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Migration and Labor Market Imbalances:

Do Immigrants Move to Where

Their Labor is Needed?

HABILITATION THESIS

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Declaration

I hereby declare that the Habilitation Thesis titled *Migration and Labor Market Imbalances: Do Immigrants Move to Where Their Labor is Needed?* is my own work and that I have cited all of the literature and other expert resources therein in accordance with applicable legal regulations, the Internal Rules and Guidelines of Masaryk University, and the internal managing acts of Masaryk University and the Faculty of Economics and Administration.

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Abstract

The economic literature suggests that immigrants are more fluid than natives in responding to changing shortages in the labor market. Drawing on the EU LFS and EU SILC datasets, we study the relationship between residual wage premia as a measure of skill shortages in different occupation-industry-country cells and the shares of immigrants and natives working in these cells. We confirm that immigrants from the EU-12 and the rest of Europe (outside the EU) are more responsive to skill shortages in comparison with the natives, and we find statistically significant positive results for African and American immigrants in specific economic, institutional, and policy contexts. Immigrants appear to be more responsive to skill shortages in relatively poorer and high-unemployment countries relative to the natives. This implies that immigration can help these economies with fluid labor. The relative responsiveness of some immigrant groups declined during the crisis years (those from the rest of Europe), whereas other groups of immigrants became particularly fluid during the Great Recession, such as low-skilled immigrants from EU-12 and the high-skilled African and American immigrants. Our results suggest that immigrants may play an important role in labor adjustment during times of asymmetric economic shocks, and support the case for well-designed immigration policy and free movement of workers within the EU.

Key words: labor supply, migration, skill shortage, institutions, policy, integration

Acknowledgments

Contents

1 Introduction

In the economic literature, labor mobility is seen as a way to improve the flexibility of the labor market, facilitating its adjustment to shifts in employment demand between sectors of the economy, demographic shocks on the supply side, and other external influences (see e.g. Kahanec and Zimmermann, 2016, and Ritzen and Zimmermann, 2014). Labor mobility can be low in segmented labor markets with barriers to mobility between submarkets, which results in slower adjustment to structural shocks, leading to the contemporaneous presence of skill shortages and unemployment. When immigrants fill jobs that have been vacant due to skill shortages or when immigrants move out of sectors suffering from negative economic shocks to take up jobs in booming sectors, they facilitate the adjustment of the economy to structural shocks.

Migration costs faced by workers born in the EU may be substantial and prevent people from moving across regions. Slow labor market adjustment can lead to significant economic costs, which include the costs of forfeited production due to vacant positions, unemployment and loss of earnings, the social costs of unemployment benefits, and other indirect costs. According to Lucifora and Origo (2002), these costs, including short- and long-term as well as direct and indirect components, were in the range of 6.9 – 7.1% of GDP across selected EU countries in 1999. Bennet and McGuinness (2009) find that hard-to-fill and unfilled vacancies are related to substantially lower firm productivity. Moreover, skill gaps contribute to skill mismatch in filling vacancies, with both under- and over-skilling lowering labor productivity (Tang and Wang, 2005; Quintini, 2011). With many unfilled high-skilled positions, an

economy performs below its potential in terms of innovation. Furthermore, skill shortages can lead to a broadening of wage differentials across sectors and skills, with wages for sought-after skills rising and wages for skills in excess supply dropping (Neugart and Schömann, 2002). This can contribute to increasing inequalities between the wages of skilled and unskilled workers (Lucifora and Origo, 2002).

1.1 Can migrants fill labor shortages?

Labor shortages and skill mismatches cause involuntary company adjustments, reduced productivity levels, and diminished economic growth prospects. They also lead to overqualification among workers (working in a job below one's education level), which can cause productivity loss for companies and wage penalties for workers. The extent to which migration and migration policy can address the issue of labor shortages and skill gaps is a widely debated issue. Martin and Ruhs (2011) suggest several methods to be used by employers to eliminate labor shortages, e.g. increasing wages, training less skilled workers, changing production processes, increasing imports, and admitting the migrant labor force. The latter can lead to over-dependence on migrants in some sectors. Several studies suggest that managed migration can solve the labor shortage problem (Boswell et al., 2004; Kahanec and Zimmermann, 2010).

A study by Ruhs and Anderson (2008) on labor market shortages and immigration policy attempts to analyze the key question of how to connect the admission of migrants with the labor market needs in the destination country, while emphasizing the controversy in approaches toward filling labor and skill shortages with the migrant labor force. Employers often claim that labor shortages should be filled by migrants as native workers are either not willing or qualified to perform certain jobs,

while labor unions often propose that it is mere exploitation of cheap labor. Ruhs and Anderson (2008) emphasize that there is no universal definition for skills shortage and no optimal policy to address this issue, as shortage and skill evaluation depends on employers. According to the authors, employers may prefer migrants because they tend to have higher skills and a better "attitude" to work, they have lower wage and employment expectations, and because of migrant characteristics and immigrant status restrictions or a readiness to accept jobs below their skills. The authors claim that in some industries, existing shortages and an overreliance on migrants could have been caused by a low level of labor market regulation and low level of vocational training (e.g. in the UK construction sector), or low wages and poor working conditions (social care in the UK).

A study by Kahanec et al. (2013) analyzes existing structural inefficiencies in labor markets characterized by labor and skill shortages and mismatches. The authors suggest that improved labor market flexibility could improve labor market adjustment, particularly in sectors with low resident labor mobility. In this case, the foreign labor force could be an option to mitigate labor shortages. A study on the labor market assimilation of immigrants in Spain by Fernández and Ortega (2006) finds that immigration was important for satisfying the labor demand in many sectors, such as services and construction, where the native force supply would not meet the demand. They also find that immigration helps to reduce wage pressures. However, the analysis shows that there might be challenges for Spain to retain the immigrant flows.

1.2 Migrants' responsiveness to skill shortages

Studying the effects of immigration on the US labor market, Borjas (2001) finds that newly arrived immigrants tend to settle in states with higher wages (paid for the skills migrants possess) and consequently help to equalize economic opportunities across states. This could be explained by the fact that newly-arrived immigrants, after deciding to depart their home country and actually leaving it, have already incurred a significant proportion of the costs of mobility. This proportion of migration costs does not influence their future location decisions within the destination labor market. In contrast, the costs of mobility within the domestic labor market influence the decisions of the native employees and of earlier immigrants.

The theoretical model conceptualized by Borjas (2001) illustrates how immigration can facilitate the adjustment of labor markets after temporary or structural shocks, thereby contributing to economic efficiency. This is how immigration can be seen as grease on the labor market wheels (Borjas 2001). The impact of immigration grease may diminish with the assimilation of immigrants into local environments as their costs of departing their current positions may become more similar to those of natives. In addition, immigration grease may be impeded by policies that restrict geographic or job mobility directly or indirectly linked to immigrant status. This is how the economic, institutional and policy context can have a role in determining how responsive low- and high-skilled immigrants are to labor market imbalances as compared to natives. The empirical analysis can shed light on the country characteristics that influence how immigration can reduce labor market imbalances and contribute to its flexibility.

Empirical findings confirm that immigrants are more responsive to wage differentials in the labor market than natives. This is found in the US labor market (Borjas, 2001), in Spain (Amuedo-Dorantes and De la Rica, 2010, who use a measure of employment prospects rather than wages), in Norway (Røed and Schøne 2012), the UK (Dustmann, Frattini and Preston, 2012) and in the EU (Guzi et al. 2015).

In this study, we contribute to the literature by exploring the diversity across EU member states to analyze how immigrants' relative responsiveness to skill shortages varies across institutional contexts, for different types of immigrant groups, and over the business cycle. On this basis, five research questions emerge that are important both for our understanding of immigrants' labor market mobility and in understanding implications for migration and integration policies.

- First, are immigrants more or less responsive than natives to skill shortages across and within EU labor markets?

- Second, under what economic, institutional, and policy contexts do immigrants respond to skill shortages more (or less) fluidly than natives?

- Third, how does responsiveness to labor market imbalances vary across different immigrant groups in terms of their origin and time since immigration?

- Fourth, how does the responsiveness of immigrants to skill shortages vary with demographic characteristics?

- Fifth, how does responsiveness to skill shortages vary over the business cycle?

We address these questions by investigating the labor markets of the EU-15, primarily using data from the EU Labor Force Survey (EU-LFS) and the EU Statistics on Income and Living Conditions (EU-SILC). The Member States that joined the EU in 2004, 2007, and 2013 are not included in the analysis due to the relatively more limited

inflow of immigrants into these countries and resulting small sample sizes (Kahanec and Zaiceva, 2009).

In this work, we build on the approach of Guzi et al. (2015, 2018), who are the first to measure the responsiveness to skill shortages of immigrants relative to natives in the EU-15. We contribute novel elements to the literature on labor mobility between different types of immigrants and their responsiveness to labor market imbalances. We further contribute to the policy debate by investigating the labor market fluidity of immigrants across economic, institutional, and policy contexts. In particular, we investigate if the mobility of immigrants differs between countries with different levels of GDP, economic growth, unemployment rate, generosity of welfare spending, openness to admitting immigrant workers, and the scale of immigration. Finally, we study whether and how various low- and high-skilled immigrant groups in the EU-15 responded to asymmetric economic shocks across sectors, occupations, and states before and during the Great Recession.

This study is structured as follows. In the second chapter, we introduce a theoretical framework to formalize the location decisions by natives and immigrants. We develop a measure of skill shortages and describe the estimation strategy to identify the average responsiveness of immigrants to skill shortages as compared to natives. In the third chapter, we introduce the data and compare the labor market outcome of immigrants and natives. The fourth chapter reports the results of the baseline finding and measures the variation in immigrants' responsiveness to labor and skill shortages across demographic characteristics. In the fifth chapter, we show how immigrants' responsiveness to skill shortages varies in economic, institutional, and policy contexts. In the sixth chapter, we present results over the business cycle.

2 Methodology and empirical framework

The neoclassical theory of migration asserts that migration is stimulated primarily by rational economic considerations of relative benefits and costs, mostly financial but also psychological (Todaro and Smith 2006). The origins of the theory date back to works of Hicks (1932), Lewis (1954), and Harris and Todaro (1970), who explained migration in the process of economic development and argued that migration is driven by geographic differences in labor supply and demand and the resulting differentials in wages between labor-rich versus capital-rich countries. Under the assumption of full employment, it predicts a linear relationship between wage differentials and migration flows (Bauer and Zimmermann 1999; Massey et al. 1993; Borjas 2008). In the extended neoclassical models, migration is determined by *expected* rather than actual earnings and the key variable is earnings weighted by the probability of employment (Bauer and Zimmermann 1999; Massey et al. 1993; Czaika 2015).

Human capital theory enriches the neoclassical framework by incorporating individual socio-demographic characteristics as an important determinant of migration at the micro-level (Bauer and Zimmermann 1999, Sjaadstad 1962). Human capital endowments, skills, age, marital status, gender, occupation, labor market status, as well as preferences and expectations, strongly affect migration choices. Heterogeneity between individuals is an important factor and different individuals in the same sending country demonstrate different propensities to migrate and preferences for various destination countries (Bonin et al. 2008). The propensity to migrate generally decreases with age and typically increases with education level (Bauer and Zimmermann 1999).

The theoretical framework of this work is based on the model first presented by Borjas (2001). The basic intuition of his model is that immigrants can be expected to be more fluid than natives in responding to changing skill and labor imbalances in the labor market. This is because immigrants' costs of departing their home, job, and networks of family members and friends in the country of origin are sunk upon arrival to a new country.[1] Therefore, it costs immigrants little to choose one place above another as a destination. It follows that this should be especially true for newly-arrived immigrants, not yet deeply amalgamated in their new milieu in the receiving country. In contrast, natives' decision to move entails pecuniary and non-pecuniary costs of parting with their home, job and networks. As a result, the location decisions of immigrant workers should be more responsive to wage differentials than those of natives.

Following Borjas (2001), our model assumes that natives and immigrants are allocated across states (C) and occupation-industry groups (K). Let W_{kc} denote the wage of worker $k \in K$ in country $c \in C$. We assume that W_{kc} is net of any adjustment costs, such as re-qualification costs, which are fixed and equal for all workers in a given country and occupation-industry group. A worker moves to a new country or to a new occupation-industry group from their original country (c_0) and occupation-industry group (k_0) if

$$max_{c \in C, k \in K}(W_{kc}) - W_{k_0 c_0} - D > 0 \qquad (1)$$

where D stands for the costs of moving between countries, occupations, and industries, and, more specifically, it is assumed to include all pecuniary and non-pecuniary (psychological) costs of leaving behind the country, occupation, and industry of origin.

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[1] Sunk costs include monetary and nonmonetary (e.g. social costs) investments made by immigrants that are nonrefundable (lost) after movement.

It is reasonable to assume that for natives, moving costs can be substantial, and thus moves occur only when the incentives (e.g. wage differential) are large. In contrast, for immigrants these costs are sunk upon arrival and thus assumed to be zero.[2] Following this argument, new immigrants can be expected to be the most responsive to wage differentials among all other immigrant groups, who are in turn likely to be less fettered by D than the natives. The more time passes from initial immigration, the more similar the migration decisions of immigrants become compared to those of natives, due to the gradually increasing attachment to the location and employment.[3]

It is clear that as long as $D > 0$, the cost induces friction into labor market adjustment, as there can be situations in which wage differentials persist across countries and occupation-industry groups without inducing relocation. This can lead to inefficiencies in the allocation of workers across industries and occupation groups. In principle, capital flows could lead to the equalization of wage differentials, but with substantial lags and adjustment costs.

