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A WAVE OF CHANGE: LABOR MARKET AND SOCIAL SECURITY IMPACTS OF  
THE EU REFUGEE INFLOW

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694

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# A Wave of Change: Labor Market and Social Security Impacts of the EU Refugee Inflow

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## Abstract

The recent massive inflow of refugees to the European Union (EU) raises a number of unanswered questions on the economic impact of this phenomenon. To examine these questions, we constructed an overlapping-generations model that describes the evolution of the skill premium and of the welfare benefit level in relevant European countries, in the aftermath of an inflow of asylum-seekers. In our simulation, relative wages of skilled workers increase between 8% and 11% in the period of the inflow; their subsequent time path is dependent on the initial skill premium. The entry of migrants creates a fiscal surplus of about 8%, which can finance higher welfare benefits in the subsequent periods. These effects are weaker in a scenario where refugees do not fully integrate into the labor market.

**Keywords:** skill premium, welfare benefits, refugees, European Union, international migration.

## I. Introduction

One of the most significant events of 2015, in many ways tragically so, was the emergence of a refugee wave into European countries. The majority of these refugees were escaping the civil war in Syria, seeking a safe asylum location and, in many instances, a place in which to rebuild their lives. While the size of this inflow was not unprecedented in Europe, its sheer magnitude took most people by surprise: in Germany, asylum applications reached over 750,000 before the end of the year, which is more than the three previous years combined. The arrival of the refugees in such large numbers gave rise to a debate over its social and economic impacts on European countries, and whether those impacts merited an intervention by national governments to either integrate asylum seekers into native societies or to deny their permanence and resettle them as soon as possible. Plenty of arguments were put forward for every side of

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<sup>1</sup> I would like to thank Prof. Cátia Batista for her invaluable guidance and helpful advice. I would also like to thank my colleagues, family and friends for their constant support and thoughtful suggestions.

the discussion, one of the most preeminent being humanitarian in nature – as it posited that it would be a breach of the fundamental values of the European Union not to concede asylum to people in need. However, this argument has been met with its fair share of objections, not least of which the idea that the assimilation of these displaced migrants will depress wages and disrupt national labor markets.

These events occurred while, for a long time, European economies have been facing significant changes in their demography. Birth rates have fallen without a corresponding increase in death rates; as a result, the UN projects that the rate of natural increase (live births minus deaths) will become negative around 2040 for almost all European countries. This puts a strain on the ability of governments to maintain the size of welfare programs, namely in what concerns pension benefits for an ageing population.

This work project explores the labor market and welfare benefit consequences of the European refugee wave, in a context of demographic deterioration. Our research question is, thus, to understand what types of individuals benefit more from a migratory shock such as the current one. These types differ along two dimensions: education (skilled workers vs. unskilled workers) and working status (active population vs. retirees). We used an overlapping-generations model to compare the evolution of the skill premium - the ratio of the wages of skilled workers to those of unskilled workers - and of the social security benefit level in a scenario of an unskilled migrant inflow to that of a counterfactual scenario, in which this exogenous migration shock does not occur. We then calibrated the model to the present situations of four European countries in terms of their labor market and projected population growth rates, so as to ascertain whether countries on opposite sides of the spectrum of relative earnings and demographic evolution respond differently to the same migratory shock.

We find that that the arrival of (mostly unskilled) migrants leads to an increase in the skill premium for the same period in all the countries analyzed, due to a decrease in the relative

quantity of skilled labor. Although the relative earnings of highly educated workers decrease in the following period, the size of this fall varies across economies, depending on the overall impact from two counteracting forces: the relative quantity of skilled labor and its relative efficiency. Additionally, we find that the arrival of migrants creates a fiscal surplus, allowing for the financing of higher welfare benefits; this surplus then evolves in the same way as the projected population growth rates for the selected countries. Finally, when allowing for less-than-full integration of migrants into the labor force, we find that the variations of the skill premium and of the level of the welfare benefit decrease relative to the baseline model, both in the current and in the subsequent periods.

## **II. Literature Review**

Regarding the labor market impact of migrants in the host economies, the empirical evidence contradicts the somewhat prevalent view that immigration causes a decrease in native wages and employment. In fact, it is hard to find significant downward effects of an immigration wave in those two outcomes: early studies using natural experiments found small impacts on non-migrant earnings and unemployment rates (Card 1990). In more recent times, researchers have focused on two key aspects that determine the labor market consequences of immigration: the education/experience distribution of the migrant wave and the substitutability between immigrants and natives. Borjas (2003) identified sizable negative effects on native wages inside the national labor market; Ottaviano and Peri (2012), on the other hand, found that an increase in immigration led to very limited effects on the wages of unskilled native workers, and even to a positive effect in the wages of highly-educated natives. Diverging from Borjas, the authors use the more traditional two education groups (“high” and “low”) and assume a small degree of imperfect substitutability, for which Card (2009) provided empirical evidence. Several authors have pointed out a number of motives why this should be the case, ranging from task specialization and division (Peri and Sparber 2009), to a ‘skills downgrading’ due to lack of

literacy or other informational frictions (Dustmann, Frattini, and Preston 2013). Finally, Docquier, Ozden, and Peri (2013) simulated the effects of immigration on the long-run dynamics of the labor market and found a positive effect on the wages of low-education natives, without finding evidence of negative repercussions on average native wages or employment.

There is no consensus on the overall fiscal impact of an immigrant. In early work on this topic, one-year analysis of migrant fiscal contributions reached wildly different conclusions, depending on the assumptions about welfare (Borjas 1994). Smith and Edmonston (1997) find a small positive impact on a country's fiscal situation, but this impact is very uneven; highly educated immigrants had large positive contributions, while their less-educated counterparts had strong negative contributions. In a dynamic general equilibrium framework, Storesletten (2000) finds a large positive fiscal NPV for middle-aged medium and high skilled immigrants in the U.S.; however, later work by the researcher for Sweden found that increasing generosity of the welfare state reduced the net contributions of immigrants (Storesletten 2003). Using a dynamic two-period framework of the economy and the pension system, Razin and Sadka (1999) found that unskilled migration brings benefits to each and every income and age group; however, this finding was later disputed by researchers using generational accounting methods (Rowthorn, 2008). Closely linked is the idea that immigration renews the demographic structure of the host country and thus helps sustain the benefit system, although the literature to empirically support this hypothesis has been scant: a good summary can be found in Zaiceva and Zimmermann (2014).

