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How Immigrants Helped EU Labor Markets to Adjust during the Great Recession

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Abstract

The economic literature starting with Borjas (2001) suggests that immigrants are more flexible than natives in responding to changing sectoral, occupational, and spatial shortages in the labor market. In this paper, we study the relative responsiveness to labor shortages by immigrants from various origins, skills and tenure in the country vis-à-vis the natives, and how it varied over the business cycle during the Great Recession. We show that immigrants in general have responded to changing labor shortages across EU member states, occupations and sectors more fluidly than natives. This effect is especially significant for low-skilled immigrants from the new member states or with the medium number of years since immigration, as well as with high-skilled immigrants with relatively few (1-5) or many (11+) years since migration. The relative responsiveness of some immigrant groups declined during the crisis years (those from Europe outside the EU or with eleven or more years since migration), whereas other groups of immigrants became particularly fluid during the Great Recession, such as those from new member states. Our results suggest 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. The paper provides new insights into the functioning of the European Single Market and the roles various immigrant groups play for its stabilization through labor adjustment during times of uneven economic development across sectors, occupations, and countries.

JEL codes: J24, J61, J68

Keywords: immigrant worker, labor supply, skilled migration, labor shortage, wage regression, Great Recession

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1 Introduction

The Great Recession that started in 2008 profoundly affected European economies and labor markets. Whereas some of them, mainly in the southern peripheries of the EU, suffered from protracted recessions, others, such as Germany and Slovakia, recovered from a moderate recession swiftly. The Baltic states on the eastern flanks of the EU dipped into rather severe recessions in the early stages of the Great Recession, but managed to revitalize their economies and regain top positions among EU's fastest growing economies relatively quickly. Poland, on the other hand, did not record a recession during this time (see Figure A1 in Appendix).

Whereas fluctuations in economic growth impact the situation in the labor market, labor adjustment affects aggregate GDP dynamics as well. With limited fiscal capacity and no room for monetary adjustment between the member states of the Euro Area, the role of labor mobility as a possible vehicle of adjustment to such asymmetric economic shocks became ever more important. However, the debates surrounding the UK leaving the EU (Brexit) or the Hungarian anti-refugee referendum of October 2nd, 2016, document, that many EU citizens perceive labor mobility unfavorably. On that background, it is important to inform the mobility debate in Europe with hard analysis and data about immigration's effects on EU member states' labor markets.

Some immigrant groups, such as those originating from the member states that joined the EU in 2004 and 2007 (EU-12) tend to be relatively young and well educated (Kahanec, 2013). As such, they can be expected to adjust to changing economic conditions more flexibly. On the other hand, groups of immigrants from outside the EU may face institutional, regulatory, or socio-economic constraints limiting their adjustment potential. According to Dustmann, Glitz and Vogel (2010), the net of the role of differences in individual characteristics and region of residence in Germany and the UK immigrants' risk of unemployment is more sensitive to the economic cycle than that of the natives. De la Rica and Polonyankina (2013) document increased competition for jobs among immigrants during the Great Recession in Spain. Relative to the natives, immigrants moved into jobs more intensive in manual skills during the recession years.

The economic literature proposes, that in several countries immigrants helped to cushion the economic downturn during the Great Recession. Kahanec and Zimmermann (2016) provide an account of the effects of post-enlargement labor mobility on receiving and sending EU

member states. They 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.

In a theoretical model, Borjas (2001) argues that such relative responsiveness of immigrants to wage differentials can be explained by the fact that for immigrants, the costs of parting with their homes and jobs are sunk upon arrival to the destination country. For the natives, however, such costs still affect their migration decision. Lower costs of immigrants' mobility should then result in a higher responsiveness of immigrants to wage differentials vis-à-vis the natives. Borjas (2001) and Dustmann, Frattini and Preston (2012) empirically confirm that in the US and UK, respectively, immigrants respond to wage differentials across sectors, and occupations more fluidly than the natives. Guzi, Kahanec and Kurekova (2015) document this result for the EU-15.[1]

In this paper we contribute to this literature by studying whether and how various immigrant groups in the EU-15 responded to asymmetric economic shocks across sectors, occupations and states before and during the Great Recession. Specifically, we measure the responsiveness to labor shortages of immigrants relative to natives building on the approach of Borjas (2001), Dustmann *et al.* (2012) and Guzi *et al.* (2014, 2015); and extend this framework to gauge the evolution of immigrants' relative responsiveness over the business cycle. We primarily use 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 among the receiving countries in the analysis due to the relatively limited inflow of immigrants into these countries and the resulting small sample sizes (Kahanec and Zaiceva, 2009).

The study is structured as follows. First, we introduce a theoretical framework to formalize the location decisions by natives and immigrants. Second, we provide a measure of labor shortages, and describe the estimation strategy to identify the aggregate responsiveness of immigrants from different origins in labor shortages, as compared to natives over the business cycle during the Great Recession. Finally, we discuss and interpret the results and the ensuing policy implications.

[1] EU-15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

2 Theoretical framework

The theoretical framework of this paper is based on the model first presented by Borjas (2001). The basic intuition underlying the model is that native workers face high costs of parting with their initial location, networks, and economic and social relationships. The existing wage differentials between countries are not sufficient to motivate large numbers of workers to move. In contrast, immigrants, having arrived at their destination only relatively recently, do not face such costs. For them, these costs of migration are sunk and do not fetter their migration decision. As a result, the location decisions of immigrant workers should be more responsive to wage differentials than those of natives.

The 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

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

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. It is reasonable to think that for natives, moving costs can be substantial, and so 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

[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 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. Still, for the purposes of this paper it suffices to assume this simplified cost structure. The model could be extended to a more complex cost structure in a straightforward way. Also, 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.

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 where 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 occupations groups. In principle, capital flows could lead to the equalization of wage differentials, but with substantial lags and adjustment costs.