2.1 Measuring skill shortages

The term skill or labor shortage has no universally accepted definition. It is used to denote a shortfall of individuals in the workforce (labor shortage), but also to refer to a

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[2] Immigrants may come to the EU not only for economic reasons, but also as refugees or as relatives or dependent minors of economic immigrants. The model assumes that immigrants make a decision under perfect information. The costs of migration may be assumed to differ by the country of origin and destination, by individual skills or other circumstances. Such cost differences could be, for example, due to the distance between the home and the new language. Nevertheless, for the purposes of this work, it suffices to assume this simplified cost structure. The model could be extended to a more complex cost structure in a straightforward way. In addition, the model could be presented in a dynamic version, with wages and costs as stochastic variables. In this case, the key relationships would hold in terms of expected present values.

[3] On the process of integrating immigrants into destination economies, see Constant, Gataullina and Zimmermann (2009).

gap between workers and jobs in the economy (mismatch) (Trendle, 2008). *Labor shortage* is generally conceptualized as a disequilibrium state of excess demand (Zimmermann, Bonin, Fahr, & Hinte, 2007, p 69). Defined in the most basic sense, labor shortages arise where the demand for workers in a particular occupation exceeds the supply of workers who are qualified, available and willing to do that type of work (Veneri, 1999). It may arise in the short term from sudden shifts in consumption patterns, trade patterns or have a more long-lasting nature due to rapid structural changes in the economy typically spurred by technological progress.

Skill shortage is a more specific way to approach the concept of labor shortages. Skill shortages may have a number of forms that can be proxied through different parameters, and also require different policy interventions (Rutkowski 2009), e.g. a skill shortage of workers might occur in occupations in which the specific skills cannot be easily substituted. This might happen in the aftermath of economic restructuring biased towards production that requires specific skills. A second type of skill shortage is possible when there are workers with occupational skills that are in demand, but they lack other essential skills, such as IT skills or soft skills (soft-skills gap) (see also Anderson and Ruhs 2008; Trendle 2008). Striestka-Ilina (2007) uses the term *skill gaps* to describe a qualitative mismatch between the supply or availability of human resources and the requirements of the labor market. This term is used with respect to employers who are not satisfied with the overall skill-set of the workforce – existing or labor market entrants – who might be lacking a variety of skills despite having acquired education.

The *mismatch* is generally defined as the occurrence of a shortage of some skills/occupations and a simultaneous excess of other skills (Arratibel et al. 2007;

Rutkowski, 2009). Different 'types' of mismatch on the labor market have been proposed (Boswell, Stiller, and Straubhaar 2004; Anderson and Ruhs 2008) as follows:

- Qualitative mismatch appears when the qualifications of workers and the qualification profiles of vacancies are not matched;

- Regional mismatch occurs when unemployed persons seeking work and firms offering suitable jobs are located in different regions and the jobs and/or the labor are immobile; such a mismatch can be exacerbated by information deficits when supply does not meet labor demand due to a lack of information;

- Preference/expectation mismatch arises when unemployed or labor market entrants are unwilling to take up a certain type of work, even if it matches their qualifications, due to inadequate remuneration, working conditions, or status.

Labor market mismatch demonstrates itself in the form of skill shortages in the economy which, in reality, are often an outcome of all three types of mismatches described above: qualitative, regional, and preference. The existence of skills or labor shortages is therefore defined as a situation in which employers have considerable difficulty filling vacancies for an occupation – or specialized skill needs within that occupation – at current levels of remuneration and conditions for employment, and a reasonably accessible location (Trendle 2008). Quintini (2011) suggests that skill shortages can be caused by labor shortages, geographical mismatch, or insufficiency of workers with the necessary skills.

Measuring skill shortages is a non-trivial task, and a range of different approaches can be identified in the literature. A common approach to measuring skills or occupational shortage is computing the unemployment-to-vacancies ratio (U/V ratio), which shows the number of jobseekers per one job opening (Obadic, 2006; Padoa-

Schioppa, 1991; Rutkowski, 2009). Education (ISCED) and occupation (ISCO) are the most frequently used dimensions for the analysis. The larger the index for a particular skill group, the larger the mismatch or the shortage for that category. A large variation in indexes across occupational (or educational) groups signals a large skill mismatch in the economy. A high U/V ratio across occupations means that there is a lack of jobs rather than skill mismatch.

According to Quintini (2011), skill shortages can be measured by employers' assessment (through surveys), vacancy rates or wage growth. The vacancy rate approach is dependent on the quality of vacancy data, which may be focused on low-skilled positions and thus underestimate more skilled segments (see also Boswell et al. 2004). The wage-growth approach is also limited as it does not include non-financial incentives (e.g. training and attracting the foreign labor force).

Various studies argue that in order to identify occupations with shortages, it is necessary to look at multiple indicators, such as unemployment and vacancy rates, employment growth, wage growth, and their changes over time (Zimmermann et al. 2007; Martin and Ruhs, 2011; Veneri, 1999). However, synthesizing these different measures into one all-encompassing indicator to be used in quantitative analysis is not a trivial matter. Cohen (1995) considered six top-down indicators for 193 occupational groups: occupational unemployment rate and change in occupational employment; change in wages; expected long-run growth of occupation; total replacement demand for the occupation; number of certifications to employ foreign workers; and vocational specifications required. He projected demand for a number of highly-skilled positions, but according to Martin (2010), his efforts were largely unsuccessful. Veneri (1999) used three criteria to identify the presence of labor shortages in 68 occupations in the

1990s: employment growth at least 50% above the average, median wage growth at least 30% above the average, and the occupational unemployment rate at least 30% lower than the average of all occupations. This method has not proved successful as the presence of shortage in occupations identified by employers was not confirmed by these criteria. Zimmermann, et al. (2007) made another attempt to merge indicators that may signal labor shortages into a single summarizing indicator. They developed several procedures, but found too much variation between the different indicators to deliver convincing conclusions for immigration policy.

Employers' own assessment represents the most direct way of estimating the existence of shortages. The length of time it takes for an employer to fill a vacancy, or the share of employers who report difficulty in recruitment are possible measures (Constant and Tien, 2011; Quintini, 2011). Lucifora and Origo (2002) define external and internal skill shortages and use the number of hard-to-fill vacancies as a measure of shortage. However, problems with international comparability and the frequency of surveys represent two major disadvantages of using this type of survey data.

In this study, we use unexplained wage premiums as an indicator of skill shortage, following Borjas (2001), Dustmann et al. (2012) and Guzi et al. (2015, 2017, 2018). We proxy skill shortages at the level of occupation-industry-country cells by wage premiums as the part of wages that remains unexplained after compositional differences across cells is netted out. In particular, for each year separately we estimate a log-wage regression of the form

$$W_{ikc} = X_{ikc}\beta + \gamma_{kc} + \varepsilon_{ikc}, \tag{2}$$

where W_{ikc} is the log wage of worker i who belongs to occupation-industry group k in country c, X_{ikc} is a vector of individual characteristics including gender, education,

work experience and work experience squared, and ε_{ikc} is the error term.[4] The wage and all variables in vector X_{ikc} are normalized to have zero means. The vector γ_{kc} can be then interpreted as the (adjusted) percent wage differential between the average wage of individuals in the particular occupation-industry-country cell and the mean wage for a given year in the EU-15. The indicator of skill shortage γ_{kc} is used in the analysis to measure immigrants' responses to changes in residual wage premia, in relation to the natives' response.

2.2 Measuring immigrant-native relative supply

The second key variable in the analysis is the measure of the relative supply of immigrants and natives in each occupation-industry-country cell. Following Borjas (2001), the index is expressed by the ratio of immigrants belonging to a given occupation-industry group in a given country and year, and the total number of immigrants in the EU-15, relative to a similarly defined relative supply of natives in the cell and year. Formally

$$Z_{kct} = \frac{M_{kct}/M_t}{N_{kct}/N_t},$$ (3)

where M_{kct} is the number of immigrants belonging to occupation-industry group k, and country c in year t. The total number of immigrants in the EU-15 in year *t* is denoted as M_t. The denominator similarly indicates the relative supply of natives N_{kct}/N_t in the particular cell and year. The index equals 1 when immigrants and natives have the same distribution across occupation-industry groups and countries. The index

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[4] By including education as an independent variable, we eliminate any wage differentials that arise due to the educational attainment of workers, but we assume that the residual wage premia are invariant across skill groups.

is greater than 1 if immigrants in a given occupation-industry-country cell were overrepresented relative to the natives, and it equals 0 if no immigrants are present in a particular occupation-industry-country cell. In the empirical analysis, the index is calculated for different immigrant groups distinguished by their origin or time since immigration in order to test their differences in the responsiveness to skill shortages in relation to natives. We further calculate the index for workers with and without tertiary education, and with and without children to test the variation in immigrants' responsiveness to skill shortages across various contexts.

2.3 Empirical strategy - the baseline specification

To measure the relative responsiveness of immigrants to changing shortages in the labor market, we adopt a first-difference regression model as follows:

$$\Delta Z_{kct} = \alpha + \beta \Delta \gamma_{kct-1} + \delta_1 GDP_{ct-1} + \delta_2 UR_{ct-1} + \delta_k + \delta_c + \delta_t + \mu_{kct}, \quad (4)$$

where $\Delta \gamma_{kct}$, our measure of skill shortage, is lagged by one year. This is because the reaction of workers to changes in the labor market is likely to be delayed. The dependent variable is the relative supply of immigrants Z_{kct}. The model also includes an occupation-industry cell, and country and year fixed effects (δ_k, δ_c and δ_t), which act as controls for any specific factors that might affect the relative supply of immigrants. Additionally, the model includes lagged values of country-level unemployment rate and GDP growth to account for variation in economic conditions between countries and over time. We estimate this model using the Ordinary Least Squares method with robust (Eicker-Huber-White) heteroskedastic-consistent standard errors, and every observation

is weighted by the total number of individuals in the cell.[5] We do not adjust for differences in living costs in the construction of γ_{kct} in Equation 2; this is done in the regression model of Equation 4 through the inclusion of country-year fixed effects.

2.5 Endogeneity

The measure of skill shortage captures any increase in the price of labor that cannot be explained by the changing composition of workers in terms of gender, education, and work experience in the given occupation-industry-country cell. Although estimating the model in first differences, including country and year fixed effects, controls for a range of additional factors specific to these categories, there may still be changes in residual wages that need not reflect increased shortage of labor in the given group or country, but are rather due to changing wage bargaining, regulation, or other factors that change the price of labor beyond the variation captured by the compositional and fixed effects. Whereas this potentially introduces measurement error in the link between measured and actual skill shortages, it does not affect our key argument, measuring immigrants' and natives' relative responsiveness to changing residual wages (whether due to shortages or other factors).

Another obvious issue in this type of models is that any measure of wages, such as γ_{kct}, may be endogenous with respect to any measure of the labor force in the given labor market, such as Z_{kct}. We acknowledge this issue, and note that as immigrants constitute a relatively small share in most labor markets and Z_{kct} is a measure of *composition* and not *size* of labor supply in the given labor market (industry-occupation-

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[5] Analytic weights (aweights in Stata) are typically appropriate when analysis is based on data containing averages.

country cell), the possible endogeneity of γ_{kct} may be less problematic than in other models linking wages and labor supply. Moreover, we lag γ_{kct} by one year, as is common in the literature (e.g. Borjas, 2001; Dustmann, et al. 2012; and Guzi et al., 2017, 2018). Finally it is possible that immigrants increase the relative supply of labor in a given skill group, which should cause wages to decrease for that group and therefore the estimated coefficients can be interpreted as a lower bound.

3 Data and Sample Characteristics

The empirical part of this study draws from representative samples of households in fifteen EU member states[6] obtained from the European Union Labour Force Survey (EU-LFS) and EU Statistics on Income and Living Conditions (EU-SILC). Both data sets are representative household surveys conducted annually in all member states of the EU, and follow the international standard classification of economic activity (coded according to NACE) and occupation (coded according to ISCO). Both datasets include information on respondents' personal circumstances (including nationality and country of birth), their labor market status, and job characteristics during the reference period. The sampling structure of the surveys focuses primarily on permanent residents and therefore does not capture short-term and seasonal migration.[7] Thanks to its large sample size, the EU-LFS provides reasonably reliable information about the share of foreign-born and native population across occupation and industry cells in each country. We use the information on workers' earnings from the EU-SILC to measure skill shortages across occupation-industry-country cells, as explained above. The empirical analysis exploits samples from 2004-2016 of individuals aged 15 to 64. For the estimation of skill shortage (Equation 2), we rely on a sample of 0.8 million individuals in the EU-SILC dataset. The index of relative supply (Equation 3) is calculated based on 14.3 million employed individuals in the EU-LFS dataset. Additional variables, such as

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[6] The sample includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom. Unfortunately, as the regional classification is not consistently included in the data, an analysis at the regional level is not possible.

[7] The EU-LFS has been used in several studies that analyze immigration in Europe, as it uniquely provides both cross-country and longitudinal dimensions (e.g. Dustmann and Frattini, 2011; D'Amuri and Peri, 2014).

national GDP annual growth, and total unemployment rate were obtained from Eurostat.[8]

The terms 'immigrant population' or 'immigrant individuals' are used in the broad context of immigration, and the origin of immigrants is based on the country of birth. One exception is Germany, for which immigrant origin can be determined only by nationality. The native population refers to people residing in the country of birth. The EU-LFS allows us to distinguish immigrants by the year of immigration and their origin (the choice of broader regions of origin is determined by the respective variable in the dataset). In the analysis, we distinguish six groups of immigrants which aggregate several geographic regions: *EU-15* (includes EU-15 and EFTA), *EU-12* (includes countries which joined the EU in 2004 and 2007), *Europe* (includes European countries outside the EU-15 and EU-12), *Africa* (Africa and Middle East), *Asia*, and *America* (includes both Americas, Australia and Oceania).

