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DO IMMIGRANTS MAKE US SAFER? CRIME, IMMIGRATION, AND THE LABOR MARKET (updated version)

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Do Immigrants Make Us Safer? Crime, Immigration, and the Labor Market

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Abstract

We present a two-country labor matching model to account for the existing, inconclusive empirical evidence on the relationship between immigration and crime. According to our model, inflows of relatively unskilled immigrants negatively affect the labor market equilibrium and, therefore, sharpen criminal activities. On the other hand, inflows of relatively skilled immigrants boost economic activity and reduce the crime rate. Given this preliminary result, we endogenize the migration decision, showing that the host country' s labor-market characteristics are crucial in determining the impact of migrants on crime rate. Countries characterized by low unemployment rates attract both skilled and unskilled immigrants, making the direction of the relationship between immigration and crime unclear. Countries with high unemployment rates attract only unskilled workers, thus favoring the emergence of a positive relationship between immigration and crime. We test the theoretical predictions of our model on a panel of 97 regions located in 12 European host countries built by combining the European Social Survey and the Eurostat Labor Force Survey. We identify a threshold level of unemployment rate above which the crime rate positively responds to immigration.

Keywords: Immigration, Crime, Labor Market, Frictional Unemployment.

JEL classification: F22, J61, J64, K42.

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1 Introduction

"Do immigrants make us safer?"[1] Among the "hot" issues faced by policymakers in industrialized countries, the relationship between immigration and crime is one of the most controversial. The native population often perceives immigration as a source of criminality. Analyzing data from the National Identity Survey from 1995 to 2003, Bianchi et al. (2012) reported that much of the population in $OECD$ countries?from a low of 40 percent in the United Kingdom to a high of 80 percent in Norway?is concerned that immigrants increase crime (see also Martinez and Lee, 2000; Bauer et al., 2000).

Notwithstanding public opinion, however, the sign of the relationship between immigration and crime remains an open question for social scientists. While immigration is found in some cases to be negatively associated with the host country's crime rate (see, e.g., Reid et al., 2005; Moehling and Piehl, 2009), the correlation is positive or statistically insignificant in other cases (see, e.g., Borjas et al., 2010; Alonso-Borrego et al., 2012; Bianchi et al., 2012; Spenkuch, 2014). Bianchi et al. (2012) and Spenkuch (2014) found a positive correlation only between immigration and property crimes, whereas, using an instrumental variable (IV) technique, Nunziata (2015) found that the relationship between immigration and crime is not statistically significant. In this respect, other studies have attempted to address endogeneity issues by exploiting political reforms on immigration legislation. For instance, using a regression discontinuity design, Pinotti (2017) estimated that, on average, immigrant legalization reduces the crime rate of legalized immigrants by 0.6 percentage points. Similarly, Fasani (2018) found that Italian regions in which a higher share of immigrants obtained legal status also exhibited a more significant reduction in non-EU immigrant crime rates. However, this effect seems to be relatively small and transitory.

Figures 1 and 2 display the lack of a clear relationship between immigration and crime in Europe, using Eurostat data on the percentage of foreign-born population and the number of thefts per 100,000 inhabitants. Denmark, for instance, is characterized by a lower immigration rate (2.4 percent) than Sweden (7.4 percent) but a similar rate of property crimes (4,736 and 4,209 thefts per 100,000 inhabitants, respectively). Analogously, immigration is lower in Italy (1.47 percent) than in Spain (4.37 percent), whereas the crime rate is higher in Italy (1,918 thefts per 100,000 inhabitants) than in Spain (381 thefts per 100,000 inhabitants). At the same time, comparing Italy with Germany or Ireland, Germany and Ireland have higher shares of immigrants than Italy but similar crime rates.

[Figures 1 and 2 about here]

The theoretical literature provides no clear explanations for this puzzling evidence. Existing models either focus on the relationship between (un)employment and crime or analyze the economic determinants of the decision to migrate. In

[1] New York Times Magazine, December 3, 2006.

traditional theories of rational choice (Sah, 1991; Becker, 1968), agents decide to engage in criminal activity when the expected earnings from crime overcome the associated expected costs. Similarly, agents migrate to foreign countries when the expected net benefits of moving abroad are higher than the expected net benefits of remaining at home and participating in the domestic labor market (Ortega, 2000). However, with the appreciable exceptions of Dai et al. (2013) and Zhang (2019), few theoretical models have attempted to combine immigration with crime and labor market opportunities; and, as far as we know, no study has considered the decisions to migrate and to engage in criminal activity simultaneously.

Considering job-search activities and crime as economic alternatives, we study how the relationship between immigration and crime depends on the host country' s structural characteristics. The main idea behind our model is that the probability that immigrants will engage in criminal activity is affected by their labor market opportunities in the host country. Indeed, the greater the capacity of the labor market in the host country to absorb new jobseekers, the lower the immigrant's (economic) incentive to engage in criminal activity. Empirical evidence supports this reasoning. For instance, Gould et al. (2002) showed that both wages and unemployment are significantly related to crime. In particular, when the labor market prospects of young, unskilled workers fall, crime rates increase (and vice versa). Other studies reaching similar conclusions include Ehrlich (1973), Machin and Meghir (2004), Altindag (2012), Summerfield (2019), and Bennett and Ouazad (2019). Interestingly, Bennett and Ouazad (2019) found that unemployment benefits do not offset the detrimental effects of lost labor income on crime.

Figures 3 and 4 display countries' unemployment rates and immigrants' employment shares, which can be evaluated against the stylized facts on immigration and property crimes mentioned above. As expected, Figure 3 shows that Northern European countries tend to exhibit lower unemployment rates compared to Mediterranean countries. This could explain the higher immigration rates observed in the former countries, but it also stands at odds with the hypothesis of a positive association between unemployment and crime, especially considering countries such as Sweden, North Macedonia, and Greece. Figure 4 completes the picture, revealing, for example, that the fraction of employed immigrants in Sweden is not particularly high when compared to Norway; this is in turn associated with a higher crime rate in Sweden compared to its neighboring country. This descriptive evidence is, in principle, compatible with the notion that immigrants' employment opportunities contribute to the impact of migration flows on property crime.

[Figures 3 and 4 about here]

If the empirical evidence on the relationship between unemployment and crime is rather robust, the impact of immigration on labor market conditions is less clear. According to Borjas (2003), immigration reduces natives' wages,

whereas Ottaviano and Peri (2012) and Peri et al. (2015) found the opposite effect. Moreover, as suggested by Card (2005), the overall evidence that immigration harms the opportunities of less-educated natives is scant. Reviewing the empirical literature on how employment and wages respond to immigration, Edo (2019) stressed the fact that, even if immigration has null or slightly positive impact on labor market indicators, immigration may, during the adjustment process, have negative consequences for workers' employability and earnings. In particular, immigrants tend to reduce the wage level of similar native workers.

This article provides a simple and intuitive two-country model for analyzing how immigration influences labor market conditions and hence crime opportunities. We consider a job-search model in which wages and unemployment depend on immigrants' human capital. As in standard matching theory, firms and workers face search costs. In line with previous studies, we assume that, compared to natives, immigrants bear higher search costs as a result of several different factors, including immigration (sunk) costs, language difficulties, discrimination, and narrower social networks for labor contacts (see, e.g., Kee, 1995; Ortega, 2000; Kahn, 2004; Frijters et al., 2005; Chassamboulli and Palivos, 2014). Search costs lead to frictional unemployment and imperfectly competitive wages that result from a (Nash) bargaining process between firms and jobseekers. In addition to pursuing labor opportunities, agents can choose to undertake criminal activity, which also presents expected costs and potential earnings. In particular, the marginal agent will be indifferent between committing a crime and participating in the labor market if and only if the expected net benefits of jobseeking equal those of criminal activity.

Our results reveal the existence of threshold effects in the labor market, which helps to explain why the relationship between immigration and crime is so puzzling. In particular, since firms bear search costs to fill vacant positions and, as in Ortega (2000), Chassamboulli and Palivos (2014), or Battisti et al. (2017), they cannot *ex ante* discriminate by applicants' differential productivity, the arrival of unskilled immigrants induces firms to reduce the number of vacancies. The deterioration of labor market conditions makes crime more profitable than job-seeking activity, inducing some unemployed people to become criminals. By contrast, the arrival of relatively skilled individuals stimulates firms to open new vacancies and induces previously inactive agents to look for a job. Notably, a key feature of our model is the endogenous nature of migration. If the arrival country is characterized by involuntary structural unemployment, it can attract only agents with worse options in their home country —that is, agents with low abilities—which will further depress the economy of the host country. On the contrary, countries with less unemployment and better job market conditions will also attract more educated workers, who may alleviate or even offset the adverse effects of unskilled migration.

Using data from the European Social Survey (ESS) and the Eurostat Labor Force Survey (LFS) from twelve European countries and a specification in differences, we empirically test the theoretical implications of our model. We identify a threshold level of the unemployment rate above which the crime rate positively responds to immigration. To address possible endogeneity issues, we

use the same instrumental variable (IV) approach adopted in Nunziata (2015). The idea is to construct an exogenous instrument that captures migration-push factors —such as wars, political repression, poverty, economic stagnation, and other events—that are conditionally uncorrelated with our outcome of interest and do not depend on specific characteristics of the arrival country. Differences in migration are instrumented by changes in migration outflows toward European regions from world areas of provenance, weighted by the predetermined share of immigrants from the same areas living in each region.

The rest of this paper is organized as follows. The next section places our contribution within existing literature. Section 3 presents the model and states the main theoretical results regarding the interplay among immigration, crime, and the labor market. Section 4 provides supporting evidence in favor of the model, and Section 5 concludes.