The situation of the refugees is somewhat different from the one analyzed in the aforementioned literature, as they are to a certain extent 'forced' to migrate. Again, results on subsequent research were mixed in terms of labor market outcomes (see Sarvimäki, Jääntti, and Uusitalo, 2009). Falck, Link, and Heblich (2011) studied the displacement of ethnic Germans into West Germany and concluded that the introduction of a law with the intent of promoting integration

of the expellees improved the quality of their jobs and occupations. Finally, Aljuni and Kawar (2014) conducted a preliminary analysis of the Syrian refugees' entrance into the Jordanian labor market, with results pointing to downward pressure on wages in the informal sector but no evidence of displacement effects.

### III. Theoretical Framework

We use an overlapping-generations model, adapted from Razin and Sadka (2000). In this model, a member of each generation lives for two periods: in the first period, they are endowed with 1 unit of time that they can divide between investing in education and working. In the second period individuals can no longer work or invest in education; instead, they receive a demogrant<sup>2</sup> from a pay-as-you-go, defined-benefit pension system.

#### *Household Decisions: Investment in Education and Saving Choices*

We assume all individuals born at time  $t$  have identical preferences over first-period and second-period consumption given by the log-utility Cobb-Douglas function:

$$U(c_t, c_{t+1}) = \log c_t + \delta \log c_{t+1} \quad (1)$$

where  $\delta < 1$  is the intertemporal discount factor. Individuals maximize utility subject to a two-period budget constraint, which is different for skilled workers and for unskilled workers due to labor income heterogeneity between the two types<sup>3</sup>.

In this economy, people are either “unskilled” or “skilled”. Although all individuals are born unskilled, they can choose whether to invest  $e$  units of time in becoming skilled and then proceed to work the remaining  $(1 - e)$  units of time within their first period of life, or to remain unskilled and to spend 1 unit of time as an unskilled worker. Since  $e$  reflects the effort required by an individual to become skilled, it is an inverse measure of each person's innate ability (a

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<sup>2</sup>A grant based on purely demographic principles such as age and sex.

<sup>3</sup> In this model, capital income is assumed to be zero. This assumption, although not realistic, will not affect the results if we calibrate the world interest rate to zero, so as to mimic the current situation of very low interest rates in the developed economies' capital markets.

higher  $e$  indicates that the individual has to expend more time in becoming educated).  $e$  ranges between 0 and 1; for simplicity, we assume it is uniformly distributed across the population.

Also for simplicity, we normalize the number of individuals born in period  $t = 0$  to 1.

Unskilled workers receive an after-tax wage of  $w(1 - \tau)$  for each unit of time spent working, while skilled workers receive an hourly after-tax wage of  $q_t w(1 - \tau)$ , where  $q_t$  is defined as the ratio of the compensation of skilled labor relative to that of unskilled labor. Thus,  $q_t$  is the skill premium in this economy.

The skilled worker intertemporal budget constraint then becomes:

$$c_t + \frac{c_{t+1}}{1+r} = (1 - e)q_t w(1 - \tau) + \frac{b_{t+1}}{1+r} \quad (2a)$$

where  $r$  is the interest rate and  $b_{t+1}$  is the retirement pension benefit that the worker receives in the second period of their life. Similarly, the unskilled worker budget constraint is

$$c_t + \frac{c_{t+1}}{1+r} = w(1 - \tau) + \frac{b_{t+1}}{1+r} \quad (2b)$$

In this setting, the education and savings decisions are fully separable. The decision to become skilled or not is purely static in nature: this decision only has consequences on the same period's labor income, and not on future benefits. Additionally, the pension benefit  $b_{t+1}$  is attributed on a purely demographical basis, thus assuming the same value for both types of workers.

The schooling decision of individuals can be understood as a trade-off between the time involved in becoming skilled and the skill premium, which is the return associated with that investment. Agents with a relatively low  $e$  (indicating low effort necessary to become skilled) will opt to invest in education to reap the benefits of higher relative wages since they lose relatively few wage income when investing in education, while agents with relatively high  $e$  (indicating high effort to become skilled) will prefer to remain unskilled, so as to work longer and receive the corresponding compensation. This means that there will be an equilibrium level

of  $e$ , denoted  $e^*$ , that equalizes the returns to skilled and unskilled labor, according to the following equation:

$$(1 - e^*)q_t w(1 - \tau) = w(1 - \tau), \quad (3)$$

From this condition, we know that every individual with  $e < e^*$  will become skilled, while every individual with  $e > e^*$  will remain unskilled. We assume that people choose the level of investment in education based on the skill premium observed in the previous period, since educational investments are made in advance. Thus, this equation can be rewritten as:

$$e_t^* = 1 - \frac{1}{q_{t-1}}. \quad (4)$$

Since we normalize the size of the working population to 1,  $e_t^*$  can be interpreted as the proportion of skilled workers.

Taking the educational investment decision as given, the solution to the utility maximization problem of the individuals yields the following savings functions:

$$S_t^{skilled} = \frac{\delta}{1+\delta} (1 - e) q_t w(1 - \tau) - \frac{b_{t+1}}{1+r}, \text{ and} \quad (5a)$$

$$S_t^{unskilled} = \frac{\delta}{1+\delta} w(1 - \tau) - \frac{b_{t+1}}{1+r}. \quad (5b)$$

### *The Production Function and the Skill Premium*

Output in this economy<sup>4</sup> is given by an aggregate production function, which combines skilled labor ( $H_t$ ), unskilled labor ( $U_t$ ), and capital ( $K_t$ ) to produce a single, representative final good.

We assume a two-level CES function, as it is parsimonious in the number of parameters and restricts the substitution elasticities between the various factor inputs to be constant over time.

A drawback of this specification is that it is necessary to impose a restriction in the nesting of

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<sup>4</sup> We will deal with the case of a small open economy with access to world capital markets, so the domestic interest rate will converge to the world rate.



the various inputs: either the elasticity of substitution between  $K_t$  and  $U_t$  is restricted to be the same to the one between  $H_t$  and  $U_t$  or, alternatively, the elasticity of substitution between  $K_t$  and  $H_t$  is restricted to be the same to the one between  $U_t$  and  $H_t$ . Following Krusell, Ohanian, Rios-Rull, & Violante (2000), we adopt the first nesting structure and define output as:

$$Y = \left( \mu U_t^\sigma + (1 - \mu) (\lambda K_t^\rho + (1 - \lambda) H_t^\rho)^\rho \right)^{\frac{1}{\sigma}} \quad (6)$$

Using this specification, factor income shares are defined by  $\mu$  and  $\lambda$ , and substitution elasticities are defined by  $\sigma$  and  $\rho$ :  $\frac{1}{1-\sigma}$  is the elasticity of substitution between the capital/skilled labor composite and unskilled labor, while  $\frac{1}{1-\rho}$  is the elasticity of substitution between capital and skilled labor. If  $\sigma > \rho$ , then capital is more complementary with skilled labor than with unskilled labor; this means that a higher stock of capital will increase the marginal product of skilled labor and thus, the skill premium, as will become clear later in our analysis.

