Immigration, search frictions and redistribution: A quantitative welfare analysis*

Michele Battisti (ifo Institute)
Gabriel Felbermayr (University of Munich and ifo Institute)
Giovanni Peri (UC Davis and CESifo)
Panu Poutvaara (University of Munich and ifo Institute)

Wednesday 22nd January, 2014

Abstract

The effect of immigration on wages, employment, and native welfare may be crucially affected by labor market frictions and institutions in host countries. We propose a model of search and matching in which native and immigrant workers are perfect substitutes within skill classes. They differ with respect to job break-up risk and outside options, but firms cannot distinguish between them at the recruitment stage. This setup allows replicating the observed differences in wages and unemployment rates within skill-classes. It implies that immigration affects job creation incentives of firms. Additionally, our model also features the traditional complementarity effects as well as fiscal redistribution induced through unemployment insurance and the provision of a public good. We calibrate the model to match salient empirical moments from 20 OECD countries. Our quantitative analysis that, compared to a counterfactual situation of autarky, observed immigrant stocks lead to welfare gains for natives in all but one country. In two thirds of all cases, both skill classes benefit. Effects are, however, non-linear. A simple Monte Carlo simulation stresses the importance of considering unemployment and public policy in an analysis of the overall effects of migration on receiving countries.

JEL-Codes: F22, J61, J64.
Keywords: Immigration, Search, labor Market Frictions, Cross-Country Comparisons.

*The authors thank Robert Breunig and Syed Hasan for providing invaluable assistance in procuring descriptives from the Australian HILDA dataset, and Christoph Eder for providing summary statistics from the Canadian labor Force Survey and 2006 Microcensus. We also thank the participants of the 2013 TEMPO conference in Nottingham and seminar participants at the University of Munich and CERDI. All remaining errors are ours.

1 Introduction

In many OECD countries, foreign-born workers make up a substantial share of the total labor force. While this is by no means a new phenomenon, the economic benefits of immigration for the native population are still very much debated. Economists have long been optimistic about the existence of a positive immigration surplus for natives based on factor complementarities. However, in the presence of redistributive welfare states and/or of labor market frictions giving rise to unemployment, the effect of immigration on native welfare is unclear. So far, there has been little quantitative work on models capturing all these different aspects.

This paper tries to fill this gap by using a model that features complementarity between high- and low-skilled workers, labor market frictions combined with Non-Walrasian wage setting, and a redistributive welfare state. Our formal setup is rich enough to replicate the large heterogeneity in labor market outcomes between natives and immigrants across skills classes and countries. We use our framework to quantify the welfare effects of observed levels of immigration compared to a hypothetical autarky situation for 20 countries. We also conduct an *ex ante* analyzes which computes the welfare effects of additional immigration under different institutional setups.

Our formal analysis is based on a number of important stylized facts on the labor market characteristics and outcomes of migrants relative to natives within skill groups for our sample of countries. We show that, in about a third of the surveyed countries, immigrants are on average better educated than natives. In some of the major European host economies (France, Germany, United Kingdom), they are substantially less educated, while in others, such as the US, natives and immigrants tend to be similarly educated. In the traditional models, the existence of an immigration surplus hinges on native and migrant employment featuring *different* skill compositions. However, in all countries sampled, immigrants have higher rates of unemployment than natives in both skill categories. Evidently, this fact has direct implications for complementarity-based welfare gains from immigration.

In all countries surveyed, and in each skill class, natives command a wage premium over immigrants. These premia differ dramatically across countries; they are highest in Italy and Greece, but low in Australia, the United States and Switzerland. The wage gap may reflect differences in (effective) labor productivity, or outside options between natives and migrants.[1] We will allow for both of these channels. Through their effects on the expected firm-level rent from a filled job they are important determinants of job creation. At identical outside options, when migrants suffer a productivity disadvantage, increasing their share in the economy disincentivizes job creation. In contrast, at given productivities, when immigrants have lower outside options, a higher share of immigrants incentivizes job creation.

Finally, in all countries surveyed, governments are responsible for a substantial share of total expenditure. Moreover, all countries run unemployment insurance schemes. However, in both of

[1] It may also reflect pure discrimination, a possibility that we rule out in our exercise.

these dimensions, cross-country heterogeneity is huge. The presence of redistribution has obvious implications for native welfare if immigrants and natives differ with respect to their likelihood to be unemployed or earn low wages. Our quantitative model allows for fiscal redistribution and the provision of public goods.

Much of the large existing literature on the effects of immigration features a "*near obsession with the wage impact of migration*" (Hanson, 2009). The effects of labor market frictions, wage bargaining, and fiscal redistribution have been much less studied. Longhi, Nijkamp, and Poot (2008) provide a discussion and meta analysis of the empirical literature on the wage effects of immigration, most of which provides reduced-form evidence. Starting with Borjas (2003),[2] the literature has used a structural approach focused on the estimation of elasticities of substitution between different labor market cells under conditions of perfect competition. In such models, if the composition of the immigrant inflow differs from that of natives, and if different types of workers are imperfect substitutes, the representative native worker benefits from immigration. So, whenever immigration yields an overall native welfare gain, it always creates winners and losers.[3]

Clearly, immigration into a labor market in which wages cannot adjust will lead to increased unemployment and income losses to natives (Brecher and Choudhri, 1987). In the presence of wage bargaining, however, immigration can improve labor market outcomes, for example by reducing the outside option of trade unions (Schmidt, Stilz, and Zimmermann, 1994). In that sense, it is possible that immigrants grease the wheels of the labor market because their presence can mitigate the effects of existing distortions. Such an argument is also made by Chassamboulli and Palivos (2014) who use a search-and-matching model of unemployment in which immigrants have lower outside options of natives and where workers of similar skill but different origin are *ex ante* identical. These papers are mostly theoretical, or provide quantification only for one specific economy.

Recent papers apply the structural empirical approach of Borjas (2003) to a situation where wages are set non-competitively. D'Amuri, Ottaviano, and Peri (2010), Felbermayr et al. (2010), Brücker and Jahn (2011) and Brücker, Jahn, and Upward (2013) postulate, in reduced form, that wages are decreasing functions of unemployment rates. While they do allow for unemployment, they do not introduce a public sector. Moreover, labor market imperfections are not micro-founded and the role of labor market institutions is not explicitly modeled. Finally, with the exception of Felbermayr et al. (2010), the cited studies do not calculate welfare effects.

Finally, there is also a rich literature on the fiscal effects of immigration. Storesletten (2000, 2003) computes the net gain of immigrants in a dynamic equilibrium model featuring demographics and fiscal policy for the US and Sweden. He finds that immigration can strongly benefit natives if

[2] Also Ottaviano and Peri (2012) and the references therein.

[3] In a neoclassical, perfectly competitive single-sector economy with one fixed factor (capital), the average contribution of an immigrant worker to output is equal to the average product of labor. The claim on output by that immigrant – equal to the marginal product of labor – is always lower, so that the representative native agent in host economy benefits from the presence of immigrants. See Berry and Soligo (1969) for an early analysis and Borjas (1994) for an overview discussion.

it occurs in the 'right' age bracket (middle age workers) and if immigrants have a sufficiently high employment probability. Observed migration, however, often falls short from the ideal composition, so that de facto immigration is a burden to the native tax payer.[4] Dustmann, Frattini, and Preston (2013) provide a very comprehensive recent analysis of the net fiscal contribution of immigrants in the UK and finds an overall positive impact. However, virtually all papers in this literature abstract from a micro-founded modeling of labor market imperfections and from complementarity-based welfare gains.

The contribution of this paper is to embed the canonical complementarity channel into a framework in which labor markets are affected by search frictions, wages are bargained, and a public sector redistributes income to unemployed and low-wage workers. To do so we develop a two-sector search-and-matching model in which perfectly competitive firms create vacancies for high- or low-skilled workers, which are imperfect substitutes. Crucially, however, firms cannot distinguish ex ante between natives and immigrants. Only, after sunk vacancy creation costs are paid, and when matching was successful, do they learn about the workers' status. We allow immigrants to differ from natives regarding to their exogenous job break-up rate. This rationalizes the empirical fact that foreign-born workers face higher unemployment risk than natives, controlling for observable worker characteristics.[5] Moreover, as Chassamboulli and Palivos (2014), we assume that migrants may have different reservation utilities than natives: they may not have access to the same level of welfare protection than natives and they may lack the social networks that make leisure enjoyable. The model gives rise to an endogenous unemployment rate; unemployed workers receive unemployment benefit payments indexed to their earlier wages. Unemployment benefits and more overt redistribution by means of a demogrant are financed through proportional taxation.

In our model, immigration affects native welfare through four channels: a traditional complementarity effect, a job-creation effect, and a fiscal redistribution effect. How these channels relate to native welfare depends very much on model parameters. We calibrate our model such that it matches 14 salient empirical moments that we have collected for 20 OECD countries. We treat each countries as a closed economy, ignoring source countries (for which we do not have the required data) and ignoring terms-of-trade effects of international migration. Two recent papers by Benhabib and Jovanovic (2012) and Giovanni and Levchenko (2014) take a more global view, but they ignore the fiscal and job-creation effects of migration.[6]

We use our calibrated model for each of our 20 countries to simulate the effects of three policy

[4] In many countries there is has been a fierce debate about the net fiscal contribution of immigrants. For Germany, see Sinn et al. (2001) and Bonin (2002).

[5] See, e.g., Arai and Vilhelmsson (2004).

[6] Benhabib and Jovanovic (2012) target world welfare directly, and attempt to estimate the level of migration that a global social planner would choose, in a model with human capital externalities as in Lucas (1990). They find that from a global perspective migration ought to be much larger than it is today. Giovanni and Levchenko (2014) quantify the welfare effects of international migration in a model that carefully incorporates TFP and skill differences, within a Melitz (2003) framework of international trade. In that model, due to a home market effect (driven by trade costs), immigration exerts a welfare effect that we do not capture in our work.

experiments. First, we simulate natives welfare effects from a one percentage point increase in the migration share, keeping the composition of the immigrant stock constant. This ex ante analysis yields positive effects for the vast majority of the countries, as well as a large degree of heterogeneity across them. Second, we calculate the welfare effects of immigration as we can observe it in the data. In one exercise, we quantify the difference between the status quo and an hypothetical autarky situation; in another exercise, we quantity the welfare gains resulting from observed migration that occurred between 2000 and 2011, thereby allowing for recent immigration waves to be compositionally different from past ones. The results are instructive for the role of policies and of migrant characteristics. After these simulation exercises with data from our 20 real-world countries, we construct a dataset of artificial countries using a distribution derived from real countries, in order to see the relative importance of different ingredients of our model for the gains from migration that we obtain. We find some suggesting evidence that heterogeneity is unemployment rates across countries, as well as share and skill composition of the immigrant populations, are very important determinants of welfare gains for natives.

The remainder of this paper is structured as follows. Section 2 reports a number if important stylized facts that inform our modeling strategy. Section 3 presents our model and discusses analytical results obtained in simplified versions. Section 4 discusses our calibration strategy and provides our quantitative results. Finally, Section 5 concludes.

2 Pertinent Stylized Facts

In this section we provide some pertinent stylized facts for those 20 OECD countries that we will use in our quantitative exercise.[7] We configure our modeling framework such that it is able to replicate these facts in the baseline scenario. Interestingly, despite of their basic nature and their obvious relevance, there is no single collection of comparable statistics available in the literature or by some international institution. Using a variety of data sources,[8] we document a surprising degree of cross-country heterogeneity that has not been reported before.

Immigrants in the work force. Figure 1 reports the share of foreign-born workers in the work force of 20 OECD countries. That share ranges from roughly 10% in Portugal to almost 40% in Luxembourg. The average is 17% and the standard deviation is 7%.[9]

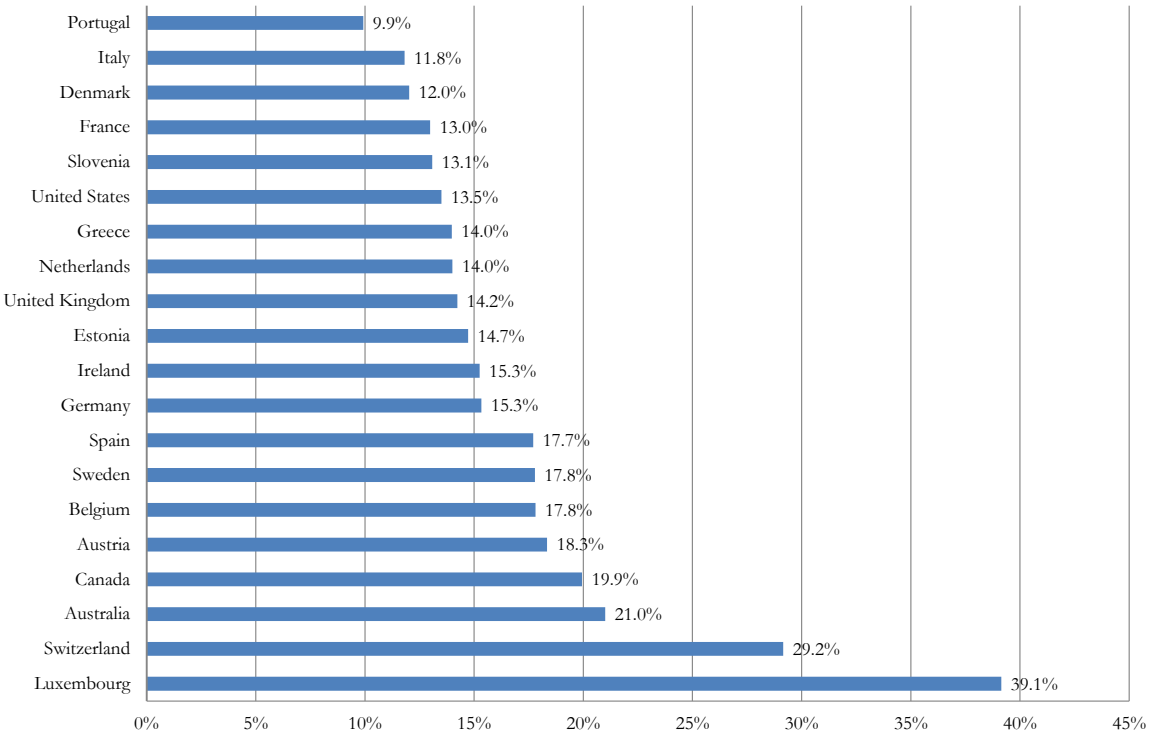
Figure 2 plots the share of high-skilled workers in the native (x-axis) and immigrant (x-axis) labor forces. It also shows a 45 line, along which the skill composition of the two stocks are identi-

[7] We have been able to compile a set of comparative and reliable moments for 16 EU member states, plus Switzerland, the United States, Canada and Australia.

[8] See Table D.7 in our Appendix D for a detailed description of data sources.

[9] Note that these data relate to the share of migrants in the work force, not in total population.

Figure 1: Share of foreign-born across countries



Sources: Eurostat, US Census, Canadian Census, HILDA. See Web Appendix for details on data sources.

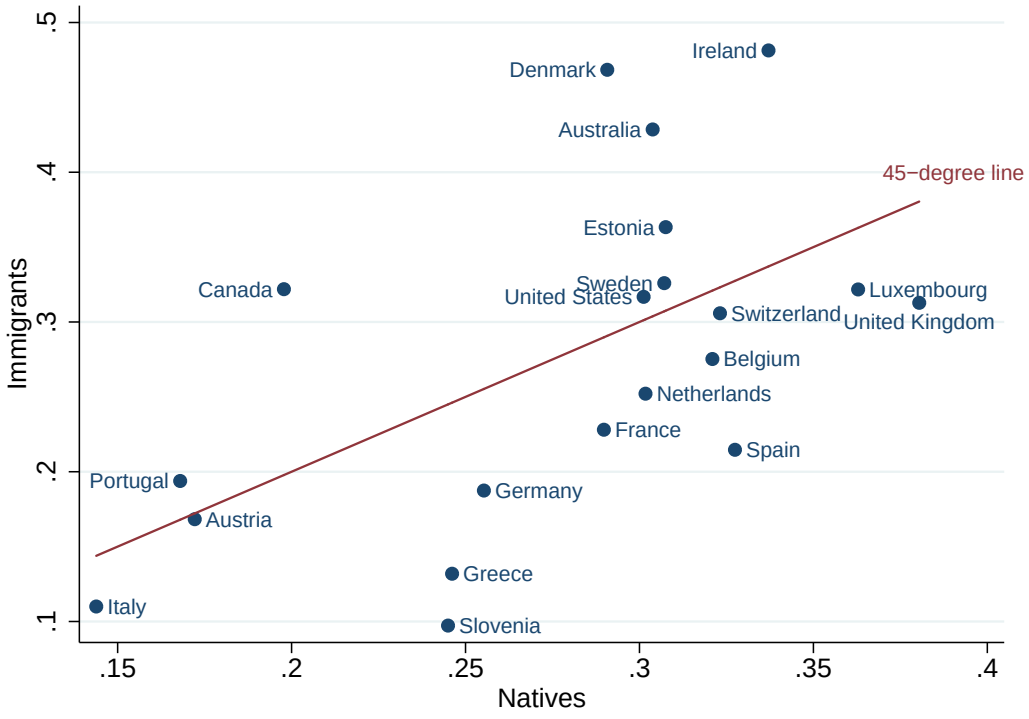
cal.[10] On average, 28 percent of natives are highly skilled, but the figure varies considerably across countries, ranging from 38 percent in the United Kingdom to 14 percent in Italy. Interestingly, on average, the share of highly-skilled immigrants is also 28%, but the variance of that share across countries is substantially lower. In Canada, Australia and in Denmark, immigrants are more likely to be high-skilled than natives, in the US, Sweden, Switzerland, Austria, and Portugal the shares are approximately identical. In the other countries, all of them in the EU, the share of high-skilled in the immigrant work force is lower, sometimes substantially, than that of natives.

Labor market outcomes for natives and immigrants. Next, we illustrate the evidence on labor market outcomes for natives and immigrants. First, in our data set, high-skilled natives command an average wage premium of 54% relative to low-skilled natives.[11] Cross-country het-

[10] These figures are calculated using educational attainments: low skilled are up to secondary school certificate, i.e. up to level 4 of the ISCED classification system included. High skilled, on the other hand, are those with levels 5 and 6 of the ISCED scale. We are aware of the fact that educational attainment will provide information on workers skills, but will also be related to the educational system of each country, with large heterogeneity in the way individuals choose their educational paths and the skill education may provide. Because we use the same classification throughout the paper, the main results should not be driven by country heterogeneity in that dimension. This is nevertheless something we would like our reader to be aware of.

[11] Here we use gross wages to calculate skill premia. Therefore, differences across countries would be even larger if we included taxes in this figure.

Figure 2: Share of High Skilled among Immigrants and Natives



Sources: EU LFS and EU-SILC, CPS, US Census, Canadian LFS, HILDA.