3.1 Distribution of workers in occupations and industry

In the analysis, we estimate the sensitivity of the relative labor supply of immigrants to wage differentials across occupation-industry-country groups. For each of the EU-15 countries, we partition the labor force into occupation-industry-country cells defined by four occupation levels based on the ISCO classification, and nine industry groups based on the NACE classification (see Table 3.1). This categorization generates 36 occupation-industry groups, for each of which we calculated the skill shortage and the index of the relative supply of immigrants in each country and year. In

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[8] Data from the Eurostat database accessed in February 2018: GDP growth rate expressed in the percentage change on the previous year (table *tec00115*), and total unemployment rate (table *tsdec450*).

the analysis, we allowed only occupation-industry-country cells of sufficient size in all years.[9]

Table 3.1 Definition of occupation and industry groups

Occupation category	ISCO-1 coding	Occupation group
Legislators, senior officials and managers	1	High
Professionals	2	High
Technicians and associate professionals	3	High
Clerks	4	Intermediate general
Service workers and shop and market sales workers	5	Intermediate general
Skilled agricultural and fishery workers	6	Intermediate specific
Craft and related workers	7	Intermediate specific
Plant and machine operators and assemblers	8	Intermediate specific
Elementary occupations	9	Low

Economic activity	NACE coding	Industry group
Manufacturing, mining and quarrying and other industry	C,D, E	1
Construction	F	2
Wholesale and retail trade	G	3
Transportation and storage, accommodation and food service	H,I	4
Information and communication, financial and insurance activities	J,K	5
Education	M	6
Human health	N	7
Public administration, defence, and social work activities	O, P, Q	8
Agriculture, forestry and fishing	A, B	9

[9] In each country, cells are selected if they include at least 20 observations in the EU-SILC database, and the weighted size of cells in the EU-LFS database is 50,000. Unfortunately, in the first year, data for several countries are not available. In the 2004 EU-SILC dataset, Germany, the Netherlands, and the United Kingdom are missing. In the EU-LFS data, we cannot identify the origin of respondents in Italy in 2004.

Tables 3.2 and 3.3 illustrate the distribution of immigrants across occupation and industry groups. Interestingly, the occupational structure of EU-15 immigrants is almost identical to that of the native workers, while the other immigrant groups are over-represented in occupations requiring lower qualifications. One striking observation is that immigrant workers from the EU-12 and rest of Europe (outside the EU) are substantially more frequently employed in lower-ranked occupations (intermediate specific or low group) relative to not only the natives, but also to all the other immigrant groups. This points to a high degree of over-qualification. This may be due to the relatively recent arrival of these immigrants in the receiving countries, but may also signify patterns of temporary migration, whereby down-skilling (and saving on the costs of acquiring country-specific human capital) may be an optimal strategy for temporary immigrants (Kahanec and Shields, 2013). The distributional patterns observed for immigrants from Africa and America are very similar. In contrast, Asian immigrants are more employed in occupations requiring higher qualifications than all the other immigrant groups except the EU-15.

With respect to distribution across sectors, immigrant workers are primarily concentrated in construction (except for the Asian group); transportation, accommodation and food; and they are least concentrated in the education sector. Some immigrant groups are concentrated in other industries, e.g. EU-15 group in finance, EU-12 in agriculture, European in manufacturing, African in health, Asian in wholesale, and American in public administration and social work.

Table 3.2 Distribution of native and immigrant workers across occupation groups

Occupation group	Native	EU15	EU12	Europe	Africa	Asia	America
High	0.43	0.46	0.19	0.17	0.32	0.35	0.31
Intermediate general	0.27	0.24	0.23	0.23	0.26	0.31	0.28
Intermediate specific	0.22	0.19	0.31	0.35	0.21	0.15	0.17
Low	0.08	0.11	0.27	0.25	0.21	0.19	0.24

Source: Own rendering based on EU-LFS 2004-2016 data

Note: Occupation groups are described in Table A1 in the Appendix. The sample includes individuals aged 15 to 64 in EU-15 countries. Immigrants are recognized by the country of birth or nationality (Germany). Population weights are applied.

Table 3.3 Distribution of native and immigrant workers across industry groups

Industry group	Native	EU15	EU12	Europe	Africa	Asia	America
Manufacturing	0.17	0.16	0.17	0.22	0.13	0.12	0.10
Construction	0.07	0.08	0.15	0.14	0.08	0.03	0.08
Wholesale and trade	0.14	0.12	0.11	0.13	0.13	0.16	0.11
Transportation and food	0.11	0.15	0.18	0.16	0.16	0.25	0.17
Communication and financial	0.14	0.17	0.11	0.12	0.16	0.13	0.15
Education	0.08	0.08	0.03	0.03	0.06	0.05	0.06
Human health	0.12	0.10	0.08	0.07	0.13	0.12	0.09
Public administration	0.13	0.12	0.13	0.12	0.12	0.12	0.21
Agriculture and fishing	0.03	0.01	0.04	0.02	0.02	0.01	0.02

Source: Own rendering based on EU-LFS 2004-2016 data

Note: Industry groups are described in Table A2 in the Appendix. The sample includes individuals aged 15 to 64 in EU-15 countries. Immigrants are recognized by the country of birth or nationality (Germany). Population weights are applied.

3.2 Composition of immigrants by origin and length of stay

This section provides the characteristics of the immigrant population in EU-15 countries. Evidence is based on EU-LFS data that includes 12% of immigrant in the population aged 15 to 64. According to the data, the share of immigrants increased from 8.9% in 2004 to 14.7% in 2016. Figure 1 presents the composition of immigrant population by origin and by the years since immigration. The relative size of immigrants born in another EU-15 country has been decreasing from more than 25% in 2004 to less than a fifth of immigrant population in recent years. The inflow of immigrants from outside EU-15 countries intensified after the EU enlargements in 2004 and 2007 (Kahanec, Pytlikova and Zimmermann 2016). Figure 1 illustrates that the development of the EU-12 group was particularly dynamic and more than doubled from 7 to 17% over the studied period. In general, the foreign-born population in the EU-15 is dominated by individuals from Africa, who comprise one fourth of the immigrant population. Immigrants from Asia also increased their relative share during the studied period. The relative number of immigrants from rest of Europe and America has changed less, with each group comprising approximately one sixth of the immigrant population.

The composition of the immigrant population in the EU-15 also varies by time since arrival. The period after the European enlargement in 2004 was characterized by rising inflows of new immigrants that declined with the outbreak of the Great Recession (see Figure 1). In 2016, almost two thirds of the immigrant population comprises established immigrants who reside in the host country for more than ten years. New immigrants with less than six years since arrival and immigrants with six to ten years since immigration have an equal share.

Figure 1 Composition of immigrant population by origin and years since arrival in the EU-15

By origin
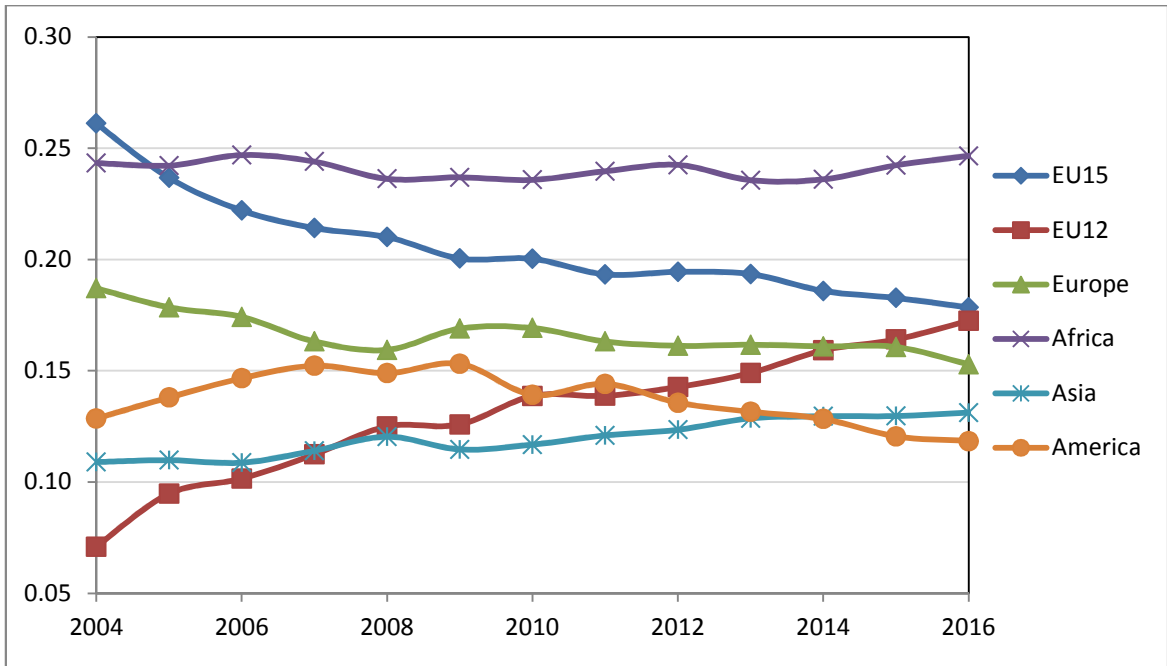
By years since immigration
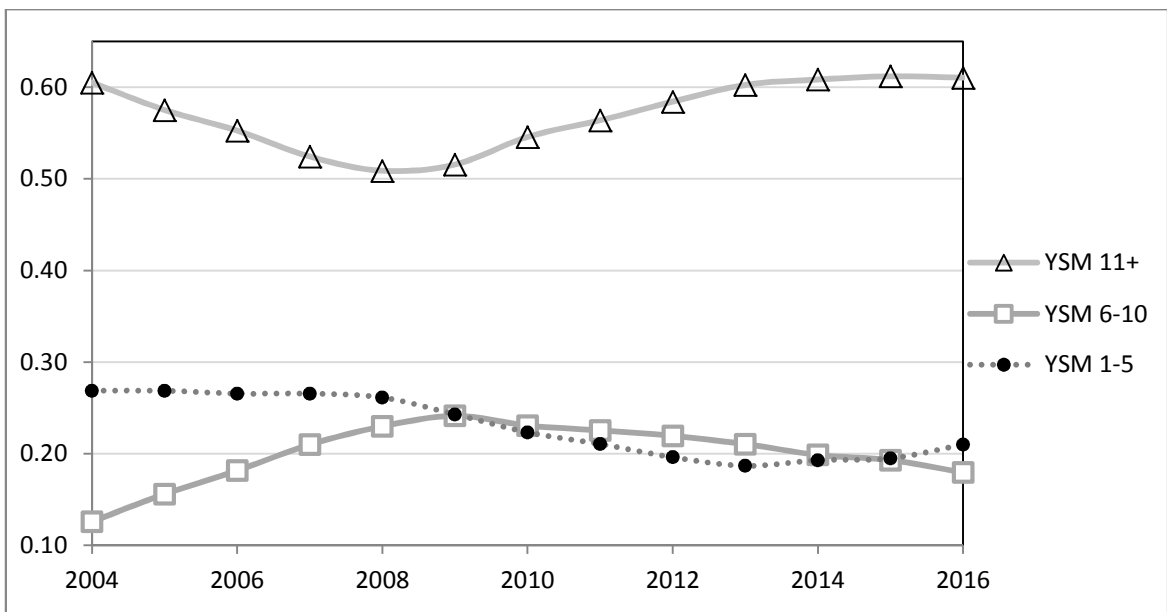
Source: Own rendering based on EU-LFS 2004-2016 data

Note: Shares add up to unity. Immigrants are recognized by the country of birth or nationality (Germany). YSM indicates the group of immigrants by years since immigration. Population weights are applied.

3.3 Labor market outcomes and working conditions of immigrants

This section reports differences in labor market outcomes between immigrants and natives. In Figures 2-5, we first show employment and unemployment probabilities and then show the incidence of a long-term unemployment spell, on-the-job search behavior, and job mobility across economic sectors.

Figure 2 depicts the ratio of employment and unemployment rates, respectively, for immigrants of different origins relative to native workers. Ratios closer to one indicate that immigrants' position in the labor market is similar to that of natives. Immigrants from the EU-15 and EU-12 show employment to population ratio on par with the natives and both groups even outperform the natives in recent years. With respect to unemployment, EU-12 immigrants are more unemployed relative to natives and their incidence of unemployed increased around the inception of the Great Recession, but has been decreasing since then. The unemployment of immigrants from the EU-15 remains at levels similar or better relative to natives (the ratio is close to unity or below). Immigrants from Asia and rest of Europe show rapid improvement in their labor attachment, with increasing participation and falling unemployment over the studied years, although the Great Recession slowed down the adjustment process. The opposite trend is visible for immigrants born in Africa and America, as their employment and unemployment rates have deteriorated since 2008 relative to natives.

