North-North Migration and Agglomeration in the European Union 15*

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Abstract

This paper revisits empirical evidence on migration within the European Union-15, disaggregated by occupation. We find that workers move to countries where their type is relatively more abundant among natives. This is at odds with traditional models of migration. We develop a model with external economies of scale that generates an agglomeration force in high-educated labor. Our main result is that a country that is relatively abundant in highly educated labor force will attract foreign labor of the same type. We argue this type of model is more suitable to analyze migration flows between countries of similar income level.

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1 Introduction

In light of current selective migration reforms, this paper revisits empirical evidence on migration within the European Union 15[1] (EU15), disaggregated by occupation. We document that foreign-born workers within this area live in countries where their type is relatively more abundant among natives. This is at odds with traditional models of migration. We build a model with a sector exhibiting external economies of scale that allows for international labor flows between countries that are similar both in terms of income and individual characteristics of workers. The main result is that, if a country has a relatively larger fraction of native population working in a high educated intensive sector, this country will attract foreign labor of the same type. This is consistent with migration patterns observed in high-educated occupations in our sample of analysis.

The share of total immigrants relative to the population in Europe is now similar to that of the United States (US), number which was was much smaller around 1960 (Dustmann and Frattini, 2012). Regardless of the migratory inflows generated by the decolonization process and the incorporation of Eastern European countries to the European Union (EU), 20% of the immigrants in the EU15 are native from other EU15 countries. Recent policy changes are likely to be behind these numbers. Two examples of these changes are the creation of a free mobility area, established by the consolidation of the Schengen Area in 1995, and the changes in national policies that formalize agreements reached under the framework of the European Higher Education Area (EHEA).

The EHEA is the result of a series of agreements signed between 1999 and 2009, involving changes in national educational policy by the member states[2]. These changes include the transferability of academic credits and the mutual recognition of degrees across the EHAE. While the Schengen Area is just one of many labor free mobility areas in the OECD (OECD, 2012), the EHEA represents the first *human capital free mobility area*. For our analysis, this means that, nowadays, skills are more transferable and workers are more mobile within this area, which enhances the importance of the intra EU migration phenomenon. These two types of free mobility policies, of workers and skills, are likely to reinforce each other.

Selective migration policies have gained weight, among industrialized countries, in detriment of traditional quotas and family reunification. This type of policies favor inflows of highly skilled labor. Within the EU, for instance, the United Kingdom is considering adopting a point-based immigration scheme, where potential immigrants earn points on the basis

[1] The EU15 comprised the following 15 countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom.

[2] All European countries except for Belarus are part of the EHEA.

of their qualifications and skills, among other factors. More recently, the Great Recession has brought up concerns that were not present at the time the free mobility agreements were signed.

Most models that examine migration analyze migration flows from poorer regions, where a type of labor is abundant, to richer regions, where it is scarce. We relegate the discussion of this type of models and its by-products to the next subsection, in relation to their main references. We refer to this approach as the *south-north* approach. In this setup, immigrants can have higher expected earnings abroad, because of differences in countries' income levels or because of the relative scarcity of their type of labor as compared to the host country. We will show that this is not the case between workers of the EU15.

Using data from the European Labor Force Survey, we find that, if a EU15 country has a relatively larger fraction of native population working in a high-educated occupation, this country will attract foreign EU15 labor of the same type. We also document that high-educated occupations display concentration patterns in the sense that workers in those occupations tend to cluster in specific countries.

We develop a model with external economies of scale where wages are strictly increasing in the amount of high-educated (HE) labor, both foreign and native, employed in a country. Hence, at the individual level, it is worthy for the most able households to become HE and to move to the country where there are more HE native workers. This is consistent with the migration patterns observed in high-educated occupations in our sample of analysis, which we refer to as *north-north* migration patterns. Therefore, by incorporating the previously described agglomeration mechanism, the model we propose in this paper successfully generates the EU15 migration flows and concentration patterns for our sample data.

The paper is organized as follows. Section 2 discusses some of relevant literature in migration related to our paper. Section 3 describes the data and documents patterns of intra-EU15 migration by occupation. Section 4 describes the model and the equilibrium. Section 5 reports and discusses the results. Section 6 concludes.

2 Related Literature

A large proportion of the literature on migration focuses on migration flows from low income (south) to high income (north) countries. An emblematic case is the US-Mexico migration. In this literature, individuals migrate because of the relative scarcity of their own type of labor in the host country, which rewards those that cross the border with higher labor

earnings. International labor flows generate a reallocation of labor that is jointly determined by the demand and the supply of both native and foreign workers. Once net wages equalize in both countries, this approach predicts that migration flows will cease. We refer to this approach as the south-north approach.

Recent policy changes have driven attention to a different type of labor flows where workers migrate to countries similar to their source country and where their type is relatively more abundant. We refer to this as north-north migration. This type of flows can not be explained by the south-north literature because its basic mechanism is contradicted from the beginning. This section reviews some of the migration literature that falls in within the south-north traditional approach and point to where they fail to explain and predict the intra-EU15 flows.

A new generation of migration models was born when self-selection of immigrants and brain drain started to gain importance. A seminal work in self-selection of immigrants is Borjas (1995) In his model, self-selection is driven by the correlation between skills across countries and their relative earnings distribution dispersion. With this model, Borjas aims to explain migration flows towards the United States and the differences in the earnings of immigrants by country of origin. Moreover, immigrant cohorts from the same source country might differ according to changes in the relative rate of return to skill. Despite his claim that his model is able to explain migration flows for many host countries, this is only true when the host country is relatively richer than the source country.

Urrutia (2001) goes a step further in this line of thought and models migration flows from Mexico and India to the US in a south-north approach. He extends the analysis allowing for differences in migration costs due to distance and language barriers, that he models as a fixed cost and as a temporary loss of ability respectively. By considering these two aspects, Urrutia generates a self-selection pattern that can account for heterogeneity in the performance of immigrants from different source countries, which is observed in the data. His main result is that immigrants from distant countries are more likely to belong to the top abilities distribution. This result goes in the opposite direction to the one we are interested in this paper, where migrants from and to EU15 move across proximal countries and yet belong to the top abilities distribution for some occupations.

Lopez-Real (2011) incorporates a new source of heterogeneity of workers. In his model, workers are heterogeneous in years of schooling and ability. Lopez-Real finds that self-selection in ability is always positive and that differences in TFP determine whether self-selection in schooling is positive or negative. Nonetheless, his model cannot explain the concentration we document among EU15 countries. Moreover Lopez-Real assumes the host

country is a large open economy while the source country is a small open economy. This is not the case for EU15 countries since they are similar in terms of size and openness.

Dustmann and Frattini (2012) provide an overview of immigration to Europe from the Second World War to the early 2010s. The authors document the existing disparities between immigrants born in the EU and those born outside of the EU, with special focus on labor markets. Overall, they find that EU immigrants are more similar to the native population than immigrants from elsewhere. For instance, EU immigrants are more similar to natives with respect to occupational and educational attainment distributions. Non-EU immigrants are found to be more concentrated than EU nationals in less skilled occupations. Hence their observations support our evidence that the intra-EU migration flow differentiates itself from the aggregate migration flow to the EU15 countries in a peculiar way: a large fraction of it mimics the characteristics of the national population, with some exceptions.

Dustmann and Frattini calculate the employment probability for those groups controlling for gender, education, region and age. They conclude that non-EU immigrants are in disadvantage in all countries studied, lagging behind by at most 20 percentage points in employment probability compared to natives with the same characteristics. Meanwhile EU immigrants are at most 8 percentage points behind. The differences across immigrants documented in their work foster relevant questions that are left unanswered by the traditional south-north literature. Why are migration flows across EU15 countries more intense than what is predicted by the south-north models provided that those countries are considerably more homogeneous? Why do the EU15 migrants are so different from those coming from other parts of the world?