In a competitive equilibrium, factors are paid their marginal contributions to output. Thus, formalizing  $q_t = \frac{MPH_t}{MPU_t}$ , we obtain:

$$q_t = \frac{1-\mu}{\mu} (1 - \lambda) \left( \lambda \left( \frac{K_t}{H_t} \right)^\rho + (1 - \lambda) \right)^{\frac{\sigma-\rho}{\rho}} \left( \frac{U_t}{H_t} \right)^{1-\sigma} \quad (7)$$

The stock of capital is determined by the amount of savings of the previous period's generation and by the capital that is left from the previous period, after taking out depreciation<sup>5</sup>:

$$K_t = S_{t-1} + (1 - \phi)K_{t-1} \quad (8)$$

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<sup>5</sup> Since we assume there is no return on capital, we disregard capital imports and exports in this model.

Total savings are given by aggregating the individual savings functions of households, (3a) and (3b):

$$S_t = \frac{\delta}{1+\delta} w(1-\tau)L_t - \frac{b_{t+1}L_t}{1+r} \quad (9)$$

where  $L_t$  is a weighted average of the effective labor provided by skilled and unskilled workers. Since  $H_t$  and  $U_t$  are measured in effective labor units, we can decompose into two parts: input quantity, which is the number of working hours supplied by skilled and unskilled workers, and effective labor provided by each worker. Skilled workers provide 1 unit of effective labor per unit of time, while unskilled workers provide  $\theta_t < 1$  units of effective labor. However, the latter spend all of their time working, while a skilled individual works only  $(1 - e_t)$  units of time; this means that skilled workers provide less hours of work than their unskilled counterparts. The total of skilled workers, thus, provides  $(1 - \bar{e}_t)$  hours of working time, where  $\bar{e}_t$  is the average level of  $e_t^*$ . Taking logs and simplifying, we can adapt (7) to our model by adopting the following specification:

$$\ln q_t \approx \lambda \frac{\sigma-\rho}{\rho} \left( \frac{K_t}{(1-\bar{e}_t)e_t^* N_t} \right)^\rho + \sigma \ln \frac{1}{\theta_t} - (1-\sigma) \ln \left( \frac{(1-\bar{e}_t)e_t^*}{(1-e_t^*)} \right) \quad (10)$$

where  $N_t$  represents the working population at time  $t$ .

We can see that the relative wages of unskilled workers change according to three different types of effects. The first one is the *relative quantity effect*,  $(1-\sigma) \ln \left( \frac{(1-\bar{e}_t)e_t^*}{(1-e_t^*)} \right)$ , through which an increase in the proportion of skilled workers will make this factor input less scarce, thus reducing  $q_t$ , the skill premium. The second one is the *relative efficiency effect*,  $\sigma \ln \frac{1}{\theta_t}$ , through which an increase in the effective labor units provided by the unskilled population will decrease the skill premium, . The last one is the *capital-skill complementarity effect*,  $\lambda \frac{\rho-\sigma}{\rho} \left( \frac{K_t}{(1-\bar{e}_t)e_t^* N_t} \right)^\rho$ : if  $\rho < \sigma$ , an increase in the abundance of capital relative to skilled labor increases the skill premium.

The effective labor provided by unskilled workers,  $\theta_t$ , is modeled as being negatively affected by the level of educational investment in the economy:

$$\theta_t = 1 - (e_t^*)^\gamma, \quad \gamma > 0 \quad (11)$$

This formulation is an adaptation of the *skill-biased technological change* argument. Understood within the perspective posited by Nelson & Phelps (1966), the argument states that highly skilled workers will simultaneously be the source and the main beneficiaries of technological change, as they will be quicker in adapting to innovation than the unskilled workers. This idea was further developed in Acemoglu (1998), where the complementarity of new technologies with the skills of highly educated workers is positively dependent on the relative size of the latter. It makes sense, then, that when the number of skilled workers increases, the relative quantity of effective labor provided by the unskilled workers decreases. The parameter  $\gamma$  can be understood as an “adjustment cost”; when  $\gamma = 1$ , the effect of the increase in the size of the skilled population leads to a linear decrease in  $\theta_t$ .

At time  $t = 0$  there is a migration shock as  $m$  individuals enter the country. We assume that immigrants at the time of entry suffer a skill downgrade, so that all of them are unskilled workers; this is in line with the findings of Dustmann et al. (2013). Since they do not make any educational investment in the period of arrival, this shock will only impact the contemporaneous value of the skill premium. The equation for  $q_0$  then becomes:

$$\ln q_0 \simeq \lambda \frac{\sigma - \rho}{\rho} \left( \frac{K_0}{(1 - \bar{e}_0) e_0^*} \right)^\rho + \sigma \ln \frac{1}{\theta_0} - (1 - \sigma) \ln \left( \frac{(1 - \bar{e}_0) e_0^*}{1 - e_0^* + m} \right) \quad (12)$$

### *Population Dynamics and the Pension System*

We assume a simple pay-as-you-go, defined-benefit (PAYG-DB) pension system in the economy, which taxes current effective labor supply to finance transfers to the same period’s retirees. Thus, we ignore debt dynamics in this framework.

Initial effective labor supply at time  $t = 0$  is a constant elasticity of substitution function, represented by:

$$L_0 = \{[(1 - \bar{e}_0)e_0^*]^\sigma + [\theta_0(1 - e_0^*)]^\sigma\}^{\frac{1}{\sigma}}, \quad (13)$$

where  $(1 - \bar{e}_0)e_0^*$  corresponds to the effective unskilled labor input and  $\theta_0(1 - e_0^*)$  corresponds to the effective skilled labor input.