Figure 2 Immigrant-to-native ratio of employment and unemployment rates
in the EU-15 for various immigrant groups

Employment rate
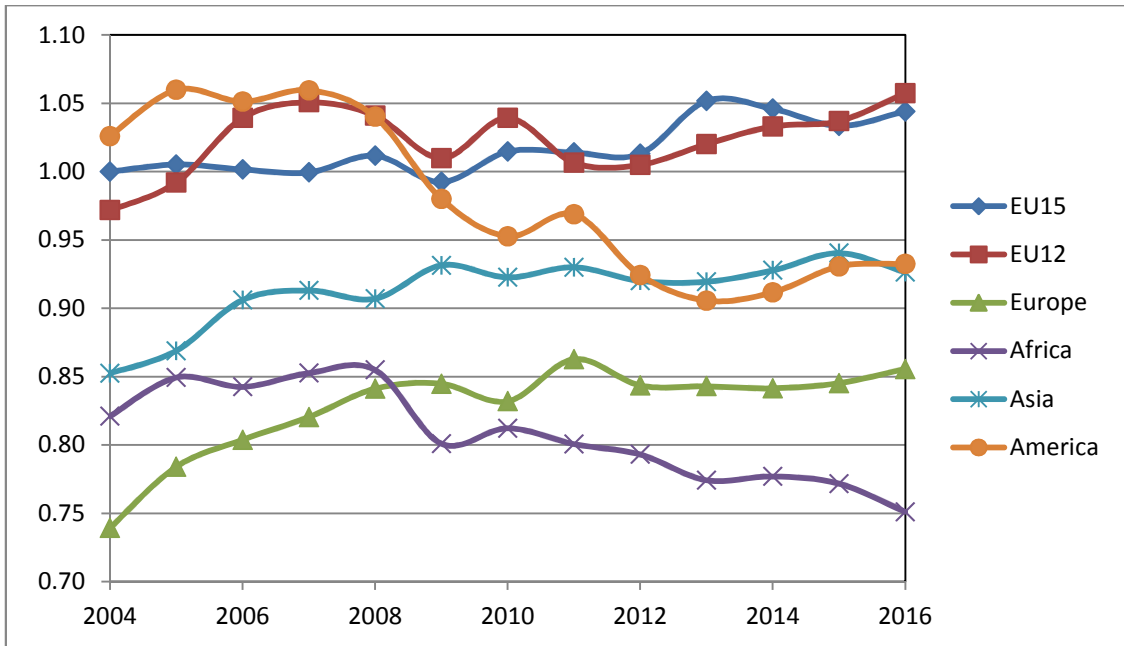
Unemployment rate
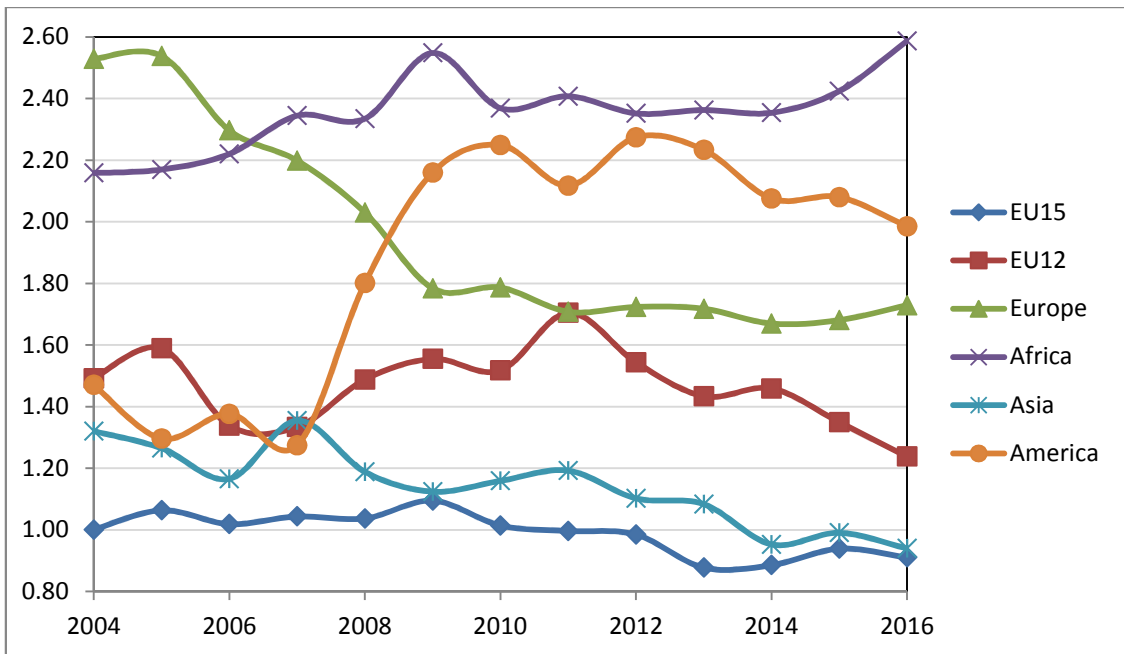
Source: Own rendering based on EU-LFS 2004-2016 data

Note: Ratio. Population weights are applied.

In a similar fashion, we demonstrate the differences in job search behavior, unemployment duration, and mobility across economic sectors. Figure 3 compares the share of workers in the immigrant and native workforce who seek other employment when they already have a job. The relatively high rates of on-the-job searches among immigrants compared to the natives may suggest a lower attachment to their current job, but also an increased risk of involuntary job-to-job transitions or unemployment. In particular, immigrants from Africa and America exhibit high search intensity, which increased after 2008 when their incidence of unemployment remained high (see Figure 2). We generally observe higher job search intensity for all immigrants than for natives. The only exception is workers from the EU-15 who exhibit the same intensity of search behavior as natives.

Figure 4 reports the immigrant-to-native ratio of long-term unemployment, defined as a period without a job for more than eleven months. This reflects the ability of workers to find employment and avoid long spells of unemployment. It appears that the inception of the Great Recession hit immigrants from Africa and America, and to lesser degree from the EU-12, who show prolonged unemployment spells relative to natives. Interestingly, Asian immigrants managed to avoid long unemployment spells throughout the period and particularly during the years of the Great Recession. The ratio for immigrants from rest of Europe was one of the highest throughout; converging to unity before 2009, but further increasing afterwards. The incidence of long-term unemployment for EU-15 immigrants converged to unity and remained on par with natives in the most recent years. The EU-12 immigrants show a significantly high ability to avoid long-term unemployment relative to natives and other immigrant groups.

Figure 3 Immigrant-to-native ratio of the proportion of workers who look for another job
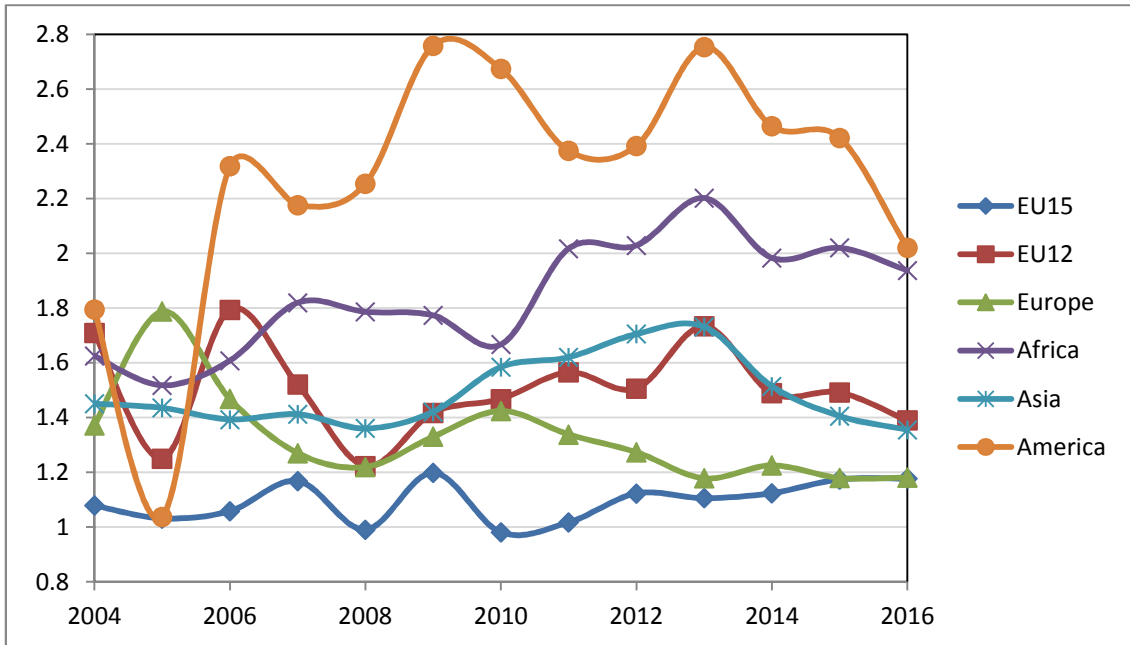
Source: Own rendering based on EU-LFS 2004-2016 data

Note: The sample includes employed workers. Population weights are applied.

Figure 4 Immigrant-to-native ratio of workforce without a job for more than 11 months
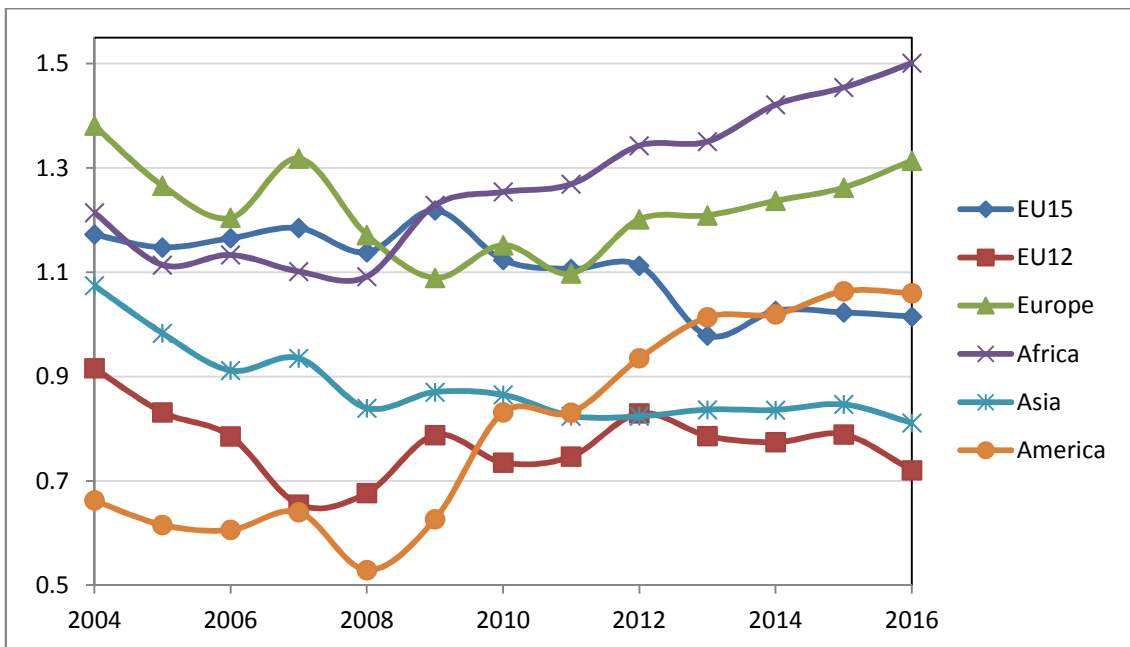
Source: Own rendering based on EU-LFS 2004-2016 data

Note: The sample includes employed and unemployed people. Population weights are applied.

Finally, Figure 5 compares the share of immigrant and native workers who changed economic sectors (according to NACE classification) during the previous year. We generally observe higher inter-sectoral mobility among immigrants than among natives. Interestingly, immigrants with high on-the-job search (especially those from America and to a lesser degree also those from Africa and the EU-12) are also among the more mobile across sectors in the labor market. Before 2009, immigrants from America and the EU-12 were substantially more likely to change economic sectors within one year than natives. Their inter-sectoral mobility converged in later years but remained high relative to natives.

Figure 5 Immigrant-to-native ratio of proportion of workers who changed industry during the previous year
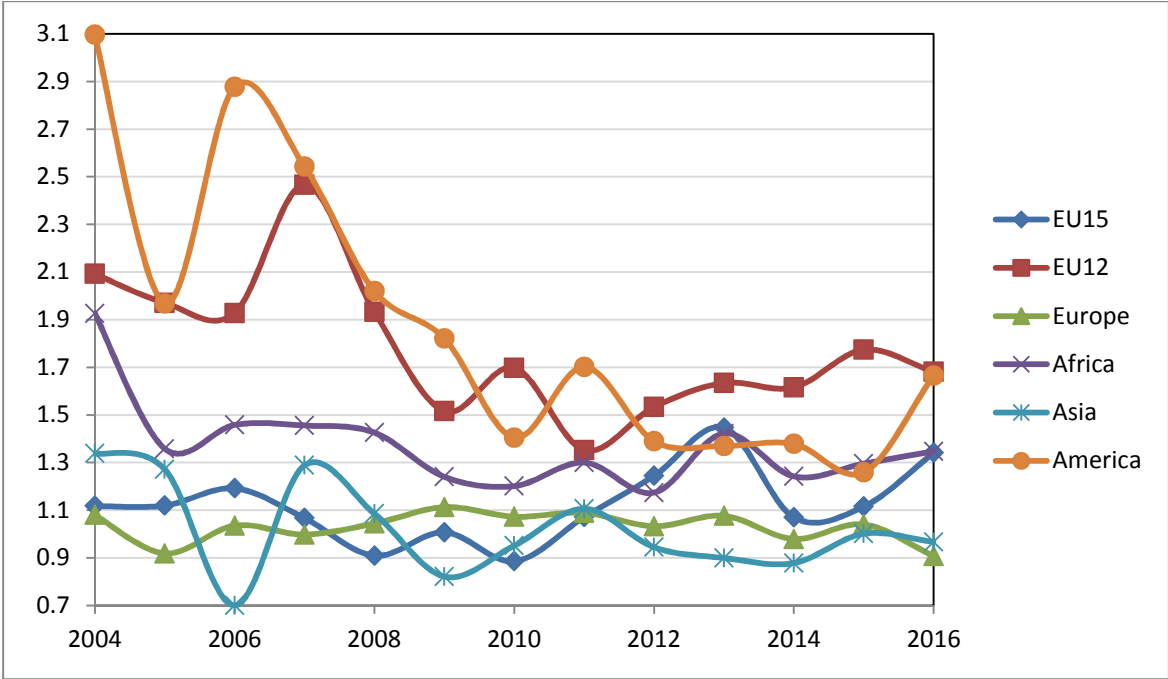
Source: Own rendering based on EU-LFS 2004-2016 data

Note: The sample includes employed people in the current and previous year. Population weights are applied.