2 Related Literature

Our theoretical framework is inspired by standard models of search in the labor market (Diamond, 1981; Mortensen, 1982a, 1982b; Pissarides, 1984b,1984a). As in these traditional search models, because of imperfect information and other friction, the process of matching jobseekers with vacant positions imposes time and economic costs on both firms and workers and leads to frictional unemployment. We depart from standard matching models by also considering a second activity (crime), which has some victimization costs for individuals and operating firms. As Becker (1968) argued, income can come from the labor market or from criminal activity; therefore, individuals compare the costs and benefits of committing a crime with the expected value of the job-seeking activity. Indeed, the previous empirical literature has shown that agents with better opportunities in the labor market are less likely to be involved in illegal activities (see, e.g., Block and Heineke, 1975; Ehrlich, 1973; Machin and Meghir, 2004; Mocan et al., 2005; Altindag, 2012).

In considering the contributions most related to our work, we can distinguish two separate strands of the economic literature. The first strand analyzes the impact of immigration on the host country's labor market conditions, while the second strand investigates how labor market outcomes affect criminal activity and vice versa. Finally, some recent studies have attempted to link immigration with choices about labor and crime, but these have not considered the endogenous nature of the decision to migrate.

Regarding that migration decision, Ortega (2000) undoubtedly offered the most related contribution to the present paper. Ortega presented a two-country labor-matching model (with no crime) in which domestic firms offer job vacancies to residents, taking into account the average search costs of the population, and jobseekers look for positions in either their own country or in the other country. Migrating to the other country imposes mobility costs on agents. In each country, the equilibrium wage is the outcome of a bargaining process between firms and jobseekers based on a matching function with constant returns

to scale. Based on this framework, Ortega derived two main results. First, depending on the characteristics of the two countries' labor markets, the model admits multiple equilibria in terms of migration (no-migration, full-migration, and partial-migration equilibria). Second, these equilibria can be Pareto-ranked according to the corresponding migration intensity, with the full-migration and no-migration equilibria representing Pareto-superior and Pareto-inferior outcomes, respectively. We present a generalization of Ortega (2000) in which agents face a choice between migration and crime as alternatives to unfavorable labor conditions. This approach allows us to study the sign of the relationship between immigration and crime and whether this interplay depends on structural characteristics of the labor market.

Leaving aside agents' decisions to migrate, Burdett et al. (2003, 2004) and Engelhardt et al. (2008) presented a one-country search model to investigate the interaction between crime and labor. In Burdett et al. (2003), each firm posts a (fixed) wage, hiring any jobseeker who is willing to work for that wage, while crime is introduced as an opportunity to steal others' resources. The probability that agents will engage in criminal activity depends on both their labor conditions and the fixed probability of their arrest. Finally, all agents face the risk of crime victimization; the higher the probability that an agent will engage in criminal activity, the higher the risk of crime victimization in the economy. Burdett et al. (2003) showed that introducing crime as an alternative economic activity has two main implications: (1) it causes wage dispersion among homogeneous workers and (2) it introduces multiple equilibria in terms of combinations of crime and unemployment rates. Burdett et al. (2004) extended their original model to a setting with an on-the-job search. Considering a job-search model in which agents have to choose between formal employment and crime-related activities, Huang et al. (2004) argued that crime represents an implicit tax on human capital accumulation and multiple equilibria can arise. Finally, Engelhardt et al. (2008) showed that, in equilibrium, the probability that economic agents will commit crimes depends on their labor-force status, with unemployed agents the most likely to engage in criminal activity. Based on their model, the authors concluded that, while labor policies (e.g., unemployment insurance, small-wage subsidies, hiring subsidies) reduce the crime rate by altering labor-market conditions, crime policies affect the crime rate without significantly distorting the labor market.

More recently, Dai et al. (2013) and Zhang (2019) introduced immigration to a crime-labor model. Dai et al. (2013) indicated two potential channels affecting the nexus between crime and immigration. The first channel supports the existence of a positive link between immigration and crime, arising from the pressures that unskilled immigrants put on job-market competition. The second channel, meanwhile, relates to skill upgrading and supports the negative effect of immigration on crime some studies have found. More precisely, greater competition among unskilled workers negatively impacts unskilled wages, inducing natives to acquire additional human capital. Zhang (2019) considered a frictional labor market in which immigrants positively affect the tightness of the labor market by reducing firms' costs. The reduction in the wage level induces

employees to become involved in criminal activity, whereas, given the increase in matching probability, unemployed workers prefer to look for a job instead of committing a crime. Despite these improvements, Zhang's model continues to consider the decision to migrate as exogenous.

Our model builds on these previous studies in terms of the structure of the labor market; however, we introduce migration as an endogenous source of heterogeneity and study the impact of this heterogeneity on the host country's crime rate. In other words, we investigate how the arrival of new migrants with different levels of human capital: (1) depends on previous labor market conditions and (2) affects both job opportunities and criminal activity. This approach is validated by an increasing number of empirical studies assessing the effect of immigrants' productivity on crime. For instance, examining Spanish data from 1999 to 2009, Alonso-Borrego et al. (2012) showed that the relationship between immigration and crime depends on immigrants' human capital. Finally, our model is also consistent with studies that condition the impact of immigration on crime to the unemployment rate. Comparing native Germans with ethnic German immigrants that have similar socioeconomic characteristics, Piopiunik and Ruhose (2017) found that immigration significantly increases crime; the identified effect is stronger in regions with a high unemployment rate.

Following Ortega (2000), then, we consider a two-country model, where natives and immigrants can differ in terms of productivity. Moreover, as in Huang et al. (2004) and Dai et al. (2013), we model crime as a voluntary, deterministic choice instead of a random opportunity. That is, individuals can always commit a crime and need not wait for the arrival of a stochastic chance. Crime is also a reversible choice; individuals can change their status and switch from criminal activity to job-seeking at any time. In other words, we model crime as a separate (illegal) activity with its own costs. This assumption is consistent with the facts that time is continuous and that job-searching is a time-consuming activity generating search costs. The main limitation of these assumptions is that job-seekers and criminals in the model share common traits. Thus, within each ethnic group, the selection into the crime market results from a pure crowding-out effect. However, as Burdett et al. (2003, 2004) argued, assuming a continuous distribution of skills and the possibility of committing crime at work may also generate some problems. In particular, if workers can also commit crimes and agents are heterogeneous, all unemployed will engage in crime if those employed at the reservation wage do so.

3 The Model

Consider an open economy with two countries, A and B. Each has population P_i, with $i = A, B$, made of a continuum of agents. Since the territory size of each country is fixed, P_i also measures each country's population density. Agents live forever and can be employed (E_i), unemployed (U_i), or criminals (N_i). It follows that $P_i = E_i + U_i + N_i$. Time is continuous, and agents who are not working choose at any point in time whether to participate in the labor

market as jobseekers or to commit crime (see, e.g., Huang et al., 2004; Dai et al., 2013). We conduct the analysis in the steady state.[2]

Subsection 3.1 describes the structure of the labor market in country i. Subsection 3.2 analyzes the crime decision made by agents living in country i when the labor market is in the steady state. Finally, Subsection 3.3 presents the main equilibrium results.

3.1 The Labor Market

The labor market of country i is characterized by search frictions. That is, because of imperfect information in the labor market, the matching process between vacancies and jobseekers is costly in terms of time and other economic resources. Given these costs, the interaction between firms and jobseekers generates an equilibrium level of frictional unemployment. We assume the following matching function in the labor market:

$$Q_i = Q(U_i, V_i), \tag{1}$$

where V_i is the number of vacancies available at each instant in country i and the matching function is increasing in both the unemployment level and the number of vacancies. Since time is continuous, $Q(U_i, V_i)$ can be interpreted as the flow rate of matches. Following the standard literature, we assume that the matching function is homogenous of degree one. Therefore, we can rewrite Equation (1) in terms of the tightness of the labor market, $\phi_i \equiv \frac{V_i}{U_i}$:

$$\frac{Q_i}{V_i} = q(\phi_i). \tag{2}$$

Because $Q_i \leq V_i$ and $Q_i \leq U_i$, $q(\phi_i)$ represents the probability that a vacancy will be filled, and it is decreasing in ϕ_i. Therefore, the corresponding instantaneous probability of filling a vacancy is $q(\phi_i)dt$. Assuming a Poisson distribution, the average time it takes to find a match for a vacancy is $\int_0^\infty e^{-q(\phi_i)t}dt = \frac{1}{q(\phi_i)}$.

Similarly, the matching probability in country i is $F(\phi_i) = \phi_i q(\phi_i)$, with an instantaneous probability of $F(\phi_i)dt$ that is increasing in ϕ_i. The average duration of unemployment is therefore $\frac{1}{F(\phi_i)}$. The dynamic equation that describes the evolution of employment is given by $\frac{dE_i}{dt} = F(\phi_i)U_i - s_i E_i$, where s_i is the exogenous separation rate. By using the constraint on the population size, $E_i = P_i - U_i - N_i$ and by solving the dynamic equation of employment for U_i, we obtain the following Beveridge curve:

$$\hat{u}_i \equiv \frac{u_i}{(1-n_i)} = \frac{s_i}{s_i + F(\phi_i)}, \tag{3}$$

[2]We do not explicitly model incarceration flows here; therefore, P_i can be considered as the fraction of the total population that is not in jail. Nonetheless, in equilibrium, the fractions of captured criminals and released prisoners are always the same.

where $n_i = \frac{N_i}{P_i}$ is the crime participation rate, $u_i = \frac{U_i}{P_i}$ is the percentage of people who do not have a job but are actively looking for work, $(1 - n_i)$ is the labor force participation rate, and $\hat{u}_i$ is the unemployment rate (defined as the ratio between jobseekers and the overall labor force).

