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## **The Brain Drain Problem**

A study into the dynamics of brain drain in Europe

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# The Brain Drain Problem

A study into the dynamics of brain drain in Europe

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## Abstract

I study the cause and consequences of the brain drain in over thirty OECD countries. The theoretical model behind it is based on two period life individuals who face the choice of education in the first period and the choice to emigrate in the second. The migration database I use is the latest available and has not been empirically analyzed yet. The data are from the census of 2010/2011 and they are in a rough form; all the constructions and elaborations are my own. I therefore analyze the effect of brain drain on the human capital at home and find that the relationship is not straightforward as the previous literature confirms.

**Keywords:** Brain drain, Migration, Immigration, Skilled emigration, Human Capital

# 1. INTRODUCTION

With the expansion of globalization, migrating has become easier over the years. Starting from the end of World War II and the peaceful period afterwards, people started to move from country to country. Nowadays, migration has become a controversial issue, has been debated a lot in politics and has contributed to the radicalization of people and masses. In fact, there is a lack of knowledge around the subject, especially regarding numbers and figures.

In 2014 for the first time after the 2007 economic crisis, the migration flow increased, reaching the pre-crisis level (OECD, International Migration Outlook 2015, 2015). During these seven years, migration trends decreased mainly because of the drop in free movement migration and family migration. Instead, the mobility of international students is increasing since 2000 and it is an important feature that leads to some permanent stay (OECD, International Migration Outlook 2010, 2010).

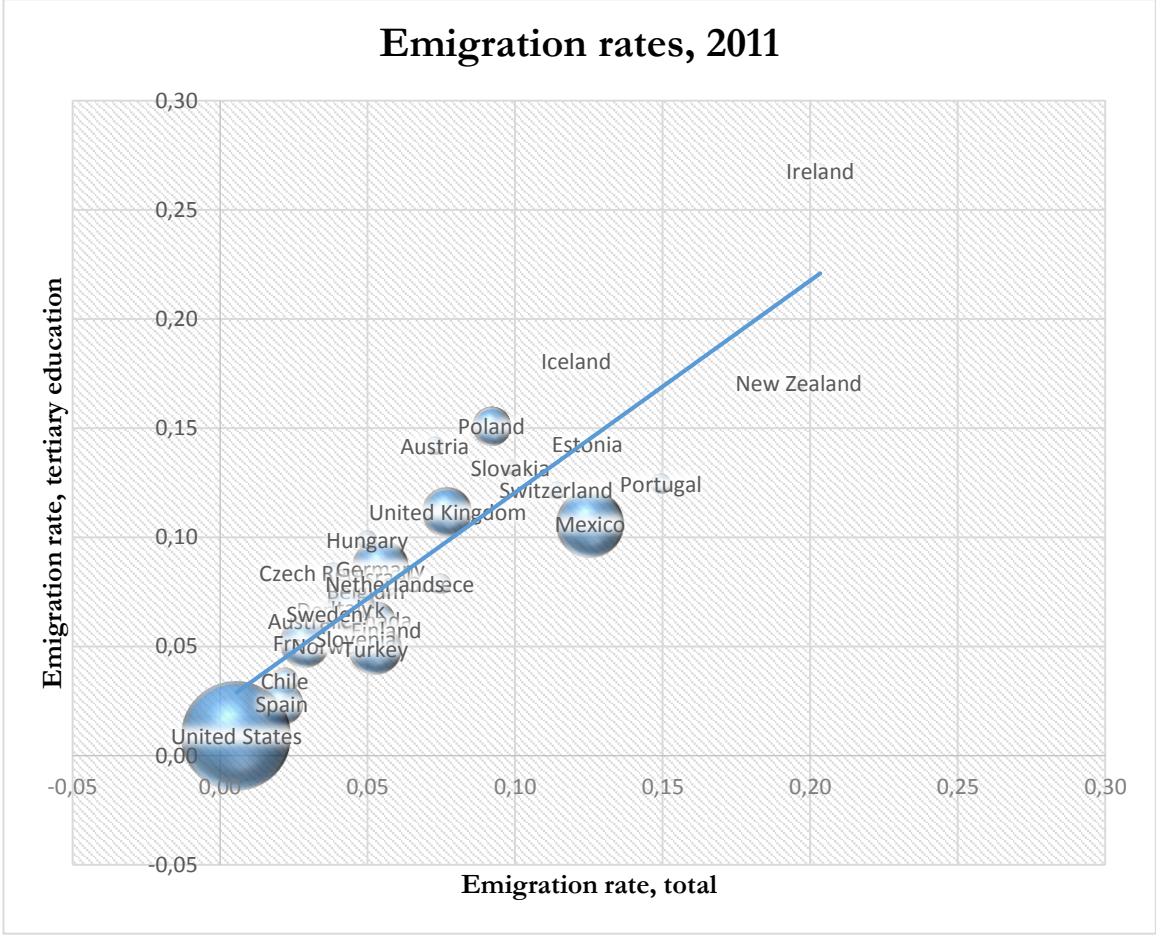
There is a particular migration phenomenon called brain drain, which is the migration of skilled workers. In recent years, the skilled workers migration has received a lot of attention from policy-makers, in particular because the movement of labor across borders can lead to the transmission of ideas around the globe. Therefore, many OECD countries started a battle to attract qualified workers in order to stimulate economic growth. An important feature of this particular migration that needs to be mentioned is the fact that the migration of skilled individuals is generally higher on average than the total migration. Of the thirty-two countries I have analyzed in my thesis, over twenty of them present skilled emigration rates greater than the emigration rate for all adults, as shown in Figure 1 below.

The purpose of my thesis is to research whether the migration of skilled workers can affect society at home and in which way. This research question has been debated a lot in literature which has produced a lot of papers using OECD's 2000/2001 census migration database. However, the majority of my work consists in analyzing the new data collected in the 2010/2011 census, which, to my knowledge, has not yet been empirically analyzed. The theoretical framework proposed is a simplified and modified version of the framework Beine et al. (2006) used in their paper. The individuals face two decisions in a two period life: whether to invest in education in the first period and whether to migrate in the second. If they decide to migrate, the human capital in the home country will suffer a reduction. As regards human capital of a country, I mean a measure of

economic value, which evaluates the skills and education of the population<sup>1</sup>. The concept of human capital involves that the presumption that not all labor is equal; on the contrary, employees are a resource that can be improved with investment in education.

I then run three regression models to test my hypothesis. The first one is to test whether human capital is affected by skilled migration, the second to test if skilled migration is influenced by human capital and the third to understand whether economic growth is affected by human capital and skilled migration. What I found is in line with the previous literature on the subject. The results are not straightforward for the first two regressions and the relationship seems to run from skilled migration to human capital and not backwards. Economic growth is only affected by skilled migration and not by human capital. However, the latter result may be biased by measurement errors and specification issues.

Figure 1 - Emigration rates



<sup>1</sup> www.investopedia.com

The remainder of the thesis is as follows. In the next section, I discuss the theoretical and empirical literature review regarding the topic of migration and brain drain. In Section 3, I explain in detail the theoretical framework used to model the following regressions. In Section 4, I present the empirical analysis, describing the data sources, descriptions and issues, some variable constructions, the three regression models (human capital, highly-skilled emigration and economic growth) and results. In Section 5, I conclude with a brief discussion about the results, a possible economic interpretation of them and a conclusion with the main implication of brain drain.

## **2. LITERATURE REVIEW**

The theories behind the concept of brain drain are various and they have been developing over the years. Studies on the subject are quite recent and the term “brain drain” was coined in 1963 by the British Royal Society in order to describe the outflow of scientists and technologists from UK to Canada and the United States during the 50s and 60s (Giannoccolo, 2009).

The terminology around brain drain is numerous, starting from the different definitions of brain drain. In fact, in an OECD Report (1987), the concepts of brain exchange and brain drain waste are mentioned for the first time; the first expression means a circular migration of workers, who return to the home country with more skills than before leaving, and the second means a waste of skills of the worker, who is employed for a position that requires less skills than he possesses. Brain return is mentioned for the first time in a paper of Glaser (1978); it means that students and skilled workers are more committed to return to the home country.

In the early studies, all the literature about the subject was oriented on the negative effects on the sending country due to the loss of human capital (Romer, Lucas). Only in the late 90s, some papers started to analyze a possible positive outcome for sending countries, so that brain drain became brain gain. The reasoning behind this is that in a poor country with a low human capital return, the incentive of acquiring education is low; however, education is highly valued in the rest of the world and when migration is allowed, the population has incentives to invest in education. Overall, even if some of the educated people emigrate from the poor country, the average education level of the population will increase (Beine, Docquier, & Rapoport, 2001).

The brain drain has been extensively studied with various theoretical models, which try to explain the phenomenon through push and pull effects, human capital, growth and brain gain (Giannoccolo, 2009).

