Master Course International Economics and Business Studies

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The Impact of Skilled Migration on Growth for the Post-1980-Globalizers

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Abstract

This thesis gives inside into the theoretical and empirical research with respect to brain drain. It is treating the development of brain drain theories, empirical evidence, development numbers and the macroeconomic impact on the post-1980-globalizers. Recent theoretical and empirical evidence indicated that a brain gain is possible when its impact on human capital is measured. However, the results of this paper only showed a negative impact of skilled migration on both income and human capital formation. In order to truly establish a full understanding of the impact of brain drain a lot of work needs to be done in researching skilled migration and its second round effect on the economy.

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1. Introduction

For a lot of developing countries the emigration of skilled workers and highly educated people is a huge problem. One example is the high percentage of outward skilled migration for the Caribbean islands to mainly the US and other OECD countries. According to the Migration & Development Brief[1] of the World Bank for most of these islands the percentages lay between the 40 and 90% and results in outflow of human capital and scarce resources. This, at first sight, harmful phenomenon is in the field of economics also known as 'brain drain.' Because of the demand pull for skilled people by the developed countries, the developing countries are deprived from their most scarce factor: human capital. This is where term 'brain drain' comes from; the international transfer of resources in the form of human capital. Since international migration becomes more and more skill biased the increase of it seems to have a detrimental effect on the source country. The problem of skilled migration shows a close relationship with the phenomenon of globalization. With the increase of factor mobility, resulting from this globalizing process, the pressure on international migration increased mainly due to the rising gap in wages between developing and developed countries and the demographic features of the developed countries. International migration from developing to developed countries shows the same evolution as the change in trade, and is therefore seen as an essential component of globalization. In this paper the effects of international migration and globalization are combined by looking at the impact of skilled migration on growth for the post-1980-globalizers. Is skilled migration really harmful for the developing countries or can we find empirical evidence for a possible brain gain?

The focus in this paper lays on a group of developing countries referred to as the post-1980-globalizers. This group of countries experienced a huge increase in trade over the last two and a half decades. The list, composed by the IMF, contains 24 developing countries from around the world who experienced the largest increase in trade shares during this period. Since most of the historic theories on brain drain are negative it would be very interesting to see if empirical evidence can contradict this negative view. So the objective of this thesis is to research empirically if the most globalizing countries in the world suffer or benefit from

[1] Burns & Mohapatra (2008)

skilled migration. Is it possible to create a general model which suits the group of countries mentioned in the table below, and construct some fundamental statements on the link between brain drain and globalizing countries.

Table 1.1 - Overview of the Post-1980-Globalizers

Argentina	Dominican Rep	Jordan	Paraguay
Bangladesh	Haiti	Malaysia	Philippines
Brazil	Hungary	Mali	Rwanda
China	India	Mexico	Thailand
Colombia	Ivory Coast	Nepal	Uruguay
Costa Rica	Jamaica	Nicaragua	Zimbabwe

Most of the brain drain discussions in the past were based on theory since empirical evidence was scarce due to data problems. In the recent past and present time the focus became more and more empirical due to the increasing quality of data. The empirical evidence also made theoretical discussions alive again. With this development it is possible to make an adequate combination of theory and research and fully discuss the phenomenon of brain drain.

First this paper tries to contribute to the existing literature by giving a full theoretic overview of the visions on brain drain. Second, for the post-1980-globalizers a specific dataset will be composed in order to model three different regression models to explain human capital, growth and migration. With these models the link between skilled migration and growth can be researched. The objective is not only to find a good model to fit the link between these variables but also to find evidence for using new instruments to support the existing models. The main goal is to make a multiple linear regression in order to explain the relationship between these variables. The research above will be accompanied with tables and graphs showing the development of the individual or combined variables.

Chapter 2 will explain the theory on migration, growth an brain drain. An historic overview on the most important theoretic streams will be given in this chapter. In chapter 3 the most important economic changes will be displayed. With tables and graphs the most important developments of this group of countries for the last 35 years will be given. In chapter 4 the empirical research done in this field will be discussed, accompanied by the empirical research composed for this paper. This paper ends of with a conclusion on the research results which will be combined with the discussed literature.

2. Theory on Brain Drain, Migration and Growth

This chapter will discuss the theoretic part of this thesis. The theory discussed is fundamental for understanding the different opinions and models developed over the last fifty years. This part is also used as a fundament for the following chapters and to formulate the hypothesis in the empirical part.

2.1 Migration

The share of migrants in industrial countries' population doubled over the past three decades, and since this share is assumed to continue to grow migration is a very important economic topic. The definition of an international migrant, according to the United Nations, is as any person who changes his or her country of usual residence. With the definitions of usual residence and migrant being:

"*The country in which a person lives is the country in which he or she has a place to live, where he or she normally spends the daily period of rest. Temporary travel abroad for purposes of recreation, holiday, visits to friends and relatives, business, medical treatment or religious pilgrimage does not change a person's country.*" Complementary: "*The term 'migrant' in article 1.1 (a) should be understood as covering all cases where the decision to migrate is taken freely by the individual concerned, for reasons of 'personal convenience' and without intervention of an external compelling factor."* [2]

The definition from the UN and WTO in 1994 states that a person is considered to be a resident in a country, if the person has lived there for most of the past year, or if that person has lived there for a shorter period but intends to return within 12 months to live there permanently. We can distinguish two different types of migration: the long term and short term migration. The long term migrants are the people who move to a country different from their own usual residence for duration longer than a year. The short term migrants are those that move to a country other than their usual residence for a stay shorter than one year, but longer than 3 months. There are many reasons behind the movement of people, but one of the most important incentives behind migration is the loss of returns on locally effective human capital at the original location. The achievable level of utility varies across regions because of

[2] Definitions quoted from the glossary of the UNESCO website www.unseco.org

the differences in labor market conditions and in the available technologies that generate household commodities from which people can gain utility. In order to gain this level of utility people can move to the desired regions, but only after a certain period of forced living in the region they were randomly assigned too. Generally there are four streams in the migration theory, namely: sociological theory, economic theory (macro and micro), geographical theory and a unifying theory.

The sociological approach on migration, by Stouffer (1960), states that the number of migrants is directly proportional to the number of attracting opportunities in the country of destination, and indirectly proportional to the number of opportunities existing in their home country. The push-pull theory by Lee (1966) is directly connected to the notion of opportunities. The pushing factors of migration flows are the economic, social, political and demographic circumstances in the home country. While the comparative advantages in the more developed regions are seen as the pull component. Taylor (1986) states that the reason for differences in the number of migration opportunities can also be addressed to the process of networking building. The assumption is that the existence of networks reduces the risks to which the migrants may be exposed and also reduces the migration costs. In recent years, the networking building theory has transformed into the theory of transnational social spaces which acknowledges the existence of migration related cross-border linkages between individuals and groups. The social capital of these spaces exists of ties between different individuals and groups leading to norms of reciprocity, solidarity and mutual obligations. These social assets may not be able to make the transfer across borders easier but make it more convenient for immigrants to adapt and settle in the host country. The institutional theory and the notion of cumulative causation by Massey et al. (1990 and 1993) are additions to the networking theory. The first one refers to the institutional organizations who support migration. This theory mentions the important role of regular (job recruitment and counseling) and irregular (smuggling and trafficking) aspects of migration. The extension of the network theory lays in the facilitating of migration by institutions. The second one is based on the assumption that migration is a process of evolution, which refers to the interaction between source and host countries in the field of institutional and socio-economic changes. While we assume that the migration decision arises from a series of rational economic decisions, in

reality, its fundamental origin lays in the history of past economic and political contact and power asymmetries between sending and receiving nations (Portes et al. 2000).

The macroeconomic theories on migration consist of the neo-classical theory, the Keynesian theory and the dual-labor market theory. The emphasis in the neo-classical theory of Lewis (1954), lays on the substitutability between commodity and factor movements. This theory states that since international labor movements are sensitive to wage differentials, by liberalizing their trade, countries can reduce wage differentials and with this reduce migration. In the neoclassical approach migration is the result of a disequilibrium, with the equilibrium being reached by the movement of factor flows due to a surplus of labor or capital between the two countries. Labor will flow from the country abundant in labor to the country in scarce of labor, and capital will flow from the country that is capital abundant towards the country scarce in capital. In this equilibrium migration and wage differentials are solved. This model is a simplification of reality and therefore ignores the problems of return migration and population flows even when wage differential do not play a role. This shortcoming is discussed by the Keynesian theory of Hart (1975) and the theory of Milne (1993) who respectively address this population flow to the difference in unemployment between regions and the time lagged link with business cycles.

The neoclassical economic theory on migration by Harris & Todaro (1970) focuses on the movements of labor and capital as a difference in wages between the rural and urban area. Workers from the rural area have lower wages and are attracted to the high wage urban regions, which lead to a decrease in the wages in the region of destination. As a consequence of the increase in the labor supply for the urban area the wage level in the original rural area will increase, till the point where the difference in the wages between the two regions will be equal to the cost of movement for the workers.

The dual labor market theory of Piore (1979) is different from the others since it is not the differences in wages that stimulates the migration flows but the differences in the recruitment practices and the demand for labor in the destination countries. The theory also puts the focus on the lack of motivation of the host country citizens to occupy bottom level positions, that have no prospect and the segmentation of the labor market caused by the capital intensity. These bottom level positions are therefore occupied by the immigrants since the nationals are

unwilling to take these positions. Putting the different macroeconomic views together the generalized perspective is that there are many forces that stimulate migration. With the flow of capital coming from the developed world in search of raw materials, cheap labor and new consumer markets, and the flow of labor from the developing world in search of higher returns on labor, with a wide choice of objectives driven by many different reasons.

The neoclassical microeconomic theory of Sjaastad (1962) explains the individual level migration decision. It assumes that the destination of a migrant is chosen by maximizing the net present value of the expected future income reduced with the direct and indirect costs of migration. The decision making process is dependent on factors like unemployment levels, migration costs, additional qualifications gained and the risk of possible deportation. The value-expectancy concept of De Jong and Fawcett (1981) puts the accent of the migration decision on the non-economic factors like social and psychological aspects. The new economic theory of Stark & Bloom (1985) looks at the migration decision from a households' perspective because of the presents of family patterns. Households make the decision from another perspective since they want to ensure future income and therefore want to minimize the risk of losing income for a larger group. Stark (2003) further states that migration flows are also dependent on the individual preference to migrate, the power purchasing parity of savings for migration and the relative income differential.

The geographical theories emphasize that distance is the main factor in the labor flows movements. The gravity theory of migration states that movements are directly proportional to the population sizes of the two regions and indirectly proportional to the distance between the regions. Theories on mobility transition address that migration went through a process of change. Going from border or continent migration, to rural-urban movements, to interregional movements and nowadays to the form of a circular movement. The unifying perspective tries to combine the mentioned models into one unified model in order to explain population flows. In these unifying models migration is a continuous interaction on both the micro and macro level, with historical, economic, cultural and political linkages between the countries. Unfortunately the models from this approach are impossible to use since they are too difficult and the quality and quantity of the migration data needed for these models is poor.

2.2 Growth & Human Capital

After the neoclassical growth models, coming from the post war period, attempts were made to make the technology part of this model endogenous. In these attempts the importance of the influence of human capital and education on growth became more and more evident. Most of the early neoclassical models on economic growth already recognized technology as the key driving force of growth. This recognition was consistent with the conclusions coming from the empirical research in this field. The sources of the technical advances in the earlier researches were however inconsistent. By making technological advances endogenous it was possible to capture stylized facts about the understandings of these advances. New growth models of endogenous growth and centrally profit-seeking investments of business firms were constructed in theoretical models by Aghion & Howitt (1992), Grossman & Helpman (1991) and Romer (1990)). Growth coming from technology was divided into physical and human capital. This division lead to papers focusing on the relationship between human capital and growth. Most economic theorists have embraced the principle that certain kinds of education equip people to perform more effectively. Education enhances the ability to receive, decode and understand information. This information processing and interpreting is important for learning to perform many different jobs. Researchers were not only interested in human capital but also in the relationship between education and growth. The main contributors to this literature were Uzawa (1965), Nelson & Phelps (1966) and Lucas (1988).

Investigation in the returns of investment in education was given new life in the 1990's by two developments. Micro labor literature has produced several new estimates of the monetary returns to schooling, by means of natural experiments in which variability in worker's schooling attainment was generated by some exogenous and arguably random force. The macro growth literature has investigated whether the aggregate level of schooling in a cross-section of countries is related to the countries subsequent GDP growth rate. Two issues have motivated the use of aggregate data to estimate the effect of education on the growth rate of GDP; 1) it can generate insides into endogenous growth theories, 2) it can capture external returns to human capital that are missed in the microeconomic literature.

The important role of human capital in the endogenous growth models gives a couple of options. Human capital can for example be used to broaden the concept of capital. Sustained growth is then under the influence of the accumulation of human capital over time. Examples

of these models can be found in the theories of Uzawa (1965) and Lucas (1988). Human capital can also be used as an attribution to the existing stock. This attribution lays in the generation of innovations and/or in the ability to adapt new technologies. Romer (1990) is one of the economists who used human capital in his theory as innovations. Nelson & Phelps (1966) approached human capital as the ability to adapt. By putting these two views together you can say that human capital leads to technological progress and sustainable growth.