The model of this paper is based on Chipman (1970). For our model, the most important feature of his theoretical framework is the presence of increasing returns to scale in the production of the skilled intensive good, that are external at the firm level. This is the main force that induces agglomeration of workers with similar characteristics after migration. In this paper, we use the aforementioned feature and generalize the model of Haupt and Uebelmesser (2010), which focus on high-educated flows, by creating a second sector with a constant returns to scale (CRS) technology, and by having a general equilibrium environment. We incorporate features of their model by allowing households to simultaneously choose education and migration in the skilled intensive sector. In the future our aim is to open the migration option for workers in the CRS sector too, in order to generate heterogeneity of migration flows.

3 Data and Empirical Evidence

3.1 Data and Classifications

One of the main limitations of the analysis of migration patterns across different countries is the lack of comparable data. It is often the case that each country uses a different definition of immigrant based on either nationality or country of origin. Harmonized data on migration status and occupation for European countries are available from two sources: the European Labor Force Survey (EU-LFS), which consists of repeated cross-sections of individuals from 1983-2013; and the Database on Immigrants in OECD Countries (DIOC), which reports aggregate numbers of workers by different demographic and labor market cateogries based on Census data, with a comprehensive list of variables and countries only for the year 2001[3]. In this analysis, we use the EU-LFS and we consider a worker to be immigrant if she was born in a country different from the one in which she works.

The European Union Labor Force Survey Database

The European Union Labor Force Survey (EU-LFS hereafter) is a harmonized household sample survey that contains quarterly detailed information on individuals per country for 28 European countries. The data covers the years from 1983 onwards, due to availability of our variables of interest we keep the years of 1996 to 2010, for a total of 31,663,252 observations.

The core variables in the analysis are country of residence, country of birth, educational attainment, employment status, hours worked, and occupation (identified by the 1988 International Standard Classification of Occupations, ISCO-88 hereafter). Out of the 28 countries available in the EU-LFS, we keep EU15 countries.

The ISCO-88: Description and Relation to Educational Classification

The ISCO-88 is one of the occupational classifications published by the International Labour Office (ILO, 1990). It uses information on national coding for over 80 countries and organizes them into a standard classification of occupations.

Even though each occupation presents a different skill specialization content in terms of tasks,we find convenient is that its ordering coincides with its corresponding educational

[3]A version for 2005 is available, but the information disaggregated by occupation is incomplete for a large part of the countries.

level. In particular, eight of the nine major ISCO-88[4] groups are ordered with reference to education levels[5] defined for ISCO-88 (See Table 6 for a detailed description of each group). Five out of nine major ISCO-88 groups (4, 5, 6, 7 and 8) have the same average education level (lower or upper secondary education). These five groups, together with Elementary Services (group 9)[6], will be considered *Low-Educated* in the analysis below. The remaining groups (1-3) include occupations that require tertiary education and therefore will be classified as *High-Educated*.

3.2 Empirical Analysis

This section is organized in three parts. In the first part, we provide empirical support our north-north approach showing that EU15 immigrants are different from non EU15. Henceforth we limit the study to foreign-born workers whose country of origin is a EU15 member. Then we focus on the distribution of foreign-born workers across occupations, compared to the distribution of native-born workers. In the second part, we compute the correlation between the occupational distributions of foreign-born workers and that of native-born workers, for each country. We use this correlation to explain the relation between natives and foreigners. Finally in the third part, we compute a proxy for concentration of total workers depending on their occupation. For this measure, we use the educational component of the ISCO-88. A detailed definition and explanation of these measures will be provided below.

North-North Empirical Analysis

Many authors[7] have emphasized the differences between EU15 immigrants and other foreigners. In particular, EU15 immigrants have similar characteristics as natives, for example both groups have high levels of education and are more concentrated in skilled occupations. Figure 1 depicts the distribution of employment across occupations, ordered by wage, for natives and foreigners. In line with previous findings, we observe that EU15 foreigners behave in a similar fashion as natives and very differently from non EU15 immigrants. Additionally, in panel (a) we observe that the share of EU15 foreigners exceeds that of natives in the top

[4]We exclude Armed Forces (group 0).

[5]The ISCO levels of education are based on the first (1976) version of the International Standard Classification of Education (ISCED). ISCO defines 4 levels of education: 1 for primary education, 2 for lower and upper secondary education, 3 for tertiary education not leading to a university degree and 4 for tertiary education leading to a university degree.

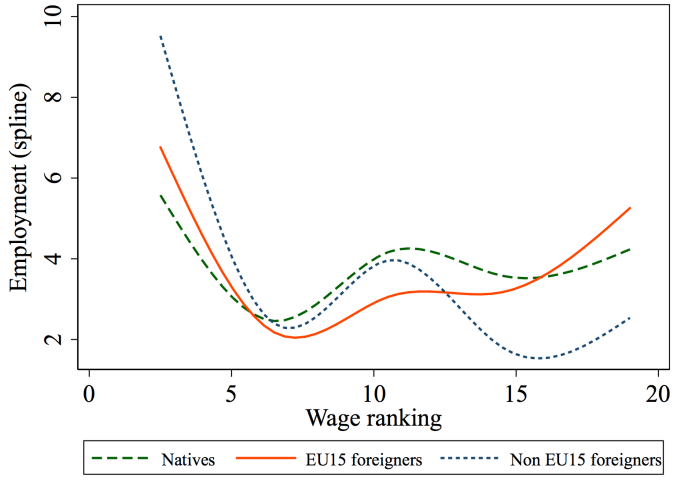
[6]Elementary Services is the only major group of occupations in which the average education level is primary school.

[7]Dustmann and Frattini (2012) among others, see section 2.

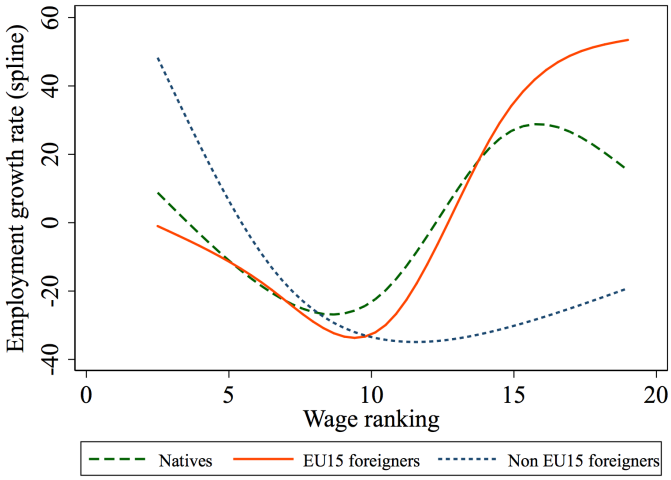
paid occupations. Panel (b) in Figure 1 shows the evolution of this distributions. Notice that this graph is reminiscent of the polarization literature: employment growth is larger in both tails of the wage distribution and negative in the middle, for natives and EU15 immigrants. We emphasize that both the share and growth rate of EU15 workers in the top paid occupations exceed that of any other group. In this paper we will concentrate on this particular group of occupations.

Figure 1: Employment distribution: Percentage (2010) and growth rate (1996-2010)

(a) Employment by migrant status



(b) Growth rate of employment (1996-2010)



Note: Wage ranking orders occupations by their mean wage across 10 European countries across all years, following wage information in Goos et al. (2014). We restrict the number of countries to match their wage ranking. Panel (a) plots the median spline of employment shares by migrant status, pooled across countries. Panel (b) plots the median spline of the growth rate of these employment shares from 1996-2010.For detailed information on occupations refer to Table 5 in the appendix.

Occupational Migration Patterns

"Do people migrate to countries where there are more native workers of their type or where there are less?" This subsection addresses this question from an empirical perspective.

