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Brain Drain, Brain Gain and Its Net Effect

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Brain drain, brain gain and its net effect*

Sandra Berger†

Abstract

With a total of 272 million migrants worldwide in 2019, the world has seen an absolute increase in their flows over the past decades. Today, more than half of such flows are composed of movements between developing countries. While literature on the impact of migration is abundantly present, the associated works largely focus on the impact of high-skilled immigration. Instead, relatively few empirical studies have analysed the impact of high-skilled emigration, especially on low-income countries of origin. Consequently, this paper aims to contribute to the recent effort of identifying the pathways through which a country of origin might benefit from the emigration of high-skilled individuals. To do so, it provides an overview of literature outlining the determinants of high-skilled migration, and the impacts that these have in relation to the human capital, labour market and macro-economic development of low-income countries of origin. Based on the insights gathered, a conceptual framework on measuring the net brain gain effect is proposed; one that draws on three established theories - the human capital theory, migration theory and brain circulation theory. This subsequently results in the formulation of an empirical methodology to assess the net brain gain effect.

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List of acronyms

FDI	Foreign Direct Investment
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
ICT	Information Communication Technology
ILO	International Labour Organization
ISCED	International Standard Classification of Education
UNCTAD	United Nations Conference on Trade and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNESCO	United Nations Educational, Scientific and Cultural Organization
USD	United States Dollar

1. Introduction

In 2019, the total number of international migrants attained an estimated number of 272 million worldwide according to United Nations estimates, representing an increase of roughly 17 per cent from 2013.¹ As such, approximately 3.5 per cent of the global population lives in a country different from their country of birth – a percentage that has been roughly constant since the 1960s.² While many migrants emigrate to the developed world, more than half of the total migration flows worldwide are composed of movements between developing countries.³ The majority of the latter are, nevertheless, constituted of mainly low- and middle skilled individuals. High-skilled flows are relatively more prominent when considering South-North migration.⁴

Overall, the flows of the high-skilled⁵ amongst the global stock and flow of migrants have seen a rapid increase in their number along with increasingly “asymmetric and skewed patterns” along a number of dimensions.⁶ More and more, a pattern is developing that depicts the departure of high-skilled migrants from a wider to a narrower set of countries of destination. The latter, in particular, includes the developed countries of Australia, Canada, the United Kingdom, the United States as well as the Gulf Cooperation Council (GCC) countries.

This growing trend of migration, especially that of the skilled, can be deemed to be one of the major aspects of globalization. Not only have the labor supply pressures from developing countries remained strong over the past 30 years, but demand pressures by developed nations for skilled migrants from developing countries has increased. Over time, this has contributed to a large and increasing absolute wage differential for skilled workers across the two locations. In addition to this, the increased high-skilled migration led to relatively large losses in skilled labor in the country of origin – a concept known as the brain drain effect. This not only drains the nation of its human capital, but also impacts its labor market and productivity, thereby also the country’s economic growth.

¹ (UNDESA, 2020)

² (Kone & Özden, 2017); (Ozden, Parsons, Schiff, & Walmsley, 2011)

³ (Sparreboom, Mertens, & Berger, 2019)

⁴ Based on the UNESCO ISCED levels, high-skill occupations consist of these major groups: (1) legislators, senior officials and managers; (2) professionals; and (3) technicians and associate professionals. Medium-skill occupations consist of these major groups: (4) clerks; (5) service workers and shop and market sales workers; (6) skilled agricultural and fishery workers; (7) craft and related trades workers; and (8) plant and machine operators and assemblers. Low-skill occupations are defined as one major group: (9) elementary occupations.

⁵ Typically defined as individuals that obtained tertiary education. An internationally agreed upon definition is still to be determined.

⁶ (Kerr, Kerr, Ozden, & Parsons, 2016)

Box 1. The evolution of the brain drain definition.

By analysing existing literature, it becomes clear that there is no distinct definition of brain drain. Instead, as time progresses and research on the topic advances, the definition adapts. As such, in the 1980s, definitions reflect the migration from poorer to richer countries and the implications it has on the transfer of technology. It was during this time period that the terminology around brain drain was transforming to include brain waste and brain exchange. While the former describes the under-utilization of a high-skilled migrants' skills and expertise, the latter implies a two-way flow of knowledge between a country of origin and a country of destination. In addition to these concepts, various studies during this period of time have also focused on brain return – an inherent part of the brain drain debate. This concept portrays the commitment of migrants to return home. A decade later, the definition of brain drain transformed to include the motivation of migration with respect to wages as well as other social and political differences amongst less developed and developed countries. It was during this time, that a further specification emerged: brain circulation. At its inception in 1998 by Johnson and Regets, the term referred to: "the cycle of moving abroad to study, then taking a job abroad, and later returning home to take advantage of a good opportunity".

In line with this trend, ever more research has emerged on this topic and its impacts. While focus was largely placed on the standard theoretical trade frameworks and their simultaneous welfare analyses in the 1960s, rising political instability and slow growth in the 1970s led to an increasingly negative connotation of the brain drain effect as researchers verified the conditions that led to it being welfare-deteriorating. This led to findings underlining the fact that the emigration of highly skilled individuals could not only lead to informational imperfections and domestic labor market rigidities, but also to increased international inequality as a result of fiscal and various other types of externalities.⁷ Evidence seemed to suggest that developed countries were becoming richer at the expense of poorer ones. Furthermore, it seemed to conclude that the welfare of non-migrants would decline if the contribution of migrants to the national output was greater than their income/consumption. As such, various solutions were offered, including Bhagwati's "brain drain tax" - a tax that aimed to disincentivize free-riding and provide a monetary compensation from the rich countries to the poor as a result of draining the latter's scientific and cultural elite.⁸

By the 1980s, there was a revival of the New Growth Theory, which believed that, as a result of additional human capital in the country of destination, positive technological externalities would arise as a consequence of migration. Economists such as Paul Romer and Robert Lucas found that the migration of skilled workers stimulated the dynamics of economic growth in the country of destination.⁹ As such, with the increasing recognition of labour as a form of capital, more and more research was undertaken on the effects of brain drain on economic growth and macroeconomic implications. As such, focus was increasingly placed on the long-run impacts of migration and education policies¹⁰ as well as on migration and trade. These impacts continued to be studied in the 1990s as witnessed by the works of Bhagwati (1991), Rauch (1991), Glaz'ev & Malkov (1992), Gould (1994), Ishikawa (1996), Wong & Yip (1999) and Beine, Docquier, & Rapoport (2001).¹¹ They found that while a high wage in the country of destination motivated high-skilled migrants to emigrate, high-income countries attracted

⁷ (Bhagwati & Hamada, 1974), (McCulloch & Yellen, 1977)

⁸ (Bhagwati J. , 1979); (Giannoccolo, n.d.); (Bhagwati & Dellafar, 1973); (Bhagwati & Patrington, 1976); (Krugman & Bhagwati, 1976)

⁹ (Romer, 1986); (Romer, 1987); (Romer P. , 1990a); (Lucas, 1988)

¹⁰ (Chiswick C. , 1989); (Reubens, 1983); (Blomqvist, 1986); (Kindleberger, 1986); (Wong K.-Y. , 1986); (Djajic, 1989)

¹¹ Authors obtained from (Giannoccolo, n.d.)

foreign labour in order to increase their productivity and, as such, their economic growth. Yet, it was also found that the effects of migration were detrimental for the country of origin when considering its impact on growth and welfare dynamics. Several literature suggested that over the long-run, this impact of migration would result in a divergence between high- and low-income countries. As such, it was proposed that countries create incentives for return, such as increasing the opportunity of employment in the country of origin.

Given these insights, literature started to focus on analysing the motivation to migrate at a more micro-economic level during the 1990s.¹² Specific attention was placed on analysing the relationship between migration and wage differentials as well as income taxation.¹³ By the late 1990s, a shift towards a more positive connotation was achieved as a result of the concept being increasingly used in public and as such in policy (as evidenced in **Table 1**).¹⁴ It became evident that the effect of high-skilled migration did not only have negative impacts on the country of origin, but also positive ones that could partially or completely offset the consequences of a loss of talent. In fact, by incentivizing migration, the fraction of the educated population would increase. As not all educated citizens would have the ability to migrate, the average level of education of the remaining population would rise; thereby benefiting the country of origin.

Emerging literature has since then focused on identifying the channels through which a country of origin might benefit from the emigration of high-skilled individuals. This included identifying the conditions that needed to be present for the net effect of high-skilled migration to be positive or negative on the country's development and its welfare. Increasingly more attention was, as such, paid to the effects of individual motivations and incentives; the short, medium, and long-run impacts of remittances sent home by migrants abroad;¹⁵ as well as on the impact that return migration and the diaspora has on knowledge, technology, innovation, trade¹⁶ and foreign-direct investment.¹⁷ Furthermore, by 2010, the use of micro-data allowed for important individual heterogeneity to be captured thereby placing increased attention on the educational and professional employment trajectory of emigrants, as well as the impact that return migration has on the country of origin in terms of the accumulation of savings, the alleviation of credit constraints, and the increase in human capital, entrepreneurship and wage premiums.¹⁸

¹² (Benabou, 1993); (Acemoglu, 1996); (Carrington, Detragiache, & Vishwanath, 1996); (Davenport, 2004)

¹³ (Davies & Wooton, 1992); (Wilson, 1992); (Engerman & Jones, 1997)

¹⁴ (Kone & Özden, 2017)

¹⁵ (Mahroum, 2000); (Olesen, 2003); (Faini, 2003); (Yang, 2008); (Bollard, McKenzie, Morten, & Rapoport, 2011); (Docquier & Machado, 2015)

¹⁶ (Meyer J. , 2001); (Rauch & Trindade, 2002); (Kerr W. , 2008); (Felbermayr & Jung, 2009); (Mountford & Rapoport, 2011); (Saxenian, 2005); (Agrawal, Kapur, McHale, & Oettl, 2011)

¹⁷ (Kugler & Rapoport, 2007); (Javorcik, Özden, Spatareanu, & Neagu, 2011)

¹⁸ (Dustmann & Kirchkamp, 2002); (Piracha & Vadean, 2010); (Wahba, 2015a)

Table 1. Timeline of brain drain literature¹⁹

	Topics	Countries studied	Motivation to migrate	Effects on the country of origin	Potential solutions
1950s – 1960s	Social welfare	UK, West Europe, USA and Canada	Political and social	Negative effect on welfare, the social structure and the population.	International organizations and institutions ²⁰
1970s	Decline in welfare, taxes, and public goods	Less-developed countries and a few developed ones	Incomplete labor market information or a shortage of labor demand	Negative economic and developmental short-run effects	Coordination among countries and the implementation of a brain drain tax
1980s	Macroeconomics, education, growth, and trade	Less developed and emerging countries	Wage differentials	Negative economic and developmental effects focused on the long run	Incentives for return migration and an increase in employment opportunities
1990s – 2000s	Microeconomics, innovation, technology and growth, macroeconomic impacts of brain gain	Developed and few less-developed countries	Individual motivations	Negative and positive effects	Individual incentives and the implementation of macroeconomic conditions leading to brain gain
2010s	Microeconomic impacts of brain gain, brain circulation, return migration, and education and employment trajectories	Developed and few less-developed countries	Individual motivations, differential returns to skills and amenities across countries, complete migration histories	Negative and positive effects	Individual incentives and the implementation of macro- and micro-economic conditions leading to brain gain

In light of this, the paper at hand aims to contribute to this recent effort by providing empirical evidence on the net brain gain effect of high-skilled migration. This includes not only the identification of determinants of high-skilled migration, especially in relation to the concepts of brain drain and brain gain, but also of their subsequent impacts in relation to human capital, the labor market and macro-economic development. Particular focus, in this regard, will be placed on - the largely under-researched - low-income countries of origin as they do not only exhibit some of the highest rates of emigration, but may potentially also be the countries most impacted. As such, section 2 of this paper provides an understanding of the pathways through which high-skilled emigration harms or benefits low-income countries of origin, focusing on the conditions needing to be present to do so. This is complemented by Section 3, which highlights the role of gender and its influence on brain drain and gain. Consequently, insights

¹⁹ Adapted from (Giannoccolo, n.d.)

²⁰ Literature from this time period underlined that the main motivation to migrate was based on political and social motivations of individuals. The effects of which were identified to be either bad for welfare or for the social structure of the sending countries. As such, it was proposed that the roles of international organizations and institutions to manage these types of migration flows needed to either be created or strengthened.

gained from these two sections are taken over to propose a conceptual framework on measuring the net brain gain effect, drawing on the main theoretical frameworks presented throughout the paper – the human capital theory, migration theory and brain circulation theory. This subsequently results in the formulation of an empirical methodology in section 4, based on an analysis of potential data sources as well as previous methods of assessment. The paper is subsequently concluded in section 5.

2. The pathways through which high-skilled emigration impacts the country of origin

The brain drain concept is strictly linked to the concept of human capital as is evident by many historical economists considering human beings and their skills to be capital (e.g., Bagehot, Fisher, Petty, Roscher, Smith, Senior, Sidgwick, etc.). In 1961, Sir William Petty was one of the first economists to attempt to estimate the monetary value of a human being in order to underline the value of human capital that was lost as a result of a war. From then onwards, the value of human beings and their skills/expertise was sporadically included in the value of capital. While some, as Sir Petty, attempted to estimate its value at both the microeconomic and macroeconomic levels, others solely included humans into the definition of capital and recognized that increased investment into this component could lead to productivity gains – as was done by Jean Baptiste Say, William Roscher, Henry Sidgwick, John Stuart Mill and Adam Smith.²¹ The latter of which stated, “the skill of a man may be regarded as a machine that has a genuine cost and returns a profit”.²²

With this increasingly growing recognition that human beings are a component of capital, their emigration, especially that of the highly trained, became known as human capital flight, and later on as brain drain. The reason for such flight can be traced back to the classic human capital model, pioneered by Sjaastad (1962), who stated that “a migrant’s goal is to maximize his/her utility by choosing the location that offers the highest net return to human capital, hence labor supply”.²³ While Sjaastad only theoretically outlined this concept, he emphasized that a potential migrant weighs his/her opportunities and the costs thereof, and as such chooses the path that maximizes the present value of lifetime earnings. This theoretical concept has become the basis of almost all modern neoclassical economic analyses of migration.²⁴

Yet, it was not until the 1990s, that literature on the “new economics of the brain drain”, although relatively scarce, empirically evidenced that migration need not diminish the stock of

²¹ (Giannoccolo, n.d.)

²² (Smith, 1937)

²³ (Chiswick & Miller, 2015)

²⁴ Becker (1964) contributed significantly to this work through his extensive research on human capital theory. He stated that “the many forms of such [human capital] investments include schooling, on-the-job training, medical care, migration, and searching for information about prices and income”. In support of Sjaastad’s arguments, Becker also asserted that migration is primarily an investment decision as it involves immediate direct and indirect costs for an uncertain future gain. Through the influence of these two authors along with various literature asserting education to be a major determinant of long run economic growth, it has become clear that the center of migration models is human capital investment.

human capital or have other negative impacts, especially when considering high-skilled migrants (see **Box 2**). Instead, various positive externalities can emerge. However, the size and direction of the net effect depend on various characteristics of the country of origin. Consequently, empirical research started to increasingly interest itself with the impact of migration on labor market and human capital outcomes and its implication for policy and development. Yet, although a large volume of research has since been produced on immigrant impacts on wages, unemployment, wealth, employment stability, occupational attainment, human capital accumulation, and labor force participation in the country of destination,²⁵ less is known on how emigration affects these variables in the country of origin – especially if the latter are characterized as less developed. This persists even though the changes in the labor force in the country of origin are larger than the proportionate changes in the country of destination.²⁶

As such, the aim of this section is to highlight three important pathways through which a less-developed country of origin might be impacted, positively or negatively, by the emigration of its high-skilled workers. These consist of i) the labour market pathway, ii) the human capital pathway, and iii) the macro-economic development pathway. The latter includes the losses or gains that the country of origin receives as a result of incentivizing emigration. This includes the fiscal impacts as well as the effects of remittances, of increased foreign direct investment and technology flows given the diaspora, and of return migration.²⁷

Box 2. Empirical research on the rise in average educational attainment in the country of origin

In the mid-1990s, a particular strand of the brain gain literature emerged with more optimistic impacts of emigration on human capital accumulation in developing countries. Such empirical research is based on the theoretical work of Mountford (1997), Vidal (1998), and Beine et al. (2011), amongst others. The authors argue that ex-ante migration prospects foster educational investments in the countries of origin. Ex-post, some individuals will emigrate, while others will remain. Depending on which of the two effects is stronger, the net impact of emigration on human capital accumulation in the country of origin can either be negative (brain drain) or positive (brain gain). Yet, a crucial assumption is that the expected benefit from migration is larger for more educated persons originating from developing countries. This is either due to the net benefit being higher or due to the probability of migration being larger. Empirical evidence of the ex-ante incentive effect has been found at the micro-economic level by a number of authors: Lucas (2004), Kangasniemi et al. (2007), Commander et al. (2008), Batista et al. (2007), Chand and Clemens (2008), and Gibson and McKenzie (2009).

Yet, to test whether this incentive effect also holds for other countries, macro-level analyses are required. Beine et al. (2008), as such, take advantage of cross-country databases on migration by educational attainment for 127 countries and confirm that the prospect of migration has a significant, positive correlation with human capital formation in the country of origin. Yet, whether or not this leads to a brain drain or brain gain is dependent on the magnitude of migration and the initial capital stock in the country of origin. As such, they first estimate the impact of skilled migration prospects on ex-ante (pre-migration) human capital levels. Consequently, in order to estimate this net effect and given selection-bias, the authors utilize counterfactual simulations for each country and region. This entails reducing the high-skill emigration rate to that of low-skilled migration. The authors find that “most countries combining low levels of human capital and low migration rates of skilled workers end up with a positive net effect. In contrast, the brain drain appears to have negative effects in countries where the migration rate of the highly educated is above 20% and/or the proportion of people with higher education is above 5%.” Given this, the authors find that in 53.4 per cent of developing countries, brain drain depletes human capital. Argentina, Brazil, China, Egypt, India, Indonesia, Mongolia, Thailand, and Venezuela are found to

²⁵ Examples: (Abowd & Freeman, 1991); (Borjas G. , 1994); (Borjas, Freeman, & Katz, 1997); (Gang & Rivera-Batiz, 1994); (Friedberg & Hunt, 1995).

²⁶ (Mishra, 2014)

²⁷ (Kone & Özden, 2017)

be countries that benefit from brain drain. Yet, while macro-economic studies such as the above illustrate promising results, the debate remains controversial. This is largely the result of data availability, which may result in misspecification biases as well as the impossibility to capture unobserved heterogeneity between countries. Furthermore, although instrumental techniques are utilized in macro-economic studies, the exact causality between skilled migration and human capital formation is not easily detected under a cross-country setting.

In order to circumvent some of these biases, Beine et al. (2011) utilize a panel database on international migration and educational attainment. The dataset includes six observations per country – from 1975 to 2000. In order to test the model predictions, the authors regressed an indicator of “ex-ante human capital formation of natives (i.e., residents + emigrants) on the skilled emigration rate and other country-specific characteristics”. The dependent variable was “a log-change in the proportion of highly skilled (individuals with post-secondary education) among natives”. In order to account for the endogeneity of migration rates, the authors utilize an IV methodology – which they find to be important to assess incentive effects in low-income countries. Having found the empirical model to be used, the authors run simulations (in the steady state) based on varying the skilled emigration rate in order to compute the ex-post proportion of human capital in the country of origin. Based on the two simulations, the authors find that skilled emigration prospects have a positive impact on human capital in low-income countries of origin, yet not in lower/upper-middle income and high-income ones. As such, it unambiguously decreases the average level of schooling in the latter, while ambiguously doing so in the former.

2.1. The labour market pathway

From a country of origin’s perspective, literature, at first, did not go far beyond descriptive statistics and theoretical understanding. Yet not long after that, did it attempt to estimate the impact of migration on costs and forgone production or on expected future earnings.²⁸ Over the years, this resulted in much debate and disagreement surrounding the impact of emigration, especially of the highly skilled, on the country of origin. A debate that to date is still largely theoretical, with little empirical research having been concluded on the topic given an absence of reliable comparative data on international migration by level of skill.

2.1.1 The potential negative wage impacts of high-skilled emigration

The traditional view implies that brain drain reduces the potential for development of a country of origin as a result of the loss of high-skilled workers – especially in countries where the proportion of educated to the population is low. This has been supported by literature, which finds that high-skilled emigration may negatively impact the country of origin’s labor market outcomes, especially of non-migrants; thereby, adversely impacting national productivity as well.²⁹ Yet, it must also be noted that the extent to which different groups of non-migrants are affected varies. While workers with similar skills to those that have emigrated tend to gain, those with different skills lose.³⁰ However, the magnitude of this impact on low- and high-skilled non-emigrants may be challenging to quantify (see **Box 3**) and may also depend on a number of factors including the elasticity of labor, the mix of output, the elasticity of capital, technological adaptations, as well as increases in productivity or differences in the volume of international trade.³¹

To date, negative impacts on wage have largely been found by research on high-income countries of origin, such as those undertaken by Docquier, Ozden and Peri (2011) and Elsner

²⁸ (Scott, 1970)

²⁹ See Elsner, 2022; Elsner, 2015; Abdelbaki, 2009; Mahoodi, n.d.

³⁰ (Elsner, 2015)

³¹ (Dustmann, Fabbri, & Preston, 2005); (Dustmann, Glitz, & Frattini, 2008); (Basso & Peri, 2015)

(2015). According to Docquier, Ozden and Peri (2011), the emigration of the high skilled reduces the wages of those with lower skills between 1 and 6 per cent when considering OECD countries. The larger impacts are noted for countries that have relatively high emigration rates such as Cyprus, Malta, Ireland, New Zealand, and Portugal. For countries with intermediate levels of emigration (i.e., Latvia, South Korea, United Kingdom, and Canada), the negative impact on the wages of those left behind average about 1 per cent. The losses are a result of foregone complementarity effects and lost externalities from the departure of high-skilled individuals. This is supported by Elsner (2022), who finds that the effect of emigration on wages is small for most OECD countries, but large for those countries with relatively high emigration rates. While in the case of the former, the average wage of individuals declines by 0.5 per cent over a ten-year period, this equates to 2 to 3 per cent in the case of the latter.

