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The Unified Economic Development Theory

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Abstract

This article presents a unified development theory provided by the intercept of the modern growth and the brain drain literatures to bring a modern view of development. We find that, knowledge is an increasing function according to modern growth and a decreasing function according to the brain drain, thereby, defines a threshold where development may take-off. After the cross of this locus, the economy yields multiple equilibria where development may rise or a poverty trap may settle. Finally, when development holds, it is the resulting effect of several mechanisms such as: the capacity to innovate through R&D, knowledge adoption and absorption in the production sector are engines of growth and development. Moreover, human capital increase substitutes diaspora over time and accelerates the speed of convergence of the development path to its frontier.

Keywords

Technology Adoption, Technology Absorption, Knowledge Externalities, Diaspora

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1. Introduction

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' low economic performance mainly caused by high skilled labours 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 on goods like books, physical capital, car, etc, Usually called technology and diffused through international trade. The second aspect of knowledge is embodied on human being that is called human capital. 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. In use, technology and human capital are complementary, since buying a high tech innovation for good production for example, requires skills labours 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

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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 raise 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 labour 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 more costly and not interesting enough for the long run growth to hold without government deficit increase, thus gave up[1]. 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 labour trained abroad[2] 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?. 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 labour international mobility. Since the main mechanics proposed to slow the brain drain didn't work [3] (Bhagwati, 2009). Therefore, additional knowledge possessed by developing countries abroad or diaspora [4] whom presence at home would be useful to enhance development, then the economy will increase it speed of convergence to its development frontier, unfortunately, remain outside of the development dilemma.

Consequently, through this reflection, the aim 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.

Proposition 1: there exist a development take-off locus, (h,D*) defined as an intercept of knowledge, h* located on an increasing curve of growth performance, G(h) and BD(h) located on the decreasing brain drain curve in knowledge on the space*

Proof: see figure 1 and the synthesis of the literatures of growth and of the brain drain in regard to knowledge provision in developing countries

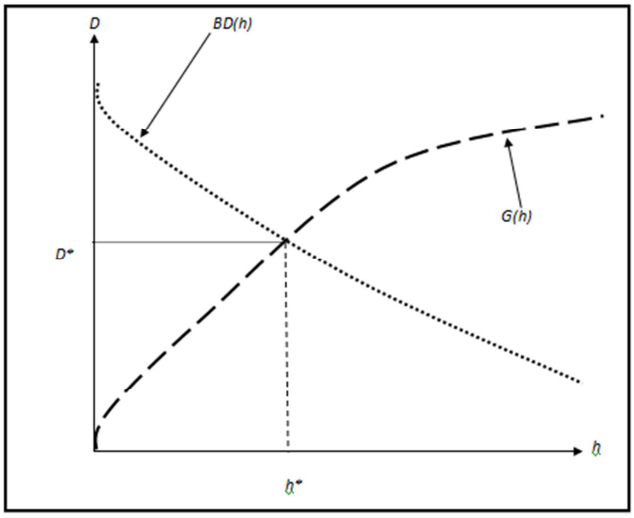

Figure 1. Displays development take-off defined by equilibrium *(h*, D*)* between knowledge provided by modern growth theory and diaspora, a situation characterizes by the brain drain theory on the space.

What can be explicitly learned from the literatures of the brain brain (1) and modern endogenous growth (2) to support development? Since we know now, that, their link defines a stable long-run development take-off equilibrium?

1.1. 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

1 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 much 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.

2 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.

3 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 trans- ferred to the home country government; ii) the rationale for the tax is double: com- pensation (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).

4 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

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 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[5], 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 diaspora[6] 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 emigration, 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 that the diaspora knowledge-access[7]. 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 name 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.

1.2. The Modern Growth Theory Contribution to Economic Performance

From the beginning[8] 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 growth are unknown since all inputs are remunerated at their margin productivity. Increasing returns[9] can't arise from that

5 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.

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

7 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.

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

9 increasing 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

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 can't hold. Therefore, Arrow's (1962) paper on learning by doing, argued that increasing returns arise because new knowledge is discovered as investment and production take place and remains a public good not remunerated like the other inputs of production. The theory was blocked until the mid-1980s, then Romer (1986) is the first model to prove the existence of the equilibrium in the model of competition with 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)[10]; Lucas (1988); Aghion and Howitt (1992); Grossman and Helpman (1991a)[11]; 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 or in people called human capital. The difference among the two kinds of knowledge in models is highlight 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. Consequently, as a non rival good, knowledge can't be kept secret and 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 (Eicher, 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. Feenstra (1996) joins the previous authors' 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 it as relatively, thus in the creation of knowledge for industrial countries case and natural resources for the poor countries. But 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, manufactured goods are those which improve gains in exchange trade. Therefore, Helpman (2004), Coe and Helpman (1995) Baldwin, Braconier, and Forslid (2005) and Keller (2010)[12], 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)[13] 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).

