How Immigration Grease is Affected by Economic, Institutional and Policy Contexts: Evidence from EU Labor Markets

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Abstract
Theoretical arguments and previous country-level evidence indicate that immigrants are more fluid than natives in responding to changing skill shortages across countries, occupation-groups or industries. The diversity across EU member states enables us to test this hypothesis across various institutional, economic and policy contexts. 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 find that immigrants' responsiveness to skill shortages exceeds that of natives in the EU15, in particular in member states with low GDP, higher levels of immigration from outside EU, and more open immigration and integration policies; but also those with barriers to citizenship acquisition or family reunification. Whereas higher welfare spending seems to exert a lock-in effect, a comparison across different types of welfare states indicates that institutional complementarities alleviate such effect.

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I.   INTRODUCTION

Immigrant mobility is viewed as a vehicle of labor market adjustment that may help economies to adjust to sectoral shifts, demographic changes, or other shocks due to external factors (see e.g. Kahanec and Zimmermann, 2016, or Ritzen and Zimmermann, 2014). In segmented labor markets with low labor mobility, adjustment to such shocks is sluggish, and shortages and redundancies abound. An inflow of immigrant workers into sectors suffering skill shortages, and their outflow from declining sectors, may offer an effective mechanism through which such imbalances are reduced.

'Labor shortage', often used interchangeably with 'skill shortage' and 'skill gap' in the literature (Quintini, 2011), is generally understood as a state of disequilibrium in the labor market due to excess demand (Zimmermann, Bonin, Fahr, and Hinte, 2007). 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). Skill shortages thus reflect imperfect or sluggish adjustment to changes in the labor market and may result in economic costs of non-trivial magnitude. Lucifora and Origo (2002) estimate these costs in the short-run and long-run, as well as the direct and indirect costs of skill shortages in a set of European countries in the late 1990s, and conclude that costs generated by skill gaps average around 7% of GDP. A number of other studies have found that skill shortages negatively affect labor productivity, for example when firms fill jobs with over- or under-skilled workers, or do not fill them at all (Tang and Wang 2005; Bennet and McGuinness 2009; Quintini 2011). The shortage of high-skilled workers might decrease the innovation potential in the economy. As a corollary of this argument, faster, more flexible adjustment to labor shortages is desirable from the economic perspective.

An important consequence of skill shortages is the impact on wages, as firms may be forced to raise wages in order to attract relatively scarce skilled labor. The elasticity of labor supply with respect to wages can differ across different groups of workers, sectors and occupations (e.g. Lichter, Peichl, and Siegloch 2015 for literature review). If shortages lead to wage increases in selected sectors, this can result in widened wage differentials across skills levels and larger inequalities (Lucifora and Origo, 2002; Neugart and Schömann, 2002).

This paper analyzes immigrants' responsiveness to skill shortages relative to natives across country contexts. The theoretical argument outlined by Borjas (2001) proposes that immigrants are more responsive to changing skill shortages than natives. If we conceptualize the costs of labor mobility as including the costs of parting with the region, occupation, or sector of origin, requalification and overcoming institutional barriers, then for immigrants, unlike natives, some costs are sunk. As a result, skill shortages, and the resulting wage premia, should influence immigrants' decision as to where to locate in the destination state or region more than they influence natives. Existing studies have confirmed this outcome 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), and in the UK (Dustmann, Frattini and Preston, 2012). However, the immigrants' responsiveness to skill

shortages (and thus their spatial and occupational mobility) may differ across countries' economic, institutional, and policy contexts, as is suggested by e.g. Anderson and Ruhs (2008) or Kogan (2007, 2011). This literature also suggests that factors specific to immigrants' origins and the degree of their assimilation into host market's contexts may affect immigrants' migration costs and the degree to which they are sunk. Therefore, immigrants' origins, maturity in the host labor market, and country contexts may interact in a nontrivial way in determining immigrants' responsiveness to labor market imbalances. This issue remains unexplored in the literature, however.