First, we define the occupational distribution of foreign and native workers in country i as:

$$S_N^i = \left(s_{N1}^i, s_{N2}^i, ..., s_{NJ}^i\right), \text{ where } \quad s_{Nj}^i \equiv \frac{\#\text{ native workers in occupation } j \text{ and country } i}{\#\text{ native workers in country } i}$$

$$S_I^i = \left(s_{I1}^i, s_{I2}^i, ..., s_{IJ}^i\right), \text{ where } \quad s_{Ij}^i \equiv \frac{\#\text{ EU15-immigrant workers in occupation } j \text{ and country } i}{\#\text{ EU15-immigrant workers in country } i},$$

respectively, where J is the number of subgroups considered, $J = 26$ for the ISCO 2-digit.

Then, for each occupation j , we extract the shares by country for both native and immigrant workers: $(s_{Nj}^1, ..., s_{Nj}^I)$ and $(s_{Ij}^1, ..., s_{Ij}^I)$. Next, we compute the correlation between the occupational distribution of native workers and that of EU15 foreign-born workers. We interpret this as an empirical measure of how EU15 foreign-born workers allocate themselves across countries based on the given distribution of natives. More specifically, we regress S_N^i on S_I^i and a set of year dummies. Table 1 shows an example of how this shares look like for for subgroup 12 (Corporate Managers).

Table 1: Share of Natives and Immigrants by Country of Residence

12: Corporate Managers, 2010

Country	Share Natives	Share Foreign EU-15
Austria	3.56	6.02
Belgium	7.40	14.12
Denmark	2.81	4.40
Spain	2.52	3.64
Finland	6.51	4.70
France	5.88	5.95
Greece	1.69	2.00
Ireland	9.08	14.60
Italy	2.09	2.75
Luxembourg	1.51	3.36
Netherlands	5.38	4.72
Norway	5.48	5.75
Portugal	2.07	3.98
Sweden	4.57	3.74
United Kingdom	12.07	11.53

Column 2 includes the ratio between the number of native-born workers in occupation 12 and the total number of native-born workers. Column 3 includes the ratio between the number of foreign-born workers in occupation 12 and the total number of foreign-born workers.

We obtain a correlation of 0.66, significant at the 1% level. As a comparison, this number is only 0.40 for immigrants from outside the EU15. The result of this empirical analysis is that if a country has a relatively larger fraction of native population working in a high-educated occupation, Managers in the example shown in Table 1, this country will attract foreign labor of the same type.To answer the question that we posed at the beginning of the subsection, people do migrate to countries where there are more native workers of their type. This is an example of what we previously referred to as north-north migration patterns.

Concentration Patterns

"Do countries keep a balanced distribution of workers across occupations or are some groups of workers more concentrated in one country?" To answer this question, we present a measure of concentration of workers.

First, we define the occupational distribution of the total working population in country i as:

$$S^i = \left(s_1^i, s_2^i, ..., s_J^i\right), \text{ where } \quad s_j^i \equiv \frac{\#\text{ all workers in occupation } j \text{ and country } i}{\#\text{ all workers in country } i}$$

Recall that ISCO-88 occupations are ordered according to educational level. In the data description we have defined *high* and *low-educated* occupations. Notice that we can express S^i as $S^i_{HE} \bigcup S^i_{LE}$, where S^i_{HE} contains the shares corresponding to subgroups of groups 1-3, and S^i_{LE} those to subgroups of groups 4-9. Then, for each pair of countries in our sample, i and h, we compute $Corr(S^i_{HE}, S^h_{HE})$ and $Corr(S^i_{LE}, S^h_{LE})$, for each year of the sample. Then for each country i and year we compute the average (across education levels) of each pairwise correlation with the other countries in the sample. Finally we calculate the average across years.

We want to emphasize the difference with respect to the previous analysis. In this case, the population of analysis is total working population in each occupation, regardless of their country of birth. Second, this correlation is computed over the occupational distribution, by education group.

We interpret a positive correlation as evidence that the country keeps a balanced structure in that education group. A negative correlation means that a country has a lower share of its working population in occupations where other countries have a high share. We take this as evidence of concentration.

Table 2 presents the average correlations. We find two main results: First, for low-educated occupations, countries keep a more balanced structure, i.e., average correlations are

positive and high in general. Second, for high-educated occupations, there are concentration patterns. In this occupation group, the results are more heterogeneous, yet correlations are generally lower and even negative for some cases.

Table 2: Concentration Patterns (1996-2010)

Country	Average Correlation High Skill	Average Correlation Low Skill
Austria	.31	.75
Belgium	.34	.65
Denmark	.49	.76
Spain	.58	.69
Finland	.58	.68
France	.47	.77
Greece	.15	.39
Ireland	-.15	.79
Italy	.25	.66
Luxembourg	.57	.53
Netherlands	.58	.76
Norway	.38	.64
Portugal	.45	.44
Sweden	.57	.67
United Kingdom	-.43	.74

We will use these two main findings of education and concentration as input in our model. We will have two sectors: One will exhibit constant returns to scale and employ only low-educated labor. The other one will exhibit increasing returns to scale and employ only high-educated workers.

4 The Model

Framework

We consider a static, one-period model of education and migration choice. An economy consists of firms, households and governments. There are two countries: 1 and 2. Both countries have identical production technologies and initial size. We normalize initial population size to 1 in each country.

There are two productive sectors in each country: one displays constant returns to scale (CRS) and the other one increasing returns to scale (IRS) at the industry level, i.e. IRS

are external to the firm. They produce using High-Educated (HE) and Low-Educated (LE) labor, respectively.

Households are heterogeneous in ability and mobility. They make consumption, education and migration decisions and they supply labor inelastically. Their education decision determines the type of labor they will supply (HE or LE) and their migration choice determines their country of residence. Finally, there is a government that collects education payments of high-educated workers and transfers them to households in a lump sum fashion.

We begin with a closed economy, in which there is no migration choice. Next, we analyze a two-country open economy model, where we allow for free mobility of goods, labor and degrees (skills)[8].

4.1 Closed Economy

Production

There are two goods in the economy: Y and Z. Sector Y is composed of a continuum of symmetric firms in the interval $[0, 1]$ that use HE labor as their only input. Output of firm $k \in [0, 1]$ is:

$$y_k = A(H) \cdot h_k, \quad \text{where} \quad H = \int_0^1 h_k dk, \tag{1}$$

where $A' > 0$, $A'' < 0$ and h_k is the amount of HE labor used by firm k.

Production of good Y exhibits IRS at the country-industry level, but these are external to individual firms. The more HE workers in the economy, the higher the output of each producer. However, each firm $k \in [0, 1]$ is atomless and does not internalize its effect on aggregate demand of HE labor in their country. Therefore, each individual firm considers the productivity term in the production function as a constant and behaves competitively. Inverse demand of HE workers is given by:

$$w_H = A(H) \cdot P_Y \tag{2}$$

For simplicity, and since firms are identical, we characterize the equilibrium using a representative firm that demands h and produces Y.

[8] In order to capture the free transferability of academic credits and the mutual recognition of degrees across the EHAE.

Good Z is produced by a representative firm. The only input for production is LE labor and it has the following CRS technology:

$$Z = B \cdot L, \tag{3}$$

where $B \geq 1$ and L denotes the amount of LE labor used.

The inverse demand for LE workers is given by:

$$w_L = P_Z \cdot B. \tag{4}$$

Households and Government

Households are heterogeneous in ability. They are born low educated and can decide to remain uneducated and earn w_L working in the CRS sector. Alternatively, they can choose to acquire high education by paying an individual specific cost[9] and then earn w_H working in the IRS sector. Regardless of their choice, they supply labor inelastically since there is no disutility from working.

At the beginning of the period, each household $j \in [0,1]$ makes an ability draw that determines her education cost θ_j, which is negatively related to ability. For the most able individual, education will be free. For the least able individual, the cost will be the highest possible cost, $\bar{\theta}$. Education costs are uniformly distributed in the interval $\left[0, \bar{\theta}\right]$.