40

3.4 Summary of descriptive evidence

Overall, the descriptive evidence presented in this chapter indicates the favorable position of EU-15 immigrants in the European labor market. The working conditions of this group are highly comparable to the native-born workforce. For this reason, in all models we treat EU-15 countries as one entity, and study the relative responsiveness of immigrants to skill shortages in relation to the EU native group (i.e. EU-15 natives, including those living in their EU-15 member state of origin, as well as those living in another EU-15 member state). This scenario is compatible with Borjas (2001), who uses the group of US-born as a reference analysis.[10]

The findings presented in this chapter provide further evidence that immigrants from the EU-12 differ from the other immigrant groups in several respects. They exhibit high attachment to the labor market, but also relatively low risk of unemployment. Unemployment spells for EU-12 immigrants are short, their job search intensity is high, and they are able to change employment across economic sectors in the economy.

Along with immigrants from rest of Europe, EU-12 immigrants are most concentrated in elementary occupations and exhibit the highest degree of down-skilling. This is consistent with the hypothesis that being recently-arrived immigrant in the receiving countries enables these immigrants to be more flexible workers, intensely seeking employment opportunities and responding to changing economic conditions. The responsiveness of the other immigrant groups is likely to be restrained by

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[10] As a formal check of descriptive evidence, the responsiveness of EU-15 immigrants is compared with natives by estimating Equation 4. The estimate on skill shortage is not significant to confirm the similarity between these two groups.

institutional barriers, as many such immigrants do not enjoy all the provisions of free

intra-EU mobility of workers.

4 The relative responsiveness of immigrants to skill shortages

Using the data and methodology outlined above, we test the relative responsiveness of immigrants, from various origins and length of stay, to skill shortages across sectors and occupations.[11] In all models, the dependent variable is the supply of immigrants relative to the EU workforce in occupation-industry-country cells expressed in first difference. The relative responsiveness of immigrants to skill shortages is assessed in comparison with the EU workforce that represents workers born and residing anywhere in the EU-15.

4.1 Baseline estimates

Table 4.1 shows the baseline results. The top panel in the table presents estimates from the specification that includes the occupation-industry cell, country, and year fixed effects. In the bottom panel, the model is augmented to include unemployment rate and GDP growth to account for variation in economic conditions across countries and over time. The key finding is that all coefficients on skill shortage presented in Table 1 are positive, which is in line with the theoretical expectations. The positive estimates obtained for skill shortage in the baseline model indicate that the relative supply of immigrants in a particular occupation-industry-country group rose in those cells where the wage premium (indicating a skill shortage) also rose. However, the statistical significance of these results differs across immigrant groups.

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[11] This chapter extends the results published in Guzi et al. (2015, 2018).

Statistically significant estimates are obtained for EU-12 and European immigrants, whereas immigrants from Asia and America, in the statistical sense, behave similarly to the EU natives. The estimates for African immigrants fell short of statistical significance (p-values are 0.125 and 0.16 in the top and bottom panel of Table 4.1, respectively). These findings imply that immigrants are, in general, moving to occupations and industries and countries that exhibit growing skill shortages at least as much as, and for some immigrant groups more flexibly than, the natives. The inclusion of GDP growth and unemployment rate only slightly changes the effect, and importantly, the significance remains mostly unchanged.

Table 4.1 The relative responsiveness of immigrants to skill shortage

	EU12		Europe		Africa	Asia	America		YSM 1-5		YSM 6-10		YSM 11+	
Skill	0.468	***	0.65	***	0.11	-0.05	0.114		0.236		0.461	***	0.189	**
shortage	(0.168)		(0.225)		(0.071)	(0.126)	(0.107)		(0.151)		(0.152)		(0.096)	
R2	0.027		0.035		0.035	0.026	0.016		0.035		0.049		0.097	
N	2369		2281		2828	2031	2633		2474		2745		3170	
	EU12		Europe		Africa	Asia	America		YSM 1-5		YSM 6-10		YSM 11+	
Skill	0.367	**	0.611	***	0.102	-0.08	0.046		0.073		0.402	***	0.177	*
shortage	(0.167)		(0.226)		(0.073)	(0.126)	(0.109)		(0.148)		(0.154)		(0.098)	
GDP gr	0.002		0.013		-0.002	-0	0.004		0.015	***	-0.021	***	0.002	
	(0.006)		(0.010)		(0.002)	(0.007)	(0.004)		(0.006)		(0.006)		(0.002)	
UR	-0.027	***	-0.01		-0.002	-0.01	-0.013	**	-0.034	***	-0.019	***	-0.002	
	(0.009)		(0.008)		(0.004)	(0.007)	(0.006)		(0.007)		(0.006)		(0.003)	
R2	0.032		0.036		0.035	0.029	0.02		0.053		0.056		0.097	
N	2369		2281		2828	2031	2633		2474		2745		3170	

Source: Own calculations based on EU-SILC, EU-LFS, and Eurostat data.

Notes: The dependent variable is the supply of immigrants relative to EU native in the particular occupation-industry-country cell expressed in first difference. The skill shortage for the same cell is also expressed in first difference and lagged. All models include cell, year, and country fixed effects. Models in the bottom panel include GDP growth (GDP gr) and unemployment rate (UR). YSM indicates the group of immigrants by years since immigration. The number of observations in the model varies because we allow only occupation-industry-country cells of sufficient size in all years. Regressions are weighted by the number of observations for the occupation-industry-country cell. Heteroskedastic-consistent standard errors are in parentheses, *, **, *** identifying significance at 10, 5, 1 per cent levels, respectively.

To test whether our results are driven by a particular country, we have replicated the analysis using samples without Germany (to test if identifying immigrants by nationality can potentially bias the results), and without Luxembourg (the country with by far the highest share of immigrants). In both cases, the baseline estimates presented in Table 4.1 change only minimally and retain statistical significance.

The estimated coefficients on skill-shortage can be interpreted in terms of the relative elasticity of supply of immigrants and natives: $\varepsilon=(dln(Z))/(dln(W))$. This elasticity gives the percentage change in the relative number of immigrants who choose to reside in a particular occupation-industry-country cell for a given percentage change in the wage. The wage index measures the average log-wages in each occupation-industry-country cell, so that $\varepsilon=\beta/Z$. As the mean value of Z is 1.66 and 1.87 for EU-12 and European immigrants, respectively, the coefficients on skill shortage in the bottom panel of Table 4.1 imply an elasticity of supply of 0.22 and 0.33 relative to EU natives. For comparison, Borjas (2001) estimates an elasticity of 1.3 for new immigrants in the US. The estimated elasticity for all immigrants cannot be calculated based on information in his paper, but it is likely to be below one. In the UK, Dustmann et al. (2012) estimates the elasticity of 2.0 for immigrants with less than 10 years in the UK. Based on the information in their paper, the calculated elasticity for all immigrants is 0.88. Given the barriers to mobility across (and within) EU member states, we do not find it surprising that our estimate of elasticity is somewhat lower than those estimated for the US and UK.

The point estimates on skill shortages for the three groups of immigrants by years since migration in Table 4.1 indicate a nonlinear nature of the relationship between immigrants' assimilation and their relative mobility. The magnitude of

estimates follows an inverse U-shaped pattern. The coefficient on skill shortages is the highest for the middle group of immigrants, i.e. those with 6-10 years since migration, and this finding is consistent with the notion of two competing forces affecting immigrants' relative mobility in comparison with the natives: with more years since migration, immigrants learn to cope with mobility barriers, but become more firmly tied to their local contexts in host labor markets.

Significant estimates on GDP growth and unemployment rate in Table 4.1 indicate that economic circumstances influence the supply of immigrants more than that of the EU natives (e.g. Dustmann, Glitz and Vogel 2010; De la Rica and Polonyankina 2013). Interestingly the estimate for GDP growth is positive and significant for recent immigrants (YSM 1-5) and negative and significant for the middle group of immigrants (YSM 6-10). This implies that recently-arrived immigrants respond to skill shortages very fluidly in growing economies, though economic growth reduces the labor supply of the middle group of immigrants (YSM 6-10). In Chapter 6, the responsiveness of immigrants to skill shortages during the business cycle is examined in detail.

The visible drop in our estimates on skill shortage for EU-12 and recently-arrived immigrants (YSM 1-5) after inclusion of economic variables in the bottom panel of Table 4.1 signals a higher sensitivity of these immigrants to general labor market conditions. This could indicate that informational asymmetries play a greater role for these recently-arrived immigrant groups, who may be better able to discern the aggregate unemployment rate, rather than labor market imbalances across occupation-industry-country cells. The estimates for the other immigrant groups are only slightly smaller in magnitude and retain their significance, compared with the model without economic controls. These findings provide further support for the hypothesis that

immigrants respond to market incentives and opportunities more fluidly than natives. In the further analysis, we proceed with the specification that includes controls for GDP growth and the unemployment rate.

4.2 Estimates by education

In the next step, we replicate the analysis distinguishing workers with and without tertiary education. The measure of skill shortage remains the same as above, but the relative supply of immigrants and EU natives (Equation 3) is calculated separately for low- and high-skilled workers. Estimates presented in Table 4.2 confirm that the higher responsiveness of EU-12 and European immigrants, relative to the EU natives, is driven by low-educated workers. The estimated effects of skill shortage for tertiary educated workers are statistically not different from zero, meaning that these immigrant groups respond to skill shortages similarly to the corresponding EU-natives. The only exception is the group of high-skilled African immigrants, for which the estimate is positive and significant.

An interesting pattern emerges in the results by time since immigration. Among low-educated workers, the effect is significant for the group of immigrants with some, but not extensive, experience in the host country (6-10 years). On the other hand, in the group of high-educated workers, it is established immigrants (10+ years) who are more responsive to skill market opportunities than EU natives. This could mean that established high-educated immigrants are very responsive to skill shortages as they are better equipped to overcome institutional barriers to their mobility than their low-educated counterparts. The estimated effects of skill shortage for other immigrants are statistically not different from zero, meaning that those groups respond to skill shortages

47

similarly to the corresponding EU natives. Particularly, the mobility of recently-arrived low-educated immigrants may be constrained by institutional barriers linked to their inexperience and short time in the country.

Table 4.2 Relative responsiveness to skill shortages of low- and high-skilled workers

	EU12		Europe		Africa	Asia	America	YSM 1-5	YSM 6-10		YSM 11+	
				Workers with less than tertiary education								
Skill	0.447	***	0.562	**	0.047	-0.08	-0.027	0.054	0.428	**	0.168	
shortage	(0.170)		(0.229)		(0.092)	(0.155)	(0.140)	(0.162)	(0.173)		(0.113)	
R2	0.037		0.042		0.026	0.036	0.018	0.054	0.074		0.091	
N	1945		1862		2464	1672	2137	1830	2117		2930	
	EU12		Europe		Africa	Asia	America	YSM 1-5	YSM 6-10		YSM 11+	
				Workers with tertiary education								
Skill	-0.124		0.203		0.304 **	-0.19	0.164	0.115	-0.011		0.274	**
shortage	(0.369)		(0.398)		(0.136)	(0.202)	(0.156)	(0.268)	(0.202)		(0.117)	
R2	0.039		0.031		0.032	0.029	0.022	0.067	0.025		0.026	
N	1166		1006		1463	1021	1400	1199	1290		1817	

Source: Based on EU-SILC, EU-LFS, and Eurostat data.

Note: See note to Table 4.1. Estimates are obtained from separate regressions. All models include lagged GDP per capita and unemployment rate (not reported in the table) and cell, year, and country fixed effects.

4.3 Estimates by the presence of children

A key conjecture of the theoretical model presented above is that migration costs *D* are lower for immigrants than for natives. The results above indicate that these costs depend on immigrants' country of origin and years since migration. Although measuring *D* is beyond the scope of this work, we can test the presence of children, an important determinant of *D*, for immigrants' relative responsiveness to labor market imbalances.[12]

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[12] The role of housing tenure would be another interesting aspect to test. According to the EU SILC, immigrants are up to three times less likely to be homeowners, indicating lower migration costs. However, the EU LFS does not contain

Table 4.3 Relative responsiveness to skill shortages of workers with and without children

	EU12	Europe	Africa	Asia	America	YSM 1-5	YSM 6-10	YSM 11+
				Workers with children				
Skill	0.232	-0.224	-0.055	-0.06	-0.346 *	0.034	-0.318	-0.017
shortage	(0.301)	(0.421)	(0.117)	(0.181)	(0.178)	(0.276)	(0.238)	(0.119)
R2	0.052	0.021	0.022	0.03	0.021	0.041	0.084	0.039
N	1278	1437	1945	1177	1478	1286	1662	2318
	EU12	Europe	Africa	Asia	America	YSM 1-5	YSM 6-10	YSM 11+
				Workers without children				
Skill	0.3 *	0.679 ***	0.063	-0.15	0.165	0.051	0.478 ***	0.308 **
shortage	(0.176)	(0.247)	(0.102)	(0.166)	(0.131)	(0.169)	(0.144)	(0.129)
R2	0.055	0.044	0.039	0.035	0.027	0.046	0.054	0.086
N	1935	1751	2387	1626	2099	2059	2156	2865

Source: Based on EU-SILC, EU-LFS, and Eurostat data.

Note: See note to Table 4.1. Estimates are obtained from separate regressions. All models include lagged GDP per capita and unemployment rate (not reported in the table) and cell, year, and country fixed effects.

The EU LFS data includes information on whether the children of the individual are living in the same household. We use that information to calculate the index of the relative supply of immigrants and EU natives (Equation 3) separately on the sample of workers with and without children. In this way, we can test whether the presence of children in the household influences the relative responsiveness of immigrants to changing wage premia in the labor market. The reference group is composed of EU-natives as in the baseline model. The comparison of estimates for workers with and without children in Table 4.3 indicates that the presence of children reduces the mobility of immigrants in the labor market. The labor market mobility of immigrants with children is statistically not different from that of EU-natives, with the only exception being Americans with children, who are found to be less mobile than comparable EU-natives. The results obtained from the baseline model are confirmed

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housing tenure information, which makes it impossible to execute such test with this data.

and imply that higher responsiveness to skill-shortages is found particularly among immigrants from EU-12 and rest of Europe living without children.