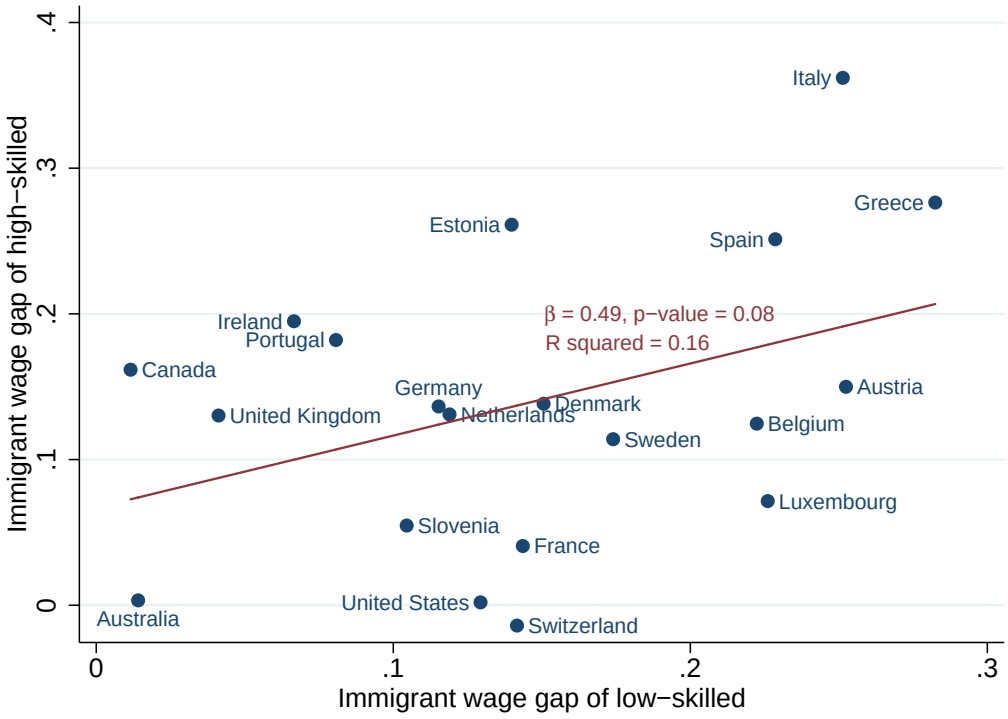
erogeneity, however, is quite substantial. The countries with the highest returns to education (for natives) are the US (111%), Portugal (108%), and Canada (81%). The countries with the lowest returns to education (for natives) are Sweden (24%), Austria (35%), and Denmark (37%). Big European host countries such as France, UK, and Germany feature returns of 45%, 52%, and 68%, respectively.[12]

Figure 3 presents the evidence on wage gaps of immigrant workers (calculated as the difference between native and immigrant wages divided by native wages) in different skill classes. On average, gross wages are 18 percent higher for natives, both amongst high-skilled and low-skilled workers. Although all host countries we consider show positive wage gaps for immigrants (with the exception of a slightly negative immigrant wage gaps for high skilled immigrants in Switzerland), there is large heterogeneity across countries. The chart also shows that there is a positive correlation between wage gaps of high skilled and low skilled workers. For example, Italy, Greece and Spain show high levels in both measures. On the other hand, Australia, Canada and the UK show relatively low wage gaps for low skilled and high skilled immigrants alike.[13] Many countries are far from the

[12] Full information is provided in Table D.7 in the Appendix.

[13] It is not the goal of our paper to analyze the sources of heterogeneity in wage gaps since our model takes the differential outside option of immigrants and natives as given. However, we believe that trying to explain the heterogeneity we

Figure 3: Immigrant Wage Gaps for low-skilled and high-skilled



Sources: EU LFS and EU-SILC, CPS, US Census, Canadian LFS, HILDA.

regression line (the R^2 is 0.16), implying that they have large wage gaps for low skilled but not for high skilled, or vice versa.[14]

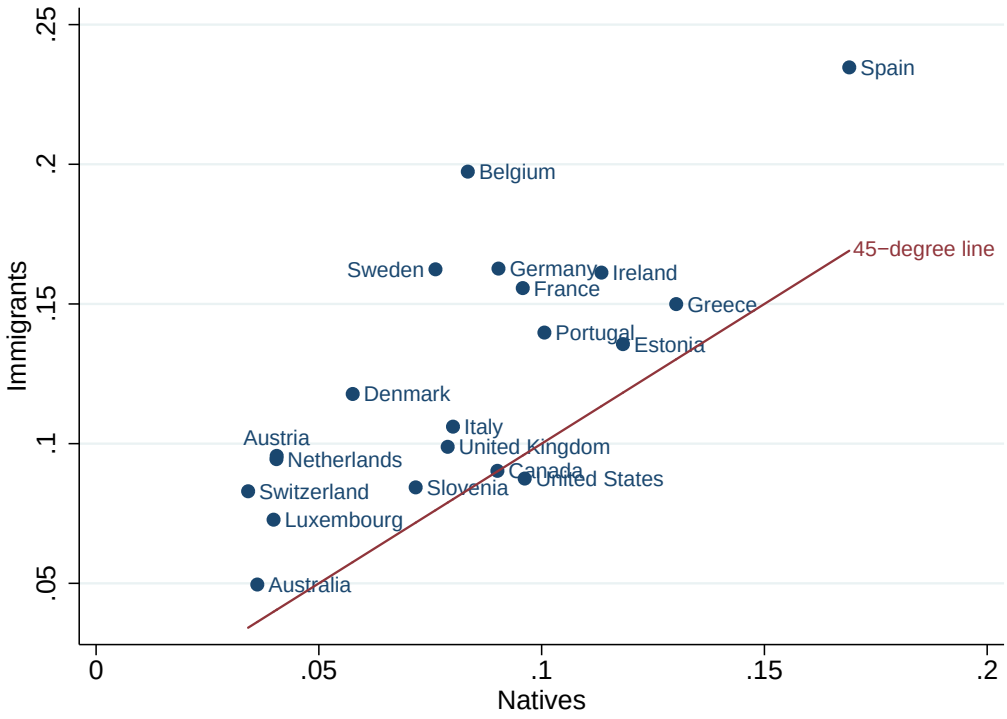
Next, we report unemployment rates for low skilled and high skilled immigrant and native workers across countries, using 2005-2012 averages (slightly shorter averages for very few countries, see our Web Appendix for details) so that results are not driven by asymmetries in business cycle fluctuations. Figure 4 plots unemployment rates of low skilled immigrants (on y-axis) against unemployment rates of low skilled natives (on the x-axis). It also graphs a 45 degree line. With the exception of the United States, low-skilled immigrants have higher unemployment rates than low-skilled natives. The gap seems relatively small in Anglo-Saxon countries (and it is zero in Canada) and more severe in some continental and Northern European countries such as Belgium, Sweden, Denmark, Germany and France. Some of these differences are staggering: for example, low skilled immigrants in Belgium are more likely to be unemployed than natives in Spain, the country with the highest unemployment rate for low skilled workers out of all of the 20 countries

show here deserves further research interest.

[14] As shown in Section D.1 of the Web Appendix to this paper, the native wage premium is higher the lower wages in source countries are. We view this as consistent with the idea that outside options of immigrants from low-wage countries are worse than those from high-wage countries.

we consider.

Figure 4: Unemployment rates of low-skilled immigrants and low-skilled natives



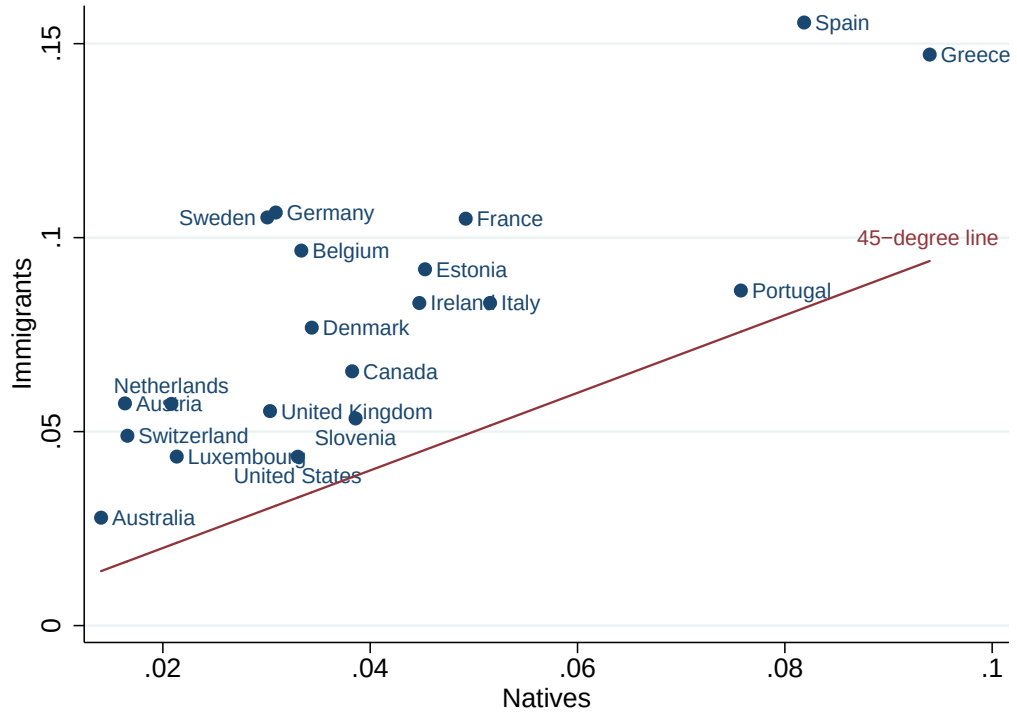
Sources: EU LFS and EU-SILC, CPS, US Census, Canadian LFS, HILDA.

Figure 5 plots equivalent statistics for high-skilled workers. Immigrants have higher unemployment rates than natives in all of the 20 countries in our data set. The gap is very large in Germany, Sweden, Spain and Greece, and it is much smaller in other countries such as the United States and Australia.

Cross-country heterogeneity in welfare state characteristics. Finally, we turn to differences in the generosity of unemployment benefits and in the size of the public sector in our sample of countries. Figure 6 plots the unemployment benefit net replacement rates on the y-axis (relationship between after tax average wages and unemployment benefits) and government expenditures as share of GDP on the x-axis.[15]

[15] Replacement rates are the result of complex rules that differ very strongly across countries. Therefore, the reader should keep in mind that average replacement rates are unlikely to capture the full extent of heterogeneity across countries in this respect. Our data source for gross replacement rates the OECD Wages and Benefits dataset, where we average net replacement rates for the 2005/2011 period. The dataset attempts to compare gross replacement rates for the first year of unemployment of male workers of sectors B to N of Revision 4 of the International Standard Classification of All Economic Activities. Nevertheless, it is unlikely that there is perfect comparability across countries. See our Appendix for details.

Figure 5: Unemployment rates of high-skilled immigrants and low-skilled natives



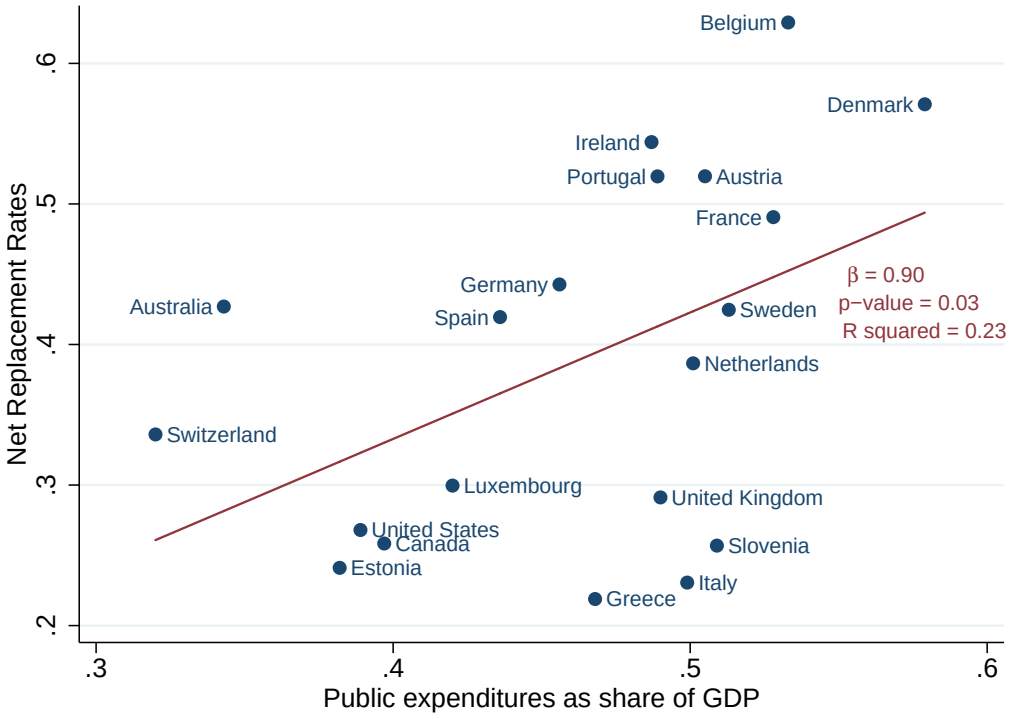
Sources: EU LFS and EU-SILC, CPS, US Census, Canadian LFS, HILDA.

Figure 6 show that the Anglo Saxon countries have in general relatively small governments with values at around 40 percent, continental Europe has values around and over 50 percent, the highest being Denmark, France and Belgium, with continental and Southern Europe gravitating around 45-50 percent, and with Belgium and Scandinavian countries over 50 percent. Perhaps interestingly, while there is a positive relationship between size of government expenditures and replacement rates, R squared are not very high at 0.23. While there are countries that score high on both measures, such as Belgium and Denmark, there are also countries that have relatively large governments but relatively low replacement rates (e.g. the United Kingdom and Italy) and others that have relatively small governments but relatively high replacement rates (such as Australia).

Four our quantitative analysis, we also require information on GDP per capita and on the capital share; see Table D.7 in the Appendix for details.

Overall, these stylized facts from our aggregate data suggest that differences in institutions and in the functioning of labor markets across countries are large. A comparative analysis of the impact of migration to host countries should take account of this heterogeneity.

Figure 6: Public expenditures and unemployment benefits



Sources: OECD Benefits and Wages (net replacement rates); IMF Data (government share)

3 Model

We describe each country by the same simple continuous time model. Countries are open to international capital flows, but they are assumed small enough not to influence world interest rates. There is no international trade in goods, and the stock of international migrants of different skills is the interesting (exogenous) policy variable. For simplicity, we omit time and country indices.

There is a single final output good whose aggregate quantity is given by Y and whose price is normalized to unity and of a public good. That good can be either consumed as a private good, used as an input in the provision of a public good G, or invested into job creation. We assume that utility is linear in the private and the public good.

3.1 Production

The final output good is assembled using capital K and a composite input good Z. In turn, good Z is produced using two intermediate inputs, Y_L and Y_H, which are linear functions of employment of low-skilled and high-skilled workers, respectively, as in Acemoglu (2001). More precisely, the

supply side is characterized by the following set of expressions:[16]

$$\begin{aligned} Y &= AK^{\alpha}Z^{1-\alpha}, \alpha \in (0,1); \\ Z &= \left[xY_L^{\rho} + (1-x)\, Y_H^{\rho}\right]^{\frac{1}{\rho}}, \rho \in (0,1); \\ Y_i &= \sum_{j \in \{N,I\}} (1-u_{ij})\, \pi_{ij} Q_{ij}, i \in \{L,H\}, \end{aligned} \tag{1}$$

where α is the output elasticity of capital, A denotes the total factor productivity, ρ governs the elasticity of substitution between the low-skill intensive good Y_L and the high-skill intensive good Y_H, $x \in (0,1)$ is a productivity parameter, Q_{ij} is the supply of different types of labor, with $i \in \{L,H\}$ indexing skills (high and low education) and $j \in \{N,I\}$ distinguishing native (N) and immigrant (I) workers. Finally, u_{ij} is the unemployment rate and π_{ij} labor productivity in market cell $i \times j$. We assume that natives and migrants are perfect substitutes in production.[17]

We assume that the stock of capital owned by natives is given by $\bar{K}$, that capital is freely mobile internationally, and that the return to capital R is determined on world markets. Then, the optimal use of capital can differ from $\bar{K}$. It is determined by the usual first order condition $r = \alpha A K^{\alpha-1} Z^{1-\alpha}$. Hence, gross capital income R generated in the economy is given by

$$R \equiv (r+\delta)K = \alpha A K^{\alpha} Z^{1-\alpha} = \alpha Y. \tag{2}$$

where $r+\delta$ is the user cost of capital, given by the sum of the interest rate on a risk-free asset and capital depreciation rate.

Intermediate goods are produced under perfect competition. So, their price equals their marginal contribution to the production of the final good Y, namely:

$$p_L = AK^{\alpha}(1-\alpha)xY_L^{\rho-1}\left[xY_L^{\rho} + (1-x)Y_H^{\rho}\right]^{\frac{1-\alpha-\rho}{\rho}} \tag{3}$$

$$p_H = AK^{\alpha}(1-\alpha)(1-x)Y_H^{\rho-1}\left[xY_L^{\rho} + (1-x)Y_H^{\rho}\right]^{\frac{1-\alpha-\rho}{\rho}} \tag{4}$$

The production function of the intermediate goods is very simple: once a worker of skill i ($= H, L$) has been hired he/she produces π_{ij} units of the intermediate good Y_i. The labor market, however, is not competitive, and therefore equilibrium prices of the intermediate goods are not equal to wages. The labor market is regulated by search and a matching function in which employer (with the recipe for the good) hire workers who produce the good and the wage is bargained to split the generated surplus.

[16] A similar structure is used in Chassamboulli and Palivos (2014) or Ottaviano and Peri (2012).
[17] See the debate in Ottaviano and Peri (2012).

3.2 Labor Markets

There are two separate labor markets for each type of workers (H and L). There is a supply of workers in each market and firms post vacancies specific to a skill. Depending on the vacancies and unemployed of each market, matches are formed each period. The supply of each group is taken as exogenous and natives and immigrants of the same skill type compete for the same jobs. The total supply of highly educated workers is therefore $Q_H = \sum_{j\in\{N,I\}} Q_{Hj}$ while the supply of less educated workers is $Q_L = \sum_{j\in\{N,I\}} Q_{Lj}$. Immigration is represented by a change in the stock of foreign-born workers Q_{iI}.

Matching process. At the vacancy posting stage, firms cannot distinguish between natives or immigrants. In other words, they cannot direct their search activities.[18] So, while there are four types of workers, there are only two labor markets (for high- and low-skilled workers). At each instant of time, a mass V_i of open vacancies and a mass of $U_i = \sum_{j\in\{N,I\}} U_{ij}$ unemployed workers exist in each labor market i.

Denoting the mass of successful matches by M, we use a standard constant returns to scale matching function for each market that is increasing in both its arguments, concave and homogenous of degree one:[19]

$$M(U_i, V_i) = \xi U_i^{\varepsilon} V_i^{1-\varepsilon} \quad i = H, L, \tag{5}$$

where $\varepsilon \in (0,1)$ is the matching elasticity, labor market tightness if defined as $\theta_i \equiv V_i/U_i$, and ξ is a scale parameter. The rate at which a firm fills a vacancy is $M_i/V_i = q(\theta_i) = \xi\theta^{-\varepsilon}$, which decreases with market tightness. The job finding rate is $M_i/U_i = m(\theta_i) = \xi\theta^{1-\varepsilon}$, which increases with market tightness. Market tightness makes it easier to find a job and conversely harder to fill a vacancy. At each instant of time, matches are destroyed at the exogenous rate s_{ij} that may – for the reasons sketched above – differ across natives and migrants as well as across skills. We will see below that heterogeneity regarding s_{ij} is one option to generate heterogeneity in equilibrium labor market outcomes regarding wage rates and unemployment rates.

Asset equations. With these assumptions the asset equations governing the value of an open vacancy J_i^V or a filled job J_{ij}^F to a firm producing good i are

$$rJ_i^V = -c_i + q(\theta_i)\left[(1-\phi_i)J_{iN}^F + \phi_i J_{iI}^F - J_i^V\right], \tag{6}$$

$$rJ_{ij}^F = \pi_{ij}p_i - w_{ij} - s_{ij}\left[J_{ij}^F - J_i^V\right], \tag{7}$$

[18] Although immigrants and natives are ex ante identical from the firm's perspective, their specific outside options or break-up rates will lead to outcome differences ex post.