2.1 Measuring labor shortages and immigrant-native relative supply

The empirical strategy is adapted from Borjas (2001), Dustmann *et al.* (2012), and Guzi *et al.* (2014, 2015). The two key variables in the model are labor shortage and relative labor supply of immigrants and natives across countries and occupation-industry groups. Similarly to Borjas (2001), we estimate labor shortages at the level of occupation-industry-country cells as the part of wages that remains unexplained after differences in the composition of workers across cells are netted out. Specifically, for each year *t* we run a log-wage regression of this form

$$W_{ikct} = X_{ikct}\beta + \gamma_{kct} + \varepsilon_{ikct}, \qquad (2)$$

where W_{ikct} is the log wage of worker *i* who belongs to occupation-industry group *k* in country *c* and year *t*, X_{ikct} is a vector of individual characteristics including gender, education, work experience and work experience squared, and ε_{ikct} is the error term.[4] We normalize wage and all variables in vector X_{ikct} to have zero means in each year *t*. The vector γ_{kct} 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. We use γ_{kct} as an indicator of labor shortage to measure immigrants' responses to changes in residual wage premia, vis-à-vis the natives' response.

The second key variable in the analysis is the measure of relative supply of immigrants and natives in each occupation-industry-country cell. 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

[3] On the process of integration of immigrants into the destination economies, see Constant, Gataullina and Zimmermann (2009).
[4] By including education as an independent variable, we eliminate any wage differentials arising due to educational attainment of workers, but we assume that the residual wage premia are invariant across skill groups.

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

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 native have the same distribution across occupation-industry groups and countries. The index 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, we use an index calculated for workers with and without tertiary education, and for different immigrant groups distinguished by their origin or time since immigration.

2.2 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 labor 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 occupation-industry cell, 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] It is worth noting that we do not adjust for differences in living costs in the construction of γ_{kct} in Equation 2; that is done in the regression model of Equation 4 through the inclusion of country-year fixed effects.

A word of caution is due here: our measure of labor shortage captures any increase in the price of labor that cannot be explained by the changing composition of workers in terms of

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

gender, education, and work experience in the given occupation-industry-country cell. Whereas first differences, country and year fixed effects control 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 labor 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-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.*, 2015.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.

4 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 EU-LFS and EU-SILC. The national statistical offices of each member country organize these surveys in harmonized methodology. The main advantage of EU-LFS is its large sample size, but the downside is the missing information on the income status of households. The information on income is complemented from the EU-SILC database (particularly the estimation of labor shortage indicator in Equation 2). Both datasets include information on respondents' personal circumstances (including nationality and country of birth), their labor market status and job characteristics during a reference period. The sampling structure of the surveys focuses primarily on permanent residents and

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

therefore does not capture short-term and seasonal migration. The empirical analysis exploits samples from 2004-2014 of individuals aged 15 to 64.

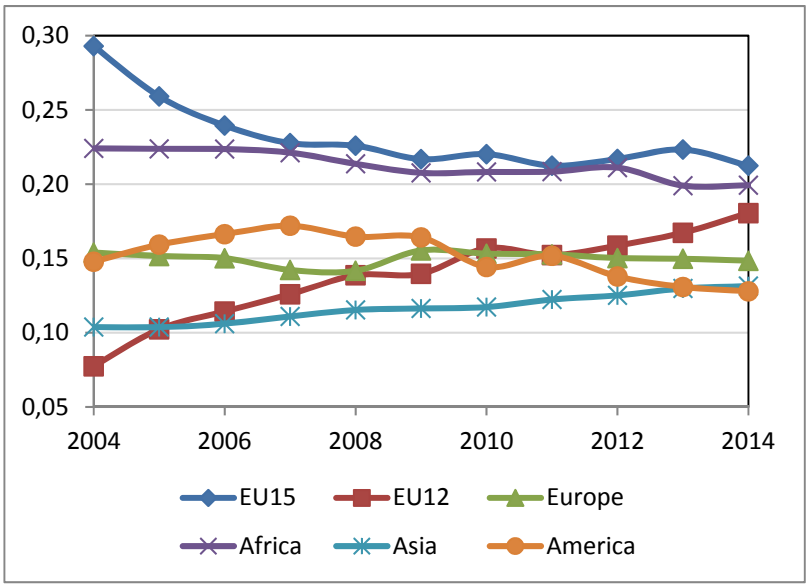
The terms 'immigrant population' or 'immigrant individuals' are used in the broad context of immigration, and the origin of immigrants is based on the country of birth. One exception is Germany, for which immigrant origin can be determined only by nationality. The native population refers to people residing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

The immigrant population in the EU-15 is dynamically developing. According to the EU-LFS the share of immigrants in the working age population in EU-15 countries increased from 8% in 2004 to 12.5% in 2014. Foreign-born population is dominated by individuals from EU-15 and Africa (each group makes a fifth of immigrant stock, see Figure 1). Immigrants from Asia and new member states (EU-12) increased their relative share during the studied period. The EU-12 group is particularly dynamic and more than doubled its share from 8 to 18 %. The relative number of immigrants from Europe, and the Americas changes very little and each group comprises less than a sixth of immigrant stock.

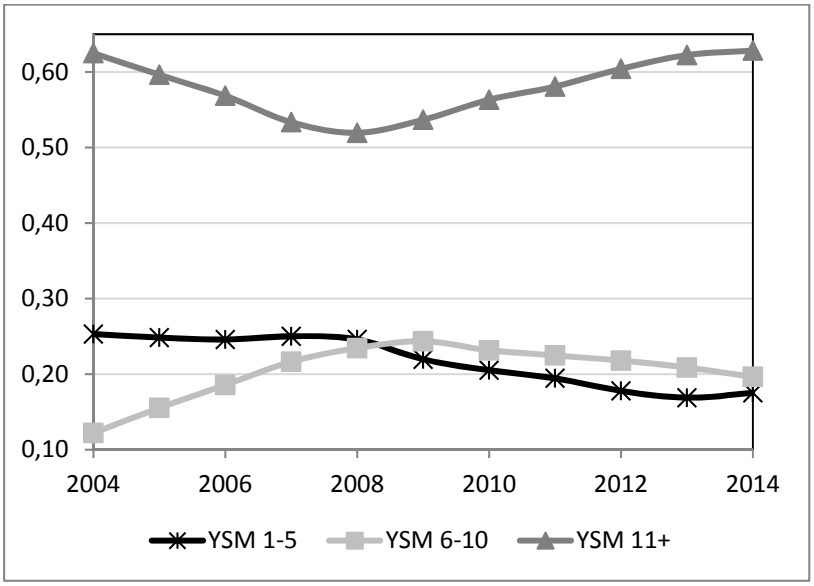
The composition of immigrant population in the EU-15 varies also by the time since arrival. The period followed by the European enlargement in 2004 was characterized by the rising inflows of fresh immigrants that weakened with the outbreak of the Great Recession (see Figure 1). In 2014 almost two thirds of immigrant stock comprises established immigrants, who reside in a host country for more than ten years. Fresh immigrants with less than six years since arrival and immigrants with six to ten years since immigration have an equal share.