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.

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

R&D raises the productivity of future innovation efforts

11 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

12 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.

13 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.

Proposition 2: *From the stable equilibrium (h*,D*), the economy admits multiple development paths, where high brain drain associated with low growth, leads the economy to development stagnation highlights by a decreasing curve in knowledge. Whereas, low brain drain associated with high growth, leads the economy to the long run development path highlights by an increasing curve in knowledge*

(see figure 2 for proof as well as table 2 which summarizes the literature of the theories provided)

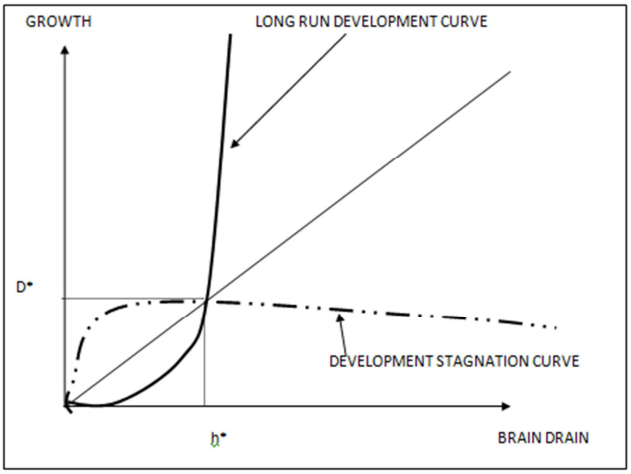

Figure 2. Multiple Equilibria in development paths.

Theories' Synthesis:

Table 1. Structure of the standard brain drain and modern endogenous growth literatures.

Knowledge		**Diaspora**
Non rival good Technology International trade	Rival good Human capital Innovations through R&D	THE BRAIN DRAIN LITERATURE
Technology adoption	Innovations introduction	Human capital increase and R&D conduction
THE MODERN GROWTH LITERATURE DEVELOPMENT TAKE-OFF		

2. The Unified Theory of Economic Development

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

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 of students, S_t get inside the education system of the developing country at the exogenous rate ~<1, where $gS_t = P_t$ 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 have done it, he returns home, get his diploma and begins to work there. 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 generate appropriate technology home, where he goes back, obtains his diploma and begins to work there. 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 hold 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 $0\leq p<1$. 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 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 technologies. 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, $h_{t+1}^* - h_t^* = (1+\delta)h_t^*$.

Proposition 3: 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 $\overline{g} = \delta\mu\gamma S_t + g\theta^{-1}$, which is higher than the one which prevails in autarchy, $\underline{g}$ expressed by $\overline{g} > \underline{g} = \mu\gamma S_t$, indeed we have: $\overline{g} > \underline{g}$

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 $\overline{g} = \delta\mu\gamma S_t + g\theta^{-1}$,

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, $\Delta_{t+1} \cong \frac{h_{t+1} - h_t}{h_t} / \frac{h_{t+1}^* - h_t^*}{h_t^*}$ is governed by equation (2) i.e

$$\Delta = \left(\frac{\delta}{1+\delta}\right)(1+1/\lambda)\lambda\gamma S_t + \frac{\theta^{-1}g}{1+\delta} \qquad (2)$$

Proposition 4: 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, μ and knowledge adoption as well as absorption in the production sector, $\sim$. 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 to the frontier. In contrast, human capital stock absence i.e S_t=0, leads the economy inside a trap with low growth and development retard allowing the increase of the gap in economic performance among rich and poor countries, θ_t over time

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

Lemma 1: in the long run, the evolution of the distance to the frontier can be expressed such that

$$\Delta = \frac{\theta^{-1}g}{1+\delta\left[1 - \frac{\gamma(1+\lambda)}{\phi}\right]} \qquad (3)$$

Proposition 5: 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 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 6: in complement, knowledge adoption and absorption, $\sim$ is also an engine of development and growth because we have $\gamma(1+\lambda) \succ \phi$

Differentiating (3) in $\sim$ 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 $\sim$ role on development.

Theory synthesis:

Table 2. Summary of the unified development theory.

THE DEVELOPING COUNTRY		
Student		
Engineer	Professor	Professors exchange program
Technology adoption (trade)	R&D	Diaspora is preferred
Technology absorption (good production)	Innovations	Knowledge increase
IN THE DEVELOPED COUNTRY		
Exchange program between students who is		
Trained to understand rich country technology		The brain drain Eviction
And adapt/ and or absorbed in good production		

3. Conclusion

We began by questions about the way development can be achieved in poor countries through knowledge and we discussed the literatures of the modern growth and of the brain drain which highlight the existence of the development take-off locus on the space. The theory built show-off multiple equilibria on the direction of the development path. In order to make the development path reach its frontier, we build a little model which highlights suitable mechanisms to

handle, all based on knowledge. Unfortunately, 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 (Grossman-Helpman, 2015).

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