Grossman & Helpman (1991) treat technical advance as a process of creative destruction, in which new technologies make the previous ones needless. In the model of Romer (1990) it was seen as externalities coming from investments in research & development and education (as Lucas (1988) states). In the endogenous growth literature Aghion and Howitt (1998) distinguish two views about the influence of human capital on growth. Firstly, the Nelson & Phelps approach (1966), adopted for example by Romer (1990) and Aghion & Howitt (1992), focuses on the influence of human capital on the discovery of new technologies. Secondly, Lucas (1988) approaches human capital as an input and therefore its growth rate influences the growth rate of the output.

Nelson & Phelps (1966) state that human capital includes education, health and aspects of social capital. The process of education can be viewed as an act of investment in people, where the educated people are the accumulators of human capital. The rate of return on education is greater the more technologically progressive is the economy. The progressiveness of the technology has implications for the optimal capital structure in the broad sense. Apparently societies should build more human capital relative to tangible capital the more dynamic is the technology. In the model of Lucas (1988) growth of output depends on the growth of physical capital and accumulation of human capital. In the steady state of this model the growth rate of output and human capital are the same. Sustained growth arises because there are constant returns to scale in the production of human capital. The growth of human capital in this model should affect output growth. In the Romer (1990) model the capital stock depends on the technological level, and capital is disaggregated because for each capital good there is a distinct monopolistically competitive firm. Human capital is defined as the proportion of people employed in the R&D sector, and when this number increases the technological progress and the production of capital increases. A faster growth in output will

therefore be generated. In the steady state the rate of growth equals the rate of technological progress. The stock of human capital in this model should affect growth.

The problem with the Lucas (1988) approach is that increased human capital should raise the growth rate, but Jones (1995) has observed that this is inconsistent with the time series data coming from the US. There is also no compelling cross-sectional evidence that large countries grow faster than small ones. Jones (1995), lead by the empirical results, states that the growth model should be endogenous with respect to economic behavior, but that it should be exogenous with respect to its relation with population growth rate. The model conclusion from this theory is similar but with adjustments for allowing economies of scale. The assumption made is that the return on research diminishes over time. Intuitively it is harder to find new technologies when the original stock of knowledge is already high.

Both the macro and micro economic literature acknowledge the role of human capital and education as a driving force for growth. A large number of micro economic researches display the evidence of a positive payoff from the investment in education. New macro economic theories are also convinced about the driving force of human capital, but the evidence is less persuading to this matter.

2.3 Brain Drain: Intuitions and Historic Overview

When discussing brain drain in short its definition as stated in Beine et al. (2001) is: "The international transfer of resources in the form of human capital." It is the negative effect for the source country caused by skilled migration[3] to another country. This effect comes from the loss of highly educated people for the home country which has a negative effect on the growth possibilities and the skill level of the economy. The intuition seems straight forward but over time the theoretic streams and empirical evidence varied substantially. The contradiction comes from the existence of opposing effects resulting from brain drain.

Developing countries can, for example, benefit from the temporary migration of educated workers when they return. These workers can elevate the overall skill level of a country because of their contact with technologically sophisticated diaspora. With this return migration the diffusion of technology is promoted and will give the source country an

[3] As Beine et al (2001) define skilled migration: "The emigration of the population that is relatively highly educated as compared to the average"

incentive to invest in new technology. Another possible positive effect from brain drain is the inflow of remittances. Remittances inflows for developing countries have reached an estimate of $240 billion in 2007 and have been growing in recent years.[4] Return migration gives an incentive to invest in new technologies, but you can only invest when resources for its purchase are present. Remittances received by developing countries reduce the credit constraints and therefore encourages investments in technology and entrepreneurship. Other fields where remittances have a stimulating impact are the extension of banking service, microfinance for undeveloped rural areas and the access to financial services. In this paper the focus does not lay on these second round effects, however it is important to mention these effects and take them into consideration in order to fully understand the impact of migration, and show that the impact found in this paper does not capture the whole migration picture.

2.3.1 Neglecting Brain Drain

The research by Grubel & Scott (1966) was executed because of the upcoming of two major problems. Namely, the observation of a possible brain drain and the large scale training programs for foreign students issued by the US government. Their studies showed no startling effect and conclude that these flows of capital are quite small compared to the total amount of capital flow. In their research they made empirical estimates of the US balance of trade in human capital from foreign exchange students and the immigration of scientists and engineers but they found the impact smaller than often alleged. Empirical outcomes were undermined by limitations and effects on the long run seem negligible. In their opinion the discussions on brain drain suffered from a weak theoretical framework. Their framework states that, contrary to old believes on economic and military power, countries nowadays wish to maximize available income for all people. This objective of migration is divided into two parts; 1) improvement of individual income, 2) no reduction of income for those left behind. This first objective is med most of the time when people migrate voluntarily. With respect to the second objective they finally conclude that there is only a loss in total welfare for those left behind under rare circumstances. Johnson (1967), who is also one of the first economists to research brain drain, downplayed the negative externalities of brain drain for the source countries. The emphasize of both their research was on the positive externalities resulting

[4] World Bank (2008), "Global Economic Prospects 2008: Technology Diffusion in the Developing World," Washington DC, World Bank.

from globalization, factor mobility and remittances. This view was mainly driven by the spirit of the age where negative effects of globalization were viewed upon as old fashioned.

2.3.2 Negative Effect of Brain Drain

Before the work of Bhagwati and Hamada (1974 and 1977) most of the theory on brain drain was based on the neoclassical model of Hicks-Samuelson's value-theoretic variety. In their opinion the results are in contrast with those of the traditional models because of the assumption of rigid wages and resulting unemployment. Emigration of educated labor can easily lead to unfavorable effects on national income, per capita income and unemployment of educated and uneducated people through the effect of migration on the wage formation. The internalization of education cost will not necessarily reduce income cost of migration, nor will payment by the foreign country eliminate the adverse effect of skilled migration. They tried to make a more complex, realistic and less comforting model for the effect of brain drain.

McCulloch and Yellen (1975 and 1977) argued that the tax approach, although useful, also had negative effects on output. Bhagwati and Hamada introduced an emigration tax proposal because of the detrimental effect brain drain would have. McCulloch and Yellen stated that the demodernization effect of this tax has a negative impact on the output for modern sectors, employment and capital stock. Since the expected earnings of unskilled workers are adversely affected by this tax and while the income of the domestic skilled workers would rise, income inequality would increase because of this tax. Although McCulloch and Yellen do not agree with the tax approach uttered by Bhagwati and Hamada they agree with their theoretical framework. Although they changed it, the basic funding was still focused on the fact that brain drain in all cases is bad for the source economy. The models coming from the 1970's where more realistic since they took the influence of institutional settings more serious and saw that brain drain imposes a negative impact on the people staying in the source country. Not only do the source countries loose but the richer destination countries also benefit, which leads to an increasing gap between them. According to this literature the implementation of a good working discouraging tax mechanism would help the source country.

2.3.3 Modern Theories on Brain Drain

The negative view of the 70's was still supported by Miyagiwa (1991) who states that brain drain raises the education and income level of the host country but that it hurts the people in

the source country. In his opinion it is not per se the unskilled people who suffer but more the people with intermediate abilities. He argues that the policies implicated to stop skilled migration are only stopping the intermediate people while the highly skilled people are still able to migrate. Brain drain has a negative impact on the source country, and policy implications at work are not able to stop this process and may even be making it worse. Miyagiwa concludes that the literature on brain drain is insufficient in two ways: 1) theory treats skilled and unskilled labor as two separate factors of production who are fixed in the supply for labor, 2) literature only focused on consequences and not the causes of brain drain. So brain drain is seen as a special case of factor mobility and theory fails to look at the process of skill formation.

Haque and Kim (1994) use a two country endogenous growth model with heterogeneous agents and human capital accumulation. They found that brain drain leads to a reduction in the steady state growth of the source country. Differences in growth (short and long run) and income make convergence unlikely, so the source countries are left behind. They think subsidies on (higher) education could be a successful solution to induce brain drain.

Kwok and Leland (1982) made an economic model of brain drain focused on Taiwan. They are more interested in the causes for migration than the consequences. One cause for this skilled migration is for example the fact that students prefer to graduate abroad since it gives them more possibilities. The main cause however is the fact that highly educated people find themselves in a lack of employment opportunities because of asymmetric info in the labor market. The skilled migrants that do return to their home country are the less productive one.

Stark (1997) thinks that literature focused to much on how to mitigate the brain drain problem. Consequences of brain drain were taken for granted and impact on the skill level of the workforce, per capita output and openness were always seen as unfavorable. In his opinion the open economy does not only lead to migration possibilities but also gives an incentive, since higher future returns to skills influences the skill decision. Openness leads to the opportunity to migrate, which leads to a higher return on investment in human capital and optimizes the skill level of the worker. The country will lose a part of its most skilled workers and gets the less skilled part back, but the human capital level is higher than in autarky.

Mountford (1997) states that since migration is not certain the brain drain effect may increase the average productivity and equality in the source country. The (temporary) possibility to migrate increases the average level of productivity permanently and therefore brain drain may have a positive effect. Vidal (1997) makes a simplification of the model of Mountford in order to extend the positive effect of skilled migration. The possibility of migration to a higher return to skill country provides an incentive to invest in human capital.

Beine, Docquier and Rapoport (2001) focus on the impact of migration on human capital formation and growth. They have divided the impact of brain drain in two parts; 1) the ex ante brain effect (positive influence of skilled migration due to higher returns on education), 2) the ex post drain effect (negative influence of actual skilled migration). Obviously the beneficial brain drain emerges when the first effect dominates the second. They state that brain drain can still be harmful but that the new growth literature shines a new light on the positive impact of migration on human capital. Since education is seen as a major determinant of growth the average level of education of the remaining population in the source country would increase. Under uncertainty in the migration decision the opportunity given by education still prevails. The two fundamental relationships that emerge are: 1) the positive link between migration opportunities and the level of investment in education, and 2) the growth rate is positively linked to the share of educated people and negatively affected by migration.

In this paper the theoretic model of Beine, Docquier and Rapoport (2001) is used to derive the hypothesis concerning brain drain. The Beine et al. (2001) model will be explained more extensively and mathematically not only to use it as a starting point for research but also to display in which way the theoretic models on brain drain are mainly constructed. Beine et al. (2001) divide the brain drain effect into a separate brain (ex ante) and drain (ex post) effect. When one of the two effects exceeds the other the conclusion on weather there is a brain drain or a brain gain can be made. In a small open economy they use education as a discrete variable and assume that the individual education decision is made with uncertainty in the migration probabilities. The allocation decision on education takes place in period 1 and the fixed supply of labor and productivity resulting from the investment in education and the ability to learn comes back in period 2. In this case "*Economic growth is due to the intergenerational transmission of human capital: adults' average level of human capital is*

integrally transmitted to the young of the next generation and constitutes the latter's inherited human capital."[5]

Focusing on the production sector, a firm uses the production factors K and H (capital and labor resp.) to produce Y (quantity of goods). With the production function exhibiting constant returns to scale the output per efficient labor unit can be written as; $y_t=f(k_t)$. In this model factor prices are equal to their marginal productivity, due to the competitiveness of the firms, and the interest rate, r, is seen by the economy as given. The results of these assumptions are that the wage rate is normalized to unity and the interest rate is constant. When we look at the individual behavior we start at period 1, where each individual is endowed with a inherited amount of human capital. This period allows the agent to invest time into education or not. So in period 2 the level of human capital is determined by both the inherited amount as well as the invested amount in education. In functional form this will look like this:

$$h_{t+1}^{i} = \left[1 + a^{i} e_{t}^{i\beta}\right] h_t \qquad 0<\beta<1 \qquad \textbf{(1)}$$

With h_{t+1}^{i} being the level of human capital in the second period of life, where a and β explain the individual ability, where e_t gives the amount of education and h_t gives the inherited amount of capital in period 1. We assume that people from the source country benefit from migrating abroad, which indicates a relative higher return to education net from any migration costs. Which is represented by w, and is assumed to be higher than 1 since human capital acquired is rewarded abroad by higher income. The formula now changes:

$$h_{t+1}^{i} = \left[1 + wa^{i} e_{t}^{i\beta}\right] h_t \qquad 0<\beta<1 \qquad \textbf{(2)}$$

The assumptions that this w brings along are that migration flows are sufficiently small so that they do not change wage in the host country and since w is assumed as given there is no room for convergence due to technological differences. Period 2 also contains the uncertain migration decision, which in this case will be explained by p (allowed to migrate) and 1-p (stay home). When we assume that the possibility to migrate is only based on the educational level, educated people are randomly selected among this group due to quotas imposed by the

[5] Definition quote from Beine et al (2001)

destination country. With respect to lifetime income we assume that agents are risk neutral and their goal is to maximize their expected lifetime income. The formula for the investment decision for education becomes:

$$h_t\left(1-\bar{e}\right)+\frac{p\left[1+wa^i\bar{e}^{-\beta}\right]h_t}{1+r}+\frac{(1-p)[1+a^i\bar{e}^{-\beta}]h_t}{1+r}\geq h_t+\frac{h_t}{1+r} \qquad \textbf{(3)}$$

This formula is divided into four parts. The first part indicates the investment in education at period 1. The second and third part respectively indicate the group of educated people who do or do not migrate. The sum of these three parts needs to be equal or higher than the human capital level experienced by people who did not invest in education in part 4. Within this formula the interest rate, r, is used as a discount rate for future income. The agent who wants to engage in human capital formation meets the following requirement:

$$a_i \geq a_e \equiv \frac{\bar{e}^{-1-\beta}(1+r)}{\phi(p,w)} \qquad \textbf{(4)}$$