[19] Ljungqvist and Sargent (2005) also analyze the case in which there are separate matching functions by level of unemployment benefits, or for both skills and benefits.

where c_i is the flow cost of an open vacancy (denoted in terms of the numéraire good), and $\phi_i \equiv U_{iI}/\left(U_{iI}+U_{iN}\right)$ is the share of immigrants among those searching for a job. The flow value of an open vacancy, rJ_i^V, has no j dimension, since natives and workers are ex ante undistinguishable. With the rate $q\left(\theta_i\right)$ an open vacancy is turned into a filled job, which comes with a capital gain equal to the expected value of the filled job minus value of the open vacancy. Similarly, the flow value of a filled job is equal to the flow return of a filled job $(p_i - w_{ij})$ minus the capital loss that materializes when the match breaks (which materializes at rate s_{ij}).

For workers, the asset equations governing the value of employment, J_{ij}^E, and unemployment, J_{ij}^U, are

$$rJ_{ij}^U = \tilde{g} + b_{ij} + h_{ij} + m(\theta_i)\left[J_{ij}^E - J_{ij}^U\right], \tag{8}$$

$$rJ_{ij}^E = \tilde{g} + w_{ij}\left(1-t\right) - s_{ij}\left[J_{ij}^E - J_{ij}^U\right], \tag{9}$$

where t is proportional tax rate on labor, $\tilde{g}$ is the utility from the public good (provided by the government, see below), $b_{ij} < \pi_{ij}p_i$ measures monetary unemployment benefits received, and h_{ij} denotes the non-monetary utility value of leisure, including value of home production and enjoyment of leisure. Without loss of generality, we normalize h_{ij} to zero for natives ($h_{HN} = h_{LN} = 0$) and we postulate that h_{iI} will be negative for immigrants, because of a combination of the possibility of having to return to the origin country and earn lower wages, and lower utility of leisure for being in a foreign country and/or higher search costs, hence $h_{iI} < 0$.[20] The flow value of unemployment is given by the flow return of unemployment $(b_{ij} + h_{ij})$ plus the capital gain arising from a successful match, which arrives to the worker at rate $m\left(\theta_i\right)$. Similarly, the flow value of employment is the net wage minus a capital loss arising from job destruction.

Wage bargaining. Firms post vacancies until the value of posted vacancies is zero, i.e., the free entry condition $J_i^V = 0$ is met for both skill classes. As is customary in the literature, we assume that wages are bargained once a match has been formed (and the identify of the worker – being a native or an immigrant – has been revealed). Let the bargaining power of the worker be $\beta \in (0,1)$; then, the worker receives the share β of the total surplus of the match $\left(J_{ij}^E + J_{ij}^F - J_{ij}^U - J_i^V\right)$. With the free entry condition, this implies

$$\left(1-\beta\right)\left(J_{ij}^E - J_{ij}^U\right) = \beta J_{ij}^F. \tag{10}$$

As usual, we focus on steady states. This means, amongst other things, that flows into unemployment and out of it are supposed to exactly balance for all types of workers. So, the instant

[20] Our calibration exercise does not require this assumption, since we will use data on unemployment benefits and wages to calibrate separation rates and outside options, without putting restrictions on the sign of h_{ij}.

change in unemployment (denoted with a dot on top of the variable) in market i for workers of type j needs to be identical to zero, i.e., $\dot{U}_{ij} = s_{ij}Y_{ij} - m(\theta_i)U_{ij} = 0$ for $i = H, L$ and $j = N, I$. Substituting the definition $U_{ij} = Q_{ij} - Y_{ij}$ we obtain the expression of steady state employment and unemployment:

$$Y_{ij} = \frac{m(\theta_i)}{s_{ij} + m(\theta_i)} Q_{ij}; \quad U_{ij} = \frac{s_{ij}}{s_{ij} + m(\theta_i)} Q_{ij} \quad \text{for } i = H, L \text{ and } j = N, I \tag{11}$$

Clearly, higher tightness leads to lower unemployment, and higher split rates to more. Therefore, employment rates are $Y_{ij}/Q_{ij} = m(\theta_i)/\left[s_{ij} + m(\theta_i)\right]$ and unemployment rates are $U_{ij}/Q_{ij} = s_{ij}/\left[s_{ij} + m(\theta_i)\right]$,.

3.3 Public sector

The government collects income by proportional taxation on labor. Capital, which is assumed to be fully mobile internationally, is not taxed. The government uses its revenues to finance the payment of unemployment benefits and the provision of a public good G.[21] With these assumptions, the government budget constraint is

$$\sum_i \sum_j b_{ij} U_{ij} + G = t \sum_i \sum_j w_{ij} Y_{ij}. \tag{12}$$

The left-hand side of equation (12) corresponds to government expenditures, given by the sum of total unemployment benefits and the public good G. The right-hand side corresponds to government revenues. We will treat b_{ij} and G as exogenous[22] and let t adjust such that (12) is satisfied.

3.4 Equilibrium

Job-creation conditions. Putting together asset equations (6), (7), and the free entry condition $J_i^V = 0$, one can derive, for each labor market i, a relationship between labor market tightness θ_i

[21] We denote the per capita amount by g, the total amount by G. For simplicity, we refer to this as a public good. However, this is a rival good so we should more precisely refer to publicly provided private good, in the sense that we assume that the public good is delivered to each individual so that its total amount depends linearly on population size (which in turns means that w do not need to explicitly include population size in our model). We have tested this assumption on our data by running a regression of log of public expenditures on the log of population size, obtaining a coefficient of 1.03 (t statistic: 18.66; R squared: 0.95). An ancillary regression of per capita government expenditures (in logs) on population size (in logs) gives a point estimate of 0.04 (t statistic: 0.67). These results are consistent with our hypothesis that public good provision can be thought of as the public provision of a private good.

[22] We actually take replacement rates from the data and calculate unemployment benefits using replacement rates and wages.

and the expected present discounted value of the job rent:

$$\frac{c_i}{q(\theta_i)} = \sum_{j \in \{N,I\}} \phi_{ij} \frac{\pi_{ij} p_i - w_{ij}}{r + s_{ij}}. \tag{13}$$

This is a free entry condition. It says that the expected cost of creating a vacancy (the left-hand-side) must be equal to the expected per period operating profit from a job filled with either a native or a migrant, $\pi_{ij} p_i - w_{ij}$, discounted by the specific effective discount rate $r + s_{ij}$ (the left-hand-side). The job rent can be high because high labor productivity π_{ij}, a low wage w_{ij}, or a low separation rate s_{ij}. For given immigrant wages w_{iI} and goods prices p_i, equation (13) yields a decreasing relationship between the native wage w_{iN} and labor market tightness θ_i : The higher θ_i, the more congested is the labor market from the firm's point of view, and the higher are expected search costs. For the free entry condition to continue holding, w_{iN} has to decrease.

Wage equations. Inserting the value functions (8) and (9) into (10), and recognizing that the free entry condition implies $J_{ij}^F = (\pi_{ij} p_i - w_{ij}) / (r + s_{ij})$ from (7), one can express the bargained wage rate as a convex combination of the value product of a match, $\pi_{ij} p_i$, and the outside option $b_{ij} + h_{ij}$,

$$w_{ij} = \beta \frac{r + s_{ij} + m(\theta_i)}{(r + s_{ij})[1 - t(1 - \beta)] + \beta m(\theta_i)} \pi_{ij} p_i + (1 - \beta) \frac{r + s_{ij}}{(r + s_{ij})[1 - t(1 - \beta)] + \beta m(\theta_i)} (b_{ij} + h_{ij}). \tag{14}$$

Expression 14 shows that the wage paid by the firm is a pseudo-weighted average of a term that depends on the total value of production from the worker (p_i) and on its outside option $b_i + h_{ij}$. The lower is the bargaining power of the worker (β) the closer is the wage to the outside option. If $\beta = 0$, $w_{ij} = (b_i + h_{ij}) / (1 - t)$ which is exactly the outside option. If $\beta = 1$, the worker appropriates all the product of his-her labor $\pi_{ij} p_i$ and the outside option is irrelevant. Moreover, the tighter is the market (as $m(\theta_i)' > 0$) the larger is the weight on p_i and the lower on $b_i + h_{ij}$ as workers have a stronger bargaining position.[23] It is also straightforward to show that (for a given equilibrium value of labor market tightness) higher separation rates are associated with lower wages. This means that if we adjust the separation rates of two groups in such a way that market tightness is unaffected, the group with higher separation rates is also going to have lower equilibrium wages.

From both (13) and (14), it is easy to see that heterogeneity between natives and migrants in productivity labor π_{ij} and in split rates s_{ij} have qualitatively very similar effects. Lower productivity of migrants and higher split rates shift down the job-creation curve in wage-tightness space. Similarly, π_{ij}, s_{ij}, and h_{ij} shift the wage curves 14 in the same qualitative fashion. Hence, for the sake of simplicity, in the sequel, we set $\pi_{ij} = 1$, since heterogeneity in split rates and outside options is sufficient to generate heterogeneity in firms' incentives to create vacancies and lead to

[23] Note that utility obtained from public goods consumption drops out from (14).

heterogeneity in equilibrium wage and unemployment rates.

Definition of equilibrium. We have the following set of ten equilibrium conditions: two job-creation conditions (13) for each skill category, four wage equations (14), two profit maximizing conditions on goods markets (32) and (4), one first-order condition governing the optimal capital stock (2), and the government budget constraint (12). We use them to solve for ten equilibrium objects: $\{\theta_L, \theta_H; w_{LN}, w_{LI}, w_{HN}, w_{HI}; p_L, p_H; K, t\}$. Knowing θ_i, one immediately knows u_{ij} and hence U_{ij}, Y_{ij} as well as ϕ_i. Note that choosing the price of the final output good as the numeraire implies a restriction on goods prices p_L, p_H which makes one of the profit maximizing conditions (32) and (4) redundant.[24]

3.5 Analytical results for a simplified version of the model

The model we have outlined above is a rich model that captures several mechanisms through which natives may be affected by the characteristics and size of the immigrant population. Because of the complexity of the model, and in particular because of the fact the we include a government budget constraint, which introduces complex interdependencies among all endogenous variables, analytical results from the full model would be extremely complex to analyse.

Instead, in this section we focus on two different mechanisms of our model separately, namely the role of immigrant outside options and that of differential split rates, working with a simplified version of our setup in order to be able to derive useful insights from some analytical results.

Remark 1. Assuming that no government exists (no public good, and b_{ij} being a non-monetary value of leisure), and setting $s_{ij} = s_i$ (split rates are the same for immigrants and natives, as in Chassamboulli and Palivos, 2014), we show that

(i) A balanced inflow of immigrants always increases wages and decreases unemployment rates of natives, and therefore increases native welfare;

(ii) A worsening of the outside option of immigrants also increases wages, decreases unemployment rates and increases welfare for natives;

(iii) An inflow of immigrants of skill i will unambiguously benefit natives of skill $i' \neq i$. It may benefit natives of skill i as well, but that depends on parameters.

Proofs in the Appendix.

The result in (i) is intuitive. In a model where immigrants and natives only differ in their outside option, as in Chassamboulli and Palivos (2014), immigrants may affect natives only through skill complementarity and through vacancy creation. However, the skill complementarity channel

[24] That restriction arises from setting the price index dual to the production function system (1) equal to unity. I.e., $P = A^{-1}(r+\delta)^{\alpha}\Pi^{1-\alpha}(\alpha^{-\alpha}(1-\alpha)^{\alpha-1})$ with $\Pi = (p_L^{\rho/(\rho-1)}x^{1/(1-\rho)} + p_L^{\rho/(\rho-1)}(1-x)^{1/(1-\rho)})^{\rho/(1-\rho)}$.

is inactive in this case because we are assuming that the flow of immigrants has the same skill composition of natives. The job creation channel, operating through immigrant outside options, is driven by the fact that immigrants' lower outside option translates into larger surplus for the firm from matching with an immigrant. Given our assumption of ex ante anonymity, higher labor market tightness resulting from larger surpluses will benefit natives of both skills. At higher levels of labor market tightness, natives will be less likely to be unemployed in the steady state, will obtain higher wages at the bargaining stage and will therefore have higher welfare.

The result in (ii) is driven by the very same mechanism: The surplus from the match that the firm gets is a negative function of the outside option of the worker. And because of the fact that we assume that vacancies cannot be specifically for immigrants or native, the additional vacancies that firm will post will benefit natives as well.

The intuition for (iii) is also quite straightforward: without a government, an inflow of immigrants of skill i will affect natives of skill $i' \neq i$ only through the factor complementarity production channel, which is unambiguously positive. On the other hand, our model cannot deliver sharp predictions concerning the effect on natives of the same skill of immigrants. The reason is that there are two counteracting effects at work: a factor competition effect (which is negative for natives) and a vacancy creation effect (positive for natives). The latter will tend to dominate when natives have high unemployment rates and when wage gaps between immigrants and natives are large.

Remark 2. Assuming that no government exists (no public good, and b_{ij} being a non-monetary value of leisure), and setting $h_{ij} = 0$, (separation rates are now larger for immigrants, but outside options are the same) we show that

(i) A balanced immigrant flow decreases wages and increases unemployment rates of all natives, and therefore decreases native welfare;

(ii) Results of an unbalanced flow is always negative for natives of the same skill, may be positive or negative for natives of different skills;

(iii) An increase in the immigrant split rates rates negatively welfare of all natives, through both wages and unemployment rates.

Discussion in the Appendix.

The intuition for the result in (i) above is equivalent (but in the opposite direction) as result (i) for Remark 1. the only effect of a balanced immigrant inflow is through the vacancy creation effect, which is negative in this case: more immigrants mean that the expected surplus from a match is lower. in order for firms to be profitable to post vacancies, market tightness will have to adjust downwards, being down wages and unemployment rates of natives. The result in (ii) refers to the effect of the inflow of immigrant of one skill type on natives on another skill type. The result

is indeterminate in this case, because on the one hand natives of the other skill type will benefit through the factor complementarity channel, which makes them more rare in the market, but will also be hurt through the production function: ceteribus paribus, equations 32 and 4 show that at lower employment rates of one skill correspond lower employment rate in the other skill as well. Result (iii) is then straightforward from the intuition of result (i) and (ii): if the same immigrant now have larger split rates, expected surplus will be lower and therefore welfare will be lower for workers of the same skill class. Through production complementarities, there will also be a spillover effect for natives of a different skill. We discuss the details in the Appendix.

The two remarks above exemplify the mechanisms that are at work in our model and allows analyzing some policy instruments in some special cases. They also show that our full model does not have clear analytical predictions in its general form. We will next present a series of quantitative exercises, where we use data on moments for many countries to calibrate the model and simulate welfare effects for the various countries.

4 Quantitative Exercise

We are now ready to explain how we parameterize our model for the 20 countries in our data set and to describe the results of our counterfactual experiments. Our main object of interest is average (across employed and unemployed agents) group-specific welfare $\mathcal{W}_{ij}$ which our assumptions allow us to write as

$$\mathcal{W}_{ij} = y_{ij} + g \tag{15}$$

where y_{ij} denotes real after tax income (labor income, unemployment benefits, and interest income). Remember that the final consumption good is used as numéraire. Here, g denotes utility derived from the public good. As explained above, g is a rival public good (or, equivalently for our purposes, just a demogrant). We are also interested in overall native or immigrant (per capita) welfare, which we define as $\mathcal{W}_j = \sum_i \frac{Q_{ij}}{\sum_i Q_{ij}} y_{ij} + g$.

4.1 Calibration

In a first step towards a clean parameterization of our model, we replace some of the model parameters with empirically observable counterparts. In this vein, we replace unemployment benefits b_{ij} by $\varrho w_{ij}(1-t)$, where ϱ is the country-specific replacement rate that we can indeed observe for our 20 countries. Similarly, we assume that all capital used in the status quo equilibrium is native owned, so that $\bar{K} = K$, and we pin down that unobserved capital stock by using information on the user cost, and the capital share α in GDP Y. Then, $\bar{K} = \alpha Y/(r+\delta)$.

Directly observable data and external parameters. With these substitutions, the model uses the following set of 22 exogenous parameters $\{\beta, \varepsilon, \rho, r, \delta; \alpha, \varrho, Q_{ij}, s_{ij}, c_i, \xi, A, x, G, h_{iI}\}$, with

Table 1: Parameters taken from available data or the literature

Parameter	Description	Mean	s.d.	Source
Parameters without country variation				
β	worker bargaining power	0.5	n.a.	Petrongolo and Pissarides (2001)
ε	matching elasticity	0.5	n.a.	Petrongolo and Pissarides (2001)
ρ	substitution elasticity	0.5	n.a.	Ottaviano and Peri (2012)
r	interest rate (monthly)	0.004	n.a.	Chassamboulli and Palivos (2014)
δ	depreciation rate (monthly)	0.0061	n.a.	Chassamboulli and Palivos (2014)
c_L	cost of low-skilled vacancy	0.421	n.a.	Chassamboulli and Palivos (2014)
Parameters varying across countries				
ϱ	replacement rate	0.39	0.13	OECD Benefits and Wages
α	capital share	0.35	0.05	OECD Unit Labor Cost Indicators
Q_{LN}	share of low skilled natives	0.72	0.07	Eurostat, Census, HILDA
Q_{HN}	share of high skilled natives	0.28	0.07	Eurostat, Census, HILDA
Q_{LI}	share of low skilled immigrants	0.15	0.08	Eurostat, Census, HILDA
Q_{HI}	share of high skilled immigrants	0.06	0.05	Eurostat, Census, HILDA

$i \in \{H, L\}$ and $j \in \{N, I\}$. Some of these parameters are taken to be invariant across countries; most feature country variation. Table 1 lists model parameters which we take from the empirical literature or which we can observe directly in standard data bases. We follow Petrongolo and Pissarides (2001) and most of the related literature by setting the bargaining power of workers equal to the elasticity of the matching function, ensuring that the Hosios condition is met. The parameter ρ governs the elasticity of substitution between the high-skill intensive and the low-skill intensive good, and hence, the elasticity of substitution between high- and low-skilled workers. In line with Ottaviano and Peri (2012), we set $\rho = 0.5$, which corresponds to an elasticity of 2. The user cost of capital $(r + \delta)$ is about 12% per year, or about 1% per month. This assumption is identical to Chassamboulli and Palivos (2014) and to other papers in the literature. Finally, we set c_L to 0.421, as Chassamboulli and Palivos (2014).[25] The mentioned parameters do not vary across our 20 countries, mostly due to data limitations.

Table 1 also presents exogenous data that we take from the data and does vary across countries. For example, the average net replacement rates ϱ, which we take from OECD data, feature substantial heterogeneity across countries, as discussed in Section 2. The same is true for capital shares α, which we also take from OECD data. Finally, we use observed data on immigrant stocks Q_{ij}; see Section 2 for details. Without loss of generality, we have normalized the levels such that $\sum_j Q_{iN} = 1$.[26]

[25] This choice is an arbitrary normalization, which we checked by changing the value of c_L and verified that results are unaffected.

[26] To be precise, we do not observe population stocks exactly, but can construct the four population shares that we need from the immigrant share, the skill composition of natives and of immigrants, and this normalization.

Calibration of unobserved model parameters. The remaining 11 parameters of the model are calibrated such that the baseline equilibrium of our model reproduces a number of moments that we observe for our 20 OECD economies. Table 2 shows the 11 empirical moments that we target. Table 3 presents the 11 parameters that we obtain by forcing our model to exactly reproduce this set of moments, country by country. These moments mostly have country variation and have been discussed in Section 2 above. Note that the standard deviations reported in Table 3 refer to variation across countries.