In contrast, relatively little research has been undertaken on low-income countries of origin. The only study known to the author is that of brain drain's effect on wages in Iran, which has shown positive impacts if the left-behind workers were substitutes, and negative wage impacts if they were complements.³² Other than this, most low-income country studies find positive impacts on wages rather than negative ones, as explained in the next sub-section. Yet, before delving into those, it is of importance to highlight that wage changes are only one of several economic reactions in response to the emigration of workers. Others include changes in capital flows, production inputs, trade patterns, remittances, and internal migration. Emigration of workers may leave the country with fewer workers to operate machinery, thereby causing an outflow of capital. Alternatively, having fewer workers may compel companies to switch from labor- to capital-intensive production. Furthermore, the emigration of workers may leave gaps in regional labor markets, causing internal migration by those left behind to fill these vacancies. Lastly, by remitting money to the country of origin, emigrants may impact labor supply and the reservation wages of non-migrants. Each of these effects may feedback into the impact that emigration has on the level of wages and productivity in the country of origin – thereby affecting the aspirations, attainment, and distribution of human capital in the country of origin.³³

³² (Mahoodi, n.d.)

³³ (Elsner, 2015)

Box 3. Challenges in quantifying the impact of emigration on wages of non-migrants

Five challenges are noted when analysing the impact of emigration on the wages in the country of origin. The first related to counting the number of emigrants. Countries of origin tend to not have systems in place that register the number nor the demographic characteristics of their emigrants. To circumvent this challenge, previous literature has focused on using data from receiving countries or using datasets that have included questions on emigration (e.g., Mexico and Poland).

The second challenge relates to where the emigrant acquired his/her education. In countries of destination, datasets usually assume that the immigrant has attained his/her schooling in the country of origin. For immigrants for which it is clear that they received their schooling in the country of destination, it is ambiguous to which group of native-born individuals their educational attainment constitutes a shock. However, to account for this, empirical analyses often restrict their sample to solely include individuals that have migrated as adults, thereby reducing the likelihood that schooling was obtained in the country of destination. Yet, when doing so, effects are likely to be underestimated as explained by Mishra (2014).

The third challenge relates to the issue of correlation vs. causality as wages could also have been impacted by other economic changes (e.g., trade, FDI, policy, etc.). To circumvent this challenge, researchers have used simulation methods. These allow for the creation of a model economy, which replicates important features of the economy under analysis. Within this model, researchers then simulate how emigration would affect wages, while holding all other factors such as capital flows and trade constant. Another solution would be to use a natural experiment (large emigration due to policy change or a natural disaster) or the use of instrumental variables.

The fourth challenge reflects the potential selection bias in estimating the impact of emigration. This bias results from the fact that emigrants could represent a non-random sample from the population.

The fifth challenge relates to the duration of migration. Most empirical studies treat emigration as permanent even though migration today is largely temporary. As such, the models do not account for return, repeat, nor circular migration. While this would be important to accurately measure the impact of emigration on wages, such models would require repeated observations of migration flows – data that is not readily available.

2.1.2 The potential positive wage impacts of high-skilled emigration

In comparison to the previous sub-section, empirical evidence on the positive impacts of emigration on the wages of individuals left behind in low-income countries of origin is ample. As with much of research, the earliest evidence is theoretical of nature, with the rise in wages being assumed to be the result of emigration. Mahmood (1991) used a Heckscher Ohlin model to indicate this for Pakistan, proposing that emigration may have increased the real wages of the nation in the 1970s. By 1999, simulation models were introduced, which assumed emigration to be a shock in a calibrated equilibrium model. Yet, these were largely focused on the impacts on developed countries of origin such as Ireland, Sweden, and Poland.³⁴ By 2007, Hanson focused on regional-level variation by examining how emigration affected the regional labour supply and regional wages in Mexico. The results illustrate that the hourly wages in states associated with high levels of emigration rose between 6 to 9 per cent when compared to low-emigration states – with the effect being strongest for those in the middle of the income distribution. Thereby supporting previous similar studies by Robertson (2004) and Chiquiar (2004), who find that Mexican states that have larger international trade and migration links are found to experience faster growth rates in average income and labor earnings.

³⁴ O'Rourke and Williamson (1999) and Boyer et al. (1994) found that emigration significantly increased the real wages in Ireland and Sweden. This was supported by Budnik (2012) for Poland, where emigration led to an 8 per cent increase in wages.

However, the use of regional variation within such models implies a number of problems that have been extensively discussed in the context of immigration by Borjas, Freeman, and Katz (1997). Without their addressal, the impact of emigration on wages may be underestimated. A more robust methodology as such would be to undertake national level studies. In 2007, Mishra introduced the first econometric study of the impact of emigration on the national-level wages of Mexico. She uses a widely accepted methodology developed by Borjas (2003) and finds a strong, positive correlation between the emigration of Mexican workers and the national wages of those left behind. In fact, a 10 per cent reduction in Mexican workers as a result of migration, increases the average wage of individuals with similar education levels and work experience by 4.4 per cent. She also finds that this positive correlation is significantly higher for the higher skilled – thereby serving as a possible explanation as to why wage inequality in Mexico is increasing. These findings have been supported by Aydemir and Borjas (2007) for Mexico, Borjas (2008) for Puerto Rico, and Gagnon (2011) for Honduras (see **Table 2** for the statistically and economically significant effects of these authors). Additionally, Beine et al. (2008) have found these wage effects to be particularly strong for small island nations such as Jamaica, Haiti, and Trinidad and Tobago.

Table 2. The impact of a 10 per cent increase in emigration on the national and regional wages in the country of origin³⁵

Country	Level of analysis	Estimated impact	Dependent variable	Source
Mexico	Regional	6-9 per cent	Average hourly earnings	Hanson (2007)
Mexico	National	4.4 per cent	Wage	Mishra (2007)
Mexico	National	5.6 per cent	Monthly earnings	Aydemir and Borjas (2007)
Puerto Rico	National	2.1 per cent	Wage	Borjas (2008)
Honduras	National	2.0 per cent	Wage	Gagnon (2011)

2.2. The human capital pathway

The accumulation of human capital is a life-long process and a key driver of wages and economic wellbeing of a country. In economic literature, the increased attainment of education has long been accepted as the primary index of skill in the labor market, especially for migrant workers. As the returns to skills vary across time and geographic locations, the incentives of individuals to migrate and their aspirations to increase their education adjust accordingly. How exactly these aspirations, along with the overall attainment and distribution

³⁵ Adapted from the table presented in Mishra (2014)

of human capital is impacted by the emigration of high-skilled individuals from low-income countries of origin is examined in this sub-section.

Up to the early 2000s, literature surrounding these impacts remained rather theoretical. In fact, these theoretical papers solely evidenced the possibility of high-skilled emigration leading to the accumulation of human capital in the country of origin.³⁶ The simplest of such theories is rooted in the neo-classical framework and states that the decision to invest into education is driven by the prospects of potential higher returns abroad.³⁷ While many may emigrate, a lot of those who have raised their level of educational attainment will not be able to, thereby increasing the net stock of human capital in the country of origin (i.e., brain gain).³⁸ Yet, few empirical studies have produced conclusive results on these theoretical concepts. As such, no clear consensus can be reached on whether high-skilled emigration positively or negatively impacts the aspirations, attainment, and distribution of human capital of those left behind.

2.2.1 The potential negative education impacts of high-skilled emigration

While Mountford (1997), Vidal (1998), and Beine et al. (2001) suggest that high-skilled emigration may ultimately contribute to the formation of human capital in the country of origin under a context of probabilistic migration, this is based on the argument that higher returns to education in the countries of destination lead individuals, under prospects of migration, to invest into education in the country of origin. Yet, for this incentive effect to work, education must not only provide individuals with a chance to migrate, but also with one that allows them to access legal, and high-skill employment. Without the latter, the prospect of migration may result in a disinvestment into education in the country of origin as evidenced, among others, by McKenzie and Rapoport (2011) for Mexico, De Brauw and Giles (2008) for China, and Checchi et al. (2007) for a panel of over 100 countries.

However, these disincentives may also result from the underlying perceptions that education is not a prerequisite to migrate, that emigration is easy, or that its returns are low. For example, Kandel and Kao (2001) report lower educational aspirations at all academic levels of Mexican children raised in households where international migration occurs. Kandel and Massey (2002) argue that migration becomes part of the family's life plan in migrant origin countries. They find that the migration outlook to the United States influences the behaviour of children in Mexico. This is achieved through two channels, the increase in the probability of migration as well as the reduction in their odds of continuing with education. As such, a child's low desire to complete education could be a result of the perception that education is not a prerequisite to migrate. Rather, the children may underestimate the return on educational investments as

³⁶ (Gibson and McKenzie, 2012)

³⁷ Lucas (2004) argues that the educational choice of Filipino students responds to the changes in the international demand for high-skilled workers. Commander et al. (2008) find evidence to support the incentive effect under the prospect of migration when considering the IT sector, especially the software industry. Kangasniemi et al. (2007) found evidence of an incentive effect in a survey on medical doctors in the United Kingdom. Of the Indian doctors surveyed, roughly 30 per cent acknowledged that the prospect of migration affected the effort put into education.

³⁸ (Mountford, 1997); (Stark, Helmenstein, & Prskawetz, 1997); (Vidal, 1998); (Stark & Wang, 2002); (Beine, Docquier, & Rapoport, 2001); (Beine, Docquier, & Rapoport, 2008); (Docquier & Rapoport, 2012); (Böhme, 2015)

a result of their exposure to 'easy' emigration. Similarly, McKenzie and Rapoport (2011) evidence a reduction in educational attainment by children in areas that are characterized by high rates of emigration. This can potentially be explained by the fact that emigrants may be exposed to low returns to human capital in the countries of destination. In line with this conclusion, Hartog and Zorlu (2009) as well as Sanromá et al. (2009) find that the often low returns to education could discourage potential migrants from adjusting their aspirations upwards.

In addition to this, social norms may impact human capital accumulation in the country of origin as a result of brain drain. In many developing countries, societal and cultural norms require boys to take over the work that is left behind if a father is no longer residing in the household. As a consequence, paternal emigration may reduce the time allocated towards education, and instead increase the workload of the children - as evidenced in the short-run by Antman (2011), especially for boys aged 12 to 15. Yet, the prolonged absence of a parent may also lead to detrimental effects on the educational attainment of children as a result of a lack of guidance and encouragement as evidenced by Biavaschi, Giulietti, & Zimmermann (2015). In either case, importance should be placed on this issue given that the effect of parental nurture is considered to be one of the main drivers of the intergenerational transfer of human capital.

Yet, it must be noted that educational aspirations, the perception of migration and its returns, as well as familial background effects and spillovers in the transmission of human capital can also shape its composition/distribution. According to Beine, Docquier, & Rapoport (2001), a potentially detrimental effect on human capital formation in the country of origin is evidenced if some or all of the high-skilled labours emigrate. This is supported by Beine et al. (2008) who argue that the losses from brain drain are associated with their size. Yet, for this to occur, the effects related to the loss of high-skilled human capital must outweigh the growth in educational investments created through potential migration opportunities given the perception that expected returns to education are higher in the country of destination. Consequently, the overall loss in the country of origin remains small as long as skilled emigration³⁹ and/or the rate of highly skilled migration remains below 20 per cent and 5 per cent, respectively.⁴⁰ Yet, it does become bigger once the rates of emigration rise (see *Error! Reference source not found.* for a more in-depth explanation of the methodology). Therefore, the main prerequisites for a net brain drain effect⁴¹ to be negative is under the instance that the country is not an originally closed and underdeveloped economy in which the probability of migration is low,⁴² or ii) a high-growth economy in which the probability of migration takes

³⁹ Individuals having obtained tertiary education.

⁴⁰ These numbers are a result of the empirical analysis undertaken by Beine et al. (2008) as described in *Error! Reference source not found.*

⁴¹ The authors define a beneficial brain drain effect to be when the average level of human capital is higher in the economy opened to migration than in the economy without migration possibilities.

⁴² As such, any investments into human capital by the country would lead to a positive net effect given that the probability of migration is low. The complete theoretical explanation with the adequate equations and assumptions can be read in Beine, Docquier, & Rapoport (2001).

on an intermediate value.⁴³ Docquier, Lohest and Marfouk (2007) and Di Maria and Lazarova (2012) support this. While the former find that a large brain drain effect in a country can either be attributed to the economy being open or to a strong self-selection of its emigrants, the latter provide evidence that the sign and magnitude of the impact of accumulated human capital on the growth rate of GDP per capita given an increase in skilled migration is detrimental for the least and most developed countries, while benefits may be reaped by countries with an intermediate level of development.

In addition to this, Di Maria and Lazarova (2012) provide evidence that an increase in emigration does not only affect the level of human capital, but also its composition. By excluding the latter effect, the authors warn that the brain drain effect may be underestimated. This is also supported by two cross-sectional studies undertaken by Groizard and Llull (2006, 2007). While the research in 2006 measures human capital in the same period as the occurrence of brain drain thereby basing its approach on anticipatory expectation-building, the study undertaken in 2007 utilizes a 5-year lag relying on the assumption that education decisions by individuals are based on observed migration (i.e., retrospective expectation-building). The authors conclude that while a negative impact of brain drain is seen on tertiary enrolment levels in the country of origin, its positive impact on secondary enrolment should also be considered in the theoretical models of brain drain as an individual's choice to migrate may also be motivated by prospects of acquiring a better tertiary education abroad. Thereby, illustrating a potential larger impact of brain drain on the prospective development of the country of origin than is currently empirically evidenced.

2.2.2 The potential positive education impacts of high-skilled emigration

Yet, despite the literature underlining the potential negative impact of high-skilled migration on human capital accumulation in the country of origin, an equal amount of empirical literature is present that evidences the opposite – i.e., a potential positive impact.

In 2001, Beine, Docquier and Rapoport proxied the emigration of high-skilled individuals through the use of gross migration rates. This was undertaken for a cross-section of 37 developing countries in which they found a significant positive effect of high-skilled emigration on the gross formation of human capital in the country of origin. This effect seemed to be stronger for countries with a low initial level of GDP per capita. This result was confirmed by Beine, Docquier and Rapoport (2008), who utilized Docquier and Marfouk's (2006) estimates of high-skilled emigration in a cross-section of 127 developing countries. The authors found that doubling the prospects of high-skill emigration raised the proportion of highly skilled non-migrants by 1.05 times over a period of 10 years and by 1.23 times over the long-run. However, it is to be noted that the rate of emigration needed to be less than 20 per cent in order for

⁴³ In the second case, the probability of migration must be high enough to induce investment by individuals in human capital, while it must be low enough to not induce a strong brain drain effect. The complete theoretical explanation with the adequate equations and assumptions can be read in Beine, Docquier, & Rapoport (2001).

these results to hold true. As such, the countries in which a net brain gain effect was established were Argentina, Brazil, China, Egypt, India, Indonesia, Mongolia, Thailand, and Venezuela (see **Error! Reference source not found.** for further information on the methodology used). In 2010, Beine, Docquier and Rapoport obtained similar estimations when using alternative estimates for the emigration of the high-skilled (i.e., accounting for the location in which the human capital was acquired) and human capital definitions (e.g., basing them on literacy or school enrollment instead of educational attainment).

However, omitted variable bias, reverse causality and other unobserved heterogeneity issues cannot properly be addressed with the use of cross-sectional data as it may cause spurious positive correlations between high-skilled emigration and human capital formation.⁴⁴ In 2008, Beine et al. addressed the issue of reversed causality by utilizing two sets of instrumental variables – emigration stocks in 1990 (i.e., networks) and population size. Docquier, Faye and Pestieau (2008) achieve similar results using additional instruments in their first stage regressions. These included geographical proximity to developed countries and indicators of disadvantageous location such as whether the country was landlocked or a small island state. Using a growth accounting framework, Easterly and Nyarko (2009) utilize some of the mentioned instruments along with one representing former colonial ties to find that high-skilled emigration causes gross skill creation but no net skill depletion in the sampled developing countries. Beine, Docquier and Oden-Defoort (2011) went a step further by utilizing a panel setting with Defoort's (2008) dataset. The authors controlled for country fixed effects as well as for the endogeneity of the emigration rate. The latter was achieved through the use of a dynamic Generalized Method of Moments technique. Their results support the findings already presented – a significant human capital incentive effect that is stronger for countries with initially low levels of income; however, are in opposition to those found by Beine, Defoort, & Docquier (2010), who acknowledge the impact at low levels of income, but reject the effect for lower-middle, upper-middle, and high-income countries.

While most models concerned with the impact of migration on human capital investments and a possible brain gain are developed based on the assumption that earning differentials are the main determinant of migration,⁴⁵ more recent literature has found this to be problematic as it does not account for the intrinsic value of education – i.e., the interest, motivation, and enjoyment that individuals themselves experience when engaging in education.⁴⁶ As such, through the use of microeconomic evidence, this proposition could be tested empirically.

Yet, a key challenge in doing so is to identify a credible source of exogenous variation in either the returns to skill abroad or migration opportunities.⁴⁷ This exogenous variation is needed if

⁴⁴ This is possible through the fact that increases in the quantity of human capital may be accompanied by increases in its quality, as such making human capital more internationally transferable and thereby creating the spurious correlations. At the same time, reverse causality could result from the fact that an increase in the number of highly skilled in the country of origin could generate an excess supply of skills in the short-run and translate into more emigration.

⁴⁵ Examples: (Stark, Helmenstein, & Prskawetz, 1997), (Mountford, 1997), (Vidal, 1998), (Beine, Docquier, & Rapoport, 2001).

⁴⁶ (Bénabou & Tirole, 2003)

⁴⁷ (Gibson & McKenzie, 2012)

one wants to examine the responsiveness of educational attainment. Under such a framework, Chand and Clemens (2008) find that the 1987 military coup in Fiji – resulting in physical violence and discriminative policies against the minority - incentivized Indo-Fijians to acquire more education in order to migrate when compared to ethnic Fijians. This was prevalent in secondary (Form 7) and in bachelor degrees. In 2010, Shrestha uses a 1993 change in the educational requirements for Gurkha British Army recruits to illustrate the rise in the probability that affected males would complete primary and secondary education given the consequent rise in educational returns abroad. Furthermore, in 2012, Batista, Lacuesta and Vicente estimated that in Cape Verde, the emigration of high-skilled individuals not only has a net positive effect but is also responsible for the bulk of human capital formation in the country.

Likewise, Gibson and McKenzie (2012) illustrate that 85 per cent of all the high ranking high-school students of Tonga and Papua New Guinea considered the possibility of emigration while still in high school. This contemplation led them to change their course choices and take additional classes. It was found that disciplines in science and commerce were favored. The authors also found an alignment of the educational curriculum with the history and culture of possible countries of destination. As such, the authors concluded that these substantial spillover effects in addition to the high returns on education/skills largely explain the positive effect of high-skilled emigration in terms of the formation of net human capital.

Furthermore, unlike the negative impacts detailed in the aforementioned sub-section, several complementing studies also argue that brain gain can occur as a result of a change in the educational aspirations of parents/caregivers or due to a change in the motivation of children towards education given that these can be important determinants of behavior and as such a key element of economic development.⁴⁸ In relation to human capital accumulation, several authors have proposed that the exposure to new role models (e.g., individuals with a higher level of education) can positively influence a child's educational aspirations or even the investment behavior of households.⁴⁹

Kandel and Kao (2001) find positive effects of parental migration on children's educational performance in Mexico. While the improved financial situation of the migrant households plays a large role in this, the authors also attribute the impact to changes in the motivation of children towards education as a result of parental migration.⁵⁰ Mansuri (2006) presented evidence for Pakistan that points in a similar direction. Taken together, the evidence suggests that aspirations are an important determinant of behavior and as such intergenerational human capital transfer and economic development.⁵¹ Such a positive correlation is also

⁴⁸ (Ray, 2006)

⁴⁹ (Beaman, Duflo, Pande, & Topalova, 2012); (Macours & Vakis, 2009); (Krishnan & Krutikova, 2013)

⁵⁰ This can be attributed to a general improvement of the well-being of children, less need for child labour, as well as them having access to information and social networks that reduce their likelihood that migration will fail in the future.

⁵¹ (Beaman, Duflo, Pande, & Topalova, 2012); (Macours & Vakis, 2009); (Krishnan & Krutikova, 2013)

reported by Czaika and Vothknecht (2014) when analyzing the relation between economic aspirations and migration using the Indonesian Family and Life Survey.

2.3. The macro-economic development pathway

Human capital has, over the years, been found to be one of the most fundamental contributors to economic growth and development.⁵² Consequently, its deficiency is one of the main reasons as to why developing countries remain underdeveloped and poor – a situation that is intensified through the loss of high-skilled labour. Despite this, relatively recent research has emerged that illustrates that the potential negative impacts of high-skilled emigration on the country of origin can be partially or wholly offset through remittances, increased foreign direct investment and technology flows, as well as return migration. Yet, conclusions on which of the two effects is strongest and what the net effect of high-skilled emigration is on a country of origin remain inconclusive and highly country dependent as the next sub-sections will showcase.

2.3.1 The fiscal balance

While under circumstances of no migration, the educated and trained individuals, upon completion of their degree, work, live, and pay their taxes in the country of origin, this is not the case when allowing for migration. In fact, under the latter, the government cannot wholly or only partially recoup the costs incurred of the provision of public services, such as education, given that their citizens live abroad.⁵³ Although this effect occurs for all levels of skill among migrants, it is strongest in the case of the highly skilled.⁵⁴

Thereby, under the circumstances in which an individual has received public or private educational support from his/her government, the decision to emigrate may lead to a loss of earning potential as well as a simultaneous loss of tax revenue for the country of origin.⁵⁵ As a consequence of the brain drain, the country may face a reduction in its development prospects. This is especially true in a developing context given that such countries may have a shortage of skilled labor when compared to that of developed nations. To counteract this loss, several measures can be instituted by the country of origin to limit the migration of its skilled individuals, such as restrictions on international recruitment, taxes on highly trained emigrants, and systems of compensation from destination country governments to origin country governments.⁵⁶ One of the many challenges of this, however, is the fact that the value of fiscal losses cannot be calculated for certain. This can be due to a variety of factors including: i) the fact that a large proportion of skilled professionals, especially from developing countries, were

⁵² (Lucas, 1988); (Romer P. , 1990b); (Mankiw, Romer, & Weil, 1992); (Siggel, 2001); (Pistorius, 2004); (De La Fuente & Domenéch, 2006); (Riley, 2012).

⁵³ (Grubel & Scott, 1966); (Johnson H. , 1967); (Berry & Soligo, 1969); (Bhagwati & Hamada, 1974); (Kwok & Leland, 1982)

⁵⁴ (UNCTAD, 2012)

⁵⁵ (Chiswick & Miller, 2015)

⁵⁶ (Ratha, et al., 2011); (Bhagwati & Rodriguez, 1976); (Bhagwati & Wilson, 1989)

educated or trained outside of their country of origin;⁵⁷ ii) a substantial proportion of the public investment into the education and training of emigrants is recouped before their departure through, for example, movement restrictions for a certain amount of years in exchange for funding; and iii) the inflow of remittances sent by emigrants.⁵⁸ As such, it may be difficult to decide on the extent to which the mitigation measures of brain drain should be implemented.