This formula displays the agent who is indifferent in whether or not he is going to invest in human capital. So a_e is the individual ability of this critical agent who is indifferent in investing or not, and φ(p,w)=1+p(w-1) lying between 1 and w. When there is no possibility to migrate, so p=0, the numerator of formula 4 disappears and the ability will be:

$$a_f = \bar{e}^{-1-\beta}(1+r) \qquad \textbf{(5)}$$

For the case of certainty of migration the formula (p=1) would be like formula (6). With formula (5) representing the numerator and with p=1 the denominator becomes w.

$$a_m = a_f / w \qquad \textbf{(6)}$$

More people want to invest in education so the ability goes up but the population p_m will go to 0. The remaining population for in the source country for p=0 and p=1 would respectively be Pf=max{0;($\bar{a}$ - a_f)/($\bar{a}$ - $\underline{a}$) and Pm=0. When we arrive at the possibility level where we want to be, between 0 and 1, we get the following formula for the remaining population:

$$P_e = \max\left\{0; \frac{(1-p)(\bar{a}-a_e)}{a_e - \underline{a}(1-p)(\bar{a}-a_e)}\right\} \quad \textbf{(7)}$$

The agent with a probability between 0 and 1 is defined by $a_m<a_e<a_f$ and the proportion of educated people staying at home would equal formula (7). After looking at the individual behavior it is now time to analyze the effects of the migration possibilities for the source country as a whole. As mentioned the higher educated population has a random probability to migrate. The skill composition of the educated people leaving the country is equal to that of the staying fraction; therefore the average level of human capital can be formulated as followed:

$$h_{t+1} = \frac{\bar{a}-\underline{a}}{a_e - \underline{a} + (1-p)(\bar{a}-a_e)}\left[\int_{\underline{a}}^{a_e} h_t U(a)da + (1-p)\int_{a_e}^{\bar{a}} (1+a\bar{e}^{\beta} h_t U(a)da\right] \quad \textbf{(8)}$$

The first part of this human capital formula represents the proportion of remaining educated people to the total population. The second part, U(a), is the uniform distribution of the total ability in a country [$\bar{a}$, $\underline{a}$]. When we derive the equilibrium growth factor for the source country it would be like this:

$$g_{t+1} = \frac{h_{t+1} - h_t}{h_t} = \frac{(1-p)\bar{e}^{\beta}(\bar{a}^2 - a_e^2)}{2[a_e - \underline{a} + (1-p)(\bar{a}-a_e)]} \quad \textbf{(9)}$$

The growth is represented by g_{t+1} and the source of this growth comes from the accumulation of human capital over generation. Every individual has an inherited amount of human capital. So the educated people not leaving the country are well endowed with human capital and are assumed to transmit their human capital within the country and equally to the next generation. The formula shows that growth (g_{t+1}) comes from the change over time in human capital. This human capital is transferred to next generations by the not migrating group (1-p), who is endowed with educational level e and has ability a_e.

From this formula we can extract and separate the brain and drain effect. The 'drain effect' slows down growth which in this formula comes from the fact that the growth rate is directly proportional to (1-p). However this equilibrium growth factor is also a decreasing function of

a_e. This is called the brain effect since a_e itself is a negative function of p and therefore increases growth all together. So the question remains: under what kind of conditions will the brain drain be beneficial for the source country? Beine et al. (2001) conclude that this condition will only be satisfied if and only if the probability of migration has the following condition:

$$p \times Z(p) = p(Ap^2 + Bp + C) < 0 \quad \textbf{(10)}$$

With: $A = (w-1)^2, B = (w-1)\left(\frac{\bar{a}^2 - a_f^2}{\bar{a}a_f} + 3 - w\right), C = \frac{\bar{a}^2 - a_f^2}{\bar{a}a_f} - 2(w-1)$

The brain effect, with these conditions, will display for intermediate values of p (so C>0 and B<0, which gives two positive signs) and for low values of p (C<0, which will give one positive and one negative sign). With Z (which needs to be higher than 0 when benefiting) and A (because of the square) always having positive values.

Hemmi (2003) places a comment on the Beine et al. (2001) paper by extending the model with fixed costs. In this paper he tries to show that the opportunity to migrate might induce an opposite effect on the long run growth rate and therefore also the transitional growth rate. The most important change in the model is the introduction of fixed into the function which changes the following formula. This formula is placed in the appendix with an extra note of explanation since it is not really relevant for understanding this brain drain model.

3. Development of the Post-1980-Globalizers

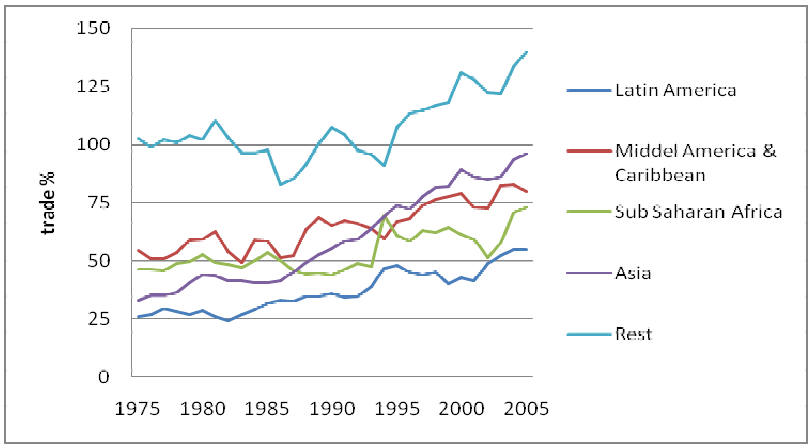
The graphs on development for the post-1980-globalizers displayed in this chapter will be divided into different regions since putting al the 24 countries into one graph would make them indefinable. The Latin American average in this case represents the countries Argentina, Brazil, Colombia, Paraguay and Uruguay. Middle America and the Caribbean contains the countries Costa Rica, Dominican Republic, Haiti, Jamaica, Mexico and Nicaragua. The average of Asia is represented by Bangladesh, China, India, Malaysia, Nepal, Philippines and Thailand. Sub Saharan Africa (SSA) contains the countries Ivory Coast, Mali, Rwanda and

Zimbabwe. Jordan and Hungary do not fit in any of these groups and are therefore put together in the group 'Rest' or mentioned separately from the graphs.

3.1 Openness

The reason why this group of countries was chosen was the fact that they all experienced a high degree of globalization since the 1980's. This globalization process can be displayed by showing the development of trade with the variable openness. Openness is the sum of exports and imports of goods and services measured as a share of gross domestic product. As graph 3.1 shows all regions experienced an increase in their trade percentages[6] from 1975 to 2005.

Graph 3.1 - Openness



[a] *Data Source: World Bank, WDI Online database for institutional subscribers*

[b] *The rest contains Hungary and Jordan*

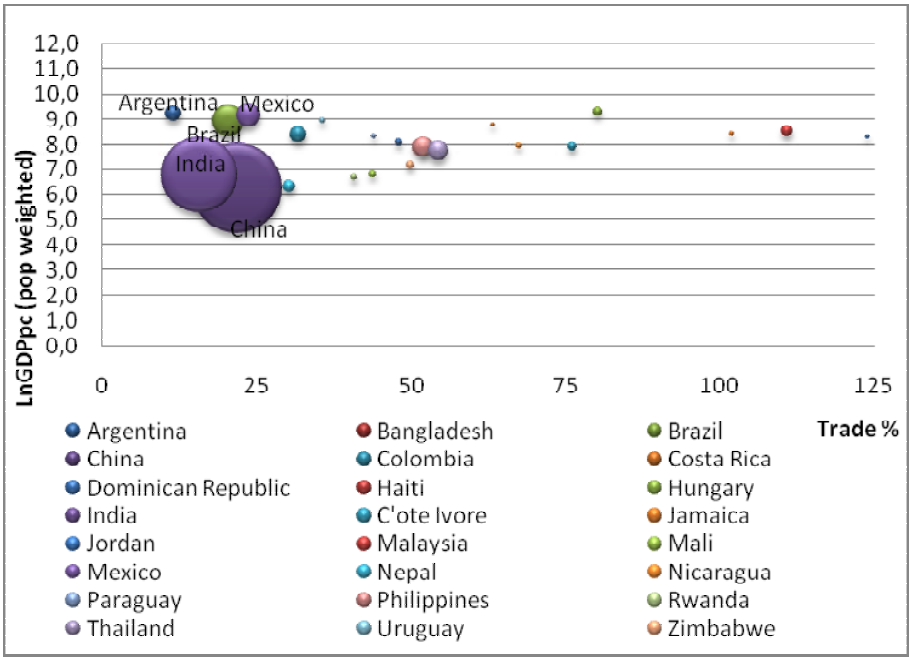
3.2 Growth: Population & Income

Graph 3.2 and 3.3 display the evolution of income for all countries. In order to still show the relationship with respect to trade this variable was inserted on the x-axis. On the y-axis the logarithm of GDP per capita was used in order to indicate the income level. To indicate the importance of the individual countries the bubbles are population weighted. Since there are 24 countries in these graphs the bubbles are overlapping each other therefore some of them are labeled. These two graphs will indicate the difference between 1980 and 2005. Important to mention is that differences in the graphs with respect to income do not seem that large,

[6] For full understanding the definitions of the variables are given in table 4.1

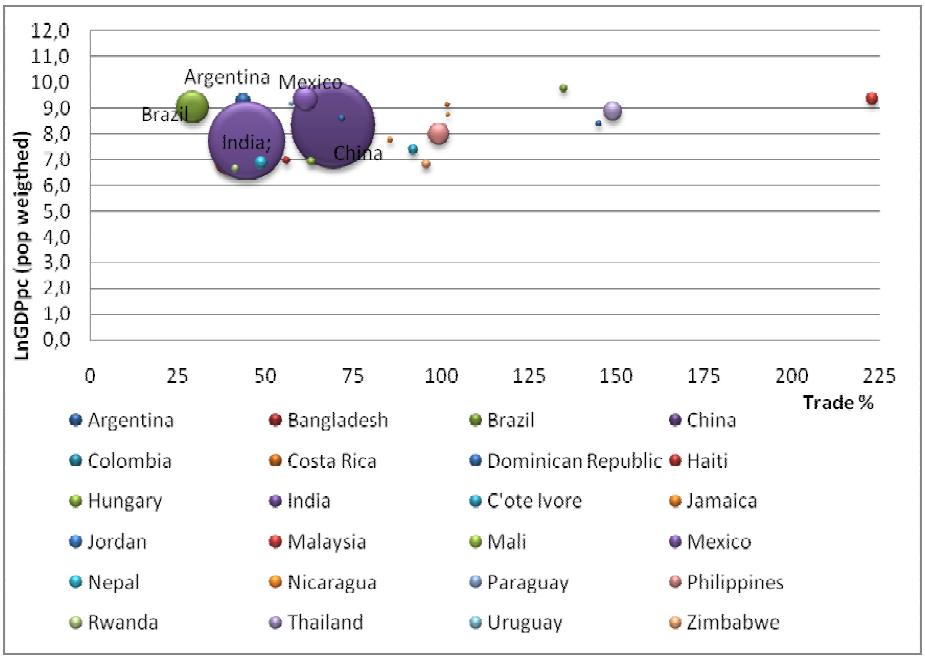
however we need to keep in mind that the logarithm of the GDP is taken so the absolute income growth is extremely large.

Graph 3.2 - GDP per capita vs. Trade (population weighted) 1980



[a] *Data Source: World Bank, WDI Online database for institutional subscribers*

Graph 3.3 - GDP per capita vs. Trade (population weighted) 2005



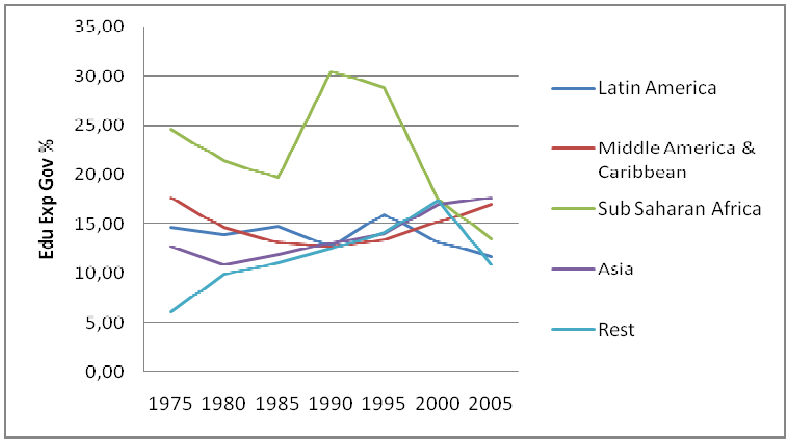
[a] *Data Source: World Bank, WDI Online database for institutional subscribers*

Graph 3.2 and 3.3 clearly display the increase in income level for all countries and especially for China. Over the last 25 years all countries moved to a position upper right in the graph. The increase of openness was already shown in graph 3.1 but more interesting to see is the higher position of the bubbles concerning the income level.

3.3 Education: Attainment & Expenditure

A more diversified result arises when the educational aspect comes into the discussion. When we look at the educational expenditure as a percentage of the total expenditures by the countries' government the regions show a different pattern. For example the expenditures of the Asian countries and Rest steadily increased over time while the expenditures of all the Latin American countries sway between 12 and 18%. The SSA countries show a even more unpredictable pattern going from a decrease to a sharp increase followed by a sharp decrease in the last 15 years leaving them at a lower level then in 1975.