Consider the problem faced by a generic, value-maximizing firm entering the search process. Let J_i^v be the value of an unfilled vacancy and J_i^e be the expected value of a filled one.[3] Since firms do not know *a priori* whether they will fill a vacancy with a native or a non-native worker, they can only formulate some expectations *ex-ante*. In particular, we will have that $J_i^e = (1 - \delta_{ij})J_{ii} + \delta_{ij}J_{ij}$, where J_{ii} and J_{ij} are the values of vacancies filled by native and immigrant workers, respectively. Therefore, δ_{ij} is the conditional probability that, after the match, the vacancy will be filled by a j-born worker living in i. It can be written as $\delta_{ij} = \frac{m_j - n_{ij}}{1 - m_i + m_j - n_i}$, where m_j denotes the fraction of individuals migrating from country j to country i, and n_{ij} is the fraction of immigrants opting to engage in crime.

The two no-arbitrage conditions (i.e., hiring a jobseeker and firing a worker) the firm faces are:

$$\begin{cases} r_i J_i^v = q(\phi_i)(J_i^e - J_i^v) - c_i \\ J_i^e = \overline{H}_i - \overline{w}_i - s_i(J_i^e - J_i^v) - k\upsilon_i, \end{cases} , \tag{4}$$

where r_i is the interest rate, $\overline{H}_i \equiv (1 - \delta_{ij})H_{ii} + \delta_{ij}H_{ij}$ is the average productivity (human capital) of an individual living in country i, H_{ij} is the productivity of a worker living in country i who was born in country j, $s_i(J_i^e - J_i^v)$ is the turnover cost in terms of the firm's value, c_i is the cost of searching for a new employee, and $k\upsilon_i$ represents the expected victimization cost that a firm bears after the match. Following Burdett et al. (2003, 2004), we assume that, at each instant of time, a criminal can steal resources at maximum equal to k, while υ_i is the instantaneous probability of being victimized. By definition, this probability is the ratio of the number of criminals operating at each instant of time (N_i) to the number of potential victims, namely, individuals (P_i) and firms with a filled vacancy (E_i). Hence, victimization probability can also be written as $\upsilon_i = n_i/(2 - u_i - n_i)$, where n_i also represents the crime rate.[4]

Given the market's free-entry condition, both the expected value of a vacancy and the victimization cost associated with the vacancy must be null. Hence, the first equation of system (4) implies that the expected value of a filled vacancy equals the cost of posting it:

$$J_i^e = \frac{c_i}{q(\phi_i)}. \tag{5}$$

[3] For the sake of simplicity, as in Ortega (2000), we abstract out the presence of physical capital. However, our main results are not qualitatively affected by this assumption.

[4] Crime statistics refer to crime rate as the ratio of crimes in a given area to the population located in the same area. Therefore, victimization probability and crime rate differ, because the latter does not account for the fact that some crimes victimize businesses instead of workers.

Moving to the labor force, let V_{ij}^u and V_{ij}^e be the current values of being unemployed and employed, respectively, for a j-born individual living in country i. Thus, we can, as for the firms, specify two no-arbitrage conditions for unemployed agents. The first condition requires that the current value of being a jobseeker be equal to the expected value of finding a job, and the second condition requires that the current value of being employed be equal to the expected value of losing the job and moving back to the status of jobseeker:

$$\begin{cases} r_i V_{ij}^u = F(\phi_i)(V_{ij}^e - V_{ij}^u) - z_{ij} - k\upsilon_i \\ r_i V_{ij}^e = w_{ij} - s_i(V_{ij}^e - V_{ij}^u) - k\upsilon_i \end{cases}, \tag{6}$$

where z_{ij} is the search cost faced by a j-born agent living in country i. In system (6), we assume that firms and individuals bear the same victimization cost, which excludes the possibility that results are driven by differences in victimization cost.

The equilibrium expression of the market wage is the outcome of negotiation between firms and jobseekers. Denoting by γ_i the relative bargaining power of workers and assuming a Nash bargaining process (NBP), we have:

$$w_i = \arg\max(V_{ij}^e - V_{ij}^u)^{\gamma}(J_i^e - J_i^v)^{1-\gamma}, \quad \gamma \in (0,1). \tag{7}$$

Following Ortega (2000), we assume that workers differ in terms of their search costs but not in terms of their bargaining power. In particular, we assume that $z_{ii} = 0$ and $z_{ij} = z$. The existence of these costs can be explained by several factors, such as language difficulties, discrimination, or narrower social networks for labor market contacts (see, e.g., Kee, 1995; Kahn, 2004; Frijters et al., 2005).

As a result of the NBP, the total surplus $\Omega_{ij} = V_{ij}^e - V_{ij}^u + J_i^e - J_i^v$ is partitioned between jobseekers and firms as follows: $V_{ij}^e - V_{ij}^u = \gamma_i \Omega_{ij}$. Using this solution and considering systems (4) and (6), we obtain the current value of a jobseeker:

$$\omega_{ij} \equiv r_i V_{ij}^u = \alpha_i(H_{ij} - k\upsilon_i) - (1-\alpha_i)z_{ij} - k\upsilon_i. \tag{8}$$

where $\alpha_i \equiv \frac{\gamma_i F(\phi_i)}{\gamma_i F(\phi_i) + r_i + s_i}$. Because α_i increases with $F(\phi_i)$, and this is a positive function of ϕ_i, the value of a jobseeker increases with the tightness of the labor market and productivity, whereas it decreases with the probabilities of being victimized and the search costs. Denoting by $\overline{z}_i$ the workers' expected search costs, we use (6) and (8) to derive the expected wage level in country i as follows:

$$\overline{w}_i = \gamma_i(\overline{H}_i + \phi_i c_i - k\upsilon_i) - (1-\gamma_i)\overline{z}_i, \tag{9}$$

From (4), (5), and (9), we obtain the equilibrium level of ϕ_i:

$$(\overline{H}_i - k\upsilon_i) - \frac{(r_i + s_i)c_i}{q(\phi_i)} = \gamma_i(\overline{H}_i + \phi_i c_i - k\upsilon_i) - (1-\gamma_i)\overline{z}_i. \tag{10}$$

The left-hand side of (10) represents the job-creation function, a downward-sloping curve in the space $(\phi_i, \overline{w}_i)$, whereas the right-hand side of (10) is the

wage curve, upward sloping in the same space. In addition to all the usual effects of search parameters on the tightness of the labor market, Equation (10) shows that a higher probability of being victimized induces firms to post fewer vacancies. This happens because a higher probability of being victimized enhances the expected victimization cost, discouraging firms from posting new vacancies.

Lemma 1 states that unskilled immigrants negatively impact the tightness of the labor market, whereas rather skilled ones improve labor market conditions.

Lemma 1. *The labor market tightness weakly increases (decreases) with immigration if and only if $H_j \geq H_i - z$ ($H_j < H_i - z$), that is, if immigrants are sufficiently skilled (unskilled) with respect to natives.*

From now on, we say that immigrants are relatively "skilled" ("unskilled") if $H_j \geq H_i - z$ ($H_j < H_i - z$). The explanation of Lemma 1 is straightforward; it is based on the fact that firms decide to open a vacancy before meeting applicants. Indeed, if immigrants are rather unskilled, the reduction in firms' labor costs caused by immigrants' search costs does not compensate for the decrease in expected productivity.

This result is consistent with Battisti et al. (2017), who argued that the wage gap between natives and immigrants is driven mainly by differences in outside options and skills. Moreover, they also found that, when immigrant workers have inferior outside options, immigration boosts firms' incentives to create vacancies.

3.2 Crime Decision

In line with Huang et al. (2004) and Dai et al. (2013), crime results from a deterministic, rational decision. Therefore, an agent will engage in criminal activity when returns to property crimes exceed the instantaneous value of looking for a job. Besides, after having committed a crime, a criminal who is not caught can look for a job. As in Burdett et al. (2003, 2004), each criminal steals a constant amount of resources k and keeps those resources in any case.[5] Nonetheless, criminal activity does not protect offenders from being victimized.

Following Dai et al. (2013), we write the instantaneous benefit of committing a crime net of victimization and incarceration costs as follows:

$$\pi_{ii} = k + (1-p)\omega_{ii} - k\upsilon_i - pd_{ii}, \tag{11}$$

and

[5] In our setting, crime revenue is the ratio between the total victimization cost, $k\upsilon_i(P_i+E_i)$, and the number of criminals, N_i. Total victimization cost is obtained by multiplying the expected victimization cost ($k\upsilon_i$) by the number of potential victims ($P_i + E_i$). Therefore, by definition of the victimization probability, the expected revenue simply becomes k. Moreover, for the sake of simplicity, we assume that criminals in jail receive no flow payments. This hypothesis does not affect our results. Indeed, Burdett et al. (2003, 2004) assumed a fixed flow payment for agents in jail; such a payment would only affect the intercept of the crime profit function.

$$\pi_{ij} = k + (1-p)\omega_{ij} - k\upsilon_i - pd_{ij}, \tag{12}$$

where $p \in (0,1)$ is the probability of being incarcerated, and d_{ij} is an additional incarceration cost.[6] Here, natives and immigrants differ in terms of their incarceration costs. This source of heterogeneity takes into account the fact that police generally target immigrants differently than natives. For instance, Moehling and Piehl (2009) showed that migrants are more likely to end up in jail than are natives. Moreover, natives and immigrants usually differ in terms of their social capital, crime opportunities, skills, and quality of legal services they can access. Finally, immigrants can also be deported after committing a crime. Following Dai et al. (2013), we assume $d_{ii} = 0$ and $d_{ij} > 0$. In particular, because immigration restrictions and police targeting likely depend on immigrants' law-breaking behavior (see, e.g., Mastrobuoni G., 2015; Pinotti, 2017; Fasani, 2018), we endogenize this cost, in line with Levitt (1996), by assuming that it positively depends on the immigrants' crime rate: $d_{ij} = d(n_{ij})$.[7]

3.3 Equilibrium Analysis

This section focuses on the relationship between immigration and crime, assuming that country i is the arrival country registering migration inflows from country j. In particular, we derive the equilibrium values of the victimization probability and study how immigration affects the crime rate in the arrival country.