With migrants entering the economy, the supply of effective labor for year 0 thus becomes:

$$L_0 = \{[(1 - \bar{e}_0)e_0^*]^\sigma + [\theta_0(1 - e_0^*) + \theta_0\mathbf{m}]^\sigma\}^{\frac{1}{\sigma}} \quad (14)$$

In the first period of their lives, individuals bear children at the rate  $n_t$ , which is allowed to vary over time. We assume that, while migrants are all unskilled at the time of entry, their offspring assume the same characteristics and preferences of the native population – that is to say, they integrate seamlessly into the economy. Thus, the supply of effective labor from year 1 onwards becomes:

$$L_t = (1 + m) \prod_{i=1}^t (1 + n_{i-1}) \{[(1 - \bar{e}_t)e_t^*]^\sigma + [\theta_t(1 - e_t^*)]^\sigma\}^{\frac{1}{\sigma}}. \quad (15)$$

The welfare benefits are fully financed from contributions  $T$  on each period's workers, given by

$$T_t = \tau w L_t \quad (16)$$

Since the working population at period 0 is set to 1, the working population at period -1

is equal to  $\frac{1}{1+n_{-1}}$ , since they bore children at the rate  $1 + n_{-1}$ . Thus, there are  $\frac{1}{1+n_{-1}}$

retirees in period 0. The individual welfare benefits will then be:

$$b_0 = \frac{T_0}{\frac{1}{1+n_{-1}}} = twL_0(1 + n_{-1}), \quad (17a)$$

$$b_1 = \frac{T_1}{(1+m)} = \frac{twL_1}{(1+m)}, \quad \text{and} \quad (17b)$$

$$b_t = \frac{T_t}{(1+m)} \times \prod_{i=2}^t (1 - n_{t-i})^{-1}, \quad b_t \geq 2. \quad (17c)$$

## **IV. Methodology and Data**

We will now use the theoretical model described above to evaluate the effects of a migratory inflow on the skill premium and welfare benefit level of four European countries. Given that we will want to identify and compare the different impacts of the migrant wave in terms of these outcomes, our approach will be to classify a sample of European economies along two dimensions: the current skill premium and the projected population growth rates for the next 25 years. The countries selected for analysis will be those that represent the ‘polar cases’ for the two dimensions; that is, the countries who place farthest away from the EU averages for both the skill premium and the population growth rates. This way, we will select two countries with the highest and lowest values for the skill premium and the population growth rates. Once country selection is complete, we will evaluate the model’s fit to each economy’s current skill premium. Afterwards, we compare the model’s projections for each country’s skill premium and welfare benefit level evolution for two scenarios: one with migration and one without.

### *Country Selection*

For the population growth rates, we used data from the United Nations’ Department of Economic and Social Affairs for the 5-year rates of natural increase (live births minus deaths) of European countries from 1950 to 2015 and the official projections for 2015-2100. Since each period is calibrated to 25 years, we calculated the projected population growth rate for each year as the geometric average of the five natural increase rates that cover the 25 subsequent years<sup>6</sup>.

To calculate the skill premium, we combined Eurostat data on the European countries’ employment level and on the median hourly earnings in 2010, disaggregated by three educational levels (less than primary, primary and lower secondary education – labelled as

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<sup>6</sup> As an example, we calculated the projected population growth rate for 2015 as the geometric average of the projected natural increase rates for 2015-2020, 2020-2025, 2025-2030, 2030-2035, and 2035-2040.

“low”; upper secondary and post-secondary non-tertiary education - labelled “medium”; and tertiary education - labelled “high”). The skill premium can then be calculated as the ratio of the median hourly earnings of the workers with “high” education to the employment-weighted average of the earnings of workers with “medium” education with the workers with “low” education. This is consistent with the relative amount of workers with “high” education that countries have in 2010, according to equation (4).

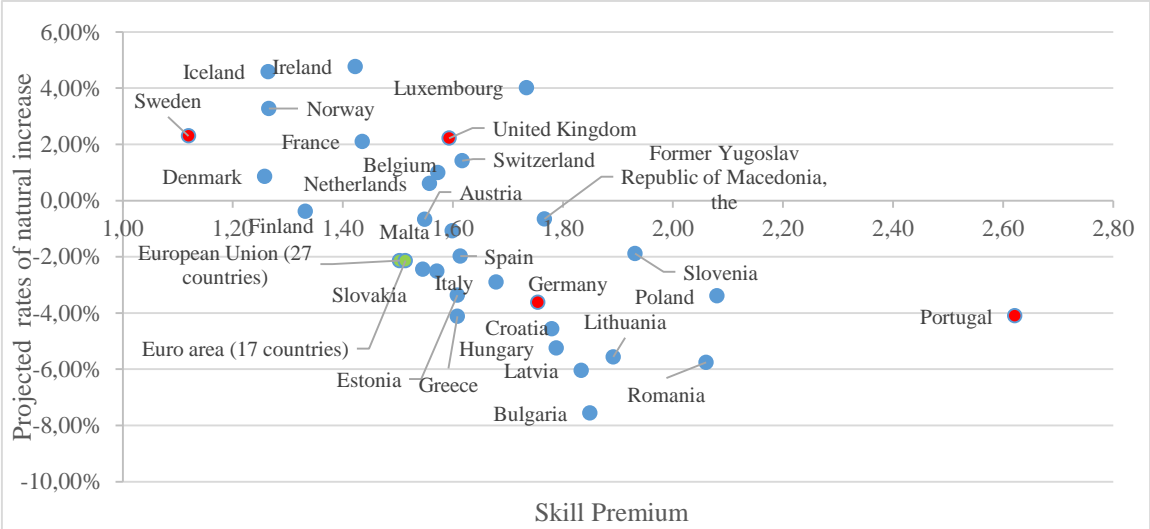


Figure 1. Skill premium and projected natural increase rate for European countries.

It is possible to see, from Figure 1, that two of the countries in red stand far away from the European averages. The first country, Portugal, has both the highest skill premium in the sample of countries (2.62) and one of the lowest projected natural increase rates (-4.1%). Sweden, on the other hand, has the lowest skill premium in the sample (1.12) and one of the highest projected rates of native population increase (2.3%). The disparity between these two economies makes it interesting to compare their projected responses to an inflow of migrants. The two other countries in red, Germany and the United Kingdom, were selected for two reasons: not only have they been historically on the receiving end of migrant waves, but they also differ with respect to their government’s positions regarding the integration of refugees, the former having offered to accept more asylum seekers than the initial EU quota predicted while the latter having refused to do so.

