain gain (diaspora back home)
Technology Adoption		
THE MODERN ENDOGENOUS GROWTH		
Technology adaptation in good production sector		Human capital increase and R&D conduction
DEVELOPMENT TAKE-OFF		Innovations Take-Off

Table 1 summarizes the interaction between the brain drain and the modern growth theory

5. The Unified Theory of Economic Development

Let us present first, how development can arise from knowledge in least developed countries in order to increase their economic growth performance and reduce the brain drain eviction (see the theory synthesis 2 in table 2) in poorest countries.

To formulate the unified development theory and provide results associated, let us describe an overlapping generation world where the agents live for two periods, at each period of time, the stock of professors, P_t and the stock of students, S_t enter together in the education system of the developing country at the exogenously specified rate ~<1, where $\gamma S_t = P_t$ the students are trained to be next period engineer, E_{t+1} to absorb and adapt new innovations in the production sector or professor, P_{t+1} to conduct R&D at university, mainly focused on appropriate technology discovery. The dynamic of knowledge in the closed country is $h_{t+1} - h_t = \mu h_t P_t$ since the growth rate in knowledge depends on professors' human capital level, h_t and the research sector productivity i.e the capacity to innovate, μ. The poor country's government cooperates with foreign universities for the students to do their internship in developed countries' systems just before ending their training in order to understand the last technology created. When trained to be an engineer, the student must learn deeply how to adapt new developed countries' innovations in the production sector through learning by doing when production is holding inside a firm (Arrow, 1962) and after having done it, he returns home, gets his diploma and begins to work home. Whereas, when trained to be a professor, through universities' exchanges, the student learns on last discoveries, on the way innovations are or can be generated in order to create appropriate technology home, where he goes back, obtains his diploma and begins to work. The same thing is done for the professors, who go abroad for a short stay in the two directions i.e from rich to poor country as well as from poor to rich country, the aim is to increase incentives for diaspora to return home through great advantages in career evolution available for them. Cooperation among rich and poor governments yields temporary positions in both developed and developing countries education system. In this case, a proportion of q agents from diaspora among N_t is willing to come back home. Therefore, the contracts signed are established on the basis of the information holds on diaspora existence, thus mainly focus on the statistics of the diaspora residency ex-ante. Therefore, the proportion of q of the whole diaspora who come back home, increases knowledge stock which becomes, $P_t + qN_t$ indeed, the link with students becomes, $\gamma S_t = P_t + qN_t$ and $\lambda P_t = qN_t$ where $\lambda<1$ and $0 \leq q<1$. Following Benhabib and Spiegel (2005), once the country is open, knowledge productivity depends on the country's capacity to innovate through R&D conducted by professors, μ and to adopt as well as to absorb new technologies in the production sector, ~ by engineers which is a by-product of education system, diasporas coupled to abroad stays, induces developed country's variables of economic performance. Therefore, the dynamics of knowledge production can now be written such that:

$$h_{t+1} - h_t = \delta\mu h_t \left(P_t + qN_t\right) + g\left(h_t^* - h_t\right) \qquad (1')$$

Where h_{t*} denotes the level of productivity in the rich country at time t, ~$_t$ measures the productivity gain resulting from innovations, g measures the speed of adoption of the rich country's technology.

The knowledge reduction gap among the two countries is denoted by, $\theta^{-1} = h_t^* - h_t / h_t$ In the leading economy, we simply have,

$$h_{t+1}^* - h_t^* = (1+\delta)h_t^* \qquad (2')$$

Proposition7: *the opening of the poor economy leads the growth rate increase over time due to knowledge increase and the brain drain eviction absence expressed by* $\bar{g} = \delta\mu\gamma S_t + g\theta^{-1}$ *, which is higher than the one which prevails in autarchy,* $\underline{g}$ *expressed by=* $\underline{g}$ $\mu\gamma S_t$ *, indeed we have:* $\bar{g} > \underline{g}$

Proof: from the assumptions, of the model, we can see that, the growth rate in autarchy is given by the equation $\underline{g} = \mu\gamma S_t$ and from equation (1') we can see that, in open economies, the growth rate is now expressed by $\bar{g} = \delta\mu\gamma S_t + g\theta^{-1} = h_{t+1} - h_t / h_t$,

Where $(h_{t+1} - h_t) / h_t$ is the growth rate expression in the both cases.