Figure 1 The composition of immigrant population by origin and years since arrival in EU-15

By origin



By years since migration



Source: Own rendering based on EU-LFS 2004-2014 data

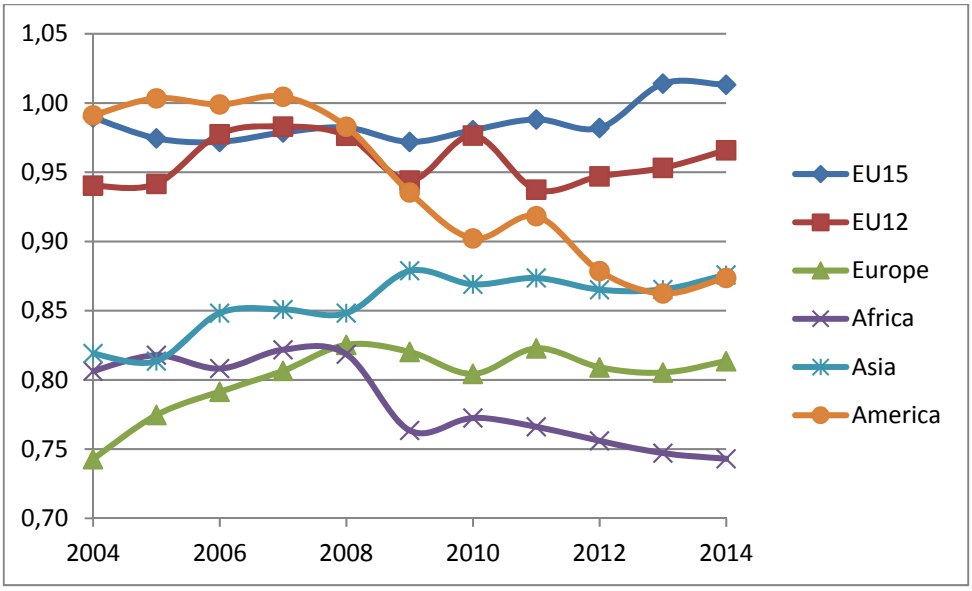
Note: Shares add up to unity. Immigrants are recognized by the country of birth or nationality (Germany). YSM indicates the group of immigrants by years since migration. Population weights are applied.

In the following figures we contrast the labor market status of immigrant vis-à-vis natives and then compare their job search behavior and mobility across economic sectors. Figure 2 depicts the ratio of employment and unemployment rates respectively of immigrants of different

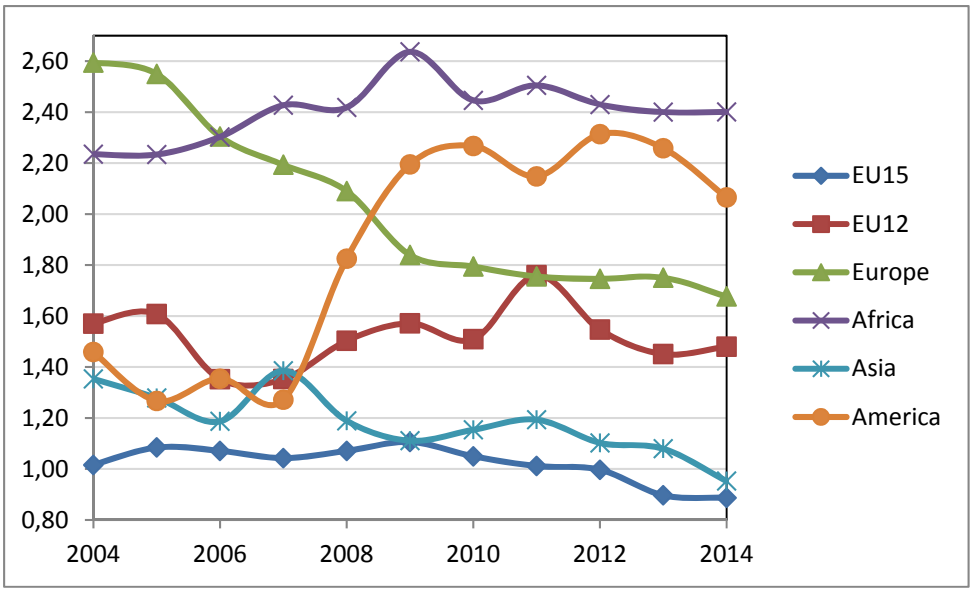
origins relative to native workers. Ratios closer to one indicate that immigrants' position in the labor market is similar to that of the natives. Immigrants from the EU-15 and EU-12 show labor market participation on par with the natives and EU-15 immigrants even outperform the natives in the recent years. The EU-12 immigrants are more unemployed relative to natives and their incidence of unemployed increased around the inception of the Great Recession. Immigrants from Asia and 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 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 2004-2014 data