Notice that, as Ortega (2000) argued, if there exists scope for migration from country j to country i, agents born in country i prefer to stay there. Thus, country j remains populated by natives, who never bore a search cost, and the value of being a jobseeker in country j, as well as profits from crime, will not change after the migration process. This means we can study only the effects of immigration on the crime rate in country i.

3.3.1 Equilibrium

In a domestic equilibrium, unemployed agents must be indifferent between looking for a job and committing a crime. Thus, since natives and immigrants differ in terms of both job and crime conditions, their respective equilibrium equations are:

$$\omega_{ii}(m_j, n_{ij}, \upsilon_i) = \pi_{ii}(m_j, n_{ij}, \upsilon_i) \tag{13}$$

and

[6] This specification comes from having assumed that every action (i.e., looking for a job or committing a crime) is instantaneous. If we assume that both actions require time, then the opportunity cost of looking for a job must be discounted by a factor $e^{-r\,dt}$. However, because $(1-p)e^{-r\,dt} < 1$, this would not affect our results.

[7] Notice that our conclusions hold even if we assume that immigrants bear a fixed incarceration cost Ãă la Dai et al. (2013).

$$\omega_{ij}(m_j, n_{ij}, \upsilon_i) = \pi_{ij}(m_j, n_{ij}, \upsilon_i). \tag{14}$$

Similarly, the equilibrium equation for country j is given by:

$$\omega_{jj}(\upsilon_j) = \pi_{jj}(\upsilon_j). \tag{15}$$

Hereafter, we restrict the analysis to situations in which an interior domestic equilibrium exists and is stable.[8] As in Ortega (2000), individuals from country j will move to country i if and only if the costs associated with migration can be redeemed through a higher job-seeking value (or crime value). In particular, assuming that countries are always in a domestic equilibrium, we can write the migration decision as follows:

$$\begin{cases} m_j = 0 \;\; if \;\; max\left[\widetilde{\omega}_{ij}, \widetilde{\pi}_{ij}\right] \leq \omega_{jj} = \pi_{jj} \\ m_j = 1 \;\; if \;\; max\left[\overline{\omega}_{ij}, \overline{\pi}_{ij}\right] > \omega_{jj} = \pi_{jj} \\ m_j = m_j^* \;\; if \;\; \omega_{ij} = \pi_{ij} = \omega_{jj} = \pi_{jj} \end{cases}, \tag{16}$$

where $\widetilde{\omega}_{ij}$ ($\widetilde{\pi}_{ij}$) and $\overline{\omega}_{ij}$ ($\overline{\pi}_{ij}$) are the job-seeking (crime) values of a j-born agent moving to country i under no migration and full migration, respectively. The first condition describes the no-migration equilibrium, whereas the second condition captures the opposite case of full migration from j to i. Finally, the last equation corresponds to the interior-migration equilibrium, where migration involves only a fraction of j-born agents.

Equations (10) and (13)−(16) determine the equilibrium levels of our endogenous variables: ϕ_i, υ_i, υ_j, n_j, and m_j. In the next section, we study how the victimization probability and the crime rate vary with the arrival of j-born agents as well as how the type of immigration (skilled or unskilled) depends on the host country's labor market characteristics.

3.3.2 Immigration and Crime

In our setting, immigration affects matching probability through the tightness of the labor market and hence affects the job-seeking value and returns to crime. This means that we can determine the impact of immigration on victimization probability by investigating how the domestic equilibrium depends on the tightness of the labor market. Proposition 1 concerns the relationship between immigration and victimization.

Proposition 1. *If, compared to natives, immigrants are relatively skilled (unskilled), then victimization probability weakly decreases (increases) with immigration.*

The proof of Proposition 1 follows from Lemma 1. Indeed, the arrival of unskilled immigrants decreases the tightness of the labor market (Lemma 1) and hence reduces the probability of finding a job. This causes a drop in the number

[8] In Appendix B, we discuss the necessary and sufficient conditions for the existence of a stable interior equilibrium.

of vacancies and an increase in the unemployment rate. Contraction of economic activity leads to a reduction in job-seeking value, and some unemployed agents will therefore decide to move from legal to illegal markets. The opposite holds in the case of relatively skilled immigration.

Because in a domestic equilibrium agents living in a country are indifferent between looking for a job and committing a crime, we can prove that, if immigrants are not too skilled, immigration always implies some foreign criminality. Empirical evidence supports the assumption that immigrants' average productivity is lower than the average productivity of natives (Battisti et al., 2017).

Lemma 2. *If $H_j < H_i + \frac{1-\widetilde{\alpha}_i}{\widetilde{\alpha}_i} z$, the fraction of immigrants involved in criminal activity is always positive.*

Related to Lemma 2, Lemma 3 determines the direction of migration when immigrants are not too skilled.

Lemma 3. *An interior migration equilibrium implies that, if $H_j < H_i + \frac{1-\widetilde{\alpha}_i}{\widetilde{\alpha}_i} z$, the victimization probability in the arrival country will be lower than or equal to the victimization probability in the departure country.*

The explanation of Lemma 3 passes through the definition of an interior migration equilibrium. Since in an interior equilibrium immigrants are indifferent between looking for a job in country i or in country j, they must also be indifferent between committing a crime in one country or the other. Therefore, j-born agents will migrate to country i if and only if the lower victimization cost in i compensates for the extra cost of incarceration.

So far, we have considered the case of homogeneous workers migrating from country j to country i. In reality, however, immigrants are heterogeneous in terms of both human capital and nationality. In addition, if, on the one hand, immigration affects victimization probability, it is also true, on the other hand, that immigration depends on the probability of being victimized in the home and host countries. In other words, immigration is endogenous. Assuming that countries differ only in terms of productivity, Proposition 2 determines when a country attracts only unskilled migrants instead of both types.

Proposition 2. *There exists a threshold level in labor market tightness below which a country attracts only unskilled immigrants.*

We know that j-born agents move to country i when the job-seeking value or the crime value redeem the costs associated with migration. In particular, each potential migrant knows that her impact is negligible on the arrival country's labor market tightness. Thus, in order to observe migration from j to i, the no-migration condition must be violated: $max\left[\widetilde{\omega}_{ij}, \widetilde{\pi}_{ij}\right] > \omega_{jj} = \pi_{jj}$. Hence, the labor market tightness of country i in autarky must be sufficiently high to satisfy this inequality. Because immigrants' benefits ($\widetilde{\omega}_{ij}$ and $\widetilde{\pi}_{ij}$) increase with their productivity, a critical value in the labor market tightness $\widetilde{\phi}_i$ will exist above which even skilled agents will find it convenient to migrate.

3.3.3 Testable Prediction

This section derives a testable implication of our model that also explains why previous studies have been inconclusive in establishing the relationship between immigration and crime. Empirical studies usually consider crime rate to be a suitable measure of crime. However, we know that this measure does not include firms that are victims of property crimes. Lemma 4 accounts for this issue, showing that both the crime rate and the victimization probability react to immigration in the same direction. In other words, crime rate represents a good proxy of victimization risk.

Lemma 4. *If immigration increases (decreases) the victimization probability, it also increases (decreases) the crime rate.*

According to Lemma 4, even if unskilled migration reduces the number of new firms looking for a worker and (therefore) the number of potential victims, this effect never discourages the entrance of some individuals to the crime market.

According to Proposition 2, countries with tight labor markets may attract both skilled and unskilled migrants. In this situation, some fraction of immigrants will enter the labor market and positively affect its conditions, whereas others will engage in criminal activity. This explains why it is hard, from an empirical point of view, to assess the relationship between immigration and crime. Nonetheless, as the next proposition states, our model allows us to determine a sufficient condition to observe a positive relationship between immigration and crime in the arrival country.

Proposition 3. *If the unemployment rate in the arrival country is sufficiently high, then the relationship between immigration and crime rate is positive.*

The intuition behind this result is that rational agents migrate if and only if the value of being a jobseeker or a criminal in their home country is lower than the value of being a jobseeker or a criminal in the arrival country. Therefore, when country i is characterized by a high unemployment rate, only unskilled immigrants may have an incentive to settle there. Indeed, in this situation, only unskilled migrants can have a job-seeking value in their home country lower than the job-seeking value in the arrival country. At the same time, Proposition 1 shows that, if immigrants are relatively unskilled, the relationship between immigration and crime is positive. In other words, a country with high unemployment will only attract workers with a low stock of human capital. Hence, firms will not open new vacancies, and both the crime rate and the victimization probability will increase.

Proposition 3 implies the existence of a threshold level of unemployment above which the relationship between immigration and crime is positive. Estimating this threshold is the objective of our econometric analysis.

4 Empirical Evidence

4.1 Data and Empirical Strategy

This section provides some empirical tests of whether our theoretical results are consistent with the data on migration and crime. Following Nunziata (2015), we exploit the increased immigration flows into western European countries in the 2000s to estimate the effect of changes in immigration patterns on the crime rate. Our objective is to assess whether the impact of immigration on crime is mediated by labor market tightness.

We construct our data by matching individual crime victimization data from the ESS with immigration penetration data by European region from the LFS and other sources collected for the years preceding the Great Recession (2002−2008) and with pre-determined census data on regional immigration by area of provenance collected before 2002. Our sample constitutes 12 western European destination countries, the only countries for which all data are available over the period of analysis: Austria, Denmark, Finland, France, Ireland, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the UK. Ninety-seven regions in total are covered in our analysis, with most regions coded NUTS 2 except for those in France, Denmark, and the UK, which are NUTS 1.