It follows that the evolution of the distance to the frontier, $\Delta_{t+1} \cong \frac{h_{t+1} - h_t}{h_t}_{\ t} / \frac{h_{t+1}^* - h_t^*}{h_t^*}$ is governed by equation (3') i.e

$$\Delta = \left(\frac{\delta}{1+\delta}\right)(1+1/\lambda)\lambda\gamma S_t + \frac{\theta^{-1}g}{1+\delta} \qquad (3')$$

Proposition 8: *knowledge through education highlights by current human capital, S_t plays a great role on development since it leads to the country's capacity to innovate through R&D i.e μ and knowledge adoption as well as absorption in the production sector, $\tilde{}$. Finally, current human capital acts like a substitute of diaspora which once complement with professors in knowledge transmission target, accelerates the speed of convergence of the development path, $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ to the equilibrium, $\left(k^*, h^*, g_h^*, g_k^*\right)$ where $\bar{g} = g_k^* + g_h^* > \underline{g}$. In contrast, human capital stock absence i.e S_t=0, leads the dynamical path of the economy, $\left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ inside a trap with low growth and development retard, $\left(\underline{k}, \underline{h}, \underline{g}_{-k}, \underline{g}_{-h}\right) < \left(k^{\min}, h^{\min}, g_h^{\min}, g_k^{\min}\right)$ allowing the increase of the gap in economic performance among rich and poor countries, θ_t over time*

Proof: see equation (3')

Assumption 2: the evolution of the economy to the frontier, Δ depends on human capital stock and their link is such that: $\Delta = \varphi S_t$ where φ is a parameter inside 0 and 1

Lemma 2: *in the long run, the evolution of the distance to the frontier can be expressed such that*

$$\Delta = \frac{\theta^{-1}g}{1+\delta\left[1-\dfrac{\gamma(1+\lambda)}{\varphi}\right]} \qquad (4')$$

Proof: using equation (3') and the definition of the distance to the frontier, we determinate the value of (4') given by lemma 2

Proposition 9: *the development path is closer to its frontier in the gap reduction performance of the economy, θ; the speed of adoption of rich countries technology, g; the knowledge externalities between diaspora and home skilled labor, λ and the exogenous ratio of student and professor stocks, γ; in contrast, the development path distance to the frontier is increased by φ, the parameter which enlarges the distance between the development path to its frontier*

Proof: differentiating the above equation i.e (4') in each parameter announced, we can see the sign of the derivative such that when it is negative, it alters the function, otherwise, when it is positive, it increases the power of development.

Proposition 10: *in complement, knowledge adoption and absorption, $\tilde{}$ is also an engine of development and growth because we have $\gamma(1+\lambda) \succ \varphi$*

Proof: differentiating (4') in $\tilde{}$ yields a condition on its sign and knowing that φ is a parameter inside 0 and 1, we conclude to the positivity of the parameter $\tilde{}$ role on development

6. Conclusion

We began the study by comparative development over time since the beginning and highlight the sources of economic growth through which raised the emerging countries, thus provided its foundations and point out the locus where the both take-off took place over time. During the ex-ante multiple equilibria, all the countries were under development, then around the 18th century, Great Britain dynamical path reached its development frontier and through externalities, knowledge spread all over the closest Western countries and became stable after the post war 2 for almost all of them. Then ex-post multiple equilibria emerged inside which Eastern European countries were included and the second take-off occurs around the years 2000 for some Asian countries as well as for Eastern European Countries after the Berlin Wall fall in 1989 making countries going back to liberalism and cease the planning policy application based on Karl Marx thought, thereby allow a new classification in countries' economic performance such that Western countries' dynamical path included Japan remained settled on the highest dynamical path even joined by other countries such as Russia to form the G8 countries i.e the most rich and powerful countries in the whole world. Instead, the emerging countries fluctuate between the threshold or the equilibrium to the highest for some of them (south Corea for example). In contrast, the lowest dynamical path is the one hold by African countries, whereas, the Latin American Countries reached the threshold. Our investigations were motivated by the citation of Robert Lucas Jr., (1988) on the crucial role of growth in the world economy. Consequently, after having discussed comparative development, we found that African Countries still the last, we present a unified development model in order to study the way those countries can escape under development and poverty through knowledge increase, then we showed how to implement the crucial growth mechanisms in those countries in order to make their dynamical path jumps on those of the leaders over time. The results found suggest a scientific cooperation between poor and rich countries in knowledge exchange and the diasporas call to support development at home as well as the brain drain eradication over time. The methodology used is the intercept of both the modern growth and the brain drain literatures to define the equilibrium upon with the mechanisms of economic development are provided and the action understood. Unfortunately, as already evocated, the mechanisms used to highlight the results given by the model are not tested yet because of the lack of data as well as suitable empirical methods availability (Grossman-Helpman, 2015).