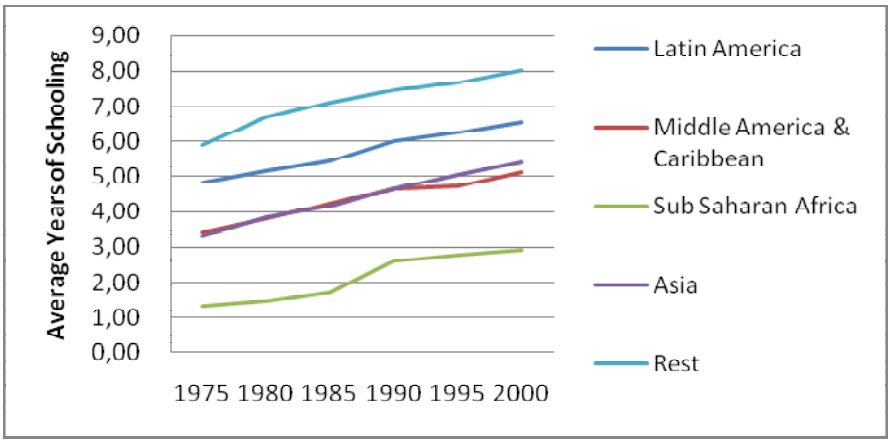
Graph 3.4 - Development of the expenditures on education



[a] *Data Source: UN Database, UNESCO UIS Data*
[b] *The expenditure on education is a percentage of the total expenditure of the government*

Obviously expenditures do not tell the whole story when we talk about education. More important is the effective use and result of educational expenditures. The next two graphs will display the development of the years of schooling and the education attainment in tertiary education. The years of schooling is an important indicator to show how much time of their life citizens of a country invest in their personal development. The tertiary educational attainment indicates the level of a certain country and if the higher education became a larger part of the total education of a country.

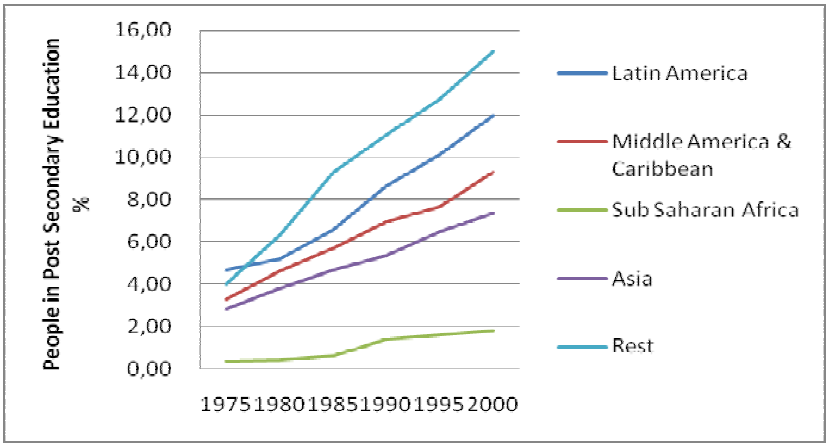
Graph 3.5 - Years of Schooling



[a] *Data Source: Penn World Tables (2006)*

Both graph 3.5 and 3.6 clearly show a strictly increasing path for all regions. Taking a look at the individual data we can see that all countries, with the exception of a one year decrease for Nepal, also have a strictly increasing development when it comes to years of schooling. Even more consistent than years of schooling the educational attainment without any exception showed a strictly increasing pattern in the graph and for all individual countries. Maybe a bit premature but if the countries in this dataset indeed suffer from skilled migration their rise in educational level, and therefore the human capital level, makes a case for a possible positive return of brain drain.

Graph 3.6 - Educational Attainment



[a] *Data Source Barro and Lee (2000)*

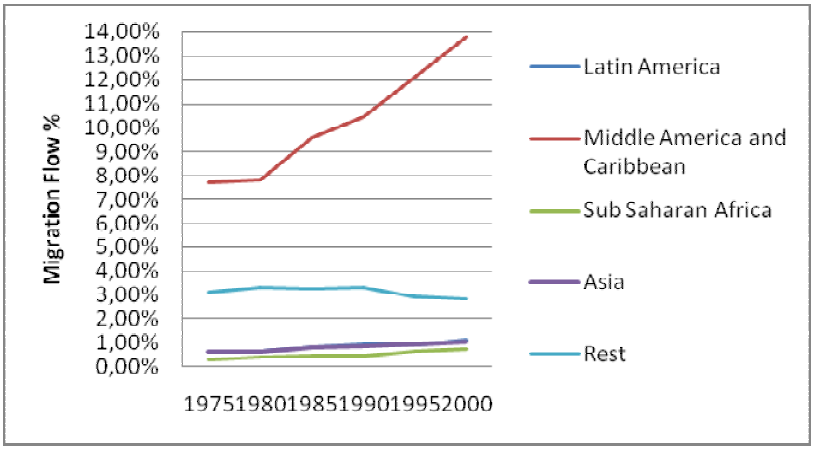
[b] *Educational attainment in this case shows the the percentage of people with tertiary education*

3.4 Migration & Remittances

The positive educational development of the post-1980-globalizers indicates an increasing level of human capital. Whether or not this positive development also is a positive externality resulting from brain drain will be researched in the next chapter. For now we can only examine if (skilled) migration is really a matter of concern for these countries, starting of with the development of the emigration rate.

Clearly the observations of Middle America and Caribbean are well above the other emigration rates. The numbers of the Middle American countries (Mexico, Nicaragua and Costa Rica) are also high compared to the other regions, but the average has really been lifted by the Caribbean representatives (Dominican Republic, Jamaica and Haiti). Jamaica showed the highest percentages in this case with an average of going from 28% to more than 35%. Latin America, Asia and Sub Saharan Africa also showed a strictly increasing pattern in their migration flow, although on a much lower level.

Graph 3.7 - Migration Flow



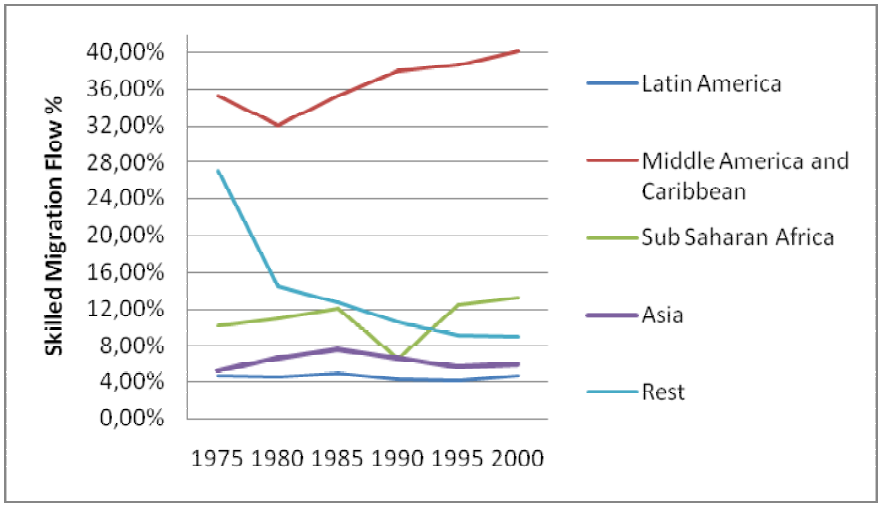
[b] *Data Source: World Bank, WDI Online database for institutional subscribers*

[a] *The emigration rate in this graph represents the migrants aged above 25 as a percentage of the total population aged above 25*

For Hungary and Jordan the first two decades there was an increasing migration flow, however the last decade there was a decrease. The development for Hungary might be explained by the fact that the first two decades, of the time period chosen, it was attractive (with respect to income in Europe) and not that hard to migrate (with respect to distance to European countries). Since the last decade Hungary developed, especially compared to its

surrounding countries, so people feel less of an urge to migrate and therefore the migration rate decreased. Latin American and Caribbean countries occupy a special place in the migration debate. As part of the "New World," they were the main destinations for two centuries, and many countries in South America continued to receive migrants in large numbers until quite recently, mostly from Europe. However, the pattern has shifted dramatically over the last two decades, and millions of people have emigrated, with the majority going to the US. This is due to their geographic position, the existence of large social networks and the relative ease of social and economic assimilation. Looking at the skilled migration in graph 3.8 we can see that Latin America and especially the Caribbean play an important role and indeed suffer from it.

Graph 3.8 - Skilled Migration



[a] *Data Source: Defoort (2005)*

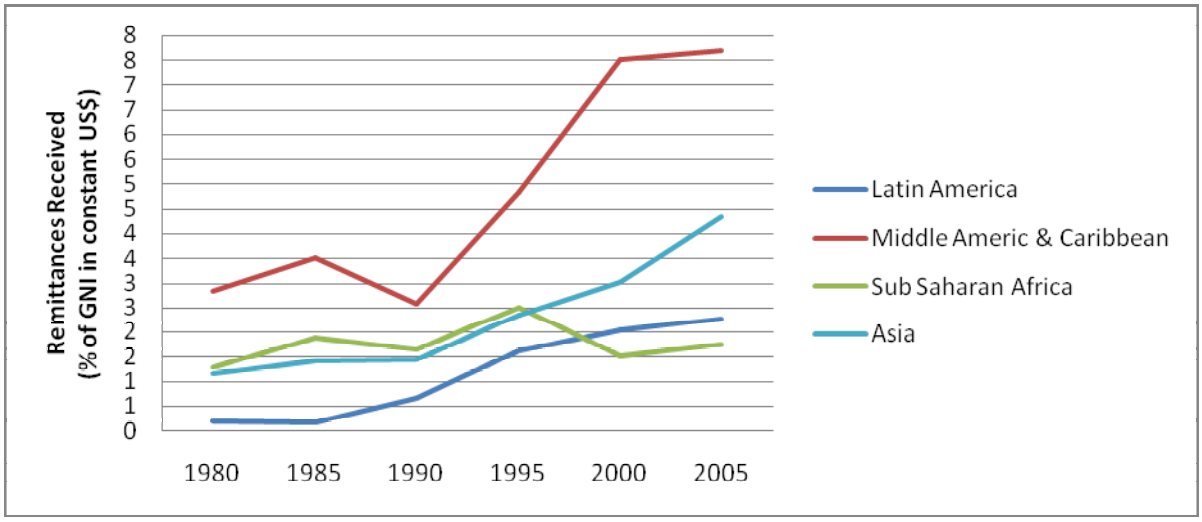
[b] *Skilled migration in this case is defined by the migrants with post secondary education aged above 25 as a percentage of the total population with post secondary education aged above 25*

Clearly the Middle American and Caribbean countries lay well above the other regions with respect to skilled migration. While the other regions are stable (Latin America and Asia), decreasing (Rest) or showing a more diverse pattern (Sub Saharan Africa), Middle America and the Caribbean experienced a large increase in skilled migration starting from the 1980's. The main difference in these patterns lays in the migration profile of the Caribbean. The Mexican and Central American migrant population is distributed more towards the bottom end of the educational spectrum while the Caribbean and South American migrant population is distributed to the upper end of this spectrum.

When educated workers migrate their home countries may lose from this. One negative effect might be the loss of potentially positive externalities generated by the educated workers in their home country. A second negative effect is the loss of potential tax revenue from the incomes of these people. A third negative effect is the loss of public funds spent on their education. Off course there are also some potential gains. Educated migrants might earn higher incomes in their destination countries and the remittances they send can be a significant source of income. They also establish important cultural and economic links between their home countries and the global economy.

Money send back by migrants to their home country can have a positive effect on human capital and income for the source country. Caribbean countries suffer from massive migration of educated workers. Over 40 percent of people from the Caribbean with university education live outside their country of origin. In countries which already suffer from human capital shortages, skilled migration can reduce the capacity to deliver key services. The Caribbean region has also received increasing amounts of remittances. With remittances being on average 6% of regional GDP over 1998-2003, they exceed FDI inflows in the Caribbean.

Graph 3.9 - Remittances Received



[a] *Data Source: World Bank, WDI Online database for institutional subscribers*

[b] *The following countries have been removed due to a lack of data: Argentina, Uruguay, Nicaragua, Zimbabwe, Nepal, Jordan and Hungary.*

From table 3.9 this increasing pattern can not only be seen for Middle America and the Caribbean but also for all other regions, with the exception of Sub Saharan Africa which has a

more diverse pattern. The group 'Rest' in this part defined by the countries Hungary and Jordan both show constant percentages but on a whole different level. For Hungary the percentage stays around 0.3% while for Jordan the percentage is much higher and swaying between 15 and 25 % without a clear path.

4. Empirical Evidence

4.1 Previous Studies

The following overview on the previous done empirical research discusses the results, limitations, data- and specification issues regarding brain drain. This will lead to a good understanding of what is needed for a well considered research. Outcomes and difficulties can be used as an intuition for a certain relationship, avoid mistakes and give insides into limitations regarding brain drain research.

For a long time the issue of brain drain was discussed in a theoretic way due to a couple of reasons. One reason for this theoretic discussion was the fact that economist in the early years of occurrence did not see it as a real threat, so further research in their opinion was unnecessary. Brain drain was seen as a phenomenon arising from an increasing globalizing world, which was only viewed upon as positive and therefore the negative effect of brain drain was neglected in the early stages of existence. Another reason is that the occurrence of brain drain was new for the economist, therefore research first needed to be done in the theoretic field in order to find some fitting models for the problem. The last and most important reason for the lack of empirical research was data related. For a long time data on skilled migration and educational attainment was inadequate or unavailable. Fortunately the last ten to fifteen years empirical research in the brain drain area came to acceleration due to the increase in data quality and a full understanding of all issues regarding brain drain.