## **2.3 2.1 THEORY ON MIGRATION, BRAIN DRAIN AND HUMAN CAPITAL**

### **Migration**

The brain drain is a particular migration, therefore, the oldest theoretical models on the subject used migration theories. At a macroeconomic level, factor movements drive the migration decision. According to the neoclassical theory, migrations take place because of geographical differences in labor between regions (Lewis, 1954). The migration flows will occur from the country abundant in labor to the country scarce in labor. Harry & Todaro (1970) also analyzed the migration theory through the neoclassical model. However, their focus was on the labor movements as a consequence of wage differentials between regions or countries. They formulated a two-sector model of rural-urban migration, in which they recognized that the minimum urban wage was higher than the agricultural one.

The neoclassical theory encompasses also the microeconomic aspect of migration. Sjaastad (1970) is one of the first researches that tried to model the individual migration decision. The individual maximizes his expected future income net of all the costs related to the migration. The decision of whether to migrate is influenced by factors like unemployment, wage differentials, physical and psychological migration costs, qualifications previously obtained (Borjas, 1987) (Sjaastad, 1970).

A new innovative, migration framework was proposed by Lee (1996), different from neoclassical theories. According to his paper, the decision to migrate is influenced by economic, environmental, cultural and socio-political factors. Therefore, migrations happen not only because of opportunities in the destination, but also because knowledge of the destination facilitates the movements. This analytical framework exposed by Lee is referred to as the “push-pull” model and it is often used in empirical models to explain migration, in particular skilled migration.

### **Growth and Human capital**

The first approaches to the subject were made with the so-called New Growth Theory, in which economic growth is the result of endogenous forces such as increasing returns associated with new knowledge. The contribution of Romer (1986) and Lucas (1988) is important, as they study the investments in human capital as a positive spillover effect, which stimulates the economic growth.

Human capital refers to the education, training, social and personal abilities, which will influence the future real income of the individual. Even if the human capital is a sum of factors, in most papers it has been addressed as education attainment (Becker, 1962). Therefore, some researches started to study the relationship between education and growth. Theoretically, and until this point, literature considers brain drain damage detrimental for sending countries; furthermore,

the negative effect of it has been verified empirically (Giannoccolo, 2009). Therefore, for this reasons, some papers tried to redistribute the welfare through countries affected by the brain drain with a tax paid by emigrants (Bhagwati, 1976). This tax was meant for the less developed countries facing brain drain towards developed countries.

The negative effect related to skilled emigration is not only the loss of human capital for the sending countries. In addition to the risks previously mentioned, the destination country may not recognize the migrant's skills (Pires, 2015). This is called brain waste and the main consequences are a decrease in education investments, lower chances of a positive self-selection and less possibility of a positive brain drain (brain gain). The theory explained in the paper of Pires (2015) is worth mentioning because he considered the returns on education at an uncertain destination.

### **Brain gain**

Recent studies have theorized the possibility of a beneficial brain drain, also called brain gain. This is possible when the average level of human capital is higher in the economy open to migration than in a closed economy (Beine, Docquier, & Rapoport, 2001). They used an endogenous growth model of two periods with heterogeneity of the individuals; economic growth is due to the human capital transmission between generations. At the theoretical level, the brain gain is possible in two cases: the first case is when the economy was previously closed or underdeveloped and migration probabilities are not too high; the second is when the economy had already high growth rates and migration probabilities are intermediate.

## **2.4 2.2 PREVIOUS EMPIRICAL STUDIES**

### **Negative effects**

The phenomenon of brain drain is usually considered among one of the negative aspects of international migration, due to the loss of skilled workers, ideas, innovation and, most important, human capital. The OECD Database on Immigrants and Expatriates is one of the most complete databases used to study skilled emigration. However, this database has its limits, such as lack of information on the brain drain to non-OECD countries and on the area of expertise of the stock of skilled emigrants (OECD, *The Brain Drain and Negative Social Effects: When is the Home Country Hurt?*, 2007). From this study, we learn that the countries most affected by the brain drain are regions of Central America, Southwest Asia, Eastern Europe and Africa.

Since human capital is very important for the growth process, brain drain might seriously affect the development of countries which experience it. Studies have found that in small countries (population below 1.5 million people in 2000), the level of brain drain is extremely high: the skilled emigration rate is 43.2% (Beine, Docquier, & Schiff, 2008). The research also shows that brain



drain also affects high-income countries in the same proportion as developing countries. The regression performed by Beine et al. (2008) has the emigration rate of skilled workers as dependent variable; it is calculated as the ratio of skilled emigrants over the sum of skilled residents and skilled emigrants. The explanatory variables used are GDP per capita and its square value, geographical distance, colonial links, linguistic proximity, ethnic diversity in origin countries, socio-political environment and size of the country of origin. They conclude that small countries are the main losers from brain drain because of the higher sensitivity to push factors, due to the country size.

The economic theory suggests that education and a good schooling system can be a catalyst for economic growth. However, other papers observe that many highly skilled professionals emigrate from developing countries because of the lack of opportunities. Brain drain can also be detrimental because investments in the schooling system may not lead to a faster economic growth, unless policies against brain drain are implemented (Carrington & Detragiache, 1999). This paper tries to estimate the magnitude of brain drain and which countries are the main receivers and sources in the US and OECD countries. One of their discoveries was that on average, immigrants in the US are more educated than the average person in their home country, meaning that the average education of immigrants was very high. They also study skilled immigration in OECD countries. However, due to the lack of precise data about the education of immigrants, they assume the same distribution of US skilled migrants. Overall, they find higher migration rates for highly educated migrants.

Usually, the migration data available are not detailed enough to provide a clear picture about the type of migration, meaning that very few data are collected on the skilled and unskilled migration flows. In addition, due to the difficulty in measuring emigration flows, most of the databases focus on immigration data. Dumont & Lemaître (2005) tried to use the newly available database from the 2000 census on the population to build a new database on migration. In this paper there are four major findings: first, the foreign-born rate in OECD countries is higher than the foreign population rate; second, in the majority of OECD countries, the skilled immigrants rate is higher than the skilled emigrants rate; third, it is easier for high-skilled workers to emigrate; and last, for non-OECD countries skilled migration has different effects. There are three different methods to estimate the expatriates: statistics of people registered in embassies, emigration surveys in the origin countries and immigration surveys in the receiving countries. This paper, however, does not rely on the methods described above and instead uses the data on the foreign-born population by place of birth in OECD countries. This method has some downsides, such as people who do not report their place of birth in the census and people who were born abroad, but are citizens of their current country. The results presented in the paper, consequently, have to be

considered a lower bond, due to the missing observations. The emigration rate calculated here, based on the OECD database on migration, is the foreign-born population from the country of origin  $i$  and level of education  $l$  divided by the sum of foreign-born and native-born population of the same country and level of education (Dumont & Lemaître, 2005). This method will be carefully explained in the data section, as I will use it to calculate the emigration rate variable in my regressions.

### **Positive effects**

The empirical work on the subject of brain drain is very recent. The paper by Beine et al. (2001) is one of the first on the matter. This study observes the conditions under which beneficial brain drain is possible. The reasoning behind this is that in a poor country with a low human capital return, the incentive of acquiring education is low; however, education is highly valued in the rest of the world and when migration is allowed, the population would have incentives to invest in education. Overall, even if some educated people will emigrate from the poor country, the average education of the population will increase. At the empirical level, they show that beneficial brain drain cannot be excluded because education decisions are also affected by the migration prospect (Beine, Docquier, & Rapoport, 2001).

Recent data about brain drain show that the skilled emigration rate is higher in developing rather than developed countries (Beine, Docquier, & Rapoport, Brain Drain and Human Capital formation in developing countries, 2008). The consequences of this phenomenon are obvious for the receiving countries: the level of human capital increases along with labor productivity. As regards the sending countries, the effects are not clear. In fact, the effects can be both positive (return on migration, remittances) and negative (welfare of the workers in the origin countries decreases). The aim of this paper is to show that brain drain in poor developing countries can be a catalyst for education investments in the sending countries. It finds evidence of the existence of a positive relationship between the rate of skilled emigration and the human capital level at home. In addition, countries with an initial low level of human capital combined with a low skilled emigration rate experience a beneficial brain drain and vice versa. However, overall there are more loser than winner countries.

Other studies have also investigated how, and under which circumstances, brain drain is beneficial for sending countries. Some of the researches in this specific subject have demonstrated empirically that brain gain is possible due to an increase in human capital, investments in education, remittances, brain circulation and return migration. All the major studies on this subject use cross-section regression because of the lack of data availability. In fact, they may suffer from some problems related to the misspecification biases and unobserved heterogeneity. Beine et al. (2011)

aim to analyze brain gain with a panel database. They use a  $\beta$ -convergence regression model of human capital accumulation. The results confirm the existence of brain gain; in particular, the phenomenon is present in low-income countries, in which migration prospects have a significant impact on the decision of education.