Given this, the provision of evidence on the value of the fiscal loss is one of the key objectives of literature analysing the fiscal impact of emigration. Studies that have focused explicitly on estimating this impact include examples from the developing and developed world. An example of such is shown by Kirigia et al. (2006), who illustrated that the public investment into the medical training per physician by the Government of Kenya amounted to USD 48,169 – an exorbitant fiscal loss of the country where an average person earns approximately USD 1.3 per day. This loss is equivalent to that calculated for a variety of other African countries, where annual costs of medical schooling range between USD 5,000 to USD 10,000.⁵⁹ In 2009, Desai et al. analyzed the fiscal impact of high-skilled emigration from India to the United States. This involved estimating the counterfactual earnings distributions of emigrants through two methods, which are subsequently integrated into a model of the Indian fiscal system. The first method utilizes the estimated earnings and participation equations to determine expected earnings. The latter is conditional not only upon the participation of an Indian emigrant resident in the United States, but also on his/her probability of participation. Consequently, the lower bound of the counterfactual income estimates is estimated. The second method uses observable characteristics to determine what the emigrant's percentile rank would be in both the Indian income and participation distribution; thereby providing the upper bound of the counterfactual income estimates. These calculations in addition to modelling the Indian fiscal system allows the authors to find a negative impact on fiscal revenue of 2.5 per cent as well as a net fiscal impact of emigration that is equal to less than 1 per cent of India's gross national income.

Furthermore, Gibson and McKenzie (2012) present results of a survey undertaken on high-skilled emigrants in Tonga, the Federated States of Micronesia, Papua New Guinea, Ghana, and New Zealand. The authors estimate that the net annual fiscal cost per high-skilled migrant equates to USD 500 to 1,000 in Tonga and Micronesia, and USD 6,300 to 16,900 in Ghana and Papua New Guinea. Campos-Vazquez and Sobarzo (2012) focused on the fiscal impact of emigration in Mexico. In their analysis, they look to compare a number of scenarios. Under one such scenario, a reduction in the Mexican labor supply of 6 per cent, reduces tax revenue by 2 per cent. In another scenario, the reduction in the labor supply is coupled with an increase in the capital stock of 18 per cent. Here, tax revenue increases by 7 per cent – pointing towards

⁵⁷ Yet, it is important to keep in mind that although individuals may be trained/educated abroad, this may have been funded by the country of origin. If this is the case, this would need to be counted into the fiscal losses of the country of origin.

⁵⁸ (Clemens M. , 2011)

⁵⁹ (Hagopian, et al., 2005); (Clemens M. , 2011)

the difficulty in estimating the true fiscal loss of brain drain to the country of origin given that many factors need to be accounted for.

2.3.2 The contribution of remittances to the fiscal balance

Given the aforementioned fiscal losses that can be incurred by a country of origin upon the emigration of its citizens, it is of importance to note that international migration may also contribute to the country's fiscal balance through the remittance of money from individuals working abroad – an avenue known to be the most tangible link between development and migration according to Russel (1992) and Ratha (2007). This is due to remittances having the capability of improving the current account of the countries of origin, contributing to international reserves, and helping to finance imports. They are furthermore associated with an improved outcome to education, nutrition, and health, a reduction in poverty as well as increased business investments. In turn, these effects may contribute to long-run productivity of the nation and also improve the stability of consumption and output through the increase of investment supply from both foreign and domestic sources.⁶⁰ Combined, all these factors ultimately contribute to the economic growth of the country.⁶¹

Yet, while it is an important source of liquidity for individuals in the country of origin, evidence remains mixed on the size and magnitude of the impact that high-skill levels have on remittance behavior.

Macro-economic evidence

From an empirical perspective, previous literature has studied the effect of education on remittances relying on macro-economic data. This is achieved by investigating the correlation between remittance inflows and high-skilled emigration rates at the country level. While a number of country studies⁶² have focused on this, empirical findings seem to be inconclusive of the effect of remittances on key variables.

In 1986, Straubhaar, uses Turkish data to analyze the relationship between remittances and the exchange rate as well as the real return to investment. In both instances, the author finds insignificant effects. In an analysis for India, Gupta (2005) finds effects that are in line with those by Straubhaar, but also acknowledges that the economic activity in the country of destination is of importance when determining the flow of remittances.

Both Faini (2006) and Niimi, Özden, and Schiff (2010), using a macroeconomic, cross-country approach, find that high-skilled emigrants' remit less than lower-skilled individuals. Faini illustrates that the proportion of income remitted declines with the proportion of high-skilled amongst the emigrants of a country of origin. This is especially the case for more permanent

⁶⁰ (Chami, Hakura, & Montiel, 2009); (Mohapatra, Joseph, & Ratha, 2009); (Aggarwal, Demirgüç-Kunt, & Martinez Peria, 2006); (Gupta, Pattillo, & Wagh, 2009)

⁶¹ (Rajan & Zingales, 1988); (Ghirmay, 2004); (Akinlo & Egbetunde, 2010)

⁶² (Straubhaar, 1986); (El-Sakka & McNabb, 1999); (Chami, Fullenkamp, & Jahjah, 2003); (Gupta P. , 2005)

migrants as they are more likely to move with families or inter-marry at the country of destination. Furthermore, permanent migrants also migrate longer distances and, as such, have less contact with their country of origin. As such, the author concludes that the negative impact of brain drain cannot be offset by higher remittances. This is supported by Naufal (2007) as well as Niimi, Özden, and Schiff (2010), the latter of which take potential endogeneity of migration and the migrants' educational level into account. Nevertheless, such analyses can, at best, identify whether sending a higher share of high-skilled migrants results in more or less remittances being received by the country of origin than sending lower-skilled workers.⁶³

In 2016, Bredtmann, Flores and Otten enhance the approach utilized by Faini (2006). The authors create a cross-country dataset by combining household surveys from five Sub-Saharan African countries that enables them to analyze the correlation between migrants' education on their remittance behavior. The authors address the potential bias from unobserved heterogeneity across the households of migrants in the country of origin through two channels. First, they utilize data that matched the households in the country of origin and destination. Second, household fixed effects are employed that only use within-household variation for identification. Combined, an insignificant impact of migrants' education on the probability of remitting money to the country of origin is found.

However, in contrast to these, macroeconomic evidence supporting the effect of education on remittances is also present. Manning (2007) found positive correlations between remittances and the total rates of emigration to OECD member states as well as between remittances and the emigration rates of skilled workers. Gibson and McKenzie (2012) noted that the countries that are concerned about the emigration of their high-skilled, usually also appreciate the remittances and job opportunities that this process provides for the lower skilled. In 2011, Docquier et al. utilize a panel database on bilateral remittances and find a positive correlation between the share of high-skilled emigrants and the amount of remittances received in their countries of origin. Nevertheless, they further argue that this effect along with the magnitude of remittances sent home is strongly influenced by the immigration policy of a country of destination. For example, when considering destination countries with guestworker agreements or more restrictive family reunion policies a positive correlation is found between skill-level and sending remittances. Le Goff and Salomone (2016) support these findings.

In addition to this, literature that supports the impact of remittances often times cite the direct effects on the stimulation of consumption, improved education, the reduction of poverty, the curtailing of foreign exchange and credit constraints, increased investment as well as positive spill-overs as liquidity to small enterprises; especially in the case of small and poor countries.⁶⁴ In fact, in many countries the amount of money remitted may contribute substantially to the

⁶³ (Manning, 2007)

⁶⁴ (Woodruff & Zenteno, 2001); (Boucher, Stark, & Taylor, 2005); (Adams R. , 2006); (Docquier & Rapoport, 2006); (Yang & Martinez, 2006); (McKenzie & Rapoport, 2007); (Yang, 2008); (Gibson & McKenzie, 2012); (Antman F. , 2013)

nation's GDP (e.g. Tonga, Haiti, Nepal, Kyrgyzstan, Tajikistan, etc.), while also being a key source of foreign exchange.⁶⁵

Box 4. Empirical research quantifying the effects of remittances on education.

Literature that focuses on the effects of remittances on education has been of particular interest as it provides an avenue of research that may evidence that human capital accumulation can break intergenerational poverty. Yet, evidence to date has been controversial. While some authors find a positive correlation between migration and remittances on the probability of schooling, others conclude migration to have detrimental and remittances insignificant effects on education.

In the case of positive correlations, authors argue that a higher likelihood of schooling is a result of households having additional income, given wage premiums for migrants, which they invest into education (Shrestha 2017; Alcaraz et al. 2012; Calero et al. 2009; Göbel 2013; Sintov and Cojocar, 2013). Furthermore, remittances may keep children in school and delay their entry into the labour market (Sintov and Cojocar, 2013; Bouoiyour and Miftah 2016), may allow them to have better access to higher levels of education (Sintov and Cojocar, 2013), or may even reduce the hours worked by children allowing them to dedicate more time to human capital accumulation (Coon 2016). Lastly, remittances may also allow individuals to use the education they have by waiting for a profession of their choice rather than needing to find any employment opportunity to survive (Sintov and Cojocar, 2013).

On the other hand, remittances may not be able to offset the other negative effects imposed on households through migration. For example, studies argue that the negative impact of migration on education may be the result of children having to compensate for a missing family member. This could entail needing to join the labour market and/or to take over domestic responsibilities (Amuedo-Dorantes and Pozo 2010; Bouoiyour and Miftah 2015; McKenzie and Rapoport 2011; Cortes 2015). Furthermore, remittances may also have an insignificant impact on education or may even hinder it (Bargain and Boutin 2015; Nepal 2016; Pilarova and Kandakov 2017; Davis and Brazil 2016).

Freund and Spatafora (2005) extend this notion by looking into the development of the financial sector in the countries of origin. While few studies have looked into this, the authors find a significant positive correlation between the financial sector and formal remittance flows. This is mainly a result of formal channels reducing the costs paid to remit and as such reducing the remittances sent through informal channels. This is supported by work undertaken by Niimi, Özden, and Schiff (2010), who argue that the level of financial sector development has a positive impact on total and per capita remittances. This is also the case when considering population size and national income. In addition to this, remittances also provide a nation the opportunity to create transnational networks⁶⁶ and networks for knowledge/ technological transfer⁶⁷ – a channel that will be analyzed in the following sub-section. Nevertheless, although these effects are of importance, the size of the impact still depends on the quantities transferred and on their distributional impact.⁶⁸

Micro-economic evidence

Though much literature has focused on the macroeconomic aspect of migration, there are also several that delve into the microeconomic determinants of remittances. This type of analysis allows for a direct investigation of the relationship between remittance behavior and the migrants' education. In 1991 and 1998, Adams used micro evidence to underline the fact that

⁶⁵ (Manning, 2007)

⁶⁶ (Chiswick B. , 2005)

⁶⁷ (Mohapatra & Burns, 2008); (Gibson & McKenzie, 2012); (Schellinger, 2017)

⁶⁸ (Docquier & Rapoport, 2011)

remittances are used unproductively on conspicuous expenditure; thereby hindering the growth effect that remittances may have had. Models of a more elaborate nature build on this to conclude a negative relationship between remittances and problems of moral hazard on the side of the recipient, as well as the incentives to work; ultimately also leading to a decline in growth. This is supported by Chami et al. (2003), who argue that remittances may not be a source of capital for effective development.

In 2010, Dustmann and Mestres make use of consecutive waves of the German Socio-Economic Panel database. After controlling for intentions to return as well as the household composition in the country of destination, the authors find a negative correlation between education and remittances. This is partially supported by Bollard et al. (2011), who finds an ambiguous relationship between education and the probability of remitting, yet a strong positive effect between education and the amount remitted by utilizing data of 14 household surveys in eleven countries of destination. The latter only holds, however, on the condition that the migrant is already remitting. As such, the authors estimate that a migrant with a university degree will, on average, remit close to USD 1,000 per year, while one without a university degree, remits USD 750 annually. This finding is supported by research undertaken by Bollard et al. (2010) as well as Bredtmann, Flores and Otten (2016). While the former focus on African migrants and illustrate that the relationship between remittances and education is non-linear, the latter argue that this effect holds for sub-groups of internal migrants and migrants in non-OECD countries; however, vanishes when solely considering migrants in OECD countries.

This supports evidence found by Funkhouser (1995), who states that immigrants from Central America with higher levels of education tend to remit less than immigrants with lower levels. However, of the immigrants that do remit, those with higher levels of educational attainment are more likely to send more. Gibson and McKenzie (2012) support this finding. Among the most highly skilled migrants from countries exhibiting the highest rate of high-skilled migration, the frequency as well as the amount remitted can be high. The authors reported that between 68 per cent and 93 per cent of the highly skilled migrants from developing countries remit. The average amount of remittance being roughly USD 5,000. This amount of annual remittance is also supported by Clemens (2011), who undertook a survey of African physicians in the United States and Canada.

2.3.3. The effects of the diaspora

While the financial flows between migrants and the country of origin are seen to be the center of the relationship between migration and development, it is also widely acknowledged that remittances are a fraction of these flows. In fact, according to Dilip Ratha of the World Bank, “remittances tap the incomes of migrants, but the greater challenge is to mobilize the wealth of the diasporas”.⁶⁹ As such, this section explores how diasporas - defined generally as the

⁶⁹ (Terrazas, 2010)

networks maintained between migrants and their country of origin - contribute to partially or completely offsetting the loss of human capital as a result of emigration⁷⁰.

Irrespective of skill levels, these contributions can be achieved either directly through brain circulation and virtual returns,⁷¹ or indirectly through the creation and development of networks. The latter includes business networks (e.g., trade and foreign direct investment), scientific networks (e.g., technological diffusion), and political networks (e.g., institutions). Depending on the network chosen, positive externalities including improved business opportunities, the knowledge of new markets, improved trade, the reduction in transaction costs as well as the facilitation of flows of services, goods and knowledge emerge, which ultimately play a crucial role in supporting the sustainable development in the country of origin and integrating them into the global market.⁷² While the theoretical effects of these channels have long been recognized in the early sociological work on brain drain; evidence utilizing empirical channels is rather recent.

Considering the theoretical underpinning of the effect, Gaillard and Gaillard (1997) as well as Meyer (2001) recognized that the migration of the high-skilled, especially of scientists, can enable the international diffusion of knowledge and of technology. While much of the literature in relation to the diaspora is focused on the contributions of the highly skilled, it needs to be noted that medium- and low-skilled workers also contribute to the country of origin.⁷³ Yet, to be kept in mind is that even though the effect of the diaspora may be beneficial for the country of origin, the gains need to be evaluated carefully. In fact, benefits are likely to be small, especially for lower income countries, as they depend highly on a favorable investment climate. In addition to this, it is uncertain whether the effect depends on the number or the proportion of high-skilled living in the developed world.⁷⁴

Box 5. The acquisition of knowledge and skills

International migrants exhibit a range of skill and educational background. While some are highly skilled, others may have no formal education or may have completed primary or secondary degrees. The differences between those that choose to migrate and those that do not become more pronounced throughout the years. In fact, time spent abroad allows migrants to be exposed to different languages, cultures and business environments allowing them to acquire new skills. According to Dustmann et al. (2011), this accumulation of capital is achieved through a number of channels including accumulated experience, formal education, on-the-job training, and learning-by-doing. While all migrants can acquire new knowledge and skills, the effect becomes more pronounced the more skilled the migrants are. This is achieved through a process known as cumulative causation driven by the increasing returns to skills (UNCTAD, 2012). In turn, the higher accumulation of capital could thus also imply a larger investment into the country of origin by the high-skilled diaspora.

⁷⁰ Yet, it needs to be noted that this impact also largely depends on the definition of a diaspora. If third- or fourth-generation descendants of migrants are included into it, then there would be no loss of human capital to offset.

⁷¹ This consists of high-skilled migrants, which teach students in their countries of origin through online classes.

⁷² (Terrazas, 2010)

⁷³ (Orozco, 2003); (Lowell & Gerova, 2004); (Lucas R. , 2004); (Orozco, 2006); (Portes, Escobar, & Radford, 2007); (Crush, 2011)

⁷⁴ (Manning, 2007)

Business networks

It is common knowledge that the accumulation of human, financial and physical capital are some of the main determinants of economic growth. It is also widely acknowledged that the lack of these factors of production are potentially inhibiting low-income countries from achieving development. This is aggravated by the increased outflow of skilled migrants from the country of origin, thereby depleting the stock of human capital and potentially leading to brain drain. However, in recent times, rapidly developing literature has emphasized the possible positive effect of emigration. In addition to the inflow of remittances described in the previous section, the transfer of growth-enhancing technology, trade, and foreign direct investment (known as the business network effects) also contributes to the potential creation of a brain gain effect. As such, literature has focused on foreign direct investment (FDI) as one of the channels through which technology is diffused or transferred. Migrants may be personally involved in this channel, thereby increasing the flow of foreign capital into the country of origin.

Across this literature, two schools of thought exist. The first follows standard trade models and predicts that migration and FDI are substitutes, while the second focuses on the more recent socio-economic literature in which these factors are seen as complements. The latter effect has largely been described from a case study perspective, especially in the software industry.⁷⁵

In 2007, Checchi et al., who question the beneficial cycle between FDI and human capital in the brain gain literature, use data on skilled migration rates for the years 1990 and 2000 and find that tertiary enrolment is positively correlated with FDI. This would imply that countries facing a continuous inflow of investment would upgrade the skills of their citizens. However, when accounting for the negative correlation between tertiary enrolment and emigration, the aforementioned effect becomes insignificant. In addition to this, the authors also find a negative relationship between FDI and secondary school enrolment. From a different perspective, Kugler and Rapoport (2007) find that, in 1990, a 1 per cent increase in emigration to the US by workers with secondary education, reduce the annual FDI growth rate to the country of origin by 0.1 per cent. The authors also find a positive effect on current FDI in the service and manufacturing sectors of the country of origin when accounting for past high-skilled emigration, indicating the complementarity of effects.

In contrast, Tong's empirical analysis (2005) finds a positive correlation when considering ethnic Chinese networks across South-East Asia and beyond. This positive correlation is also evidenced by Murat, Pistorresi, and Rinaldi (2008), Docquier and Lodigiani (2010), Javorcik et al. (2011), and Leblang (2011); particularly for high-skilled migrants. Docquier and Lodigiani (2010) support this notion as they find evidence of positive externalities between FDI and high-skilled migration; thereby suggesting that brain gain effects are associated with skilled migration. From a micro-economic perspective, Foley and Kerr (2008) analyze the business

⁷⁵ (Saxenian, 2001); (Arora & Gambardella, 2005); (Commander, Chanda, Kangasmieni, & Winters, 2004)

network effect at the firm-level. They specifically consider the link between high-skilled immigration to the United States and FDI in the country of origin. In order to do so, they look into patents by ethnicity and find a positive correlation between this and FDI in the inventor's country of origin. In fact, a 1 per cent increase in the firm's pool of inventors, increases the share of FDI in the country of origin by 0.1 per cent.

In addition to the link to businesses, FDI can also be related to direct investments to households. Data from the OECD has found that households receiving international remittances invest into productive capital including real estate, businesses, land, and agriculture.⁷⁶ Gibson and McKenzie (2012) noted that these effects are the exception. According to their analysis, only 5 to 8 per cent of high-skilled migrants originating from low-income countries directly invest into their country of origin. Of those that did, the amounts invested were relatively small at less than USD 18,000. The main deterrents, apart from a lack of economic and political stability, included a lack of investment incentives, no support from the government in the country origin as well as no guarantee for investments.⁷⁷ Docquier and Lodigiani (2010) support this argument to the extent that they find that the creation of bilateral FDI⁷⁸ is anticipated to differ based on the size of the diaspora and the country of origin.

Scientific networks

While diaspora networks have largely analyzed the relationship between migration and FDI, recent literature has focused on the international diffusion of inventive activity and ideas,⁷⁹ firms' internationalization strategy,⁸⁰ as well as on the internationalization of research and development activities.⁸¹ From a development perspective, Montobbio and Sterzi (2013) and Clemens et al. (2014) delved into the relationship between diasporas and transnational inventive activities, especially between developing and developed nations. Cultural and language differences seriously undermine the internationalization of inventive activity in addition to difficulties screening potential partners, differences in laws and regulations as well as difficulties in managing and administrating common projects.⁸² Yet, while the emigration of the highly skilled weakens the local knowledge networks, it also helps the remaining inventors to access knowledge accumulated abroad; thereby potentially contributing to the country of origin and partially offsetting the negative impacts as a result of the brain drain.

In 1991, it was largely believed that the cultural and geographical barriers hinder the formation of innovation networks across countries. As such, it was assumed that this phenomenon was primarily present at the national level.⁸³ This was supported by Guellec and van Pottelsberghe

⁷⁶ (Ratha, et al., 2011); (De Haas, 2005); (Osili, 2004)

⁷⁷ (UNCTAD, 2012)

⁷⁸ Inflows and outflows of capital as a result of high-skilled migration due to the networks created, which provides market information, reduce transaction costs, thereby promoting trade, investment and technology adoption in the country of origin.

⁷⁹ (Kerr W. , 2008); (Oettl & Agrawal, 2008); (Agrawal, Kapur, McHale, & Oettl, 2011)

⁸⁰ (Saxenian, Motoyama, & Quan, 2002); (Foley & Kerr, 2013)

⁸¹ (Patel & Vega, 1999); (Guellec & Van Pottelsberghe de la Potterie, 2002); (Picci, 2010)

⁸² (Foray, 1995); (Montobbio & Sterzi, 2013)

⁸³ (Patel & Pavitt, 1991)

de la Potterie in 2002. Analyzing patent data from 1995, the authors found that solely 4.7 per cent of European patents and 6.2 per cent of patents in the United States have foreign co-inventors.⁸⁴ Picci (2010) found similar results for European patents in 2005, in which only 8 per cent had foreign co-ownership.

While this may be the case, more recent data highlights the positive impacts that result due to an emigration of talent. In 2006, Kuhn and McAusland find that high-skilled workers may be used more productively abroad. In fact, the emigration of inventors may raise global innovation and thereby allow for positive returns to the country of origin through the import of products at a lower cost or with improved technology. This complements findings by Saxenian (2005), who argues that the gains flow back to the developing countries of origin in the form of enhanced ideas for innovation, skills, and personal connections.