Table 2: Matched Moments

Moment	**Source**	**Mean**	**S.d.**
Native wage premium, low-skilled	EU-SILC, Censuses, HILDA	1.18	0.11
Native wage premium, high-skilled	EU-SILC, Censuses, HILDA	1.18	0.15
Return to skill, native workers	EU-SILC, Censuses, HILDA	1.54	0.23
Unempl. rate low-skilled natives	EU LSF, CPS, Can. LFS, HILDA	0.08	0.04
Unempl. rate low-skilled immigrants	EU LSF, CPS, Can. LFS, HILDA	0.12	0.05
Unempl. rate high-skilled natives	EU LSF, CPS, Can. LFS, HILDA	0.04	0.02
Unempl. rate high-skilled immigrants	EU LSF, CPS, Can. LFS, HILDA	0.08	0.03
Avg. job duration, low-skilled (quarters)	Chassamboulli and Palivos (2014)	29.4	n.a.
Avg. job duration, high-skilled (quarters)	Chassamboulli and Palivos (2014)	52.6	n.a.
Government Expenditures	IMF	0.45	0.06
Real GDP, US=1 (PPP)	World Bank WDI	0.82	0.29

All shares refer to working age population, aged 15-64.

All the moments above are constructed for each of our 20 countries.

Table 3: Calibrated Parameter Values

Parameter	**Description**	**Mean**	**S.d.**
ξ	Match Efficiency Parameter	0.42	0.18
A	Total Factor Productivity	0.57	0.11
x	Low Skill Share in Production of Intermediates	0.51	0.05
c_H	Cost of high skill vacancy	0.72	0.55
G	Public expenditures	0.36	0.12
s_{LN}	Break-up rate, low skilled natives	0.03	0.00
s_{LI}	Break-up rate, low skilled immigrants	0.05	0.01
s_{HN}	Break-up rate, high skilled natives	0.02	0.00
s_{HI}	Break-up rate, high skilled immigrants	0.03	0.01
h_{LI}	Value of Leisure Discount for low-skilled Immigrants	-0.97	1.09
h_{HI}	Value of Leisure Discount for high-skilled Immigrants	-1.60	1.25

Calibrated from moments of the data of our 20 countries, full model.

Driven by unemployment rate differences, we calibrate separation rates to be larger for immi-

grants than for natives (the gap being 2 percentage points for low skilled, 1 for high skilled). The parameters h_{LI} and h_{LI} are on average negative as we have postulated in Section 3. However, that is not an assumption and indeed for high skilled immigrants in Australia, Switzerland and the US they are positive, meaning that based on separation rates alone we would over-predict wage gaps, which are in reality smaller because of good outside options by immigrants. Using the calibrated parameters of table 3, in the next sections we will perform a few comparative statics using German data to evaluate the action generated by our model, and then we will move to simulating welfare effects form a few counter-factual scenarios, in each of our 20 countries.

4.2 Results

This section presents a series of simulation exercises for our 20 countries, using the calibrated model discussed in the previous section. We will focus primarily on welfare effects for native workers (although we will present some results on welfare effects of incumbent immigrants as well). This focus is motivated on the one hand by the fact that there is an almost complete lack of coordination of migration policies across countries, which implies that policies are likely to be driven (now and in the near future) by preferences of natives.

Below, we present results from three sets of simulation exercises. First, we carry out an ex ante analysis which calculates the welfare consequences of an increase in the stock of immigrants. We also conduct an ex post analysis by which we compare the level of welfare in the status quo situation with welfare in a counterfactual equilibrium for which we either assume that immigration had never occurred (autarky) or in which the observed inflows over the last ten years had never happened.

4.2.1 Ex Ante Scenario: Marginal Welfare Gains for Natives

We first look at the welfare effect of equivalent treatments in all of our 20 countries. In particular, we simulate the effects of increasing the size of the immigrant share of the labor force by one percentage point (for example from 10 to 11 percent of the labor force), leaving its skill composition unchanged. The counterfactual refers to some postulated future immigration; hence, we refer to it as an ex ante scenario.

We use this scenario to dissect the welfare effects of the different mechanisms that are present in our model. To save space, we do this for two prominent countries, the US and Germany.[27] We start with the most parsimonious models, Model 1, which has no difference between immigrants and natives and no public sector. All effects derive from the complementary channel. If immigrants and natives had the same skill mix, effects would be zero. Similar analysis (albeit more detailed) is provided by Borjas (2003) or Ottaviano and Peri (2012), amongst many others. Model 2 builds on Model 1 and additionally accounts for observed immigrant-native wage gaps by allowing for

[27] Full details are available in table B.1 at the end of our main Appendix.

Table 4: Welfare effects (%) in different model varieties

	US			Germany		
	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$
Model 1: only complementary effects	0.00	0.01	-0.02	0.00	-0.05	0.11
Model 2: adding wage heterogeneity	0.04	0.08	0.00	0.07	0.03	0.17
Model 3: adding unemployment heterogeneity	0.04	0.08	0.00	0.02	-0.03	0.12
Model 4: adding redistribution through b_{ij}	0.05	0.08	0.01	0.02	-0.02	0.12
Model 5: adding redistribution through G	0.05	0.06	0.03	-0.01	-0.03	0.04

differences in the outside option of immigrants and natives. This model is equivalent to that of Chassamboulli and Palivos (2014), and allows for a second mechanism by which natives are affected by the presence of immigrants, namely the vacancy creation effect described above. Model 3 is a further generalization, allowing for unemployment rates to be different between immigrants and natives, consistent with the evidence from our data. Models 4 and 5 introduce a government in our model, through the presence of unemployment benefits financed through labor taxation in Model 4, and with the further addition of a tax-financed public good in Model 5.

Table 4 provides the results. Welfare effects for Model 1, i.e. a model where immigrants and natives are perfect substitutes but, possibly, of different skill composition,[28] are positive but very close to zero on average in both Germany and the US. The picture is similar in all countries studied (see table B.1 at the end of our main Appendix). However, the small overall effects mask larger effects on specific skill-groups. High-skilled natives in Germany see a 0.11% increase in their welfare, while low-skilled lose 0.05%. In the US, high-skilled individuals lose -0.2%, while low-skilled individuals win. This pattern reflects the fact that immigrants are slightly more educated than natives in the US, but substantially less so in Germany. So, in the US, immigration drives up the relative supply of skilled workers, thus reducing their wages (and, thus, welfare), while, in Germany, the opposite happens. As a matter of fact, in such a model, immigration is never Pareto improving, as one skill class always must lose.

Simulated effects change substantially in Model 2, where lower outside options of immigrant workers make a new vacancy creation effect operative that adds to the complementarity gains. That effect is always positive as immigration adds incentives to create jobs, thus lowering unemployment. Now, native welfare goes up by 0.07% in Germany and by 0.04% in the US. It turns out that, in both countries, both skill groups win from immigration, which has obvious political economy implications. Across all countries (see Table B.1 at the end of our main Appendix), both skill groups win in 14 out of 20 cases. When the skill composition of migrants is heavily biased towards high-skilled, a distributive conflict continues to exist. This is because the job creation effect of immigration does not matter most on the labor market for high-skilled workers where unemployment is low anyway.

[28] We assume that capital stocks adjust endogenously in all models.

Model 3 allows unemployment rates to be different between immigrants and natives. In the model, this weakens the vacancy creation effect, thus resulting in lower levels of market tightness. It also blurs the complementarity channel. Overall native welfare is affected very little in the US where migrants and natives have similar unemployment rates, but it is cut almost by a factor 4 in Germany where immigrants suffer substantially higher unemployment rates than natives. In both countries, a distribution conflict along the lines resulting from complementarity effects (Model 1) emerges again. If one assumes that unemployment benefits are financed by proportional taxation (implying transfers from the employed to the unemployed), welfare effects change very little as the implied redistribution effects are very minor. Again, this is a robust finding across all 20 countries (see Table B.1 in the Appendix).

Model 5, the most general setup, introduces public good provision in order to get a realistic extent of redistribution. This effect turns the overall welfare effect marginally negative in Germany, but does not affect the US numbers much, reflecting the relatively low importance of public expenditure. Out of 20 countries, native welfare falls in seven European economies: besides Germany, this happens in Austria, Belgium, Luxembourg, the Netherlands, Sweden and Switzerland. On average though, natives gain in our sample. Because of different characteristics of the immigrant population, the effects of introducing a tax-financed public good are very different across countries. Countries with small wage and employment gaps and highly-skilled immigrant population have larger gains to natives under Model 5. On the other hand, countries with large wage and/or employment gaps and/or large shares of low skilled among immigrant (most countries in our sample), see a decrease of gains from marginal increases in migration shares between model 4 and model 5. For six of our countries (Austria, Belgium, Germany, Luxembourg, the Netherlands and Sweden) introducing public good provision turns a marginally positive effect to a marginally negative one, due to redistribution from natives to immigrants (largely driven by redistribution from high skilled to low skilled). Our model does not predict economically large negative effects from incremental migration in any of the countries we examine.

Table 5 shows welfare effects for all countries for our full model (Model 5). It also reports the effect for the incumbent immigrant population. With the exception of Australia, where due to very highly skilled migration fiscal transfers go in favor of natives, our simulations imply that incumbent immigrants benefit from additional immigration. This finding is due to our assumption of perfect substitutability between immigrants and natives. Immigrants benefit from the arrival of additional immigrants due to the vacancy creation effect (just as natives, but more strongly due to their higher chance of being unemployed) while not being hurt by the fiscal redistribution channel. Effects working through labor market imperfections and fiscal redistribution can, therefore, easily turn the conventional wisdom upside down that the main losers from additional immigration are immigrants who have arrived earlier.

Table 5: Welfare effects (%) of a one percentage point increase in immigration

Countries	Natives			Immigrants		
	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$	$\mathcal{W}_I$	$\mathcal{W}_{LI}$	$\mathcal{W}_{HI}$
Australia	0.01	0.06	-0.08	-0.01	0.09	-0.11
Austria	-0.03	-0.03	-0.03	0.19	0.20	0.11
Belgium	-0.02	-0.03	-0.01	0.12	0.12	0.12
Canada	0.04	0.08	-0.08	0.08	0.11	0.03
Denmark	0.06	0.11	-0.05	0.18	0.27	0.10
Estonia	0.05	0.07	0.02	0.24	0.16	0.37
France	0.02	0.00	0.05	0.09	0.09	0.08
Germany	-0.01	-0.03	0.04	0.06	0.02	0.20
Greece	0.07	0.02	0.18	0.26	0.22	0.48
Ireland	0.05	0.10	-0.03	0.18	0.16	0.21
Italy	0.07	0.05	0.14	0.37	0.30	0.81
Luxembourg	-0.02	-0.03	-0.01	0.04	0.05	0.02
Netherlands	-0.01	-0.03	0.02	0.10	0.07	0.19
Portugal	0.08	0.09	0.07	0.21	0.15	0.37
Slovenia	0.02	-0.04	0.17	0.04	0.01	0.22
Spain	0.04	-0.01	0.12	0.18	0.10	0.42
Sweden	-0.02	-0.01	-0.04	0.08	0.10	0.04
Switzerland	-0.04	-0.03	-0.04	0.00	0.03	-0.06
United Kingdom	0.00	-0.03	0.05	0.06	-0.03	0.21
United States	0.05	0.06	0.03	0.09	0.14	0.03
Average	0.02	0.02	0.03	0.13	0.12	0.19
Median	0.02	0.00	0.02	0.10	0.10	0.16

All columns refer to our full model, i.e. model 5 as of Table 4.

4.2.2 Ex post scenario: Total Gains from Migration

In this section, we discuss the implications of our calibrated model for native welfare differences between the status quo and an 'autarky' scenario where countries do not have any foreign born individual. While we are aware that this exercise might be of little direct policy relevance, we believe that it offers a useful benchmark for learning something about the overall importance of migration for native workers implied by our model. Table 6 presents our simulation of total migration gains for all our 20 countries.

First, we find positive effects for 19 out of our 20 countries: according to our simulation exercise, natives have benefited from migration overall. Magnitudes of the welfare effects vary largely across countries, however. Interestingly, it is the countries with less flexible labor markets, higher unemployment rates and less skilled natives who are predicted to have gained the most, according to our model. We are fully aware of the limitations of our analysis, but this does seem to be suggesting that immigrants 'greasing the wheels' of the labor market is an important phenomenon. The large

Table 6: Welfare Effects (%) for natives, autarky vs. status quo

Countries	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$
Australia	0.24	1.26	-1.72
Austria	1.77	1.74	1.94
Belgium	1.70	1.37	2.30
Canada	1.19	1.79	-0.57
Denmark	1.90	2.39	0.86
Estonia	1.47	1.47	1.46
France	0.77	0.52	1.27
Germany	0.31	-0.07	1.23
Greece	2.02	1.40	3.51
Ireland	1.77	2.30	0.95
Italy	1.87	1.64	2.97
Luxembourg	0.72	0.45	1.15
Netherlands	0.48	0.23	0.98
Portugal	1.27	1.23	1.41
Slovenia	0.52	-0.20	2.30
Spain	1.90	0.96	3.43
Sweden	0.63	0.77	0.34
Switzerland	-0.14	0.04	-0.46
United Kingdom	0.35	-0.22	1.10
United States	0.80	0.97	0.53
Average	1.08	1.00	1.25
Median	0.99	1.10	1.19

All columns refer to model 5 as of Table 4.

heterogeneity in our estimates is also consistent with the idea that optimal migration policies may be different in different countries. Compared to the marginal effects discussed above, which are negative for some countries, they also offer possible avenues for future research starting from the consideration of Collier (2013) that the relationship between immigrant share and native welfare might be nonlinear, such that looking at marginal effects in order to get at total effects (which is usually what one has to do at least implicitly when empirically evaluating marginal changes) may be problematic.

The second and third column of Table 6 report total effects of migration for low skilled and high skilled natives separately. For 15 out of our 20 countries, effects are positive for both low skilled and high skilled natives, showing that the vacancy-creation effect is important. Australia, Canada and Switzerland show negative effects for high skilled natives. We simulate negative effects for low skilled natives in Germany, the United Kingdom and Slovenia, although very small in magnitude considering the magnitude of the treatment. For these countries, given our results one could venture to suggest a possible redistribution mechanism from high skilled natives to low skilled natives through the tax system.

Our 'ex ante' and 'ex post' had the goal of analyzing what our model predicts as the effect of a common shock across our 20 countries. In reality, these countries have been subject to very different shocks in terms of size and skill composition of their immigrant populations in the last decade, and so the simulations above are not informative if our goal is to get a sense of he effects of recent migration patterns. In order to address this, next we analyze the welfare effects for natives of a change in migration stock and skill mix that mimics that of the last 10 years.

4.2.3 Using data on recent migration trends

Table 7 below describes the treatment we are looking at (constructed to mimic actual migration flows between 2000 and 2011, please see our Appendix for additional details on the way we constructed these variable and on related data limitations), and its effects on native welfare. The first two columns of Table 7 show that all of our countries have a larger immigrant share in 2011 compared to 2000. For some of these countries, such as Australia, Canada, Switzerland, these differences are very large. The third and fourth column report the share of foreign born that are highly-skilled, according to our definition. While most countries see an increase in the share of high skilled among immigrants, the opposite is true for a few countries, including Canada, Germany, Greece and the United Kingdom.

The last three columns of Table 7 report welfare effects for natives of the treatment we just described. Sixteen countries out of twenty see positive effects for the average native, and in five of these countries there was a Pareto improvement, with both low skilled and high skilled natives benefiting. Overall, because migration has been relatively skilled and because of fiscal transfers hurting high skilled natives, low skilled have benefited more on average, 0.33 percent as compared

to virtually zero for high skilled natives. None of the four countries where we see a negative overall effect report an effect that is large in magnitude.

Table 7: Native Welfare Effects (%) from observed 2000-2011 migration flows

Countries	% Immigrant		% High Skilled		Native Welfare Gains		
	2000	2011	2000	2011	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$
Australia	11.82	21.00	28.80	42.86	0.30	1.37	-1.77
Austria	12.69	18.34	11.66	16.83	0.01	0.20	-0.82
Belgium	12.50	17.81	25.48	27.53	0.03	0.05	-0.01
Canada	10.69	19.94	42.55	32.19	0.07	0.04	0.16
Denmark	10.33	12.02	23.94	46.84	0.52	1.28	-1.10
Estonia	13.82	14.72	31.14	36.33	0.15	0.41	-0.31
France	10.43	12.98	20.68	22.80	0.09	0.11	0.05
Germany	13.55	15.33	21.77	18.74	-0.08	-0.26	0.36
Greece	12.32	13.98	16.60	13.19	0.01	-0.18	0.45
Ireland	10.18	15.25	42.13	48.13	0.46	0.91	-0.25
Italy	5.15	11.81	12.50	11.00	0.69	0.57	1.29
Luxembourg	23.23	39.14	23.01	32.17	-0.03	0.50	-0.85
Netherlands	9.35	14.01	18.99	25.21	0.10	0.21	-0.13
Portugal	4.63	9.92	19.57	19.38	0.54	0.54	0.55
Slovenia	1.75	13.08	11.65	9.73	0.41	-0.23	2.00
Spain	6.59	17.71	21.75	21.46	0.85	0.27	1.79
Sweden	11.49	17.78	25.27	32.59	0.05	0.36	-0.57
Switzerland	19.11	29.16	24.10	30.58	-0.20	0.39	-1.20
United Kingdom	9.56	14.23	36.65	31.28	-0.07	-0.43	0.42
United States	9.19	13.50	27.23	31.68	0.30	0.53	-0.05
Average	10.92	17.09	24.27	27.53	0.21	0.33	0.00
Median	10.56	14.99	23.48	29.06	0.09	0.31	-0.03

All columns refer to model 5 of Table 4.

We construct immigrant shares and skill composition from OECD data.

See our Appendix for details.

4.3 Sensitivity Analysis

Above, we have presented aggregate outcomes for different groups of workers. In the following, we investigate the relative importance of the different channels and drivers that matter for the native welfare. Since our analytical framework features many different mechanisms, and we take a cross-country perspective, we adopt a parsimonious Monte Carlo type of analysis.

We first construct simulated data by drawing 10,000 times from a truncated normal distribution $\mathcal{N}(\mu_k, \sigma_k)$ where μ_k is the average of moment k ($k = 1, ..., 14$) across the 20 countries that we use for our analysis, and σ_k is the corresponding standard deviation.[29] Below we present results in

[29] We cut the distribution at two standard deviations away from the mean to avoid our procedure to create values that

which each artificial moment is drawn independently from a univariate normal distribution. In our Web Appendix we present equivalent results obtained from drawing from a multivariate normal distribution with 14 dimensions, which takes account of all of the information of the full variance-covariance matrix of our moments.[30]

After having created moments (wages, unemployment rates, GDP, government share etc.) for our 10,000 artificial economies, we proceed by calibrating our full model for each of these 10,000 economies to calibrate the parameters that match these moments. We then use the parameters that we have thereby calibrated to calculate welfare gains for native workers arising from increasing the share of foreign born in the labor force by one percentage point (equivalent to the incremental scenario we discussed above). Finally, we run a simple OLS regression (for all natives, and then separately by skill) where we have welfare gains for natives as a dependent variable.[31] In particular we run a semi-log 'moment regression':

$$\Delta \ln \mathcal{W}_{iN} = \sum_k \beta_k \ln X_{ik} + u_i \tag{16}$$

where $\Delta \ln \mathcal{W}_{iN}$ denotes the proportional welfare gain for natives in economy i, and X_{ik} is an $i \times k$ matrix of moments randomly generated as described above. These include immigrant shares, skill compositions, wage gaps, replacement rates and government share, GDP, skill premia, unemployment rates and capital shares. Finally, u_i is an error term that captures specification error.[32]

Table 8 presents our estimates for equation (16) above, using our i.i.d. drawn artificial economies.[33] For clarity of exposition, we show beta coefficients and t-statistics. Column 1 presents our estimates where the dependent variable is the welfare gain for all natives arising from increasing the share of immigrant in the population by one percentage point, in each of our 10,000 artificial economies. Columns 2 and 3 present equivalent estimates looking at the welfare gains of low skilled and high skilled natives respectively.