This paper's main contribution to the literature is that we explore the diversity across EU member states to study how immigrants' relative responsiveness to skill shortages varies across institutional contexts, and for different immigrant groups. To address this issue, we formulate three specific research questions. First, are immigrants more, or less, responsive than natives to skill shortages across and within EU labor markets? Second, under what economic, institutional or policy contexts do immigrants respond to skill shortages more (and under what less) fluidly than the natives? Third, how does responsiveness to skill shortages vary across different immigrant groups in terms of their origin as well as time since immigration?

We study these questions using the EU Labor Force Survey (EU-LFS) in combination with the EU Statistics on Income and Living Conditions (EU-SILC) as our main sources of data. Due to the relatively low numbers of immigrants residing in the EU member states that joined the EU in 2004, 2007 and 2013 (Kahanec and Zaiceva, 2009), we limit our sample to the EU15 countries. [1] Our empirical strategy expands on that used by Borjas (2001), Dustmann et al. (2012), and Kahanec and Guzi (2017), which we amend to study how immigrants, relative to natives, respond to skill shortages under different economic, institutional and policy contexts.[2] In particular we test how immigrants' responsiveness to skill shortages, vis-à-vis the natives, differs with respect to GDP level, unemployment rate, the generosity of welfare spending, immigrant integration programs, the restrictiveness of migration policies, migration rate, the scale of non-EU immigration and welfare state type.

We define a worker as an immigrant if he or she was born abroad. One exception is Germany, for which immigrant origin can be determined only by nationality in our data. The EU-LFS allows us to distinguish five groups of immigrants: EU12 (includes countries which joined EU in 2004 and 2007), Europe (includes European countries outside the EU15 or EU12), Africa (Africa and Middle East), Asia, America (includes both Americas, Australia and Oceania). [3] Such comparative framework provides a further test of the robustness of the 'immigration grease' hypothesis. For example, it enables us to study it both in the context of free mobility within the EU (looking at EU12 immigrants) and under the mobility restrictions governing immigration from non-EU countries to and within the EU15. In addition, differences in the responsiveness to labor shortages of immigrants with different years since migration may

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[1] Including Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, the United Kingdom.
[2] See also Guzi, Kahanec and Kureková, 2014.
[3] EU12 includes the countries that joined the EU in 2004 and 2007: Bulgaria, Cyprus, Czechia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.

indicate that assimilation into local contexts plays a role, as foreseen by our theoretical model. On the one hand, longer experience in the host country may more firmly attach immigrants to their local contexts and hence increase their migration costs and reduce their mobility. On the other hand, however, it may also help immigrants to cope with informational asymmetries as well as institutional and other barriers to their mobility, and thus increase their responsiveness to labor and skill shortages.

We proceed as follows. In the ensuing section we introduce the theoretical model. We then develop a measure of labor and skill shortages and an empirical framework evaluating the average responsiveness of immigrants, relative to natives, to such shortages. In the next step we report the results of the baseline finding and measure the variation in immigrants' responsiveness to labor and skill shortages across various contexts. Finally, we discuss the results and their policy implications, and conclude.

II.   THEORETICAL MODEL

To understand EU natives' and immigrants' location decisions, we develop a theoretical model in the spirit of Borjas (2001). Consider an initial allocation of EU natives and immigrants across the EU member states C and occupation-industry groups K. Denote W_{kc} the wage that a worker in group $k \in K$ earns in country $c \in C$. For simplicity we assume that requalification or any other adjustment costs A_{kc} pertaining to occupation-industry group k and country c are fixed and equal for all individuals, and that W_{kc} is net of any such costs.

The decision about mobility in the labor market is formalized first for an EU native and then for a foreign worker. An EU native worker considers moving from her initial country C_0 and occupation-industry group K_0 to another member state or occupation-industry group if

$$0 < I = \max_{c \in C, k \in K}(W_{kc}) - W_{K_0 C_0} - D, \tag{1}$$

where D measures the costs of parting with their country or occupation-industry group of origin, K_0 and C_0, and includes any pecuniary costs of out-migration, but also non-pecuniary psychological costs related to the disutility of separation from social, professional or family networks, which are for simplicity's sake assumed to be fixed.

It follows that whenever $D > 0$ there is room for variation in wages W_{kc} across countries and among native workers with the same human capital, and hence inefficient allocation of natives across countries and occupation-industry groups. We assume that the distribution of capital is sticky, and hence capital movement generally does not eliminate wage differentials across countries and natives with the same human capital.