## *Calibration*

To assess the model's fit for the sample of countries of interest, it is necessary to set values for a first group of parameters – those that will assume not to vary across economies. This group of parameters is given by the set  $\{\sigma, \rho, \gamma, w, \tau, \delta, \phi\}$ . Following Krusell et al. (2000), we adopt a value for  $\sigma$  of 0.4, yielding an elasticity of substitution between the capital/skilled labor composite and unskilled labor of 1.67, and a value of -0.5 for  $\rho$ , yielding an elasticity of substitution of 0.67 between capital and skilled labor<sup>7</sup>. The value of the parameter  $\gamma$  is not directly established in the literature; Stokey (1996) used a value of 0.7 for the adjustment cost parameter of a human capital accumulation equation, which is the concept most similar to the effect we want to capture. Given that we are interested in relative wages, not absolute,  $w$  is normalized to 1. Following Razin and Sadka (2000), the tax rate  $\tau$  is fixed at 0.3 and the subjective discount factor  $\delta$  is set at 0.95. Finally, capital depreciation  $\phi$  is fixed at 0.05, which is the value used in Krusell et al. (2000) for the rate of depreciation of capital structures; results are robust to other commonly used values for capital depreciation, within the interval  $[0; 0.1]$ . We now need to set the starting conditions  $K_0, \theta_0, e_0^*$  and the labor share  $\lambda$  for each country. We use data from the Penn World Table 8.1 to calculate each economy's stock of capital per worker in 2011; we also obtain the labor share from this source. Since each country's working population in  $t = 0$  is normalized to 1, the stock of capital per worker is equal to the total stock of capital  $K_0$ <sup>8</sup>. The proportion of skilled workers  $e_0^*$  is set using Eurostat data on the education of the employed population, corresponding to the ratio of the number of workers with tertiary education to the size of the employed population with lower educational attainment.  $\theta_0$  is obtained using equation (11), while the skill premium  $q_0$  is calculated as the ratio of the median

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<sup>7</sup> In Krusell et al. (2000), the elasticities quoted refer to capital equipment, and not capital as a whole. The results are robust to the choice of elasticities from a range of values in the literature.

<sup>8</sup> Normalizing the number of workers in all countries to 1 may lead to distortions in the relative size of their capital stocks. However, the results are robust to different normalization procedures, including those that maintain scale between economies.

hourly earnings of the workers with “high” education to the population-weighted average of the earnings of workers with “medium” and “low” education, as previously stated.

Table 1. Selected countries’ starting conditions.

	$K_0$	$\theta_0$	$e_0^*$	$\lambda$	$q_0$
Portugal	186298	0.612	0.258	0.334	2.622
Sweden	144863	0.482	0.391	0.364	1.120
United Kingdom	170365	0.446	0.43	0.367	1.593
Germany	214448	0.588	0.282	0.391	1.755

We set each period to equal 25 years;  $t = 0$  corresponding to 2015,  $t = 1$  corresponding to 2040 and so on.

Model Fit

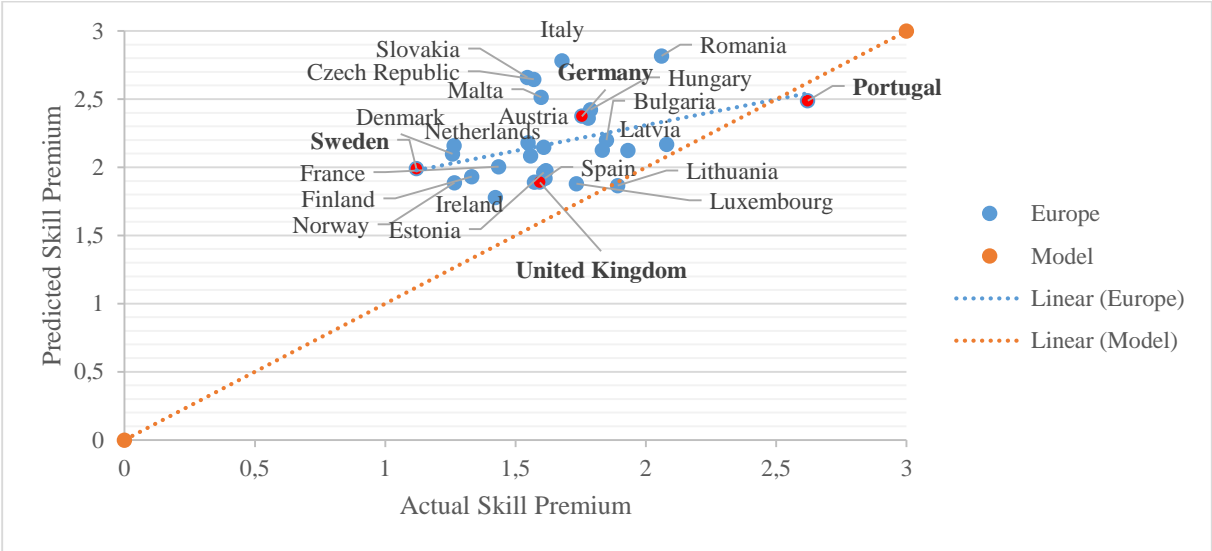


Figure 2. Model predictions vs. actual values for the skill premium.

Figure 2 illustrates the model’s predictions for each countries’ skill premium compared with their actual values. The orange line represents an “ideal” fit, meaning a model prediction that exactly matches the skill premium in 2010; the greater the vertical distance to this line, the worse the model’s forecasts. We can see that the model generally overestimates the skill premium for the sample of countries; only Lithuania and Portugal have a higher skill premium than predicted. The model performs somewhat worse for countries with low skill premia, with Sweden presenting the greatest forecast error. The accuracy of the model’s forecasts does cause



some concern as to the credibility of the projections for the evolution of the skill premium. In section V, we identify some issues with the model that explain this imprecision and explore possible solutions.

### V. Simulation Results

We now simulate how the four selected economies respond to a migratory inflow corresponding to 10% of the working population in period 0, corresponding to 2015 ( $m = 0.1$ ). Even though, in reality, each country will receive different numbers of asylum-seekers (and far less than in our projections), it is more interesting for us to focus on how each countries' skill premium and benefit level evolves in response to a simulated shock of similar relative magnitude.

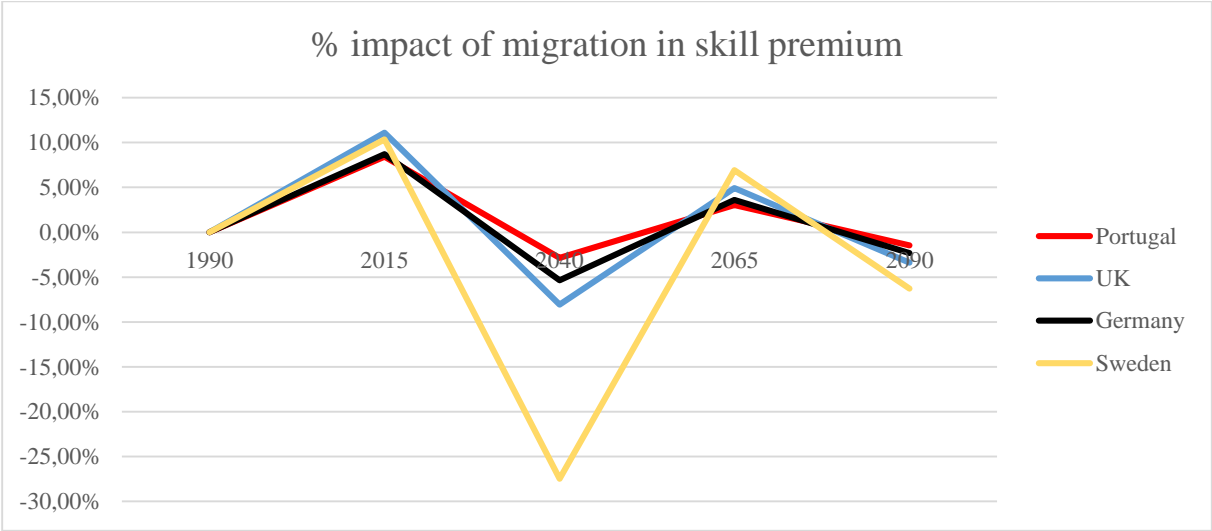


Figure 3. Impact of migration shock on the skill premium of each period, relative to a scenario of no migration.