First, looking at the qualitative effects is instructive for our understanding of the various channels that are active in our model. Larger wage gaps between immigrant workers and native workers generate more powerful vacancy creation effects, and therefore are associated with larger gains for natives, ceteris paribus. The effects of unemployment rates are all significant: larger unemployment rates of immigrants have a negative marginal effect on gains from migration, unemployment rates of natives a positive one. The latter is driven by the fact that in economies where unemployment

are outside of the range that makes economic sense.

[30] Implications of the two different techniques are comparable.

[31] We actually run two types of regressions, one that uses artificial moments and regressors, explained below, and the other that uses parameters of our model that are generated from those moments through our calibration exercise, which we present in our Web Appendix for the interested reader.

[32] The theoretical model is highly non-linear; the investigation device (16), however, is approximately log-linear.

[33] In our Appendix, we also present results from a parameter regression with the same sample of artificial economies, together with both moment and parameter regressions of a sample where artificial countries are drawn from a *joint* normal distribution from moments of our data.

Table 8: Native Welfare Gains by Skill, Semi-log Moment Regression

Dependent variable: Welfare Gains of Natives from one 1% point increase in immigrant stock			
	(1)	(2)	(3)
	All	Low skilled	High skilled
Low Skilled Immigrant Wage Gap	0.062***	0.057***	0.062***
	[6.50]	[6.04]	[7.38]
High Skilled Immigrant Wage Gap	0.024**	0.019**	0.034***
	[2.52]	[2.03]	[3.98]
Unemployment Rate: Low Skilled Natives	0.166***	0.128***	0.227***
	[17.24]	[13.70]	[26.91]
Unemployment Rate: Low Skilled Immigrants	-0.100***	-0.067***	-0.172***
	[-10.41]	[-7.13]	[-20.34]
Unemployment Rate: High Skilled Natives	0.055***	0.039***	0.082***
	[5.74]	[4.21]	[9.70]
Unemployment Rate: High Skilled Immigrants	-0.030***	-0.027***	-0.027***
	[-3.14]	[-2.86]	[-3.17]
Share of immigrants	-0.108***	-0.089***	-0.139***
	[-11.30]	[-9.53]	[-16.44]
Share of Low Skilled among immigrants	-0.098***	-0.244***	0.362***
	[-10.24]	[-26.01]	[42.81]
Share of Low Skilled among natives	0.076***	0.161***	-0.186***
	[7.89]	[17.19]	[-21.94]
Replacement Rate	0.042***	0.028***	0.065***
	[4.34]	[3.04]	[7.72]
Government Expenditures	-0.034***	-0.030***	-0.026***
	[-3.56]	[-3.18]	[-3.10]
Per capita GDP	0.064***	0.062***	0.055***
	[6.68]	[6.59]	[6.48]
Native Skill Premium	0.001	-0.001	0.002
	[0.10]	[-0.08]	[0.21]
Capital Share	-0.007	-0.008	-0.009
	[-0.77]	[-0.82]	[-1.12]
Observations	10,000	10,000	10,000
R^2	0.082	0.126	0.288

All regressors are in natural logarithms.

Standardized beta coefficients; t statistics in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Artificial economies obtained with i.i.d. sampling.

rates of natives are high, the advantages coming from the 'greasing' of the labor market generated by migration are larger. The limiting case is instructive: if unemployment rates of natives tend to zero, the gains from migration that go through vacancy-creation effects tend to zero as well, and the benefits of immigrants could then come only from the factor complementarity effect or form the fiscal redistribution effect.

Next we look at the marginal effects of the size and composition of the immigrant stock. The negative effect of the share of immigrants suggests decreasing marginal returns to migration, driven by nonlinearities in our model. Looking now at skill compositions, a larger share of low skilled among immigrants has a small negative effect overall, which is the results of a large negative effect on low skill natives and a large positive effect on high skill natives (because of complementarity effects). Once again this suggests that low-skilled and high-skilled natives are likely to have different preferences over immigration policy.

Focusing on government policy, our regressions suggests a positive effect of the replacement rate (holding government expenditures constant, which implies a decrease in public good provision). Our interpretation of this comes from the fact that larger replacement rates are associated with less vacancy creation, ceteris paribus, which means that the positive effect on vacancy creation generated by immigrants is more important. On the other hand, larger government expenditures are associated with higher taxes on labor income (which tends to be smaller for immigrants), and because of redistribution effects this makes the effect of having a larger inflow of migrants smaller.

Finally, we include data moments concerning productivity. Ceteris paribus, a larger per capita GDP implies higher productivity, and this is associated with an increase of the gains from migration, holding all other covariates constant. The native skill premium (i.e. the difference between gross wages of high and low skilled natives) and the capital share are found to be unimportant. The fact that the capital share plays a very small role in this case is related to our assumption of perfect capital mobility and therefore exogenous return to capital income for natives, and to our assumption of zero capital taxation.

The regression estimates we discussed quantify the marginal importance of each of the moment for generating welfare gains for natives. In order to being able to group together the overall effect of several of our variables, we perform a very simple variance decomposition exercise. We set to one the share of the overall variance of the dependent variable that we explain with our generated moments (i.e. normalizing $R^2 = 1$), so that the shares we present below are shares of the part of welfare gains that are explained by our regressors. We show the contribution of a few of our covariates together, dividing them up by type. Results are presented on table 9 below.

Looking at all natives together (column 1) we notice that our model suggests that the single most important determinants of gains from migration are unemployment rates, explaining over half of the total explained variance in gains from migration. For low skilled and high skilled natives in isolation, on the other hand, the most important factors are population shares, with proportions

Table 9: Semi-log Moment Regression Variance Decomposition

	(1) All Natives	(2) Low skilled	(3) High skilled
Wage Gaps	4.83%	2.42%	1.63%
Unemployment Rates	52.46%	19.21%	31.39%
Migrant Share and Skill Composition	34.21%	74.28%	63.80%
Public Policy: Repl. Rates and Public Expenditures	3.38%	1.16%	1.85%
GDP, Skill Premia, Capital Share	5.21%	2.92%	1.32%

R^2 is set to one in each of the columns, so that rows add up to one.

Artificial economies obtained with i.i.d. sampling.

of explained variance over 60 percent. For all three groups, public policy plays a relevant but not overly important role, between 1.2 and 3.4 percent. Overall this suggests that labour market policies that favor employment may have the potential of affecting gains from migration more than policies aimed at modifying redistribution policies in response to migration.[34]

5 Conclusions

The impact of immigration on wages, employment and welfare of natives depends on the characteristics of immigrants and of natives and on their interaction. Crucially, it also depends on the institutions of the host country. Despite their presence in the public debate on migration, economic modeling of labor market effects often implicitly assume market clearing in the labor market, and assumes away a government in charge of public good provision and transfers to the unemployed. In this paper, we have proposed a model that attempts to address this issue.

We have proposed a standard search-and-matching model of the labor market, in which workers with different educational attainments are imperfect substitutes. Natives and migrants are perfect substitutes within their skill classes, but they differ with respect to the job break-up rates and outside options. As in Chassamboulli and Palivos (2014), firms cannot tell natives and migrants apart ex ante. However, firms know the composition of the labor market which matters for the expected profitability of filled jobs. Immigration may decrease or increase the expected job rent, and may discourage or encourage job creation.

This mechanism allows us to address two important stylized facts in the data: within their skill classes, immigrants face higher idiosyncratic risks of job loss and are paid lower wages than natives. Moreover, our model provides us with sufficient flexibility to match the existing cross-country heterogeneity with regard to these facts. We are also able to capture the observed cross-country differences with respect to labor market institutions and the role of the government.

[34] We present and discuss results of our regressions based on drawing our artificial economies from a joint normal distribution in our Web Appendix.

Our model combines the classical complementarity-based view on the welfare effects of immigration, with search frictions and wage bargaining on the labor market. Moreover, as stressed in the public finance literature, migration may induce fiscal redistribution that can hurt natives who typically hold better paying jobs and are less likely to be unemployed. Indeed, time and again, surveys show that unemployment and fiscal transfers are the most important determinants of overall attitudes towards migration by natives (Boeri, 2010).[35] Since attitudes are likely to shape migration policies at least to some extent, it is important for researchers to address the issues that seem to be most important in the public's perception within a rich general equilibrium model.

After presenting a set of crucial stylized facts for 20 OECD countries, we calibrate our model for each of these countries and investigate the gains from migration in terms of native welfare. We find that natives in 19 out of 20 countries are better off with the observed migration stocks than in a hypothetical situation of autarkic labor markets. Moreover, in contrast to a purely complementarity-based view, in our setup there is the possibility that all workers benefit from immigration. In fact, this is the case in a majority of countries. Also contrary to conventional wisdom, under the assumption of our model, countries with more rigid labor markets and with larger government shares that have benefited the most from migration. This is due to the fact that, on net, immigration turns out to grease the wheels of the labor market, and this effect is particularly pronounced where labor market frictions are strongest. Countries, in which immigration has little effect on the skill composition, where unemployment is relatively low but redistribution is important, face relatively low gains from immigration. Finally, our analysis suggests that native welfare is hump-shaped in the level of immigration.

With an objective to provide a cross-country perspective, our framework is admittedly stylized. It would be worthwhile to estimate a richer structural model of friction-ridden labor markets with detailed wage data from a single country, and to simulate counterfactual scenarios. Similarly, our model ignores intertemporal considerations, which are nonetheless important: migrants become more similar to natives over time, and one important channel of fiscal redistribution runs through the pension system. To capture these aspects, one would require an overlapping generations framework. We view our paper as a first step towards developing a flexible quantitative model that integrates opposing forces and that allows for a proper welfare analysis. More analysis is clearly welcome.

[35] In contrast, the same data from the European Social Survey indicate that the wage effects of immigration are relatively unimportant, despite their prominent role in the economic literature.

Appendix

A Analytics of Simplified Models

A.1 Remark 1

Before we can discuss this specific result, we need to derive a few equations, which are simplifications of the model we presented above. Assuming that separation rates are the same for immigrants and natives, the ratio of native and immigrants among employed and unemployed is the same as their ratio in the labor force: immigrants and natives have the same chance of getting matched with a firm (because of ex ante non-identifiability) and have the same of transitioning from employment to unemployment (because they have the same split rates). Hence ϕ_i, introduced in equation 6 is equal to $Q_{iI}/(Q_{iI}+Q_{iN})$ in this case, i.e. the share of immigrants in the labor force. Moreover the ratio Y_H/Y_L that determines the marginal productivity of each type of workers can be written as:

$$\frac{Y_H}{Y_L} = \frac{m(\theta_H)\left[s_L + m(\theta_L)\right]}{m(\theta_L)\left[s_H + m(\theta_H)\right]} * \frac{Q_{HN}+Q_{HI}}{Q_{LN}+Q_{LI}} \tag{17}$$

Also in equilibrium the vacancy/employment ratio is $s_i/q(\theta_i)$.

Substituting 17 into 32 and 4, we can write the two equilibrium conditions that determine the equilibrium market tightness θ_H and θ_L explicitly.

$$p_L = xA\left[x + (1-x)\left(\Lambda(\theta_H,\theta_L)\Omega\right)^{\rho}\right]^{\frac{1-\rho}{\rho}} = \frac{b_L - \phi_L h_{LI}}{1-t} + c_L \frac{(r+s_L)\left(1-t\left(1-\beta\right)\right) + \beta\xi\theta_L^{1-\varepsilon}}{\xi\theta_L^{-\varepsilon}\left(1-\beta\right)\left(1-t\right)} = p_L^{BE} \tag{18}$$

$$\begin{aligned} p_H &= (1-x)\,A\left[x\left(\Lambda(\theta_H,\theta_L)\Omega\right)^{-\rho} + (1-x)\right]^{\frac{1-\rho}{\rho}} \\ &= \frac{b_H - \phi_H h_{HI}}{1-t} + c_H \frac{(r+s_H)\left(1-t\left(1-\beta\right)\right) + \beta\xi\theta_H^{1-\varepsilon}}{\xi\theta_H^{-\varepsilon}\left(1-\beta\right)\left(1-t\right)} = p_H^{BE} \end{aligned} \tag{19}$$

where the term

$$\Lambda(\theta_H,\theta_L) = \frac{\xi\theta_H^{1-\varepsilon}\left[s_L + \xi\theta_L^{1-\varepsilon}\right]}{\xi\theta_L^{1-\varepsilon}\left[s_H + \xi\theta_H^{1-\varepsilon}\right]}$$

depends positively on the tightness of market H and negatively on the tightness of market L. The term $\Omega = \frac{Q_{HN}+Q_{HI}}{Q_{LN}+Q_{LI}}$ is the supply of highly educated relatively to less educated. This term may also be affected by immigration if the relative composition of more and less educated among immigrants is different than among natives.

(i) A balanced inflow of immigrants (one that does not affect skill composition in the labor force) always increases the market tightness of both markets, decrease unemployment rates, and increases wages of each group of natives. The reason is that with a larger share of immigrants the expected value of a vacancy is higher for the firm (ϕ_L and ϕ_H are larger), hence they create more of them and they can afford to pay higher average wages paid to natives. If the flow is balanced, on the other hand there is no effect through $\Lambda(\theta_H, \theta_L)$ and the relative marginal productivity do not change

Corollary: the same result is obtained if H and L are perfect substitutes.

When the inflow of immigrants is balanced (an inflow of a set of immigrants where the ratio to low to high skilled is the same as in the original native population) is not going to affect Ω and since immigrants of each type are as productive as natives, there is also no effect through $\Lambda(\theta_H, \theta_L)$.

Therefore, the left hand side of equation (18) remains the same (I first look at the effects in the low skilled market, then I will look at high skilled). The right hand side of the same equation will need to adjust to the increase in ϕ_L (and equivalently for ϕ_H). Since this change has no first order impact on the left-hand side of equation (18) we can write the partial derivative of θ_L with respect to ϕ_L for the right-hand side of equation (18)

$$\frac{\partial \theta_L}{\partial \phi_L} = -\frac{d/d\phi_L}{d/d\theta_L} = \frac{\frac{h_{LI}}{1-t}}{c_L \frac{(1-\epsilon)\beta\xi\theta_L^{-\epsilon}(\xi\theta_L^{-\epsilon}(1-\beta)(1-t))-[(r+s_L)(1-t(1-\beta))+\beta\xi\theta_L^{1-\epsilon}][(1-\beta)(1-t)\xi(-\epsilon)\theta_L^{-\epsilon-1}]}{[\xi\theta_L^{-\epsilon}(1-\beta)(1-t)]^2}} \tag{20}$$

The sign of this derivative will be driven by the sign of the term

$$(1-\epsilon)\beta\xi\theta_L^{-\epsilon}(\xi\theta_L^{-\epsilon}(1-\beta)(1-t))-[(r+s_L)(1-t(1-\beta))+\beta\xi\theta_L^{1-\epsilon}][(1-\beta)(1-t)\xi(-\epsilon)\theta_L^{-\epsilon-1}] \tag{21}$$

which simplifies to

$$[\beta(1-\beta)(1-\epsilon)\xi^2+\beta\xi\epsilon(1-\beta)(1-t)]\theta_L^{-2\epsilon}+\xi\epsilon(r+s_L)(1-t(1-\beta))(1-\beta)(1-t)\theta_L^{-\epsilon-1} > 0 \tag{22}$$

Equivalently, using equation (19) we find

$$\frac{\partial \theta_H}{\partial \phi_H} = -\frac{d/d\phi_H}{d/d\theta_H} > 0 \tag{23}$$

This confirms the intuition that as the number of immigrants increases without changing the ratio between high skilled and low skilled workers, the value of a vacancy goes up, due to the fact that immigrants leave a higher surplus to the firm. Since we have a free entry condition that ensures that the equilibrium value of a vacancy is zero, more vacancies will be created compared to the total number of workers, thereby increasing market tightness in both

markets.

Now it is straightforward to see that as market tightness decreases in both markets, unemployment rates for natives will also decrease, since

$$U_{iN} = \frac{s_i}{s_i + m(\theta_i)} Q_{iN} \quad \text{for } i = H, L \tag{24}$$

In this equation, the arrival of new immigrants will only affect the unemployment rate through θ_i. As θ_i increases, $m(\theta_i)$ also increases (the probability to find a job is higher the higher market tightness is), which negatively affects the unemployment rate of natives. Evaluating the effects on equilibrium wages is only slightly more complicated. We use our wage bargaining equation, observing that the match surplus will be a positive function of market tightness, i.e. $\frac{\partial p_i}{\partial \theta_i} > 0$.

What we are interested in is the effect of a change in market tightness on wages of natives.

$$\begin{aligned} \frac{\partial w_{iN}}{\partial \theta_i} =& \beta p_i \frac{m'(\theta_i)[)r + s_i)(1 - t(1-\beta)) + \beta m(\theta_i)] - [r + s_i + m(\theta_i)\beta m'(\theta_i)]}{[(r+s_i)(1 - t(1-\beta)) + \beta m(\theta_i)]^2} \\ &+ b(1-\beta) \frac{-(r+s_i)\beta m'(\theta_i)}{[(r+s_i)(1-t(1-\beta)) + \beta m(\theta_i)]^2} \end{aligned} \tag{25}$$

After a few simple steps, this simplifies to

$$\frac{\partial w_{iN}}{\partial \theta_i} = \beta m'(\theta_i)[(1-\beta)(r+s_i)(p_i(1-t) - b)] \tag{26}$$

Therefore

$$\frac{\partial w_{iN}}{\partial \theta_i} > 0 \text{ if and only if } p_i(1-t) - b > 0 \tag{27}$$

which is not an additional condition since we needed to assume this from the start to avoid corner solutions in which all workers are unemployed.

(ii) A change in the outside option for immigrants, which may be the result of policy changes affecting immigrants in the receiving countries or changes in the pool of immigrants affects labor market tightness through the same channel discussed above, namely vacancy creation effects that affect natives because of ex ante anonymity. If the value outside option for immigrants decreases, unemployment of natives falls and wages of natives increase.

In particular, consider a decrease in h_{iI} (i.e. an increase in its absolute value). Note that h_{iI} only enters equations (18) and (19) when it is multiplied by ϕ_i. Therefore the effect of a change in h_{iI} is analytically equivalent to a change in ϕ_i. This is intuitive given that, due to the assumption that employers cannot identify immigrants beforehand and due to the fact

that firms are risk neutral, having more immigrants or changing the outside option of current immigrant has the same qualitative effects. Therefore, the effects of labor market tightness in both markets, on unemployment rates and wages of natives are equivalent to the analysis above.

(iii) Just for clarity in the exposition, let us consider an inflow less skilled immigrants, which will of course increases the share of less educated in the economy. Here we focus on the effects on high skilled natives (the effects on low skilled are less straightforward since more immigrants will affect market tightness on the one hand by increasing the expected surplus per worker, on the other hand increasing competition for jobs).