The decision for immigrant workers from outside the EU to come to the EU is governed by

$$I = \max_{c \in C, k \in K}(W_{kc}) - W_{K_F C_F} - (D + B_c), \qquad (2)$$

where $W_{K_F C_F}$ denotes the immigrant's wage in their country of origin, and B_c denotes their migration costs reflecting the institutional, legal or labor market barriers specific to country c that are borne solely by immigrants. Such costs include any restrictions stipulated in their work or residence permits, or related to their foreign citizenship, limiting their job or geographic mobility in the EU. These costs depend on economic, institutional or policy variables characterizing host labor markets. For example, transferability of residence and work rights and qualifications within and across EU member states facilitates immigrants' responsiveness to wage incentives. Similarly, transferability of rights to social welfare services probably has a positive effect, too. These effects are compounded if they also concern family members. Immigration policy may also affect immigrants' responsiveness if the selection of immigrants upon entry affects observed or unobserved costs of future migration. On the other hand, policies and institutions that restrict migrants to certain regions, countries or jobs, or restrict the transferability of their rights and human capital tend to limit their responsiveness to wage differentials.[4]

We assume that immigrants move to the EU for economic reasons only if $I > 0$, i.e. the wage increment resulting from their immigration to the EU compensates for the costs of migration.[5] Furthermore, among the countries and occupation-industry groups available in the EU, the model assumes that immigrants choose the one offering the highest wage.[6] An important implication of this model is that immigrants should be more sensitive to wage differentials across EU countries and occupation-industry groups than the natives of those countries. This is because immigrants in the EU have already arrived in the EU, and hence the costs D of parting with their source environments are sunk for them upon arrival; these costs are still positive for the EU country natives. It also follows that immigrants' sensitivity to wage variation should be mainly due to the locational decisions of newly arriving immigrants, since immigrants' sensitivity to wage differentials will decline gradually with years since migration, as they become attached to their destinations and occupation-industry groups in a similar way to the natives.[7]

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[4] Some of these costs may affect natives as well. We assume that due to foreign citizenship or immigration history, such costs are larger for immigrants than natives, and without loss of generality normalize B_c to be zero for the natives.

[5] $I > 0$ does not necessarily hold for immigrants who have moved for other than economic reasons, including refugees or dependent migrants such as spouses or minors. We also assume that immigrants have perfect information about I.

[6] In reality D and requalification costs may differ across destination or source countries, skill-industry groups, or individuals. For example, the various languages spoken in the EU may vary in their distance from the immigrants' native language, and hence the cost of learning the destination country's language may differ across destinations and immigrants' native languages. Although this is an important consideration, for the argument we develop in this section it is sufficient that costs D are sunk for immigrants, but not for comparable EU-country natives. The model could be straightforwardly extended to include more complex inter-temporal decisions and to treat wages and migration costs as stochastic variables, in which case the key relationships would hold in terms of expected present values.

[7] See e.g. Constant, Gataullina and Zimmermann (2009) and Kogan (2011) on immigrant assimilation in host societies and labor markets.

Our theoretical model thus implies that immigration can increase the efficiency of host labor markets by providing European economies with fluid labor that by improving the allocation of labor across countries and occupation-industry groups greases the wheels of the European labor markets. On the other hand, this mechanism may be impeded by immigrants' adjustment in, and growing attachment to host labor markets, as well as any barriers to mobility specifically pertaining to their immigrant status. The degree to which this occurs may interact with economic, institutional or policy variables characterizing the host economy. Hence, the responsiveness of immigrants to wage differentials (relative to the natives) under various economic, institutional or policy contexts is an empirical question.