### 3. THEORETICAL FRAMEWORK

As mentioned previously, brain drain is the migration of skilled workers from their native country to a foreign one. In other words, brain drain is a transfer of human capital from one country to another. The theoretical framework, presented here, is an adjustment of the one described by Beine et al. in their paper (Beine, Docquier, & Rapoport, 2008). The modifications I apply relate to the liquidity constraints on education expenses; in their paper Beine et al. consider only poor developing countries in which credit constraints are sometimes binding for the attainment of education. Since in my research I will analyse OECD countries, I can safely assume that there are no liquidity constraints and therefore I will not consider them in the model.

The model, presented here, is based on the neoclassical economic theory, which relies on the wage differential between the receiving and the sending country. The migration is driven by a disequilibrium in wages between regions: when the wage differential is positive, workers migrate from the low wage country to the high wage country to re-establish the equilibrium. In this particular case, the neoclassical theory can explain at a microeconomic level the international migration phenomenon. The individual migrates after a rational calculation of cost-benefit, in which there is a positive return in migration (Massey, et al., 1993).

I consider an economy which produces goods and human capital; individuals maximize their utility function subject to a budget constraint. The equation that describes the amount of goods produced in the economy is the following

$$Y_t = w_t L_t$$

where  $Y_t$  is the output,  $w_t$  is the wage rate and  $L_t$  is the unit of labor measured in efficiency units. Each individual is born with one unit of human capital endowment. Individuals live for two periods (youth and adulthood) and they have to make two decisions, one in each period: whether to spend money on their education and whether to migrate. The education program  $e$  is unique and the level of education is positive related to the level of human capital. The cost of education  $c$  is decreasing in personal ability; the number of efficiency unit is  $h > 1$  for the individual who has chosen education.

The second decision the individual has to face is whether to migrate or not; skilled workers emigrate with probability  $p$  while unskilled workers emigrate with probability  $\underline{p}$ . Since skilled workers are more likely to migrate than unskilled ones (Borjas, 1987), I assume  $p > \underline{p}$ . For the sake of simplicity, I assume  $\underline{p} = 0$ , while regarding  $p$ , I assume that it is exogenous, i.e. the probability of migration for skilled workers is independent from external factors.

As said before, the wage earned in the home country in both periods is  $w$ , while the wage earned in the destination country is  $w^*$ . Since skilled workers will migrate to a more technologically advanced country, I assume that  $w^* > w$ . The education decision is the following:

$$w_t - c + (1 - p)w_{t+1}h + pw_{t+1}^*h > w_t + w_{t+1}$$

The individual will choose to invest in education when the expected earnings with education are higher than the earnings without education. Therefore, the critical threshold is:

$$c < c_{p,t} \equiv w_{t+1}(h - 1) + ph(w_{t+1}^* - w_{t+1})$$

The threshold is increasing with the wage differential ( $w_{t+1}^* - w_{t+1}$ ), meaning that the difference between the wages in the two countries is higher and the incentive to invest in education in order to migrate is also higher. The threshold for the probability of migration  $p$  is also increasing, meaning that the education choice is going to be preferred in the case of a higher probability of migration.

At this point, I want to insert the human capital in the model. Therefore, in order to measure the human capital of a country, I denote  $H_t$  as the rate of educated people in period  $t$  and  $H_{a,t}$  and  $H_{p,t}$  respectively as the rate of educated people in period  $t$  before and after the migration occurs. The individuals choosing education are denoted as:  $H_{a,t} = F(c_{p,t}^*)$ , where  $c_{p,t}$  is the education threshold. For simplicity, I assume that unskilled workers do not migrate. The skilled workers who remain in the country are then measure as:

$$H_{p,t} = \frac{(1 - p)H_{a,t-1}}{1 - pH_{a,t-1}}$$

If we take the first derivative, we have the equilibrium in the steady state:

$$\frac{\partial H_p}{\partial p} = \frac{(1 - p)\partial H_a / \partial p - H_a(1 - H_a)}{(1 - pH_a)^2}$$

Looking at the equation above, some observations can be made. First of all, this theoretical framework allows for the possibility of beneficial brain drain in case  $\partial H_p / \partial p$  is positive for some

values of  $p$ , which means that the proportion of individuals educated that remain in the country of origin increase. Second, for a positive  $\partial H_p / \partial p$  at the current emigration rate, the rate of skilled emigration and the human capital formation have a positive relationship. Lastly, in order to see the overall effect of skilled migration on the formation of human capital, I compare the proportion of human capital after the migration in an open economy and a closed one; given that  $\tilde{H}$  is the level of human capital in the closed economy, we have beneficial brain drain if  $H_p > \tilde{H}$ . However,  $\partial H_p / \partial p$  is neither positive nor negative *a priori* and depends on the wage differential and on the probability of skilled migration  $p$ ; if  $p \rightarrow 1$ , then  $\partial H_p / \partial p$  is negative, meaning that when all the skilled workers migrate, the level of human capital in the country of origin is decreasing. All these observations lead to the following equation:

$$y_i = \beta_i + \beta_1 x_i + \varepsilon_i$$

where  $\beta_i$  captures the country specific effects, while  $x_i$  and  $y_i$  are respectively the skilled emigration rate and the human capital formation parameter. According to the existing literature, the human capital formation is negatively affected by the skilled emigration rate in the case of developed countries (OECD, *The Brain Drain and Negative Social Effects: When is the Home Country Hurt?*, 2007), while an increase in the human capital is possible in the case of developing countries due to the skilled migration (Beine, Docquier, & Rapoport, 2001).

### 3.3 HYPOTHESIS

Based on the theoretical framework previously described, I expect to find a positive relationship between migration opportunities and individuals who invest in education or are highly-educated (hypothesis I). Furthermore, I expect that the migration of highly skilled people has a negative effect on the economy growth (hypothesis II). These two hypotheses are actually the most important questions in the brain drain literature so far.

## 4. EMPIRICAL ANALYSIS

### 4.1 DATA: DESCRIPTION AND SOURCES

The aim of this thesis is to perform a study about brain drain using the most recent database available on the subject. Starting from 2000, the OECD started to collect data based on population censuses of OECD countries. This data collection made it possible to calculate emigration rates by skill level and therefore study the brain drain problem.

Here, I use the Database on Immigrants in OECD countries (DIOC) for 2010/11<sup>2</sup>, which is based on the population census, administrative registers, national statistical authorities and the Labour Force Surveys (LFS) provided by Eurostat. The destination countries are thirty-two<sup>3</sup>, while the origin countries are more than two hundred. The three core variables in the database are the country of residence, the country of birth and educational level. The other variables present in the database are demographic characteristics such as age and gender, region of birth, occupations, field of study and labor market status. In particular, the file I analyzed has the following variables: country of residence, country of birth, region of birth, sex, age, educational attainment, labor force and indication of whether foreign-born.

*Table 1 - Data sources of the DIOC 2010/2011 Database*

Sources description		Sources description	
Australia	Census, 2011	Israel	European Labour Force Survey 2011
Austria	European Labour Force Survey 2010/2011	Italy	Census, 2011
Belgium	Census, 2011	Luxembourg	Census, 2011
Canada	National Household Survey NHS 2011	Mexico	Census, 2010
Chile	The National Socio-Economic Survey, 2011	Netherlands	Census, 2011
Czech Republic	Census, 2011	New Zealand	Census, 2013
Denmark	Population Register 2011	Norway	Population Register 2011
Estonia	Census, 2011	Poland	Census, 2011
Spain	Census, 2011	Portugal	Census, 2011
Finland	Population Register 2010	Slovakia	Census, 2011
France	Census, 2011	Slovenia	Census, 2011
Germany	Micro Census, 2011	Sweden	Population Register 2010
Greece	Census, 2011	Switzerland	European Labour Force Survey 2010/2011
Hungary	Census, 2011	Turkey	European Labour Force Survey 2010/2011
Iceland	Census, 2011	United Kingdom	Census, 2011
Ireland	Census, 2011	United States	American Community Surevy 2007-2011

An important variable used here is the human capital. This variable is of my own calculation and is the rate of people that have obtained tertiary education over the population aged 25 or above.

<sup>2</sup> [www.oecd.org/migration](http://www.oecd.org/migration)

<sup>3</sup> The OECD countries included are Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.

The variable is built such that it does not contain international students. Tertiary education means a minimum ISCED level of 5, which correspond to the Bachelor<sup>4</sup>.

For all the other variables used in the regression models, the sources and descriptions are in the table below.