Looking at equation (19) we can see that an increase in Q_{LI} will affect Ω. By reducing the relative size of the high skilled population, it will increase market tightness in the high skilled market. From equation (19) we can then look at the effect of an increase in θ_H on p_H:

$$\frac{\partial p_H}{\partial \theta_H} = c_H \frac{(1-\epsilon)\beta\xi^2\theta_H^{-2\epsilon}(1-\beta)(1-t) + \epsilon[(r+s_H)(1-t(1-\beta)) + \beta\xi\theta_H^{1-\epsilon}][(1-\beta)(1-t)\xi\theta_H^{-\epsilon-1}]}{[\xi\theta_H^{-\epsilon}(1-\beta)(1-t)]^2} \geq 0 \tag{28}$$

so that higher labor market tightness is associated with a larger surplus from the match, lower unemployment rates and higher wages for high-skilled natives, thought effects that have been already extensively studies for simpler but equivalent search models.

A.2 Remark 2

Results (i) and (ii) operate through identical mechanisms as in the case of remark 1, with the fundamental difference that the effect of larger migration stocks is now negative, rather then positive, for the expected surplus from a match. Given this equivalence, we focus here on (iii).

For simplicity, consider a situation where immigrants and natives have identical separation rates. We then increase split rates of immigrants of one type and look at the effects for natives (of either type). Naturally, the direct stronger effects will be on the immigrant themselves. However, our focus here is primarily on natives, which means that we are focusing on the indirect effect of separation rates, which operates through the job creation margin, activated through market tightness.

In this paragraph we discuss effects on natives of the same skill level, while on the next paragraph we discuss effects on natives of a different skill level. If immigrants have higher separation rates than natives, this means that the surplus from being matched with an immigrant is lower, because the match lasts shorter on average. Therefore, from the free entry condition

$$rJ_i^V = -c_i + q(\theta_i)\left[(1-\phi_i)J_{iN}^F + \phi_i J_{iI}^F - J_i^V\right] = 0 \tag{29}$$

bearing in mind that we are ruling out that the firm can target natives or immigrants when it created a vacancy, we see that as the value of a filled vacancy falls (which will be the case if separation rates are larger), equilibrium market tightness will have to fall in order for the equality to hold. Intuitively, in order for firms to break even in an environment where they get a lower surplus from the match, the market will have to adjust so that the probability of filling a vacancy will be larger for firms. In other words, at higher levels of separation rates for immigrants, less vacancies get created (both for natives and immigrants) so that equilibrium market tightness is lower.

The rest of the discussion in this paragraph follows from the results on labor market tightness, which is the channel through which separation rates of immigrants affect labour markets of natives.[36] Below, we discuss the effects on wages and unemployment rates. These are generated by difference in separation rates, but since they operate though labor market tightness, they have been previously looked at in the context of search models. Higher separation rates for immigrants, which bring about lower equilibrium labor market tightness, generate larger unemployment rates for natives. Unemployment rates for natives of skill i are

$$u_{iN} = \frac{s_{iN}}{s_{iN} + m(\theta_i)} \tag{30}$$

since $m(\theta_i)$ is increasing in θ_i (in our model we use the functional form $m(\theta_i) = \xi\theta^{1-\varepsilon}$), the unemployment rate of natives will be higher the lower is equilibrium market tightness, even though separation rates of natives are unchanged.

We next discuss the effect of separation rates of immigrants on wages of natives, operating once again through market tightness. Let us write gross wages of natives as a function only of market tightness and exogenous parameters again:

$$w_{iN} = \beta \frac{r + s_{iN} + \xi\theta^{1-\varepsilon}}{(r + s_{iN})(1 - t(1-\beta)) + \beta\xi\theta^{1-\varepsilon}} p_i + (1-\beta) \frac{r + s_{iN}}{(r + s_{iN})(1 - t(1-\beta)) + \beta\xi\theta^{1-\varepsilon}} b_{iN} \tag{31}$$

We want to investigate the sign of $\frac{\partial w_{iN}}{\partial \theta_i}$. it is straightforward to see that the second term, i.e. the term referring to the outside option (the second term of equation 31) is now larger. The price $p_i = p_i(\theta_i)$ is a positive function of labor market tightness, and it is easy to show that the expression $\beta \frac{r+s_{iN}+\xi\theta^{1-\varepsilon}}{(r+s_{iN})(1-t(1-\beta))+\beta\xi\theta^{1-\varepsilon}}$ is also a positive function of θ_i. Therefore, an increase in the separation rates of immigrants, reducing labor market tightness, also lowers wages for natives.

Within a wage bargaining framework, wages are a convex combination of the surplus from the match and the outside option of the worker. So all channels work in the same direction. Lower labor market tightness lowers also the value of the outside option to the worker (because it is harder

[36] We are abstracting from the fiscal channel here, which adds a further mechanism: if immigrants have larger separation rates, they will have larger equilibrium unemployment rates, which imply larger transfers from natives even in the absence of wage gaps.

to find a job when unemployed), the price of the intermediate good is lower, and its weight is also lower (because the expected value of a match following the current match is lower). So there are several channels all operating in the same direction.

Summarizing, through its negative effects on labor market tightness, higher separation rates for immigrants result in higher unemployment rates and lower wages, for immigrants but also for natives of the same skill class).

These dynamics will also have second-order spillover effects of the same sign on native workers of a different skill class. This effect operates through the equations governing prices of the intermediate goods:

$$p_L = AK^{\alpha}(1-\alpha)xY_L^{\rho-1}\left[xY_L^{\rho}+(1-x)Y_H^{\rho}\right]^{\frac{1-\alpha-\rho}{\rho}} \tag{32}$$

$$p_H = AK^{\alpha}(1-\alpha)(1-x)Y_H^{\rho-1}\left[xY_L^{\rho}+(1-x)Y_H^{\rho}\right]^{\frac{1-\alpha-\rho}{\rho}} \tag{33}$$

At lower employment level in one sector (skill level) corresponds lower price in the other sector. The mechanism feeds on itself and moves the system along a saddle path to a new steady state. Therefore, our model predicts that larger separation rates for immigrants in one sector will lower wages and increase unemployment of natives of the same skill level and also of natives of a different skill level (although this indirect effect is likely to be small).

B Data Sources

The calibration of our model requires us to have information from of different types, in particular concerning population shares (skill shares of the labor force in each country, percentage of foreign-born individuals in each country, skill shared among immigrants), wages (skill premia and immigrant wage gaps by skill level), unemployment rates for each skill, generosity of the unemployment insurance scheme, GDP per capita and size of the public sector. For each of these, we list our data sources below. Following Chassamboulli and Palivos (2014) and Krusell, Ohanian, Rios-Rull, and Violante (2000), we define skilled workers as those workers that hold a Bachelor degree (or equivalent) or above.

B.1 Population shares

For all of the EU countries in our analysis, we have used information on population shares from the 2012 Eurostat Yearbook (data for 2011). [37], restricting our sample to individuals between 15 and 64 years of age with skill information derived from the ISCED education classification system. From the Eurostat Yearbook we use data on the share of low skilled among natives, the share of low skilled among immigrants and the share of foreign born in the population.

[37] Data are freely available from http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

For the US, equivalent population shares are constructed using the Public Use Micro File dataset from the 2005 US Census.[38] Similarly, for Canada we construct population shares using the Micro File version of the 2006 Canadian Census.[39] For Australia, we use the 2009 wave of the panel dataset Household, Income and labor Dynamics in Australia (HILDA) representative survey.[40] For the US, Canada and Australia we do the equivalent sample restrictions that we described above for EU countries.

B.2 Capital Shares

We calculate capital shares using labor share data from the OECD.[41] We average labor income shares for the period 2005-2012 and calculate the capital share α as the complement to one of the labor share.

B.3 Wages

For EU countries, we constructed measure of the wage gap between low skilled and high skilled native workers (i.e. the skill premium), and of the gaps between immigrants and natives workers (for low skilled and high skilled workers) using the European Union Statistics on Income and Living Conditions (EU-SILC) for year 2011 (2010 for Ireland).[42]

For the US, Canada and Australia we construct wage gaps based on the datasets we described above: 2005 PUMF US Census, 2006 Canadian Population Census, 2009 HILDA Panel dataset.

B.4 Unemployment Rates - By skill and migration status

In the descriptive section of our paper we present figures for unemployment rates by skill class and by immigration status. Although this is a basic statistics we were not able to find this summary information for a large number of countries and using high-quality data, so we had to use a few data sources to generate these statistics. For all EU countries and Switzerland (but not Germany) we have used descriptive data from the EU labor Force Survey. We thank Eurostat for sharing these statistics up to 2012. For Germany, there no information on country of birth on the European labor Force Survey so we used the micro data of the EU labor force survey ourselves and used nationality information instead, for years 2005-2011. For the United States, we used the Current Population Survey for years 2005-2012. For Canada, since the labor Force Survey (LFS) does not

[38] Data available from https://international.ipums.org/international/.

[39] It is possible for Canadian researchers to access the micro data of the 2006 Canadian Census through CHASS of the University of Toronto http://www.chass.utoronto.ca/.

[40] We thank Robert Breunig for providing us with the statistics we needed from the HILDA survey. More information on the survey is available in Wooden and Watson (2007) and Salehin and Breunig (2012).

[41] The data is freely available from the OECD website.

[42] We thank Eurostat for providing us with summary statistics based on the EU-SILC dataset. More information on the EU-SILC dataset is available from http://epp.eurostat.ec.europa.eu/portal/page/portal/microdata/eu_silc.

include migration information, we constructed unemployment rates by skill level for 2005-2012, and then used the 2006 Census Microfiles to construct unemployment rates for immigrants and natives. We then construct trends using the census data and the LFS data together. For Australia, we use data from the Household, Income and labor Dynamics in Australia (HILDA) Survey from 2005 to 2011 (Waves 5-11). For wage gaps and unemployment rates, we average data over this period to maximize comparability across countries and minimize the role of business cycle and short term fluctuations, given that the focus of our study is on steady state comparisons. We thank Robert Breunig and Syed Hasan for providing us with the necessary descriptive statistics. Although the level of comparability in high, as it often the case with studies involving many countries readers should be aware that comparisons are not exact.

B.5 Replacement Rates

In order to parameterise the level of unemployment benefits differently for each country we utilise data on the average net replacement rates, i.e. the ratio between unemployment benefits and average net wages. We use data from the OECD Wages and Statistics Dataset, averaging net replacement rates for the period 2005-2011 to smooth out business cycle fluctuations. Replacement rates are constructed for the average worker across the same sectors in all countries, to maximize comparability.

B.6 Gross Domestic Product

We use data on 2011 Gross Domestic Product (PPP) in international dollars from from the World Bank World Development Indicators.[43]

B.7 Government Expenditures

Our data source for government expenditures is the variable "General government total expenditure" as percentage of GDP from the World Economic Outlook Database, April 2013 of the International Monetary Fund. For each country, we take an average for 2005-2012 to make sure that heterogeneity across countries are not driven by asymmetries in the respective business cycles.

B.8 Stocks and skill compositions, 2000-2011

In section 4.2.3 we analyze the welfare effect for natives of the actual 2000-2011 migration flows across countries. Unfortunately, we are aware of no perfect data for this exercise. This is due to the fact that simply using stock data is very much undesirable, because differences in stocks are driven by population dynamics unrelated to migration. Therefore, one would want to use data on net flows in this period. Regrettably, we are aware of no skill-specific flow data for these countries.

[43] The data are freely available from http://databank.worldbank.org/.

Therefore, we use OECD data on inflows and outflows to construct net flows in the period 2000-2011, which we use to construct the size of the treatment. Since we are unable to have information of the skill composition of that specific flow, we will use stock data for 2000 from the dataset constructed by Frédéric Docquier, Çaglar Özden, Christopher Parsons and Ehran Artuc, aggregated at the level of the destination country. Although this procedure is imperfect because it uses stock data to infer the skill composition of a flow, it seems to be better than using stock data for the size of the immigrant inflow as well, ans as far as we are concerned it is one can do given data limitations.

Table B.1: Native Welfare Gains from Incremental Migration

Countries	Model 1			Model 2			Model 3			Model 4			Model 5		
	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$	$\mathcal{W}_N$	$\mathcal{W}_{LN}$	$\mathcal{W}_{HN}$
Australia	0.01%	0.08%	-0.13%	0.01%	0.09%	-0.12%	0.00%	0.08%	-0.13%	0.00%	0.08%	-0.13%	0.01%	0.06%	-0.08%
Austria	0.00%	0.00%	0.01%	0.08%	0.09%	0.07%	0.05%	0.05%	0.04%	0.04%	0.04%	0.04%	-0.03%	-0.03%	-0.03%
Belgium	0.00%	-0.04%	0.06%	0.09%	0.07%	0.12%	0.03%	0.01%	0.06%	0.03%	0.01%	0.07%	-0.02%	-0.03%	-0.01%
Canada	0.01%	0.09%	-0.20%	0.04%	0.11%	-0.13%	0.03%	0.10%	-0.14%	0.03%	0.10%	-0.14%	0.04%	0.08%	-0.08%
Denmark	0.01%	0.14%	-0.22%	0.09%	0.21%	-0.13%	0.05%	0.17%	-0.17%	0.07%	0.19%	-0.16%	0.06%	0.11%	-0.05%
Estonia	0.00%	0.04%	-0.06%	0.09%	0.12%	0.05%	0.07%	0.10%	0.03%	0.08%	0.11%	0.03%	0.05%	0.07%	0.02%
France	0.00%	-0.05%	0.09%	0.07%	0.04%	0.12%	0.03%	-0.01%	0.08%	0.04%	0.00%	0.10%	0.02%	0.00%	0.05%
Germany	0.00%	-0.05%	0.11%	0.07%	0.03%	0.17%	0.02%	-0.03%	0.12%	0.02%	-0.02%	0.12%	-0.01%	-0.03%	0.04%
Greece	0.01%	-0.09%	0.19%	0.15%	0.07%	0.31%	0.13%	0.05%	0.29%	0.15%	0.06%	0.31%	0.07%	0.02%	0.18%
Ireland	0.01%	0.11%	-0.13%	0.07%	0.15%	-0.04%	0.04%	0.13%	-0.07%	0.05%	0.15%	-0.08%	0.05%	0.10%	-0.03%
Italy	0.00%	-0.02%	0.10%	0.14%	0.12%	0.25%	0.13%	0.10%	0.23%	0.13%	0.11%	0.24%	0.07%	0.05%	0.14%
Luxembourg	0.00%	-0.02%	0.04%	0.03%	0.02%	0.06%	0.02%	0.00%	0.05%	0.02%	0.00%	0.05%	-0.02%	-0.03%	-0.01%
Netherlands	0.00%	-0.04%	0.06%	0.06%	0.03%	0.12%	0.03%	0.00%	0.09%	0.03%	0.00%	0.09%	-0.01%	-0.03%	0.02%
Portugal	0.00%	0.02%	-0.06%	0.08%	0.08%	0.06%	0.05%	0.06%	0.04%	0.08%	0.09%	0.04%	0.08%	0.09%	0.07%
Slovenia	0.01%	-0.11%	0.27%	0.07%	-0.04%	0.30%	0.06%	-0.05%	0.29%	0.06%	-0.05%	0.30%	0.02%	-0.04%	0.17%
Spain	0.01%	-0.09%	0.13%	0.13%	0.04%	0.25%	0.08%	-0.01%	0.19%	0.09%	0.01%	0.21%	0.04%	-0.01%	0.12%
Sweden	0.00%	0.01%	-0.02%	0.08%	0.10%	0.04%	0.02%	0.04%	-0.01%	0.02%	0.04%	-0.01%	-0.02%	-0.01%	-0.04%
Switzerland	0.00%	-0.01%	0.02%	0.02%	0.03%	0.02%	0.00%	0.01%	0.00%	-0.01%	-0.01%	-0.01%	-0.04%	-0.03%	-0.04%
United Kingdom	0.00%	-0.06%	0.07%	0.05%	-0.02%	0.12%	0.03%	-0.04%	0.11%	0.03%	-0.03%	0.11%	0.00%	-0.03%	0.05%
United States	0.00%	0.01%	-0.02%	0.04%	0.08%	0.00%	0.04%	0.08%	0.00%	0.05%	0.08%	0.01%	0.05%	0.06%	0.03%
Average	0.00%	0.00%	0.01%	0.07%	0.07%	0.08%	0.05%	0.04%	0.05%	0.05%	0.05%	0.06%	0.02%	0.02%	0.03%
Median	0.00%	-0.02%	0.03%	0.07%	0.08%	0.06%	0.04%	0.05%	0.04%	0.04%	0.04%	0.04%	0.02%	0.00%	0.02%

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Web Appendix

A Detailed Derivations of Simpler Model

Subtracting the asset equation governing the value of unemployment (8) from that of employment, (9) and, we obtain

$$\begin{aligned} r\left[J_{ij}^{E}-J_{ij}^{U}\right] &= w_{ij}\left(1-t\right)-s_{i}\left[J_{ij}^{E}-J_{ij}^{U}\right]-b_{i}+h_{ij}-m(\theta_{i})\left[J_{ij}^{E}-J_{ij}^{U}\right], \\ J_{ij}^{E}-J_{ij}^{U} &= \frac{w_{ij}\left(1-t\right)-b_{i}+h_{ij}}{r+s_{i}+m\left(\theta_{i}\right)}. \end{aligned}$$

Substituting the free entry condition $J_{i}^{V}=0$ into (10), one can rewrite the Nash bargaining condition as

$$\begin{aligned} \left(J_{ij}^{E}-J_{ij}^{U}\right) &= \beta(J_{ij}^{E}-J_{ij}^{U})+\beta J_{ij}^{F} \\ \left(1-\beta\right)\left(J_{ij}^{E}-J_{ij}^{U}\right) &= \beta J_{ij}^{F} \end{aligned}$$

The value for a filled job can be rearranged to yield

$$J_{ij}^{F}=\frac{p_{i}-w_{ij}}{r+s_{i}}.$$

So, we obtain the following wage equation:

$$\left(1-\beta\right)\frac{w_{ij}\left(1-t\right)-b_{i}+h_{ij}}{r+s_{i}+m\left(\theta_{i}\right)}=\beta\frac{p_{i}-w_{ij}}{r+s_{i}}$$

$$\left(1-\beta\right)\frac{w_{ij}\left(1-t\right)}{r+s_{i}+m\left(\theta_{i}\right)}-\left(1-\beta\right)\frac{b_{i}-h_{ij}}{r+s_{i}+m\left(\theta_{i}\right)}=\beta\frac{p_{i}}{r+s_{i}}-\beta\frac{w_{ij}}{r+s_{i}}$$

$$\left[\frac{\left(1-\beta\right)\left(1-t\right)\left(r+s_{i}\right)+\beta\left(r+s_{i}+m\left(\theta_{i}\right)\right)}{r+s_{i}+m\left(\theta_{i}\right)}\right]w_{ij}=\beta p_{i}+\left(1-\beta\right)\frac{\left(r+s_{i}\right)\left(b_{i}-h_{ij}\right)}{r+s_{i}+m\left(\theta_{i}\right)}$$

$$\left[\frac{\left(1-\beta\right)\left(r+s_{i}\right)-t\left(1-\beta\right)\left(r+s_{i}\right)+\beta\left(r+s_{i}\right)+\beta m\left(\theta_{i}\right)}{r+s_{i}+m\left(\theta_{i}\right)}\right]w_{ij}=\beta p_{i}+\left(1-\beta\right)\frac{\left(r+s_{i}\right)\left(b_{i}-h_{ij}\right)}{r+s_{i}+m\left(\theta_{i}\right)}$$

$$w_{ij}=\beta\frac{r+s_{i}+m\left(\theta_{i}\right)}{r+s_{i}+\beta m\left(\theta_{i}\right)-t\left(1-\beta\right)\left(r+s_{i}\right)}p_{i}+\left(1-\beta\right)\frac{\left(r+s_{i}\right)\left(b_{i}-h_{ij}\right)}{r+s_{i}+\beta m\left(\theta_{i}\right)-t\left(1-\beta\right)\left(r+s_{i}\right)}$$

$$w_{ij}=\beta\frac{r+s_{i}+m\left(\theta_{i}\right)}{\left(r+s_{i}\right)\left(1-t\left(1-\beta\right)\right)+\beta m\left(\theta_{i}\right)}p_{i}+\left(1-\beta\right)\frac{\left(r+s_{i}\right)}{\left(r+s_{i}\right)\left(1-t\left(1-\beta\right)\right)+\beta m\left(\theta_{i}\right)}\left(b_{i}-h_{ij}\right)$$

Now, if $\beta=0$

$$w_{ij}=\frac{b_{i}-h_{ij}}{1-t}$$

From the free entry condition

$$\begin{aligned}
\frac{c_i}{q(\theta_i)} &= (1-\phi_i)\frac{p_i^{BE}-w_{iN}}{r+s_i}+\phi_i\frac{p_i^{BE}-w_{iI}}{r+s_i} \\
p_i^{BE} &= \frac{c_i(r+s_i)}{q(\theta_i)}+(1-\phi_i)w_{iN}+\phi_i w_{iI} \\
p_i^{BE} &= \frac{b_i-\phi_i h_{iI}}{1-t}+c_i\frac{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}{q(\theta_i)(1-\beta)(1-t)}
\end{aligned}$$

so that, with $t=0$, we have $p_i^{BE}=b_i-\phi_i h_{iI}+c_i\frac{r+s_i+\beta m(\theta_i)}{q(\theta_i)(1-\beta)}$.