III. **METHODOLOGY AND EMPIRICAL FRAMEWORK**

3.1 Measuring skill shortages and immigrant-native relative supply

There are two key variables of interest in our baseline model: skill shortages and the relative labor supply of immigrants and natives across countries and occupation-industry groups. Measuring skill shortages is a non-trivial task, and a range of different approaches can be identified in the literature. According to Quintini (2011), skill shortages can be measured by employers' assessment (through surveys), vacancy rates or wage growth. 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 in time (Zimmermann et al. 2007; Martin and Ruhs, 2011; Veneri, 1999). However, synthesizing these different measures into one encompassing indicator to be used in quantitative analysis is not a trivial matter. For example, Zimmermann, et al. (2007) developed various procedures to merge indicators that may signal labor shortages into a summarizing indicator, but found too much variation between the different indicators to deliver convincing conclusions for immigration policy.

Employers' own assessment represents a most direct way of estimating the existence of shortages. The length of time it takes for the employer to fill a vacancy, or the share of employers who report difficulty in recruitment are possible measures (Constant and Tien, 2011; Lucifora and Origo, 2002; Quintini, 2011). The vacancy rate approach is an alternative. However, it is dependent on the quality of vacancy data, which is often focused on low-skilled positions and underestimate more highly skilled segments (see also Boswell et al. 2004). Moreover, vacancy-based approaches are not robust with respect to whether vacancies remain unfilled due to actual skill or labor shortages, or low wage offers. The wage-growth approach has its limitation, too, as it does not include non-financial incentives. Finally, it has to be noted that measures of labor and skill shortages encompass economic factors as well as any variation in the institutional, political, and other parameters of bargaining between employers and employees. Yet, given data limitations, the literature has developed salient approaches and interpretations of the measures of skill and labor shortages, or imbalances.

We use unexplained wage premiums as an indicator of skill shortage in our empirical section, following Dustmann et al. (2012). Specifically, exploiting available longitudinal data for comparative cross-country research, we proxy skill shortages at the level of occupation-industry-country cells by wage premiums, the part of wages that remains unexplained after compositional differences across cells are netted out. In particular, for each year separately we estimate a log-wage regression of the form

$$W_{ikc} = X_{ikc}\beta + \gamma_{kc} + \varepsilon_{ikc}, \tag{3}$$

where W is the log wage of worker i who belongs to occupation-industry group k in country c, X is a vector of worker i's characteristics including gender, education, work experience and work experience squared, and ε is the error term. We normalize wage and all variables in vector X to have zero means. Skill shortage indicator γ_{kc} is a vector of fixed effects for occupation-industry-country cells, which can be interpreted as the (adjusted) percent wage differential between the average wage of individuals in the particular cell and the mean wage for a given year in the EU (adjusted for any differences in the individual characteristics listed above).

We next calculate the measure of relative supply of immigrants and natives for occupation-industry-country cells. Following Borjas (2001) we define the index of relative labor supply Z_{kct} for occupation-industry-country cells in each year t separately as

$$Z_{kct} = \frac{M_{kct}/M_t}{N_{kct}/N_t}, \tag{4}$$

where M_{kct} is the number of immigrants belonging to occupation-industry group k and country c in year t while M_t is the total number of immigrants in the EU15 in year t. The denominator similarly indicates the relative supply of natives N_{kct}/N_t in the particular cell and year t. The index equals 1 when immigrants and native workers belonging to the same occupation-industry group have the same geographic distribution. The index would be greater than one if immigrants in occupation-industry group k were overrepresented in country c. When no immigrants are present in a particular group then the index equals 0.

3.2 The empirical model

Our baseline empirical framework is developed following Borjas (2001). To measure the relative responsiveness of immigrants to skill shortages across occupation-industry-country cells we adopt a first-difference regression model as follows:

$$\Delta Z_{kct} = \beta_1 \Delta\gamma_{kct-1} + \delta_k + \delta_c + \delta_t + \mu_{kct} \tag{5}$$

The first-differenced wage index $\Delta\gamma_{kct}$ is lagged by one year, as the reaction of workers to skill shortages is likely to be lagged. The model also includes occupation-industry group, country and year fixed effects, δ_k, δ_c and δ_t, respectively, which control for any specific factors that might change the relative supply of immigrants. In the empirical section, the model is also augmented with the 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. Because the observations represent averages at the cell level, every observation is weighted by the total number of individuals in the cell.[8]