*Table 2 - Variable sources and definitions*

<b>NAME</b>	<b>VARIABLES</b>	<b>SOURCE</b>	<b>DESCRIPTION</b>
<b>area</b>	Country size	WDI (World Bank)	Land area is a country's total area (sq. km)
<b>debt</b>	Central government debt	WDI (World Bank)	Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date over the GDP (%).
<b>dens</b>	Population density	WDI (World Bank)	Population density is midyear population divided by land area in square kilometers (people per sq. km).
<b>eduexp<sup>5</sup></b>	Educational expenditure	WDI/UNESCO	Government expenditure on education as % of government expenditure
<b>exp</b>	Exports of goods and services	WDI (World Bank)	Exports of goods and services represent the value of all goods and other market services provided to the rest of the world measured as % of GDP
<b>FDI</b>	Foreign direct investment	WDI (World Bank)	Foreign direct investment are the net inflows of investment to acquire a lasting management interest as % of GDP.
<b>GDP</b>	Gross Domestic Product	WDI (World Bank)	GDP measured in current US\$
<b>GDPgrw</b>	Gross Domestic Product growth	WDI (World Bank)	Annual percentage growth rate of GDP at market prices based on constant local currency (%).
<b>GDPpc</b>	GDP per capita	WDI (World Bank)	GDP per capita is gross domestic product divided by midyear population measured in current US\$
<b>GDPpcgrw</b>	GDP per capita growth	WDI (World Bank)	Annual percentage growth rate of GDP per capita at market prices based on constant local currency (%).

<sup>4</sup> For more information regarding ISCED levels see: <http://www.uis.unesco.org/Education/Documents/isced-2011-en.pdf>

<sup>5</sup> In case of missing observations, for this variable I took the data of the following year (2011); this is the case of Greece, Luxemburg and Turkey.

NAME	VARIABLES	SOURCE	DESCRIPTION
<b>income</b>	Net national income growth	OECD data	Net national income is the gross domestic product plus net receipts of wages, salaries and property income from abroad measured in current US\$.
<b>LE</b>	Life expectancy at birth	WDI (World Bank)	Life expectancy at birth indicates the number of years a newborn infant would live.
<b>open</b>	Openness ratio	OECD data	The openness ratio measures the total volume of trade over the GDP.
<b>pop</b>	Population	WDI (World Bank)	Total population counts all residents regardless of legal status or citizenship.
<b>rem</b>	Personal remittances	WDI (World Bank)	Personal remittances comprise personal transfers and compensation of employees measured as % of GDP.
<b>unempl</b>	Unemployment	WDI (World Bank)	Unemployment refers to the share of the labor force that is without work but available for and seeking employment (%).

## Constructions

Emigration is particularly difficult to measure; it is harder to count people leaving a country than those arriving. The extent of migration movements is usually measured in two different ways: registrations in foreign embassies and surveys, both in origin and in receiving countries. However, all these methods have their disadvantages. First, registration in embassies overseas is not always compulsory and the data may vary a lot across countries with different legislations. Second, some countries have implemented surveys in origin countries asking households how many members of the family were living abroad; the data collected with this method were biased for a number of reasons, such as short stays abroad, international students and of course the entire family unit moving abroad (Dumont & Lemaître, 2005).

The measure I have chosen to use in my thesis for emigration is the following. The expatriate community is defined as foreign born individuals by place of birth in all OECD countries; the emigration rate is then calculated as the stock of emigrants over the sum of the residents and emigrants:

$$emigr_i = m_i = \frac{EM_i}{EM_i + N_i}$$

Where  $m_{i,t}$  is the emigration rate,  $EM_{i,t}$  is the stock of foreign-born individuals and  $N_{i,t}$  is the stock of native individuals of country  $i$  at time  $t$ .



The emigration rate calculated above can also be produced by level of educational attainment and country of origin. It is calculated by dividing the foreign-born population from country of origin and educational attainment or skill level  $s = l, h$ , by the total native-born population<sup>6</sup> of the same country of origin and educational attainment.

$$emigrHS_i = m_i^s = \frac{EM_i^s}{EM_i^s + N_i^s}$$

This estimate, even if it is the more accurate, has its problems. First, is it difficult to identify foreign-born persons who were citizens in their resident country when born, for example, children born in foreign countries with national parents. Second, some people did not specify their country of birth in national census (Dumont & Lemaître, 2005). Therefore, the estimates in this paper have to be considered as a lower bound.

### **Data issues**

There are some issues with the data that need to be discussed. Since I used the raw data of the DIOC 2010/2011 database, I had to do my own calculation regarding the emigration rate, including foreign and native-born, human capital and skilled migrants. I have come across some data issues that I am going to describe. Regarding the variable country of birth, the major biases are due to the imprecise information and confidentiality issues. Sometimes it is defined at a continental level and sometimes it is defined as other (OTH) if too imprecise or unknown (UNK) and it cannot be determined. In some cases, such as Japan, data based on the country of birth are not available and instead migrants are defined on a citizenship-based method; also, the data regarding the native-born population do not specify the level of education. Therefore, Japanese data cannot be included in the analysis as they cannot be compared to the other countries' data. In the United States, the data on the countries of origin with less than 15.000 populations are not available because of the American Community Survey regulations.

Another relevant issue is the lack of information about the educational attainment for individuals aged 15 or older, which is critical for my research. In some countries, the percentage of people with unknown education is higher than 10%<sup>7</sup>.

## **4.2 EMPIRICAL MODEL**

In order to confirm or reject the hypotheses previously mentioned, I perform three regressions using a cross-section analysis. The regressions are the following:

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<sup>6</sup> The total native-born population is the sum of the resident native born and the expatriates of the same country.

<sup>7</sup> The highest rates are: Luxembourg (19%), Japan (12%), Australia (12%) and New Zealand (11%).

- (I).  $HC_i = \beta_0 + \beta_1 emigrHS_i + \beta_2 eduexp_i + \beta_3 rem_i + \beta_4 GDPpc_i + \beta_5 unempl_i + \beta_6 pop_i + \varepsilon_i$
- (II).  $emigrHS_i = \beta_0 + \beta_1 GDPpc_i + \beta_2 pop_i + \beta_3 dens_i + \beta_4 eduexp_i + \beta_5 rem_i + \beta_6 open_i + \beta_7 unempl_i + \varepsilon_i$
- (III).  $GDPgrw_i = \beta_0 + \beta_1 emigrHS_i + \beta_2 HC_i + \beta_3 income_i + \beta_4 le_i + \beta_5 FDI_i + \beta_6 eduexp_i + \beta_7 unempl_i + \varepsilon_i$

The above regressions are inspired by the work of Beine et al. (2001). For regressions (I) and (II), I begin with the estimation of the effect of the highly skilled emigration on the dependent variable and I consequently add all the other control variables in order to test the robustness of the results. Furthermore, I perform several tests in order to check for heterogeneity and endogeneity; I do not check for autocorrelation since my data do not have the time dimension. The method used in this research is the Ordinary Least Squares method for cross-section. I also perform the Breusch-Pagan and the White-test in order to check for heteroskedasticity. After finding that heteroskedasticity was the main problem, I performed all the regressions using OLS with HAC (heteroskedasticity and autocorrelation consistent) standard errors.

### **Model (I): human capital**

I use regression (I) to test the first hypothesis of positive relationship between the human capital and the skilled emigration rate. The dependent variable is  $HC_i$ , which measures the human capital as the rate of people that have obtained tertiary education over the population aged 25+.

The key independent variable is the skilled emigration rate,  $emigrHS_i$ . According to the theoretical model, the relationship between human capital formation and skilled emigration is neither positive nor negative *a priori* and depends on the wage differential and on the probability of skilled migration. However, the previous empirical studies have found that the human capital is increasing with the skilled emigration rate in case of small and underdeveloped countries. This means that in my analysis I expect to have a negative relationship, as I am considering only OECD countries, which are by definition the richest.

The cost of acquiring education is included in the regression using the variable  $eduexp_i$ . From the literature, I expect that an increase in the government expenditure in education will be followed by an increase in human capital formation, as the cost of education is lower for individuals.

In this model, remittances are considered one of the positive externalities of emigration, as they are a transfer of income from receiving to sending countries. This variable is denoted as  $rem_i$

and since it is an inflow of income, I expect it to increase the human capital formation as it encourages investments in education and technology. Another income-related variable in the regression is  $GDPpc_i$ , which measures the GDP per capita. An increase in GDP per capita may lead to a less binding income constraint, which means that individuals have more resources to invest in human capital formation.

### **Model (II): highly skilled emigration**

For the second regression, the dependent variable is  $emigrHS_i$ , which is the highly skilled expatriate emigration rate calculated by me (for further specifications see the next section). This variable represents the migration incentives of the highly educated fraction of the population. The independent variables described next are:  $GDPpc_i$ ,  $pop_i$ ,  $dens_i$ ,  $eduexp_i$ ,  $open_i$  and  $unempl_i$ .

In this model, I expect the variable GDP per capita, measured by  $GDPpc_i$ , to be negatively correlated to the emigration rate. Individuals would be motivated to migrate when the GDP per capita is low, as the neoclassical model of migration predicts.