Table 2. *Summarizes the unified development theory proposed by this article.*

In the Developing Country		
Students		**Domestic Professors**
-Technology Adotption through international trade	R&D conduction	
-Technology Adaptation i.e good production integration	Innovations	
EXCHANGE PROGRAMS IN THE DEVELOPED COUNTRY		
Students		Professors
Interships of developing countries' students in the developed country's system		Visiting professors
Engineer training	Professor training	Diaspora preferred
How to adopt and absorb technology	Understand ho to produce appropriate technology	
DEVELOPMENT TAKE-OFF		

Acknowledgements

The author is associate Professor at University Marien N'Gouabi (BZV, Congo) and President of CEDESC (Clamart, France) and wishes to thanks the Editor and the Anonymous referees for helpful comments, any error which may appear in the text is solely mine.

References

[1] Acemoglu, D. (2005): Institutions and Growth, in Aghion, P. and Durlauf, S., eds.: *Handbook of Economic Growth, North Holland.*

[2] Agrawal, A., D. Kapur, and J. McHale (2008): Brain Drain or Brain Bank: The Impact of Skilled Emigration on Poor-Country Innovation, *NBER Working Paper* No 14592, December.

[3] Aghion, P., and Howitt, P. 1992. A Model of Growth through Creative Destruction. *Econometrica* 60 (2): 323–51.

[4] Arrow, K. J., 1962. The Economic Implications of Learning by Doing, *Review of Economic Studies* 29, 155-173.

[5] Azariadis, C. and Drazen, A., (1990): Threshold externalities in economic development, *Quarterly Journal of Economics*, 501-526.

[6] Beine, M., Docquier, F. and Rapoport, H., (2001): Brain drain and economic growth: theory and evidence, *Journal of Development Economics*, 64, 1: 275-89.

[7] Berry, A.R. and Soligo, R., (1969): Some welfare aspects of international migration, *Journal of Political Economy*, 77, 5: 778-94.

[8] Bhagwati and Hanson, eds.: Skilled immigration: problems, prospects and policies, *Oxford University Press*, pp. 3-11.

[9] Bhagwati, J.N. and Hamada, K., (1974): The brain drain, international integration of markets for professionals and unemployment, *Journal of Development Economics*, 1, 1:19-42.

[10] Chen, H.-J. (2006): International migration and economic growth: a source country perspective, *Journal of Population Economics*, 19: 725-48.

[11] Domingues Dos Santos, M. and Postel-Vinay, F., (2003): Migration as a source of growth: the perspective of a developing country, *Journal of Population Economics*, 16, 1: 161-75.

[12] Domingues Dos Santos, M. and Postel-Vinay, F., (2004): The impact of temporary migration on human capital accumulation and economic development, *Brussels Economic Review*, 47, 1: 77-88.

[13] Fernando, A.; Buera F. J., and Lucas, R. E., Jr. 2014. Idea Flows, *Economic Growth, and Trade*, Unpublished.

[14] Barro, R. J., and Sala-i-Martin, X., (1991), Convergence across States and Regions." *Brookings Papers on Economic Activity,* no. 1, 107–182.

[15] Barro, R. J., and Sala-i-Martin, X., (1992a). "Convergence." *Journal of Political Economy,* 100, April, 223–251.

[16] Barro, R. and Sala-i-Martin, X, 2004, *Economic Growth, MIT Press.*

[17] Braconier, H.; and Forslid, R.; 2005, Multinationals, Endogenous Growth, and Technological Spillovers: Theory and Evidence; *Review of International Economics* 13 (5): 945–63.

[18] Richard, B. E., and Nicoud, F. R.; 2008, Trade and Growth with Heterogeneous Firms, *Journal of International Economics* 74 (1): 21–34.

[19] Chen, H., 2008, The endogenous probability of migration and economic growth, *Economic Modeling Journal.*

[20] Coe, D. T., and Helpman, E.; 1995; International R&D Spillovers; *European Economic Review* 39 (5): 859–87.

[21] Docquier, F., and Dalacroix, D., (2012), Do Brain Drain and Poverty Result from Coordination Failure?, *The Journal of Economic Growth*, 17(1), 1-26.

[22] Domar, E. D., (1946), Capital Expansion, Rate of Growth and Employment, *Econometrica,* 49, p. 14-33.

[23] Eaton, J. and Kortum, S.; (1999), International Technology Diffusion: Theory and Measurement; *International Economic Review* 40 (3): 537–70.

[24] Eaton, J., and Kortum, S.;.(2002), Technology, Geography, and Trade. *Econometrica* 70 (5): 1741–79.

[25] Eicher, T., (1996), Interaction between endogenous human capital and technological change, *Review of Economic Studies*, 63, 127-144.

[26] Feenstra, R. C. (1996), Trade and Uneven Growth, *Journal of Development Economics* 49 (1): 229–56.