Given ability, prices, wages and transfers $(\theta^j, P_Y, P_Z, w_H, w_L, T)$, each household j chooses an education level and consumption bundle $\left\{e^j \in \{HE, LE\}, \ \ c_Y^j, c_Z^j\right\}$ to solve:

$$\begin{aligned} \max_{\left\{e^j, c_Y^j, c_Z^j\right\}} \quad & \lambda \log c_Y^j + (1-\lambda) \log c_Z^j \\ \text{s.t.} \quad & P_Y c_Y^j + P_Z c_Z^j \leq W^j \\ & W^j = w_H - \theta_j + T \quad \text{if } e^j = HE \\ & W^j = w_L + T \qquad\quad \text{if } e^j = LE \\ & c_Y^j \geq 0, \quad c_Z^j \geq 0 \end{aligned}$$

The last agent of our economy is the government (G). This agent collects education payments and transfers them equally to all households in a lump-sum fashion . The revenue of the government is given by:

$$G^R = \int_{\mathcal{H}} \theta_j dj = \int_0^{\theta^*} \theta_j dF(\theta) = \int_0^{\theta^*} dF(\theta), \tag{5}$$

[9] In general, the education cost can be interpreted as effort or ability.

where F is the *cdf* of θ_j, $\mathcal{H} \equiv \{j \in [0,1] \mid e^j = H\}$ and θ^* is a threshold that characterizes the set of educated workers. We will elaborate further on this cutoff value in the next subsection. Government expenditures are equal to:

$$G^E = \int_0^1 T dj, \tag{6}$$

where T is the percapita transfer.

Definition 4.1. ***Autarky Equilibrium:*** *Given the ability distribution $U[0,\bar{\theta}]$, a competitive equilibrium for this economy is: (i) education and consumption choices from households: $\left\{\left(e^j, c_Y^j, c_Z^j\right)\right\}_{j\in[0,1]}$, (ii) production plans: (Z, L, Y, h), (iii) lump-sum transfers T, (iv) prices: $\{P_Z, P_Y, w_H, w_L\}$ and (v) an endogenous threshold θ^* such that:*

1. *Given prices, transfers the ability draw θ_j, (c_Y^j, c_Z^j, e^j) solves j's problem, $\forall j$.*
2. *Given prices, the production plan of the IRS sector, (Y, h), satisfies $w_H = A(H) \cdot P_Y$.*
3. *Given prices, the production plan of the CRS sector (Z, L) satisfies $w_L = B \cdot P_Z$.*
4. *Government budget balances:*

$$\int_{\mathcal{H}} \theta_j dj = \int_0^1 T dj$$

5. *Labor markets clear*

$$\begin{aligned} H^s &\equiv \int_{\mathcal{H}} j dj \\ H &\equiv h = H^s \\ H + L &= 1 \end{aligned}$$

6. *Goods markets clear*

$$\begin{aligned} Y &= \int_{\mathcal{H}} c_Y^j dj + \int_{\mathcal{H}^c} c_Y^j dj \\ Z &= \int_{\mathcal{H}} c_Z^j dj + \int_{\mathcal{H}^c} c_Z^j dj \end{aligned}$$

Characterization of the Equilibrium

Households consumption demand functions are:

$$c_Y = \frac{(\lambda)}{P_Y} \cdot W^j \tag{7}$$

$$c_Z = \frac{(1-\lambda)}{P_Z} \cdot W^j, \tag{8}$$

Given the ability draw θ_j, households maximize net labor income in order to maximize utility. Their education decision boils down to:

$$e^j = \begin{cases} HE & \text{if } w_H - \theta_j \geq w_L \\ LE & \text{otherwise} \end{cases} \tag{9}$$

This inequality determines individual supply of HE labor. Using the distribution of education costs $\theta_j \sim U[0, \bar{\theta}]$, we get an expression for aggregate supply of HE labor:

$$H = F(w_H - w_L) = \frac{w_H - w_L}{\bar{\theta}} \tag{10}$$

Notice that equation 10 implies that, all else equal, the higher the maximum cost of acquiring education, the smaller the share of HE people working in the IRS sector. We emphasize this result, since it will be the main difference between countries in the integrated economy. Note that the education decision is determined by a cutoff rule: every household j with $\theta_j \leq \theta^*$ will become HE, where $\theta^* = w_H^* - w_L^*$.

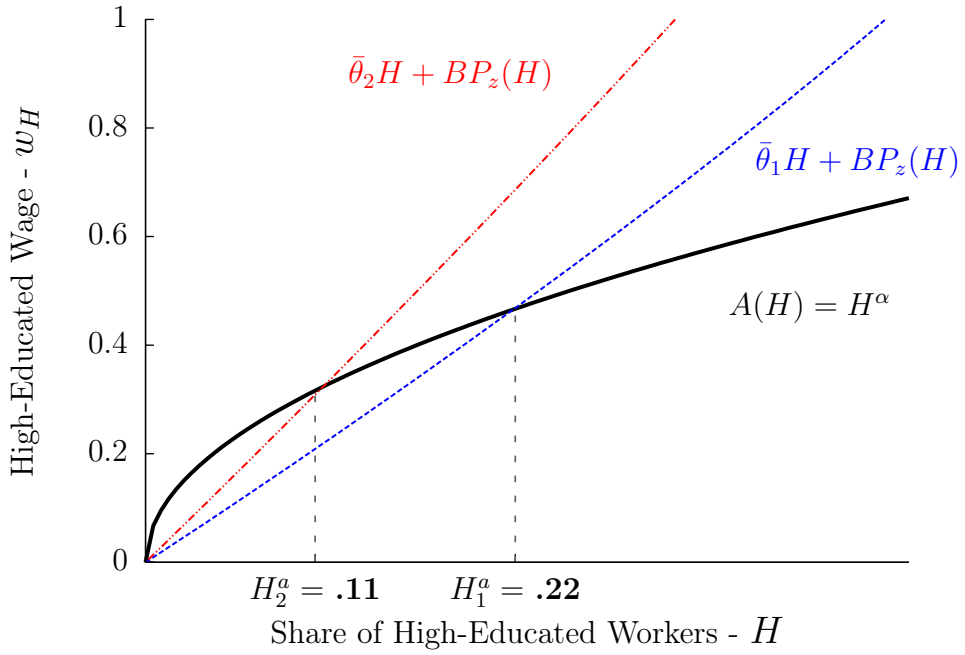
To complete the characterization of the equilibrium, we normalize $P_Y \equiv 1$. Combining the firm's inverse demand for labor and using the market clearing conditions:

$$H^* = \frac{A(H) - BP_Z^*(H)}{\bar{\theta}} \tag{11}$$

$$P_Z^*(H) = \frac{(1-\lambda)HA(H)}{\lambda B(1-H)} \tag{12}$$

In Figure 2, we illustrate the equilibrium under different ability supports. We use the following specification: $A(H) = H^\alpha$, $\alpha = 0.5$, $\lambda = 0.8$, $B = 1$, $\bar{\theta}_1 = 2$ and $\bar{\theta}_2 = 3$.

Figure 2: Autarky Equilibrium



4.2 Integrated Economy

We now consider an integrated world economy consisting of two countries indexed by i. Countries are identical in production technologies, preferences and population sizes, but differ in the distribution of ability. The world population is normalized to 2 (1 for each country). Both goods are tradable and both countries are big.

Households are heterogeneous in mobility and ability. In each country, there is an exogenous fraction $\gamma \in (0,1)$ that is perfectly mobile, and a fraction $(1-\gamma)$ that is perfectly immobile. Both types of labor, HE and LE, are perfect substitutes across countries. That is, natives and immigrants are assumed to be equally productive. The ability distribution is $\mathcal{U}\left[0, \bar{\theta}^i\right]$, where $\bar{\theta}^i$, $i \in \{1,2\}$, is now country specific. The distribution of ability is the same across mobile and immobile groups. People pay for education in their country of origin and can freely transfer their degree across countries.