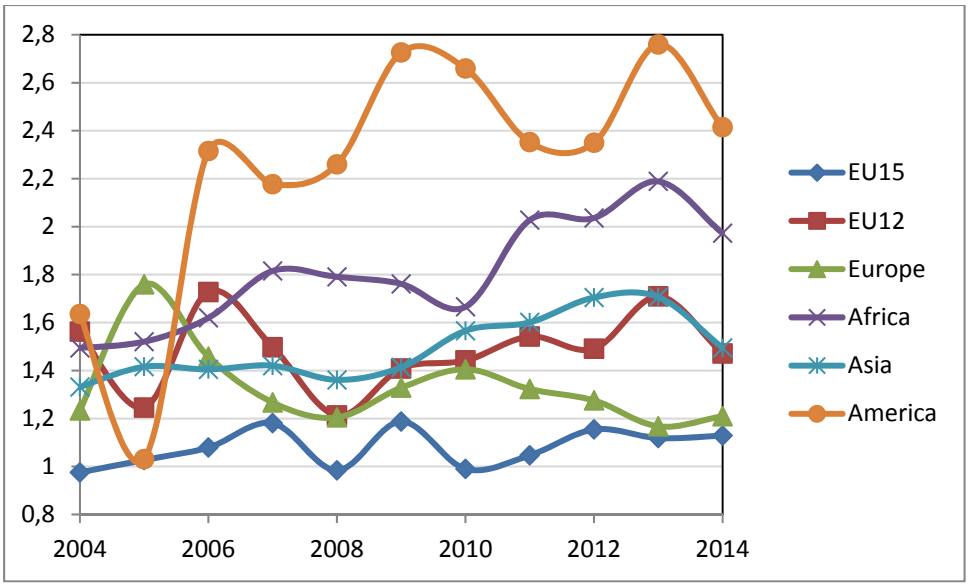
Note: Ratio. Population weights are applied.

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 vis-à-vis the natives may point at lower attachment to their current job but also to an increased risk of involuntary job-to-job transitions or unemployment. In particular, immigrants from Africa and America significantly increased their search intensity during 2006-7, while in parallel they exhibited higher incidence of unemployment in the following years (see Figure 2). We generally observe increasing differences across various immigrant groups and the natives in their search behavior over the studied period.

Figure 4 contrasts the proportion of labor force without a job for more than eleven months for immigrants and natives. Apparently the inception of the Great Recession hit immigrants from Africa, America and to lesser degree from EU-12, who prolonged their unemployment spells relative to the natives. Interestingly, Asian immigrants managed to avoid long unemployment spells throughout the period and particularly during the years of Great Recession. The ratio for immigrants from Europe outside the EU 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 was similar to natives and even improved in the most recent years.

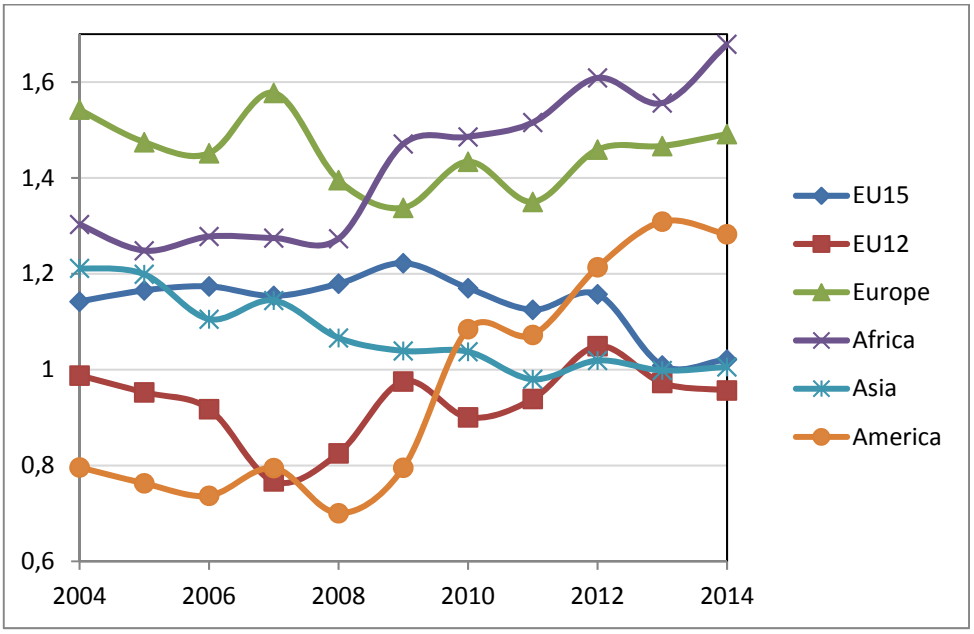
Figure 3 Immigrant to native ratio of the proportion of workers who look for another job



Source: Own rendering based on EU-LFS 2004-2014 data

Note: Sample includes employed workers. Population weights are applied.

Figure 4 Immigrant to native ratio of workforce without a job for more than 11 months

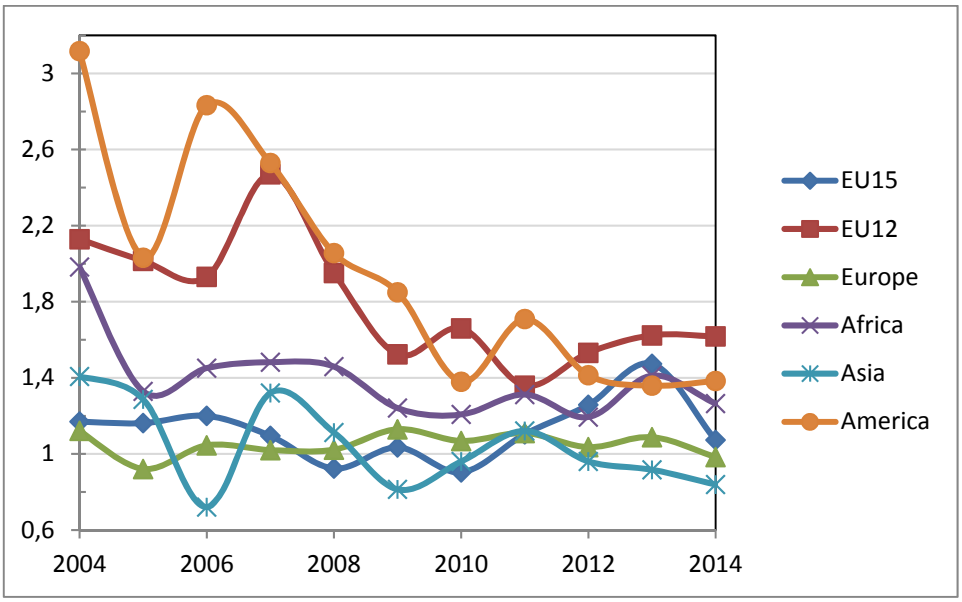


Source: Own rendering based on EU-LFS 2004-2014 data

Note: 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 or the EU-12 were substantially more likely to change economic sectors than natives within one year; however, their inter-sectoral mobility converged in later years.