The variable  $pop_i$ , which measure the population size, is used as a proxy for immigration quotas: these quotas are less binding for small states than larger ones (Beine, Docquier, & Rapoport, 2001). Therefore, I expect the population variable to be negatively correlated to the emigration rate, which may indicate that immigration constraints are binding.

In order to measure the cost of acquiring education, largely described in the theoretical model, I use two different variables. The first one is  $dens_i$ , defined as the population density. The reasoning behind this is that in a high population density country, the distance to schools is less and so is the opportunity cost of education; a higher population density leads to a lower education cost, which increases the expected earnings with education. From the theoretical model, it follows that educated people have a higher probability to migrate and therefore I expect population density to be positively related to the highly skilled emigration rate. The second one is  $eduexp_i$ , which measures the public government expenditure in education. The higher the government expenditure in education, the lower the cost of acquiring education for the individual. This means that I also expect this variable to be positively related to the highly skilled emigration rate.

The variable  $open_i$ , which is the openness ratio of a country, is expected to be positively related to the emigration rate as countries which trade more are expected to have less restriction on the migration policies. Unemployment,  $unempl_i$ , as the literature confirms, is expected to be a push factor for skilled emigration. And last, the variable  $rem_i$ , representing the remittances, is expected to be positively related to the emigration rate as they represent income from the destination to the home country.

### **Model (III): economic growth**

The last regression is used to test the second hypothesis regarding the relationship between economic growth and brain drain. The dependent variable I use is  $GDPgrw_i$ , measured as the annual growth of GDP per capita, and the key regressor is  $emigrHS_i$ , the skilled emigration rate. As the hypothesis II states, I expect the economic growth to be negatively related to the emigration rate. This is because of the loss of human capital, which is a negative spillover effect of the migration and detrimental for economic growth.

In this regression, I also add the starting level of human capital accumulation in the country,  $HC_i$ . Since human capital is known as a positive factor for economic growth, I expect it to have a positive relationship with the dependent variable.

Other regressors in the model (III) are the following. The initial level of income,  $GDPpc_i$ , is in the regression as I expect it to be a positive influence on economic growth. The variables  $FDI_i$ , Foreign Direct Investments,  $income_i$  and  $eduexp_i$  are expected to have a positive effect on economic growth as they stimulate investments and improve human capital. The last variable considered in this model is the life expectancy, denoted by  $le_i$ . It is measured as the expected life length at the moment of birth and it may indicate the socio-economic development of the country. Of course, the higher the life expectancy, the lower is the economic growth as the population is older and less productive.

## **4.3 RESULTS**

The econometric approach used is the OLS method with HAC (heteroskedasticity and autocorrelation consistent) standard errors. The first two models are estimated completely in logs, while the third one is estimated in levels due to the negative values of some growth variables. The issues I encountered regarded mainly the heteroskedasticity problem of a non-constant variance across the cross-section data, which I addressed using the Newey-West standard errors. The results of the three regression models are presented in the output tables in the text below.

### **Human capital (I)**

The first regression to consider is the human capital model. The purpose of this regression is to verify the determinants of the human capital formation according to the literature. Table 3 shows the results of the human capital model.

The first important consideration to be made regards the emigration skill rate. Since the human capital variable is measured as the rate of people that have obtained tertiary education over the population aged 25 or above, I would expect that the highly skilled emigration is negatively

correlated to the human capital formation. This is because individuals with tertiary education that emigrate are diminishing the stock of human capital left in the origin country. Many empirical researches have studied the phenomenon and have concluded that overall the major effect of the highly-skilled emigration is detrimental for the sending countries. The only exception is the observed effect of brain gain, possible with very specific characteristics that are not present in my database. In the results table below, the variable highly skilled emigration is positive related to the human capital; however, the variable is mainly insignificant, except for the regression (3) in which the p-value is 0.09. Overall, I cannot exclude a positive relationship between human capital and skilled emigration rates, even though miscalculation errors and unobserved biases must be accounted for.

*Table 3 - Human Capital results*

<b>Dep variable: HC</b>	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
<b>constant</b>	-5,2205 0,0000	-3,6015 0,0008	-3,9029 0,0001	-3,8061 0,0015
<b>emigrHS</b>	0,0639 0,3102	0,0978 0,0888	0,0815 0,1257	0,0888 0,2385
<b>GDPpc</b>	0,3942 0,0000	0,4275 0,0001	0,4499 0,0000	0,4495 0,0001
<b>rem</b>	-0,0721 0,0009	-0,0769 0,0007	-0,0684 0,0051	-0,0654 0,012
<b>unempl</b>	0,2511 0,0762	0,3932 0,0023	0,4111 0,0006	0,4079 0,0006
<b>eduexp</b>		0,7181 0,0000	0,6870 0,0001	0,6559 0,0006
<b>debt</b>			-0,0751 0,0849	-0,0815 0,2113
<b>open</b>				-0,0501 0,6487
<b>pop</b>				-0,0090 0,8207
<b>R<sup>2</sup></b>	0,4416	0,6171	0,6386	0,6411
<b>Adjusted R<sup>2</sup></b>	0,3588	0,5434	0,5519	0,4943
<b>F-stat</b>	5,3376	8,3794	7,3632	4,3666
<b>Prob</b>	0,0027	0,0001	0,0001	0,0023
<b>N obs</b>	32	32	32	32
<b>Countries</b>	32	32	32	32

P-value is under the respectively coefficient.

As expected, the wealth of a nation contributes to the increase of education attainment, as shown by the GDP per capita positive relationship with the human capital variable, significant in all four regressions.

Remittances are significant and negatively related to human capital formation. This result is not supported by the literature and it is rather unexpected. Remittances can be interpreted as an income and in that respect, income stimulates education expenses and therefore human capital formation. However, in this case, as the relationship with human capital is negative, I am inclined to interpret the effect as reverse causality.

Unemployment is positive and significant: this finding is counter-intuitive. How the unemployment rate stimulates human capital formation? The answers to this question are two. First of all, it is possible that these variables are related in a time series analysis and in the long run a high unemployment rate stimulates the education investment. Second, the two variables are not economically related in this regression and cannot be interpreted accordingly.

Investments in education is positive and significant as expected, meaning that higher education expenditures are affecting the formation of human capital. The last three variables are not significant; however, they were added in order to test the robustness of the regression, which ultimately holds.

### **Highly skilled emigration (II)**

The second regression performed is trying to define the determinants of highly-skilled migration and the results are shown in Table 4.

From the literature, the main variables are demographical ones and education expenses (Beine, Docquier, & Rapoport, 2001). The variable population is negatively related to the highly skilled emigration rate and mostly significant. This result is also similar to the one Beine et al. (2001) found in their paper: the population size represents the immigration quotas and this is true in a lot of OECD countries. A more populated country is likely to have more binding immigration quotas than a less populated one (Beine, Docquier, & Rapoport, 2001). The negative relationship between population and highly-skilled emigration suggests that immigration quotas are binding. The other demographic variable is population density, which is negative and significant in two out of three regressions.

The openness ratio is one of the core variable in the regression as it is positive and significant in five out of six regressions. As expected, the more a country has interactions with other countries, the more incentives its inhabitants have to migrate.

The other variables in the model, such as unemployment, human capital, area of the country and education expenditures, are not significant.

Table 4 - Skilled emigration results

Dep variable: emigrHS	(1)	(2)	(3)	(4)	(5)	(6)
<b>constant</b>	-0,5219	-0,3166	2,2997	2,4143	0,8129	1,3438
	0,6569	0,7975	0,4781	0,3883	0,7768	0,6279
<b>open</b>	0,7146	0,7072	0,4293	0,4046	0,5492	0,5374
	0,0004	0,0005	0,1126	0,0691	0,0083	0,0158
<b>GDPpc</b>	-0,0773	-0,1609	-0,2496	-0,2532	-0,1655	-0,1992
	0,4524	0,2569	0,3001	0,2608	0,5133	0,3453
<b>dens</b>	-0,0814	-0,0821	-0,0126			
	0,0821	0,0771	0,8611			
<b>rem</b>	0,1257	0,1271	0,1279	0,1269		
	0,0000	0,0000	0,0004	0,0011		
<b>unempl</b>		-0,2671	-0,3046	-0,3067	-0,2382	-0,2533
		0,2432	0,3020	0,2866	0,3851	0,3535
<b>pop</b>			-0,1168	-0,1249	-0,1379	-0,1245
			0,1509	0,0369	0,0270	0,0613
<b>HC</b>			0,1450	0,1540	-0,0966	
			0,6076	0,5442	0,6697	
<b>area</b>						-0,0181
						0,7927
<b>eduexp</b>						0,0349
						0,9092
<b>R<sup>2</sup></b>	0,5192	0,5401	0,5686	0,5683	0,4811	0,4802
<b>Adjusted R<sup>2</sup></b>	0,4480	0,4517	0,4428	0,4647	0,3813	0,3555
<b>F-stat</b>	7,2897	6,1070	4,5195	5,4846	4,8209	3,8499
<b>Prob</b>	0,0004	0,0007	0,0025	0,0010	0,0030	0,0074
<b>N obs</b>	32	32	32	32	32	32
<b>Countries</b>	32	32	32	32	32	32

P-value is under the respectively coefficient.