[27] Garcia Pires, A., (2015), Brain Drain and Brain Waste, *Journal of Economic Development, 40(1).*

[28] Grossman, G. M., and Helpman, E., (1991a), Innovation and Growth in the Global Economy. *Cambridge, MA: MIT Press.*

[29] Grossman, G. M., and Helpman E.; (1991b), Trade, Knowledge Spillovers, and Growth, *European Economic Review* 35 (2–3): 517–26.

[30] Grossman, G. M., and Helpman, E.; (2014), Growth, Trade and Inequality. *National Bureau of Economic Research Working Paper 20502*.

[31] Grossman, G. M., and Helpman, E., (2015), Globalization and Growth, *American Economic Review, 105(5): 100–104*.

[32] Grubel, H. and Scott, A., (1966): The international flow of human capital, *American Economic Review,* 56: 268-74.

[33] Haque, N. U and Kim, S., (1995): Human capital light: impact of migration on income and growth, IMF Staff Papers, 42, 3: 577-607.

[34] Helpman, E., (2004), The Mystery of Economic Growth. Cambridge, MA: Belknap by *Harvard University Press.*

[35] Harrod, R. F., (1939), An Essay in Dynamic Theory, *Economic Journal,* 49, p.14-33.

[36] Kanbur, R. and H. Rapoport (2005): Migration selectivity and the evolution of spatial inequality, *Journal of Economic Geography*, 5, 1: 43-57.

[37] Keller, W.; (2010), International Trade, Foreign Direct Investment, and Technology Spillovers. In *Handbook of the Economics of Innovation.* Vol. 2, edited by Bronwyn H. Hall and Nathan Rosenberg, 793–829. Amsterdam: Elsevier B. V..

[38] Kim, K. H. (1976), "The Economics of the Brain Drain: Pros, Cons and Remedies," *The Journal of Economic Development*, 1 (1), 55-80.

[39] Kerr, W. R. (2008): Ethnic Scientific Communities and International Technology Diffusion, *Review of Economics and Statistics*, 90: 518. 537.

[40] Loubaki, D., (2012), On the Mechanics of the Brain Drain Reduction in Poorest Developing Countries, *Journal of Economic Development*, 37, (3), September 2012, p.75-105.

[41] Loubaki, D., (2015), Poverty Reduction, Brain Drain and Development, *American Journal of Economics, Finance and Management,* Vol. 1, No. 5, 2015, pp. 537-553.

[42] Lucas, R. E., Jr. (1988), On the Mechanics of Economic Development, *Journal of Monetary Economics* 22 (1)*:* 3–42.

[43] Mc Cullock, R. and Yellen, J. T., (1977): Factor mobility, regional development and the distribution of income, *Journal of Political Economy*, 85, 1: 79-96.

[44] Melitz, M. J., (2003), The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity; *Econometrica* 71 (6): 1695–1725.

[45] Miyagiwa, K., (1991), Scale economies in education and the brain drain problem, *International Economic Review*, 32, 3: 743-59.

[46] Mountford, A. (1995): Can a brain drain be good for growth?, NBER Working Paper No 9508, Tilburg University, January.6.

[47] Peretto, P. F., and Valente, S., (2011), Resources, Innovation and Growth in the Global Economy; *Journal of Monetary Economics* 58 (4): 387–99.

[48] Perla, J., Tonetti, C. and Waugh, M. E., (2014), Equilibrium Technology Diffusion, Trade, and Growth, Unpublished.

[49] Romer, P. M., (1990), Endogenous Technical Change, *Journal of Political Economy* 98 (5, Part 2)*:* S71–S102.

[50] Romer, P. M. (1986): Increasing returns and long-run growth, *Journal of Political Economy*, 94, 5: 1002-37.

[51] Sampson, T., (2014), Dynamic Selection: An Idea Flows Theory of Entry, Trade and Growth, Unpublished.

[52] Sachs, J. (2005) The End of Poverty: How we Can Make it Happen in Our Lifetime, *London: Penguin Books.*

[53] Sachs, J. and Warner, A., (1995), Economic reform and the process of global integration, *Brookings Paper on Economic Activity, 1, 1-95.*

[54] Smulders, S. and Bovenberg, A. L., Environmental quality and pollution-augmenting technological change in a two-sector endogenous growth model, *Journal of Public Economics*, 57, 1995, 369-391.

[55] Solow, R. M., 1956, A Contribution to the Theory of Economic Growth, *Quarterly Journal of Economics*, 70 (1), 65-94.

[56] Stark, O. and Wang, Y., (2002): Inducing human capital formation: migration as a substitute for subsidies, *Journal Public Economics*, 86, 1: 29-46.

[57] Young, A. 1991, Learning by Doing and the Dynamic Effects of International Trade, *Quarterly Journal of Economics* 106 (2): 369–405.