Firms' problems in each country remain unchanged. Since both goods are perfectly tradable, prices will equalize across countries. This, together with the fact that the CRS sectors are identical, imply that wages of the low educated sector are also equalized across countries ($w_L^1 = w_L^2$).

In the open economy we have two types of households: mobile and immobile. Immobile ones face the same problem as in the closed economy. Mobile households, however, now have the additional choice of migration. More formally, a mobile worker j in country i chooses:

(i) Her education level: $e_j^i \in \{HE, LE\}$, which determines the sector where she will work.

(ii) Her migration status: $m_j^i \in \{N, M\}$, where N stands for *Native* and M for *Migrant*. This decision, given (i), determines her country of residence and, therefore, her wage.

Given mobility, ability, prices, wages and transfers $\left(\gamma, \theta_j^i, P_Y, P_Z, w_H^i, w_L^i, T^i\right)$, each household j from country $i \in \{1, 2\}$ chooses an education level, a migration status and a consumption bundle: $\left\{e_j^i \in \{HE, LE\}, m_j^i \in \{N, M\}, \ cy_j^i, cz_j^i\right\}$ to solve:

$$\begin{aligned}
&\max_{\{e_j, m_j, cy_j, cz_j\}} \lambda \log cy_j^i + (1-\lambda) \log cz_j^i \\
&\quad s.t. \quad P_Y cy_j^i + P_Z cz_j^i \leq W_j^i \\
&\quad where \quad W_j^i = w_H^i - \theta_j^i + T^i \qquad \text{if } e_j^i = HE \quad m_j^i = N \\
&\qquad\qquad W_j^i = w_H^{-i} - \theta_j^i + T^i \qquad \text{if } e_j^i = HE \quad m_j^i = M \\
&\qquad\qquad W_j^i = w_L^i + T^i \qquad\qquad \text{if } e_j^i = LE \quad \forall m_j^i \\
&\quad s.t. \quad cy^j \geq 0 \quad cz^j \geq 0
\end{aligned}$$

Without loss of generality, we assume that, in the case of indifference, a worker remains in her country of origin. This implies that low-educated individuals will always stay in their home country, i.e. $m_j^i = N \quad \text{if } e_j^i = LE$.

Since households pay for education in their country of origin, regardless of their migration status, government revenue in country i revenue becomes:

$$G^{Ri} = \int_{\mathcal{H}_N^i} \theta_j^i dj + \int_{\mathcal{H}_M^i} \theta_j^i dj = \int_{\mathcal{H}_N^i \bigcup \mathcal{H}_M^i} \theta_j^i dj,$$

where $\mathcal{H}_N^i$ denotes the set of HE workers born in country i that choose to stay home, and $\mathcal{H}_M^i$ is the set of HE workers that choose to work abroad. Formally:

$$\begin{aligned}
\mathcal{H}_N^i &= \left\{j \in [0,1] \mid e_j^i = HE \text{ and } m_j^i = N\right\} \\
\mathcal{H}_M^i &= \left\{j \in [0,1] \mid e_j^i = HE \text{ and } m_j^i = M\right\}
\end{aligned}$$

Thresholds and HE Labor Supply

In the integrated economy, education level and migration status are jointly determined. Because of mobility heterogeneity, there are two cutoffs for each country: one for immobile and one for mobile workers. The first one is determined by the education premium at home, and the second one can be decomposed in a migration premium and an education premium.

For immobile workers, the education decision follows the same rule as in the closed economy. Therefore an immobile worker j from country i becomes HE if her net wage of working in the HE intensive sector of i is higher than the one she would earn in i if she remains LE, i.e., $w_H^i - \theta_j^i \geq w_L$. The threshold for immobile workers in country i is thus given by:

$$\theta_{immobile}^{i*} = w_H^i - w_L \tag{13}$$

and every immobile individual j with $\theta_j^i \leq \theta_{immobile}^{i*}$ will choose $e_j^i = HE$.

For intuition, we define $w_H^i - w_L$ as the education premium at home, this is the spread between the wage of a high educated worker and a low educated one. Notice the threshold for immobile workers is given by this premium and every worker that needs to pay a a cost below this value will choose to be high educated and benefit from the spread.

For mobile workers, the education decision must now incorporate the possibility of higher earnings abroad. Hence a mobile worker j in country i decides to become HE if her net wage of working in the HE intensive sector of one of the two countries is higher than the one she would earn in i if she remains LE, i.e., $\max\left\{w_H^i, w_H^{-i}\right\} - \theta_j^i \geq w_L$. The education cost threshold for mobile workers is thus given by:

$$\theta_{mobile}^{i*} = \max\left\{w_H^i, w_H^{-i}\right\} - w_L \tag{14}$$

and every mobile individual j with $\theta_j^i \leq \theta_{mobile}^{i*}$ will choose $e_j^i = HE$.

Regarding the migration decision, a HE worker will go wherever she gets a higher wage. This is, $\forall j$ with $e_j^i = HE$:

$$\begin{aligned} m_j^i &= N \quad \text{if } w_H^i \geq w_H^{-i} \\ m_j^i &= M \quad \text{otherwise} \end{aligned}$$

Further manipulation of the threshold for mobile workers (**??**) show that it can be de-

composed in a migration and an education premium as follows:

$$\theta^{i*}_{\text{mobile}} = \max\left\{w^i_H, w^{-i}_H\right\} - w_L = \underbrace{\max\left\{w^i_H, w^{-i}_H\right\} - w^i_H}_{\text{Migration Premium}} + \underbrace{w^i_H - w_L}_{\text{Education Premium}}$$

If the migration premium is positive, mobile HE workers benefit from both premia. They earn higher wages because they are high educated and on top of that they get access to even higher wages abroad because they migrate.

Definition 4.2. ***Integrated Equilibrium:*** *Given mobility γ and ability distributions $\mathcal{U}[0, \bar{\theta}^i]$, $i \in \{1, 2\}$, a competitive equilibrium for the two-country economy is:*

- *education, migration and consumption choices from households:* $\left\{e^i_j, m^i_j, cy^i_j, cz^i_j\right\}_{j\in[0,1], i\in\{1,2\}}$,
- *production plans:* $\{Y^i, h^i, Z^i, L^i\}_{i\in\{1,2\}}$,
- *lump-sum transfers from the government* $\{T^i\}_{i\in\{1,2\}}$
- *prices:* $\{w^i_H, w^i_L\}_{i\in\{1,2\}}$, P^w_Z, P^w_Y, *and*
- *cutoff education costs:* $\{\theta^{i*}_{immobile}, \theta^{i*}_{mobile}\}_{i\in\{1,2\}}$ *such that:*

1. *Given prices, transfers, mobility and ability θ^i_j:* $\left\{e^i_j, m^i_j, cy^i_j, cz^i_j\right\}_{i\in\{1,2\}}$ *solve j's problem $\forall j$*
2. *Given prices, production plans of IRS sectors* $\{Y^i, h^i\}_{i\in\{1,2\}}$ *satisfy* $w^i_H = A(H^i) \cdot P^w_Y$
3. *Given prices, production plans of CRS sectors* $\{Z^i, L^i\}_{i\in\{1,2\}}$ *satisfy* $w_L = B \cdot P^w_Z$
4. *Government budget balances in each country ($i = 1, 2$):*

$$\int_{\mathcal{H}^i_N \bigcup \mathcal{H}^i_M} \theta^i_j dj = \int_0^1 T^i dj$$

5. *Labor markets clear (in each $i = 1, 2$):*

$$\begin{aligned} H^{si} &\equiv \int_{\mathcal{H}^i} j dj \\ h^i &= H^i \qquad\qquad H^i = H^i_N + H^{-i}_M \\ L^i &= L^i_N + L^{-i}_M \\ 1 &= H^i_N + H^i_M + L^i_N \qquad \textit{wlog} \quad L^{-i}_M = 0 \end{aligned}$$

6. Good markets clear:

$$Y^1 + Y^2 = \int_{\mathcal{H}^1} c_Y^H dj + \int_{\mathcal{H}^2} c_Y^H dj + \int_{\mathcal{L}^1} c_Y^L dj + \int_{\mathcal{L}^2} c_Y^L dj$$
$$Z^1 + Z^2 = \int_{\mathcal{H}^1} c_Z^H dj + \int_{\mathcal{H}^2} c_Z^H dj + \int_{\mathcal{L}^1} c_Z^L dj + \int_{\mathcal{L}^2} c_Z^L dj$$

Where $\mathcal{H}^i = \mathcal{H}_N^i \bigcup \mathcal{H}_M^i$ *and* $\mathcal{L}^i = (\mathcal{H}_N^i \bigcup \mathcal{H}_M^i)^c$.