In 2008, Agrawal et al. used patent citation data associated with inventions from India to estimate the net effect of the emigration of inventors on the access to domestic knowledge. While the authors find evidence for significant co-location and diaspora premiums, they also argue that the difference between these two effects is a sufficient condition for a negative impact of high-skilled migration on the domestic economy. As such, their conclusions highlight that the optimal level of emigration may partially depend on the relative value of inventions. During the same year, Kerr (2008) confirmed that knowledge diffuses transnationally through ethnic networks and that this has sizable impacts on the output of the country of origin. This is especially the case when considering the Chinese diaspora in the United States. This finding was supported by Agrawal et al. (2011), who focus on inventors of United States patents by studying the flow of knowledge between India and its diaspora in the United States. In 2015, Breschi et al. use a name analysis to assess the role of ethnic ties in the dispersion of scientific knowledge. Their analysis includes ten countries who have some of the highest skilled emigration rates to the United States. These are situated in Europe and in Asia. In each of the countries, the authors test whether the patents of foreign inventors are disproportionately cited by inventors in the country of origin (the brain gain effect) or by co-ethnic migrants (the diaspora effect). The resulting evidence suggests that a diaspora effect is found for Asian countries and Russia (the only European country). Furthermore, they argue that diaspora effects do not necessarily translate to a brain gain effect. This was most notable for India. In fact, as a whole, the authors find that the effect of the diaspora and the brain gain bear less weight in the diffusion of technical knowledge than when considering channels such as multinational companies or co-invention networks. The authors note this to be due to the “absorptive capacities⁸⁵ of the country of origin, [rather] than with the international dimension of the diffusion process under consideration”.

⁸⁴ This increased to 25 per cent in 2007 according to Wadhwa et al. (2007).

⁸⁵ Absorptive capacity can be viewed as a company's ability to recognize the value of new information, understand it, and use it make profit. Such absorption can aid an organization to become more flexible, innovative and achieve higher levels of performance than it would without doing so. As such, the conclusion of these authors is that the creativity and knowledge generated within a firm is of more importance in the diffusion of knowledge than when considering ethical ties.

In addition to this, at the firm level, Foley and Kerr (2013) discover significant impacts when analyzing the relationship between ethnic inventors in the United States and research and development linkages to the country of origin. This occurs in the form of knowledge flows or research and development alliances. These findings have been supported by Schellinger (2017), who argues that mobility within the European Union of high-skilled workers is likely to stimulate innovation, while simultaneously boosting the knowledge economy. As these authors argue, ethnic inventors in countries of destination are especially pertinent for firms as it allows them to overcome barriers to the internationalization of inventive activity and benefit from foreign opportunities.⁸⁶

Nevertheless, there is also literature that awakes caution. According to Breschi et al. (2014), literature present on the transfer of knowledge is usually limited to the United States – the largest receiving country – and its largest providers of foreign-born scientists and engineers. This leads some authors, including Gibson and McKenzie (2012), to believe that high-skilled emigration may not systematically participate in these activities. Instead, literature may have focused extensively on the Indian and Chinese diaspora, making them the exception instead of the rule.

2.3.4. The effects of return migration

The gains to the country of origin as a result of contributions by returnees are numerous, yet often depend on the country's development as well as the potential opportunities for involvement. This paper delves into two avenues of contribution related to knowledge and entrepreneurship.

Stark et al. (1998) were the first to reveal the likelihood of brain gain coupled with brain drain in a context of migration, imperfect information, and return. Under these circumstances, low-skill workers invest into education to emigrate and are consequently pooled with high-skilled workers on the foreign labor market. Once individual productivity is uncovered, low-skill workers return to their country of origin with a stock of human capital that they would otherwise have not acquired if it were not for the opportunity to emigrate. As such, this allows for the dampening of the negative impact of brain drain and as such gives rise to brain gain. In the case of skilled migration, return rates increase with home country skill prices and growth prospects.⁸⁷ Docquier and Rapoport (2012) support this notion, yet add that a positive net effect is most probable if the migration experience is not too long and if the productivity differential between the country of origin and destination is neither too small nor too large.

The knowledge pathway

According to Dustmann and Kirchkamp (2002), returnees often use the skills and experience that they have attained abroad to work in knowledge-intensive activities (e.g., business

⁸⁶ (Miguélez, 2016)

⁸⁷ (Kwok & Leland, 1982); (Dustmann & Weiss, 2007)

manager positions, government, and consultancies). They also forge long-lasting relationships in both the country of origin and destination that, upon return, can be linked and sustained.⁸⁸ There is also evidence to support the notion that returnees significantly increase the technological capacity and innovation activities in the country of origin. In addition to this, Mayr and Peri (2009) also find that human capital acquired through a migration experience to Western Europe yields a higher return premium in the country of origin, as such giving rise to a positive selection in return migration. The authors conclude that an increase in the probability of high-skill emigration from 0 to 20 per cent, increases educational attainment by a full year when controlling for the quality of repatriated human capital. The model used was also able to identify the conditions under which a brain gain could occur when education decisions and return migration were endogenous. This was supported by Dustmann et al. (2011). Yet, Gibson and McKenzie (2012) add that return decisions are affected by country characteristics and personal considerations outside of the sphere of income maximization when finding comparatively high rates of return in spite of the substantial monetary losses entailed by migrants.

The entrepreneurship pathway

The increase in technological capacity in the country of origin can also be achieved through the establishment of businesses by returnees. Several avenues that allow migrants to more likely be entrepreneurs when compared to non-migrants are the accumulated savings while living abroad, the additional skills acquired as well as the business connections that were established.⁸⁹ To note is that entrepreneurial activities can emerge from both low- and high-skilled migration yet are more likely in the case of the latter. Ammassari (2003) finds that skilled returnees to Ivory Coast and Ghana fostered beneficial development impacts in both the private and public sector. However, while the most recent cohorts were focused on investing directly into entrepreneurship, former cohorts largely assisted in building the nation. As such, cross-generational differences can be witnessed among returnees. The authors also found that of the benefits that returnees to developing countries cited as the most important, specialized technical expertise and communication skills ranked highest, along with contributions to labor productivity and work morale. Of the modest amount of accumulated savings that the returnees brought with them (on average less than USD 10,000), the majority used it on housing and the consumption of durable goods rather than investing it into businesses. De Zwager et al. (2005) find that long-term Albanian emigrants have accumulated savings of between 10 to 15 billion Euro. Of this group, approximately 38 per cent have an intention to invest upon the return to Albania, which when applying an average multiplier effect, results in a remittance pool of Euro 8.5 to 9.7 billion. In Ghana and the Ivory Coast, Black and Castaldo (2009) argue that returnees invest into business activities and that the holding of communication ties to the country of origin throughout the migration experience facilitates

⁸⁸ (Glick Schiller, Basch, & Blanc-Szanton, 1992)

⁸⁹ (King, 1986); (Gitmez, 1988); (Massey et al., 1987); (Ahmed, 2000); (Murphy, 2000); (McCormick & Wahba, 2001); (Gedeshi & Mara, 2003); (De Zwager, Gedeshi, Germeji, & Nikas, 2005); (Wahba & Zenou, 2011)

this process. In 2011, Gubert and Nordman learn that roughly 33 per cent of returnees to Algeria, Tunisia and Morocco invested in businesses, yet the authors do not find a relationship between entrepreneurship and migration duration.

3. The gender perspective of brain drain/gain

From a gender perspective, Docquier et al. (2009) find that highly skilled women were increasingly more likely to migrate when compared to their male counterparts with the rate of growth of high-skilled women exceeding that of low-skilled women and high-skilled men when considering most countries of the OECD between 1990 and 2000. Yet, although the growth rates for high-skill female migration were higher - given that they are increasingly targeted in labor migration, especially in the domestic and caring sectors - a gender gap (in favor of men) in overall emigration rates existed in 2000. A decade later, this conclusion was no longer supported by evidence – instead, the reverse could be established both in 2010 and 2015. Yet, while the loss of human capital from less developed countries is already creating concerns, this is exacerbated when considering high-skilled female emigration as female human capital constitutes a scarcer resource when compared to that of males and has been shown to be a fundamental element for development and growth.⁹⁰

As such, literature has, over time, placed more interest on the impact of female skilled emigration on the labor market, education, economy, and the well-being of individuals left behind. Yet, the total compilation of such literature is still relatively scarce when compared to that written on the impact of immigration, especially when considering less developed countries of origin.⁹¹ However, shedding light on the potential impact of high-skilled female emigration from less developed countries of origin is of special importance as women often face inequitable access to higher education and high-skilled jobs. As such, when compared to the emigration of males, the emigration of women will most likely incur a higher relative loss of human capital/ brain drain given their role in the family as well as in the labor market.⁹²

A first attempt to view emigration through a gendered lens was undertaken by Dumont et al. (2007).⁹³ Before then, it was largely assumed that attachment to families, domestic life and the need for protection reduced the probability of women to migrate abroad.⁹⁴ The authors were as such also the first to estimate the impact that high-skilled female emigration has on the country of origin; thereby confirming the existence of a brain drain gap between men and women. In fact, they take their analysis a step further and find that high-skilled female emigration does not only reduce GDP per capita in the country of origin, but also infant mortality, child mortality, and secondary female enrollment rates. This is in line with arguments presented by past literature, which have shown female educational attainment to not only

⁹⁰ (World Bank, 2007); (WEF, 2016)

⁹¹ (Bang & Mitra, 2010)

⁹² (Docquier, Lowell, & Marfouk, 2009)

⁹³ (Ravara, 2018)

⁹⁴ (Docquier F. , Marfouk, Salomone, & Sekkat, 2012)

lower fertility rates, but to also improve health, infant mortality, and a child's level of education.⁹⁵ This is likely due to increased income, increased bargaining power, as well as lower fertility rates, allowing the mother to invest more into a smaller family thereby improving the quality of education per child.⁹⁶

In addition to this, Knowles et al. (2002) find a positive correlation between female educational attainment and labor productivity, while that of males is often negative or insignificant. This provides a reasoning as to why a significant negative relationship between the rate of emigration of high-skilled women and the GDP per capita of the country of origin – a correlation that was larger than that found for high-skilled men - was found by Docquier et al. (2009).

In 2010, Bang and Mitra supported the existence of the brain drain gap. They furthermore find that fertility rates and differences in educational attainment and literacy account for a significant part of this gap between men and women, while differences in labor force participation, share of income, and the rate of female government representation do not. As such, by accounting for such differences, the authors find that high-skilled women have a lower probability to emigrate from countries in which fertility is lower and educational opportunities higher. Docquier et al. (2011) complement this by finding that high-skilled women are not more likely to emigrate than their male counterpart when accounting for emigration decisions within family units.

In addition to lowering overall rates of fertility and contributing to the education, healthcare and consumption of children, the emigration of high-skilled women may also curtail child labor given the remittances sent home.⁹⁷ In fact, literature has found that women tend to remit more and for a longer period of time with a larger proportion devoted for their children's education when compared to men even though their wages are lower.⁹⁸ The latter is of special importance as it can empower girls by providing them with a change to access education.⁹⁹ The impact that this has on labor supply has been documented by a number of authors. For example, in Cambodia, having an emigrant household member and receiving remittances positively impacts the national labor supply of women. This has been supported by several other authors.¹⁰⁰

Furthermore, the emigration of women has also been found to become a driver of change when considering family relations and structures. By modifying the traditional gender roles, the migration of females may also have a positive impact on community activities and operations¹⁰¹, thereby impacting development in the country of origin – as evidenced by Clots-Figueras (2012) in India.

⁹⁵ (Schultz, 1988); (Behrman & Deolalikar, 1988) and (Subbarao & Raney, 1995)

⁹⁶ (World Bank, 2007); (Behrman, Foster, Rosenzweig, & Vashishtha, 1999); (Basu, 2002); (Quisumbing, 2003)

⁹⁷ (Yang, 2008); (Ghosh, 2006)

⁹⁸ (Ramirez, Dominguez, & Marais, 2005); (Piper, 2005)

⁹⁹ (Docquier, Faye, & Pestieau, 2008)

¹⁰⁰ (Adams R. , 2011); (Acosta, 2007); (Cabegin, 2006)

¹⁰¹ (Katseli, Lucas, & Xenogiani, 2006)

However, it must be noted that literature outlining the various channels on how high-skilled female emigration contributes to the country of origin is scarce – especially when focusing on developing countries. Furthermore, hardly any literature studies the impacts that such emigration has on development, human capital accumulation, labor market outcomes, etc. As such, this is a gap in research that needs to be addressed in the future once adequate data is available to do so.

4. Measuring the net brain gain effect

Literature focused on analyzing the impact of migration was pioneered by a number of individuals including Becker (1964), Sjaastad (1962) and Harris and Todaro (1970), among many others. Harris and Todaro focused on the micro-economic forces driving migration. Later, the New Economics of Labor Migration approach was introduced by Stark and Bloom (1985). This methodology put the decision to migrate into a broader context by considering the socio-economic situation of entire households and not just the individual migrant. Finally, more recent literature built on this approach to explore the linkages between individual beliefs and the migration decision-making process.¹⁰²

As a consequence, theoretical studies have started to question the core notion of the brain drain effect. These point towards the fact that human capital formation in the country of origin may not be exogenous to migration. Thus, higher human capital returns in the country of destination when compared to those in the country of origin cause high-skilled emigration, but also result in non-migrants to increasingly invest into human capital given the prospects of migration. Yet, if a proportion of the latter does not migrate, emigration could either lower or raise the total human capital stock in the country of origin depending on which effect is greatest.

While previous empirical studies testing the proposed net brain gain effect are scarce, the next sub-section will shed light onto macro- and micro-economic studies that have attempted this. This includes research that has identified the impact of high-skilled emigration on either the stock of human capital or the potential investment into it.

4.1 Previous empirical studies

4.1.1 Macro-level

In order to examine the extent to which the human capital incentive effect can be generalized across countries, and whether or not this effect is strong enough to result in a net brain gain effect, macro-economic analyses are required. To date, the concept of brain drain has largely used macro-economic models analyzing the effect of South-North human capital transfer.¹⁰³ This has largely been done with the use of regression models to identify the determinants of specific components and explain cross-country differences in high skilled migration.¹⁰⁴ In the

¹⁰² (Kvartiuk, Petrick, Bavorova, Bednarikova, & Ponkina, 2020)

¹⁰³ Examples: (Boeri, Brücker, Docquier, & Rapoport, 2012); (Schellinger, 2017)

¹⁰⁴ (Docquier, Lohest, & Marfouk, 2007)

past, these calculations were based on the original dataset on international migration by educational attainment for the years 1990 and 2000.

When observing the impact of brain drain, Docquier (2006) included the impact of human capital formation, the role of remittances, the impact of return migration, the effects of diaspora externalities and the impact on governance and corruption. The author utilized the Docquier-Marfouk dataset for his estimations. In order to examine the joint determinants of schooling gaps and the average emigration rates, SURE regression models¹⁰⁵ were applied. This allowed for an explanation on the source of regional differences in brain drain. The explanatory variables included in the regressions can be seen in *Table 3*.

Table 3. Explanatory variables by overarching theme

Theme	Explanatory variables
<i>Country size at origin</i>	The log of native population, a dummy for country size.
<i>Level of development</i>	The log of the share of tertiary education among native-born individuals, gross national income per capita, a dummy for the level of development of the nation, a dummy for whether or not the country is an oil exporting nation.
<i>Socio-political environment at origin</i>	A variable of political stability and the absence of violence, government effectiveness, property rights, religious fractionalization.
<i>Geographical and cultural proximity between developing countries and OECD countries</i>	Distance to OECD countries, linguistic proximity, and colonial links with the OECD country.
<i>Main destination of emigrants</i>	Dummy indicating the selectivity of the country and a dummy indicating whether the main destination country belonged to the EU15 member states.

In 2008, Beine, Docquier, and Rapoport used a cross-section of 127 developing countries and found that the prospect of migration significantly impacts the stock of human capital. They attempted to assess the net effects in the short run using counterfactual simulations¹⁰⁶ for each nation and region. Docquier, Faye and Pestieau (2008) complement this study by testing a number of functional forms of the incentive mechanism. This included educational policies in the country of origin or the use of an adjusted measure of skilled emigration to account for the country of training. Brzozowski (2008) largely follows the methodology of Beine et al. (2003) and Brücker et al. (2008), yet also offers minor adjustments. In general, the methodology includes standard OLS regressions along with an instrumental variable methodology to account for the endogeneity of migration. In order to analyze the incentive

¹⁰⁵ "A single model may contain a number of linear equations. In such a model it is often unrealistic to expect that the equation errors would be uncorrelated. A set of equations that has contemporaneous cross-equation error correlation (i.e. the error terms in the regression equations are correlated) is called a seemingly unrelated regression (SUR) system. At first look, the equations seem unrelated, but the equations are related through the correlation in the errors." (UCLA, 2020).

¹⁰⁶ This consists of decreasing the rate of high-skill emigration to that of low-skill emigration. This is achieved through a natural counterfactual experiment which compares the observed proportions/numbers of skilled residents to those calculated by the authors using predictions of human capital estimations and emigration rates that were calculated based on low-skilled workers. For more information see Beine et al. (2008).

effect, two sets of equations are estimated – the migration equation and the human capital equation. The former has a variety of applications in literature; while some solely consider the inflow of high-skilled migrants, others look to adjust to include the net outflows. The migration rate is then estimated with a standard OLS function in order to identify potential instrumental variables that are correlated with the migration rate and uncorrelated with human capital. Some variables that have been identified include population density, racial tension, and country size. The human capital equation on the other hand depends on the investment into education as a per cent of GDP and remittances as a per cent of GDP. This equation measures whether there is a positive brain effect, as new economics of brain drain suggests.

Nevertheless, it needs to be noted that while the use of tertiary educational attainment as the measure of the investment in education allows to measure the overall net effect, it is strongly biased by the demographic composition of the population in the country of origin. As such, an increase in the share of skilled individuals in a country may not be solely due to a higher probability of migration, but also due to a larger share of young individuals. In addition, Faini (2002) highlight that this measure is also biased by unskilled migration. As such, it has been proposed that educational enrollment rates are a safer and more neutral measure of the investment in education. In addition to this, a number of other factors could facilitate cross-country analyses of the net brain gain effect. This includes needing a broad definition of high-skilled workers in order for it to be broadly applicable to a number of national data. This will also allow for more comparable findings across data for national studies. Furthermore, the potential demographic differences across countries should call for the analysis of the socio-demographic profiles of migrants as these affect the extent of the net brain gain. Lastly, it should be noted that the net effect is best assessed by not only considering the stock of immigration, but also the flows of highly skilled emigrants and immigrants. While the former can be assessed through national censuses or labor force surveys, the latter can only be estimated through the use of aggregate data. While this may be accurate and reliable in developed countries, obtaining this information from developing ones may be a challenge.

In order to circumvent the difficulty of detecting causality between skilled migration and the formation of human capital with cross-country studies, Beine et al. (2011) propose the use of panel analyses. The authors use a recent and original panel database on human capital and international migration. This database consists of countries that have six points of observations across the 1975 to 2000 time period. Theoretically, the authors demonstrate that the relationship between international migration and human capital accumulation depends on the level of development in the country of origin – a factor that had been overlooked up to then in existing literature. Furthermore, the authors underline the importance of treating the probability of migration as endogenous. The authors illustrate that the emigration of skilled workers has a positive impact on human capital formation in the country of origin. They also find that the incentive effect is strongest for poor countries. As such, by increasing the expected return to education, the prospect of migration raises the number of native-born individuals investing into human capital.

Given these results, the authors then turn to assess whether these incentive effects are strong enough to bring about a net brain gain in low-income countries. In order to do so, the authors use the estimated model to simulate the net impact of high-skilled emigration on the level of human capital in low-income countries. For each possible value of the previously modelled country fixed effect, the simulation model varies the skilled emigration rate between 0 and 100 per cent. Furthermore, the empirical model is used to compute the ex-post share of high-skilled left in the country of origin at its steady state.¹⁰⁷ The simulation model combines the two effects found previously – ex-ante, skilled migration fosters human capital formation of native-born individuals in low-income countries, while ex-post, skilled migration reduces the number of highly-skilled individuals in the country of origin. For each of these effects, an equation was simulated.

Given this estimation technique, Beine et al. (2011) find an inverted U-shaped relationship between human capital and high-skill emigration. As such, only at low levels of high-skill emigration (between 20 to 30 per cent) does brain drain have a small, positive net impact on human capital accumulation in the country of origin. Once the optimal level of emigration has been exceeded, the human capital loss increases exponentially. Furthermore, in middle-income and high-income countries that do not exhibit a significant ex-ante incentive effect, the net effect is likely to be negative. Measuring the net brain gain effects at the macro-economic level requires nationally representative data and can rely on various analytical approaches. Based on the above review, several recommendations have been made in **Box 6**.

Box 6. Recommendations for a macro-economic analysis

1. Use panel data with an Instrumental Variable methodology in order to explicitly cope with the endogeneity of migration rates. This has been noted to be particularly important when analyzing the incentive effect in poor countries. Potentially, lagged migration rates can be used as an instrument.
2. Collect data on human capital of residents and emigrants in each country of origin to extend the database used by Beine et al. (2011) for more recent years.
 - a. Collect data on total emigration rates by level of education for each country under analysis– i.e., the stock of highly-skilled native-born over all highly-skilled native-born (residents and emigrants). This requires quantifying both the share of highly skilled within the emigrant population and within the resident population. While the latter is a good proxy for ex-post human capital stock, both shares combined proxies the ex-ante human capital stock.
 - b. Collect data on socio-demographic characteristics of emigrants and their families in each country of origin.
 - c. Collect data on the determinants of human capital formation and include them as fixed effects in the model. These can include educational investment, education policies, returns to skills, ethnic discrimination, governance, quality of education, stability of the economy, gross national income per capita, a dummy for the level of development of the nation, a dummy for whether or not the country is an oil exporting nation, distance to OECD countries, linguistic proximity, and colonial links with the OECD country, political stability, government effectiveness, property rights, religious fractionalization, selective-immigration policies, amongst others.

¹⁰⁷ This is of importance as human capital adjustments are dynamic. As such, the maximum impact of brain drain on human capital will be at the steady state.

3. As not all countries send their migrants to OECD nations and as data may not be available for countries outside of the OECD, a reliability index can be generated and included in the analysis. As such countries under a specific threshold of this index can be excluded or included using a weighted least squares model.
4. Classify countries of origin into the income classification provided by the World Bank and include them as explanatory variables into the model. Undertaking this distinction instead of interacting the emigration rate with GDP per capita avoids problems associated with endogeneity as well as implausible assumptions on the conditional effect of migration. This will allow for an understanding of which group of countries have an ambiguous and non-ambiguous effect on human capital.
5. For groups of countries in which the impact was ambiguous, it can be determined whether the incentive effect is strong enough to generate a net brain gain utilizing the methodology identified by Beine et al. (2011).