### Economic growth (III)

The last regression I perform is the growth model, whose results are displayed in Table 5.

The variable I am most interested in is skilled emigration and it is significant and negative through all the regressions performed. This result is consistent with the literature and with the dataset I used. Since the countries analyzed in this paper are OECD and on average richer than the rest of the world, the skilled emigration is detrimental for the economic growth of the country because it drains valuable human capital from the source country.

The other variables in the regression are control variables for economic growth and were added for completeness of the analysis and also to understand the effect of skilled emigration on economic growth. In the following paragraph I am going to briefly explain them.

Table 5 - Growth results

Dep variable: GDPgrw	(1)	(2)	(3)	(4)	(5)	(6)
<b>constant</b>	0,0214	1,5989	1,6683	1,6835	1,8113	1,8296
	0,0151	0,0102	0,0124	0,0104	0,0049	0,0159
<b>emigrHS</b>	-0,1318	-0,1437	-0,1014	-0,0818	-0,0821	-0,0823
	0,053	0,0048	0,0312	0,0368	0,0366	0,0394
<b>income</b>	0,3776	0,4040	0,4460	0,4770	0,4774	0,4741
	0,0029	0,0003	0,0005	0,0001	0,0001	0,0011
<b>le</b>		-0,3605	-0,3774	-0,3763	-0,4062	-0,4102
		0,0106	0,0123	0,0104	0,0046	0,0149
<b>FDI</b>			0,0690	0,1130	0,1131	0,1121
			0,1445	0,0065	0,0063	0,0152
<b>eduexp</b>				-0,1908	-0,2147	-0,2178
				0,1310	0,1450	0,1849
<b>HC</b>					0,0257	0,0267
					0,3842	0,4142
<b>unempl</b>						-0,0080
						0,9171
<b>R<sup>2</sup></b>	0,3780	0,5413	0,5615	0,5887	0,5925	0,5926
<b>Adjusted R<sup>2</sup></b>	0,3351	0,4921	0,4965	0,5096	0,4948	0,4738
<b>F-stat</b>	8,8120	11,0133	8,6421	7,4431	6,0595	4,9875
<b>Prob</b>	0,0010	0,0001	0,0001	0,0002	0,0005	0,0014
<b>N obs</b>	32	32	32	32	32	32
<b>Countries</b>	32	32	32	32	32	32

P-value is under the respectively coefficient.

Without any surprise, income is significant and positive related to economic growth. As the population grows older, the percentage of working population over the total population decreases and the economic growth is affected negatively; this is shown in the table, as the life expectancy variable is negative related to the economic growth and significant at the 5% level. FDI are positive and significant as the literature describes, since more investments stimulate economic growth.

Variables, such as expenses in education, human capital and unemployment are not significant in my research, although they are used in the literature to describe growth.

## 5. DISCUSSION

The results obtained in the above section confirm only one hypothesis out of the two I enounced in the previous section. The model presented in this thesis suffers from specification issues and measurement errors. Omitted variables and unobserved heterogeneity issues cannot be addressed properly in a cross-section analysis (Docquier & Rapoport, 2012). The nature of the dataset itself is affected from systematic and random error since the data are collected from a census. Worth to



mention is also the critical period analyzed: 2010 is right after the economic crisis. Migration flows are negatively influenced by the crisis, especially temporary migration, free movement migration and family migration (OECD, International Migration Outlook 2010, 2010).

The relationship between skilled migration and human capital is not straightforward, neither in my research, nor in the literature (Beine M. D., 2006). The results I obtained are mostly insignificant; however, the effect seems to run from skilled emigration to human capital and not *vice versa* (Model I, table 3). The same results are obtained by Beine et al. (2006); they found that skilled migration has a positive global impact on human capital. Overall, the effect of skilled emigration, observed in my regression, is small and confirms the results of Beine et al (2005), which found that low-income and high-income countries migration does not significantly affect human capital formation.

An interesting outcome of this research is the relationship between remittances and human capital formation, which is displayed in the first regression model. Remittances are significant and negatively related to human capital formation. This result can be seen as a reverse causality of emigration on the education rate of the people remaining in the origin country: an increase in remittances might mean an increase in the volume of highly skilled emigration, which might cause a decrease in the rate of tertiary educated individuals over the total population. Of course, this result contradicts the positive coefficient found for the relationship between human capital and emigration rate of the highly skilled. However, it is possible that the increase in remittances is due to the increase in earnings of the highly skilled emigrants and not to the increase in volume of highly skilled emigrants (Faini, 2007). If this is the case, the overall effect of these two determinants on human capital is uncertain and needs more specific data to be studied thoroughly.

## **6. CONCLUSION**

Migrations have increased exponentially over the past decades. In the last twenty years, many economists have studied the migratory events in order to determine its determinants and causes. The above analysis has shown that the new data on migration are confirming the results of the last decades. The migration from and towards OECD countries is increasing, but the trends are basically the same. Skilled migration is higher than total migration, confirming the theoretical model, in which the simplifying assumption states that non-skilled individuals do not migrate.

Human capital is directly affected by skilled migration. However, I do not find conclusive evidence of the opposite, i.e. human capital is not influenced by skilled migration. Moreover, the last regression showed that economic growth is affected by skilled migration, but not human

capital. Nevertheless, the results can be biased as specification issues are a major problem in these regressions.

As the introduction of a population census is quite recent and they are carried out every ten years, I expect that in the future there will be more data available. The restricted database to which I had access can be expanded with more frequent censuses, in order to be able to perform an advanced research on the determinants of skilled emigration and human capital.

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## 5 APPENDIX

Table 6- Immigrant and emigrant population with tertiary education in OECD countries, 2011

### Highly Skilled migrants

	<b>From OECD to country</b>	<b>From country to OECD</b>	<b>difference</b>	<b>Other HS immigrants</b>
Australia	3.568.163	3.021.533	546.630	1.093.795
Austria	845.200	866.424	-21.224	77.517
Belgium	2.031.381	2.075.188	-43.807	114.003
Canada	9.419.140	8.879.969	539.171	2.424.430
Chile	3.073.446	3.163.817	-90.371	58.351
Czech Republic	1.188.369	1.232.846	-44.477	43.473
Denmark	1.062.658	1.081.404	-18.746	43.600
Estonia	269.530	289.512	-19.982	72.759
Finland	1.218.107	1.270.686	-52.579	28.740
France	11.279.454	11.330.644	-51.190	1.070.822
Germany	14.593.180	14.858.385	-265.205	1.066.490
Greece	1.679.438	1.728.461	-49.023	129.649
Hungary	1.413.294	1.529.373	-116.079	74.722
Iceland	58.580	65.096	-6.516	2.342
Ireland	896.754	996.765	-100.011	82.206
Israel	1.338.350	1.319.425	18.925	649.480
Italy	5.865.030	6.106.688	-241.658	405.939
Japan	130.663	349.083	-218.420	187.008
Luxembourg	73.303	49.351	23.952	8.082
Mexico	7.522.234	8.342.526	-820.292	47.836
Netherlands	3.191.075	3.304.338	-113.263	254.727
New Zealand	1.047.807	1.024.090	23.717	226.119
Norway	1.043.897	1.012.133	31.764	68.187
Poland	5.613.069	6.576.304	-963.235	80.636
Portugal	1.119.343	1.215.191	-95.848	125.396
Slovakia	741.905	832.204	-90.299	5.936
Slovenia	288.713	300.306	-11.593	18.956
Spain	9.328.925	9.095.437	233.488	738.860
Sweden	1.737.015	1.698.126	38.889	188.725
Switzerland	1.445.060	1.231.512	213.548	139.577
Turkey	4.969.979	5.165.630	-195.651	259.940
United Kingdom	13.243.411	13.412.295	-168.884	2.125.551
United States	67.748.921	64.464.240	3.284.681	8.730.445