Characterization of the Integrated Equilibrium

For households, optimal consumption choices are as in the closed economy. However, the introduction of migration choice generates two equilibrium objects in the HE sector: (i) Aggregate supply of native HE labor H_N^i and (ii) Aggregate supply HE emigrants H_M^i. Each one is determined in equilibrium according to individual-specific mobility and ability draw, following the cutoff rules described above. These thresholds are determined by the relative price of final goods, which, at the same time, depend on the aggregate stock of HE workers.

Individual supply of HE immobile labor is given by

$$e_j^i = HE \text{ if } w_H^i - \theta_j^i \geq w_L$$

Using the distribution of θ_j^i and the share of immobile workers $1-\gamma$, we get an expression for the aggregate supply of immobile HE native workers:

$$H_{N,immobile}^i = \left(\frac{w_H^i - w_L^i}{\bar{\theta}^i}\right) \cdot (1-\gamma) \tag{15}$$

Individual supply of HE mobile labor is given by:

$$e_j^i = HE \text{ if } \max\left\{w_H^i, w_H^{-i}\right\} - \theta_j^i \geq w_L$$

Using the distribution of θ_j^i and the share of mobile workers γ, we get an expression for the aggregate supply of mobile HE natives and emigrants:

$$H_{N,mobile}^i = \left(\frac{w_H^i - w_L^i}{\bar{\theta}^i}\right) \cdot \gamma \qquad H_M^i = 0 \qquad \text{if } w_H^i \geq w_H^{-i} \tag{16}$$

$$H_{N,mobile}^i = 0 \qquad H_M^i = \left(\frac{w_H^i - w_L^i}{\bar{\theta}^i}\right) \cdot \gamma \qquad \text{otherwise,} \tag{17}$$

where

$$
\begin{aligned}
H^i &= H^i_N - H^i_M + H^{-i}_M, \quad H^i_N = H^i_{N,mobile} + H^i_{N,immobile} \\
w^i_H &= A(H^i) \\
w^i_L &= BPz \\
Pz &= \frac{(1-\lambda)\left(A(H^i)\cdot H^i + A(H^{-i})\cdot H^{-i}\right)}{\lambda(2 - H^i - H^{-i})}
\end{aligned}
$$

This completes the characterization of equilibria for the general case. In the next section, we provide a discussion of specific cases.

5 Results and Discussion

We are interested on the comparison of countries with different distribution of native HE population. In particular we want model two countries, one with a higher fraction of native HE workers to show it will attract HE immigrants, in line with our empirical analysis. In our model we generate a heterogeneity on HE native shares by considering different abilities distribution, which in turns translates into different education costs.

Assumption 5.1. *Maximum education cost in country 1 is lower than in country 2, i.e.* $\bar{\theta}_1 < \bar{\theta}_2$.

Assumption 5 implies that, in autarky, both the share of HE workers and their wage are higher in country 1 than in country 2 [10].

Since the sector that uses HE labor as input exhibits external economies of scale, we expect that, by opening the borders and allowing for labor mobility, foreign HE workers will flow to country 1. This will be analyzed in *Case 1.*

We acknowledge that in our model, as in other models with external economies of scale, there is a multiplicity of equilibria. For our analysis, this means that, even if country 1 has a higher labor and wage in the HE intensive sector in autarky, it is possible for HE labor to cluster in country 2. For this equilibrium to arise, people would need to expect higher wages

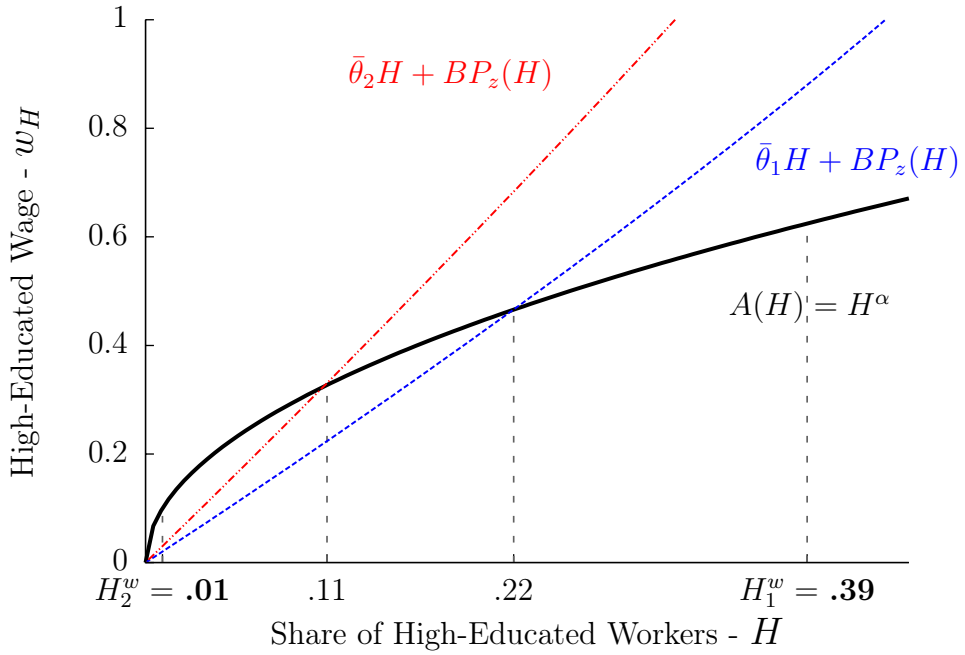
[10] See Figure 2.

in country 2 even though they are lower in autarky. For completeness, we will briefly discuss this equilibrium in *Case 2*[11]

For *Case 1* we conjecture and impose[12] that $w_H^{1w} > w_H^{2w}$.

As a result, every mobile household from 2 will migrate to country 1, whereas every mobile household from country 1 will stay there. Figure 3 illustrates this equilibrium and contrasts it to the equilibrium in autarky. For the open case, we set the ratio $\bar{\theta}^2/\bar{\theta}^1$ to 1.5 and the mobile fraction γ to 0.5 [13]. In particular we use $\bar{\theta}_1 = 2$ and $\bar{\theta}_2 = 3$ to account for the differences in ability. Table 3 contains the numerical results, and Figure 3 provides an illustration. In autarky, 22% of the total population in country 1 is HE, in contrast to 11% in country 2. When workers are allowed to move freely, these numbers change to 39% and 1%, respectively. This is, 39% of the residents of country 1 are employed by the IRS sector, while only 1% of the residents of country 2 are HE.

Figure 3: Specialization Patterns: Case 1



[11] We plan to extend the analysis of this Case by introducing beliefs in the model. However at this stage of the paper, we have not modeled them modeled beliefs explicitly, this is an additional reason for why we will only comment briefly on *Case 2*.

[12] After this conjecture we verify with the numerical results, following a guess and verify approach.