Grubel & Scott (1966) concluded from their empirical work that the discussions on brain drain suffer from a weak theoretical framework. Their empirical study showed no startling effect and concludes that these flows of capital are quite small. Empirical outcomes were undermined by limitations and effects on the long run seem to be small. More interesting, compared to this first attempt to empirically research brain drain, are the more recent studies.

These researches are better represented and experience less trouble with respect to the quality and quantity of data, and are funded by more satisfying theoretic models. Carrington & Detragiache (1999) used USA census and OECD migration data for 1990 and combined this with Barro & Lee (1993) education data in order to make a benchmark for skilled migration. Limitations in their estimates concerned the exclusion of a number of countries due to a lack of data and the fact that the total educational level of migrants were based on the educational level of US migrants only. Therefore their estimates ignore skilled migration to for example the Middle East, while this may be a large proportion for countries like India. Carrington & Detragiache (1999) conclude that high skilled migration estimates can be found for small countries in the Caribbean, Central America and Sub Saharan Africa. They conclude that for very small countries the skilled migration is of significant influence while for countries like China and India the absolute numbers are high but the skilled migration rates are not.

Beine et al. (2001) in their empirical work instead of considering a growth factor depending on the proportion of the educated in the remaining population, they make it depend on the average level of human capital of a generation of remaining adults. Their model is explained in the theoretic part and states that with this assumption they can separately model the brain and drain effect. In the empirical part they test the direct effect of migration on education and the indirect effect of migration on growth. Their model controls for omitted variables[7] by putting public expenditures in education and workers' remittances into their models. Beine et al. found some methodological issues when empirically researching brain drain. With respect to data issues they address that there are no harmonized numbers across countries on the skill characteristics of international migrants due to a lack of qualitative data collection on migration. Therefore they used gross migration rates as a proxy variable for brain drain which lead to statistical problems. One problem is the fact the migration numbers vary a lot between sources, since data coming from the source country differ highly from the data given by the host country. Beine et al. (2001) use the host country numbers of the OECD since immigration data is more reliable and focuses more on long term migration. Their second problem was the fact that they did not use migration rates by educational attainment but just raw emigration rates. For the contribution of migration rates on human capital formation they

[7] The term omitted variables refers to the situation where variables who are not included as independent variable into the model while there influence on the dependent variable is expected to be high

introduced remittances as a share of GDP in order to indicate the second round effect of migration. Their third problem was a specification problem regarding the endogeneity of migration. It is important in the brain drain research to know which variables predict the dependent variable. Factors that influence the migration decision are for example wage differentials and immigration quotas. Wage differentials are easily explained by a certain variable, it is however more difficult to explain a quota system with a certain variable. They assume that large countries are more bounded to countries than small ones and that population size is a good determinant for migration quotas. The fourth problem relates to the non-linear form of their theoretic model. To solve this problem they composed a dummy to distinguish the underdeveloped group from the developing countries and used education expenditures as a control variable. With applying a cross-section analysis of 37 developing countries they conclude that the possibility of a beneficial brain drain cannot be rejected.

Commander et al. (2003) point out, after discussing the Carrington & Detragiache (1998), that since the 1990's the general consensus appears to be that skilled migration has increased and is accelerating but that data is lacking. They acknowledge that the flow in highly skilled people has increased at a higher rate than of the lower skilled people and that there is a greater sectoral diversity. In their opinion all the theoretic models composed lacked a systematic match with the data. They criticize the fact that analyses were not taken to the firm level and that the heterogeneity of sending countries was ignored. Another interesting comment they make on the development of the relationship of the people who migrate and stay behind. Most theoretic models focus on the duality between these two groups while over last decades this changed due to technological improvements in the field of modern communication, software and networking.

In their second empirical study Beine et al. (2003) evaluate the growth effects of brain drain for the source countries of migrants. They use the Carrington & Detragaiche (1998) data on migration by educational level and find evidence for the support of the beneficial brain drain hypothesis. While observing 50 developing countries they found that most countries with low levels of human capital and low migration rates of skilled workers are positively affected by brain drain. However their full sample estimation result also had to deal with some econometric issues. One problem is the influence of a higher share of educated agents in a country, which is likely to raise skilled migration rates. In order to deal with this problem

some explanatory variables needed to be added to the relationship. Variables like population density, life expectancy, population size, racial tension, stock of migrants in origin and wage differentials were tested as instrumental variables. Looking at the correlation with migration and the error term, and using the F and J-test only population density was taken out as instrument. The conclude that gross investment in human capital and growth of GDP per head the results show that migration prospects has a positive effect on the formation of human capital, which in his turn indeed favors GDP growth.

Faini (2003) did not find any significant effect of tertiary migration on domestic enrolment in higher education. However, his research was done using enrolment data so due to measurement problems his outcomes need to be taken with caution. The purpose of his paper was to take a further look at the empirical evidence concerning the link between skilled migration, education and remittances. He found results suggesting that the concerns in sending countries about the economic impact of skilled migration are justified. His results show that a higher skilled migration share is associated with a lower flow of remittances. He also found little evidence suggesting that raising the skill composition of migration has a positive effect on the educational achievements in the home country. Outcomes in his work showed that the tertiary enrolment ratio in sending countries is negatively associated with the skilled content of migration.

The empirical investigation of Beine et al. (2006)[8] builds on the framework of the convergence model with respect to human capital levels. They tried to measure the impact of the emigration of skilled workers on the long run human capital level. Their panel data analysis shows that skilled migration stimulates human capital formation for the source country in low income countries. The results show that the educational decision is not affected by migration prospects for middle and high income countries. There are, however, some methodological issues which came up. One problem is the Nickel bias which indicates that the use of fixed effects and lagged terms leads to inconsistency in outcomes. This bias is minimized by the use of panel data, but Beine et al. (2006) also used instrumental variable estimations as an alternative approach. They also experienced the problem of endogeinity for the migration rates of skilled workers with respect to human capital. Like mentioned earlier

[8] When referring to this article both Beine et al (2006) and the update of February 2007 are meant

this can be minimized by finding instruments that determine skilled migration. After controlling for these issues they found that a catching up movement with respect to education level can be seen between 1975 and 2000. The migration of skilled workers coming from less developed countries also had a positive effect on the long run human capital level.

The research of Docquier (2006) states that although brain drain is a major source of concern for origin countries it can also have a positive influence by ways of remittances, return migration, diaspora externalities, quality of governances and increasing return to education. The problem with this conclusion is the fact that most of the developing countries suffer too much from brain drain, because of high skilled migration, that profiting from this phenomenon is difficult. However, empirical results show that skilled migration induces some significant positive effects on developing countries, and optimal skilled migration rates vary across countries and depend for example on the level of development, education policy, population and political environment. In the attempt to find a generalization Docquier (2006) concludes from this paper and other empirical studies that the optimal skilled migration rate lays between 5 and 10 percent and that percentages between 15 and 20 are harmful for development. Looking at the properties of countries he concludes that large and middle sized countries benefit from skilled mobility and countries from SSA and Central America suffer. Docquier (2006) also emphasis that analysis on skilled migration with the focus on occupations and sectors are needed to take away the shortages in resulting from research done. Furthermore he concludes that policy recommendations can hardly be made since the empirical works in this field are limited by a lack of data, omitted variables bias[9], endogenity problems and sample sizes. Work in micro surveys need to be done to capture the relationship between emigrants and the country of origin. In discussing al empirical research done in the past Docquier (2006) comes to some generalizations with respect to brain drain, namely: 1) brain drain stimulates human capital accumulation, 2) skilled migration induces remittances, 3) return migration and brain circulation are good for growth, 4) skilled diaspora facilitates technology transfers.

In the revision of their paper of 2003 Beine et al. (2008) aim to research the same relationship but now with using recent data on emigration rates by educational level calculated by

[9] This bias occurs when included omitted variables are correlated with the dependent variables, which results in biased and inconsistent outcomes with the OLS procedure

Docquier and Marfourk. In this new analysis they find evidence of a positive effect of skilled migration prospects on gross human capital levels. Countries combining low levels of human capital and low skilled emigration rates are more likely to experience a brain gain. In calculating the countries individual outcomes for brain drain they found more losers than winners. Main globalizers like China, India and Brazil seem to benefit largely which makes the total benefits of the winners higher than the total losses for the losers. In their conclusion they state that brain drain increases the number of skilled workers in developing countries and it has a great distributional effect for the developing countries. Interesting to see is what the calculation of other authors obtained for the individual countries. In the appendix paragraph 7.2 displays the results of empirical research done by Beine et al. in 2006. This table displays the skilled migration percentages and its impact on the skilled proportion.

Interesting to see from the impact on human capital is the fact that the net effect for the post-1980-globalizers is negative, and that the percentages for the losers are generally higher than the positive percentages. The highest positive impact is found in Argentina, which is only 1.5%, while the biggest loser is Jamaica, with an impact of -14% on its skilled proportion. In the next paragraphs of this chapter it will be interesting to see what the outcomes of the empirical research will bring since the development numbers in chapter 3 show good results for this group, while the empirical results for the individual countries gives a total loss on the skilled proportion in the source country. Contrary to the theoretic models the empirical research shows a more unified conclusion with respect to the impact of brain drain. With the exception of Faini (2003) most of outcomes indicate that skilled migration raises the human capital level of the source country and that there is indeed evidence for a beneficial brain drain. However the group of losers seems to be larger than the group of winners, and total losses seem to be higher than total profits.

4.2 Empirical Research

In this paragraph the theory and previous done empirical evidence are combined in order to compose an adequate research for this paper. Hypothesis, variables, sources, techniques, problems and results will be discussed to truly capture the macroeconomic impact of brain drain.

4.2.1 Relationships and Hypothesis

The theory and the empirical evidence contain certain relationships which can be deducted and used as a foundation for the panel data research in this thesis. The fundamental relationships emerging from these modern theories on brain drain are dual. First there is a positive link between migration opportunities and the proportion of young individuals who are highly educated and willing to invest in high education. From this first positive 'brain' relationship the following hypothesis can be constructed:

1) H0: The formation of human capital is positively affected by the outward migration of skilled people

   H1: The formation of human capital is not or negatively affected by the outward migration of skilled people

The second link is the relationship between the growth rate and the share of educated people and is called the drain effect. Theory states that the growth rate is negatively affected by the skilled migration rates, which leads to the following hypothesis:

2) H0: Skilled migration has a negative influence on GDP growth per capita

   H1: Skilled migration does not or positively influences GDP growth per capita

These two relationships are the most important ones needed to be researched in this thesis, however there are some other important relationships in need of some explanation. The first two hypothesis will be used to compose the income and human capital models in order to research the separate brain and drain effect. Alongside these two models another dependent variable, namely skilled migration, will be explained by a third model. This model is discussed first and is used to explain where migration of the highly educated and skilled people comes from. The function of this model is to explain the reasons for migration and to control for the reverse effect when trying to determine the impact of migration on education.

4.2.2 Regression Models and Variable Definitions

The dependent variable in the first model is skilled migration, which is in the other two models used as an explanatory variable. Skilled migration is represented by the ratio of the number of skilled migrants compared to the total number of migrants, calculated by Defoort

(2006). The other explanatory variables for the migration model are extracted from the migration theory in chapter 2 and the Beine et al. (2008) migration model. The regression formula for the migration model is written below, with the subscript notations i and t respectively representing the country and time index in all formulas.

Migration Model

$$\ln(skmi_{it}) = x_i + \beta_1 \ln(pop_{it-1}) + \beta_2 \ln(ms_{it-1}) + \beta_3 \ln(o_{it-1}) + \beta_4 \ln(dens_{it-1}) + \beta_5 \ln(dist_{it-1}) + \beta_6 \ln(smepv_{it-1}) + \varepsilon_{it} \quad (11)$$

The human capital model focuses on the brain effect resulting from skilled migration. Human capital is represented by the educational attainment percentage calculated by Barro & Lee (2000). This percentage indicates the amount of people with tertiary education of the population being aged over 15. Some adjustments in this variable, which will be explained, were made in order to improve the results of this research. Conform the first hypothesis one of the explanatory variables is skilled migration in order to proof the assumed positive relationship. Regression formula (12) will be used to explain human capital.

Human Capital Model

$$\ln(HC_{it} - HC_{it-1}) = x_i + \beta_1 \ln(HC_{it-1}) + \beta_2 \ln(skmi_{it-1}) + \beta_3 \ln(rr_{it-1}) + \beta_4 \ln(le_{it-1}) + \beta_5 \ln(grw_{it}) + \beta_6 \ln(mf_{it-1}) + \beta_7 dum(LA_i) + \beta_8 dum(75to85_i) + \varepsilon_{it} \quad (12)$$

The income model shows the drain effect with the dependent variable being GDP growth, represented by calculating the growth rate of the natural logarithm of the GDP per capita based on PPP[10] in constant 2005 international dollars. According to the second hypothesis one of the explanatory variables needs to be skilled migration in order to test the assumed negative relationship. The composed regression model for income growth will look like the formula displayed in formula (13).