Inserting p_i^{BE} into the wage equation, the wage of natives is

$$\begin{aligned}
w_{iN} &= \beta\frac{r+s_i+m(\theta_i)}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}p_i+(1-\beta)\frac{r+s_i}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}b_i \\
&= \beta\frac{r+s_i+m(\theta_i)}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}\left(\frac{b_i}{1-t}-\frac{\phi_i h_{iI}}{1-t}+c_i\frac{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}{q(\theta_i)(1-\beta)(1-t)}\right) \\
&\quad+(1-\beta)\frac{r+s_i}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}b_i \\
&= \beta\frac{r+s_i+m(\theta_i)}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}\frac{b_i}{1-t}+(1-\beta)\frac{r+s_i}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}b_i \\
&\quad-\beta\frac{r+s_i+m(\theta_i)}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}\frac{\phi_i h_{iI}}{1-t}+c_i\beta\frac{r+s_i+m(\theta_i)}{q(\theta_i)(1-\beta)(1-t)} \\
&= \left[\frac{\beta[r+s_i+m(\theta_i)]/(1-t)+(1-\beta)(r+s_i)}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}\right]b_i-\beta\frac{r+s_i+m(\theta_i)}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}\frac{\phi_i h_{iI}}{1-t} \\
&\quad+c_i\beta\frac{r+s_i+m(\theta_i)}{q(\theta_i)(1-\beta)(1-t)} \\
&= \frac{b_i}{1-t}-\beta\frac{r+s_i+m(\theta_i)}{(r+s_i)(1-t(1-\beta))+\beta m(\theta_i)}\frac{\phi_i h_{iI}}{1-t}+c_i\beta\frac{r+s_i+m(\theta_i)}{q(\theta_i)(1-\beta)(1-t)}
\end{aligned}$$

B Origin countries

For each of our 20 destination countries we identified the top five origin countries of origin by skill. We identify these stocks using a unique dataset constructed by Frédéric Docquier, Çaglar Özden, Christopher Parsons and Ehran Artuc.[44]

From their dataset we isolate, for each destination country, the top five countries of origin for low skilled and high skilled separately. We then merge in GDP data in order to get a measure of average wages in the origin countries. In particular, we use GDP per capita PPP for the year 2011. For four countries of origin (Cuba, Iran, Jamaica and Suriname) the World Development Indicators dataset of the World Bank does not report information for 2011. For those countries we use the equivalent metric taken from the CIA World Factbook, for the year 2011.

[44] For more information on the dataset please see (Docquier, Ozden, Parsons, and Artuc, 2012). We thanks Christopher Parsons for making the dataset available to us.

Below, table B.1 below shows the list of the top 5 origin countries of low skilled and high skilled countries for our 20 OECD countries, as well as GDP per capita (PPP) of each of these origin countries.

Table B.1: Top five origin countries by skill of immigrants

	Low skilled immigrants		**High skilled immigrants**	
Destination	**Origin**	**GDP**	**Origin**	**GDP**
Australia	United Kingdom	35.66	United Kingdom	35.66
Australia	Italy	32.65	New Zealand	30.06
Australia	New Zealand	30.06	China	8.40
Australia	Greece	25.85	Vietnam	3.41
Australia	Vietnam	3.41	India	3.63
Austria	Serbia and Montenegro	11.88	Germany	39.49
Austria	Bosnia and Herzegovina	9.08	Czech Republic	26.21
Austria	Germany	39.49	Poland	21.26
Austria	Turkey	17.11	Hungary	21.66
Austria	Czech Republic	26.21	Romania	15.14
Belgium	Italy	32.65	France	35.25
Belgium	France	35.25	Netherlands	42.77
Belgium	Morocco	4.95	Congo, Dem. Rep. of the	0.37
Belgium	Netherlands	42.77	Germany	39.49
Belgium	Turkey	17.11	Morocco	4.95
Canada	Italy	32.65	United Kingdom	35.66
Canada	United Kingdom	35.66	Philippines	4.12
Canada	China	8.40	India	3.63
Canada	India	3.63	United States	48.11
Canada	Portugal	25.37	China	8.40
Denmark	Turkey	17.11	Germany	39.49
Denmark	Bosnia and Herzegovina	9.08	Sweden	41.47
Denmark	Germany	39.49	Norway	60.41
Denmark	Sweden	41.47	United Kingdom	35.66
Denmark	Norway	60.41	Bosnia and Herzegovina	9.08
Estonia	Russia	21.25	Russia	21.25
Estonia	Ukraine	7.21	Ukraine	7.21
Estonia	Belarus	14.94	Belarus	14.94
Estonia	Latvia	17.57	Kazakhstan	13.10
Estonia	Kazakhstan	13.10	Latvia	17.57
France	Portugal	25.37	Morocco	4.95
France	Algeria	8.66	Algeria	8.66
France	Morocco	4.95	United Kingdom	35.66
France	Italy	32.65	Germany	39.49
France	Spain	32.05	Belgium	38.77

	Low skilled immigrants		High skilled immigrants	
Destination	**Origin**	**GDP**	**Origin**	**GDP**
Germany	Turkey	17.11	Turkey	17.11
Germany	Italy	32.65	Poland	21.26
Germany	Greece	25.85	Serbia and Montenegro	11.88
Germany	Croatia	19.47	United States	48.11
Germany	Poland	21.26	Austria	42.20
Greece	Albania	8.87	Albania	8.87
Greece	Bulgaria	14.83	Georgia	5.47
Greece	Romania	15.14	Cyprus	32.25
Greece	Georgia	5.47	Bulgaria	14.83
Greece	Pakistan	2.75	Ukraine	7.21
Ireland	United Kingdom	35.66	United Kingdom	35.66
Ireland	United States	48.11	United States	48.11
Ireland	Germany	39.49	Germany	39.49
Ireland	Nigeria	2.53	France	35.25
Ireland	Romania	15.14	Nigeria	2.53
Italy	Morocco	4.95	Albania	8.87
Italy	Albania	8.87	Germany	39.49
Italy	Romania	15.14	United Kingdom	35.66
Italy	Philippines	4.12	France	35.25
Italy	Tunisia	9.35	United States	48.11
Luxembourg	Portugal	25.37	Belgium	38.77
Luxembourg	France	35.25	France	35.25
Luxembourg	Germany	39.49	Germany	39.49
Luxembourg	Italy	32.65	United Kingdom	35.66
Luxembourg	Belgium	38.77	Netherlands	42.77
Netherlands	Germany	39.49	Germany	39.49
Netherlands	Indonesia	4.64	Indonesia	4.64
Netherlands	Turkey	17.11	Suriname	11.90
Netherlands	Suriname	11.90	Belgium	38.77
Netherlands	Morocco	4.95	United Kingdom	35.66
Portugal	Cape Verde	4.10	Brazil	11.64
Portugal	Angola	5.92	Ukraine	7.21
Portugal	Brazil	11.64	United Kingdom	35.66
Portugal	Guinea-Bissau	1.24	Germany	39.49
Portugal	Ukraine	7.21	Spain	32.05

	Low skilled immigrants		High skilled immigrants	
Destination	**Origin**	**GDP**	**Origin**	**GDP**
Slovenia	Bosnia and Herzegovina	9.08	Croatia	19.47
Slovenia	Croatia	19.47	Serbia and Montenegro	11.88
Slovenia	Serbia and Montenegro	11.88	Bosnia and Herzegovina	9.08
Slovenia	Macedonia	11.26	Germany	39.49
Slovenia	Germany	39.49	Macedonia	11.26
Spain	Morocco	4.95	France	35.25
Spain	Ecuador	8.67	Argentina	17.55
Spain	France	35.25	Germany	39.49
Spain	Colombia	10.03	Morocco	4.95
Spain	Germany	39.49	United Kingdom	35.66
Sweden	Finland	37.46	Finland	37.46
Sweden	Serbia and Montenegro	11.88	Iran	13.40
Sweden	Bosnia and Herzegovina	9.08	Poland	21.26
Sweden	Denmark	40.91	Iraq	3.86
Sweden	Norway	60.41	Germany	39.49
Switzerland	Italy	32.65	Germany	39.49
Switzerland	Germany	39.49	France	35.25
Switzerland	Portugal	25.37	Italy	32.65
Switzerland	Serbia and Montenegro	11.88	United Kingdom	35.66
Switzerland	France	35.25	United States	48.11
United Kingdom	Ireland	41.68	India	3.63
United Kingdom	India	3.63	Ireland	41.68
United Kingdom	Pakistan	2.75	United States	48.11
United Kingdom	Jamaica	9.10	Germany	39.49
United Kingdom	Germany	39.49	Pakistan	2.75
United States	Mexico	15.27	Mexico	15.27
United States	El Salvador	6.83	Philippines	4.12
United States	Cuba	9.90	India	3.63
United States	Vietnam	3.41	Canada	40.37
United States	China	8.40	Korea	30.29

GDP stands for 2011 GDP (in 1,000 international dollars) per capita PPP (2010 for Cuba).
Data sources: Docquier et al. (2011), World Bank.

C Additional Monte Carlo Simulations

In the body our our paper, we illustrated a simple regression using moments as regressors. We also run an equivalent 'parameter regression':

$$\mathcal{W}_{iN} = \sum_{\ell} \tilde{\beta}_{\ell} \ln \pi_{i\ell} + \tilde{u}_i \tag{34}$$

where $\pi_{i\ell}$ is an $i \times \ell$ matrix of parameters of our model, including separation rates, TFP parameter, relative skill productivity, match efficiency, vacancy costs, level of the public good, immigrant search costs and capital stock owned by natives.

C.1 Parameter Regression, i.i.d sampling

This section presents the results of equation 34. While moments are uncorrelated by construction in our artificial data because of our i.i.d. sampling (see next section for jointly normal sampling), parameters are obtained through the calibration of our model and convey different information from the moments. Therefore, we present three separate regression tables, which build up our full regression specification.

Table C.2 below summarizes the results that have welfare gains of all natives as our dependent variable. We focus on column 4 for the comments here. The main messages of the moment regression in the body of the text are equivalent here. The extent by which immigrants' outside options differ from that of natives is associated with larger welfare gains, separation rates have effects that mirror those of unemployment benefits, larger levels of public goods are associated with smaller gains (however, the effect is quantitatively small). In addition, a more efficient matching process is associated with larger welfare effects, once one controls for the low skilled share in the production of intermediates x, which is found to be very important (it governs relative unemployment rates across skills as well as skill premia). Tables C.3 and C.4 present equivalent estimates looking at native welfare gains by skill.

C.2 Joint sampling

The goal of our main Monte Carlo simulations were to evaluate the relative importance of different channels that are present in our quantitative model. With that objective in mind, we thought that generating artificial economies sampling each moment from our data separately could give us the most useful artificial data to differentiate the channels. As one could expect, across our countries moments are actually correlated, for example countries with high unemployment rates for low skilled workers tend to have relatively high unemployment rates for high skilled workers as well. This is an information one would not want to ignore if the goal of the Monte Carlo exercise was to learn something about what is important in our economies (and in economies that are similar to them) rather than to learn the functioning of the model only. In this section we present the results based upon creating artificial data using all of the information contained in the variance-covariance matrix of our moments, i.e. drawing our artificial economy from a joint normal distribution with 14 dimensions.

Below, we present the results from equations 16 and 34 with our 10,000 observations obtained from drawing from a joint normal distribution.

Table C.2: Native Welfare Gains, Parameter Regression

Dependent variable: Welfare Gains of Natives (linear)				
	(1)	(2)	(3)	(4)
h_{LI}	0.129***	0.072***	0.068***	0.057***
	[12.94]	[6.58]	[5.95]	[9.59]
h_{HI}	0.041***	0.028***	0.025**	0.016***
	[4.15]	[2.62]	[2.26]	[2.75]
ξ		-0.004	0.000	0.029***
		[-0.37]	[0.00]	[4.28]
s_{LN}		0.109***	0.109***	0.114***
		[8.03]	[8.05]	[16.26]
s_{LI}		-0.076***	-0.079***	-0.093***
		[-5.23]	[-5.34]	[-12.22]
s_{HN}		0.025**	0.024**	0.033***
		[2.09]	[2.01]	[5.37]
s_{HI}		-0.032**	-0.033***	-0.048***
		[-2.55]	[-2.67]	[-7.43]
g			0.013	-0.028**
			[1.11]	[-2.34]
A				0.006
				[0.73]
x				0.840***
				[164.34]
K				-0.015
				[-1.44]
Observations	10000	10000	10000	10000
R^2	0.020	0.048	0.049	0.748

All regressors are in natural logarithms.

Standardized beta coefficients; t statistics in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Artificial economies obtained with i.i.d. sampling.

C.2.1 Moment Regression

Table C.5 below summarizes our regression results for overall native welfare effects using simulated data obtained from a joint normal distribution of our moments, for all natives and by skill. While the main message is similar to that of the table presented in the body of the text, there are some interesting differences. For instance, the effect of the size of government is now insignificant, probably because of high correlation between government size and other variables. The native skill premium is not found to be important, while unemployment rates of high skilled immigrants no longer have a significant effect.

Table C.3: Low Skilled Native Welfare Gains, Parameter Regression

Dep. var.: Welfare Gains of low-skilled Natives (linear)				
	(1)	(2)	(3)	(4)
h_{LI}	0.102***	0.069***	0.062***	0.050***
	[10.18]	[6.31]	[5.37]	[8.10]
h_{HI}	0.032***	0.017	0.011	0.001
	[3.19]	[1.59]	[0.99]	[0.19]
ξ		0.012	0.020*	0.052***
		[1.06]	[1.70]	[7.25]
s_{LN}		0.122***	0.122***	0.128***
		[8.92]	[8.95]	[17.47]
s_{LI}		-0.023	-0.030**	-0.044***
		[-1.55]	[-1.99]	[-5.52]
s_{HN}		-0.047***	-0.049***	-0.040***
		[-3.93]	[-4.07]	[-6.19]
s_{HI}		-0.078***	-0.082***	-0.096***
		[-6.27]	[-6.50]	[-14.29]
g			0.025**	-0.024*
			[2.20]	[-1.89]
A				0.010
				[1.13]
x				0.835***
				[156.22]
K				-0.005
				[-0.47]
Observations	10000	10000	10000	10000
R^2	0.012	0.033	0.033	0.725

All regressors are in natural logarithms.

Standardized beta coefficients; t statistics in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Artificial economies obtained with i.i.d. sampling.

C.2.2 Parameter Regression

Purely because of space considerations, we condense the three tables we presented for i.i.d. sampling above into a single table, table C.6 below. Perhaps not surprisingly, estimates are quite different from those obtained drawing artificial data with i.i.d. sampling from each moment., because of high correlation across some of the moments, and therefore relatively little additional power brought by some of the variables, e.g. the share of low skilled in production x.

Table C.4: High Skill Native Welfare Gains, Parameter Regression

Dep. var.: Welfare Gains of high-skilled Natives (linear)				
	(1)	(2)	(3)	(4)
h_{LI}	0.176***	0.062***	0.069***	0.062***
	[17.75]	[5.96]	[6.29]	[8.19]
h_{HI}	0.056***	0.055***	0.060***	0.057***
	[5.71]	[5.41]	[5.75]	[7.73]
ξ		-0.047***	-0.054***	-0.047***
		[-4.37]	[-4.78]	[-5.27]
s_{LN}		0.041***	0.041***	0.040***
		[3.17]	[3.15]	[4.43]
s_{LI}		-0.210***	-0.204***	-0.214***
		[-15.21]	[-14.43]	[-21.77]
s_{HN}		0.237***	0.238***	0.244***
		[20.87]	[20.96]	[30.96]
s_{HI}		0.129***	0.132***	0.120***
		[10.90]	[11.07]	[14.44]
g			-0.022**	-0.004
			[-2.02]	[-0.23]
A				-0.020*
				[-1.88]
x				0.679***
				[103.31]
K				-0.068***
				[-5.14]
Observations	10000	10000	10000	10000
R^2	0.036	0.130	0.131	0.583

All regressors are in natural logarithms.

Standardized beta coefficients; t statistics in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Artificial economies obtained with i.i.d. sampling.

Table C.5: Native Welfare Gains by Skill, Moment Regression

	(1) All	(2) Low skilled	(3) High skilled
Low Skilled Immigrant Wage Gap	0.151***	0.132***	0.107***
	[12.57]	[12.12]	[14.30]
High Skilled Immigrant Wage Gap	0.076***	0.044***	0.087***
	[6.86]	[4.33]	[12.58]
Unemployment Rate: Low Skilled Natives	0.347***	0.280***	0.283***
	[17.12]	[15.21]	[22.27]
Unemployment Rate: Low Skilled Immigrants	-0.364***	-0.258***	-0.356***
	[-19.65]	[-15.33]	[-30.61]
Unemployment Rate: High Skilled Natives	0.057***	0.042***	0.055***
	[3.55]	[2.89]	[5.42]
Unemployment Rate: High Skilled Immigrants	0.009	-0.030	0.079***
	[0.44]	[-1.53]	[5.87]
Share of Immigrants	-0.236***	-0.161***	-0.231***
	[-12.55]	[-9.40]	[-19.57]
Share of Low Skilled among Immigrants	-0.229***	-0.673***	0.725***
	[-17.29]	[-55.88]	[87.14]
Share of Low Skilled among Natives	0.113***	0.384***	-0.436***
	[8.20]	[30.62]	[-50.26]
Raplacement Rate	0.148***	0.110***	0.129***
	[15.25]	[12.45]	[21.24]
Government Expenditures	-0.007	0.003	-0.026***
	[-0.48]	[0.19]	[-2.82]
Per capita GDP	-0.124***	-0.112***	-0.068***
	[-7.36]	[-7.32]	[-6.44]
Native Skill Premium	0.167***	0.110***	0.154***
	[11.28]	[8.21]	[16.63]
Capital Share	0.025*	0.013	0.004
	[1.68]	[0.93]	[0.47]
Observations	10000	10000	10000
R^2	0.349	0.463	0.744

All regressors are in natural logarithms.

Standardized beta coefficients; t statistics in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Artificial economies obtained with sampling from joint normal.