[13] The rest of the parameters are the same as in Figure 1 of the closed economy

Table 3: Numerical Results (Case 1)

	Autarky		**Integrated**	
	Country 1	Country 2	Country 1	Country 2
Residents	1	1	$1 + H_M^2$	$1 - H_M^2$
HE	21.66	10.47	39.14	1.13
LE	78.34	89.53	70.64	89.08

The relation between HE immigrants and HE natives in country 1 is given by:

$$\frac{H_M^2}{H_N^1} = \frac{\bar{\theta}_1}{\bar{\theta}_2}\gamma \tag{18}$$

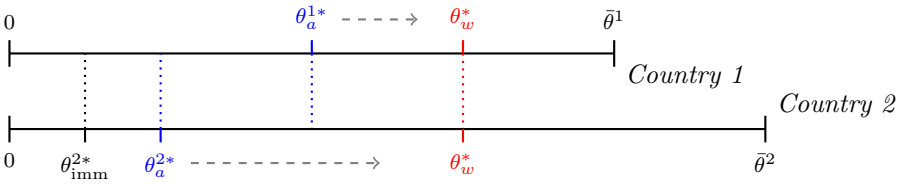
Equation 18 establishes a linear relation between HE natives and immigrants. Given a stock of H_N^1, the share of workers who migrate from country 2 to 1 is determined by two factors, depending only on parameters of the model. The first one is trivial: immigration increases with mobility (higher γ). The second factor is the relative difference in education costs: the higher the education costs in country 2 with respect to country 1, the lower the share of immigrants for a given number of HE natives. For a constant level of $\bar{\theta}_1$, increases in $\bar{\theta}_2$ discourage workers from country 2 from becomming HE since the cost they have to pay at home does not compensate for the higher wages abroad.

As *Case 1* and Figure 3 illustrate, the main result of our model is that if a country has a relatively larger fraction of native population working in the high educated (IRS) sector, this country will attract foreign labor of the same type. This is consistent with "north-north" migration patterns observed in HE occupations our sample of analysis. The model we propose in this paper allows for the possibility of workers migrating to a place where there are more of their type, as opposed to the standard south-north approach where migration flows are due to scarcity: workers migrating to places where there are less of their type.

Additionally we find that in a human capital free mobility are with free mobility of labor and transferability of education, the interaction between migration and education decisions

increase the total HE labor stock. Other workers decide to become HE to take advantage of migration premium and spillovers from the IRS sector. This translates into agents willing to pay higher education costs (see Figure 4).

Figure 4: Thresholds



In our numerical exercise, the threshold for becoming HE increases for both countries under the integrated economy. In the host country HE wages increase with the inflow of HE immigrants due to the production externality and therefore more people become HE. In the source country mobile workers are willing to pay more for their education since they can benefit from higher wages abroad.

In *Case 2*, even though we begin with $w_H^{1a} > w_H^{2a}$, we conjecture and impose $w_H^{1w} < w_H^{2w}$. As a result, there is agglomeration of HE labor in country 2 [14]. Despite the fact that this case is possible, it is not desirable because it induces a lower level of world GDP, consumption and welfares (see Table 4).

Table 4: Sectoral Output, World GDP and Welfare

	Output			**Welfare**		
	$Y_1 + Y_2$	$Z_1 + Z_2$	Total GDP	Cou.1	Cou.2	Total
Case 1	0.25	1.60	0.31	-1.60	-2.39	-3.99
Case 2	0.18	1.64	0.23	-2.25	-2.14	-4.40

[14] See the system of equations that determines the equilibria and the figure in appendix.

6 Conclusion

In this paper, we have first provided evidence that, if a EU15 country has a relatively larger fraction of native population working in a high-educated occupation, this country will attract foreign EU15 labor of the same type. This result is in line with what we have refer to as north-north migration pattern, where workers migrate to countries similar to their source country and where their type is relatively more abundant. We have also documented that high-educated occupations display concentration patterns in the sense that workers in those occupations tend to cluster in specific countries.

As we have emphasized, the intra EU15 migration phenomenon cannot be studied under the traditional south-north approach. The reason is that this framework assumes differences between the source and the host countries in terms of both income and characteristics of their labor force that are not observed in the EU15. To fill this gap, in this paper we propose a model that allows for workers flows between similar countries. Moreover, our model successfully generates the EU15 migration patterns we have documented and it also rationalizes agglomeration consistent with the concentration findings we have documented.

The mechanism of our model is the following: wages for HE labor are strictly increasing in the amount of HE labor, both foreign and native, employed in a country. This is achieved via external economies of scale in the sector intensive in HE labor. Hence, at the individual level, it becomes worthy for the most able households to become HE and to move to the country where there are more HE native workers.

To properly analyze selective policies of migration, it is imperative to propose better mechanisms of analysis that allow for bilateral flows of workers from economically similar countries. The theoretical framework developed in this paper provides useful insight about how to model a mechanism capable of driving migration and generating agglomeration.

Our model can be extended along several dimensions. For instance, we used the convenient relation between the ISCO-88 occupation classification and the education level to relate our model to the data. However, we acknowledge that reducing the types of workers to be based only on education limits the applications of our model. In this sense, allowing for occupational differences might be insightful. We think important differences arise in terms of transferability of skills and mobility between occupations, regardless of their education level. Additionally we could allow for migration in the CRS sector.

Another interesting direction is to include more structure in the CRS sector. In particular we could include a sector in the model that displays CRS or even decreasing returns to scale,

and that is attached to the size or structure of the population in each country. This could be interesting since there are differences within the low-educated (LE) group in the data. Service Elementary occupations workers behave very differently from, for example, Machine Operators[15]. This could happen because the former group faces a considerably inelastic demand and is directly attached to the population size. In contrast, the latter group is more exposed to country-specific sectoral shocks. For instance, we think of the 2000's construction boom in Spain as an exogenous increase in Spain's construction labor productivity, B^i, that can drive a positive correlation between the share of native and immigrants.

[15]Groups 91 and 81 at the 2-digit ISCO-88 level, respectively.

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Appendix

Solving for the Equilibrium

System of equations that characterize equilibria in case 1:

$$\begin{aligned}
H_N^1 &= \frac{w_H^1 - Bp_z\left(H_N^1, H_M^2, H_N^2\right)}{\bar{\theta}_1} \\
H_N^2 &= \frac{w_H^2 - Bp_z\left(H_N^1, H_M^2, H_N^2\right)}{\bar{\theta}_2}\left(1-\gamma\right) \\
H_M^2 &= \frac{w_H^1 - Bp_z\left(H_N^1, H_M^2, H_N^2\right)}{\bar{\theta}_2}\gamma \\
p_z\left(H_N^1, H_M^2, H_N^2\right) &= \frac{1-\lambda}{\lambda}\frac{A\left(H_N^1+H_M^2\right)\left(H_N^1+H_M^2\right)+A\left(H_N^2\right)\left(H_N^2\right)}{B\left(2-H_N^1-H_M^2-H_N^2\right)}
\end{aligned}$$

which can be reduced to:

$$\begin{aligned}
\bar{\theta}_1 H_N^1 &= A\left[\left(1+\frac{\bar{\theta}_1}{\bar{\theta}_2}\gamma\right)H_N^1\right] - \frac{1-\lambda}{\lambda}\frac{\left[\left(1+\frac{\bar{\theta}_1}{\bar{\theta}_2}\gamma\right)H_N^1\right]w_H^1 + H_N^2 w_H^2}{\left(2-\left(1+\frac{\bar{\theta}_1}{\bar{\theta}_2}\gamma\right)H_N^1 - H_N^2\right)} \\
\frac{\bar{\theta}_2}{1-\gamma}H_N^2 &= A\left(H_N^2\right) - \frac{1-\lambda}{\lambda}\frac{\left[\left(1+\frac{\bar{\theta}_1}{\bar{\theta}_2}\gamma\right)H_N^1\right]w_H^1 + H_N^2 w_H^2}{\left(2-\left(1+\frac{\bar{\theta}_1}{\bar{\theta}_2}\gamma\right)H_N^1 - H_N^2\right)}
\end{aligned}$$