The ESS provides individual-level information on crime victimization, namely whether the respondent or household member has been a victim of assault or burglary within the last five years. These two types of crime, assault and burglary, constitute a significant proportion of all reported crimes. Aggregate European data on types of crime shows that the incidence of assault and burglaries generally correlates with the extent of other kinds of theft. Survey data can provide a more accurate measure of crime victimization than can administrative sources, since surveys collect information on all crime events, including those not reported to police (Buonanno et al., 2011; Lauritsen and Rezey, 2013).

We measure regional immigration using Eurostat LFS data, which is characterized by sampling rates between 0.2 and 3.3 percent of the total population and average region-per-year cell sizes that vary between 2,977 and 115,508 respondents across countries. Immigration shares are calculated for the previous five years in order to match them with the victimization data. Our preferred definition of an immigrant is, in line with most of the literature, an individual who was born abroad. This definition avoids distortions caused by differences in national legislation regarding naturalization. Of all immigrants born abroad who were surveyed by the LFS, around 71 percent were born in non-European countries. Summary statistics are provided in Table 1.

[Table 1 about here]

In line with Proposition 3, we use as a threshold variable the unemployment rate (ages 15-64). The data from Eurostat are measured at the regional level, allowing for a certain degree of variability in our sample. We also perform some

robustness checks using a measure of long-term unemployment from the OECD that is, however, only available at the country level. When estimating the effects of immigration on crime, we must handle unobservable regional factors that could affect both crime and immigration and thereby induce a spurious correlation between the two. Such factors could be time-varying, so simple fixed-effects estimates may be insufficient to account for the bias of the omitted variables.

A more general instrumental variable approach is thus advisable in this setting. Besides the ability to account for region-specific, time-varying omitted factors (that are not captured by regional dummies or by country-specific time dummies) possibly affecting migration patterns and crime victimization, this approach may account for more complex sources of measurement error in regional immigration.

Following Card (2001), Dustmann et al. (2013), and Bianchi et al. (2012), we use the predetermined geographical distribution of previous immigrants? flow to construct an instrument for subsequent flows in a specification in differences. These differences are measured by changes in migration flows toward European regions from world areas of provenance, weighted by the predetermined share of immigrants from the same areas located in each region. These changes in immigration patterns account for the exogenous supply (push) factors that increase immigration from each area of provenance, such as those related to wars, political repression, famine, economic stagnation, and other events exogenous to our outcome of interest. The exogenous changes in migration are weighted by the predetermined share of immigrants previously located in a region from each area of origin, since immigrants tend to locate in areas that have previously hosted individuals from the same area of provenance (Munshi, 2003).

In our specification in differences, changes in crime rate are regressed on changes in migration penetration. Assuming we have A possible flow areas a in the world and that, prior to the period under investigation, each region r in country c is characterized by a certain share $s^a_{c_i r}$ of immigrants from each area, the change in immigration in that region will be approximately equal to:

$$\Delta m_{c_i rt} \approx \sum_{a=1}^{A} s^a_{c_i r} \Delta \ln M^a_{c_i rt} - \Delta \ln P_{c_i rt}. \tag{17}$$

Equation (17) provides a basis for constructing an instrument for $\Delta m_{c_i rt}$ that aims to solve possible problems due to endogeneity and measurement errors. To this end, we define exogenous changes in immigration from each flow area of origin a as the change caused only by supply-push factors. These factors pertain to each flow area of origin and are unobservable, but their consequences may be observed by examining the marginal changes in global immigration patterns of individuals from each area a.

In each European region, however, the change in immigration from area a to region r could be caused by both exogenous supply (push) and endogenous demand (pull) factors that pertain to the region of destination. Therefore, we eliminate any changes in regional immigration that could be caused by demand

(pull) factors at the local level by considering changes in immigration from each flow area of origin a in all regions other than r. This process amounts to substituting $M^a_{c_irt}$ with M^a_{ht} in equation (17), where $h \neq c_ir$. Therefore, our instrument becomes:

$$\tau_{c_irt} = \sum_{a=1}^{A} s^a_{c_ir} \Delta \ln M^a_{ht} - \Delta \ln P_{c_irt}. \tag{18}$$

Equation (18) identifies an instrument for the total change in immigration in country c and region r at time t by using the changes in immigration from flow area a caused by exogenous supply (push) factors observed in all regions excluding r, weighted by the predetermined share of immigrants from area a in region r.

Our definition of flow areas a is provided by the census collected in 2000 (i.e., prior to the timeframe of the analysis). Therefore, in our baseline specification, we consider A=12 subcontinental flow areas for each region, and we derive the predetermined share at the regional level, that is, $s^a_{c_ir}$.[9]

The instrument in the baseline IV model becomes:

$$\tau_{c_irt} = \sum_{a=1}^{A} s^a_{c_ir} \Delta m^a_{ht} - \Delta \ln P_{c_irt}. \tag{19}$$

By instrumenting Δm_{c_irt} with (19) and including a set of regional controls X, we then estimate the following model of crime victimization in differences:

$$\Delta n_{ic_irt} = \beta \Delta m_{c_irt} + \gamma' \mathbf{X}_{c_irt} + \varepsilon_{c_irt}. \tag{20}$$

4.2 Empirical Findings

Table 2 reports our findings from estimating our IV models for five different levels of regional unemployment: higher than 4, 5, 6, 7, and 8 percent. The unemployment rate in the sample varies from a minimum of 2.6 percent to a maximum of 12.6 percent. Table 2 has three panels, each considering a different definition of immigrants: individuals born abroad, individuals born outside Europe, and foreign citizens.

All two-stage least squares (2SLS) estimates are equivalent to limited information maximum likelihood (LIML) estimates, since the model is just-identified. In all cases, the instrument is positively and significantly correlated with the immigration measure. The F-test statistic of excluded instruments is typically around 10 or larger, that is, relatively safe as regards weak instruments (Bound et al., 1995). In addition, in the presence of weak instruments, the bias increases with the number of instruments, whereas our just-identified IV model is median unbiased and is, therefore, likely immune from the weak instrument problem.

[9] The twelve subcontinental areas are North America, South and Central America, Northern Africa, Southern Africa, Near and Middle East Asia, other Asian countries, Oceania, Northern Europe, Western Europe, Eastern Europe, Southern Europe, and EFTA countries.

Columns 1 and 2 report the IV estimates and first-stage regression, respectively, for the entire sample. Although Column 2 shows that the instrument is positively correlated with the change in immigration and the F-test statistic is sufficiently high, the coefficient of Δm_{crt} reported in Column 1 is positive and statistically insignificant. This means that, consistently with Nunziata (2015), no causal relationship emerges between the arrival of new migrants and crime. This evidence remains unchanged even when we restrict the sample to regions with an unemployment rate above 4 percent (Columns 3 and 4), 5 percent (Columns 5 and 6), 6 percent (Columns 7 and 8), or 7 percent (Columns 9 and 10). In other words, the effect of immigration on crime victimization is never significant with unemployment below this level. However, the effect becomes positive and statistically significant once the unemployment rate rises above 8 percent (Columns 11 and 12). This result holds for all types of immigration and confirms Proposition 3: above a critical value of the unemployment rate, the crime rate positively responds to immigration.

[Table 2 about here]

As a further robustness check, we estimate the same model using a measure of long-term unemployment observed at the country level. Unfortunately, since long-term unemployment is only available at the country level and is less representative of frictional unemployment, we now lose the intra-country variability exploited in Table 2. The results are displayed in Table 3. Consistently with our previous findings, the point estimates for the effect of immigration on crime increase with higher values of long-term unemployment and are statistically significant only for the highest values of long-term unemployment (at the 5 percent level in panel B and the 10 percent level in panels A and C).

[Table 3 about here]

According to Proposition 2, regions characterized by a too low labor market tightness attract less-skilled immigrants, and this mechanism is crucial in explaining Proposition 3. Therefore, a fundamental test to validate our theoretical model consists of comparing the share of immigrants with primary, secondary, upper-secondary and tertiary education in regions with an unemployment rate higher than 8 percent with the rest of the sample. Table 4 provides the results of an independent t-test. For both low- and high-unemployment regions, we report the average share of immigrants having completed primary, secondary, upper-secondary and tertiary education, the corresponding standard errors, and the 95 percent confidence interval. All differences between the means of the low- and high-unemployment groups are highly significant (i.e., at least at the 5 percent level). In particular, as expected, the share of immigrants with an upper-secondary or tertiary education is higher in regions with low unemployment (i.e., less than or equal to 8 percent) than in regions with high unemployment (i.e.,

higher than 8 percent).[10] The next subsection concludes the analysis by calibrating our theoretical model in order to see if it is consistent with the empirical evidence of an unemployment threshold of 8 percent.

[Table 4 about here]

4.3 Numerical Calibration

Following Hornstein et al. (2011), we set the monthly real interest rate equal to 0.0041 (i.e., 5 percent per year) and the average monthly separation rate s_i at 3 percent. As in Hornstein et al. (2007) and Ortega (2000), we assume a Cobb-Douglas matching function with an elasticity coefficient of 0.5. This value agrees with the microeconometric estimates reported in Petrongolo and Pissarides (2001). As Hornstein et al. (2007) suggested, we consider $\gamma_i = 0.89$ to match a labor income share of 0.7. We normalize natives' human capital to 1 and assume a search cost for immigrants $z = 0.01$. The extra cost of being caught is set to zero for natives (i.e., $d_{ii} = 0$) and equal to $pd_{ij}n_{ij}$ for non-natives.

The remaining parameters (i.e., k, p, c_i, and d_{ij}) were calibrated to obtain reasonable values of our endogenous variables: n_i, n_{ij}, υ_i, and ϕ_i. According to the National Crime Victimization Survey, conducted by the U.S. Bureau of Justice Statistics, the rate of property victimization (υ_i) was 2.36 percent in 2017, with an estimated number of property crime offenses in the United States of $7,694,086$. We assume a labor market tightness of 0.12, which leads to a job-finding probability of 34.6 percent. This value is consistent with Shimer (2008) and Hall R. E. (2018), who estimated a job-finding probability between 34 and 31 percent for workers over a duration of fewer than six months. Finally, in line with our data, we assume a migration rate of 10 percent.