Table C.6: Native Welfare Gains by Skill, Parameter Regression

	(1) All	(2) Low skilled	(3) High skilled
h_{LI}	0.079***	-0.046***	0.273***
	[6.97]	[-4.02]	[29.34]
h_{HI}	0.070***	0.088***	-0.009
	[7.13]	[9.04]	[-1.13]
ξ	-0.085***	0.082***	-0.349***
	[-7.84]	[7.63]	[-39.60]
s_{LN}	0.311***	0.408***	-0.075***
	[19.30]	[25.32]	[-5.70]
s_{LI}	0.035*	0.187***	-0.295***
	[1.96]	[10.37]	[-19.98]
s_{HN}	-0.069***	-0.191***	0.213***
	[-5.36]	[-14.79]	[20.22]
s_{HI}	-0.250***	-0.309***	0.028**
	[-17.39]	[-21.60]	[2.41]
g	0.190***	0.446***	-0.357***
	[7.12]	[16.77]	[-16.43]
A	-0.192***	-0.413***	0.314***
	[-12.14]	[-26.19]	[24.37]
x	-0.013	-0.015*	-0.002
	[-1.49]	[-1.76]	[-0.33]
K	-0.430***	-0.318***	-0.433***
	[-18.57]	[-13.76]	[-22.91]
Observations	10000	10000	10000
R^2	0.282	0.286	0.522

All regressors are in natural logarithms.

Standardized beta coefficients; t statistics in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Artificial economies obtained with sampling from joint normal.

D Summary of Matched Moments and Data Sources

D.1 Immigrant-Native Wage Gaps and Source Country wages

Our model distinguishes between immigrants and natives along two dimensions. First, we allow immigrants and natives to have different break-up rates, which generates both a wage gap and an unemployment gap in our model. Second, we allow immigrants to have different outside options, i.e. different utility costs of unemployment (which can be also thought of as higher search costs). We use wage gaps between immigrants and natives for each skill level to parameterize the difference between the outside option of immigrants and natives at each skill level, h_{LI} and h_{HI} in our model, as explained in most details in the model section below. There are multiple reasons why the outside option from an employment contract may be worse for immigrants. Many of these factors are likely to be unobservable to us, lower wealth levels and assets ownership (in particular housing), lower quality of social networks that may lower the utility from non-employment, lower utility of leisure spent in a foreign country with less accessible amenities. Another important element is given by the fact that when unemployed, immigrants may lack the support structure that natives have access to, and may have to return to their country of origin. Let us imagine that the utility from moving back home is positive correlated with average wages in the country of origin, capturing the fact that low average real wages denote a less desirable labour market. In this case we would expect that the poorer the country of origin of an immigrant is, the lower the outside option in the host country, and therefore the higher the wage gap between immigrants and natives will be.[45]

This latest consideration can be empirically investigated. Using a unique dataset with skill-specific bilateral stocks of foreign born individuals for a large number of countries for year 2000,[46] we identify the main origin countries for each of the 20 host countries we analyze, and calculate the average GDP per capita for this set of countries, separately for low skilled and high skilled individuals.[47] First, we look at the extent by which countries of origin are different for low skilled and high skilled immigrants. Figure D.1 shows that there is very large variation among our origin countries in terms of the weighted average of the GDP per capita in the origin countries of the main source countries. Some countries, such as Greece for example, attract immigrants from relatively poor countries.

At the other end of the spectrum, Denmark, Switzerland, Luxembourg and Ireland have a pool of foreign born residents that come from rich countries. Many of the countries in our sample are relatively close to the 45 degree line, meaning that the main origin countries of their low skilled and high skilled immigrants have similar average incomes. However, many countries are relatively far from equality and attract high skilled immigrants from relatively rich countries and low skilled from relatively poor countries. This is the case of Italy, Portugal, Spain, Austria. For example, in the case of Italy the main origin countries of low skilled immigrants are Morocco, Albania, Romania, the Philippines and Tunisia. For high skilled, the first five are Albania, Germany, the United Kingdom, France and the United States. Only Australia and Sweden show the opposite

[45] This is a highly simplified description of reality, since immigrants can also move to a third country, so that policies and wages of all alternative destination countries will potentially matter. Because we want to check these simple predictions empirically, we need to abstract from this complication.

[46] This dataset has been constructed by Frédéric Docquier, Çaglar Özden, Christopher Parsons and Ehran Artuc. For more information on the dataset please see (Docquier et al., 2012). We thanks Christopher Parsons for making the dataset available to us.

[47] In the Appendix, we list the first five origin countries for each of our destination country.

Table D.7: Summary statistics for country-specific moments

	(1) $\frac{Q_{LN}}{Q_N}$	(2) Q_I	(3) $\frac{Q_{LI}}{Q_I}$	(4) $\frac{w_{HN}}{w_{LN}}$	(5) $\frac{w_{LN}}{w_{LI}}$	(6) $\frac{w_{HN}}{w_{HI}}$	(7) u_{LN}	(8) u_{LI}	(9) u_{HN}	(10) u_{HI}	(11) $\frac{\bar{b}}{W(1-\bar{t})}$	(12) GDP	(13) $\frac{G+B}{GDP}$
Countries													
Australia	0.70	0.21	0.57	1.40	1.01	1.00	0.04	0.05	0.01	0.03	0.43	39.7	0.36
Austria	0.83	0.18	0.83	1.35	1.34	1.18	0.04	0.10	0.02	0.06	0.52	42.2	0.50
Belgium	0.68	0.18	0.72	1.44	1.29	1.14	0.08	0.20	0.03	0.10	0.63	38.8	0.52
Canada	0.80	0.20	0.68	1.81	1.01	1.19	0.09	0.09	0.04	0.07	0.26	40.4	0.41
Denmark	0.71	0.12	0.53	1.37	1.18	1.16	0.06	0.12	0.03	0.08	0.57	40.9	0.55
Estonia	0.69	0.15	0.64	1.52	1.16	1.35	0.12	0.14	0.05	0.09	0.24	22.0	0.41
France	0.71	0.13	0.77	1.45	1.17	1.04	0.10	0.16	0.05	0.10	0.49	35.2	0.55
Germany	0.74	0.15	0.81	1.40	1.13	1.16	0.09	0.16	0.03	0.11	0.44	39.5	0.46
Greece	0.75	0.14	0.87	1.68	1.39	1.38	0.13	0.15	0.09	0.15	0.22	25.8	0.49
Ireland	0.66	0.15	0.52	1.61	1.07	1.24	0.11	0.16	0.04	0.08	0.54	41.7	0.44
Italy	0.86	0.12	0.89	1.56	1.34	1.57	0.08	0.11	0.05	0.08	0.23	32.6	0.49
Luxembourg	0.64	0.39	0.68	1.42	1.29	1.08	0.04	0.07	0.02	0.04	0.30	89.0	0.41
Netherlands	0.70	0.14	0.75	1.39	1.13	1.15	0.04	0.09	0.02	0.06	0.39	42.8	0.48
Portugal	0.83	0.10	0.81	2.08	1.09	1.22	0.10	0.14	0.08	0.09	0.52	25.4	0.47
Slovenia	0.76	0.13	0.90	1.49	1.12	1.06	0.07	0.08	0.04	0.05	0.26	27.0	0.44
Spain	0.67	0.18	0.79	1.55	1.30	1.34	0.17	0.23	0.08	0.16	0.42	32.0	0.43
Sweden	0.69	0.18	0.67	1.24	1.21	1.13	0.08	0.16	0.03	0.11	0.42	41.5	0.51
Switzerland	0.68	0.29	0.69	1.44	1.17	0.99	0.03	0.08	0.02	0.05	0.34	51.3	0.33
United Kingdom	0.62	0.14	0.69	1.52	1.04	1.15	0.08	0.10	0.03	0.06	0.29	35.7	0.43
United States	0.70	0.14	0.68	2.11	1.15	1.00	0.10	0.09	0.03	0.04	0.27	48.1	0.40
Statistics													
Mean	0.72	0.17	0.72	1.54	1.18	1.18	0.08	0.12	0.04	0.08	0.39	39.6	0.45
Median	0.70	0.15	0.71	1.47	1.16	1.15	0.08	0.11	0.03	0.08	0.40	39.6	0.45
S.d.	0.07	0.07	0.11	0.23	0.11	0.15	0.04	0.05	0.02	0.03	0.13	13.9	0.06
Min	0.62	0.10	0.52	1.24	1.01	0.99	0.03	0.05	0.01	0.03	0.22	22.0	0.33
Max	0.86	0.39	0.90	2.11	1.39	1.57	0.17	0.23	0.09	0.16	0.63	89.0	0.55
S.d./mean	0.09	0.39	0.15	0.15	0.09	0.12	0.43	0.37	0.55	0.33	0.40	0.4	0.13

Q_{LN}/Q_N Share of low skilled among natives. $Q_I = Q_{LI} + Q_{HI}$ Share of immigrants in the labor force.

Q_{LI}/Q_I Share of low skilled among immigrants. $\frac{w_{HN}}{w_{LN}}$ Skill premium among natives.

$\frac{b}{W}$ denotes the average Replacement Rate: ratio between benefits and average wages (2005 fRDB and 2010 OECD data).

$\frac{w_{LN}}{w_{LI}}$ Native/immigrant wage ratio for low skilled. $\frac{w_{HN}}{w_{HI}}$ Native/immigrant wage ratio for high skilled.

u_{ij} are unemployment rates for each skill level for immigrants and natives.

GDP is per capita GDP PPP for year 2011 in current international dollars (in 1000s).

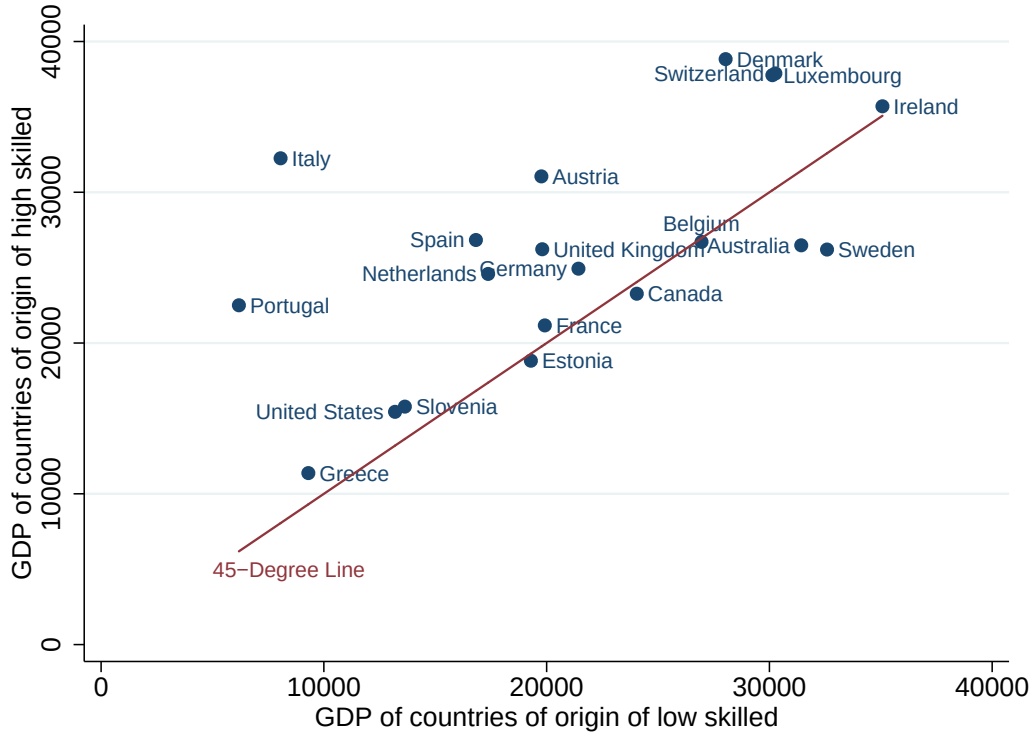
In column 11, we use OECD data for net replacement rates.

In column 13, G denotes a public good, and B denotes total unemployment benefits.

For the USA, data from IPUMS 2005 Census. For Canada, data from the 2006 Census and 2005-2012 LFS.

For EU countries: Eurostat data for population shares, EU-SILC and EU-LFS for wage gaps (see Web Appendix).

Figure D.1: Per capita GDP of countries of origin



Sources: Doquier et al. (2011), World Bank, EU-SILC, CPS, US and Canadian Census, HILDA.

pattern, whereby their high skilled immigrants population come from relatively poorer nations.[48]

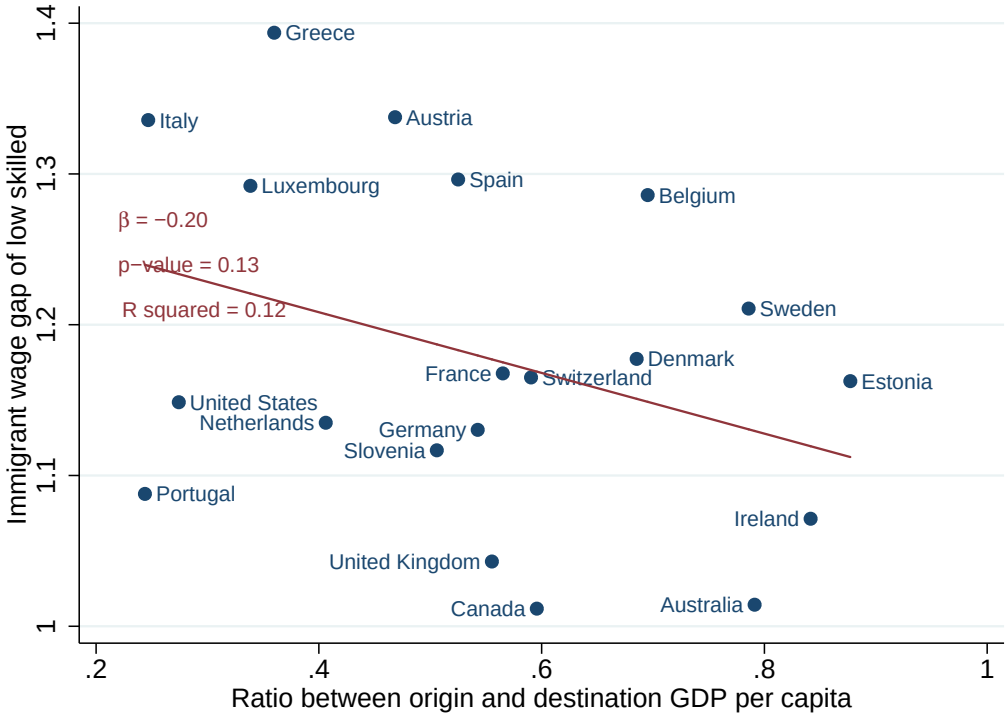
If, as discussed above, the possibility to return to the country of origin introduces the potential for GDP per capita of the country of origin to play a role for observed wage gaps in the host country. In particular, we would expect to find a negative correlation between relative GDP per capita (the ratio between the GDP per capita of the main countries of origin and the GDP per capita of destination countries) and wage gaps in the host country. Intuitively, if a destination country has immigrants from much poorer countries, the option of going back to their home country will be relatively less attractive for immigrants, resulting in higher wage gaps. We would also expect the effect to be stronger for low skilled individuals, for at least two reasons. First, the possibility of having to return home might be more concrete for low skilled immigrants, while high skilled immigrants may be more able to stay in the host country, or to move to a third country. Secondly, we use relative GDP per capita (PPP) of the origin country compared to the host country to get a measure of the economic attractiveness of returning to the home country. Although it has the advantage of availability for all of the origin countries, it is likely to be a very poor proxy in the case of high skilled workers: a high skilled worker from India or China for example will have an expected wage upon returning home that is very different from the average wage in that country.

Figures D.2 and D.3 below draw scatter plots where we plot the ratio of origin country GDP per

[48] This pattern however is primarily driven by early immigrants and political refugees. This pattern may disappear if we could consider recent immigrants only.

capita over destination country GDP per capita (in 2011) on the horizontal axis, and skill-specific wage gaps between immigrants and on the vertical axis. Figure D.2 refers to low skilled workers. We observe a negative relationship between the relative GDP of main countries of origin and the wage gap of immigrant high skilled workers in the host country, although it is not significant with a p-value of 0.12. This provides a modest support to our predictions, and we find the fact that such a rough measure of potential income upon return can explain a significant part of the variation in wage gaps across countries is quite striking, and usually ignored in the discussion on the immigrant wage gap.

Figure D.2: Relative GDP and wage gaps of low skilled workers

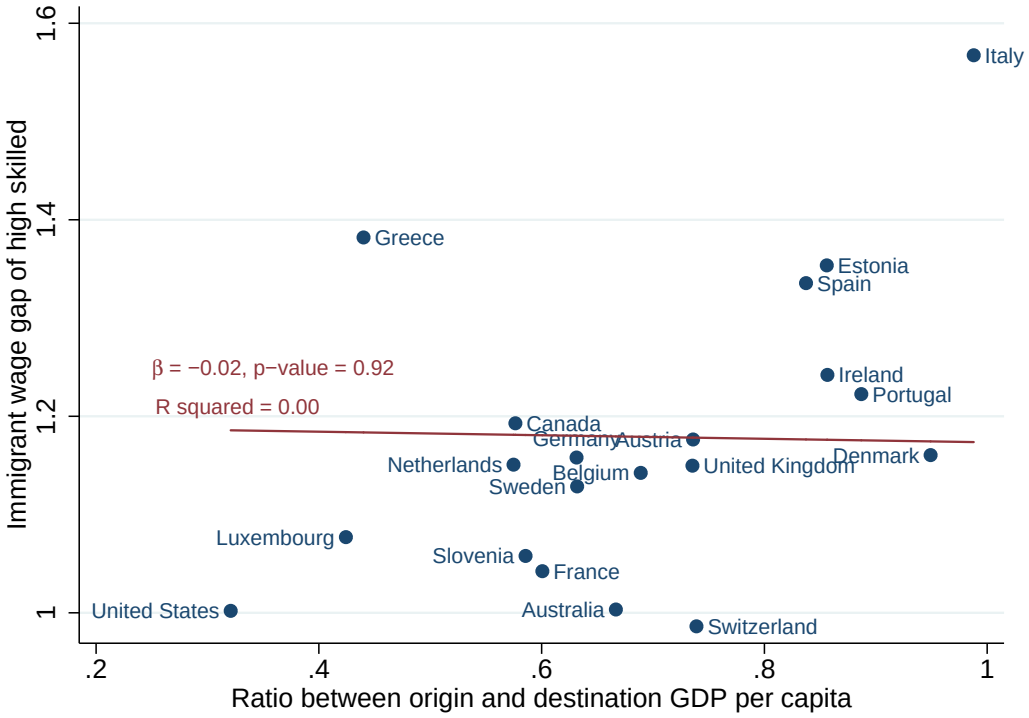


Sources: Doquier et al. (2011), World Bank, EU-SILC, CPS, US and Canadian Census, HILDA.

Figure D.3 presents equivalent statistics for high skilled individuals. As we suspected, mobility to third countries and positive selection imply that GDP per capita does not play a significant role in explaining wage gaps that we observe in the host country. The negative correlation shown by a linear prediction of the scatter plot does show a weakly negative relationship, but this is far from being significant (also when we drop Italy).

The previous sections presented a series of stylized facts about immigrants and institutions of host countries. In particular, our goals were to show that there is a very large degree of heterogeneity across countries in many variables that are relevant for our understanding of the effects of migration. Despite this large heterogeneity, among others two main messages emerge: immigrants tend to have lower wages and higher unemployment rates than natives of the same skill level. Next section will develop a model that allow for these two facts.

Figure D.3: Relative GDP and wage gaps of high skilled workers



Sources: Doquier et al. (2011), World Bank, EU-SILC, CPS, US and Canadian Census, HILDA.