Figure 5 Immigrant to native ratio of proportion of workers who changed industry during the previous year



Source: Own rendering based on EU-LFS 2004-2014 data

Note: Sample includes employed people in this and previous year. Population weights are applied.

In the core analysis below, we estimate the sensitivity of 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 (see Appendix, Table A1), and nine industry groups based on the NACE classification (see Appendix, Table A2). This categorization generates 36 occupation-industry groups, for each of which, we calculated the

labor shortage and the index of relative supply of immigrants in each country and year. In the analysis we allowed only occupation-industry-country cells of sufficient size in all years.[7]

Tables 1 and 2 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 qualification. One striking observation is that immigrant workers with tertiary education from the EU-12 and 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 their relatively recent arrival 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 a temporary immigrants (Kahanec and Shields, 2013). The distributional patterns observed for immigrants from Africa and America are very similar, especially for workers with tertiary education. In contrast, Asian immigrants are more successful and especially Asian workers without tertiary education are more often taking employment in occupations requiring higher qualifications than all the other immigrant groups except the EU-15.

Table 1 Distribution of native and immigrant workers across occupation groups

Occupation group	Native	EU-15	EU-12	Europe	Africa	Asia	America
All workers							
High	0.43	0.45	0.18	0.16	0.32	0.35	0.30
Intermediate general	0.27	0.24	0.23	0.22	0.25	0.31	0.28
Intermediate specific	0.22	0.20	0.31	0.36	0.22	0.15	0.17
Low	0.08	0.11	0.27	0.25	0.21	0.19	0.24
Workers with less than tertiary education							
High	0.27	0.26	0.10	0.10	0.17	0.20	0.14
Intermediate general	0.32	0.29	0.23	0.22	0.28	0.35	0.32
Intermediate specific	0.29	0.29	0.36	0.40	0.28	0.20	0.22
Low	0.11	0.16	0.31	0.27	0.27	0.25	0.32
Workers with tertiary education							
High	0.79	0.81	0.46	0.48	0.67	0.65	0.65
Intermediate general	0.14	0.14	0.23	0.22	0.19	0.23	0.20
Intermediate specific	0.05	0.04	0.17	0.15	0.07	0.05	0.07
Low	0.01	0.01	0.14	0.15	0.07	0.07	0.09

Source: Own rendering based on EU-LFS 2004-2014 data

[7] 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.

Note: Occupation groups are described in Table A1 in the Appendix. 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.

With respect to distribution across sectors, immigrant workers are primarily concentrated in construction (except for 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. EU15 group in finance, EU12 in agriculture, European in manufacturing, African in health, Asian in wholesale, and American in public administration and social work.

Table 2 Distribution of native and immigrant workers across industry groups

Industry group	Native	EU-15	EU-12	Europe	Africa	Asia	America
Manufacturing	0.18	0.17	0.17	0.22	0.13	0.13	0.10
Construction	0.07	0.08	0.15	0.14	0.08	0.03	0.09
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	0.16	0.11	0.12	0.15	0.13	0.15
Education	0.08	0.08	0.03	0.03	0.06	0.05	0.06
Human health	0.11	0.10	0.08	0.07	0.13	0.12	0.09
Public administration	0.13	0.12	0.14	0.11	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 2004-2014 data
Note: Industry groups are described in Table A2 in Appendix. 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.

Overall, the descriptive evidence points to a 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. In the core analysis below, the group of natives and EU-15 immigrants represent a comparison group to which the performance of immigrant groups is compared.[8]

The evidence presented above documents that immigrants from the EU-12 are different from the other immigrant groups in several directions. They exhibit high attachment to the labor market but also high 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. Together with immigrants from Europe, EU-12 immigrants are most concentrated in elementary occupations and exhibit the highest degree of down-

[8] When the responsiveness of EU-15 immigrants vis-à-vis natives is compared, the estimate on labor shortage is not significant. Analysis replicated by education attainment reveals that the high-educated group of EU-15 is more responsive relative to high-educated natives.

skilling. This would be consistent with the hypothesis that being fresh in the receiving countries enables them to be a more fluid type of workers, seeking and responding to changing economic opportunities vigorously. The responsiveness of the other immigrant groups is likely to be restrained by institutional barriers, as many of such immigrants do not enjoy all the provisions of free intra-EU mobility of workers.

5 Results

5.1 The baseline model

Using the data and methodology outlined above, we test the responsiveness of immigrants from various origins, skills, and length of stay to labor shortages across sectors, occupations and states in the EU-15 host labor markets over the business cycle during the Great Recession. In all models, we treat EU-15 countries as one entity, and study the relative responsiveness of immigrants to labor shortages vis-à-vis the EU native group (i.e. EU15 natives, including those living in their EU-15 member state of origin, as well as those living in another EU-15 member state).[9]

The results obtained on the pooled sample are presented in Table 3. The positive estimates obtained for labor 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 labor shortage) also rose. Significant estimates are obtained for EU-12 and European immigrants who respond to shortages more fluidly than the EU native group, whereas immigrants of other origins, in the statistical sense, behave similarly to the EU native. The estimated coefficient can be interpreted in terms of the relative elasticity of supply of immigrants and natives: $\varepsilon=(d\ln(Z))/(d\ln(W))$. 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 1.70 and 1.77 for EU-12 and Europe immigrants respectively, the estimates in Table 3 implies an elasticity of supply of 0.24 and 0.21 relative to EU native.[10] 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.

[9] This scenario is compatible with Borjas (2001) who uses the group of US-born as a reference.

[10] 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 the paper but it is likely 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 the paper the calculated elasticity for all immigrants is 0.88. Given 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.

Our findings also corroborate the notion developed in the theoretical section of this paper, that fresh immigrants are expected to be more responsive to the changing economic environment than those who moved longer ago. The higher responsiveness to labor shortage is identified for immigrants who reside six to ten years, and the effect is not significant for immigrants who arrived longer ago, or the fresh immigrants with up to five years since immigration.