Table 5 reports the results of our numerical simulations. In particular, Panel A summarizes the values of the calibrated parameters, whereas Panel B shows our main results. In Column 1 of Table 5, we simulated the baseline scenario, that is, the situation in which $H_j = H_i - z$ and immigration has no effect on crime. This allows us to estimate the threshold level of unemployment $\hat{u}^T$ mentioned in Proposition 3. This threshold is 7.97 percent, corresponding to the 8 percent we found in the econometric analysis. Starting from these values, we notice that a reduction in immigrants' human capital leads to an increase in both victimization probability and crime rate (Column 2). As expected, this scenario implies an unemployment rate above $\hat{u}_i^T$. By contrast, when immigrants are relatively skilled, the crime rate and the victimization probability decrease with immigration, and the unemployment rate is lower than the threshold level of $\hat{u}_i^T$ (Column 3). Finally, notice that the fraction of foreign criminals is positive (Lemma 2), and it decreases with immigrants' human capital.

[10] We also performed the same test for all European countries, and the results remain qualitatively unchanged.

[Table 5 about here]

5 Conclusions

By studying a job-search model in which individuals may commit a crime instead of looking for a job, this paper aims to explain the lack of a clear relationship between immigration and crime. In particular, the endogenous nature of migration implies the existence of threshold effects in the arrival country's unemployment rate.

According to our findings, when the unemployment rate is sufficiently high, the arrival of new migrants causes an increase in the crime rate. This happens because a country with scarce employment opportunities offers low job-seeking value, so that country may only attract workers with a lower job-seeking value in their home countries. Such workers are typically unskilled, which is why a positive relationship emerges between immigration and crime. In fact, when immigrants' productivity is relatively low compared to natives' productivity, immigration depresses legal activities more than criminal ones, generating a positive relationship between immigration and crime, with clear negative welfare effects. On the other hand, countries with a low unemployment rate attract both skilled and unskilled immigrants, and the net effect of these two migratory flows is ambiguous.

We empirically tested our theoretical results, using the same European database employed in other studies, such as Nunziata (2015) and Battisti et al. (2017). Provided that European immigration is neither too skilled or too unskilled, we established that a positive relationship between immigration and crime emerges when we restrict the analysis to high unemployment regions, that is, to regions with an unemployment rate above 8 percent.

In terms of policy implications, this paper suggests that labor market reforms devoted to reducing frictional unemployment may also alleviate public safety problems.

Appendix

A. Proofs of Theoretical Results

This appendix provides the proofs of our theoretical results.

Lemma 1. *The labor market tightness weakly increases (decreases) with immigration if and only if $H_j \geq H_i - z$ ($H_j < H_i - z$), that is, if immigrants are sufficiently skilled (unskilled) with respect to natives.*

Proof of Lemma 1. From (10) and (14), we can define the following function:

$$G_i \equiv (1-\gamma_i)(\overline{H}_i + \overline{z}_i - kv_i) - \frac{(r_i+s_i)c_i}{q(\phi_i)} - \gamma_i \phi_i c_i.$$

By applying the implicit function theorem, we get:

$$\frac{\partial \phi_i}{\partial \delta_{ij}} = -\frac{\frac{\partial G_i}{\partial \delta_{ij}}}{\frac{\partial G_i}{\partial \phi_i}} = \frac{(1-\gamma_i)(H_j - H_i + z)}{c_i\left[\gamma_i - \frac{(r_i+s_i)}{q(\phi_i)^2}\frac{dq_i}{d\phi_i}\right] + (1-\gamma_i)k\frac{dv_i}{dF_i}\frac{dF_i}{d\phi_i}}.$$

.

For the stability of the labor market, we know that the slope of the wage curve must be greater than the slope of the job-creation curve: $c_i\left[\gamma_i - \frac{(r_i+s_i)}{q(\phi_i)^2}\frac{dq_i}{d\phi_i}\right] + (1-\gamma_i)k\frac{dv_i}{dF_i}\frac{dF_i}{d\phi_i} > 0$. Thus, $\frac{\partial \phi_i}{\partial \delta_{ij}} \gtreqless 0$ if and only if $H_j \gtreqless H_i - z$. Now, when we pass from the no migration equilibrium to the migration equilibrium, the variation of δ_{ij} is always non negative, thus, in the limit case of $d\delta_{ij} = 0$, we will have no variation in the tightness. □

Proposition 1. *If immigrants are relatively skilled (unskilled), compared to natives, then victimization probability weakly decreases (increases) with immigration.*

Proof of Proposition 1. From Equation (13) and the implicit function theorem, we can obtain the derivative of the victimization probability with respect to m_j:

$$\frac{dv_i}{d\delta_{ij}} = -\frac{\frac{\partial \omega_{ii}}{\partial \delta_{ij}} - \frac{\partial \pi_{ii}}{\partial \delta_{ij}}}{\frac{\partial \omega_{ii}}{\partial v_i} - \frac{\partial \pi_{ii}}{\partial v_i}}.$$

The stability condition requires that in a neighborhood of the equilibrium $\frac{\partial \omega_{ii}}{\partial v_i} - \frac{\partial \pi_{ii}}{\partial v_i} > 0$ (see Appendix B). At the same time, $\frac{\partial \omega_{ii}}{\partial \delta_{ij}} - \frac{\partial \pi_{ii}}{\partial \delta_{ij}} = p\frac{\partial \omega_{ii}}{\partial \delta_{ij}}$, with $p \in (0,1)$. Using the chain rule of derivatives, we have that $\frac{\partial \omega_{ii}}{\partial \delta_{ij}} = \frac{\partial \omega_{ii}}{\partial F(\phi_i)}\frac{\partial F(\phi_i)}{\partial \phi_i}\frac{\partial \phi_i}{\partial \delta_{ij}}$. Since both $\frac{\partial \omega_{ii}}{\partial F(\phi_i)}$ and $\frac{\partial F(\phi_i)}{\partial \phi_i}$ are positive, $\frac{\partial \omega_{ii}}{\partial \delta_{ij}}$ has the same sign of $\frac{\partial \phi_i}{\partial \delta_{ij}}$. Lemma 1 completes the proof. □

Lemma 2. *If $H_j < H_i + \frac{1-\widetilde{\alpha}_i}{\widetilde{\alpha}_i} z$, the fraction of immigrants involved in criminal activity is always positive.*

Proof of Lemma 2. Before immigration, when $m_j = 0$, the domestic equilibrium in country i implies $\widetilde{\pi}_{ii} - \widetilde{\omega}_{ii} = 0$, that is, $k - k\widetilde{\upsilon}_i - p\widetilde{\omega}_{ii} = 0$. If $H_j < H_i + \frac{1-\widetilde{\alpha}_i}{\widetilde{\alpha}_i} z$, then $\widetilde{\omega}_{ij} < \widetilde{\omega}_{ii}$, hence $k - k\widetilde{\upsilon}_i - p\widetilde{\omega}_{ij} > 0$. In other words, $\widetilde{\pi}_{ij} > \widetilde{\omega}_{ij}$, and, assuming that there is scope for migration, some immigrants will be involved in criminal activities. □

Lemma 3. *An interior migration equilibrium implies that, if $H_j < H_i + \frac{1-\widetilde{\alpha}_i}{\widetilde{\alpha}_i} z$, the victimization probability in the arrival country will be lower than or equal to the victimization probability in the departure country.*

Proof of Lemma 3. An interior migration equilibrium satisfies the following condition: $\omega_{ij} = \pi_{ij} = \omega_{jj} = \pi_{jj}$. In particular, using Equation (12), we can write $-k\upsilon_i - pd_{ij}(n_j) = -k\upsilon_j$. At the same time, from Lemma 2, we know that if $H_j < H_i + \frac{1-\widetilde{\alpha}_i}{\widetilde{\alpha}_i} z$, then $n_j > 0$. Given the fact that $d_{ij}(n_j)$ is positive and increases with n_j, we have that $\upsilon_i < \upsilon_j$. □

Proposition 2. *There exists a threshold level in labor market tightness below which a country attracts only unskilled immigrants.*

Proof of Proposition 2. Denote with $\widetilde{\phi}_i^T$ the value of the tightness such that $\widetilde{\pi}_{ij}^T = \pi_{jj}$ when $H_j = H_i - z$. From the proof of Lemma 2, we know that $\widetilde{\pi}_{ij}^T = \pi_{jj} = \omega_{jj} > \widetilde{\omega}_{ij}^T$. Taking the derivative of returns to crime w.r.t. H_j, we have that $\frac{d\widetilde{\pi}_{ij}^T}{dH_j} \gtreqless \frac{d\pi_{jj}}{dH_j}$ iff $\widetilde{\alpha}_i^T \gtreqless \frac{d\omega_{jj}}{dH_j}\Big|_{H_j = H_i - z}$. Therefore, if $\widetilde{\phi}_i^T$ is sufficiently low, we have that $\widetilde{\alpha}_i^T < \frac{d\omega_{jj}}{dH_j}\Big|_{H_j = H_i - z}$, and immigrants with a productivity level higher than $H_i - z$ will remain in their home country, whereas unskilled migrants will decide to enter country i. □

Lemma 4. *If immigration increases (decreases) the victimization probability, it also increases (decreases) the crime rate.*

Proof of Lemma 4. The crime rate can be written in terms of victimization probability as follows:

$$n_i = \frac{(2F_i + s_i)\upsilon_i}{F_i + s_i + F_i\upsilon_i}.$$

Deriving this expression with respect to υ_i, we get $\frac{dn_i}{d\upsilon_i} = \frac{(2F_i+s_i)(F+s_i)}{(F_i+s_i+F_i\upsilon_i)^2} > 0$. □