[10] PPP stands for Power Purchasing Parity

Income Model

$$\ln(Y_{it} - Y_{it-1}) = x_i + \beta_1 \ln(GDP_{it-1}) + \beta_2 \ln(hum_{it-1}) + \beta_3 \ln(skmi_{it-1}) + \beta_4 \ln(diff_{it-1}) + \beta_5 \ln(phone_{it-1}) + \beta_6 \ln(t_{it-1}) + \beta_7 (FDI_{it-1}) + \beta_8 (smepv_{it-1}) + \beta_9 dum(LA_i) + \beta_{10} dum(SSA_i) + \varepsilon_{it} \quad (13)$$

An overview and explanation definition of all variables used in the regression models can be found in table 4.1 below.

Table 4.1 – Variable Definitions

Name	Variable	Source	Definition
Area	Country Size	WDI (World Bank)	Total area of a country in square miles
Dem	Democracy Indicator	INSCR	Scale from 0 to 10 indicating the degree of democracy in the country.
Dens	Population Density	WDI (World Bank)	Midyear population divided by land area in square kilometers.
Diff	Income difference with OECD average	Own calculation based on WB data	Ratio to indicate the income difference between OECD countries and the countries used in the database.
Dist	Average Distance	CEPII	The average distance to other countries in km
EEgov	Educational Expenditure as % of Government Expenditure	UNESCO	Total educational expenditures on tertiary education as a percentage of the total public expenditures in the related year
FDI	Foreign Direct Investment	WDI (World Bank)	Net inflows of investment to acquire a lasting share
GDP	Gross Domestic Product	WDI (World Bank)	Total GDP of a country converted to international dollars using purchasing power parity rates
Grw	GDP growth	WDI (World Bank)	Annual percentage growth rate of GDP
HC	Post Secondary Educational Attainment	Barro & Lee Dataset (2000)	Percentage of the amount of people with tertiary education of the population over 15 years.
Hum	Increase in LnHC		$\ln HC - \ln HC_{-1}$
LA	Dummy for LAC		Giving 1 for the LA countries, 0 for rest
LE	Life Expectancy	WDI (World Bank)	The average life expectancy of the country citizens in years
MF	Migration Flow	Defoort. (2006)	The emigration rate is defined as the ratio of the total number of emigrants aged 25+
MS	Migration Stock	WDI (World Bank)	International Migrant Stock (% of population)
O	Openness	Penn World Table 6.1	Same as trade but as share of GDP
Phone	Phone	WDI (World Bank)	Percentage of the number of people who have a fixed or mobile telephone line.
Pop	Population Size	WDI (World Bank)	Total population counts all residents regardless of legal status or citizenship
RR	Remittance Received	WDI (World Bank)	Workers' remittances for migrant workers
RRperc	Remittance Received %	WDI (World Bank)	Same as RR but in percentages of GNI

SkMi	Skilled Migration	Defoort (2005)	The emigration rate is defined as the ratio of the number of skilled emigrants aged 25+ Skilled workers are those with a post-secondary certificate.
SkMiGr	Skilled Migration Growth	Defoort (2005)	lnSkMi – lnSkMi$_{-1}$
SMEPV	Societal Major Episodes of Political Violence	INSCR	Indicator to show the total impact of civil and racial tension/war on a scale from 0 to 10.
SSA	Dummy for SSA		Giving 1 for the SSA countries, 0 for rest
SY	School Years	Barro & Lee (2000)	Average years of schooling
T	Trade %	WDI (World Bank)	Sum of exports and imports of goods and services
Y	GDP per capita PPP constant 2005 international $	Penn World Tables 6.1	Gross domestic product converted to international dollars using purchasing power parity rates.
75to85	Time Dummy		Representing the data from 1975 to 1985

[a] The definitions were taken from the data source and shortened to fit into the table

[b] The references to the source are given in chapter 6 on references

4.2.3 Methodology

The database, composed for the three regression models, contains panel data for the 24 most globalizing countries since the 1980's. Panel data in this case means using data for all 24 countries in a time period going from 1975 to 2005, with a lot of data being annually but with the most important numbers being represented every five year. The use of panel data gives a couple of general research advantages. First of all, with pooling time series data and cross section data you can expand the dataset and therefore the number of observations. Second you can take into account the unobserved heterogeneity between countries, which makes research more reliable. The method for researching the relationship is the Ordinary Least Squares method for multiple regressions. The OLS method is combined with a White-test in order to prevent heteroskedasticity[11] and get consistent errors and covariance. All models will be tested for serial correlation with the Durbin &Watson statistic and the LM serial correlation test. Along with lagging the variables against reverse causality, using growth rates in the convergence models and making several models for consistency, these precautions will improve and indicate the quality of the results.

4.2.4 Variables Specification and Data Issues

Brain drain evidence is subject to a couple of issues which are data and variable related. Carrington & Detragiache (1998) experience problems with the number of observations and

[11] With heteroskedasticity the OLS procedure is harmed by the fact that in the estimation more weight is put on the observations with large error variances than on the ones with small error variances

the fact that the educational level of migrants was only known for the US. The problem of the quality of data on educational level is not applicable to this research since the numbers are not based solely on US migrants but on the six major receivers of migrants. Although the data concerns the US, Canada, France, Germany, UK and Australia, the numbers are still not estimated for the Middle East and therefore the assumed large proportion coming from Asian countries cannot be fully examined. For this group of countries this problem is not that harmful since India and Jordan are probably the only two countries which could have higher skilled migration rates to this area.

The problem of Beine et al. (2001) in not finding harmonized data on skilled migration is solved by using the database of Defoort (2006), which was not available at that time. The specification problem is solved by composing a model to make skilled migration endogenous. By using variables which are assumed not to correlate with human capital and income, but who do predict skilled migration, this problem is solved. For example population size, which was seen as a good determinant for immigration quota, is uncorrelated with human capital and was therefore not used in the human capital model. There are also some other truly exogenous variables included in the migration model in order to fully determine skilled migration. The reversed causality problem, of for example skilled migration on human capital, was challenged by using lagged variables. By using lags one can see if there is delayed relationship between the two and make sure that the variables included in the model really explain the dependent variable, and not the other way around. This procedure of lags was used in all models to prevent reverse causality.

For the human capital and income models a convergence model was composed in order to remove serial correlation from the model. In the upcoming estimation results one can see from the migration model and first human capital model that they suffer highly from serial correlation. Converting the dependent variables human capital and income into growth rates solves this problem, as can be seen from the serial correlation tests. Beine et al. (2003) experienced some problems with the countries having a higher share of skilled people since they are also likely to have a higher proportion of skilled migrants. The method for dealing with this problem is to test instruments like population density, life expectancy, population size, stock of migrants and wage differentials. All the instruments are tested in order to find the right model for skilled migration.

4.3 Results

The results of the three models were composed after an elaborate process of trial and error. Taking the difficulties of other researches into account, and dealing with the problems experienced in earlier empirical research, the best possible models for this group of countries will be displayed.

4.3.1 Migration Model

The migration model is often used as a supporting model for the human capital and growth models. In the next table skilled migration will be explained without using variables highly correlated to human capital. Generally, when predicting a migration model, one has to test different variables to capture the proximity between the host and the source country (e.g. geographic and economic distance), the source country characteristics (e.g. democracy and discourse) and the host country characteristics (e.g. social and educational expenditures at host). The variables used in this model are taken from the theory discussed in chapter 2 and the empirical research done on brain drain. From table 4.2 one can see that five models are composed for the dependent variable skilled migration leaving 119 out of the 138 observations. The reason for displaying more than one outcome is to see if relationships are consistent and stable when inserting a new variable or replace one.

Table 4.2 shows that the population size (*LnPop*) has a negative influence, with an average of -0.49, on the skilled migration rate. This negative effect is in line with the results of all the migration models concerning brain drain executed by Beine et al. The result can be explained by the fact that this dataset contains a couple of small Caribbean countries who all experienced high skilled migration percentages. Contrary to these small countries with high migration numbers are the high population countries like China and India who show lower skilled migration percentages. Therefore the negative result in this model for population levels is hardly surprising and in line with the assumption that small countries are more open for migration.

Migration stock gives some additional information on the properties of migration. The higher the migration stock the lower the skilled migration is a surprising outcome and contradicts outcomes of other empirical researches. This effect might come from the fact that countries with a high migration stock have a more equal distribution looking at the educational level of

migrants. A high migration stock indicates that the source country itself is open for migration and therefore it is not only easy for skilled people to migrate but for all people. The migration stock holds the percentage of the people living in the 6 main OECD countries, so this indicates the size of the migration network on which prospective emigrants can count. This should have a positive effect on migration but not necessarily on skilled migration rates, which might explain the negative result found in this model.

Table 4.2 - Migration Model

Estimation Results using OLS

Dependent variable = skilled migration

Variable	(1)	(2)	(3)	(4)	(5)
Constant	9.157676** (2.422815)	6.787648*** (8.672505)	10.32129** (2.578007)	7.401928*** (7.375543)	10.88394*** (13.44235)
lnPop(-1)	-0.452198*** (-11.36698)	-0.452008*** (-11.49941)	-0.488192*** (-10.66060)	-0.487029*** (-9.55332)***	-0.585589*** (-11.99565)
lnMS(-1)	-0.348655*** (-7.841012)	-0.337540*** (-8.360164)	-0.334840*** (-7.279638)	-0.321649*** (-6.091611)	-0.287523*** (-6.035442)
lnO(-1)	0.638286*** (6.074750)	0.636828*** (6.089072)	0.618530*** (5.931110)	0.617263*** (6.058223)	
lnDens(-1)	0.117119** (2.283832)	0.125919*** (2.304569)	0.105838** (2.078552)	0.116858* 1.974162)	0.230937*** (3.726796)
lnDist(-1)	-0.256750 (-0.665571)		-0.314493 (-0.790181)		
Smepv(-1)			0.072102** (2.099954)	0.070237* (1.695622)	0.098656*** (2.907409)
Adjusted R^2	0.616823	0.619249	0.623487	0.625411	0.508099
D&W	0.276563	0.274122	0.268853	0.265917	0.163309
F-stat	38.99037	48.97855	33.56709	40.40237	31.47137
Prob	0.000000	0.000000	0.000000	0.000000	0.000000
Obs	119	119	119	119	119
Year	1975-2005	1975-2005	1975-2005	1975-2005	1975-2005

[a] *The indication of level of significance: *,** and *** denote respectively the 10, 5 and 1% level*
[b] *With White Heteroskedasticity-Consistent Errors & Covariance*
[c] *The T-values are given between brackets*
[d] *The (-1) behind the variables indicates a lagged variable*

Clearly the globalizing process that these countries went trough the last couple of decades induced the highly educated and skilled people to migrate to another country. The model shows that the intuition behind the variable on openness stands, since it shows a highly significant positive effect on skilled migration. The demographic variables population density and distance both show results in line with theory. According to theory and other outcomes the higher the distance the lower the migration rate, this is supported by this migration model.

A limitation to this result is that this variable was insignificant in the models composed for skilled migration. The population density of a country (Dens) is assumed to have a pushing effect on skilled migration. From the results indeed can be concluded that a higher population density leads to a higher skilled migration rate. Democracy and discourse were tested in order to test the source country characteristics. Although democracy had a small negative effect on skilled migration it was left out of the models since it was highly insignificant. This relationship, although not significant, is in line with expectations since a more democratic country the less of an urge people feel to migrate. The variable representing discourse (SMEPV) was significant and in line with the expectations. Obviously tension and wars in a country induces people to migrate.

Variables like remittances, government expenditures, income differences and life expectancy were not included into this model since these variables are expected to be highly correlated with human capital and income. These variables are not seen as truly exogenous variables and are therefore not used in the migration model but in the models on human capital and income. In order to minimize serial correlation in this model all variables related to income and life expectancy were excluded from the models because of the high correlation with human capital. In the empirical research of Beine et al. (2008) the same method was used since the exogeinity of these two variables is questionable and therefore using them would harm the model.

From the five models composed for skilled migration the direction of the relationships are clear. Although the numbers for most of the variables are significant there is a problem of positive serial correlation according to the D&W statistics and the LM serial correlation tests.[12] The assumption that errors are uncorrelated often breaks down when doing time series. In the case of positive serial correlation an overestimation of the calculation can occur, but the OLS estimation remains unbiased and consistent. And since this model is a supporting model for the other two models this problem is of less urgency.

4.3.2 Human Capital Model

The first stage for this model was to establish the relationship between human capital and the other variables in this dataset. The dependent variable in this first human capital model is the

[12] An overview on the LM serial correlation tests for all models can be found in the appendix chapter 7.3

natural logarithm of the human capital percentage. The estimation results for this dependent variable are given in the table 4.3. Remarkable in this model is the fact that skilled migration has a negative influence, with an average of -0.3, on human capital. Since this should be the positive 'brain' effect this result offsets the hypothesis stated in the beginning of this chapter. As expected income has a positive impact on human capital. This relationship is straight forward and is in line with the expected relationship since a rise in income leads to investment in human capital trough education. Remittances also showed the expected relationship with respect to human capital. Connecting this relationship with the discussed theory remittances most of the times reduces the credit constraints for the source country and therefore encourages investments in education, technology and entrepreneurship. These investments lead to an increase in the human capital level of the source country. The average years of schooling also displays a positive relationship with the human capital. Logically when people in a country are spending more time in education the educational level in a country will increases, which will influence human capital positively.

Also important for the development of human capital are life expectancy and the institutional properties of a country. Life expectancy shows a high positive effect on human capital, which indicates that a higher life expectancy leads to more time to invest in human capital. For the institutional indicator the degree of democracy was composed and included in the model. Although it is not that strong it still indicates the importance of a stable political environment. The investments variable, FDI, shows a remarkable effect since it was negative in this first model. This negative effect is significant but really marginal and therefore FDI can more or less be explained as a non influencing variable, while the expected relationship should be that FDI leads to a higher educational level by means of job opportunities and an increase in the demand for skilled people.