Figure 3 shows how the skill premium changes when the migratory inflow is introduced. In the period  $t = 0$  (2015), the impact is positive for all countries, with an increase in the skill premium ranging from 8.43% in Portugal to 11.1% in the UK compared with a scenario without migration. In this first period, the increase in the skill premium is driven entirely by the relative quantity effect; skilled workers become scarcer, and their relative marginal productivity increases. For the following periods, the skill premium evolves in a similar way, reaching below its non-migration value in  $t = 1$  (2040) but rising above it in the next period. For the UK, Germany, and Portugal, the response of the relative earnings is inversely related to their increase

in the previous period, their skill premium being respectively 8.06%, 5.34% and 2.84% below their non-migration values. This proportionality in the responses of relative wages holds for the following two periods, with the UK displaying a larger variation than the other two economies. The case of Sweden is different, as the response of the skill premium in the period after the migrant inflow is much stronger than in the other economies, reaching a value that is 27.48% lower than in the non-migration scenario. This result does not follow the proportionality that the rest of the countries show, even though in the following period the Swedish skill premium registers the highest variation relative to its non-migration value (6.92%).

These results are a consequence of the interaction between changes in the three determinants of the skill premium. On one hand, the rise in the skill premium induces a greater proportion of the population to invest in education. Through the relative quantity effect, this increase in the number of skilled workers drives their relative wage to fall. However, the relative effective labor provided by each hour of unskilled work,  $\theta_1$ , falls with the growth of educational investment, as the increased proportion of skilled workers will become more productive with the technological change that they generate.

*Table 2. Approximate magnitude of effects on skill premium.*

	Total effect $q_t$	Relative quantity effect $-(1 - \sigma) \ln\left(\frac{(1 - \bar{e}_t)e_t^*}{1 - e_t^*}\right)$	Relative efficiency effect $\sigma \ln \frac{1}{\theta_t}$	Capital-skill complement. effect $\lambda \frac{\rho - \sigma}{\rho} \left(\frac{K_t}{(1 - \bar{e}_t)e_t^* N_t}\right)^\rho$
Portugal	-0.0438	-0.0950	0.0546	-0.0000178
Sweden	-1.1186	-1.2803	0.2363	0.000
UK	-0.1643	-0.2542	0.1027	0.000
Germany	-0.1008	-0.1677	0.0734	0.000

Table 2 shows the approximate<sup>9</sup> magnitude of each of the three effects in the skill premium for the four countries in the period after the shock. We find that the relative quantity effect more

<sup>9</sup> The decomposition of the changes in the skill premium into the changes in the three effects is presented as an approximation: the sum of the three effects does not yield exactly the total effect. This is due to the exponential nature of  $q_t$ , as per equation (10). The approximation error is not large enough to compromise our conclusions regarding the relative strength of the various effects.

than offsets the efficiency effect for all four countries. However, the relative strength of these two effects varies across the group of economies; in Sweden, the quantity effect has an impact 5 times larger than that of the efficiency effect, while in Portugal it is only 74% greater (in absolute values). The variations in magnitude of these effects are generated by the different starting conditions for  $q_0$ , since the skill premium is the driving factor behind the decision of the next generation of workers to become skilled. For instance, since in Sweden the starting skill premium is very small, the vast majority of the next generation of workers will choose not to invest in education, thus becoming unskilled. An unskilled migratory shock, via its effect on the skill premium, will attenuate the future fall in educational investment. The capital-skill complementarity effect is much weaker than the other two: in fact, only in the case of Portugal do we register any sort of impact (negative in sign due to  $\rho < 0$ ).

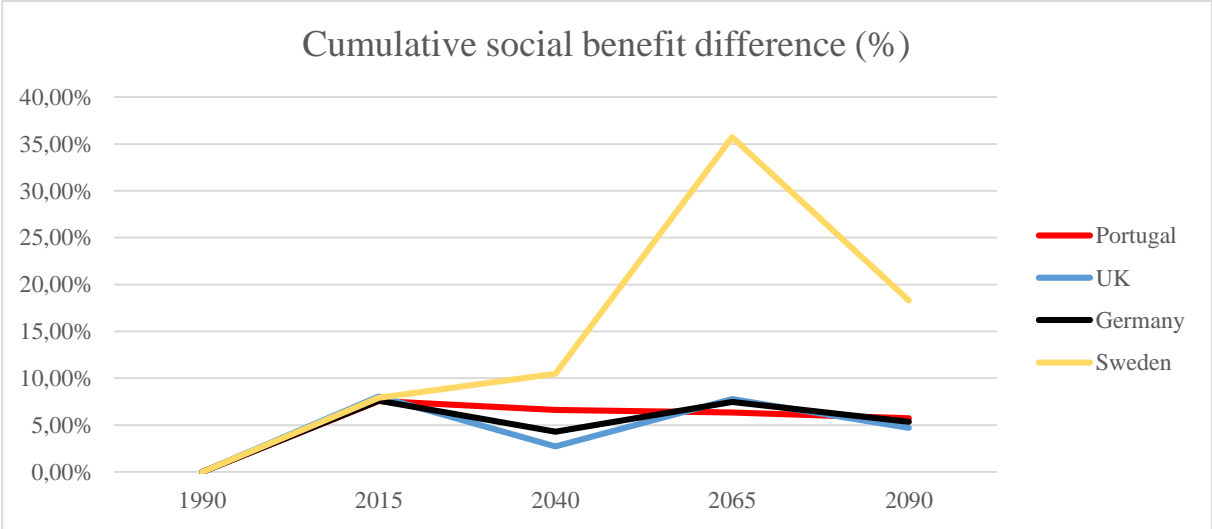


Figure 4. Cumulative welfare benefit difference relative to a scenario of no migration.