In the next step, models are run with the relative supply of immigrants calculated for workers with and without tertiary education, and results are reported in the bottom panels of Table 3. Our estimates confirm that the higher responsiveness of immigrants from EU-12 countries to labor shortages, relative to the EU natives, is driven by low-educated workers (the same conclusion holds also for immigrants from outside EU, the estimate is marginally significant (p-value =0.107)). An interesting pattern emerges in the results by time since immigration. Among low-educated workers, the effect is significant for a group of immigrants with some, but not too long, experience in the host country (6-10 years). On the other hand, in the group of high-educated workers, it is fresh (1-5 years) and established immigrants (10+ years), who are more responsive to labor market opportunities than EU natives. This could mean that recent high-educated immigrants are very responsive to labor shortages due to their costs of migration *D* being sunk, but also they may be better equipped to overcome any institutional barriers to their mobility than their low-educated counterparts. The estimated effects of labor shortage for other immigrants are statistically not different from zero, meaning that those groups respond to labor shortages similarly to the corresponding EU natives. Particularly the mobility of recent low-educated immigrants may be constrained by institutional barriers linked to their inexperience and short history in the country.

Table 3 The relative responsiveness of immigrants to labor shortage (sample 2004-2014)

	EU-12	Europe	Africa	Asia	America	YSM 1-5	YSM 6-10	YSM 11+
All workers								
Labour shortage	0.408 **	0.375 *	0.127	0.019	0.055	0.124	0.369 **	0.142
	(0.206)	(0.205)	(0.090)	(0.152)	(0.118)	(0.148)	(0.157)	(0.089)
r2	0.036	0.047	0.028	0.05	0.033	0.059	0.053	0.089
N	2193	2143	2485	1793	2246	2550	2721	2970
Workers with less than tertiary education								
Labour shortage	0.525 **	0.329	0.092	-0.028	-0.037	0.073	0.43 **	0.093
	(0.227)	(0.204)	(0.120)	(0.176)	(0.152)	(0.185)	(0.191)	(0.102)
r2	0.039	0.046	0.02	0.068	0.03	0.059	0.062	0.073
N	1809	1782	2164	1501	1777	2105	2339	2890
Workers with tertiary education								
Labour shortage	-0.424	0.389	0.322 **	-0.046	0.162	0.556 **	0.149	0.337 ***
	(0.558)	(0.474)	(0.144)	(0.249)	(0.182)	(0.277)	(0.208)	(0.123)
r2	0.058	0.056	0.019	0.034	0.026	0.054	0.028	0.027
N	979	889	1246	841	1173	1193	1369	1685

Source: Own calculations based on EU-SILC, EU-LFS, and WDI 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 labor shortage for the same cell is also expressed in first difference and lagged. All models include lagged GDP per capita and unemployment rate (not reported in table) and cell, year and country fixed effects. 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 industry-country cell. Heteroskedastic-consistent standard errors are in parentheses, *,**,*** identifying significance at 10, 5, 1 per cent levels, respectively.

5.2 The changes in the relative responsiveness of immigrants over time

In the previous, we show that EU-12 and Europe immigrants are more responsive than EU natives to labor imbalances while the responsiveness of other immigrants is not different from EU natives. In this section we study whether immigrants' responsiveness was changing over the business cycle during the Great Recession with the following empirical strategy: we estimate Equation 4 on six consecutive subsamples, each for a six year interval.[11] Our results presented in Table 4 imply that EU-12 immigrants responded to labor shortages more fluidly in samples containing more recession years. The opposite pattern emerges for the European immigrant group, where our estimates suggest higher responsiveness vis-à-vis the EU natives in the years before the Great Recession. The responsiveness of other immigrant groups to labor shortage shows less definite patterns: the responsiveness to labor shortages vis-à-vis the EU natives for the African group is significant in the sample, only consisting of recession

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

years, Asians' responsiveness peaks around the inception of the Great Recession, and Americans' responsiveness is statistically indistinguishable from that of the EU-natives throughout the studied periods.

With respect to time since immigration, the estimates for fresh immigrants (1-5 years) are higher in the later periods but the effect does not become statistically significant. The estimate of the coefficients on labor shortage for the immigrant group with the arrival of 6-10 years ago follows a hump shape with the peak around the inception of the Great Recession. The estimate for established immigrants (longer than 10 years) is strongest before the Great Recession and decreases to near-zero in later periods.

Table 4 The relative responsiveness of immigrants to labor shortage in different periods

	2004-09		2005-10		2006-11		2007-12		2008-13		2009-14	
EU12	0.421		0.420		0.648	*	0.734	**	0.760	**	0.708	*
	(0.294)		(0.282)		(0.361)		(0.371)		(0.354)		(0.366)	
r2	0.123		0.100		0.066		0.048		0.063		0.057	
N	943		1000		1000		1000		1000		1000	
Europe	0.937	***	0.801	***	0.577	*	0.142		-0.025		-0.145	
	(0.285)		(0.265)		(0.345)		(0.360)		(0.346)		(0.350)	
r2	0.105		0.123		0.063		0.052		0.047		0.054	
N	923		976		976		976		976		976	
Africa	0.033		-0.041		0.193		0.243		0.247		0.366	**
	(0.117)		(0.118)		(0.129)		(0.164)		(0.153)		(0.147)	
r2	0.092		0.053		0.058		0.039		0.051		0.043	
N	1075		1128		1128		1128		1128		1128	
Asia	0.135		0.287		0.451	**	0.188		-0.172		-0.264	
	(0.208)		(0.190)		(0.224)		(0.235)		(0.256)		(0.248)	
r2	0.107		0.105		0.064		0.038		0.051		0.083	
N	768		820		820		820		820		820	
America	0.237	*	0.190		0.058		-0.021		-0.111		-0.180	
	(0.128)		(0.123)		(0.139)		(0.150)		(0.221)		(0.234)	
r2	0.049		0.073		0.047		0.024		0.051		0.047	
N	971		1020		1020		1020		1020		1020	
YSM 1-5	0.061		0.113		0.295		0.222		0.371		0.376	
	(0.176)		(0.173)		(0.250)		(0.262)		(0.258)		(0.267)	
r2	0.090		0.094		0.098		0.113		0.142		0.142	
N	1100		1160		1160		1160		1160		1160	
YSM 6-10	0.394	**	0.395	***	0.407	*	0.552	**	0.389		0.332	
	(0.185)		(0.152)		(0.242)		(0.281)		(0.294)		(0.305)	
r2	0.106		0.137		0.055		0.061		0.089		0.077	
N	1176		1236		1236		1236		1236		1236	
YSM 11+	0.329	***	0.266	**	0.257	**	0.142		-0.009		0.016	
	(0.113)		(0.106)		(0.118)		(0.135)		(0.161)		(0.163)	
r2	0.128		0.134		0.124		0.081		0.101		0.094	
N	1285		1348		1348		1348		1348		1348	