3.3 The economic, institutional and policy determinants of immigrants' responsiveness to skill shortages

To determine whether and how the responsiveness of immigrants, relative to natives, depends on economic, institutional and policy contexts, we augment our baseline model by allowing immigrants' responsiveness to vary across countries with different contexts. Specifically, we adopt a variation of the first-difference model of Equation (5) as follows:

$$\Delta Z_{kct} = \beta_1 \Delta \gamma_{kct-1} + \beta_2 \Delta \gamma_{kct-1} \theta_c + \beta_3 \theta_c + \delta_k + \delta_c + \delta_t + \mu_{kct}, \tag{6}$$

where θ_c is an indicator variable measuring the economic, institutional or policy context in country c. This indicator variable attains value 1 when the studied context is present and 0 otherwise. To give an example with the share of total social expenditures in GDP, we dichotomize it by setting $\theta_{ct} = 1$ in countries whose average value during the studied period is above the median value across all countries, and zero otherwise. In this way the indicator identifies countries with more generous welfare spending. 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 hence enables us to shed light on the heterogeneity of immigrants' relative responsiveness to skill shortages across occupation-industry-country cells under different contexts.

3.4 The data

The analysis in this paper combines data from the EU-LFS and EU-SILC spanning the period 2004-2012. 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). 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,

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

although it may underestimate irregular migrants.[9] We use the information on workers' earnings from the EU-SILC to measure skill shortages across occupation-industry-country cells, as explained above. Additional variables, such as national GDP annual growth, GDP per capita, the share of welfare spending on GDP and total unemployment rate, were obtained from the Eurostat.[10]

For each of the EU15 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 groups, for each of which we calculate skill shortage and the index of relative supply of migrants, in each country and year, which we develop to measure the responsiveness of migrants to identified shortages. In the analysis we allowed only occupation-industry-country cells of sufficient size in all years.[11]

Tables A3 and A4 in the Appendix show the distribution of natives and immigrants across industries and occupations, respectively. We note that EU15 immigrants and natives are very similar in their labor market characteristics. In contrast, immigrant workers from the other groups are (in comparison to natives) primarily concentrated in the construction sector (except for Asians); transportation, accommodation and food; and they are underrepresented in the education sector. Some immigrant groups are overrepresented in other industries e.g. EU12 in agriculture, European in manufacturing, African in health, Asian in wholesale, and American in public administration and social work.

With respect to occupations immigrant groups are over-represented in occupations requiring lower qualification relative to native and EU15 workers. A salient finding is that immigrants from the EU12 and Europe 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 result may be due to their relatively recent arrival in the receiving countries, but it also may signal that 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 distribution of immigrants from Africa and America across occupations is very similar. In contrast, Asian immigrants more often take employment in occupations requiring higher qualifications than all the other immigrant groups, except those from the EU15.

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[9] 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).

[10] Data from Eurostat database accessed in June 2016: GDP growth rate expressed in percentage change on previous year (table *tec00115*), GDP in current prices expressed in euro per capita (table *nama_10_pc*), expenditure on social protection in % of GDP (table *tps00098*) and total unemployment rate (table *tsdec450*).

[11] In the individual analysis, the sample is always limited to employed individuals between 15 and 64 years old. In each country, occupation-industry groups are selected if they include at least 50 observations in the EU-LFS database and at least 20 observations in the EU-SILC database. Unfortunately the sample is not balanced with respect to country and year. Germany, Ireland, Italy, the Netherlands and the United Kingdom are omitted in 2004 due to missing information on the origin of respondents.

In the analysis the responsiveness of immigrants to skill shortages is tested vis-à-vis the EU workforce (i.e. the combined group of natives and EU15 immigrants).[12] This approach is most directly comparable to Borjas (2001) and Dustmann et al. (2012), as it takes the whole EU15 as the point of reference for the definition of immigrants and natives (i.e. similarly to "US" or "UK" in the two studies mentioned above, respectively).