Figure 4 shows the impact of migration on the cumulative level of welfare benefits distributed to retirees each period, as a percentage of the benefit level in a scenario of no migration. In the period of arrival, the increase in the labor supply of each country leads to more taxes being collected, which can then finance higher benefits to that period’s generation of retirees. From this point onwards, Portugal, UK and Germany are projected to experience a decrease in the welfare benefit accumulation. This is due to the greater labor force of the previous period

moving into retirement, together with the negative population growth rates that these countries experience. The projections for Sweden, again, contrast with those of the other countries, as the benefit accumulation continually increases until 2 periods after the migrant inflow. This disparity is explained by the positive population growth rates that the Nordic country has; the migrant population's offspring thus contributes to the financing of higher contributions.

*Allowing for Partial Migrant Integration*

An important issue is that of the degree of migrant integration into the host society. The baseline model assumes that all migrants are able to find work and to increase the size of the labor force. In reality, many European countries impose legal restrictions on the ability of asylum-seekers to work, some of which may last for more than one year. Even after these legal restrictions are no longer in place, refugees might not be able to find formal work in the same way as natives, due to frictions such as employer discrimination or language barriers.

In this subsection, we relax the assumption that all migrants are able to work. More specifically, we assume that only a fraction  $\psi > 0$  of migrants become unskilled workers. The remaining  $1 - \psi$  proportion of individuals, although not in employment, receive the same benefit as retirees,  $b_t$ . With this assumption, we are trying to capture the social expenditures associated with providing food and shelter to asylum-seekers.

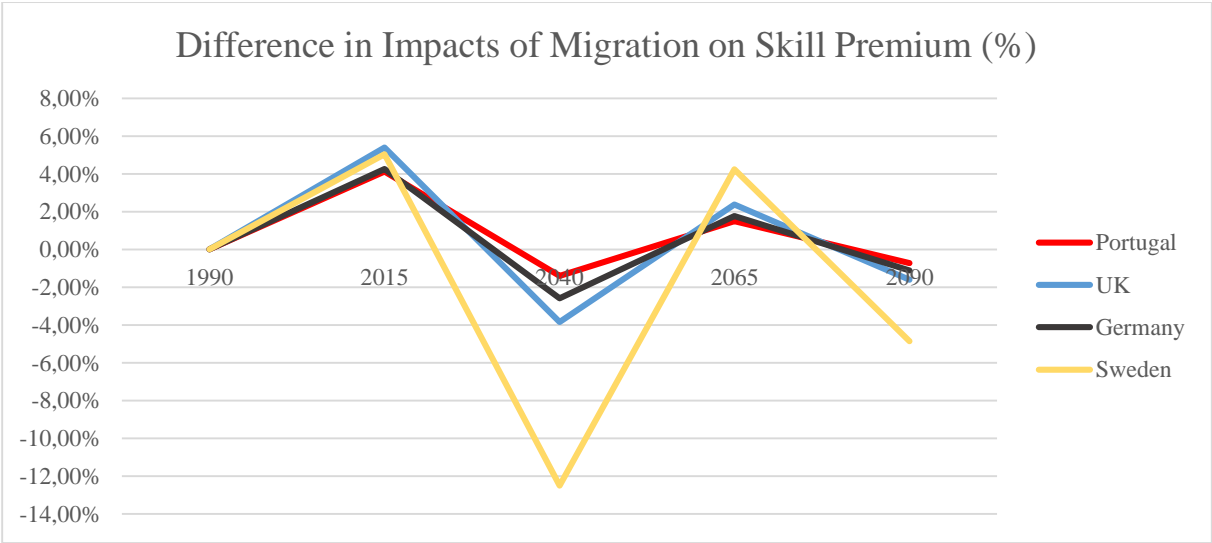


Figure 5. Difference between total and partial integration in the impact of migration shock on skill premium.

Figure 5 shows the difference in impacts on the skill premium between the baseline scenario of total integration ( $\psi > 0$ ) and a case of partial integration, where  $\psi = 0.5$ . The effects of the second scenario are identical in sign but smaller in magnitude than the baseline case; a smaller inflow of unskilled workers increases the skill premium in the current period, but not as much as before, since the relative quantity effect is weaker.

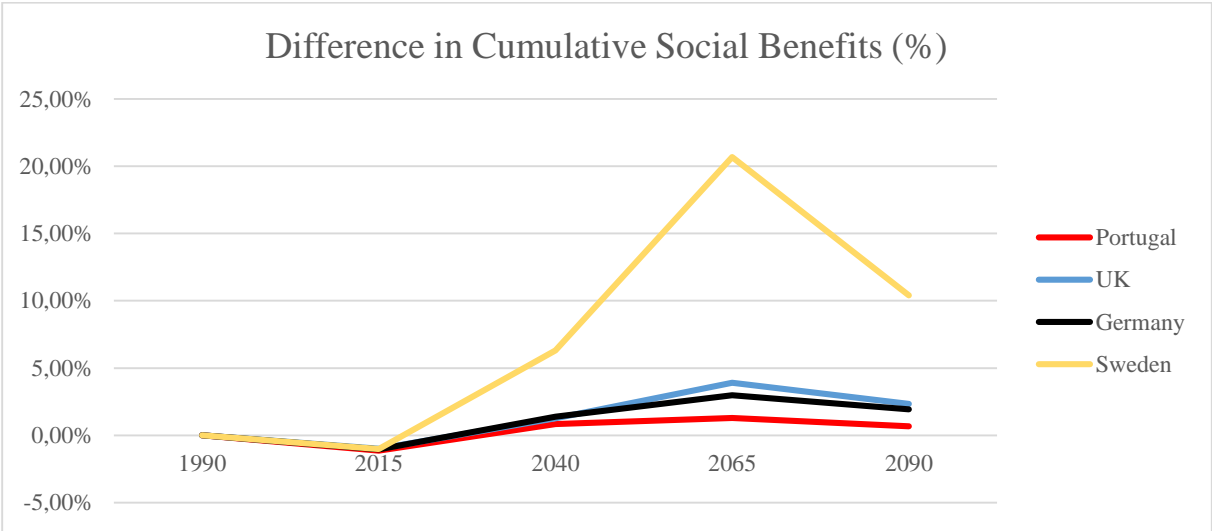


Figure 6. Cumulative welfare benefit difference with partial integration of migrants, relative to a scenario of no migration.

We show the difference in cumulative welfare benefits with partial integration of migrants in Figure 6, again for  $\psi = 0.5$ . In the first period, the effect of the migration shock is negative, as the increased labor force is more than offset by the larger number of beneficiaries, which now includes migrants as well as retirees. For the following periods, the difference in benefits becomes positive, due to the increase in the effective labor force generated by the increase in educational investment  $e_1$ . Sweden accumulates far more of a fiscal surplus than the other three economies; again, the reason for these differences in the level of benefit accumulation is the contrast in the projected natural increase rates for the four economies, since having higher population growth allows for the labor force of the following period to rise above the number of future retirees, thus financing the latter’s demogrant.