Proposition 3. *If the unemployment rate in the arrival country is sufficiently high, then the relationship between immigration and crime rate is positive.*

Proof of Proposition 3. According to Proposition 2, there exists a threshold level in the labor market tightness below which a country attracts only unskilled immigrants. Let us define with $\widehat{u}_i^T$ the unemployment rate corresponding to this threshold level. Since there is a negative relationship between the unemployment rate and the labor market tightness, when the unemployment rate of country i in autarky is higher than $\widehat{u}_i^T$, only unskilled immigrants will arrive and, for Proposition 1 and Lemma 4, we know that both the crime rate and the victimization probability will increase. □

B. Equilibrium Properties

This appendix provides two important additional results on the existence of a stable, interior equilibrium for the victimization probability. Let $\upsilon_i \in (0,1)$ be the victimization probability in equilibrium, and consider an increase from υ_i to $\upsilon_i + \eta$, with $\eta > 0$ and sufficiently small. If $\omega_{ii}(\upsilon_i + \eta) > \pi_{ii}(\upsilon_i + \eta)$, at $\upsilon_i + \eta$ looking for a job is more profitable than committing a crime. Therefore, some agents will move from the illegal to the legal market, and both the victimization probability and the crime rate will decrease. In this case, the economy moves back to υ_i. Now, consider a reduction in the victimization probability from υ_i to $\upsilon_i - \eta$. The stability of the equilibrium will require $\omega_{ii}(\upsilon_i - \eta) < \pi_{ii}(\upsilon_i - \eta)$. Since $\omega_{ii}(\upsilon_i) = \pi_{ii}(\upsilon_i)$, and both function are differentiable, we can take the limit of the fractional incremental ratio. The two conditions collapse into the following expression: $\frac{\partial \omega_{ii}}{\partial \upsilon_i} > \frac{\partial \pi_{ii}}{\partial \upsilon_i}$.

The next lemma states a necessary condition for equilibrium stability that has been used to prove our main results in Appendix A.

Lemma 5. *A necessary condition for the stability of the victimization rate is:* $1 - p - p\alpha(\upsilon_i) > 0$.

Proof of Lemma 5. Derive ω_{ii} and π_{ii} with respect to υ_i and take the difference. For the stability condition, we must have that:

$$\frac{\partial \omega_{ii}}{\partial \upsilon_i} - \frac{\partial \pi_{ii}}{\partial \upsilon_i} = p(H_i - k\upsilon_i)\frac{d\alpha_i}{dF_i}\frac{dF_i}{d\phi_i}\frac{\partial \phi_i}{\partial \upsilon_i} + k(1 - p - p\alpha_i) > 0.$$

From Equation (10), we know that $\frac{\partial \phi_i}{\partial \upsilon_i} < 0$, then $p(H_i - k\upsilon_i)\frac{d\alpha_i}{dF_i}\frac{dF_i}{d\phi_i}\frac{\partial \phi_i}{\partial \upsilon_i} < 0$ and therefore a necessary condition for the equilibrium stability is $1 - p - p\alpha(\upsilon_i) > 0$. □

Taking advantage of Lemma 5, Lemma 6 restricts the space of parameters that guarantees an interior solution for the victimization probability.

Lemma 6. *An interior equilibrium of the victimization probability requires that* $H_i \in \left(k\frac{1+\alpha_i}{\alpha_i}, \frac{k}{p\alpha_i}\right)$.

Proof of Lemma 6. From Equation (13), we can get the following relation:

$$\upsilon_i = \frac{k - pH_i\alpha_i}{k(1 - p - p\alpha_i)}.$$

We know that γ_i, r_i, s_i, $\alpha_i \in (0,1)$, and $1 - p - p\alpha_i > 0$ (Lemma 5). Thus, $\frac{k - pH_i\alpha_i}{k(1-p-p\alpha_i)} \in (0,1)$ if and only if $H_i \in \left(k\frac{1+\alpha_i}{\alpha_i}, \frac{k}{p\alpha_i}\right)$. □

Notice that, if the victimization rate ranges from zero and 1, also the crime rate lies in the same interval. Indeed, using the definition of the victimization rate, we can write $n_i = \frac{\upsilon_i}{1+\upsilon_i}(2 - u_i)$. Since $2 - u_i \leq 2$ and $\frac{\upsilon_i}{1+\upsilon_i} \in \left(0, \frac{1}{2}\right)$, we have that also n_i ranges from zero and 1.

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TABLES AND FIGURES

Table 1: Summary statistics by country

Country	Foreign Nationals	Born Abroad	Crime Victims	Age	Male	Financial Wealth	Years of Education
AT	9.6	15.2	9.8	43.8	46.3	0.3	12.3
CH	30.9	33.5	17.2	47.4	45.7	0.8	11.5
DK	3.4	5.6	24.6	46.9	49.5	0.6	13.1
ES	4.0	5.6	21.8	45.2	48.3	0.1	11.0
FI	1.4	2.3	30.6	46.2	48.1	0.4	12.4
FR	4.9	10.2	26.2	46.6	46.0	0.3	12.2
GB	4.8	8.3	25.0	47.6	45.7	0.8	13.0
IE	4.8	8.3	18.8	46.0	44.4	0.4	12.7
NL	3.9	12.0	18.9	47.9	44.4	0.5	12.9
NO	3.7	7.1	22.8	44.9	52.4	0.6	13.3
PT	2.4	5.4	16.5	48.7	39.7	0.2	7.4
SE	4.5	12.0	25.9	45.9	50.2	0.3	12.3
Total	7.2	10.4	20.6	46.4	47.0	0.4	12.0

Sample averages of main variables. Immigration measures are calculated from LFS data.

Table 2: IV difference regressions of crime victimization

	Δn_{crt}	Δm_{crt}	Δn_{crt}	Δm_{crt}	Δn_{crt}	Δm_{crt}	Δn_{crt}	Δm_{crt}	Δn_{crt}	Δm_{crt}	Δn_{crt}	Δm_{crt}
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	IV	1st stage	IV $UR > 4$	1st stage	IV $UR > 5$	1st stage	IV $UR > 6$	1st stage	IV $UR > 7$	1st stage	IV $UR > 8$	1st stage
A. Born abroad												
Δm_{crt}	0.213		0.106		0.394		0.577		1.059		1.192**	
	(0.306)		(0.319)		(0.674)		(0.384)		(0.664)		(0.574)	
Instrument		0.483***		0.504***		0.478***		0.869***		0.691***		1.000***
		(0.086)		(0.095)		(0.154)		(0.190)		(0.250)		(0.282)
Observations	265	265	218	218	149	149	118	118	91	91	72	72
F test excl. instr	26.13		24.33		9.198		24.09		10.50		17.99	
B. Born outside Europe												
Δm_{crt}	0.174		0.089		0.451		0.538		0.955		1.086**	
	(0.250)		(0.265)		(0.753)		(0.350)		(0.588)		(0.517)	
Instrument		0.591***		0.604***		0.417**		0.933***		0.767**		1.099***
		(0.111)		(0.123)		(0.192)		(0.234)		(0.309)		(0.348)
Observations	265	265	218	218	149	149	118	118	91	91	72	72
F test excl. instr	24.70		22.36		4.135		16.78		8.689		15.21	
C. Foreign national												
Δm_{crt}	0.155		0.078		0.438		0.531		0.804		0.981**	
	(0.224)		(0.235)		(0.744)		(0.337)		(0.489)		(0.486)	
Instrument		0.661***		0.683***		0.429*		0.945***		0.911**		1.216***
		(0.130)		(0.145)		(0.240)		(0.303)		(0.388)		(0.427)
Observations	265	265	218	218	149	149	118	118	91	91	72	72
F test excl. instr	22.12		19.86		3.247		10.62		7.622		12.09	

This table presents the first- and second-stage estimates of our IV regressions for different levels of the unemployment rate. Robust standard errors in parentheses.
Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 3: IV difference regressions of crime victimization (using LTUR)

	$LTUR > 1.25$	$LTUR > 1.4$	$LTUR > 2.8$
	(1)	(2)	(3)
	A. Born abroad		
Δm_{crt}	0.324	0.463	0.602*
	(0.346)	(0.296)	(0.313)
Observations	171	119	97
F test excl. instr	5.889	5.889	5.889
	B. Born outside EU		
Δm_{crt}	0.268	0.398	0.490**
	(0.284)	(0.248)	(0.250)
Observations	171	119	97
F test excl. instr	6.585	6.585	6.585
	C. Foreign national		
Δm_{crt}	0.223	0.346	0.414*
	(0.236)	(0.218)	(0.213)
Observations	171	119	97
F test excl. instr	3.646	3.646	3.646

This table presents the second-stage estimates of our IV regressions for different levels of long-term unemployment rate. Robust standard errors in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Group t-test for high and low unemployment regions

	Obs	Mean	Std. Err.	[95% Conf.	Interval]
			Primary		
$UR \leq 8\%$	6,444	0.109	0.004	0.101	0.117
$UR > 8\%$	1,238	0.250	0.012	0.226	0.275
Difference		-0.141	0.010	-0.162	-0.121
			Secondary		
$UR \leq 8\%$	6,444	0.179	0.005	0.170	0.188
$UR > 8\%$	1,238	0.221	0.012	0.198	0.244
Difference		-0.042	0.012	-0.066	-0.019
			Upper Secondary		
$UR \leq 8\%$	6,444	0.289	0.006	0.278	0.300
$UR > 8\%$	1,238	0.218	0.012	0.195	0.241
Difference		0.071	0.014	0.044	0.098
			Tertiary		
$UR \leq 8\%$	6,444	0.355	0.006	0.344	0.367
$UR > 8\%$	1,238	0.303	0.013	0.277	0.329
Difference		0.052	0.015	0.023	0.081

This table reports the results of an independent group t-test comparing the share of immigrants with primary, secondary, upper secondary and tertiary education in sample regions with an unemployment rate higher than 8 percent with the rest of the sample. The null hypothesis is that the difference between the mean of the group with $UR \leq 8\%$ and the mean of the group with $UR > 8\%$ is zero.