Unfortunately, however, macro-level and cross-national population data solely offer information on aggregate migration flows and stocks and do not allow for the assessment of multifaceted and manifold migration trajectories, which would be necessary to measure this phenomenon with accuracy.¹⁰⁸ As such, it may be beneficial to complement cross-country research with country-level studies.

4.1.2 Micro-level

In order to better understand the mechanisms underlying the relationship between highly skilled migration and human capital formation it is essential to consult micro-economic studies. To date, only a few studies have attempted to empirically test this relation at the household level.

In 2007, Kangasniemi, Winters and Commander analyzed a cohort of 1,021 Indian doctors who were working abroad through a web-based and postal survey design. While the main aim of the survey was on screening and education decisions, the survey also inquired about the background and motivations of the emigrants. This included information on income, remittances, motivation to migrate, employment opportunities in the country of origin, state of facilities, determining the sector of origin and those of possible return, intention of return, amongst other factors are important for understanding the consequences of brain drain in the medical profession. The authors find that approximately 30 per cent of the doctors surveyed indicated that the outlook of migration impacted their level of educational effort. This was a clear sign that migration incentivized students to attain more human capital. However, it needs to be noted that the survey was solely carried out with emigrants and, thereby, did not represent the doctors that remained in India. A year later, Commander et al. (2008) supported these findings for the IT sector in India.

Gibson and McKenzie (2012), however, had a number of concerns when reviewing past micro-economic literature on the impact of brain drain. First, these studies do not take into consideration the interactions migrants have with their country of origin. Second, focusing on specific occupations has a number of limitations when trying to find an appropriate

¹⁰⁸ (Schellinger, 2017)

counterfactual for individuals that have migrated. These limitations include the presence of a skill-selective criteria, which underlines the fact that high-skilled individuals who wish to migrate may select certain occupations over others and vice versa. Furthermore, the training for the occupation may only occur through the migration experience itself – a factor that is particularly the case for small countries. Lastly, the choice to remain in a specific occupation may depend on whether they were able to migrate or not. As such, while low-skilled individuals that have failed to emigrate may move into better paying employment, high-skilled workers may struggle to find certified work in their field. It is for these three reasons that it is unlikely to find an appropriate counterfactual for high-skilled emigrants in the same occupation in the country of origin.

In order to circumvent this limitation, Gibson and McKenzie (2012) look to identify a target sample before migration has occurred and to survey them regardless of the choices they have made with respect to migration and employment. The authors focus on high-achieving students graduating between 1976 and 2004 – one of numerous sub-groups of interest when looking at the consequences of brain drain. They chose to focus on countries in which these consequences are most common – a group of countries that are either characterized as small or located in Sub-Saharan Africa. The final sample included Ghana, Micronesia, Papua New Guinea, Tonga and New Zealand. The authors put together a sample frame of academic achievers by using government and school records. These individuals were then tracked down in their current country of residence and administered a survey, which included questions on the individual’s migration and educational history, current occupation, and the channels through which he/she interact with the country of origin when abroad.¹⁰⁹ With this information they look into income, human capital, remittances, involvement in trade and FDI, non-financial flows of knowledge, return migration, fiscal impacts and externalities when comparing migrants to their non-migrant counterfactuals (see **Table 4**) – thereby becoming the first comprehensive micro-level assessment of the channels through which skilled migration operates. In total, 4,131 individuals were sampled and 1,240 interviewed. The authors find that the share of pupils who put extra effort into their education as a result of the prospect of migrating abroad ranged from 8 per cent in New Zealand to over 30 per cent in Ghana.

Table 4. Indicators used to compute the net brain gain effect¹¹⁰

Theme	Indicators
Income	Annual income abroad of current migrants (USD)
	Annual income at home of return and non-migrants (USD)
	Annual income current migrants expect to earn at home (USD)

¹⁰⁹ This includes specific questions such as whether people had taken any additional classes or changed the subjects they studied during high school to improve their prospects of being able to work or study overseas.

¹¹⁰ All regressions controlled for 5-year age groups and sex, country of birth, mother and father's education, and self-assessed family wealth at the end of high school.

Human capital¹¹¹	Proportion of individuals aged 22 and over who have attained tertiary education (Bachelor's, Master's, PhD) Proportion of those with this qualification who earned it abroad (Bachelor's, Master's, PhD) Proportion of individuals aged 22 and over who took actions due to prospect of migration
Remittances¹¹²	Proportion who sent flow – all current migrants and non-student current migrants Annual value in USD of flows
Annual non-financial knowledge flows	Proportion of current migrants who are not students engaging in activity in last year – provided advice to national government; advised a home country company; provided advice about study abroad; provided advice about work abroad; sponsored home country national to work/study abroad; carried out research with people in home country; acted as an official representative an overseas event; advised people overseas about a holiday in home country.
Fiscal effects	Income tax migrants would pay if at home Sales tax migrants would pay if at home Sales tax if remittances consumed Mean household size Per capita government expenditure Per capita government health and education expenditure

In 2012, Batista et al. presented micro-economic evidence for Cape Verde in which they find evidence that cannot reject the brain gain hypothesis. To do so, a tailored household survey was conducted which included the collection of full migration histories of all members of 1,066 resident households (including both non-migrants and return migrants).¹¹³ This allowed to explicitly test the own probability of future migration channel in contrast to macro-economic studies, whose simplistic definition of brain gain may potentially miss important individual heterogeneity. By design, the macro-approach is incapable of identifying channels through which the positive brain gain effects work.

The authors use a simultaneous equation model¹¹⁴ to identify the simultaneous decisions of education decisions on own migration. This empirical exercise is done on both migrants and non-migrants. Focus is particularly placed on individuals that have not left the country and are at least 16 years old. This ensures that the schooling decision was made before emigration. Furthermore, both parents were not allowed to be migrants at the time the educational decision was made – at 12 years of age. This aided in isolating the effect of the expected own probability of migration.

¹¹¹ Estimates marginal effects using a probit estimation technique.

¹¹² Disaggregated by monetary remittances, goods/in-kind remittances, help country of origin by making a trade deal, or invested into a business start-up.

¹¹³ A limitation of the survey is that it did not include households that did not leave families behind. The authors tried to correct for this selection bias by using census data characterizing the country's immigrants in the main destination countries.

¹¹⁴ This is a statistical model in which the dependent variable of one model is in the function of other dependent variables.

The authors use a latent variable model.¹¹⁵ In total, three latent variables control the decisions on education – i) future migration decision at a specific age, ii) future education decision at that same specific age, and iii) the actual migration decision made by the individual at the age of migration.¹¹⁶ The latent variable on future education relies on several factors that may vary at the individual, household, and regional levels. Furthermore, this latent variable is influenced by the latent migration variable and vice versa. In addition to this, external shocks may impact the actual realized migration decision.

First, as previously discussed, there may be unobserved characteristics of the individual that simultaneously make her/him both more likely to emigrate in the future and more likely to get a higher educational attainment. Second, there is likely reverse causality, i.e., this individual may emigrate with a higher likelihood if she/he is more educated. Exclusion restrictions are therefore needed. This means, variables are needed that influence the migration decision and are known at the time of the education decision, but which do not directly affect the latter. Based on the full migration history, the authors propose two sets of instrumental variables. The first is the full actual duration of the longest migration spell in the household when the child is 12 years old or younger. The second is composed of economic conditions in the country of destinations to which migrants have been sent in the past year at the point when an individual is aged 16. This includes the unemployment rate and nominal GDP per capita (a proxy for the average wage level). For the latter set of instruments to work with this methodology, countries of destination need to have good macro-economic records of their economic conditions. If not, then the analysis will most likely only be able to assess migrants heading to developed nations. The authors instead find an important impact on educational attainment by the brain gain channel – the probability of completing intermediate secondary education increases in the likelihood of own future migration.

While these empirical studies have been paramount in supporting the brain gain argument, the validity of their instruments used are hard to establish, thereby placing the causality of results in question. In 2020, Abarcar and Theoharides use a migration policy experiment to investigate the impact of demand for foreign-born health care workers on the stock of health care workers and educated labor in the Philippines. This is in line with previous research identified in sub-section 4.1. To estimate the causal effect, the authors exploit the exogenous changes in the US visa scheme for nurses in 2000 and 2007. This requires a panel dataset of all migrant departures; number of institutional examinees and passers of the Philippine Nursing Licensure exam; as well as postsecondary enrollment rates, graduation rates, and the number of nursing programs, disaggregated by province, from 1990 to 2013.

¹¹⁵ A latent variable model is one that includes variables that are not directly observed but are rather inferred from variables that are observed.

¹¹⁶ These models included traditional covariates including: gender, age, number of children, asset ownership, highest completed education level of parents, perceptions of the quality of schooling, island dummy, urban area dummy, unemployment, average per capita household expenditure, skill to unskilled labour force ratio.

Given migration network theory, their empirical strategy designates provinces with low baseline nurse migration as the control group and those with high baseline migration as the treatment group. Subsequently, a pooled event study model is estimated that incorporates the visa expansion in 2000 and its contraction in 2007 along with province and year fixed effects. The latter include baseline (1990) values for the average female and male employment rate, the average age in the province, the fraction of females in a province, non-nursing enrollment and graduation rates, as well as aggregate enrollment. In light of this estimation technique, the key identifying assumption is that high nurse migration provinces would not have experienced differential changes in outcomes to those of low migration provinces in the absence of the policy changes. Yet, it also needs to be noted that potential biases may arise from cross-province migration as well as simultaneous policy changes in the country of origin that may have affected the health care sector in high migration provinces. Overall, the authors find that the increased emigration of Filipino nurses did not reduce the stock of nurses in the Philippines, but rather increased their supply as well as the total stock of college-educated labor. Yet, while this study provides a partial equilibrium effect, the quantification of the total welfare effects of emigration is yet to be determined.

Based on the above review of literature and their limitations, several recommendations have been made in **Box 7**.

Box 7. Recommendations for a micro-economic analysis

1. Given the fact that it is hard to find a good instrumental variable that is not correlated to the independent and dependent variable, it is recommended to search for a methodology that is more capable of estimating causality at the micro-level (e.g., natural experiment utilizing difference-in-difference or a regression discontinuity methodology).
2. The analysis of all skilled migrants is recommended over the analysis of a specific sub-set (e.g., doctors, engineers, etc.) due to limitations outlined by Gibson and McKenzie (2012) above. Yet, this may not need to be the case when undertaking an analysis that resembles a natural experiment (e.g., policy change, coup, natural disaster, etc.).
3. Additionally, if the net brain gain effect is to be adequately determined, then any methodology chosen should ensure to include information on variables other than emigration that could potentially influence emigration rates or the level of education attained – remittances, trade, foreign direct investment, knowledge flows, fiscal indicators, country size, level of development, political stability, governance, migration policies, education policies, among others.
4. If limited resources are present, then it is recommended to identify countries for analysis that display a high rate of brain drain that potentially also have a simultaneous rise in their stock of human capital. Combined, this potentially points towards the possibility of a net “brain gain” impact.
5. Furthermore, as data on migration is infrequent, incomplete, and not very comparable across countries, it is important to note the caveats with any analysis undertaken and to recommend possible improvements for future research.

4.2 Data considerations

Dependable and internationally comparable data with which to answer the theoretical questions on brain drain have only recently become available. In 1998, Carrington and Detragiache from the International Monetary Fund pioneered in their method of collecting census, registry data and other OECD statistics on international migration. It was the first attempt to collect a harmonized set of international data on emigration rates¹¹⁷ by three levels of educational attainment for 60 developing countries. Nevertheless, this data had a few failings including the identification of immigrants by citizenship and not by foreign-born criteria, the underestimation of immigration, the presence of an overreporting bias due to a lack of information on age, as well as assuming that educational distribution is similar across countries of destination.¹¹⁸ In the following years, a number of different data sources emerged. Adams (2003) collected data from the United States on educational attainment, while Docquier and Marfouk (2006) used national censuses and administrative data¹¹⁹ in all OECD countries to establish a new harmonized and comprehensive dataset on migration stocks/rates by education level. In comparison to the latter, all other sources lack comparative data, thereby leading to underestimations in brain drain for a large majority of countries, while simultaneously keeping the discussion on the causes and consequences of brain drain theoretical.¹²⁰ Instead, the assessment of the economic impact of brain drain requires a better understanding of the educational structure of migration in both the origin and destination countries and its determinants.

To date, most quantitative analyses utilize the Docquier-Marfouk OECD dataset on immigration data as it has the most comprehensive and recent compilation of migration indicators collected in the country of destination. It counts migrants as all working-age (25+) foreign-born individuals living in OECD member states. Skilled migrants are proxied by the total share of tertiary educated individuals in the population of all OECD member states over the stock of tertiary educated in the countries of origin. Although this data is assumed to represent approximately 50 per cent of the total world migration and more than four-fifths of high-skilled migration, it does not provide any indication of the magnitude of South-South migration. Therefore, any estimates computed utilizing this data may lead to substantial underestimations – especially when trying to analyze the brain gain effect in countries of origin. As such, data available from the OECD needs to be complemented by immigration data available in developing countries if available.

¹¹⁷ This is defined as the share of emigrants to natives (residents and emigrants) for a particular skill level at a specific point in time.

¹¹⁸ (Docquier F. , 2006)

¹¹⁹ A detailed account of the origin and skill of immigrants can be obtained from these sources.

¹²⁰ (Docquier, Lohest, & Marfouk, 2007)

Box 8. Limitations to analyses

A common issue with analyses utilizing survey data is that they only portray one side of the story. While many microeconomic studies focus on migrants in the country of destination, little has been done to incorporate the socio-economic characteristics of families in the country of origin – factors that are important determinants of the remitting behavior of migrants. This is in part due to the scarcity or unreliability of emigration statistics by the country of origin (Wickramasekera, 2002; Docquier, 2006). Omitting these factors can lead to potential biased results in estimation. These are heightened when focusing on cross-country regressions as they may suffer from misspecification biases. Additionally, failure to control for the factors that influence the process of human capital accumulation in the country of origin leads to omitted-variable biases as these factors are likely to be correlated with the initial level of human capital. It also leads to unobserved heterogeneity and the difficulty to solve potential endogeneity problems (Beine, Defoort, & Docquier, 2010). Furthermore, the use of a pure cross-sectional analysis implicitly assumes that the rate of high-skilled emigration is constant over time for each nation, which may not be the case. It is in part due to these constraints in addition to the infrequent collection of census data that cross-country analyses of international migration lag empirical literature on trade and financial flows. In fact, the most recent estimates of skilled out-migration rates are for the year 2015 when censuses were undertaken in OECD member states. As such, extending the analysis to a panel dimension allows to account for the effect of shocks to human capital accumulation common to all countries.

When considering the analysis of the net impact of brain gain, a number of methodological choices need to be considered. First, any potential analysis must correct for the age of entry as it could be that some foreign-born individuals acquired their education in the country of destination, which may lead to an overestimation of brain drain and as such a worsening of the net brain gain effect.¹²¹ Only surveys that include a comprehensive module on individual migration history can provide information on this. To date, such information is only available for a number of countries and, in general, does not offer a representative cross-sectional snapshot of an immigrants' characteristics.¹²²

Second, gender needs to be accounted for as female migrants may respond differently to push factors than their male counterparts. In recent literature, it has been found that women are more responsive to the emigration, compared to skilled men, than vice versa.¹²³ Third, defining migration as the foreign-born population rather than on the basis of citizenship is time invariant and more appropriately captures the decision to emigrate. Fourth, the consideration of solely the working-age population as those above the age of 25 maximizes comparability between immigration data and educational data from countries of origin. This is the case as it excludes those individuals that temporarily emigrate to finalize their studies.¹²⁴ Fifth, the Docquier-Marfouk dataset can be restricted to countries in the OECD area that receive migrants. While there is brain drain outside of this, literature has estimated that 90 per cent high-skilled emigrants live in OECD-countries.¹²⁵ Last, it is of importance to treat the probability of migration as endogenous according to Beine, Defoort, & Docquier (2010) – meaning that

¹²¹ Yet, here it is important to note that the acquired education in the country of destination may have been funded by resources originating in the country of origin. As such, this would still need to be accounted for as it will affect the magnitude of the brain drain effect. By not including such individuals, the effect may be underestimated given the extent to which the country of origin funds its students abroad.

¹²² (Docquier & Rapoport, 2011)

¹²³ (Docquier & Rapoport, 2011)

¹²⁴ However, this needs to be weighed against the fact that individuals that migrate may not return and instead commence work in the country of destination. If this is found to be the case, then the working-age definition should be adjusted to those aged 15 and above when collecting data (Docquier F. , 2006)

¹²⁵ (Docquier, Lohest, & Marfouk, 2007)

the probability of migration is incorporated into the model and thereby influences the level of human capital in the country of origin.

4.3 The conceptual framework

As described above, past research¹²⁶ has sought to test the brain gain proposition by using emigration rates to identify the incentive for investments into human capital. Yet, these rates are subject to concerns of endogeneity as unobserved characteristics are likely to correlate with education and emigration rates. Furthermore, the latter are likely to impact decisions pertaining to educational attainment and vice-versa. Consequently, this may lead to biased estimates of the impact of migration on human capital accumulation in the country of origin. Given such endogeneity, empirical models require a strategy in order to test for the causal identification of this theory. One of the most common strategies used has been the introduction of an instrumental variable technique. A popular instrument used has been past (local) migration rates across countries or households.¹²⁷ Yet, the validity of such an instrument has been rebutted by a number of researchers¹²⁸ as it can also be caused by factors that affect human capital formation thereby biasing the impact of emigration on human capital.

To overcome this, a number of authors (of which a few were mentioned previously)¹²⁹ have employed a different technique – a natural experiment. This requires two groups of individuals in the country of origin that are similar in all characteristics except that one group is more likely to emigrate than another given the relative change of returns to human capital in the country of origin vs. in the country of destination. The duration of such an experiment needs to be long enough so that individuals in the country of origin still have time to change their decision towards attaining tertiary education. Furthermore, pre-experiment data is also required in order to ensure that no prior differences between the two groups were present. In order for the latter technique to be utilized, one requires i) a policy change that impacts the potential of individuals to attain higher foreign returns to human capital, thereby resulting in large-scale emigration of the highly skilled within a sub-set of the population, ii) a policy change that is exogenous to economic, social and/or political characteristics of the country of origin; iii) rich census and administrative data in order to be able to control for the differences in the treatment and control groups; and, preferably, iv) main countries of destination consisting of high-income countries with skill-selective immigration policies.

Given this and the limitations presented, the analysis at hand will analyze the net brain gain effect by focusing on the micro-economic level and will aim to make use of a natural experiment (i.e., a policy change) in order to ensure the causality of the results obtained. The strategy builds on the main theoretical frameworks embedded in human capital literature, and migration and brain circulation theories.

¹²⁶ E.g.: (Beine, Docquier, & Rapoport, 2008); (McKenzie & Rapoport, 2011); (Chand & Clemens, 2008) and (de Brauw & Giles, 2008)

¹²⁷ E.g.: (Beine, Docquier, & Rapoport, 2008) and McKenzie and Rapoport (2011).

¹²⁸ E.g., (Yang, 2008) and (Chand & Clemens, 2008)

¹²⁹ E.g., (Shrestha, 2010); (Docquier, Özden, & Parsons, 2010), (Chand & Clemens, 2008), and (de Brauw & Giles, 2008)

4.3.1 The proposed methodology

Given the theoretical model presented in *Annex I*, an exogenous shock in a country of destination that increases the expected returns to education in the foreign country relative to the home country can either increase or decrease the current stock of human capital in the latter. Which impact it ultimately has is an empirical question. Often, literature tries to explain such causality through high relative returns to education and low stocks of human capital in the country of origin. Yet, as numerous characteristics can affect rates of emigration and educational attainment, such correlation is not enough to evidence a causal relationship between the two.

In light of this, the literature and their associated limitations presented above, as well as the potential scarcity of data, this report proposes to test the net brain gain effect on countries that have undergone an exogenous shock given a policy change in a main country of destination – one in which the policy restricts immigration to high-skilled migrants (potential policies for consideration can be found in **Box 9**). This allows for the analysis of causality between emigration and high-skilled human capital accumulation in the country of origin while also circumventing the potential bias resulting from endogeneity or a lack of strong and valid instrumental variables given that the latter are difficult to find.¹³⁰ As evidenced by the theoretical model above, such an exogenous shock can be associated with a variation in returns to education in the country of destination, a variation in migration probabilities as well as a variation in migration incentives.¹³¹

Such an analysis will require two groups of residents in the developing country of origin. These groups must be identical in every respect except that one group has experienced a large exogenous change in the relative returns to human capital. This would call for the conduction of a matched difference-in-difference approach, under which observed outcomes of the treated and control population are required both before and after the exogenous policy change occurred.

Box 9. Potential high-skilled policy changes in countries of destination to consider

Under the NAFTA agreement, the TN visa for Mexican professionals cited in NAFTA treaty (e.g., doctors) was implemented in 1994.

The U.S. Congress increased the numerical cap of IT-related H-1B visas from 65,000 in 1992, to 115,000 in 1998, and 195,000 in 2000.

In 2000, Germany granted up to 30,000 special work visas to foreign information, communication, and technology (ICT) specialists, mainly sought from India.

In 2000, the U.S. dramatically expanded the availability of visas for foreign nurses and their families, yet suddenly reduced them again in 2007, to pre-2000 levels.

The Malaysian skilled worker program was announced as part of their Knowledge-economy Master Plan in 2001 and attracted 5,000 skilled workers annually.

In 2002, Canada raised the intake of skilled immigrant workers from China, India, Pakistan, Philippines, and South Korea. The introduction of the EU Blue Card in 2008.

¹³⁰ (Becker S., 2016)

¹³¹ (McKenzie & Rapoport, 2011); (Beine, Docquier, & Rapoport, 2008); (Chand & Clemens, 2008).

Propensity Score Matching Methodology

The first component of a matched difference-in-difference approach is the propensity score matching methodology. A propensity score can be defined as the probability of an individual to be assigned to the treatment group conditional upon all observed characteristics. In our analysis, the propensity score will be the probability of an individual to be affected by the policy change and thereby increase his/her educational attainment.