IV.   RESULTS

4.1 The baseline model

The results of the baseline model (Equation 5) are presented in Table 1.[13] The dependent variable is the supply of immigrants relative to the EU workforce in occupation-industry-country cells expressed in first difference. We test the responsiveness to skill shortages of immigrants from various origins and length of stay in the destination country. In all models, we treat EU15 as one entity (all EU15 citizens as a single group of natives); that is, we study the relative responsiveness of immigrants to skill shortages vis-à-vis the EU workforce that represents workers born and residing anywhere in the EU15. The bottom panel of Table 1 shows the augmented model with 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. However, the statistical significance of these results differs across immigrant groups. Statistically significant estimates are obtained for EU12 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 as well (p-values are 0.134 and 0.161 in top and bottom panel respectively). Hence, immigrants are in general moving to occupations and industries and countries that exhibit growing skill shortages at least as, and for some immigrant groups more flexibly than the natives.

The point estimates on skill shortages for the three groups of immigrants by years since migration indicate a nonlinear nature of the relationship between immigrants' assimilation and their relative mobility. The inverse U-shaped relationship indicated by the finding that the coefficient on skill shortages is the highest for the middle group of immigrants, i.e. those with 6-10 years since migration, aligns well with the notion of two competing forces affecting immigrants' relative mobility vis-à-vis the natives: with more years since migration immigrants

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[12] EU15 includes immigrants born in the old EU member states and EFTA countries. When the responsiveness of EU15 immigrants vis-à-vis natives is compared in the regression, the estimate on skill shortage is not significant that gives further support for treating two groups jointly.

[13] The first-stage model (equation 3) yields results typical for wage regressions of that type and results are available upon request.

learn to cope with mobility barriers, but become more firmly tied to their local contexts in host labor markets.

The estimated coefficient on skill shortage can be interpreted in terms of the relative elasticity of supply of immigrants and natives: $\varepsilon=(dln(Z))/(dln(W))$. 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 1.76 for EU12 and Europe immigrants respectively, the estimates in top panel in Table 1 implies an elasticity of supply of 0.44 and 0.35 relative to EU native.[14] These elasticities give 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 key result confirming that immigrants are more responsive to skill shortages than natives is robust to the inclusion of control variables proxying the economic situation across countries. The estimate for GDP growth is positive, implying that economic changes tend to influence the supply of immigrants more than that of the EU natives. The relationship is particularly significant for immigrants of non-EU origins (Europe and Africa) and established immigrants. The discernible drop in our estimates on skill shortage for EU12 and fresh immigrants (YSM 1-5) in the bottom part of Table 1 signals a higher sensitivity of these immigrants to general labor market conditions. This could indicate that informational asymmetries play a bigger role for these fresh 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, vis-à-vis 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.[15] In the analysis below we proceed with the specification that includes controls for GDP growth and the unemployment rate.

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[14] 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.

[15] 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 (country with by far the highest share of immigrants). In both cases the baseline estimates change only minimally and retain statistical significance. As another robustness check we have repeated the analysis with cells defined by industry-country and occupation-country level. The sample size decreases to around 240 observations. Still the obtained estimates on EU12 and YSM 6-10 immigrant groups are significant at 5% level in both cases. These results are available from the authors upon request.

Table 1: The relative responsiveness of immigrants to skill shortage (baseline model)

	EU12	Europe	Africa	Asia	America	YSM 1-5	YSM 6-10	YSM 11+
Skill shortage	0.746 ***	0.625 ***	0.16	0.224	0.134	0.382 **	0.538 ***	0.245 ***
	(0.253)	(0.235)	(0.107)	(0.172)	(0.103)	(0.184)	(0.182)	(0.091)
R2	0.043	0.056	0.028	0.04	0.024	0.041	0.053	0.086
N	1693	1655	1921	1383	1736	1970	2103	2296
Skill shortage	0.619 **	0.601 **	0.147	0.179	0.103	0.178	0.513 ***	0.238 ***
	(0.254)	(0.235)	(0.105)	(0.174)	(0.109)	(0.177)	(0.183)	(0.092)
GDP growth	0.014	0.035 ***	0.012 **	0.009	-0.004	0.003	0.013	0.015 ***
	(0.011)	(0.014)	(0.006)	(0.009)	(0.005)	(0.009)	(0.008)	(0.004)
Unempl. rate	-0.026 *	0.013	0.001	-0.018	-0.011	-0.061 ***	-0.001	0.006
	(0.014)	(0.012)	(0.005)	(0.011)	(0.009)	(0.011)	(0.009)	(0.004)
R2	0.048	0.062	0.032	0.047	0.025	0.072	0.054	0.091
N	1693	1655	1921	1383	1736	1970	2103	2296

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

Notes: The dependent variable is the supply of immigrants relative to natives in the particular occupation-industry-country group 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. 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.