System of two equations that characterize equilibria in case 2:

$$\begin{aligned}
H_N^1 &= \frac{w_H^1 - Bp_z\left(H_N^1, H_M^1, H_N^2\right)}{\bar{\theta}_1}\left(1-\gamma\right) \\
H_N^2 &= \frac{w_H^2 - Bp_z\left(H_N^1, H_M^1, H_N^2\right)}{\bar{\theta}_2} \\
H_M^1 &= \frac{w_H^1 - Bp_z\left(H_N^1, H_M^1, H_N^2\right)}{\bar{\theta}_1}\gamma \\
p_z\left(H_N^1, H_M^1, H_N^2\right) &= \frac{1-\lambda}{\lambda}\frac{\left[A\left(H_N^1\right)\left(H_N^1\right)+A\left(H_N^2+H_M^1\right)\left(H_N^2+H_M^1\right)\right]}{B\left(2-H_N^1-H_M^1-H_N^2\right)}
\end{aligned}$$

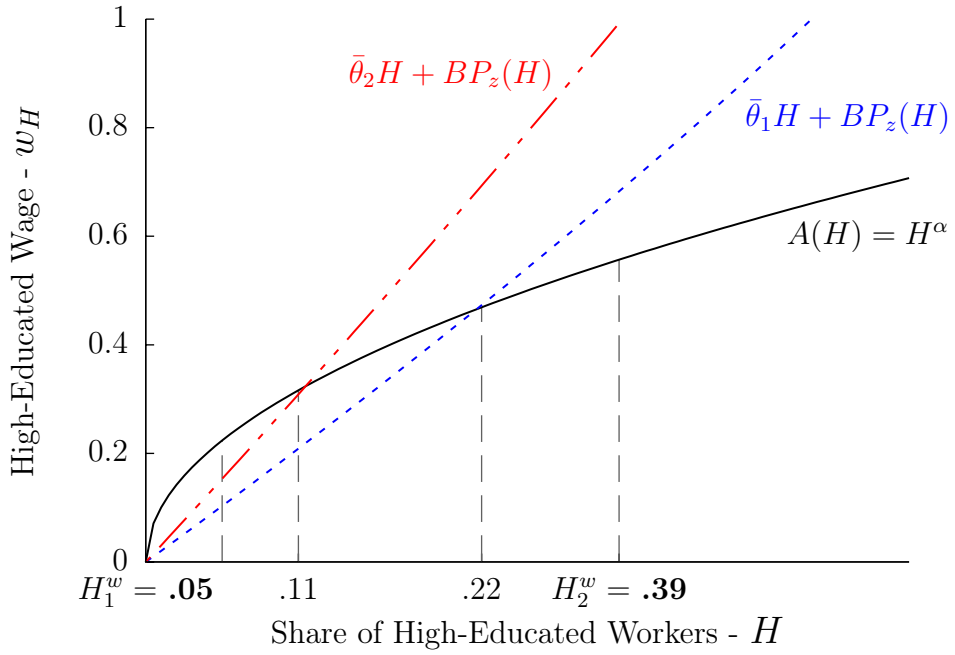
We solved these systems using a Quasi-Newton fixed point algorithm. However, we found a solution only for a range of parameter values. This is a general feature of increasing returns to scale models that generate agglomeration and present multiplicity of equilibria. When the stock of workers of each type is exogenous, finding the set of parameter values for which there is one, multiple or no equilibria is easier. However, in the model of this paper the

education choice makes the stock of HE workers endogenous which complicates the task. Further characterizing the equilibria is a priority in our research agenda.

Additional Graphs

Case 2

Figure 5: Specialization Patterns: Case 2



Additional Tables

To provide a glimpse of changes in the European job and migration structure, columns 1 to 4 of Table 5 show the employment shares of occupations, by migration status. Columns 5 to 8 show their percentage point changes between 1996 and 2010. We consider three migration categories: native-born ($Native$), born in a EU-15 country different to the one of current residency ($EU15$), and born outside the EU-15 bot working in one of our selected countries ($nonEU15$). We pool employment for each group and occupation across our 15 European countries.

Table 5: Summary Statistics Occupations

	ISCO code	Employment Share (2010)				$N_{2010} - N_{1996}$			
		Pop	Native	FB-EU15	FB-Rest	Pop	Native	FB-EU15	FB-Rest
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
High-Paying Occupations		38.16	39.74	41.64	23.50	17.58	21.82	46.47	-22.05
Corporate managers	12	4.80	4.98	6.74	2.73	8.79	12.79	36.73	-35.88
Physical, mathematical, and engineering professionals	21	4.14	4.29	4.84	2.61	51.04	59.24	52.93	-20.21
Life science and health professionals	22	2.41	2.46	2.58	1.97	9.08	12.54	52.60	-35.46
Other professionals	24	5.08	5.27	6.94	2.99	40.97	47.52	107.77	-18.27
Managers of small enterprises	13	4.70	4.73	5.71	4.20	-16.10	-16.42	16.19	-17.15
Physical and engineering associate professionals	31	4.41	4.65	4.37	2.38	15.70	20.74	13.68	-22.00
Other associate professionals	34	9.47	10.03	7.93	5.11	28.55	33.09	65.91	-1.17
Life science and health associate professionals	32	3.14	3.34	2.51	1.51	16.30	22.94	43.25	-42.30
Medium-Paying Occupations		33.81	34.20	31.19	31.20	-20.64	-20.05	-27.93	-21.24
Stationary and plant related operators	81	1.14	1.18	1.01	0.80	-19.64	-15.20	-51.45	-51.20
Metal, machinery and related trades workers	72	4.56	4.70	3.44	3.64	-26.08	-24.29	-47.88	-28.01
Drivers and mobile plant operators	83	4.59	4.60	3.20	4.88	-8.66	-9.03	-38.50	-0.18
Office clerks	41	9.71	10.30	7.64	5.19	-21.83	-18.79	-11.15	-42.21
Precision, handicraft, craft printing printing and related trade workers	73	0.38	0.38	0.44	0.36	-55.50	-56.22	-22.14	-48.90
Extraction and building trades workers	71	6.23	5.77	9.50	9.35	-10.77	-15.47	-25.21	17.12
Customer sevice clerks	42	2.42	2.50	2.25	1.82	-2.49	-1.14	58.57	-6.55
Machine operators and assemblers	82	2.99	2.99	2.47	3.12	-30.62	-29.01	-46.88	-46.14
Other craft and related trades workers	74	1.79	1.78	1.24	2.03	-39.12	-40.69	-14.95	-21.89
Low-Paying Occupations		28.03	26.06	27.17	45.30	12.37	5.92	-3.97	49.79
Laborers in mining, construction, manufacturing and transport	93	2.82	2.52	1.75	5.68	-12.84	-20.89	-35.69	39.61
Personal and protective service workers	51	11.45	11.09	10.50	14.81	18.11	14.10	15.60	56.72
Models, salespersons, and demonstrators	52	5.49	5.62	4.19	4.72	6.53	6.16	27.25	30.83
Sales and services elementary occupations	91	8.27	6.83	10.73	20.09	20.56	6.65	-18.70	53.16

Note: Occupations are ordered by their mean wage across 10 European countries across all years, follwing wage information in Goos, Manning and Salomons (2014). Columns 1 to 4 contain employment shares by migrant status, pooled across countries. Columns 5 to 8 contain growth rates of employment shares from 1996-2010.

Table 6: ISCO-88 Major Groups and Skill Level

	Major Group	ISCO Education Level
1	Legislators and Managers	4
2	Professionals	4
3	Technicians and Associate professionals	3
4	Clerks	2
5	Service and Sales	2
6	Skilled Agricultural and Fishery	2
7	Craft and Related	2
8	Plant and Machine Operators	2
9	Elementary Occupations	1