Source: Own calculations based on EU-SILC, EU-LFS, and WDI data.
Notes: Each cell includes coefficient on labor shortage estimated from separate model for different immigrant groups. See notes to Table 3.

Finally, to understand how the responsiveness to labor shortages varies according to the qualification of a worker, we replicated the estimation in Table 4 for workers with and without tertiary education and presented estimates in Table A3 in Appendix. The positive estimates for EU-12 immigrants during the Great Recession and immigrants from Europe outside the EU before and at the onset of the Great Recession are confirmed, arising primarily in the low-educated segment of the labor market. High-skilled EU-12 immigrants were particularly responsive around the inception of the Great Recession (2006-2011). 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 and statistically significant before Great Recession to negative and nearly significant in later periods. No significant difference vis-à-vis the natives is found for Asian immigrants.

The observed patterns for immigrants by the years since immigration indicate that the effect for high-educated recent immigrants (1-5 years) peaks around the onset of the Great Recession and continues through it. For low-educated immigrants with six to ten years since immigration, we find significant positive effects around the onset but also before the Great Recession. The results obtained for established immigrants (11+ years) 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 ones.

7. Conclusions

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.* 2014; 2015). Our analysis extends this literature to study immigrant groups by origin, time since immigration, and qualification level over the business cycle during the Great Recession. Using primarily the EU LFS and EU SILC datasets, we find that immigrants are in general, not less, and in many cases, are more responsive to labor market shortages than the natives.

For the pooled sample comprising the whole studied period of 2004-2014, we find that low-skilled immigrants from the EU-12, and high-skilled ones form Africa exhibit higher responsiveness to labor shortages than the natives.

We also find that low-skilled immigrants responsiveness to labor shortages peaks for those with 6-10 years since migration, possibly as a compound effect of their (still) low attachment to their specific location in the host labor market (and hence relatively low migration costs *D*), but an already sufficient adjustment to the conditions, and hence, ability to overcome barriers to migration in the host labor market. For high-skilled immigrants, the picture is the opposite, with the most recent immigrants (1-5 years) and the most established ones (11+ years) being most responsive. It is a topic for further study to evaluate the relative roles of migration costs (low for recent immigrants) and adjustment and ability to overcome barriers to migration (higher for more established immigrants).

In the analysis of immigrants' relative responsiveness to labor shortages over the business cycle during the Great Recession, where we follow the labor market using moving six-year windows, we find varying patterns for different immigrant groups. Immigrants from the new member states (EU-12) exhibited high responsiveness to labor shortages vis-à-vis the EU natives, which peaked and became significant during the Great Recession. The effect is however concentrated in the low-skilled segment of labor market. Results for immigrants from the rest of Europe (outside the EU) imply their relative responsiveness is positive and statistically significant only in the periods covering mostly 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 (2004-2009) 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. Low skilled Africans are found to be significantly more responsive than the natives only in the window fully covering the Great Recession and later years (2009-2014); and Asians are very similar to the natives, except around the onset of the Great Recession (2006-2011) for the pooled sample of both the low- and high-skilled ones.

Our findings are consistent with the findings for the pooled high- and low-skilled sample, that recent immigrants respond to labor shortages more fluidly than the natives (positive effects

for EU-12 and high-educated fresh immigrants), but some groups achieve higher mobility only after some adjustment period needed to overcome institutional and legal barriers to occupational, inter-sectoral and spatial mobility (the effect for low-educated immigrant with six to ten years since immigration). For established immigrants (YSM 11+) responsiveness to labor shortages is higher in the period before the Great Recession, during which, the effect is reduced; however, the effect for the high-skilled ones in this category peaks around the onset of the Great Recession.

To summarize, we show that immigrants in general and specific groups of immigrants in particular have responded to changing labor shortages across EU member states, occupations and sectors at least as much and often more fluidly than the natives. This is especially true for immigrants from the new member states, but also fresh and not yet established immigrants. The high-educated workers from African and American origins exhibit particularly high responsiveness to labor shortages during the Great Recession. These results may suggest the existence of two competing opposite effects on immigrants' responsiveness to labor shortages. First, fresh immigrants are more fluid as for them the costs of parting with their origins are sunk. Second, responsiveness to labor shortages is higher for immigrants who have accumulated some experience in the host labor markets, and thus, have learned how to overcome the barriers to labor mobility, or for those whose mobility is not restricted within the European Single Market. This may be one explanation why the two most mobile groups responding to labor shortages during the Great Recession are the relatively recent EU-12 immigrants and those not yet established but also with some experience. The role of the tightening migration policy and growing negative attitudes towards immigrants during the Great Recession needs to be further studied, to hopefully provide some answers why the responsiveness of European immigrants from outside the EU and those with eleven or more years since immigration dropped during the Great Recession.