The results shown seem very attractive giving high t-values for the variables and high F-statistics and R^2's for the models. However all models suffer from high positive serial correlation with values being dramatically close to zero. The relationships for this dataset are established but in order to get a model of good quality some changes have to be made. The dependent variable was changed with the same method used in the human capital model of Beine et al. (2008). The human capital level (lnHC), which was the dependent variable in the previous model, is changed into the growth of the ex ante human capital level. The Barro and

Lee (2000) five year percentages on educational attainment were subtracted from each other after taking the natural logarithm. For each country the 1975 percentage was diminished by the 1970 percentage and so on until the year 2000 in order to get the growth rate for all countries. Dummies were added to increase the models fit and lags were taken again in order to control for reverse causality.

Table 4.3 – First Human Capital Model

Dependent Variable = Level of Human Capital
Estimation Results using OLS

Variable	(1)	(2)	(3)	(4)
Constant	-7.713878*** (-4.512729)	-3.653065*** (-6.997907)	-8.816414*** (-4.499109)	-7.232597*** (-4.121762)
lnSkMi(-1)	-0.371361*** (-6.902017)	-0.391329*** (-7.364899)	-0.373413*** (-6.212132)	-0.397836*** (-6.054373)
lnY(-1)	0.429043*** (3.959082)	0.535998*** (6.653293)	0.403613*** (3.784836)	0.379683*** (4.013683)
lnRRperc(-1)	0.253027*** (6.561370)	0.269923*** (7.379130)	0.209216*** (5.230009)	0.223359*** (5.619071)
lnSY(-1)	1.013889*** (7.438825)	1.199182*** (9.777724)	1.072544*** (6.648228)	1.099633*** (7.095482)
lnFDI(-1)			-0.082956** (-2.057189)	-0.073574* (-1.839368)
lnLE(-1)	1.240318 (0.0213)		1.916998*** (3.417593)	1.500921*** (2.981911)
Dem(-1)				0.036407** (2.012406)
Adjusted R^2	0.837936	0.828899	0.858293	0.864906
F-stat	74.41970	86.98999	63.58716	57.70563
D&W	0.331351	0.310297	0.398545	0.367326
Prob	0.000000	0.000000	0.000000	0.000000
Obs	72	72	63	63
Year	1975-2005	1975-2005	1975-2005	1975-2005

[a] *The indication of level of significance: *,** and *** denote respectively the 10, 5 and 1% level.*
[b] *With White Heteroskedasticity-Consistent Errors & Covariance*
[c] *T-values are displayed between brackets*
[d] *The (-1) behind each variable indicates a lagged variable*

This second model on human capital growth shows that the initial human capital level has a negative influence on the gross investment in human capital. This implies a convergent movement in human capital levels for the post-1980-globalizers. Beine et al. (2008) found the same result for this variable when estimating gross investment in human capital in a similar way. The most important result coming from the second human capital model is the negative effect of skilled migration. This negative result, which could also be seen in the first model,

contradicts the expected positive brain effect on human capital coming from skilled migration. Although the negative effect is much lower than in the first estimates it still has an average level of -0.1275. All estimates for this variable are significant at least at the 5% level and are therefore very reliable. From this result we can state that for the post-1980-globalizers skilled migration has a detrimental effect on the human capital formation looking at the regression results in this paper.

Table 4.4 – Second Human Capital Model

Dependent Variable = Investment in Human Capital
Estimation Results Using OLS

Variable	(1)	(2)	(3)	(4)
Constant	0.268777 (0.499805)	0.207794 (0.369378)		
lnHC(-1)	-0.091907*** (-2.664015)	-0.102179*** (-3.205899)	-0.095139*** (-3.969612)	-0.087500*** (-3.420302)
lnSkMi(-1)	-0.133534** (-2.443214)	-0.137617** (-2.576708)	-0.127149*** (-3.863813)	-0.100028*** (-2.922924)
lnRR(-1)	-0.036051** (-2.254910)	-0.036805** (-2.438799)	-0.034747*** (-4.453004)	-0.025492*** (-3.253043)
lnLE(-1)	0.254849* (1.773583)	0.280878* (1.989118)	0.311673*** (6.552068)	0.239656** (5.253151)
Grw(-1)	0.004663 (1.667150)	0.005839* (1.923172)	0.004617* (1.922122)	0.005083* (1.977016)
lnMF(-1)	0.097069** (2.226954)	0.099210** (2.300014)	0.091938*** (3.694808)	0.060561** (2.445894)
LA	-0.120009** (-2.476859)	-0.113685** (-2.376406)	-0.120061*** (-3.386521)	
75to85	0.077886* (1.993397)		0.077204** (2.286596)	0.068328* (1.893210)
Adjusted R^2	0.353382	0.313561	0.360855	0.265271
F-stat	6.191838	5.959465		
D&W	2.289663	2.147210	2.301628	2.039085
Prob	0.000005	0.000019		
Obs	77	77	77	77
Year	1975-2005	1975-2005	1975-2005	1975-2005

[a] *The indication of level of significance: *,** and *** denote respectively the 10, 5 and 1% level.*
[b] *With White Heteroskedasticity-Consistent Errors & Covariance*
[c] *T-values are displayed between brackets*
[d] *The (-1) behind each variable indicates a lagged variable*

Negative effects are also estimated for the remittances received percentage. Remittances received are often used in other empirical researches which also found negative results, they were however not significant most of the time. The results in this estimation are low but

significant which leaves the tough job of explaining them since they also contradict the results coming from the first human capital model. One possible explanation for this might be that the use of remittances is not of the kind researchers expect. Most of the remittances going to poor people are not used for education but for life basics, like food and basic medical care. Remittances of the richer people might also not be used for education since they are already privileged to experience higher education, which therefore does not indicate an impact of remittances on human capital. Although the size and impact of remittances for some countries are increasing and sometimes higher than foreign investment, on average the impact on human capital seems to be small and insignificant.

The Latin American dummy is negative and significant in this dataset. The main reason for this result could be that the dummy contains ten countries of which four countries are Caribbean Islands who are assumed to be negatively affected by skilled migration. They are small countries open for trade and migration and vulnerable for exploitation. Also most of the Latin American countries in this sample suffer from the magnetic power that the US opportunities practices on their (skilled) people. In many studies this negative effect of the brain drain came forward, and apparently the assumed positive brain effect on human capital is not there for the Latin American countries. Therefore the negative effect for these countries pressure the outcomes of the other developing and globalizing countries, which makes the cross section panel data estimates negative.

Life expectancy, growth, migration flow and the time period dummy all showed a positive result. For life expectancy this result is logical since the average age of the home country citizens has a positive influence on the time people can spend on education. Since other income variables showed serial correlation or were insignificant, growth seems to be the only income indicator which shows some trustworthy results. The positive effect is significant but negligible. The migration flow shows a fairly high positive impact on human capital, which can be explained by the fact that the countries in this dataset have a distribution of their migration to the bottom levels of education. So when more non-highly educated people than highly educated people leave the country human capital increases. This is for example true for the Middle and Latin American migrants going to the US. The time dummy, representing the first ten years of the dataset, indicates that in this time period the growth in human capital made the most headways contrary to the dummies of the other time periods.

4.3.3 Income Model

The expected brain part of this chapter did not gave the results hoped for, and the result of the drain model is not expected to turn the relationship around. Again precautions were taken in order to control for serial correlation and tests were undertaken in order to estimate the quality and reliability. Also the lags of the independent variables were taken again to control for reverse causality. The second precaution taken was converting the dependent variable. In stead of using the natural logarithm of the GDP per capita the growth was calculated in the same way as in the human capital convergence model.

Alongside the precautions against serial correlation and reverse causality some other changes in variables were made in order to make the relationships in the model stronger. Therefore not only the initial human capital level is used but also the gross investment in human capital was used. The same method is applied to skilled migration in order to see if the increase in the skilled migration rate has a different and more significant impact on income growth than the normal skilled migration rate. In table 4.5 the results of the five composed models for income growth are displayed.

One can see that the initial level of income has a positive influence on income growth for the post-1980-globalizers. The impact is not that large, is not always significant and sways between 0.018 and 0.046. Looking at human capital we can see that the initial level of human capital has a negative impact on income growth. This relationship is in contradiction with the intuition that human capital has a positive impact on GDP growth. Since this negative relationship was not that large and only significant at a 10% level the variable of human capital was changed into the growth of human capital. This modification has a positive influence on the estimation results concerning the relationship with income growth. Now we can see that there is a strong positive impact of investment in human capital on income growth. These results, varying between 0.15 and 0.3, are in line with theory.

The most important relationship from this table is the one coming from skilled migration. This drain part of the empirical research displays results in line with the hypothesis stated in the beginning of this chapter. Both the initial level of skilled migration and the growth in skilled migration have a negative influence on income growth. The impact of skilled migration for the post-1980-globalizers is quite large and sways between 0.12 and 0.21. Along with the

negative impact of skilled migration found on gross investment in human capital you can state that the post-1980-globalizers suffer from brain drain and that a possible brain gain is hard to find.

Table 4.5 – Income Model

Estimation Results using OLS
Dependent variable = income growth

Variable	(1)	(2)	(3)	(4)	(5)
Constant	-0.623981** (-2.302839**)	-1.141267*** (-6.009749)	-1.292481*** (-6.334371)	-1.358420*** (-7.439575)	-1.661526*** (-5.292606)
lnY(-1)	0.021360 (2.227205)	0.032588*** (4.369009)	0.039100*** (4.924657)	0.018292** (2.079781)	0.046229*** (4.922980)
lnHC(-1)	-0.050269* (-2.717176)				
Hum(-1)		0.185144** (2.114409)	0.155603 (1.517578)	0.292603*** (3.097590)	0.184711* (1.629469)
lnSkMi(-1)	-0.014645 (-1.141137)				
lnSkiMiGr(-1)		-0.151997*** (-2.758628)	-0.153218*** (-3.028390)	-0.212443*** (-3.640277)	-0.121301** (-2.372689)
Lndiff(-1)	-0.112786*** (-4.613766)	-0.159110*** (-6.793915)	-0.168047*** (-7.597967)	-0.183872*** (-10.17281)	-0.154966*** (-7.949783)
Lnphone(-1)	0.076401*** (5.764057)	0.059993*** (4.529943)	0.057371*** (4.848882)	0.051250*** (4.269173)	0.045908*** (3.375501)
LnFDI(-1)				0.026070*** (3.349657)	
LnTrade(-1)					0.057487* (1.929329)
SMEPV(-1)			-0.012589** (0.0221)		
LA	-0.071843* (-1.985489)				
SSA	-0.107921* (-1.841574)				
Adjusted R^2	0.385576	0.442419	0.456654	0.604809	0.462842
F-stat	8.709797	14.64755	13.04644	17.83464	13.35029
D&W	1.806193	1.708526	1.738413	2.109170	1.768952
Prob	0.000000	0.000000	0.000000	0.000000	0.000000
Obs	87	87	87	67	87
Year	1975-2005	1975-2005	1975-2005	1975-2005	1975-2005

[a] *The indication of level of significance: *,** and *** denote respectively the 10, 5 and 1% level.*
[b] *With White Heteroskedasticity-Consistent Errors & Covariance*
[c] *T-values are given between brackets*
[d] *The (-1) behind a variable indicates a lagged variable*

The other variables used in these estimations are variables that are highly related to the development of income for open economies. Looking at the income difference, which was used by Beine et al. (2001) and calculated for this group of countries, one can see a negative

impact on GDP growth. Obviously the greater the economic difference between the developing open countries and the high OECD countries the greater is the negative impact on income growth. As said, this variable was calculated for this dataset by taking the difference between the average GDP per capita of the OECD countries with high income and the GDP per capita for the individual countries.

The variable on phones was used to capture a part of the developing element of a country and indicates that indeed technological and human development has a positive impact on income growth. FDI and trade were both used once in the models on income growth, and both show a significant positive influence on growth. Clearly the post-1980-globalizers benefited from opening op for the world economy by experiencing increases in international trade and receiving FDI.

The variable on discourse (SMEPV) which indicates the impact of civil and racial tensions and war on a 0 to 10 scale was used to estimate the impact of discourse in a country. As expected its impact on income growth was negative. Two other variables who also displayed negative numbers were the dummies on Latin America and Sub Saharan Africa, both showing that countries from these regions did not experience income growth. With the negative number for SSA being higher than the outcome of the LA dummy.

The outcomes of these models are rather constant and only marginally contradicting when looking at the initial human capital level and the gross investment. The LM serial correlation showed indeed that there was no serial correlation for the models above and heterkoskedasticity was removed from the model by using the White test in the OLS method. With a R^2 between 0.43 and 0.64, a probability of 0.000 and absence of serial correlation when looking at the D&W statistic we can safely assume that this model satisfying.

4.3.4 Research Conclusion

The main goal of this chapter was to test the two hypotheses formulated for the empirical relationships concerning brain drain. Looking at the results coming from the estimations the conclusion is that the hypothesis concerning income growth stands. The empirical results coming from the income models show that indeed skilled migration is of negative influence on income growth for the post-1980-globalizers. The most surprising results came from researching the first assumption that skilled migration has a positive influence on the gross

investment in human capital. This intuition, with respect to the countries used in this dataset, can be rejected looking at the estimation results. The models composed for human capital only showed negative results for skilled migration using a couple of different techniques. Though the variables concerning brain drain are subject to serial correlation, the quality of the methods used to avoid this problem were solid enough to minimize outcome problems.