Given that the level of welfare benefits varies monotonically with  $\psi$ , there are two “threshold” values for this parameter. The first one,  $\psi^{upper}$ , represents the minimum degree of migrant

integration necessary for countries to achieve an increase in welfare benefits paid out in each period, so that every generation of retirees will be better off with the migration shock. The second one,  $\psi^{lower}$ , represents the degree of migrant integration below which the economy generates less welfare benefits than in a scenario of no migration, which means every generation’s retirees are made worse off by the arrival of refugees.

Table 3. “Threshold” values of  $\psi$  for selected countries.

	Portugal	Sweden	UK	Germany
$\psi^{upper}$	56.76%	55.95%	55.65%	56.21%
$\psi^{lower}$	40.25%	-	4.81%	22.07%

Table 3 displays the values of  $\psi^{upper}$  and  $\psi^{lower}$  for the four countries analyzed. While the values for the first “threshold” are all within 1.5 percentage points of each other,  $\psi^{lower}$  varies considerably across the subsample. This is due to the heterogeneity in future population growth rates: Portugal, having the lowest projected rates of the four, needs a higher proportion of newcomers to take part in the labor force in order to finance the benefits of a larger group of retirees. It’s interesting to see that due to having positive and large projected population growth rates, there is no value for  $\psi^{lower}$  in the case of Sweden; even if no migrants work in the period of arrival, future benefits will be greater than if they did not come at all.

**VI. Critical Assessment of the Model’s Assumptions**

The projections of the model have to be understood as being dependent on and driven by its assumptions. It is worthwhile, then, to elaborate on how and where these assumptions might not reflect the economic reality of the migrant inflow into European countries. This exercise can also help illustrate why the model’s forecasts for the skill premium are somewhat imprecise, and how they could be improved.

In the construction of the model, we presented a simplified mechanism for the educational decisions of individuals: the returns to the time investment in becoming skilled are known with certainty and received in the same period. In reality, the investment in human capital is more

complex, as not only are students unaware of the actual future earnings they will receive, but their wages might also change over the course of their lifetime. Moreover, the benefits from investing in human capital might not be realized in the same country where the investment took place, as many highly-skilled individuals choose to migrate and pursue work opportunities outside of their country of birth. Accounting for these possibilities would entail modeling a more complex process for the human capital investment decision, which could improve the model's fit to European data.

Additionally, this decision, along with the amount of labor supplied, is purely static in nature. This is at odds with the fact that the retirement benefits in EU countries are not simple demogrants; in most instances, their value depends on the working time contributions, which vary according to the amounts of hours worked and the life-cycle wage profile. One possible solution would be to index the value of  $b_{t+1}$  to the earnings in period  $t$ , and to solve the household problem regarding all of its decisions from a dynamic standpoint.

Another important drawback is that the countries selected for analysis will certainly be heterogeneous in what concerns the functioning of the labor markets and the social security and tax structures, but also in their refugee integration policies. Knowing this, it may seem slightly naïve to assume that the migration wave is fully exogenous; in fact, a large strand of the literature on migration has found a significant evidence of migrant self-selection into the environments that offer the most attractive job prospects, most notably in the form of already established migrant networks (McKenzie and Rapoport, 2010). This raises issues for causal inference, as the government of an economy which would benefit the most from a migrant inflow can adopt a set of policies designed to make it a more appealing destination for the latter. In a situation like this, we are unable to isolate the causal effect of migration on the labor market and social security outcomes of the economy. However, in the context of this work project, we consider these issues to be of secondary importance, as the personal situation of refugees is

unquestionably different from that of ‘regular’ economic migrants. Since the former are fleeing from conflict, it is reasonable to assume that any degree of self-selection in the decision to migrate is relatively small.

Finally, the effect of technological change in our model is summarized in the variation of the relative efficiency of  $\theta_t$ . It is feasible that there are other channels through which relative productivity changes affect the skill premium. We also abstract from modeling significant aspects of an economy which influence the variables analyzed, such as the existence of a public sector which might absorb workers from the private sphere<sup>10</sup>, or the effects of capital returns on the working decisions of households.

## **VII. Conclusion**

In this work project, we developed an overlapping-generations model to evaluate the contemporaneous and future impact of a migrant inflow, which reproduces the recent surge in the number of refugees and asylum-seekers entering European economies, on the relative earnings of highly-educated workers. Within the same framework, we also modeled how a simple PAYG-DB system was affected by the arrival of these migrants. The model projections indicate an increase in the skill premium in the period of the migratory shock, followed by a decrease in the following period; also, countries which started with more equal relative wages – such as Sweden - are projected to experience a smaller increase of high-skilled earnings in the future, due to the positive effects of unskilled migration on the education decisions of individuals. The welfare benefit level increased as a result of the growth in the labor force, whereas their subsequent time path depends positively on the sign and size of the projected population growth rates. Also, we found that when migrants are not fully integrated into the

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<sup>10</sup> Domeij and Ljungqvist (2006) argue that this explains the low historical levels of the Swedish skill premium.



labor market, both the variation in the skill premium and the rise in fiscal benefits are smaller, with the latter being susceptible to decrease in some scenarios.

The arrival of asylum-seekers in European economies constitutes a major challenge for their societies and governments; the decisions they make regarding this issue have not only economic consequences, but also political, social and humanitarian implications. One of the ramifications of this problem is the political will – or lack thereof – of citizens to vote for measures that facilitate the entry of refugees into the formal labor market; another one is the cultural differences that emerge when people from different geographical and ethnic backgrounds are forced to live in proximity.

Even though these issues are outside the scope of this work project, we still believe that the conclusions from our projections can still be helpful to understand which groups of individuals will be most in favor of integrating refugees and what kind of policies should bring about the most benefits. For instance, a more skilled native population would be most in favor of accepting migrants into their economy, since their relative earnings increase in the first period; not only that, but pro-migration measures can also be a stimulus towards individual investment in education. Additionally, countries who adopt policies that foster higher birth rates - Sweden being the example in this work project – are able to finance higher pension benefits for retirees of all generations when migrants are allowed in and integrated. Finally, our model allows us to make a solid economic argument for measures that maximize the degree of integration of asylum-seekers into the European labor market. With these ideas in mind, we believe that there is significant scope for European governance to reconcile the humanitarian ideals it was founded upon with the economic arguments presented, and to turn this migrant wave into a tide of opportunity.

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