4.4 Estimates by age and gender

We further test how the relative responsiveness of immigrants to skill shortages varies by age and gender. The analysis is replicated with the index of the relative supply of immigrants and EU natives calculated for three age cohorts (15-29, 30-44, and 45-65) and separately for male and female workers. Table 4.4 presents results. Not surprisingly, the youngest group of immigrants is found to be more responsive to wage premia relative to their young native counterparts (the estimates are significant for immigrants from EU-12 and rest of Europe, and larger in magnitude in comparison to the baseline estimates). The labor mobility of immigrants in the middle- and old-aged groups is confirmed to be similar to EU-natives with two exceptions: Asian immigrants aged 30-44 are found to be less mobile, while immigrants in the group from rest of Europe older than 45 are more mobile as comparable to EU-natives.

The results by gender display a peculiar pattern; whereas the effect for immigrants from EU-12 is driven by male workers, the effect for Europe immigrants is driven by female workers. Interestingly, the negative effect is estimated for male immigrants of Asian origin and also in the middle-age cohort. This may imply barriers to mobility in the EU states specific to this group.

Table 4.4 Relative responsiveness to skill shortages by age and gender

	EU12		Europe		Africa	Asia		America	YSM 1-5	YSM 6-10		YSM 11+	
					Workers of age 15-29								
Skill	0.452	*	0.763	**	0.319	0.121		-0.067	0.294	0.637	***	0.311	
shortage	(0.254)		(0.325)		(0.232)	(0.250)		(0.202)	(0.243)	(0.208)		(0.259)	
R2	0.06		0.043		0.029	0.047		0.016	0.054	0.074		0.062	
N	1251		1014		1313	864		1176	1535	1368		1686	
	EU12		Europe		Africa	Asia		America	YSM 1-5	YSM 6-10		YSM 11+	
					Workers of age 30-44								
Skill	0.195		0.326		0.096	-0.43	**	-0.198	-0.045	0.039		0.091	
shortage	(0.245)		(0.313)		(0.118)	(0.212)		(0.210)	(0.216)	(0.289)		(0.164)	
R2	0.035		0.048		0.043	0.026		0.023	0.038	0.054		0.086	
N	1823		1787		2427	1537		2011	1799	2126		2813	
	EU12		Europe		Africa	Asia		America	YSM 1-5	YSM 6-10		YSM 11+	
					Workers of age 45-65								
Skill	0.01		1.243	***	0.077	-0.04		0.277	-0.564	0.424		0.178	
shortage	(0.302)		(0.356)		(0.100)	(0.186)		(0.169)	(0.414)	(0.277)		(0.111)	
R2	0.035		0.055		0.026	0.041		0.011	0.039	0.061		0.059	
N	1343		1250		2058	1371		1624	709	880		2712	
	EU12		Europe		Africa	Asia		America	YSM 1-5	YSM 6-10		YSM 11+	
					Male workers								
Skill	0.526	***	0.36		0.031	-0.28	*	-0.099	0.064	0.412	***	0.063	
shortage	(0.188)		(0.246)		(0.098)	(0.147)		(0.129)	(0.192)	(0.145)		(0.104)	
R2	0.042		0.021		0.022	0.03		0.02	0.047	0.08		0.053	
N	1580		1684		2505	1634		2066	1729	1977		2793	
	EU12		Europe		Africa	Asia		America	YSM 1-5	YSM 6-10		YSM 11+	
					Female workers								
Skill	0.154		1.036	***	0.204	0.087		0.109	0.11	0.346		0.36	**
shortage	(0.229)		(0.372)		(0.132)	(0.195)		(0.160)	(0.212)	(0.242)		(0.154)	
R2	0.029		0.061		0.04	0.021		0.014	0.054	0.034		0.089	
N	1803		1560		1933	1379		1951	1627	1855		2528	

Source: Based on EU-SILC, EU-LFS, and Eurostat data.

Note: See note to Table 4.1. Estimates are obtained from separate regressions. All models include lagged GDP per capita and unemployment rate (not reported in the table) and cell, year, and country fixed effects.

4.5 Summary of findings

Our findings corroborate the notion developed in the theoretical section of this paper that immigrant workers are expected to be more responsive to the changing economic environment than native workers. The results imply that it is primarily low-skilled migrants from EU-12 and rest of European countries and high-skilled African immigrants who are more responsive to skill shortages relative to EU-natives. Other immigrant groups respond to skill shortages similarly to the corresponding EU natives. As conjectured by the theoretical model, the presence of children increases migration costs and defers the labor mobility of immigrants. The series of additional analysis reveals that it is young cohorts of immigrants who are primarily driving our results. With respect to gender, the results are less clear and vary by the origin of immigrants.

5 Context-dependence of migrants' responsiveness

The responsiveness of immigrants and natives to skill shortages may depend on a number of contextual factors that are shaped by local economic, institutional, and policy contexts.[13] The theoretical model also implies that institutions and policies lowering the costs of adjustment, requalification, or occupational mobility should, in general, increase workers' responsiveness to skill shortages, although lock-in effects may set in with the time spent in one destination. In this chapter, we extend the model to explore how immigrants' responsiveness to skill shortages varies across various economic and institutional conditions.

5.1 Augmented model

The baseline model (Equation 4) can be augmented to study how immigrants, relative to natives, respond to skill shortages with respect to GDP level, economic growth, unemployment rate, the generosity of welfare spending, immigration context, and the restrictiveness of immigration policies. Specifically, we adopt a variation of the first-difference model of Equation (4) as follows:

$$\Delta Z_{kct} = \beta_1 \Delta \gamma_{kct-1} + \beta_2 \Delta \gamma_{kct-1} \theta_c + \beta_3 \theta_c + \delta_k + \delta_c + \delta_t + \mu_{kct}, \quad (5)$$

where θ_{ct} is a dummy variable indicating the presence of a certain type of economic, institutional and policy context in country c and year t. When the underlying contextual information used to calculate this dummy variable is continuous, such as in the case of the share of total social expenditure in GDP, the value of θ_{ct} is obtained by setting

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[13] This chapter extends the results published in Guzi et al. (2018).

$\theta_{ct} = 1$ for countries above the median value for all countries and zero otherwise. Thus, in the case of social expenditure, θ_{ct} equals 1 for countries that are among the more generous welfare states. While dichotomizing these variables results in some loss of variation in the data, it enables us to capture institutional, policy, and economic variation across the countries and work with interaction effects in a tractable way.

Adding the interaction term to the model changes the interpretation of the key coefficients. In a model without the interaction term, β_1 can be interpreted as the direct effect of a skill shortage on the relative supply of immigrants. The interaction term reflects the fact that immigrants' responsiveness to skill shortages may be different in different contexts. Hence, in a model with the interaction term, the effect of a skill shortage on the relative supply of immigrants is not limited to β_1, but is equal to $\beta_1 + \beta_2\theta_c$. β_1 is then interpreted as the effect of a skill shortage on immigrants' responsiveness when $\theta_c = 0$ (e.g. in countries with below-the-median welfare spending) and $\beta_1 + \beta_2$ is the effect of a skill shortage when $\theta_c = 1$ (e.g. in countries with above-the-median welfare spending). The introduction of interaction terms thus enables us to shed light on the heterogeneity of immigrants' relative responsiveness to skill shortages across occupation-industry-country cells under different contexts.

5.2 The behavior of immigrants under different economic conditions

We first examine the sensitivity of results to the local economic conditions. To this end, we introduce dummy variables indicating whether a country has, through our sample, an above-the-median level of GDP, economic growth, unemployment rate, or share of welfare spending in GDP ($\theta_{ct} = 1$; zero otherwise) and examine their interactions with

skill shortage.[14] Thus, we pick up the medium- to long-term economic differentials between the countries. Table 5.1 illustrates the separation of countries according to these variables. It shows that economic conditions in the EU-15 are diverse and that each of these three economic variables picks up unique dimensions of their economic development.

Table 5.1 Economic and migrant context in the EU-15

Country	GDP pc	GDP growth	Unempl. rate	Welfare spending	Migration rate	Immigration policy
AT	**33277**	**1.42**	5.21	14.23	**0.18**	-3
BE	30938	**1.48**	**7.99**	**16.20**	**0.15**	1
DE	**31431**	**1.44**	7.10	**16.23**	0.10	**60**
DK	**32769**	1.07	5.85	**17.69**	0.09	4
ES	24908	1.15	**17.27**	12.59	**0.15**	16
FI	29923	1.03	**8.11**	**16.58**	0.04	5
FR	27992	1.12	**9.27**	**16.71**	0.12	**37**
GR	21354	-1.14	**16.38**	9.48	0.09	**25**
IE	**37700**	**4.62**	**9.88**	13.63	**0.17**	8
IT	26933	-0.20	**9.24**	10.98	0.11	15
LU	**67489**	**2.92**	5.20	13.53	**0.45**	**18**
NL	**34708**	1.31	5.56	**15.58**	0.13	**20**
PT	20608	0.25	**11.47**	11.23	0.08	**16**
SE	**32592**	**2.25**	7.49	**16.57**	**0.17**	**18**
UK	28638	**1.52**	6.22	15.36	**0.15**	-50

Source: EU-LFS, Eurostat and DEMIG (2015).

Note: Reported values are average values across the period 2004-2016. GDP per capita, total unemployment, and welfare spending are taken from the Eurostat database. Based on EU-LFS, we calculate migration rate as the share of foreign-born individuals in the working age population and the share of immigrants from non-EU27 countries in the immigrant working age population. Migration policy indicator is based on 558 policy changes identified in the DEMIG POLICY database in the EU15 countries over the 2004-2014 period which relate to border/land control and legal entry/stay. The indicator of policy liberalization is calculated as the sum of policy changes coded as -1, 0 or 1 and weighted by the level of policy change (on the scale from 1 to 4). Figures in bold indicate values above the median in the respective category.

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[14] Data from the Eurostat database accessed in February 2018: GDP in current prices expressed in PPS per capita (table *nama_10_pc*), expenditure on social protection excluding pensions in percentage of GDP (table *tps00098*).

Results are reported in Table 5.2 separately for immigrants of different origins and time since arrival in the host country. The responsiveness to skill shortages for immigrants from rest of Europe, as well as more established immigrant groups (YSM6-10 and YSM11+), is statistically significant in economically weaker countries as measured by GDP per capita or economic growth. Estimates for the EU-12 immigrants are positive and fell short of statistical significant with p-value 0.14. Thus, it appears that immigrants who have acquired the right to freely move across the EU (EU-12 immigrants) or have learned how to overcome barriers to mobility (with at least six years since migration) are particularly instrumental in increasing labor market efficiency in economically weaker countries.

The interactions with the unemployment rate indicate that the immigrant groups that are particularly fluid in lower-GDP and slowly-growing countries (immigrants from rest of Europe, as well as those with at least six years since migration) are also those whose relative responsiveness to skill shortages is positive and statistically significant in countries with high unemployment rates. On the other hand, the point estimates are, in many cases, statistically not different in low- and high-unemployment countries, and also in low- and high-GDP countries.

Remarkably, all the estimated coefficients on skill shortages are statistically zero or positive. Thus, the finding that immigrants' responsiveness to skill shortages equals or exceeds that of the natives is robust to a country's economic performance as measured by countries' GDP, economic growth, and unemployment rates.

Table 5.2 Relative responsiveness to skill shortages by economic conditions

	EU12	Europe	Africa	Asia	America	YSM1-5	YSM6-10	YSM11+
Low GDP	0.404	0.928 **	0.087	0.061	0.006	0.137	0.519 **	0.245
	(0.275)	(0.366)	(0.104)	(0.214)	(0.178)	(0.189)	(0.264)	(0.153)
High GDP	0.326	0.264	0.131	-0.221	0.103	0.066	0.224	0.082
	(0.221)	(0.282)	(0.095)	(0.152)	(0.101)	(0.222)	(0.148)	(0.117)
Low GDPgr	0.426	1.005 **	0.131	0.124	0.112	0.115	0.759 **	0.351 **
	(0.311)	(0.400)	(0.114)	(0.242)	(0.196)	(0.203)	(0.298)	(0.171)
High GDPgr	0.322	0.255	0.085	-0.225	-0.004	0.09	0.057	0.012
	(0.202)	(0.262)	(0.086)	(0.143)	(0.092)	(0.203)	(0.133)	(0.104)
Low UR	0.227	0.252	0.079	-0.174	-0.096	-0.131	0.124	0.055
	(0.161)	(0.244)	(0.081)	(0.130)	(0.089)	(0.146)	(0.122)	(0.107)
High UR	0.57	1.113 **	0.138	0.053	0.207	0.416	0.697 **	0.301 *
	(0.356)	(0.451)	(0.122)	(0.283)	(0.195)	(0.294)	(0.309)	(0.171)
Low SOCX	0.486 *	1.034 ***	0.118	-0.002	0.069	0.194	0.485 **	0.263 *
	(0.263)	(0.374)	(0.093)	(0.208)	(0.153)	(0.222)	(0.231)	(0.139)
High SOCX	0.167	-0.016	0.089	-0.208	0.02	-0.056	0.203	0.002
	(0.146)	(0.21)	(0.11)	(0.137)	(0.112)	(0.154)	(0.133)	(0.115)

Source: Own calculations based on EU-SILC, EU-LFS, and Eurostat data.

Notes: See note to Table 4.1. Estimates are obtained from separate regressions. Presented results are calculated effects β_1 and $\beta_1 + \beta_2$ from interactions with skill shortage. The considered dimensions are GDP growth (GDP gr), unemployment rate (UR), and the share of welfare spending in GDP (SOCX). See Table 5.1 for the breakdown of countries.

The findings reported in Table 5.2 further imply that immigrant workers from the EU-12 and rest of Europe are more responsive to skill shortages in those EU-15 countries that are less generous in terms of welfare spending. It appears that high welfare spending makes immigrants less responsive to wage premia. This result indicates a lock-in effect of welfare generosity on the relative responsiveness to labor market imbalances. We also find that immigrants with a longer immigration history (YSM 6-10 and YSM 11+) are particularly responsive to skill shortages in low-welfare countries. In welfare-generous countries, the flexibly of immigrants in responding to labor market opportunities is statistically no different from native workers.