5. Conclusion

The post-1980-globalizers benefited largely from opening up their economy and increasingly participating in the world economy. The development numbers of this paper show that this group of countries experienced large increases in trade, income, educational attainment, FDI and remittances. Along with these positive effects of openness the problem of increasing migration numbers for the skilled people also emerged. The aim of this paper was to research if the problem of skilled migration only has a negative effect for this group of countries or that they somehow benefited from this, at first sight, harmful phenomenon. In discussing the theory on the so called brain drain phenomenon it became clear that there is more to this subject than just a detrimental effect. The new models on endogenous growth opened the eyes of the scientist with respect to brain drain and its possible positive effect on human capital. Along with the increasing quality of data, the last ten years a new stream of empirical research emerged. In tradition of these new growth theories new empirical evidence showed that old theories needed to be replaced and that possible gains from brain drain were present. Using the same approach as these new researches, this empirical investigation tried to examine the total impact of skilled migration for the post-1980-globalizers. By using three models with skilled migration, human capital and income as dependent variables the impact of brain drain was measured in a panel data analysis. Though brain drain models suffer largely from serial correlation and low data quality the results coming from this research are clear, consistent and easily explained for this group of countries. In researching the separate brain and drain affect both models show a negative impact of skilled migration on human capital as well as income growth, meaning that for the post-1980-globalizers no possible brain gain could be found. The research in this paper could not take away the feeling that brain drain has a serious constraint on this group of developing countries. Definitely the post-1980-globalizers have profited from the opening up and surely the negative effect of skilled migration is a setback for most of

these countries, especially small Caribbean countries. But when looking at the development numbers of these countries we can safely assume that the benefits coming from globalizing are larger than the negative effect coming from skilled migration. If we take a look at the numbers on income and education one can see that these developing countries made a huge step forward. And although the skilled migration seems to have detrimental impact on these developing countries, the educational level has risen and possible positive second round effects coming from return migration and remittances are not researched in this paper, while they are important when looking at the total picture. Looking at the results of this paper and other empirical outcomes most researches found more losers than winners and the loss in sum was greater than the gain. Having a group of countries containing losing areas like the Caribbean, Middle America and SSA a negative result seems more logical than contradicting. In order to confidently derive policy implications for these and other countries more research with increasing quality and quantity of data needs to be done. In order to really address the problems with respect to brain drain it is not only important to get data for a larger time period but also to get some more accurate data on age groups and sectoral compositions with respect to skilled migration. This would reveal the true migration problems of a country and makes the derivation of policy implications much easier and accurate.

6. References

Adams, R.H. (2003), "*International Migration, Remittances, and the Brain Drain A Study of 24 Labor-Exporting Countries*", The World Bank Policy Research Working Paper 3069.

Aghion, P., Howitt, P. (1992), "*A Model of Growth Through Creative Destruction*", Econometrica, 60, 323-351.

Aghion, P., Howitt, P. (1998), "*Capital Accumulation and Innovations as Complementary Factors in Long Run Growth*", Journal of Economic Growth 3, 111-130.

Barro, R.J., Lee, J.W. (2000), "*International Data on Educational Attainment: Updates and Implications*", CID Working Papers 42.

Barro, R.J., Lee, J.W. (2000), Appendix Data Tables of "*International Data on Educational Attainment: Updates and Implications*", CID Working Papers 42, available at: http://www.cid.harvard.edu/ciddata/ciddata.html

Bhagwati J., Hamada K. (1974), "*The Brain Drain, International Integration of Markets for Professionals and Unemployment*", Journal of Development Economics, 19-42.

Bhagwati J., Hamada K. (1975), "*Domestic Distortions, Imperfect Information and the Brain Drain*", Journal of Development Economics, 265-279.

Beine, M., C. Defoort and F. Docquier (2006), "Skilled Migration, Human Capital Inequality and Convergence", Manuscript, Université Catholique de Louvain-La-Neuve.

Beine, M., F. Docquier and H. Rapoport (2001), "*Brain Drain and Economic Growth: Theory and Evidence*", Journal of Development Economics 64, 275-89.

Beine, M., F. Docquier and H. Rapoport (2003), "*Brain Drain and LDCs' Growth: Winners and Losers*", IZA Discussion Paper 819.

Beine, M., F. Docquier and H, Rapoport (2008), "*Brain Drain and Human Capital Formation in Developing Countries: Winners and Losers*", The Economic Journal 118, 631-632.

Bijak, J. (2006), "*Forecasting International Migration: Selected Theories, Models and Methods*", CEFMR working paper 4.

Burns, A., Mohapatra, S. (2008), "*International Migration and Technological Progress*", Development Prospects Group, Migration and Development Brief 4.

Carrington, W.J. and E. Detragiache (1998), "*How Big is the Brain Drain?*", IMF Working paper 102.

Carrington, W.J. and E. Detragiache (1999), "*How Extensive is the Brain Drain*", Finance and Development, 46-49.

CIC, Penn World Tables 6.1, available at: http://pwt.econ.upenn.edu/php_site/pwt61_form.php

Commander, S., Kangasniemi, M., Winters, A.L. (2003), "*The Brain Drain: Curse or Boon?*", IZA, Discussion Paper 809.

CSP (2009), INSCR data page on "*Major Episodes of Political Violence and Polity*", available at: http://www.systemicpeace.org/inscr/inscr.htm

Defoort, C., (2006), "*Panel Data on Skilled Emigration Rates*", database available at: http://www.webcitation.org/getfile?fileid=3d3c11425e01ac82c82bbf19e26ae4c41d0ca42c

Dessus, S., Nahas, C. (2008), "*Migration and Education Decisions in a Dynamic General Equilibrium Framework*", The World Bank Development Economics Policy Research Working Paper 4775.

Docquier, F., O. Lohest and A. Marfouk (2006b), "*Brain Drain in Developing Countries*", Manuscript, Université Catholique de Louvain.

Docquier, F. and A. Marfouk (2006), "*International Migration by Educational Attainment (1990-2000)*", in: Ozden, C., Schiff, M. (2006), "*International Migration, Remittances and the Brain Drain*", Working Paper of the World Bank and Palgrave Macmillan 33988, Chapter 5.

Docquier, F. (2006), "*Brain Drain and Inequality Across Nations*", FNRS, IRES, Université Catholique de Louvainand IZA Bonn, Discussion Paper 2440.

Faini, R. (2003), "*Remittances and the Brain Drain: Do More Skilled Migrants Remit More?*", The World Bank Economic Review 21(2), 177–191.

Grossman, G.M., Helpman, E. (1991), "*Quality Ladders in the Theory of Growth*", Review of Economic Studies 58, 43-61.

Grubel, H.B., Scott, A.D. (1966), "*The International Flow of Human Capital*", The American Economic Review 56, 268-274.

Haque, N. U and S. Kim (1995), "*Human Capital Flight: Impact of Migration on Income and Growth*", IMF Staff Papers 42(3), 577-607.

Hemmi, N. (2003), "*Brain Drain and Economic Growth: Theory and Evidence: A Comment*", Faculty of Economics, Hokkai Gakuen University, Journal of Development Economics 77, 251– 256.

Jones, C.I. (1995), "*R&D Based Models of Economic Growth*", Journal Political Economy 103(4), 759-784.

Krueger, A.B., Lindahl, M. (2001), "*Education for Growth: Why and for Whom?*", Journal of Economics Literature 39, 1101-1136.

Kwok, V. and H.E. Leland (1982), "*An Economic Model of the Brain Drain*", American Economic Review 72, 1: 91-100.

Lucas, R.E. (1988), "*On the Meachanics of Economic Development*", Journal of Monetary Economics 22, 3-42.

Mayer, T., Zignago, S., CEPII Database on Distance Measures, Version of 3rd of May 2006, available at: http://www.cepii.fr/anglaisgraph/bdd/distances.htm

McKenzie, D, Sasin, M.J. (2007), "*Migration, Remittances, Poverty, and Human Capital:Conceptual and empirical challenges*", World Bank Policy Research, WP 4272.

McCulloch, R., Yellen L. (1975), "*Consequences of a Tax on the Brain Drain for Unemployment and Income Inequality in Less Developed Countries*", Journal of Development Economics, 249-264.

Mountford, A. (1997), "*Can a Brain Drain be Good for Growth in the Source Economy?*", Journal of Development Economics 53(2), 287-303.

Miyagiwa, K., (1991), "*Scale Economies in Education and the Brain Drain Problem*", International Economic Review 32(3).

Nelson, R.R., Phelps, E.S. (1966), "*Investment in Humans, Technological Diffusion and Economic Growth*", The American Economic Review 56, 69-75.

Nelson, R.R. (1998), "*The Agenda for Growth Theory: A Different Point of View*", Cambridge Journal of Economics, 497-520.

Rodriquez, C.A. (1975), "*Brain Drain and Economic Growth: A Dynamic Model*", Journal of Development Economics 2, 223-247.

Romer, P.M. (1990), "*Human Capital and Growth: Theory and Evidence*", NBER Working Paper 3173.

Sasin, M., McKenzie, D. (2007), "*Migration, Poverty and Human Capital*", The World Bank Migration Operational Vehicle Note 1.

Stark, O., C. Helmenstein and A. Prskawetz (1997), "*A brain gain with a brain drain*", Economics Letters 55, 227-34.

Skeldon, R. (2005), "*Globalization, Skilled Migration and Poverty Alleviation: Brain Drains in Context*", Working Paper 15.

Stark, O., Helmenstein C. and Prskawetz A. (1997), "*A Brain Gain with a Brain Drain*", Economics Letters 55, 227-234.

UN (2009), UNESCO UIS data, available trough the UN data website, available at: http://data.un.org/Browse.aspx?d=UNESCO

Vidal, J-P. (1998), "*The Effect of Emigration on Human Capital Formation*", Journal of Population Economics 11, 589-600.

Wong, K.-Y. and C.K. Yip (1999), "*Education, Economic Growth and Brain Drain*", Journal of Economic Dynamics and Control 23(5-6), 699-726.

World Bank (2006), "T*he International Migration Agenda and the World Bank: Managing Risks and Enhancing Benefits*", The World Bank.

World Bank (2009), WDI Online Database for institutional subscribers, available at: http://ddp-ext.worldbank.org

7. Appendix

7.1 Formula of the Hemmi (2003) comment

Formula 3': $$h_t(1-\bar{e}) + \frac{p\left[(1+wa^i e^{-\beta})h_t - c\right]}{1+r} + \frac{(1-p)(1+a^i e^{-\beta})h_t}{1+r} \geq h_t + \frac{h_t}{1+r}$$

The conditions made in the conclusion of Beine et al. (2001) on the brain drain model do not differ from the ones of Hemmi (2003). So in the long run the results are equivalent to those of Beine et al. (2001). But since formula 3 changes it is possible that the beneficial brain drain effect can be achieved by a rise in p even when it at first sight would be harmful for the source country. So the long run growth results are the same but the transition path to it can differ with introducing fixed costs.

7.2 Results of Beine et al. (2006 and 2008)

Country	Skilled Migration Rate [a]	Effect on the Skilled Proportion [b]
Argentina	2,7%	1,5%
Bangladesh	2,5%	0,2%
Brazil	1,4%	0,7%
China	3,0%	0,2%
Colombia	5.8%	0,2%
Costa Rica	7,1%	1,0%
Dominican Republic	14,7%	-1.2%
Haiti	NA	-4.0%
Hungary	NA	-0.1%
Ivory Coast	NA	0,2%
India	2,6%	0,3%
Jamaica	77,4%	-14%
Jordan	NA	0,7%
Malaysia	22,7%	0,1%
Mali	0,9%	0,0%
Mexico	10,3%	-0.3%
Nepal	NA	0.1%
Nicaragua	18,8%	-1.8%
Paraguay	2,0%	0,6%
Philippines	9,0%	0,1%
Rwanda	2,2%	-0,1%
Thailand	1,5%	1,0%
Uruguay	3,8%	0,4%
Zimbabwe	4,7%	-0.1%

[a] *Source: Carrington & Detragiache (1998), table 3*

[b] *Source: Beine et al. (2008), table 3*

7.3 Test Results for the Regression Models

Test Results Migration Model

Model / Test	(1)	(2)	(3)	(4)	(5)
LM Serial Correlation	0.000	0.000	0.000	0.000	0.000

[a] *The test values represent the p-values of the LM serial correlation test*
[b] *P-values close to zero indicate serial correlation, while a value higher than 0.10 indicates a rejection of the presence of serial correlation*

Test Results First HC Model

Model / Test	(1)	(2)	(3)	(4)
LM Serial Corr	0.0000	0.0003	0.0000	0.0000

Test Results Second HC Model

Model / Test	(1)	(2)	(3)	(4)
LM Serial Corr	0.825	0.907	0.809	0.853

[a] *The test values represent the p-values of the LM serial correlation test*
[b] *P-values close to zero indicate serial correlation, while a value higher than 0.10 indicates a rejection of the presence of serial correlation*

Test Results Income Model

Model / Test	(1)	(2)	(3)	(4)	(5)
LM Serial Correlation	0.3045	0.2218	0.2961	0.6635	0.2014

[a] *The test values represent the p-values of the LM serial correlation test*
[b] *P-values close to zero indicate serial correlation, while a value higher than 0.10 indicates a rejection of the presence of serial correlation*