Table 7 – Number and distribution of OECD expats by level of education

	Tertiary	Secondary	Primary	Unknown	Total
<b>Australia</b>	186.635 52%	119.355 33%	48.482 13%	6.082	<b>360.554</b>
<b>Austria</b>	123.318 34%	174.777 48%	57.262 16%	6.608	<b>361.965</b>
<b>Belgium</b>	157.148 40%	131.329 33%	102.367 26%	5.627	<b>396.471</b>
<b>Canada</b>	551.331 48%	441.093 39%	143.498 13%	7.949	<b>1,143.871</b>
<b>Czech Republic</b>	103.731 32%	138.449 43%	78.740 24%	4.071	<b>324.991</b>
<b>Denmark</b>	72.362 41%	60.467 34%	31.388 18%	11.200	<b>175.417</b>
<b>Estonia</b>	44.420 35%	55.275 43%	24.569 19%	3.653	<b>127.917</b>
<b>Finland</b>	73.404 29%	103.732 41%	69.587 27%	7.832	<b>254.555</b>
<b>France</b>	585.295 43%	396.213 29%	305.127 23%	67.372	<b>1,354.007</b>
<b>Germany</b>	1,282.604 37%	1,482.359 42%	659.412 19%	69.612	<b>3,493.987</b>
<b>Greece</b>	136.621 21%	183.760 28%	309.385 48%	16.344	<b>646.110</b>
<b>Hungary</b>	151.956 36%	182.935 43%	79.963 19%	10.806	<b>425.660</b>
<b>Iceland</b>	11.782 39%	10.097 33%	4.684 15%	3.792	<b>30.355</b>
<b>Ireland</b>	267.220 36%	217.608 30%	240.839 33%	8.974	<b>734.641</b>
<b>Israel</b>	107.981 49%	80.700 37%	27.420 13%	2.873	<b>218.974</b>
<b>Italy</b>	413.631 19%	648.110 30%	1,057.733 49%	51.968	<b>2,171.442</b>
<b>Japan</b>	349.559 55%	225.241 36%	51.150 8%	7.749	<b>633.699</b>
<b>Luxembourg</b>	12.305 32%	12.989 34%	11.290 30%	1.574	<b>38.158</b>
<b>Mexico</b>	885.670 8%	3,785.199 33%	6,648.327 59%	2.730	<b>11,321.926</b>
<b>Netherlands</b>	259.865 37%	246.907 35%	140.009 20%	54.843	<b>701.624</b>
<b>New Zealand</b>	174.756 32%	246.639 45%	93.367 17%	34.107	<b>548.869</b>
<b>Norway</b>	51.057 38%	47.931 36%	23.730 18%	11.097	<b>133.815</b>
<b>Poland</b>	994.610 31%	1,497.951 46%	658.554 20%	98.614	<b>3,249.729</b>
<b>Portugal</b>	151.581 11%	384.832 27%	876.336 61%	24.594	<b>1,437.343</b>
<b>Slovakia</b>	110.032 23%	221.926 46%	119.192 25%	33.171	<b>484.321</b>
<b>Slovenia</b>	16.036 22%	27.719 37%	29.032 39%	1.609	<b>74.396</b>
<b>Spain</b>	217.537 30%	212.029 29%	287.182 39%	16.059	<b>732.807</b>
<b>Sweden</b>	110.536 46%	81.747 34%	36.963 15%	12.790	<b>242.036</b>
<b>Switzerland</b>	149.999 31%	194.804 41%	130.394 27%	4.750	<b>479.947</b>
<b>Turkey</b>	252.643 10%	631.476 24%	1,641.279 64%	54.317	<b>2,579.715</b>
<b>United Kingdom</b>	1,496.730 41%	1,363.601 37%	678.118 18%	136.102	<b>3,674.551</b>
<b>United States</b>	584.591 51%	326.467 28%	212.359 18%	32.642	<b>1,156.059</b>

Figure 2 – Percentage of foreign-born by region of origin in OECD countries over the total population, divided by skilled and non-skilled

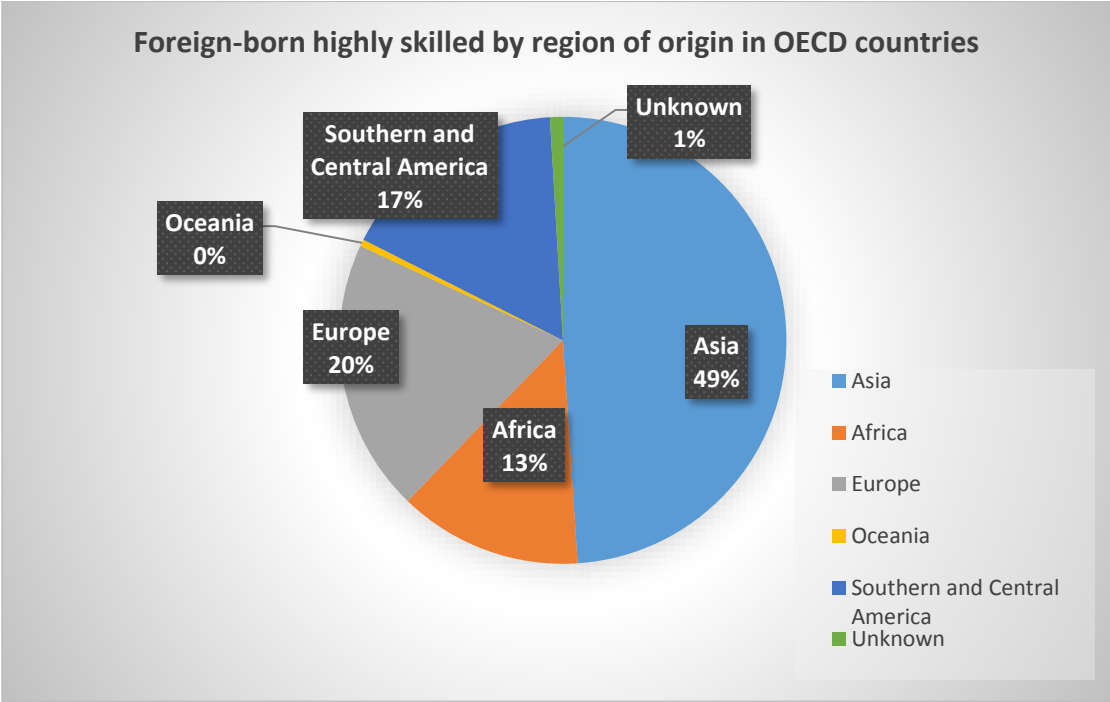
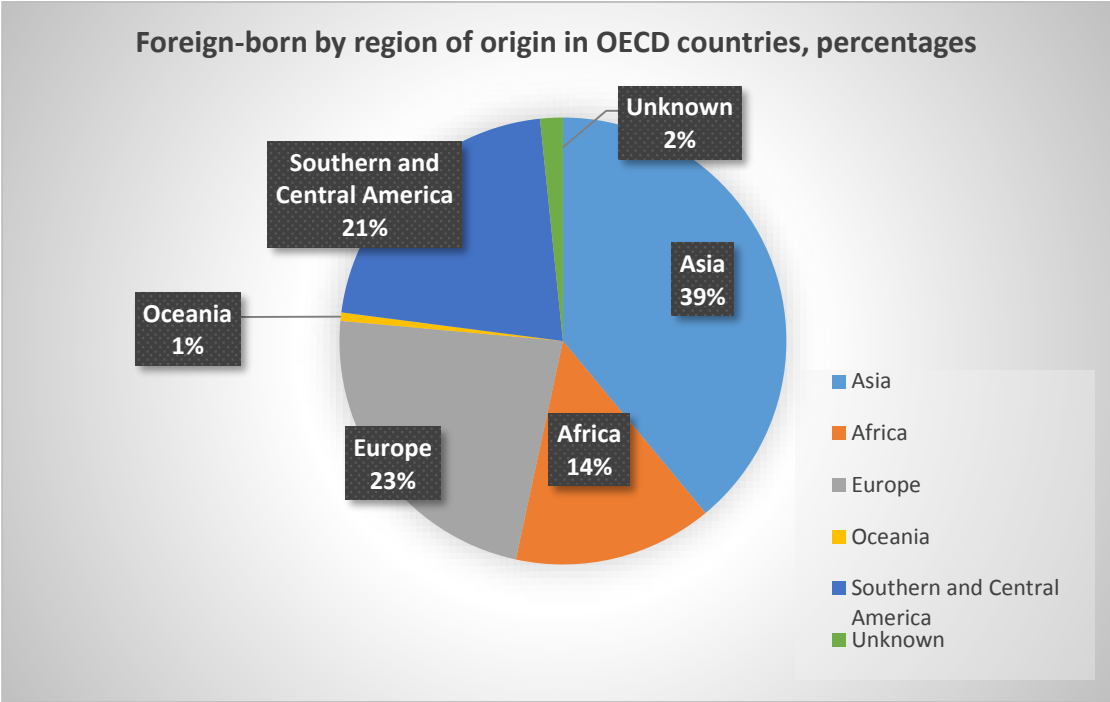