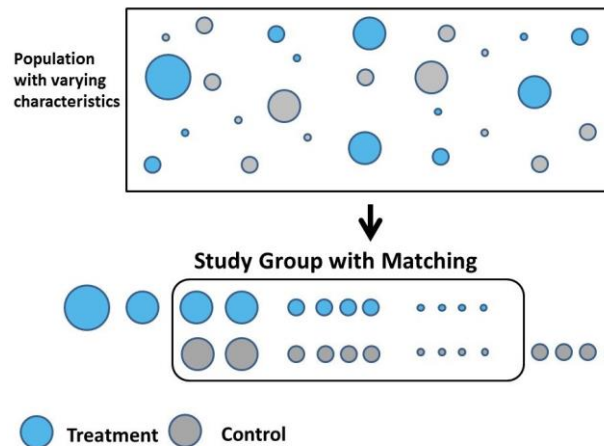


Figure 1. Propensity score matching explained¹³²

The methodology allows the analysis to provide more focus on the selection process and on the underlying assumptions. Through the imposition of a common support area, compatibility between the treatment and control group is ensured thereby allowing for the establishment of comparable groups (see **Figure 1**). Individuals with the same or similar propensity score are comparable as they are considered to have the same or similar distribution of observable characteristics. Consequently, researchers can make an unbiased and clearer comparison between individuals in the two groups compared – allowing for causal inference.

In order to estimate the propensity score, a multivariable logistic regression is used. Potential observable characteristics are included as independent variables, while the group assignment (affected by the policy change or not) is the dependent variable. In doing so, it is of importance to select appropriate independent variables in order to ensure the validity of the propensity score method. Based on these variables and the resulting propensity scores per observation, the methodology can utilize a number of matching techniques including nearest neighbor-, caliper-, and optimal matching. The resulting effectiveness of the subsequent matching can be judged by the degree of balance.

While this methodology provides great versatility, it is also a methodology that requires comprehensive data, as well as strong robustness and sensitivity analyses. As the propensity score matching technique is based solely on observable characteristics, the subsequent application of a difference-in-difference methodology allows for unobserved, but fixed characteristics to be accounted for.

¹³² (Thompson S., 2015)

Difference-in-difference Methodology

Pioneered by John Snow in 1855, the difference-in-difference methodology is a quasi-experimental research design that is used to estimate a causal effect between the treatment and control groups matched earlier (see *Figure 2*). Theoretically, this approach can be described as the difference in average outcome (education attainment (\bar{Y})) in the group affected by the policy change (treatment group (T)) before and after the policy change minus the difference in the average educational attainment in the group not affected by the policy change (control group (C)) both before and after the policy change. Empirically, it can be illustrated as:

$$\hat{\delta}_{DD} = \bar{Y}_1^T - \bar{Y}_0^T - (\bar{Y}_1^C - \bar{Y}_0^C)$$

In order to undertake this method, data both pre- and post-policy change is required – either cohort panel data or repeated cross-sectional data at the individual level. Furthermore, three key assumptions must hold: i) the intervention must be unrelated to the outcome at baseline; ii) the treatment and control groups must have parallel trends in outcome; iii) the composition of the two groups must be stable for repeated cross-sectional design; and iv) no spillover effects are present. The most crucial of these is the parallel trend assumption. One way to ensure that this assumption holds is to gather more data on indicators preceding and exceeding the year of the policy change. This will allow the researcher to analyze whether any other pre-existing differences in trends can be observed.

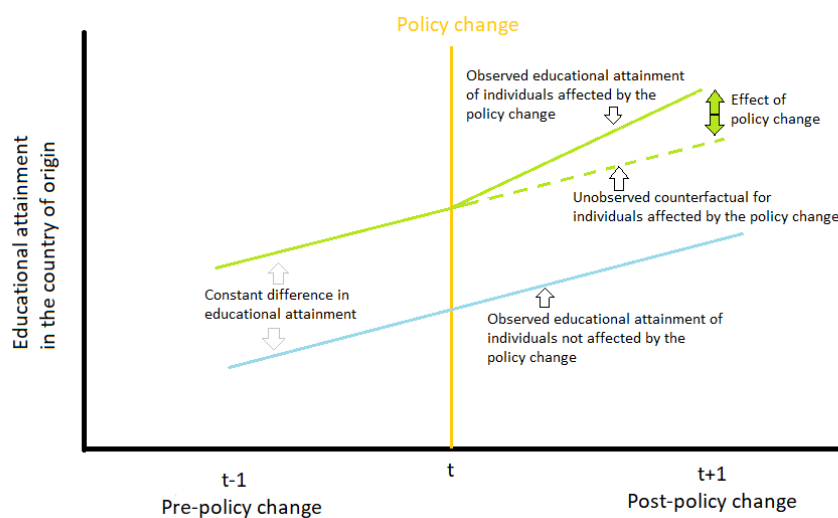


Figure 2. Difference-in-difference explained

Data requirements

In order to undertake the specified methodology, researchers will require access to census data or similar household surveys that are representative at the national (and, if required, regional) level. This data must include information on educational attainment or school enrolment by level as well as by the potential identifying criteria of the treatment and control group (i.e., race, ethnicity, gender, sectoral occupation, etc.). In addition to this, characteristics that allow for matching and that may also influence educational attainment other than the

policy change identified should be controlled for. This could include household and individual characteristics, labor force statistics in the country of origin and destination, remittances, foreign direct investment, wages and other income, level of development of the country, political instability, among other variables. Furthermore, as individuals may take time to change their educational decisions toward tertiary education, it is advised to use data that has been collected a few years after the shock occurred depending on the education system and the duration required for an individual to obtain a higher level of education.

Potential validity concerns

Given that it is difficult to ensure that the above assumptions hold (as they are made about unobservable characteristics), the identified methodology must discuss in detail the potential concerns to internal, construct and external validity as these may likely bias the estimated impact if not analyzed/resolved. In terms of internal validity, the methodology may be subject to three concerns – selection, crossover, and attrition biases.

The greatest threat to internal validity is selection bias, in which the treatment group is not randomly selected and may differ observably and unobservably from the control group in ways that may impact average educational attainment (e.g., income, social and cultural norms, literacy, wealth, etc.). The use of a matched difference-in-difference analysis may help to control for such differences prior to the analysis. The second threat concerns potential crossovers from people in the control group receiving some form of treatment. This may be the result of government incentives, changes in national policies or changes in the educational structure of the country of origin in favor of the control group that may positively influence their attainment of tertiary education – each of which will need to be analyzed in order to ensure that such potential changes have been accounted for. Lastly, attrition bias may result from the use of pre- and post- shock census data. Yet, if census counts were performed accurately, the attrition bias of the resulting data is close to zero.

When considering construct validity – the ability of the natural experiment “to separate one theoretical model of the treatment effect from another”¹³³ – concerns may arise given competing theoretical models. In this case, an increase in human capital accumulation could arise due to post-shock national supply and demand changes for tertiary education or due to remittances being sent to the country of origin by relatives who have emigrated for reasons other than the higher returns abroad. A further possibility could be national changes in the labor market for tertiary educated that provide false signaling for the treatment group. Lastly, it is possible that the treatment group invested into human capital given that their returns to investment in other assets declined more than their returns to human capital did. As such, the decision to invest into education is unrelated to migration. These potential models will need to be ruled out in order to ascertain causal impact of emigration on human capital accumulation.

This also holds true when considering external validity. Firstly, individuals could react differently to exogenous shocks in the country of destination (i.e., an increase in economic prospects abroad) when compared to those originating in the country of origin (i.e., a decrease

¹³³ (Chand & Clemens, 2008)

in economic prospects at home). Secondly, the country of analysis, given the presence of the exogenous shock, could have been non-randomly selected. As such, it is likely that the chosen country may differ from other developing countries.

As such, as with any methodology chosen, it is of importance to discuss these potential concerns for validity and provide supportive information that negates these. By doing so, the validity of the causal effect found through a matched difference-in-difference approach will be strengthened.

Box 10. Alternative in case no non-treatment group is available.

An alternative to the difference-in-difference approach above is the regression discontinuity methodology. The latter was first introduced in 1960 by Donald L. Thistlethwaite and Donald T. Campbell to estimate treatment effects in a non-experimental setting. It differs from difference-in-difference estimates in that it can be used in instances under which a group of non-treated individuals is not available or cannot be used due to selection bias. Yet, in order to identify the non-treated, researchers need to create a continuous index on which a cut-off point will determine who has been treated and who has not. Individuals just below the cut-off point are found to be a good comparison group to the treated.

In the instance of migration and an associated policy change, this would require the establishment of an index based on scores (X) attained on tests required for emigration (e.g., an international nursing examination, labour market entry exams, etc.). As such, emigrants with test scores greater than or equal to a cut-off value (c) are allowed to emigrate, while those below the value were denied the move. As such, the following mathematical equation can be derived.

$$Y = \alpha + \tau D + \beta X + \epsilon$$

Where Y refers to educational attainment/enrolment, D refers to the treatment dummy variable, which equals one if X is greater or equal to c and zero otherwise, and τ is an estimate of the causal effect of the policy change. Yet for the latter to be unbiased, there should be no reason, other than the policy change, for future educational attainment to be a discontinuous function of the test scores. Furthermore, a linear relationship between educational attainment and test scores should be present. In addition, all other factors determining educational attainment must be evolving smoothly with respect to test scores (i.e., the other variables may not jump at the cut-off point). For further information on this technique, see Lee and Lemieux (2010).

5. Conclusion

Why this paper?

As evidenced throughout this paper, the impact of high-skilled emigration on both the country of origin and destination has increasingly been at the center of literature since the 1960s. Yet, recent empirical evidence has come to prove or even negate various theoretical underpinnings from earlier. This is particularly the case for the potential positive impacts of brain drain on the country of origin. Overall, it can be said that literature on brain drain and brain gain is ambivalent as to whether countries of origin benefit from the migration of skilled workers. While there is no strong evidence to date that the implications of brain drain on either the country of origin or destination are significantly negative, the empirical studies on the net brain gain have also solely found a small net positive effect of brain drain in low-income countries.

As such, the aim of this paper has been to provide theoretical and empirical evidence on the main channels through which brain drain and brain gain are realized, as their understanding allows one to identify the relationships and variables that need to be considered when

analyzing the net brain gain effect. Based on this, the paper at hand was able to propose an empirical strategy that captures the causal impact of the net effect on low-income countries of origin taking into consideration the limitations of previous empirical methodologies in this regard.

What main channels of brain drain, and brain gain exist?

When considering the main channels through which brain drain is realized, a focus was placed on three main areas: human capital, the labor market, as well as macroeconomic development. Considering human capital, the paper has concluded that there is no consensus on whether the consequences of international migration positively or negatively affect education. In fact, the sign and magnitude of this correlation depends on a number of factors including the role of aspirations, the probability of successful migration, as well as the magnitude of migration. Each of which are influenced by both labor market and macro-economic conditions in the country of origin – such as economic growth, the utilization of skilled workers, the labor market opportunities present, the returns to skill, etc.

Yet, the correlation also works the other way, with high-skilled emigration impacting the labor market and macro-economic development outcomes of those that remain at home. In this regard, theoretical and empirical pathways of impact are outlined in this paper, where particular notice was had of the fact that less attention is placed on these pathways when considering low-income countries of origin. Usually, impacts on high-income countries of destination are analyzed and reported in literature; in part driven by the political and economic powers of the Global North, but also due to a lack of comprehensive and regular data on migration for countries of origin, especially when these are characterized as less developed.

While these channels of brain drain were largely emphasized in literature since the 1960s, more and more research had also identified positive feedback effects, which could potentially lessen or even offset the losses caused by high-skilled emigration. This stream of thought gained particular traction in the 1990s, where empirical evidence came to the conclusion that migration need not diminish the stock of human capital or have other negative impacts, especially when considering high-skilled migrants. Instead, various positive externalities can emerge. As such, this paper has reviewed evidence surrounding three important channels for brain gain in the country of origin. The first emphasizes the growing incentives to acquire human capital as it may increase their chances of emigration. The second focuses on the gains that the country of origin receives as a result of incentivizing emigration. This includes the effects through remittances, foreign direct investment as well as technology flows given the diaspora. Lastly, the third channel directs attention on the effects of return migration on development and economic growth back home. However, it must be noted that the potential positive contribution of these channels to the country of origin is not automatically realized. Instead achieving this is highly dependent on a series of conditions - economic, institutional, and political – that may not be present in most low-income countries.

How can the net effect be measured?

It is these impacts combined – through both the brain drain and gain channels – that determine the size and direction of the net effect. To empirically examine the latter, the paper proposes a methodology that builds on the main theoretical frameworks embedded in human capital literature, as well as migration and brain circulation theories. Focusing on the micro-economic level to account for individual heterogeneity, the paper at hand proposes to analyze the net brain gain effect based on an exogenous shock given a policy change in a main country of destination – thereby benefiting from a ‘natural experiment’. This will require the use of a matched difference-in-difference approach, which controls for relevant variables based on evidence reviewing the channels through which brain gain and brain drain are realized in low-income countries of origin. By doing so, the methodology circumvents concerns of endogeneity as well as instrumental validity while strengthening the causality of results obtained when estimating the net effect of emigration on human capital accumulation in the country of origin.

Yet, as with any methodology, the one at hand also has its caveats. In fact, given the assumptions underlying a matched difference-in-difference approach, potential concerns relating to internal, construct and external validity must be discussed in detail. By doing so, the validity of the analysis is strengthened with likely biases towards the impact of high-skilled emigration on human capital in the country of origin negated.

What is the way forward?

As evidenced in this paper, there is a strong need to improve international labor migration statistics along several dimensions. In fact, the lack of comprehensive, regular, and detailed data on human capital and migration has been one of the major impeding factors to comprehensively analyzing the net brain gain effect to date, especially when considering low-income countries of origin. While a large majority of developed countries have an extensive database and frequent collection of data, most developing countries need to invest in improving migration and human capital related data compilations. In particular, improvements must include an increase in the frequency of data collection; representativeness at both national and sub-national levels; the recording of emigrants as well as the socio-demographic characteristics; the recording of information detailing when and where an individual has enrolled in education; more disaggregation based on occupation and education levels; the inclusion of variables reflecting return, repeat, and/or circular migration; as well as increased data coverage and harmonization across countries of origin and destination.

In fact, according to the *ILO Guidelines concerning statistics of international labour migration*, “the absence of international standards regarding the concepts, definitions, and methodologies for the measurement of international labor migration and migrant workers continues to be a major obstacle to the production of harmonized statistics”.¹³⁴ As such, by

¹³⁴ (ILO, 2018).

having data that is not comparable across countries given the aforementioned barriers, high-skilled emigration rates and the consequent costs/benefits to the countries of origin may be over-/under-estimated. In addition to this, it inhibits a more accurate analysis of the channels through which brain drain and brain gain are realized in low-income countries of origin. For example, the paper at hand has clearly outlined the need for more research on how emigration impacts wages, unemployment, wealth, employment stability, occupational attainment, and labor force participation in the country of origin – especially if the latter are characterized as less developed.

Consequently, countries are urged to adhere to the mentioned Guidelines in order to collect standardized and relevant migration and human capital related indicators as without the necessary improvements to data collection activities, little progress in accurately assessing the net brain gain effect on low-income countries of origin can be expected in the future.

6. Glossary

Brain drain: *the term "brain drain" designates the international transfer of resources in the form of human capital and mainly applies to the migration of relatively highly educated individuals from developing to developed countries. In non-academic literature, the term is generally used in a narrower sense and relates more specifically to the migration of engineers, physicians, scientists, and other very highly skilled professionals with university training. (Docquier & Rapoport, 2006); (Özden & Schiff, 2006); (Docquier F. , 2014).*

Brain gain: this concept can be associated either with the increase of skilled workers in the country of destination or to the increase in the average level of human capital in the country of origin as a result of migration that did not occur.

Brain waste: a situation in which a migrant worker earns less than a native worker with the same set of skills. (Özden & Schiff, 2006)

Brain circulation: the return of a high-skilled individual to the country of origin or his/her migration to a third country. (Kone & Özden, 2017)

International migrant: all persons who are usual residents of one country and who are citizens of another country (foreign population) or whose place of birth is located in another country (foreign-born population). (ILO, 2018)

High-skilled migrant: tertiary educated international migrants. (Docquier & Rapoport, Globalization, Brain Drain and Development, 2011)

Migrant worker: international migrant individuals of working age and older who are either employed or unemployed in their current country of residence. (ILO, 2018)

7. Annex I

The theoretical framework

Given theoretical advancements by Stark et al. (1997), Mountford (1997), a model of emigration and human capital investment has been developed by Chand and Clemens (2008) in which successful emigration is uncertain. In a world in which no migration is present, a worker's net income is composed of the expected net wage minus the cost of human capital investment. In the country of origin, this net income is represented as:

$$\pi(\tau, h, a) \equiv (1 - \tau) * w(h) - c(a)h \quad (1)$$

where τ is the tax rate, $w(h)$ is the present-value wage as a function of human capital investment h , and $c(a)$ is the present-value cost of a unit of human capital. The latter is a strictly decreasing function of ability (a). A person will aim to choose h to maximize his/her net income. As such, if wage is continuous, differentiable, strictly increasing and concave in h , then in autarky and without migration, taxation in the country of origin decreases the average stock of human capital. As such, higher rates of taxation will reduce the gross benefits of educational attainment without affecting the latter's costs leaving individuals less attracted to invest. This correlation between income and investments into education have been proven by many authors throughout this report.

Under a scenario in which migration is possible, but success uncertain, a worker's expected income in the country of destination is represented as:

$$\hat{\pi}(p, A, \hat{h}, a, m) \equiv pAw(\hat{h}) - c(a)\hat{h} - m \quad (2)$$

where p is the probability of successful migration between zero and one, A is the ratio of foreign wage to that in the country of origin (greater than one), and m is the cost of migration (also assumed to be greater than one). As such, an individual will prefer to emigrate if the net income in the country of destination is greater than that received at home given his level of educational attainment and ability to migrate (a). If the level of educational attainment and the ability to migrate is greater than that of the general population, then the individual will prefer to migrate.

Given this, it is now possible to assess the net effect of emigration on average human capital in the country of origin. The latter is represented by the following:

$$[h] = \int_0^{\hat{a}} h^*(a) \frac{1}{a} da + \int_{\hat{a}}^{\bar{a}} \widehat{h}^*(a) \frac{1-p}{a} da \quad (3)$$

where the second part of the equation details the fact that a fraction (1-p) of those who acquire the necessary average education to migrate (\widehat{h}^*) cannot emigrate.

The expected change of the human capital stock in the country of origin to a change in the likelihood of successful emigration can be represented through the following equation:

$$\frac{dE[h]}{dp} = \theta \left[(1 - \tau) * \left(\frac{\xi}{\bar{\varphi}} \frac{d\hat{a}}{dp} \right) \right] + A\theta \left[(1 - 2p) * \left(-\frac{\ln \bar{\varphi}}{\bar{\varphi}} \right) + p(1 - p) * \left(-\frac{\xi}{\bar{\varphi}} \frac{d\hat{a}}{dp} \right) \right] \quad (4)$$

Where $\bar{\varphi} \equiv 1 - \left(\xi \frac{\bar{a}}{c} \right)$, and $\bar{\varphi}$ is greater than zero and less than one. The first term of equation (4) is always negative. It illustrates the decrease in the stock of human capital in the country of origin due to the increased probability of successful emigration. If the probability of successful emigration is less than 50 per cent, then the second term of equation (4) is always positive and depicts the increase in the stock of human capital in the country of origin as more and more individuals conclude it to be worthwhile to invest in education, while many of these do not migrate. As such, an increase in the likelihood of successful migration or tax rate can increase or decrease the stock of human capital in the country of origin. Under simplified assumptions it can thus be assumed that an individual reacts similarly to a change in the probability of successful migration as he/she does to a change in the impact of the tax rate on their wage. As such, policy changes in both of these areas will raise emigration. Yet, they will also increase or decrease the average level of educational attainment in individuals who do not end up emigrating since many of the individuals who have invested into their human capital cannot migrate.

Lastly, if countries of destination implement foreign policies that promote positive skill selection, then changes in the two mentioned areas will also raise the educational attainment of emigrants. Yet, this also depends on the level of skill-selectivity. The more skill-selective a country of destination, the higher the level of ability is required for individuals in the country of origin to emigrate. As such, fewer individuals emigrate, but the incentive to do so is stronger. Under this scenario, the net effect on the expected level of human capital in the country of origin can either be positive or negative. On the other hand, emigration that selects against skills can make it profitable for low-skilled individuals to migrate rather than to invest in further education in the country of origin. This consequently would lower the expected level of human capital in the country of origin.

Box 11. Summary of the theoretical propositions

As such, in summary the theoretical model above provides three main propositions:

1. Taxation in the country of origin decreases investments into education in the absence of migration;
2. Either an increase in the probability to successfully migrate or an increase in the rate of taxation in the country of origin can increase the stock of human capital in the country of origin; and
3. High skill-selective immigration policies in the country of destination can increase the stock of human capital in the country of origin, while immigration policies that do not select against skills can decrease this stock.

8. Bibliography

- Abarcar, P., & Theoharides, C. (2020). *Medical Worker Migration and Origin-Country Human Capital: Evidence from U.S. Visa Policy*. Washington, D.C.: The World Bank Group.
- Abdelbaki, H. H. (2009). Estimation Of The Economic Impact Of Brain Drain On The Labor Expelling Country. *International Business & Economics Research Journal* , 53-66.
- Abowd, J., & Freeman, R. (1991). *Immigration, Trade, and the Labor Market*. Cambridge: National Bureau of Economic Research.
- Acemoglu, D. (1996). A Microfoundation for Social Increasing Returns in Human Capital Accumulation . *The Quarterly Journal of Economics*, 779-804.
- Acosta, P. (2007). *Entrepreneurship, labor markets and international remittances: Evidence from El Salvador*. Washington, D.C.: World Bank and Palgrave Macmillan.
- Adams, R. (1991). The economic uses and impact of international remittances in rural Egypt. *Economic Development and Cultural Change*, 695-722.
- Adams, R. (1998). Remittances, investment and rural asset accumulation in Pakistan. *Economic Development and Cultural Change*, 155-173.
- Adams, R. (2006). International remittances and the household: Analysis and review of global evidence. *Journal of African Economics*, 396-425.
- Adams, R. (2011). Evaluating the economic impact of international remittances on developing countries using household surveys: a literature review. *Journal of Development Studies*, 809-828.
- Adams, R. J. (2003). *International Migration, Remittances, and the Brain Drain: A Study of 24 Labor-Exporting Countries*. Washington D.C.: World Bank Policy Research Working Paper .
- Aggarwal, R., Demirgüç-Kunt, A., & Martinez Peria, M. (2006). *Do Workers' Remittances Promote Financial Development?* Washington D.C.: The World bank.
- Agrawal, A., Kapur, D., McHale, J., & Oettl, A. (2011). Brain drain or brain bank? The impact of skilled emigration on poor-country innovation. *Journal of Urban Economics*, 43-55.
- Agrawal, A., McHale, J., & Kapur, D. (2008). How Do Spatial and Social Proximity Influence Knowledge Flows? Evidence from Patent Data. *Journal of Urban Economics*, 258-269.
- Ahmed, S. (2000). *Strange encounters: Embodied others in post-coloniality*. London: Routledge.
- Akinlo, A., & Egbetunde, T. (2010). Financial Development and Economic Growth: The Experience of 10 Sub-Saharan African Countries Revisited. *The Review of Finance and Banking*, 17-28.
- Alcaraz, C., Chiquiar, D., & Salcedo, A. (2012). Remittances, schooling, and child labor in Mexico. *Journal of Development Economics*, 156–65.
- Ammassari, S. (2003, March 13-14). *From Nation Building To Entrepreneurship: The Impact Of Elite Return Migrants In Cote d'Ivoire And Ghana*. Brighton: University Of Sussex.