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Appendix

Table A1 Definition of occupation group

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

Table A2 Definition of industry group

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, defense, and social work activities	O, P, Q	8
Agriculture, forestry and fishing	A, B	9

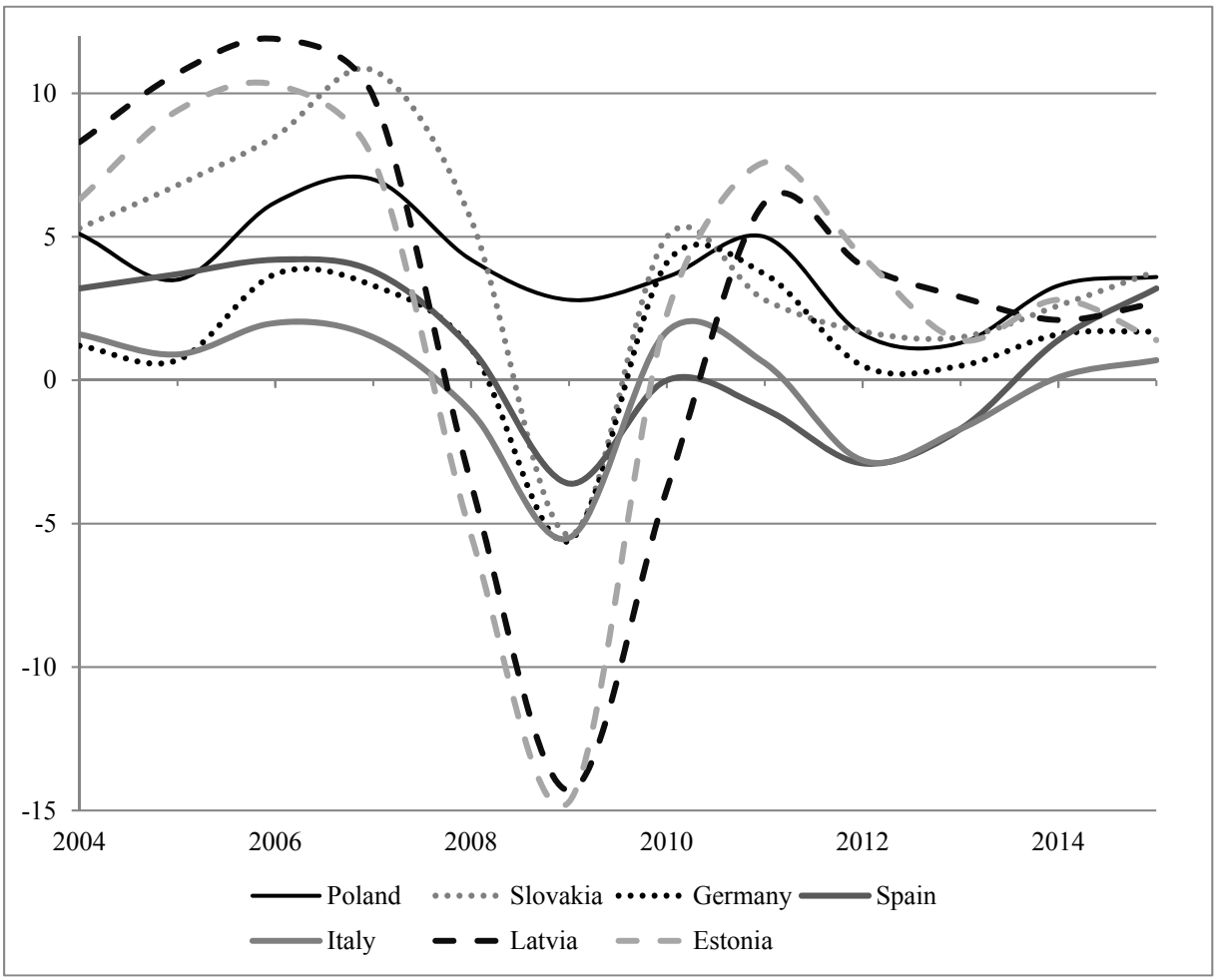
Table A3 The relative responsiveness of immigrants to labor shortage

	2004-09		2005-10		2006-11		2007-12		2008-13		2009-14	
All workers												
EU-12	0.421		0.42		0.648	*	0.734	**	0.76	**	0.708	*
Europe	0.937	***	0.801	***	0.577	*	0.142		-0.025		-0.145	
Africa	0.033		-0.041		0.193		0.243		0.247		0.366	**
Asia	0.135		0.287		0.451	**	0.188		-0.172		-0.264	
America	0.237	*	0.19		0.058		-0.021		-0.111		-0.18	
YSM 1-5	0.061		0.113		0.295		0.222		0.371		0.376	
YSM 6-10	0.394	**	0.395	***	0.407	*	0.552	**	0.389		0.332	
YSM 11+	0.329	***	0.266	**	0.257	**	0.142		-0.009		0.016	
Workers with less than tertiary education												
EU-12	0.477		0.451		0.691	*	0.768	**	0.822	**	0.845	**
Europe	0.981	***	0.778	***	0.415		0.045		-0.107		-0.148	
Africa	-0.039		-0.139		0.079		0.169		0.225		0.370	**
Asia	0.116		0.285		0.359		0.112		-0.172		-0.296	
America	0.374	**	0.271	*	-0.027		-0.269	*	-0.386		-0.476	*
YSM 1-5	-0.026		0.011		0.045		0.120		0.303		0.368	
YSM 6-10	0.519	**	0.556	***	0.555	*	0.659	**	0.481		0.384	
YSM 11+	0.293	**	0.215	*	0.176		0.053		-0.050		-0.038	
Workers with tertiary education												
EU-12	-0.059		0.689		1.006	**	0.587		0.022		-0.535	
Europe	1.010		1.062	*	1.192	*	0.700		-0.721		-0.962	
Africa	0.130		0.252		0.680	***	0.709	***	0.581	**	0.565	**
Asia	0.005		0.244		0.468		0.007		-0.362		-0.551	
America	-0.203		-0.038		0.152		0.709	**	0.695	**	0.723	**
YSM 1-5	0.443		0.679	**	1.367	***	1.099	**	0.936	**	0.702	
YSM 6-10	-0.168		-0.086		0.106		0.325		0.132		0.082	
YSM 11+	0.360	**	0.408	**	0.597	***	0.490	**	0.250		0.301	

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

Notes: Each cell includes coefficient on labor shortage estimated from separate model for different immigrant groups. Estimates in top panel are presented in Table 4 and here for comparison. *,**,*** identify significance at 10, 5, 1 per cent levels, respectively.

Figure A1 Real GDP growth rate (selected countries)



Source: Eurostat (table tec00115)