5.3 Relative responsiveness to skill shortages by immigration context

European countries differ greatly in the characteristics of their immigrant population and their immigration policies. We further explore how the relative responsiveness of immigrants to skill shortages is affected by the scale of immigration and the composition of immigrant population. Based on the EU-LFS, we calculate (i) the share of foreign-born individuals in the working age population, denoted migration rate; and (ii) the proportion of each immigrant group distinguished in our analysis in the immigrant working age population (proxy for the size of immigrant network).

In addition, we construct an indicator of liberalization of migration policies from the DEMIG POLICY database (DEMIG 2015). Migration policy indicator is based on 558 policy changes identified in DEMIG data in the EU-15 countries over the 2004-2014 period which relate to border/land control and legal entry/stay. The indicator is constructed as the sum of policy changes coded as -1, 0, or 1 (higher number implies policy liberalization) and weighted by the level of policy change (on the scale from 1 to 4). Table 5.1 presents the country mean values of these variables. In the analysis, we split the countries into two groups, with the median as the threshold, and introduce interaction variables with the skill shortage variable.

Our findings presented in Table 5.3 show that immigrants from rest of Europe and immigrants with a longer immigration history (YSM 6-10 and YSM 11+) are more responsive to skill shortages than natives in countries with a below-the-median migration rate. This indicates that a smaller immigrant population provides for greater mobility of immigrant workforce, possibly due to less competition between immigrant groups in the labor market. The opposite pattern emerges for EU-12 immigrants who exhibit higher mobility in countries with an above-the-median migration rate.

Our estimates further corroborate the importance of social networks, i.e. immigrants are more responsive to the changing economic environment when their network is larger. One channel through which the social network decreases the adjustment costs from mobility is by effectively transmitting information about the economic environment. The immigrants originating from North and South Americas and Australia exhibit higher mobility in countries where their network is smaller, which may be attributed to the labor market competition within this immigrant group.

Table 5.3 Relative responsiveness to skill shortages by immigration context

	EU12		Europe		Africa	Asia	America		YSM1-5	YSM6-10		YSM11+	
Low MR	0.297		0.793	**	0.092	0.084	0.029		0.06	0.607	**	0.26	*
	(0.260)		(0.340)		(0.103)	(0.202)	(0.180)		(0.178)	(0.276)		(0.154)	
High MR	0.411	*	0.333		0.122	-0.249	0.072		0.133	0.156		0.067	
	(0.228)		(0.302)		(0.096)	(0.164)	(0.112)		(0.225)	(0.153)		(0.116)	
Small network	0.394	**	0.216		0.064	-0.026	0.237	*:	0.207	0.365	**	0.109	
	(0.165)		(0.221)		(0.102)	(0.193)	(0.096)		(0.143)	(0.125)		(0.100)	
Large network	0.506	*	0.715	**	0.154	-0.092	0.071		0.364	0.542	*	0.277	
	(0.275)		(0.288)		(0.096)	(0.159)	(0.143)		(0.339)	(0.32)		(0.18)	
Restrictive policy	0.346		0.491		0.09	0.05	-0.155		-0.207	0.436		0.211	
	(0.288)		(0.375)		(0.091)	(0.202)	(0.197)		(0.203)	(0.286)		(0.180)	
Liberal policy	0.387	**	0.721	**	0.112	-0.208	0.2	*:	0.306	0.371	**	0.15	*
	(0.193)		(0.287)		(0.102)	(0.146)	(0.101)		(0.202)	(0.162)		(0.088)	

Source: Own calculations based on EU-SILC, EU-LFS, and Eurostat data.

Notes: See note to Table 4.1. Estimates are obtained from separate regressions. Presented results are calculated effects β_1 and $\beta_1 + \beta_2$ from interactions with skill shortage. The considered dimensions are migration rate (MR), the migration network, and the immigration policy. See Table 5.1 for the breakdown of countries.

The openness of immigration policy affects the costs of immigration and therefore the type of migrants who enter the country. A restrictive migration policy effectively reduces the inflow of immigrants in the labor market and increases the selectivity of immigrants. Consequences are difficult to predict with regard to

immigrants' potential to react to imbalances in the labor market. In contrast, an open migration policy possibly intensifies competition in the host labor market, and may therefore assist the labor market by removing shortages. Our results in Table 5.3 imply that immigrants are particularly responsive to skill shortages relative to natives in countries that have, over time, liberalized their immigration programs. It is also possible that countries with an open migration policy also operate favorable integration policies that enable immigrants to be more mobile across occupation-industry groups. Those policies may include unrestricted access to jobs, the possibility to leave and re-enter the country more easily, and the right to reside anywhere in the host country.

5.4 Summary of findings

We find that immigrants appear to be more responsive to skill shortages in relatively poorer and high-unemployment countries relative to the natives. This implies that immigration can help these economies with fluid labor.

Our results indicate that immigrant workers are particularly responsive in countries with less generous welfare spending. Guzi et al. (2018) further explore the role of welfare state institutions in determining the responsiveness of immigrants and natives to skill shortages, and conclude that more generous welfare states do not necessarily inhibit immigrants' mobility. Rather, the authors find that welfare generosity is more complex and may be shaped by various institutional complementarities, and further affected by the characteristics of different immigrant groups that mediate their access to welfare.

Finally, our results imply that immigrants are particularly responsive to skill shortages relative to natives in countries that have introduced more liberal migration

policies, and that have a lower scale of immigration.. Our findings further corroborate the importance of social networks; immigrants are more mobile in countries when their network is larger.

6 Migration as an adjustment mechanism in the Great Recession

In this chapter, we study how immigrants have responded to asymmetric economic shocks across sectors, occupations, and states in the pre- and post-crisis periods in Europe.[15] The Great Recession that started in 2008 profoundly affected European economies and labor markets, although the magnitude of impact differed considerably between states.

The limited fiscal capacity and lack of room for monetary adjustment between the member states of the eurozone make labor mobility an important vehicle of adjustment to asymmetric economic shocks. In a country experiencing a positive labor demand shock, workers are initially drawn from the unemployment pool and more inactive workers start entering the labor force. If the shock persists, real wages rise and the labor force starts growing as a result of the inflow of workers from other geographical locations. Similar dynamics may be observed in the opposite direction in the case of a negative shock. Arpaia et al., (2016) find that population movements in the EU in response to economic shocks have almost doubled since the introduction of euro, and the increase in mobility is triggered more by country than by region-specific shock. The importance of mobility as an adjustment mechanism to asymmetric labor demand shocks has therefore increased over time in the EU.

The responsiveness of migration to macroeconomic fluctuations was particularly important for Europe during the recent Great Recession. The mobility of workers can

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[15] An earlier version of this chapter was published as Guzi and Kahanec (2017).

help to offset some of the unemployment increase. Jauer et al. (2014) estimate that about a quarter of the unemployment increase during the Great Recession in the EU was absorbed by population movements. The authors find that labor market adjustment in Europe during the Great Recession of 2008 was primarily driven by immigrants from recent EU accession countries.

Migrants originating from the member states that joined the EU in 2004 and 2007 (EU-12) have increased the adjustment capacity of the labor markets to cope with asymmetric shocks (Kahanec, 2013). These immigrants are relatively young and well educated, and adjust to changing economic conditions more flexibly. Kahanec and Zimmermann (2016) document various adjustment channels at the EU-wide and national levels, through which post-enlargement mobility helped to cushion some of the economic shocks during the Great Recession. On the other hand, groups of immigrants from outside the EU may face institutional, regulatory, or socio-economic constraints limiting their adjustment potential. Findings from the literature also report that, relative to natives, the labor market situation of immigrants is more sensitive to economic shocks. Using data from Germany and the UK, Dustmann et al. (2010) show that immigrants' risk of unemployment is more sensitive to the economic cycle than that of natives. De la Rica and Polonyankina (2013) find increased competition for jobs among immigrants during the Great Recession in Spain. Relative to natives, immigrants moved into jobs more intensive in manual skills during the recession years.

In the analysis in this chapter, we explore how the labor mobility of immigrants from different origins evolved in the pre-crisis years and in the most recent, post-crisis, years.

6.1 Changes in the relative responsiveness of immigrants over time

To understand how the responsiveness to skill shortages changes over the business cycle, we use the following empirical strategy: We estimate the baseline model (Equation 4) on seven consecutive subsamples between 2004 and 2016, each for a seven-year interval.[16] As before, in all models we treat EU-15 countries as one entity and study the relative responsiveness of immigrants to skill shortages in comparison with the EU native group.

The results reported in Table 6.1 show the responsiveness of immigrants from different origins (in rows) and in different time intervals (in columns). The significant estimates for EU-12 immigrants are obtained also in the samples containing more recession years. The magnitude of effect obtained from different time periods follows a U-shaped pattern and the effect becomes insignificant around the onset of the Great Recession (2008-2014). The estimates for the European immigrant group suggest higher responsiveness compared with the EU natives in the years before the Great Recession. The responsiveness of other immigrant groups to skill shortage shows less definite patterns: The responsiveness to skill shortages vis-à-vis the EU natives for the African group is significant in the sample, only consisting of recession years, Asians' responsiveness becomes negative in the recession years, and Americans' responsiveness is statistically indistinguishable from that of the EU-natives throughout the studied periods.

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[16] The results obtained from subsamples of shorter or longer length lead to the same conclusions. The results for alternative subsamples are available from the authors upon request. Splitting the sample into seven-year intervals is preferred to provide a sufficient sample size.

With respect to time since immigration, the estimates for recently-arrived immigrants (YSM 1-5) are higher in the later periods, but the effect becomes statistically significant only in the 2009-2015 period. The estimate of the coefficients on skill shortage for the immigrant group with arrival 6-10 years ago follows a hump shape, with the peak around the inception of the Great Recession. The estimate for established immigrants (YSM 11+) is strongest before the Great Recession and decreases to near-zero in later periods.

6.2 Estimates by education

We further investigate how the responsiveness to skill shortages varies according to the qualification of a worker. To this end, we replicate the estimation in Table 6.1 for workers with and without tertiary education (we apply the same strategy in section 4.2). The results are presented in Tables 6.2 and 6.3.

The positive estimates for EU-12 immigrants during the Great Recession and immigrants from rest of Europe before the Great Recession are confirmed, arising primarily in the low-educated segment of the labor market. High-skilled immigrants from rest of Europe were particularly responsive before the Great Recession and around the inception of the Great Recession (2006-2012). High-educated immigrants from Africa and America exhibit higher responsiveness relative to comparable EU natives during the recession years. The effect for the group of low-educated Americans is peculiar, as it changes from positive (but the estimate fell short of statistical significance) before the Great Recession to negative and significant in later periods. The negative effect found for Asian immigrants in the recession years in Table 6.1 is driven by high-skilled workers.

The observed patterns for immigrants by the years since immigration indicate that the effect for immigrants with six to ten years since immigration is driven by low-educated workers. The significant positive effects are present around the onset, but also before, the Great Recession. The results obtained for established immigrants (11+ years) in Table 6.1 are confirmed for both low- and high-educated workers – the effect is present only in the years before the Great Recession for the low-skilled, and peaks around the onset of the Great Recession for the high-skilled.

6.3 Summary of findings

In this chapter, we explore how our results vary over the business cycle during the Great Recession. Low-educated immigrants from the EU-12 in particular have responded to changing wage premia more fluidly than the EU natives also at the onset of the Great Recession. The high-educated workers from African and American origins exhibit particularly high responsiveness to skill shortages during the Great Recession.

We also find that low-skilled immigrants' responsiveness to skill shortages peaks for those with 6-10 years since migration. This may point to their (still) low attachment to their specific location in the host labor market, but an already sufficient adjustment to the conditions, and hence, ability to overcome barriers to migration in the host labor market. For established immigrants (YSM 11+), responsiveness to skill shortages is higher in the period before the Great Recession, during which the effect is reduced. However, the effect for high-skilled established immigrants in this category peaks around the onset of the Great Recession.

Overall, our results suggest that immigrants may play an important role in labor adjustment during times of asymmetric economic shocks.

Table 6.1 Relative responsiveness of immigrants in different periods

	2004-2010	2005-2011	2006-2012	2007-2013	2008-2014	2009-2015	2010-2016
EU12	0.388	0.812 **	0.723 **	0.573 **	0.434	0.618 **	0.099
	(0.267)	(0.320)	(0.292)	(0.262)	(0.299)	(0.302)	(0.213)
R2	0.107	0.041	0.057	0.048	0.058	0.058	0.037
N	1085	1111	1090	1070	1070	1070	1070
Europe	1.254 ***	0.690 **	0.744 **	0.393	0.282	0.049	0.054
	(0.346)	(0.349)	(0.361)	(0.354)	(0.396)	(0.397)	(0.280)
R2	0.092	0.051	0.079	0.040	0.025	0.032	0.039
N	1051	1069	1047	1025	1025	1025	1025
Africa	0.029	0.127	0.193 *	0.226 **	0.180	0.246 **	0.012
	(0.101)	(0.104)	(0.103)	(0.114)	(0.129)	(0.122)	(0.115)
R2	0.052	0.035	0.042	0.043	0.028	0.037	0.050
N	1287	1316	1300	1285	1285	1285	1284
Asia	0.202	0.195	0.216	-0.095	-0.228	-0.322	-0.378 *
	(0.174)	(0.186)	(0.195)	(0.211)	(0.233)	(0.239)	(0.219)
R2	0.090	0.057	0.074	0.055	0.063	0.056	0.049
N	915	951	940	930	930	930	930
America	0.108	0.051	-0.040	-0.200	-0.207	-0.100	-0.008
	(0.113)	(0.128)	(0.129)	(0.190)	(0.204)	(0.218)	(0.232)
R2	0.044	0.044	0.035	0.031	0.046	0.028	0.040
N	1195	1227	1213	1200	1200	1200	1198
YSM 1-5	-0.100	0.235	0.066	0.282	0.284	0.713 **	0.062
	(0.189)	(0.250)	(0.235)	(0.243)	(0.287)	(0.307)	(0.223)
R2	0.078	0.068	0.087	0.099	0.114	0.112	0.103
N	1130	1156	1138	1120	1120	1120	1120
YSM 6-10	0.572 ***	0.617 ***	0.641 ***	0.281	0.243	0.197	0.083
	(0.192)	(0.208)	(0.230)	(0.247)	(0.300)	(0.312)	(0.259)
R2	0.105	0.050	0.073	0.068	0.071	0.069	0.093
N	1257	1283	1261	1240	1240	1240	1240
YSM 11+	0.439 ***	0.365 ***	0.360 ***	0.116	0.024	-0.052	-0.144
	(0.122)	(0.129)	(0.131)	(0.172)	(0.190)	(0.193)	(0.176)
R2	0.151	0.102	0.163	0.138	0.125	0.108	0.101
N	1450	1479	1457	1435	1435	1435	1433

Source: Own calculations based on EU-SILC, EU-LFS, and Eurostat data.