Table 8 - Descriptive stats

	Mean	Median	Maximum	Minimum	Std. Dev.	Obs.
<b>area</b>	1,058,825	185,415	9,147,420	2,590	2,513,694	32
<b>debt</b>	0.59	0.51	1.48	0.03	0.32	32
<b>dens</b>	122	102	493	3	116	32
<b>eduexp</b>	0.12	0.11	0.19	0.07	0.03	32
<b>emigrHS</b>	0.10	0.08	0.27	0.01	0.06	32
<b>FDI</b>	-0.02	0.00	0.10	-0.36	0.08	32
<b>GDPpc</b>	38,534	39,499	103,267	8,861	22,036	32
<b>HC</b>	0.24	0.24	0.43	0.10	0.08	32
<b>income</b>	0.04	0.04	0.20	-0.06	0.05	32
<b>le</b>	79.55	80.40	82.25	74.09	2.40	32
<b>open</b>	0.97	0.78	3.26	0.28	0.58	32
<b>pop</b>	33,249,135	10,523,755	309,346,863	318,041	58,146,485	32
<b>rem</b>	0.01	0.00	0.03	0.00	0.01	32
<b>unempl</b>	0.09	0.08	0.20	0.04	0.04	32



Table 9 - Percentage of foreign-born and highly skilled foreign-born over the total population in OECD countries

	Foreign-born	Highly skilled foreign-born
Luxembourg	44,6%	10,5%
New Zealand	33,3%	12,6%
Israel	31,8%	14,3%
Australia	30,4%	10,9%
Switzerland	29,7%	9,5%
Canada	24,8%	12,9%
Ireland	18,9%	7,0%
Austria	18,0%	3,2%
Estonia	17,8%	6,9%
United States	16,8%	5,1%
Belgium	16,4%	2,5%
Sweden	16,3%	4,3%
Germany	14,6%	2,8%
United Kingdom	14,3%	6,7%
Greece	13,2%	2,3%
France	13,0%	3,1%
Spain	12,9%	3,0%
Norway	12,8%	3,8%
Slovenia	12,5%	1,3%
Netherlands	11,4%	2,9%
Iceland	11,3%	3,0%
Denmark	10,0%	2,1%
Portugal	9,0%	2,0%
Italy	8,7%	1,1%
Czech Republic	7,6%	1,1%
Finland	4,9%	1,1%
Hungary	4,3%	1,2%
Turkey	3,2%	0,7%
Slovakia	3,0%	0,5%
Poland	1,8%	0,3%
Chile	1,6%	0,6%
Japan	1,2%	0,3%
Mexico	0,5%	0,1%

Table 10 - Total number of expatriates and percentage of highly skilled expatriates by country of birth

	Stock of expat	% of HS		Stock of expat	% of HS		Stock of expat	% of HS		Stock of expat	% of HS
Afghanistan	333480	23%	Dominica	49797	24%	Libya	103933	33%	Saint Lucia	38683	24%
Africa	504410	29%	Dominican Republic	988511	17%	Liechtenstein	1741	22%	Saint Vincent and the Grenadines	41374	29%
Albania	918954	11%	Ecuador	904549	16%	Lithuania	367963	35%	Samoa	80061	15%
Algeria	1522536	21%	Egypt	429383	50%	Luxembourg	38158	32%	San Marino	2917	21%
American Samoa	692	18%	El Salvador	1226200	11%	Macedonia	332049	9%	Sao Tome and Principe	18862	12%
Andorra	5927	33%	Equatorial Guinea	19994	25%	Madagascar	119458	33%	Saudi Arabia	107819	50%
Angola	228109	24%	Eritrea	88875	23%	Malawi	24235	45%	Senegal	241779	21%
Anguilla	3147	38%	Estonia	127917	35%	Malaysia	294082	58%	Serbia	549331	15%
Antigua and Barbuda	25704	32%	Ethiopia	308363	27%	Maldives	1292	36%	Seychelles	10477	27%
Argentina	643659	38%	Falkland Islands	994	31%	Mali	83737	15%	Sierra Leone	72077	36%
Armenia	613984	26%	Fiji	176181	34%	Malta	95559	21%	Singapore	136341	55%
Aruba	16267	45%	Finland	254555	29%	Marshall Islands	17329	10%	Slovakia	484321	23%
Australia	360554	52%	Former Czechoslovakia	48114	30%	Mauritania	28669	19%	Slovenia	74396	22%
Austria	361965	34%	Former USSR	437515	27%	Mauritius	137267	34%	Solomon Islands	2318	39%
Azerbaijan	756720	25%	Former Yugoslavia	320265	17%	Mexico	11321926	8%	Somalia	280507	15%
Bahamas	36236	37%	France	1354007	43%	Micronesia, Federated states	20614	14%	South Africa	568159	53%
Bahrain	15677	50%	Gabon	21491	43%	Moldova	20105	29%	South Sudan	3015	18%
Bangladesh	532415	38%	Gambia	47531	22%	Mongolia	45316	40%	Spain	732807	30%
Barbados	85350	35%	Georgia	688266	29%	Montenegro	20162	16%	Sri Lanka	560972	35%
Belarus	906370	33%	Germany	3493987	37%	Montserrat	17026	27%	Sudan	106916	35%
Belgium	396471	40%	Ghana	307406	37%	Morocco	2525091	17%	Suriname	205367	18%
Belize	49648	27%	Gibraltar	12331	35%	Mozambique	92305	33%	Swaziland	4597	46%
Benin	27357	45%	Greece	646110	21%	Myanmar	125437	34%	Sweden	242036	46%
Bermuda	21889	44%	Grenada	49742	30%	Namibia	9170	41%	Switzerland	479947	31%
Bhutan	7264	19%	Guam	71	37%	Nauru	736	32%	Syria	198151	34%
Bolivia	287926	22%	Guatemala	798176	10%	Nepal	152494	43%	Tadjikistan	428184	23%
Bosnia-Herzegovina	736059	14%	Guinea	63558	22%	Netherlands	701624	37%	Thailand	499140	30%
Botswana	12011	38%	Guinea-Bissau	40127	13%	Netherlands Antilles	82574	25%	Timor-Leste	12889	19%
Brazil	986790	29%	Guyana	362191	32%	New Zealand	548869	32%	Togo	44204	34%
British Virgin Islands	6774	41%	Haiti	695014	24%	Nicaragua	277634	25%	Tokelau	1979	20%
Brunei Darussalam	13550	51%	Holy See	169	24%	Niger	12094	38%	Tonga	49099	17%
Bulgaria	718853	27%	Honduras	518048	12%	Nigeria	525632	55%	Trinidad and Tobago	318901	36%
Burkina Faso	21738	25%	Hong Kong	513505	57%	Niue	5035	20%	Tunisia	545701	20%
Burundi	28719	38%	Hungary	425660	36%	Norfolk Islands	225	27%	Turkey	2579715	10%
Cambodia	276600	19%	Iceland	30355	39%	Northern Mariana Islands	10556	28%	Turkmenistan	176574	31%
Cameroun	156378	41%	India	3589589	62%	Norway	133815	38%	Turks and Caicos Islands	4262	20%
Canada	1143871	48%	Indonesia	344101	43%	Occupied Palestinian Territory	19702	43%	Tuvalu	2015	19%
Cape Verde	141111	8%	Iran	883968	51%	Oman	9057	41%	Ukraine	4152290	34%
Cayman Islands	5409	27%	Iraq	609041	29%	Pacific Islands (Palau)	7095	28%	United Arab Emirates	51362	35%
Central African Republic	17434	34%	Ireland	734641	36%	Pakistan	1155979	39%	United Kingdom	3674551	41%
Chad	9728	40%	Israel	218974	49%	Panama	155949	37%	United Republic of Tanzania	85014	49%
Chile	295735	37%	Italy	2171442	19%	Papua New Guinea	34950	39%	United States	1156059	51%
China	3634523	42%	Jamaica	934034	31%	Paraguay	95606	17%	United States Virgin Islands	54575	31%
Colombia	1177780	32%	Japan	633699	55%	Peru	863736	30%	Uruguay	169776	25%
Comoros	33983	14%	Jordan	98643	45%	Philippines	3000131	52%	Uzbekistan	1167607	27%
Congo	41920	35%	Kazakhstan	3250001	22%	Pitcairn	366	54%	Vanuatu	2706	31%
Cook Islands	18320	12%	Kenya	269018	47%	Poland	3249729	31%	Venezuela	439560	48%
Costa Rica	100520	30%	Kyrgyzstan	533729	24%	Portugal	1437343	11%	Vietnam	1927265	28%
Côte d'Ivoire	144712	30%	Kiribati	4185	23%	Puerto Rico	1416667	20%	Western Sahara	235	62%
Croatia	542451	16%	Kuwait	58081	53%	Qatar	11045	46%	Yemen	87553	18%
Cuba	1205375	28%	Laos	262962	20%	Romania	2641288	21%	Zambia	62143	55%
Cyprus	159520	34%	Latvia	228540	40%	Russia	2512696	37%	Zimbabwe	182796	50%
Czech Republic	324991	32%	Lebanon	436437	37%	Rwanda	37541	37%			
Denmark	175417	41%	Lesotho	2563	49%	Saint Helena	2826	18%			
Djibouti	8800	35%	Liberia	82919	31%	Saint Kitts and Nevis	19290	34%			