- Amuedo-Dorantes, C., Georges, A., & Pozo, S. (2010). Migration, remittances, and children's schooling in Haiti. . *The ANNALS of American Academy of Political and Social Science*, 224–244.
- Antman, F. (2011). International Migration and Gender Discrimination among Children Left Behind. *American Economic Review*, 645-649.
- Antman, F. (2013). The impact of migration on family left behind. In A. Constant, & K. Zimmermann, *International Handbook on the Economics of Migration* (pp. 293–308).
- Antman, M. (2011). The intergenerational effects of paternal migration on schooling and work: What can we learn from children's time allocations? *Journal of Development Economics*, 200-208.
- Arora, A., & Gambardella, A. (2005). *From Underdogs to Tigers: The Rise and Growth of the Software Industry in Some Emerging Economies*. . Oxford: Oxford University Press.
- Aydemir, A., & Borjas, G. J. (2007). Cross-Country Variation in the Impact of International Migration: Canada, Mexico, and the United States. *Journal of the European Economic Association*, 663–708.
- Bang, J., & Mitra, A. (2010). *Gender bias and the female brain drain*. Middlebury : Middlebury College.
- Bargain, O., & Boutin, D. (2015). Remittance effects on child labour: evidence from Burkina Faso. *Journal of Development Studies*, 922–938.
- Basso, G., & Peri, G. (2015). *The Association between Immigration and Labor Market Outcomes in the United States*. Bonn: IZA Discussion Papers.
- Basu, A. (2002). Why does education lead to lower fertility? A critical review of some of the possibilities. *World Development*, 1779-1790.
- Batista, C., Lacuesta, A., & Vicente, P. (2007). *Brain Drain or Brain Gain? Micro Evidence from an African Success Story*. Bonn: IZA.
- Batista, C., Lacuesta, A., & Vicente, P. (2012). Testing the 'brain gain' hypothesis: Micro evidence from Cape Verde. *Journal of Development Economics*, 32-45.
- Beaman, L., Duflo, E., Pande, R., & Topalova, P. (2012). Female Leadership Raises Aspirations and Educational Attainment for Girls: A Policy Experiment in India. *Science*, 582-586.
- Becker, G. (1964). *Human Capital: A theoretical and emirical analysis, with special reference to education*. New York: National Bureau of Economic Research.
- Becker, S. (2016). *Using instrumental variables to establish causality*. Bonn: Institute of Labor Economics .
- Behrman, J. R., & Deolalikar, A. B. (1988). Health and nutrition. In C. a. (eds), *Handbook of Development Economics*. Amsterdam: North-Holland.
- Behrman, J. R., Foster, A., Rosenzweig, M., & Vashishtha, P. (1999). Women's schooling, home teaching, and economic growth. *Journal of Political Economy*, 682-714.
- Beine, M., Defoort, C., & Docquier, F. (2010). *A Panel Data Analysis of the Brain Gain*. University of Luxembourg, University of Lille and the Catholic University of Louvain.
- Beine, M., Docquier, F., & Oden-Defoort, C. (2011). A Panel Data Analysis of the Brain Gain. *World Development*, 523-532.

- Beine, M., Docquier, F., & Rapoport, H. (2001). Brain drain and economic growth: theory and evidence. *Journal of Development Economics*, 275-289.
- Beine, M., Docquier, F., & Rapoport, H. (2003). *Brain Drain and LDCs' Growth: Winners and Losers*. Bonn: Institute for the Study of Labour.
- Beine, M., Docquier, F., & Rapoport, H. (2007). Measuring International Skilled Migration: A New Database Controlling for Age of Entry. *The World Bank Economic Review* .
- Beine, M., Docquier, F., & Rapoport, H. (2008). Brain drain and human capital formation in developing countries: Winners and Losers. *The Economic Journal*, 631-652.
- Beine, M., Docquier, F., & Rapoport, H. (2010). On the Robustness of Brain Gain Estimates. *The Annals of Economics and Statistics*, 143.
- Benabou, R. (1993). Workings of a City: Location, Education, and Production. *The Quarterly Journal of Economics*, 619-652.
- Bénabou, R., & Tirole, J. (2003). Intrinsic and Extrinsic Motivation. *The Review of Economic Studies*, 489-520.
- Berry, R. A., & Soligo, R. (1969). Some welfare effects of international migration . *Journal of political economy*, 778-794.
- Bhagwati et al. (1975). The Brain Drain: a Symposium. *Journal of development Economics*, 193-318.
- Bhagwati, J. (1979). International Migration of Highly skilled: economics, Ethics and Taxes. *Third World Quarterly*, 17-30.
- Bhagwati, J. (1991). Economics Beyond the Horizon. *The Economic Journal*, 9-14.
- Bhagwati, J. N., & Dellafar, W. (1973). The Brain Drain and Income taxation . *World Development*, 94-100.
- Bhagwati, J. N., & Hamada, K. (1974). The Brain Drain, International Integration of Markets for professionals and Unemployment: A Theoretical Analysis . *Journal of Development Economics*.
- Bhagwati, J. N., & Patrington, M. (1976). *Taxing the Brain Drain: A proposal* . Amsterdam: North Holland.
- Bhagwati, J. N., & Wan, J. H. (1979). The "Stationarity" of Shadow Prices of Factors in Project Evaluation, with and without Distortions . *The American Economic Review*, 261-273.
- Bhagwati, J., & Rodriguez, C. (1976). Welfare-Theoretical Analyses of the Brain Drain. In J. Bhagwati, *The Brain Drain and Taxation, Theory and Empirical Analysis, Vol. II*, . (pp. 85–111).
- Bhagwati, J., & Wilson, J. (1989). *Income Taxation and International Mobility*. Cambridge: M.I.T. Press .
- Biavaschi, C., Giulietti, C., & Zimmermann, K. (2015). Sibling Influence on the Human Capital of the Left-Behind. *Journal of Human Capital*, 403-438.
- Black, R., & Castaldo, A. (2009). *Return Migration and Entrepreneurship in Ghana and Cote D'Ivoire: The Role of Capital Transfers*. 44 - 58: Tijdschrift voor Economische en Sociale Geografie.
- Blomqvist, A. (1986). International Migration of Educated Manpower and Social Rates of Return to Education in LDCS . *International Economic Review*, 165-174.
- Bodenhofer, H. (1967). The mobility of labour and the Theory of human capital . *The Journal of human resource*, 431-448.

- Boeri, T., Brücker, H., Docquier, F., & Rapoport, H. (2012). *Brain Drain and Brain Gain: The Global Competition to Attract High-Skilled Migrants*. Oxford: Oxford University Press.
- Böhme, M. (2015). Migration and educational aspirations – Another channel of brain gain? *IZA Journal of Migration*, 4-12.
- Bollard, A., McKenzie, D., & Morten, M. (2010). The Remitting Patterns of African Migrants in the OECD. *Journal of African Economics*, 605-634.
- Bollard, A., McKenzie, D., Morten, M., & Rapoport, H. (2011). Remittances and the Brain Drain Revisited: The Microdata Show That More Educated Migrants Remit More. *World Bank Economic Review*, 132–156.
- Borjas, G. (1994). The economics of immigration. *Journal of Economic Literature*, 1667-1717.
- Borjas, G. (2003). The Labor Demand Curve is Downward Sloping: Reexamining the Impact of Immigration on the Labor Market. *Quarterly Journal of Economics*, 1335--1374.
- Borjas, G. (2014). *Immigration Economics*. Boston: Harvard University Press.
- Borjas, G. J. (2008). Labor outflows and labor inflows in Puerto Rico . *Journal of Human Capital*, 32–68.
- Borjas, G., Freeman, R., & Katz, L. F. (1997). How Much Do Immigration and Trade Affect Labor Market Outcomes? *Brookings Papers on Economic Activity*, 1-90.
- Boucher, S., Stark, O., & Taylor, J. (2005). *A gain with a drain? Evidence from rural Mexico on the new economics of the brain gain*. Davis: University of California at Davis.
- Bouoiyour, J., & Miftah, A. (2015). Migration, remittances and educational levels of household members left behind: evidence from rural Mexico. . *The European Journal of Comparative Economics*, 21–40.
- Bouoiyour, J., & Miftah, A. (2016). The impact of remittances on children's human capital accumulation: evidence from Morocco. . *Journal of International Development*, 266–280.
- Boyer, G. R., Hatton, T. J., & O'Rourke, K. (1994). The impact of emigration on real wages in Ireland, 1850-1914. In T. Hatton, & J. Williamson, *Migration and the International Labour Market* (pp. 221-239). London: Routledge.
- Brain drain - Definition and More*. (2019). Retrieved from Free Merriam-Webster Dictionary: <https://www.merriam-webster.com/dictionary/brain%20drain>
- Bredtmann, J., Flores, F., & Otten, S. (2016). *Remittances and the Brain Drain: Evidence from Microdata for Sub-Saharan Africa*. Bochum: RUHR economic papers.
- Breschi, S., Lissoni, F., & Miguelez, E. (2015). *Foreign inventors in the US: Testing for diaspora and brain gain effects*. London: Centre for Research and Analysis of Migration.
- Breschi, S., Lissoni, F., & Tarasconi, G. (2014). *Inventor Data for Research on Migration and Innovation: A Survey and a Pilot*. Geneva: World Intellectual Property Organization - Economics and Statistics Division.
- Brücker, H., Defoort, C., & Grün, C. (2008). *Does Migration Trigger Human Capital Investment?* . Nürnberg: IAB .
- Brzozowski, J. (2008). *Brain Drain or Brain Gain? The New Economics of Brain Drain Reconsidered*. Cracow : Cracow University of Economics.
- Budnik, K. (2012). *Impact of Emigration on Wages: A Search Equilibrium Analysis for Poland*. Warsaw: National Bank of Poland.

- Cabegin, E. (2006). *The Effect of Filipino Overseas Migration on the Non-migrant Spouse's Market Participation and labor Supply Behavior*. Bonn: Institute for the Study of labor.
- Calero, C., Bedi, A., & Sparrow, R. (2009). Remittances, liquidity constraints and human capital investments in Ecuador. *WorldDev*, 1143–1154.
- Campos-Vasquez, R., & Sobarzo, H. (2012). *The Development and Fiscal Effects of Emigration on Mexico*. Washington D.C.: Wilson Centre.
- Carrington, W. J., Detragiache, E., & Vishwanath, T. (1996). Migration with Endogenous Moving Costs. *The American Economic Review*, 909-930.
- Carrington, W., & Detragiache, E. (1998). How extensive is the brain drain. *Finance and Development*, 46-49.
- Chami, R., Fullenkamp, C., & Jahjah, S. (2003). *Are immigrant remittance flows a source of capital for development?* Washington D.C.: International Monetary Fund.
- Chami, R., Hakura, D., & Montiel, P. (2009). *Remittances: An Automatic Output Stabilizer?* Washington D.C.: International Monetary Fund.
- Chand, S., & Clemens, M. (2008). *Skilled emigration and skill creation: A quasi-experiment*. Center for Global Development.
- Checchi, D., De Simone, G., & Faini, R. (2007). *Skilled Migration, FDI and Human Capital Investment*. Bonn: IZA.
- Chiquiar, D. (2004). Why Mexico's Regional Income Convergence Broke Down? *Journal of Development Economics*, 257-275.
- Chiswick, B. (2005). *High-skilled immigration in the international arena*. Bonn: IZA.
- Chiswick, B., & Miller, P. (2015). *Handbook of the Economics of International Migration*. Amsterdam: Elsevier.
- Chiswick, C. (1989). The Impact of Immigration on the Human Capital of Natives. *Journal of Labor Economics*, 464-486.
- Clemens, M. (2011). *The Financial Effects of High-Skill Emigration: New Data on African Physicians Abroad*. Washington D.C.: Center for Global Development.
- Clemens, M., Özden, C., & Rapoport, H. (2014). Migration and Development Research Is Moving Far Beyond Remittances. *World Development*, 121-124.
- Clots-Figueras, I. (2012). Are female leaders good for education? Evidence from India. *American Economic Journal*, 212-244.
- Commander, S., Chanda, R., Kangasniemi, M., & Winters, A. (2004). *Who gains from skilled migration? Evidence from the software industry*. London: London School of Economics.
- Commander, S., Chanda, R., Kangasniemi, M., & Winters, A. (2008). Must Skilled Migration Be Brain Drain? *The World Economy*, 187-211.
- Commander, S., Kangasniemi, M., & Winters, L. (2004). The Brain Drain: A Review of Theory and Facts. *Brussels Economic Review*, 29-44.
- Coon, M. (2016). Remittances and child labor in Bolivia. *IZA Journal of Migration*, 1–26.

- Cortes, P. (2015). The feminization of international migration and its effects on the children left behind: evidence from the Philippines. . *World Development*, 62–74.
- Crush, J. (2011). Diasporas of the South: Situating the African Diaspora in Africa. In S. Plaza, & D. Ratha, *In Diaspora for Development in Africa*. Washington D.C.: The World Bank.
- Czaika, M., & Vothknech, M. (2014). Migration and aspirations—are migrants trapped on a hedonic treadmill? *IZA Journal of Migration*.
- Davenport, S. (2004). Panic and panacea: brain drain and science and technology human capital policy. . *Research Policy*, 617-630.
- Davies, J., & Wooton, I. (1992). Income Inequality and International Migration. *The Economic Journal*, 789-802.
- Davis, J., & Brazil, N. (2016). Disentangling fathers' absences from household remittances in international migration: the case of educational attainment in Guatemala. . *the International Journal of Educational Development* , 1–11.
- de Brauw, A., & Giles, J. (2008). *Migrant Labor Markets and the Welfare of Rural Households in the Developing World : Evidence From China*. Washington D.C.: The World Bank .
- De Haas, H. (2005). International migration, remittances and development: myths and facts. *Third World Quarterly* , 1269-1284.
- De La Fuente, Á., & Domenéch, A. (2006). Human capital in growth regressions: how much difference does data quality make? *Journal of the European Economic Association*, 1-36.
- De Zwager, N., Gedeshi, I., Germenji, E., & Nikas, C. (2005). *A study on: Competing for remittances*. Tirana: IOM.
- Defoort, C. (2008). *Long-term trends in international migration: An analysis of the six main receiving countries*. EQUIPPE, Universities of Lille and IRES, Université catholique de Louvain.
- Desai, M., Kapur, D., McHale, J., & Rogers, K. (2009). The Fiscal Impact of High-Skilled Emigration: Flows of Indians to the U.S. *Journal of Development Economics*, 32-44.
- Di Maria, C., & Lazarova, E. (2012). Migration, Human Capital Formation, and Growth: An Empirical Investigation. *World Development*, 938-955.
- Djajic, S. (1989). Skills and the Pattern of Migration: The Role of Qualitative and Quantitative Restrictions on International Labor Mobility. *International Economic Review*, 795-809.
- Docquier, F. (2006). *Brain Drain and Inequality Across Nations*. Bonn: The Institute for the Study of Labor (IZA) .
- Docquier, F. (2014). *The brain drain from developing countries: The brain drain produces many more losers than winners in developing countries*. Bonn: Université Catholique de Louvain and IZA.
- Docquier, F., & Lodigiani, E. (2010). Skilled Migration and Business Networks. *Open Economies Review*, 565-588.
- Docquier, F., & Machado, J. (2015). *Remittance and Migration Prospects for the 21st Century*. Clermont-Ferrand: FERDI working paper.
- Docquier, F., & Marfouk, A. (2006). International migration by educational attainment (1990-2000). In C. Ozden, & M. Schiff, *International migration, remittances and the brain drain*,. Palgrave-Macmillan.
- Docquier, F., & Rapoport, H. (1997). La fuite de Cerveux, una chance pour les pays en developpement? *Meeting of the French Economic Association*. Paris.

- Docquier, F., & Rapoport, H. (2006). *The Brain Drain*. Louvain-La-Neuve: Department of Economics, Catholic University of Louvain and the University of Bar-Ilan.
- Docquier, F., & Rapoport, H. (2007). Skilled Migration: The Perspective of Developing Countries. In J. Baghwat, & G. Hanson, *Skilled migration: prospects, problems and policies*. New York: Russell Sage Foundation.
- Docquier, F., & Rapoport, H. (2011). Globalization, Brain Drain and Development. *Journal of Economic Literature* .
- Docquier, F., & Rapoport, H. (2012). Globalization, Brain Drain, and Development. *Journal of Economic Literature*, 681–730.
- Docquier, F., Faye, O., & Pestieau, P. (2008). Is migration a good substitute for education subsidies? *Journal of Development Economics*, 263-276.
- Docquier, F., Lodigiani, E., Rapoport, H., & Schiff, M. (2016). Emigration and democracy. *Journal of Development Economics*, 1-124.
- Docquier, F., Lohest, O., & Marfouk, A. (2007). Brain Drain in Developing Countries. *The World Bank Economic Review*, 193–218.
- Docquier, F., Lowell, B., & Marfouk, A. (2009). A gendered assessment of the brain drain. *Population and Development Review*, 297-321.
- Docquier, F., Marfouk, A., Salomone, S., & Sekkat, K. (2012). Are Skilled Women More Migratory than Skilled Men? *World Development*, 251-265.
- Docquier, F., Özden, C., & Parsons, C. (2010). *The foot drain: Globalization and soccer performance*. Washington D.C.: The World Bank.
- Docquier, F., Özden, Ç., & Peri, G. (2011). *The Wage Effects of Immigration and Emigration*. Washington D.C.: The World Bank Group.
- Dumont, J., Martin, J., & Spielvogel, G. (2007). *Women on the move: the neglected gender dimension of the brain drain*. Bonn: IZA Discussion Paper.
- Dustmann, C., & Kirchkamp, O. (2002). The optimal migration duration and activity choice after re-migration. *Journal of Development Economics*, 351-372.
- Dustmann, C., & Mestres, J. (2010). Remittances and temporary migration. *Journal of Development Economics*, 62-70.
- Dustmann, C., & Weiss, Y. (2007). *Return Migration: Theory and Empirical Evidence from the UK*. 236-256: An International Journal of Employment Relations.
- Dustmann, C., Fabbri, F., & Preston, I. (2005). The Impact of Immigration on the British Labour Market. *The economic journal*, 324-341.
- Dustmann, C., Glitz, A., & Frattini, T. (2008). The labour market impact of immigration. *Oxford Review of Economic Policy*, 477–494.
- El-Sakka, M., & McNabb, R. (1999). The Macroeconomic Determinants of Emigrant Remittances". *World Development*, 1493-1502.
- Elsner, B. (2015). *Does emigration increase the wages of non-emigrants in sending countries?* Bonn: The Institute of the Study of Labor (IZA).

- Elsner, B. (2022). Does emigration increase the wages of non-emigrants in sending countries? *IZA World of Labor* .
- Engerman, S., & Jones, W. (1997). International Labor Flows and National Wages . In *Economic Development and International Trade* (pp. 200-204). The American Economic Review.
- F., D., & Lodigiani, E. (2006). *Skilled Migration and Business Networks*. Louvain: IRES .
- Faini, R. (2002). *Development, trade, and migration*.
- Faini, R. (2003). *Is the Brain Drain an Unmitigated Blessing?* Research Gate.
- Faini, R. (2006). *Remittances and the Brain Drain*. Bonn: IZA.
- Felbermayr, G., & Jung, B. (2009). The pro-trade effect of the brain drain: Sorting out confounding factors. *Economics Letters*, 72-75.
- Foley, C. F., & Kerr, W. (2013). Ethnic Innovation and U.S. Multinational Firm Activity. *Management Science* , 1529–1544.
- Foley, C., & Kerr, W. (2008). *US ethnic scientists and foreign direct investments placement*. Boston: Harvard Business School.
- Foray, D. (1995). The Economics of Intellectual Property Rights and Systems of Innovation: The Persistence of National Practices versus the New Global Model of Innovation. *Technical Change and the World Economy: Convergence and Divergence in Technology Strategies*, 109–33.
- Freund, C. L., & Spatafora, N. (2005). *Remittances: Transaction Costs, Determinants, and Informal Flows*. Washington D.C.: The World bank.
- Friedberg, R., & Hunt, J. (1995). The impact of immigrants on host country wages, employment and growth. *Journal of Economic Perspectives*, 23-44.
- Funkhouser, E. (1995). *Remittances from International Migration: A Comparison of El Salvador and Nicaragua*. 137-146: The Review of Economics and Statistics.
- Gagnon, J. (2011). *"Stay with Us?" The Impact of Emigration on Wages in Honduras O*. Paris: OECD Publishing.
- Gaillard, J., & Gaillard, A. M. (1997). Introduction: The International Mobility of Brains: Exodus or Circulation? *Science, Technology, and Society*.
- Gang, I., & Rivera-Batiz, F. (1994). Labor Market Effects of Immigration in the United States and Europe: Substitution vs. Complementarity. *Journal of Population Economics*, 157-175.
- Gedeshi, I., & Mara, H. (2003). *The encouragement of social-economic development in relation to the growth of the role of the remittances*. UNDP.
- Ghirmay, T. (2004). Financial Development and Economic Growth in Sub-Saharan African Countries: Evidence from Time Series Analysis. *African Development Review*, 415-432.
- Ghosh, B. (2006). *Migrants' Remittances and Development: Myths, Rhetoric and Realities*. Geneva: International Organization for Migration.
- Giannoccolo, P. (n.d.). *The Brain Drain. A Survey of the Literature*. Bologna: Alma Mater University of Bologna.