Table 5: Numerical Analysis

	Symbol	Baseline	Low H_j	High H_j	Theory
A. Calibrated parameters					
Natives' human capital	H_i	1	1	1	
Immigrants' human capital	H_j	0.99	0.98	1	
Skill threshold	$H_i - z$	0.99	0.99	0.99	
Stolen goods	k	0.023	0.023	0.023	
Probability of being caught	p	0.025	0.025	0.025	
Crime additional cost	d_{ij}		0.041	0.041	
Firms' search cost	c_i	0.927	0.927	0.927	
B. Results (%)					
Labor market tightness.	ϕ_i	12	11.989	12.012	Lemma 1
Matching probability in i	$F(\phi_i)$	34.641	34.626	34.658	
Victimization probability	υ_i	2.36	2.365	2.355	Proposition 1
Fraction of foreign prisoners	n_{ij}/m_j		11.791	0.618	Lemma 2
Victimization probability in j	υ_j	3.42	3.42	3.42	Lemma 3
Crime rate	n_i	4.436	4.444	4.426	Lemma 4
Unemployment threshold	$\hat{u}_i^T$	7.97	7.97	7.97	Proposition 3
Unemployment rate	$\hat{u}_i$	7.97	7.973	7.966	Proposition 3

This table presents the numerical calibration of our theoretical model. The values of calibrated parameters are in Panel A, whereas the values of endogenous variables are in Panel B. The baseline scenario refers to the no-migration equilibrium, then we reduced and increased immigrants' human capital to check the lemmas and propositions recalled in the last column.

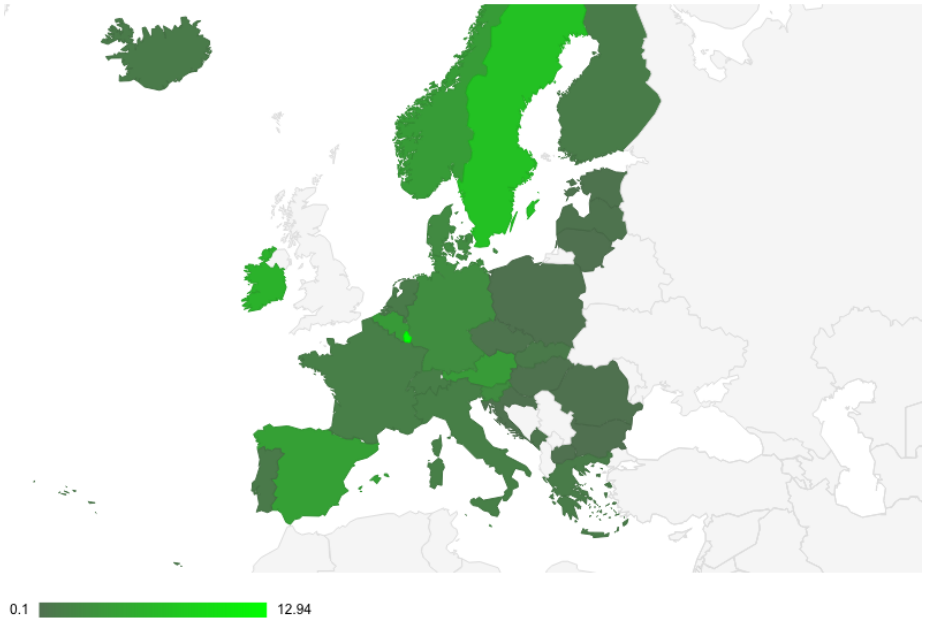

Figure 1: Percentage of foreign-born population aged 15-64 (average 2009-2018)

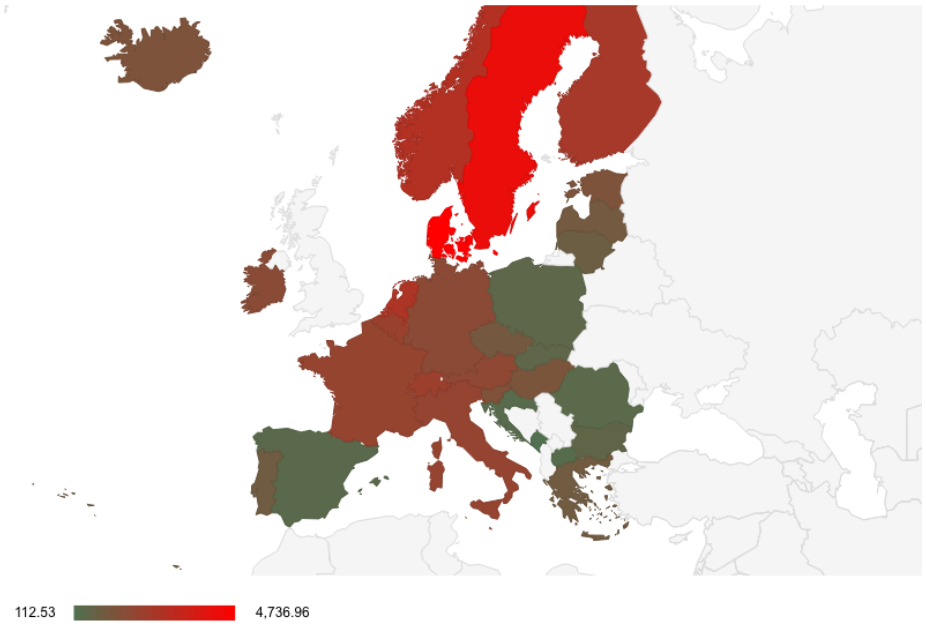

Figure 2: Number of thefts per 100,000 inhabitants (average 2008-2017)

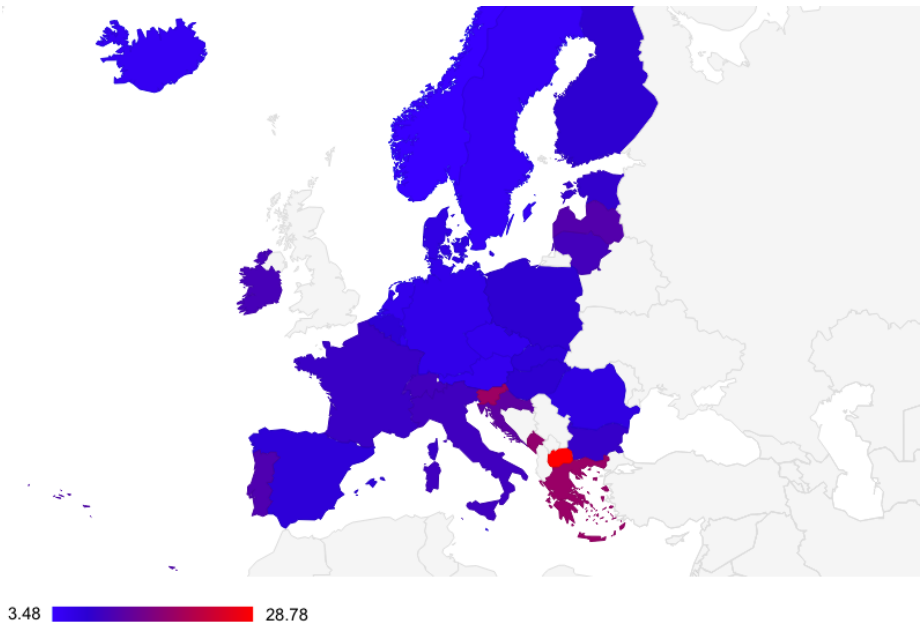

Figure 3: Unemployment rates (average 2007-2018)

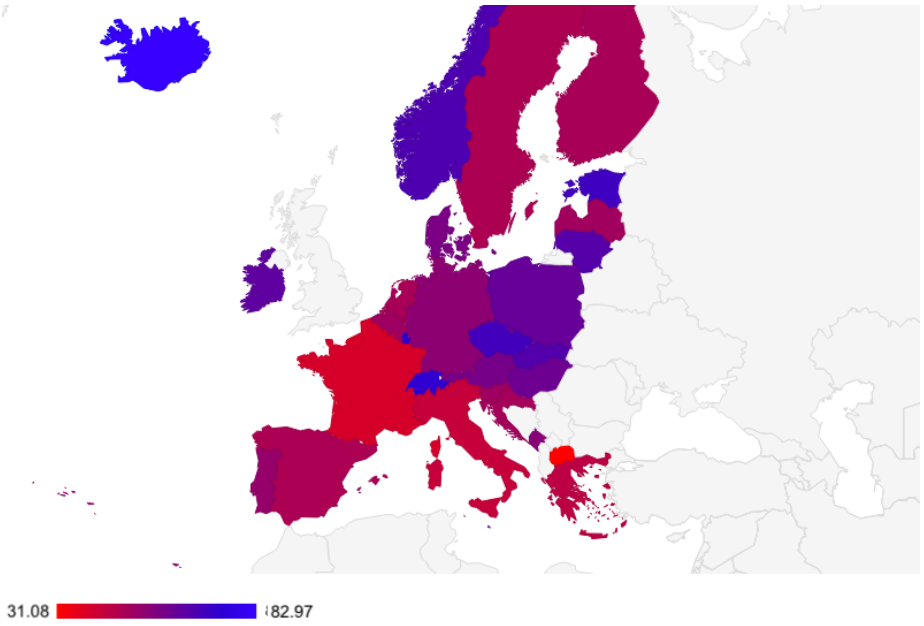

Figure 4: Percentage of employed immigrants (average 2009-2018)

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