Notes: The dependent variable is the supply of immigrants relative to EU native expressed in first difference. All models include cell, year, and country fixed effects. YSM indicates the group of immigrants by years since immigration. Each cell includes the coefficient on skill shortage estimated from a separate model for different immigrant groups (in rows) and on the sample limited to the period specified in the header row. The number of observations in the model varies because we allow only occupation-industry-country cells of sufficient size in all years. Regressions are weighted by the number of observations for the occupation-industry-country cell. Heteroskedastic-consistent standard errors are in parentheses, *, **, *** identifying significance at 10, 5, 1 per cent levels, respectively.

Table 6.2 Relative responsiveness of immigrants (workers with less than tertiary educ.)

	2004-2010		2005-2011		2006-2012		2007-2013		2008-2014		2009-2015		2010-2016
EU12	0.456		0.861	***	0.659	**	0.514	**	0.475	*	0.623	**	0.136
	(0.286)		(0.321)		(0.274)		(0.241)		(0.283)		(0.291)		(0.206)
R2	0.102		0.043		0.062		0.054		0.063		0.068		0.041
N	883		913		899		885		885		885		885
Europe	1.104	***	0.411		0.428		0.056		0.097		-0.079		0.140
	(0.353)		(0.378)		(0.353)		(0.348)		(0.376)		(0.376)		(0.288)
R2	0.098		0.060		0.088		0.057		0.036		0.040		0.037
N	860		871		853		835		835		835		835
Africa	-0.067		0.048		0.125		0.133		0.129		0.183		-0.041
	(0.127)		(0.132)		(0.129)		(0.136)		(0.159)		(0.151)		(0.138)
R2	0.038		0.033		0.039		0.037		0.026		0.033		0.042
N	1115		1146		1135		1125		1125		1125		1124
Asia	0.193		0.126		0.192		-0.138		-0.203		-0.332		-0.372
	(0.202)		(0.212)		(0.213)		(0.231)		(0.257)		(0.281)		(0.312)
R2	0.094		0.100		0.112		0.085		0.093		0.068		0.037
N	754		786		775		765		765		765		765
America	0.216		0.075		-0.175		-0.392	*	-0.505	**	-0.367		-0.223
	(0.139)		(0.149)		(0.145)		(0.222)		(0.244)		(0.267)		(0.318)
R2	0.035		0.043		0.040		0.035		0.051		0.028		0.029
N	967		995		984		975		975		975		975
YSM 1-5	-0.070		0.225		-0.035		0.085		0.055		0.351		-0.022
	(0.216)		(0.274)		(0.246)		(0.238)		(0.290)		(0.314)		(0.244)
R2	0.078		0.077		0.101		0.111		0.119		0.098		0.113
N	834		856		843		830		830		830		830
YSM 6-10	0.591	***	0.657	***	0.649	***	0.264		0.290		0.217		0.115
	(0.205)		(0.208)		(0.227)		(0.260)		(0.321)		(0.351)		(0.328)
R2	0.127		0.057		0.079		0.078		0.075		0.071		0.103
N	967		992		976		960		960		960		958
YSM 11+	0.454	***	0.322	**	0.282	*	-0.013		-0.063		-0.111		-0.190
	(0.146)		(0.146)		(0.146)		(0.185)		(0.204)		(0.212)		(0.204)
R2	0.138		0.103		0.151		0.121		0.115		0.094		0.096
N	1342		1369		1347		1325		1325		1325		1323

Source: Own calculations based on EU-SILC, EU-LFS, and Eurostat data.

Notes: See notes to Table 6.1.

Table 6.3 Relative responsiveness of immigrants (workers with tertiary education)

	2004-2010		2005-2011		2006-2012		2007-2013		2008-2014		2009-2015		2010-2016	
EU12	0.080		0.886		0.821		0.341		-0.198		-0.337		-0.370	
	(0.612)		(0.542)		(0.581)		(0.655)		(0.677)		(0.619)		(0.541)	
R2	0.087		0.059		0.092		0.112		0.089		0.068		0.036	
N	531		547		537		528		529		530		529	
Europe	1.349	**	0.878		1.351	**	0.458		-0.572		-0.405		-0.862	
	(0.640)		(0.626)		(0.611)		(0.663)		(0.736)		(0.715)		(0.544)	
R2	0.051		0.056		0.109		0.081		0.077		0.066		0.024	
N	466		474		462		450		450		450		450	
Africa	0.262		0.406	**	0.544	***	0.730	***	0.505	**	0.545	**	0.256	
	(0.188)		(0.194)		(0.199)		(0.244)		(0.251)		(0.231)		(0.234)	
R2	0.059		0.038		0.040		0.042		0.044		0.047		0.045	
N	665		684		673		664		665		665		665	
Asia	0.254		0.147		0.054		-0.183		-0.505		-0.505		-0.655	**
	(0.339)		(0.303)		(0.288)		(0.333)		(0.354)		(0.332)		(0.324)	
R2	0.060		0.081		0.066		0.057		0.066		0.070		0.087	
N	447		480		479		478		478		478		478	
America	-0.074		0.073		0.338		0.612	**	0.811	***	0.554	*	0.426	
	(0.206)		(0.234)		(0.242)		(0.296)		(0.292)		(0.295)		(0.281)	
R2	0.041		0.036		0.043		0.076		0.121		0.052		0.082	
N	629		655		650		644		643		643		642	
YSM 1-5	0.450		0.662		0.561		0.616		0.229		0.695		0.037	
	(0.443)		(0.436)		(0.430)		(0.505)		(0.531)		(0.486)		(0.363)	
R2	0.099		0.137		0.184		0.178		0.147		0.152		0.068	
N	545		561		552		545		545		545		545	
YSM 6-10	0.091		0.167		0.278		0.367		0.364		0.199		-0.095	
	(0.330)		(0.310)		(0.306)		(0.361)		(0.404)		(0.353)		(0.292)	
R2	0.041		0.034		0.045		0.031		0.059		0.044		0.071	
N	582		604		596		590		590		590		590	
YSM 11+	0.517	***	0.511	**	0.695	***	0.692	***	0.507	**	0.250		0.030	
	(0.185)		(0.198)		(0.186)		(0.222)		(0.224)		(0.208)		(0.146)	
R2	0.056		0.033		0.048		0.068		0.047		0.081		0.036	
N	822		852		841		830		830		830		829	

Source: Own calculations based on EU-SILC, EU-LFS, and Eurostat data.

Notes: See notes to Table 6.1.

7 Conclusion

The topic of migration and labor mobility has been at the center of discussion in Europe, particularly since the 2004 and 2007 EU enlargements and the European migration crisis of 2014-16. In addition to security concerns, economic arguments have played a major role in these debates, primarily concerning the economic impacts of labor mobility on the receiving labor markets. Fundamental economic arguments suggest that immigrants can be expected to be more fluid than natives in responding to changing skill and labor imbalances, and hence contribute to a more efficient allocation of labor in the EU. This is because immigrants' costs of departing their home, job, and family and friend networks in the country of origin are sunk upon arrival to a new country, as their decision to part with them has already been made. It follows that this should be particularly true for newly-arrived immigrants, not yet deeply integrated in their new milieu in the receiving country. In contrast, natives' decision to move entails pecuniary and non-pecuniary costs of parting with their original home, job, and networks.

The migration literature documents important contributions of the mobile immigrant workforce in the labor adjustment process (Borjas, 2001; Dustmann et al., 2012; and Guzi et al., 2015; Jauer et al., 2014). This work extends the methodology of Borjas (2001), Guzi and Kahanec (2017), and Guzi et al. (2018) by studying the responsiveness of immigrants to changing skill shortages. The analysis is performed in the context of the EU-15 countries, which differ in many economic, institutional, and policy variables. We use data from EU-LFS, EU-SILC, and several other auxiliary

datasets, to exploit this diversity and study how it interacts in the way in which natives and different types of immigrants respond to labor market imbalance.

We find that immigrants' responsiveness to skill shortages equals or exceeds that of the natives across all the studied contexts. In particular, cases indicating that immigrants would be less flexible than natives in responding to skill shortages are rare in this analysis. We confirm that immigrants from the EU-12 and the rest of Europe (outside the EU) are more responsive in comparison with the natives, and we find statistically significant positive results for African and American immigrants in specific economic, institutional, and policy contexts. Asian immigrants remain the only group that does not exhibit higher mobility in the labor market under any contexts. Conversely, lower labor market mobility is identified for male immigrants of Asian origin and in the middle-age cohort. This may imply barriers to mobility in the EU states specific to this group.

Our results bring additional insights to the literature, i.e. that it is low-skilled immigrants from the EU-12 and the rest of Europe and high-skilled African immigrants who are more responsive to skill shortages relative to EU-natives. Other immigrant groups respond to skill shortages similarly to the corresponding EU natives. This finding is consistent with initial observations that immigrants from the EU-12 exhibit high attachment to the labor market, their job search intensity is high, and they are able to change employment across economic sectors in the economy. Immigrants from the EU-12 and the rest of Europe are most concentrated in elementary occupations and exhibit the highest degree of down-skilling. This is consistent with the hypothesis that recently-arrived immigrants are more flexible workers, intensely seeking employment opportunities and responding to changing economic conditions. The responsiveness of

the other immigrant groups is likely to be restrained by institutional barriers, as many such immigrants do not enjoy all the provisions of free intra-EU mobility of workers.

As conjectured by the theoretical model, the presence of children increases migration costs and defers the labor mobility of immigrants. The series of additional analysis reveals that it is young cohorts of immigrants who are primarily driving our results. With respect to gender, the results are less clear and vary by the origin of immigrants.

The diversity across EU member states enables us to study how immigrants' responsiveness interacts with economic conditions and institutional factors. Immigrants appear to be more responsive to skill shortages in relatively poorer and high-unemployment countries relative to the natives. This implies that immigration can help these economies with fluid labor. An important finding is that high welfare spending may disincentivize the flexibility of immigrants relative to natives in responding to skill shortages. However, the role of the welfare state may involve various institutional complementarities beyond the impact of welfare generosity. Our results further show that immigrant workers are particularly fluid in countries with a generally lower scale of immigration, and in countries that have introduced a more open immigration policy.

In the analysis of immigrants' relative responsiveness to labor shortages over the business cycle during the Great Recession, we follow the labor market using moving seven-year windows. We find varying patterns for different immigrant groups. Immigrants from the EU-12 exhibited high responsiveness to labor shortages relative to the EU natives, which peaked and became significant during the Great Recession. However, the effect is concentrated in the low-skilled segment of the labor market. Results for immigrants from the rest of Europe imply their relative responsiveness is

positive and statistically significant only in the periods covering mostly the pre-crisis years. Again, the effect is stronger when measured among low-skilled workers. The high-skilled African and American immigrants are confirmed more mobile relative to EU natives during the Great Recession. Low-educated immigrants originating from America exhibit a peculiar pattern, however. The higher responsiveness in the pre-recession period (2004-2010) gradually diminishes and these immigrants became less responsive relative to natives during the recession years. Whether this could reflect a tightening of the migration policy with respect to non-EU groups during the Great Recession is a topic for further investigation. We also find that low-skilled immigrants' responsiveness to skill shortages peaks for those with 6-10 years since migration. This may point to their (still) low attachment to their specific location in the host labor market, but an already sufficient adjustment to the conditions, and hence, ability to overcome barriers to migration in the host labor market. For established immigrants (with more than 10 years since migration), responsiveness to skill shortages is higher in the period before the Great Recession, during which the effect is reduced. However, the effect for high-skilled established immigrants in this category peaks around the onset of the Great Recession.

As for the limitations of our study, the analysis presented does not permit causal interpretations, since the studied economic, institutional, and policy contexts cannot always be seen as fully exogenous. Similarly, although skill shortages are lagged by one period and are measured regardless of the immigrant status of workers in a cell, due to some serial correlation, the immigrant-native relative labor supply could still affect skill premia across cells. However, it may be argued that such reverse channels reinforce our results, as they tend to attenuate the studied effects (Dustmann et al., 2012). Furthermore, our data are not capturing irregular migrants who are typically even more

responsive to labor market changes. From the perspective of immigrant populations, we are unable to consider the aspect of the quality of employment that immigrants attain when flexibly responding to labor market opportunities across the EU countries.

Our study shows that the coefficient of labor-shortage is significantly positive in many, but not all economic, institutional, and policy contexts in the EU-15. This is an important result that deserves further study. Our results also indicate that policies matter; while some policies seem to enable immigrants to respond to changing labor market conditions, others may be inhibiting immigrant workers' mobility. As immigrants' labor market mobility provides for a more efficient allocation of labor in host labor markets, policies that inhibit their mobility are costly in terms of forgone GDP and forgone economic opportunities.

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