- Gibson, J., & McKenzie, D. (2009). *The Microeconomic Determinants of Emigration and Return Migration of the Best and Brightest: Evidence from the Pacific*. Bonn: Institute of Labor Economics (IZA).
- Gibson, J., & McKenzie, D. (2012). The Economic Consequences of 'Brain Drain' of the Best and Brightest: Microeconomic Evidence from Five Countries. *Economic Journal*, 339-375.
- Gitmez, A. (1988). The socio-economic re-integration of returned workers: The case of Turkey. In C. Stahl, *International Migration Bensontoday*. Paris: UNESCO.
- Glaz'ev, S., & Malkov, L. (1992). The "Brain Drain" and Social Consciousness. *Prob. Econ. Transition*, 50-54.
- Glick Schiller, N., Basch, L., & Blanc-Szanton, C. (1992). Transnationalism: A New Analytic Framework for Understanding Migration. *ANNALS*, 1-24.
- Göbel, K. (2013). Remittances, expenditure patterns, and gender: parametric and semiparametric evidence from Ecuador. *IZA Journal of Migration*, 1–19.
- Goff, M. L., & Salomone, S. (2016). Remittances and the Changing Composition of Migration. *The World Economy*, 513-529.
- Gould, D. M. (1994). Immigrant links to the home country: Empirical implications for United States bilateral trade flows. *Review of Economics and Statistics*, 302–316.
- Groizard, J., & Llull, J. (2006). *Skilled migration and growth. Testing brain drain and brain gain theories*. Univeristy of the Balearic Islands.
- Groizard, J., & Llull, J. (2007). *Brain drain and Human Capital Formation in Developing Countries. Are there Really Winners?* University of the Balearic Islands.
- Grubel, H., & Scott, A. (1966). *The International Flow of Human Capital*. American Economic Association.
- Gubert, F., & Nordman, C. J. (2011). *Return Migration and Small Enterprise Development in the Maghreb*. Florence: European University Institute.
- Guellec, D., & Van Pottelsberghe de la Potterie, B. (2002). The Value of Patents and Patenting Strategies: Countries and Technology Areas Patterns. *Economics of Innovation and New Technology*, 133–148.
- Gupta, P. (2005). *Macroeconomic Determinants of Remittances: Evidence from India*. Washington D.C.: The International monetary Fund.
- Gupta, S., Pattillo, C., & Wagh, S. (2009). Effect of Remittances on Poverty and Financial Development in Sub-Saharan Africa. *World Development*, 104-115.
- Hagopian, A., Ofosu, A., Fatusi, A., Biritwum, R., Essel, A., Hart, L., & Watts, C. (2005). The Flight of Physicians from West Africa: Views of African Physicians and Implications for Policy. *Social Science and Medicine* , 1750–1760.
- Hanson, G. (2007). Emigration, Labor Supply, and Earnings in Mexico. In G. Borjas, *Mexican Immigration to the United States* (pp. 289-328). Cambridge: National Bureau of Economic Research.
- Hanson, G. (2009). The economic consequences of the international migration of labour. *Annual Review of Economics*, 179-208.
- Harris, J. R., & Todaro, M. P. (1970). Migration, Unemployment and Development: A Two-Sector Analysis. *The American Economic Review*, 126-142.

- ILO. (2018). *ILO Guidelines concerning statistics of international labour migration*. Geneva: International Labour Organization.
- Ishikawa, J. (1996). Scale Economies in Factor Supplies, International Trade, and Migration . *The Canadian Journal of Economics*, 573-594.
- Javorcik, B., Özden, C., Spatareanu, M., & Neagu, C. (2011). Migrant Networks and Foreign Direct Investment. *Journal of Development Economics*, 231–241.
- Johnson, H. (1967). Some Economic Aspects of the Brain Drain. *Pakistan Development Review*, 379–411.
- Kandel, W., & Kao, G. (2001). The impact of temporary labour migration on Mexican children's educational aspirations and performance. *International Migration Review*, 1205-1227.
- Kandel, W., & Massey, D. (2002). The culture of Mexican migration: A theoretical and empirical analysis. *Social Forces*, 981–1004.
- Kangasniemi, M., Winters, A., & Commander, S. (2007). Is the Medical Brain Drain Beneficial? Evidence from Overseas Doctors in the UK. *Social Sciences and Medicine*, 915-923.
- Katseli, L. T., Lucas, R. E., & Xenogiani, T. (2006). *Effects of migration on sending countries: What do we know?* Paris: OECD.
- Kerr, S., Kerr, W., Ozden, C., & Parsons, C. (2016). *Global Talent Flows*. Washington D.C.: The World Bank Group.
- Kerr, W. (2008). Ethnic Scientific Communities and International Technology Diffusion. *Review of Economics and Statistics*, 518–537.
- Kindleberger, C. (1986). International Public Goods without International Government . *The American Economic Review*, 1-13.
- King, R. (1986). Return migration and regional economic development: an overview. In R. King, *Return migration and regional economic problems*. London: Croom Helm.
- Kirigia, J., Gbary, A., Muthuri, L., Nyoni, J., & Seddoh, A. (2006). The Cost of Health Professionals' Brain Drain in Kenya. *BMC Health Services Research*.
- Knowles, K., Lorgelly, P., & Owen, P. (2002). Are educational gender gaps a break on economic development? Some corss-country empirical evidence. *Oxford Economic Papers*, 118-149.
- Kone, Z. L., & Özden, C. (2017). *Brain Drain, Gain, and Circulation*. Washington D.C.: The World Bank Group.
- Krishnan, P., & Krutikova, S. (2013). Non-cognitive skill formation in poor neighbourhoods of urban India. *Labour Economics*, 68-85.
- Krugman, P., & Bhagwati, J. (1976). *The Decision to migrate: a Survey In The Brain Drain and Taxation, vol 2. Theory and Empirical Analysis*. Amsterdam: North Holland.
- Kugler, M., & Rapoport, H. (2007). International Labor and Capital Flows: Complements or Substitutes? *Economic Letters*, 155–62.
- Kuhn, P., & McAusland, C. (2006). *The International Migration of Knowledge Workers: When is Brain Drain Beneficial*. Bonn: Institute for the Study of Labor.

- Kvartiuk, V., Petrick, M., Bavorova, M., Bednarikova, Z., & Ponkina, E. (2020). *A Brain Drain in Russian Agriculture? Migration Sentiments among Skilled Russian Rural Youth*. London: Informa UK Limited.
- Kwok, V., & Leland, H. (1982). An Economic Model of the Brain Drain. *American Economic Review*, 91-100.
- Leblang, D. (2011). Another link in the chain: migrant networks and international investment. In S. Plaza, & D. Ratha, *Diaspora for development in Africa* (pp. 79-102). Washington D.C.: The World Bank.
- Lee, D. S., & Lemieux, T. (2010). Regression Discontinuity Designs in Economics. *Journal of Economic Literature*, 281-355.
- Lowell, L., & Gerova, S. (2004). *Diasporas and Economic Development: State of Knowledge*. Washington D.C.: The World Bank.
- Lucas. (1988). On mechanics of economic development. *Journal of Monetary Economics*, 3-42.
- Lucas, R. (2004). *International Migration and Economic Development: Lessons from Low-Income Countries*. Cheltenham: Edward Elgar.
- Macours, K., & Vakis, R. (2009). *hanging Households' Investments and Aspirations through Social Interactions : Evidence from a Randomized Transfer Program*. Washington D.C.: The World Bank.
- Mahmood, Z. (1991). Emigration and Wages in an Open Economy: Some Evidence from Pakistan. *The Pakistan Development Review*, 243-262.
- Mahoodi, A. (n.d.). *The Economic Impacts of Brain Drain in Iran*. Tehran: Islamic Azad University.
- Mahroum, S. (2000). Highly Skilled Globetrotters: Mapping the International Migration of Human Capital. *Research and Development Management*, 23-32.
- Mankiw, N. G., Romer, D., & Weil, D. (1992). Contribution to the Empirics of Economic Growth. *The Quarterly Journal of Economics*, 407-437.
- Manning, C. (2007). *Brain drain and brain gain: A survey of issues, outcomes and policies in the Least Developed Countries (LDCs)*. UNCTAD.
- Mansuri, G. (2006). *Migration, School Attainment and Child Labor: Evidence from Rural Pakistan*. Washington D.C.: The World Bank.
- Massey et al. (1987). *Return to Aztlan: The Social Process of International Migration from Western Mexico*,. University of California Press.
- Massey, D., & España, F. (1987). The Social Process of International Migration. *Science*, 733-738.
- Mayr, K., & Peri, G. (2009). Brain drain and brain return: Theory and application to Eastern-Western Europe. *Journal of Economic Analysis*.
- McCormick, B., & Wahba, J. (2001). Overseas Work Experience, Savings and Entrepreneurship Amongst Return Migrants to Ldcs. *Scottish Journal of Political Economy*,.
- McCulloch, R., & Yellen, J. (1977). Factor Mobility, Regional Development, and the Distribution of Income . *The Journal of Political Economy*, 79-96.
- McKenzie, D., & Rapoport, H. (2007). Network effects and the dynamics of migration and inequality: Theory and evidence from Mexico. *Journal of Development Economics*, 1-24.

- McKenzie, D., & Rapoport, H. (2011). Can migration reduce educational attainment? Evidence from Mexico. *Journal of Population Economics*, 1331–1358.
- Meyer, J. (2001). Network Approach versus Brain Drain: Lessons from the Diaspora. *International Migration*, 91-110.
- Miguélez, E. (2016). *Inventor Diasporas and the Internationalization of Technology*. Washington D.C.: The World Bank.
- Mishra, P. (2007). Emigration and wages in source countries: Evidence from Mexico. *Journal of Development Economics*, 180-199.
- Mishra, P. (2014). *Emigration and Wages in Source Countries: A Survey of the Empirical Literature*. Washington D.C.: International Monetary Fund.
- Mohapatra, S., & Burns, A. (2008). *International Migration and Technological Progress*. Washington D.C.: World Bank Other Operational Studies.
- Mohapatra, S., Joseph, G., & Ratha, D. (2009). *Remittances and natural disasters : ex-post response and contribution to ex-ante preparedness*. Washington D.C.: The World Bank.
- Montobbio, F., & Sterzi, V. (2013). The Globalization of Technology in Emerging Markets: A Gravity Model on the Determinants of International Patent Collaborations. *World Development*, 281–299.
- Mountford, A. (1997). Can a brain drain be good for growth in the source economy? *Journal of Development Economics*, 287-303.
- Mountford, A., & Rapoport, H. (2011). The Brain Drain and the World Distribution of Income. *Journal of Development Economics*, 4–17.
- Murat, M., Pistoiesi, B., & Rinaldi, A. (2008). *Italian Diaspora and Foreign Direct Investment: A Cliometric Perspective*. Modena: Center for Economic Research, University of Modena.
- Murphy, R. (2000). Return Migration, Entrepreneurship and Local State Corporatism in Rural China: The experience of two counties in south Jiangxi. *Journal of Contemporary China*, 231-247.
- Naufal, G. (2007). *Who Remits? The Case of Nicaragua*. Bonn: IZA Institute of Labor Economics.
- Nepal, A. (2016). The impact of international remittances on child outcomes and household expenditure in Nepal. *Journal of Development Studies*, 838–853.
- Niimi, Y., Ozden, C., & Schiff, M. (2010). Remittances and the Brain Drain: Skilled Migrants Do Remit Less. *Annals of Economics and Statistics*, 123-141.
- Nyarko, Y., & Easterly, W. (2009). *Is the Brain Drain Good for Africa?* Oxford: Oxford University Press.
- O'Rourke, K., & Williamson, J. (1999). *Mass migrations: impacts on labor markets, home and abroad*. Cambridge: MIT.
- OECD. (2010/11). Database on Immigrants in OECD and non-OECD Countries: DIOC-E. Paris, France: Organisation for Economic Co-operation and Development.
- OECD. (2019). *The new immigrants Global trends in migration towards OECD countries between 2000/01 and 2015/16*. Paris: OECD publishing.
- Oettl, A., & Agrawal, A. (2008). International Labor Mobility and Knowledge Flow Externalities. *Journal of International Business Studies*, 1242–1260.

- Olesen, H. (2003). Migration, Return, and Development: An Institutional Perspective. *International Migration*.
- Orozco, M. (2003). *The Impact of Migration in the Caribbean and Central American Region*. Ottawa: Canadian Foundation for the Americas.
- Orozco, M. (2006). *International Flows of Remittances: Cost, competition and financial access in Latin America and the Caribbean—toward an industry scorecard*. Washington D.C.: Inter-American Dialogue.
- Osili, U. (2004). Migrants and Housing Investments: Theory and Evidence from Nigeria. *Economic Development and Cultural Change*, 821-849.
- Özden, C., & Schiff, M. (2006). *International migration, remittances, and brain drain*. Washington D.C.: The World Bank.
- Ozden, C., Parsons, C. R., Schiff, M., & Walmsley, T. L. (2011). Where on Earth Is Everybody? The Evolution of Global Bilateral Migration 1960–2000. *The World Bank Economic Review*, 12-56.
- Patel, P., & Pavitt, K. (1991). Large Firms in the Production of the World's Technology: An Important Case of 'Non-Globalisation'. *Journal of International Business Studies*, 1–21.
- Patel, P., & Vega, M. (1999). Patterns of internationalisation of corporate technology: location vs. home country advantages. *Research Policy*, 145-155.
- Picci, L. (2010). The internationalization of inventive activity: A gravity model using patent data. *Research Policy*, 1070–1081.
- Pilarova, T., & Kandakov, A. (2017). The impact of remittances on school attendance: the evidence from the Republic of Moldova. *International Journal for Education Development*, 11–16.
- Piper, N. (2005). *Gender and Migration*. Policy and Research Programme of the Global Commission on International.
- Piracha, M., & Vadean, F. (2010). Return Migration and Occupational Choice: Evidence from Albania. *World Development*, 1141–1155.
- Pistorius, C. (2004). The Competitiveness and innovation. *Elektron, Vol. 21, No.3*.
- Portes, A., Escobar, C., & Radford, A. (2007). Immigrant Transnational Organizations and Development: A Comparative Study. *International Migration Review*, 242–281.
- Quisumbing, A. (2003). *Household Decisions, Gender and Development: A Synthesis of Recent Research*. Baltimore: John Hopkins University Press for the International Food Policy Research Institute.
- Rajan, R., & Zingales, L. (1988). Financial Dependence and Growth. *The American Economic Review*, 559-586.
- Ramirez, C., Dominguez, G., & Marais, J. (2005). *Crossing Borders: Remittances, Gender and Development*. INSTRAW.
- Ratha, D. (2007). *Leveraging Remittances for Development*. Washington D.C.: The World Bank.
- Ratha, D., Mohapatra, S., Özden, C., Plaza, S., Shaw, W., & Shimeles, A. (2011). *Leveraging Migration for Africa: Remittances, Skills, and Investments*. Washington D.C.: The World Bank.
- Rauch, J. (1991). Reconciling the Pattern of Trade with the Pattern of Migration. *The American Economic Review*, 775-796.
- Rauch, J., & Trindade, V. (2002). Ethnic Chinese Networks in International Trade. *Review of Economics and Statistics*, 116–130.

- Ravara, A. (2018). *Female Brain-Drain or Female Empowerment? A panel data analysis of brain-drain rates to OECD countries from 1980 to 2010*. Lund: Lund University.
- Ray, D. (2006). Aspirations, poverty and economic change. . In A. Banerjee, R. Benabou, & D. Mookherjee, *Understanding Poverty* (pp. 409-422). New York: Oxford University Press.
- Reubens, E. P. (1983). International Migration Models and Policies . In *Economics of Mass Migration from Poor to Rich Countries* (pp. 178-182). The American Economic Review.
- Riley, G. (2012). *Economic Growth - The Role of Human & Social Capital, Competition & Innovation*.
- Robertson, R. (2004). Relative Prices and Wage Inequality: Evidence from Mexico. *Journal of International Economics*, 387-409.
- Romer, P. (1986). Increasing Returns and Long-Run Growth . *The Journal of Political Economy*, 1002-1037.
- Romer, P. (1987). Growth based on increasing returns due to specialization . *American Economic review*, 56-62.
- Romer, P. (1990a). Endogenous technological change. *Journal of Political economy*, 71-108.
- Romer, P. (1990b). Human capital and growth: theory and evidence. *Carnegie Rochester Conference Series on Public Policy*, 251-286.
- Russel, S. (1992). Migrant Remittances and Development. *International Migration*, 267-287.
- Russel, S., Jacobsen, K., & Stanley, W. (1990). *International Migration and Development in Sub-Saharan Africa*. Washington D.C.: The World Bank Group.
- Sanromá, E., Ramos, R., & Hipólito, S. (2009). *Immigrant Wages in the Spanish Labour Market: Does the Origin of Human Capital Matter?* Bonn: Institute of Labor Economics.
- Saxenian, A. (2001). *Bangalore, the Silicon Valley of India?* Stanford: Stanford University.
- Saxenian, A. (2005). From Brain Drain to Brain Circulation: Transnational Communities and Regional Upgrading in India and China. *Studies in Comparative International Development*, 35-61.
- Saxenian, A., Motoyama, Y., & Quan, X. (2002). *Local and Global Networks of Immigrant Professionals in Silicon Valley*. San Francisco: Public Policy Institute of California. .
- Schellinger, A. (2017). *Brain Drain – Brain Gain: European Labour Markets in Times of Crisis*. Friedrich-Ebert-Stiftung.
- Schultz, T. P. (1988). Education investments and returns. In C. a. (eds), *Handbook of Development Economics*. Amsterdam: North-Holland .
- Scott, A. (1970). The Brain Drain - Is a human capital approach justified? In W. Hansen, *Education, Income and Human Capital* (pp. 241-298). Washington D.C.: National Bureau of Economic Research.
- Shrestha, S. (2010). *Effect of educational returns abroad on domestic schooling*. Mimeo: University of Michigan.
- Shrestha, S. (2017). No man left behind: effects of emigration prospects on educational and labour outcomes of non-migrants. . *The Economic Journal*, 495–521.
- Siggel, E. (2001). India's trade policy Reforms and Competitiveness industry in the 1980s. . *World Economy*, 159-183.

- Sintov, R., & Cojocaru, N. (2013). *Assessment of Links between Education, Training and Labour Migration in Moldova*. . Budapest: International Labour Organization.
- Sjaastad, L. (1962). The costs and returns of human migration. *Journal of Political Economics*, 80-93.
- Smith, A. (1937). *The Wealth of Nations*. . New York: Modern Library.
- Sparreboom, T., Mertens, J., & Berger, S. (2019). The Labour Market Impact of Immigration in Three Sub-Saharan African Economies. *Journal of International Migration and Integration* , 1225–1248.
- Stark et al. (1998). Human capital formation, human capital depletion, and migration: a blessing or a 'curse'? *Economics Letters*, 363-367.
- Stark, O., & Bloom, D. (1985). The New Economics of Labor Migration. . *American Economic Review*, 173-178.
- Stark, O., & Wang, Y. (2002). Inducing human capital formation: migration as a substitute for subsidies. *Journal of Public Economics*, 29-46.
- Stark, O., Helmenstein, C., & Prskawetz, A. (1997). A brain gain with a brain drain. *Economic Letters*, 227-234.
- Straubhaar, T. (1986). The Determinants of Workers' Remittances: The Case of Turkey,. *Weltwirtschaftliches Archiv*, 728-740.
- Subbarao, K., & Raney, L. (1995). Social gains from female education: a cross-national study. *Economic Development and Cultural Change*, 105-28.
- Terrazas, A. (2010). *Diaspora Investment in Developing and Emerging Country Capital Markets: patterns and prospects*. Washington D.C.: Migration Policy Institute.
- Thompson, S. (2015, February 18). *What is a Quasi-Experimental Design?* Retrieved from Summit: <https://www.summitllc.us/blog/what-is-a-quasi-experimental-design>
- Tong, S. Y. (2005). Ethnic Networks in FDI and the Impact of Institutional Development. *Review of Development Economics*, 563-580.
- UCLA. (2020). *What is seemingly unrelation regression and how can I perform it in STATA?* Retrieved from Institute for Digital Research and Education: <https://stats.idre.ucla.edu/stata/faq/what-is-seemingly-unrelated-regression-and-how-can-i-perform-it-in-stata/>
- UNCTAD. (2012). Mobilizing the diaspora: From brain drain to brain gain. In UNCTAD, *The Least Developed Countries Report* (pp. 86-120). Geneva: United Nations Conference on Trade and Development.
- UNDESA. (2020). International migrant statistics 1990-2019. United Nations, Department of Economics and Social Affairs; Population Division.
- Vidal, J. (1998). The effect of emigration on human capitalformation. *Journal of Population Economics*, 589-600.
- Wadhwa, V., Saxenian, A., Rissing, B. A., & Gereffi, G. (2007). *America's New Immigrant Entrepreneurs: Part I*. Duke Science, Technology & Innovation Paper No. 23.
- Wahba, J. (2015a). *Who benefits from return migration to developing countries?* Bonn: IZA.
- Wahba, J. (2015b). Selection, Selection, Selection: The Impact of Return Migration. *Journal of Population Economics*, 535–563.

- Wahba, J., & Zenou, Y. (2011). *Out of sight, out of mind: migration, entrepreneurship and social capital*. London: Center for Research and Analysis of Migration.
- WEF. (2016). *The Global Gender Gap Report – Insight Report*. Devos: World Economic Forum.
- Wickramasekera, P. (2002). *Asian Labour Migration: Issues and Challenges in the Era of Globalization*. Geneva: International Labor Office.
- Wilson, J. (1992). Optimal Income Taxation and International Personal Mobility. In *International Factor Mobility: New Issues* (pp. 191-196). The American Economic Review.
- Wong, K., & Yip, C. (1999). Education, Economic Growth and Brain Drain. *Journal of Economic Dynamics Control*, 699-796.
- Wong, K.-Y. (1986). The Economic Analysis of International Migration: A Generalization . *The Canadian Journal of Economics*, 357-362.
- Woodruff, C., & Zenteno, R. (2001). *Remittances and Microenterprises in Mexico*. Graduate School of International Relations and Pacific Studies .
- World Bank. (2001). *World Development Report*. Washington D.C.: The World Bank Group.
- World Bank. (2007). *Confronting the challenges of gender equality and fragile states*. Washington D.C.: The World Bank Group.
- Yang, D. (2008). International Migration, Remittances and Household Investment: Evidence from Philippine Migrants' Exchange Rate Shocks. *The Economic Journal*, 591-630.
- Yang, D., & Martinez, C. (2006). Remittances and poverty in migrant's home area: Evidence from the Philippines. In C. Özden, & M. Schiff, *International migration, remittances and the brain drain*. . Washington D.C.: The World Bank.
- Zorlu, A., & Hartog, J. (2009). How important is homeland education for refugees' economic position in The Netherlands? *Journal of Population Economics*, 219-246.