One important concern with the interpretation of our results is the directionality of the studied relationships. In particular, it may be that the inflow of immigrants affects wages in the local market, rather than the other way around. We propose three arguments that support the interpretation according to which skill shortages drive mobility responses, however. First, the explanatory variables in our model specifications are lagged by one year to partly mitigate the problem of reverse causality. Second, whereas the relationship we study does link the supply of labor with a measure of shortages based on wages, the labor supply variable is measured in relative terms. It follows that any reverse causality channel would need to concern the much less obvious effects of a changing *relative*, rather than absolute, supply of immigrants (i.e. immigrant-to-native ratio) in a cell on wage premiums. And third, related, Dustmann et al. (2012) argue that if immigrants increase the relative supply of labor in a given occupation-industry group, this should cause wage premiums to go down in that cell. Therefore the estimated coefficients can be interpreted as a lower bound. Beyond these arguments, however, our analysis remains descriptive.

4.2 The behavior of immigrants under different economic contexts

An implication of the theoretical model corroborated by our baseline results presented above is that immigrant workforce may serve as a cushion against economic shocks, and that immigrants are the group to move most fluidly if economic conditions deteriorate. To shed light on this hypothesis we introduce business cycle and welfare variables and interaction terms to test how responsiveness to skill shortages differs with respect to GDP level, unemployment

rate and the generosity of welfare spending. To this aim we introduce dummy variables indicating whether a country has, through our sample, an above-the-median level of GDP, unemployment rate, or share of welfare spending in GDP ($\theta_{ct} = 1$; zero otherwise) and their interactions with skill shortage. This way we pick up medium- to long-term economic differentials between the countries. Table A5 in the Appendix illustrates the partition of countries according to these variables and shows that economic conditions in the EU15 are diverse and that each of these three economic variables picks up unique dimensions of their economic development.

Our results, reported in Table 2, confirm that the responsiveness to skill shortages for immigrants from the EU12 and other 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. It seems thus, that immigrants that have acquired the right to freely move across the EU (EU12 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. However, the interactions with the unemployment rate indicate that the immigrant groups that are particularly fluid in lower-GDP countries (from the EU12, Europe, as well as those with at least six years since migration[16]) are also those whose relative responsiveness to skill shortages is positive and statistically significant in countries with low unemployment rates. Americans and fresh immigrants (YSM1-5) exhibit higher responsiveness to skill shortages in high-unemployment countries. 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 labor 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 country's economic performance as measured by countries' GDP and unemployment rates.

The findings reported in Table 2 further imply that immigrant workers from Europe are more responsive to skill shortages in those EU15 countries that are less generous in terms of welfare spending.[17] A remarkable result is how sensitive to welfare generosity fresh immigrants (YSM1-5) are. It appears that high welfare spending makes fresh immigrants even less responsive than the natives, which in itself is a rare finding in our study, while a significantly positive coefficient is found in low welfare spending countries. This result indicates a lock-in effect of welfare generosity on the relative responsiveness to labor market imbalances of fresh immigrants (vis-à-vis the natives). While 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, the difference with respect to high-welfare countries is not statistically significant.

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[16] For Africans the coefficient is significant only at 10% level.

[17] Finland, Greece, Ireland, Italy, Luxembourg, Portugal, Spain and the United Kingdom have below-median welfare spending.

The nonlinear, inverse U-shaped pattern of the effect of experience in the host country on immigrants' relative flexibility is indicated by our point estimates in low-GDP, high-GDP, low-unemployment, as well as high-welfare countries. On the other hand the point estimates indicate that fresh immigrants (YSM1-5) are the most flexible group in high-unemployment or low-welfare countries.

Table 2: Immigrant responsiveness to skill shortages, by economic conditions

	EU12		Europe		Africa		Asia	America		YSM1-5		YSM6-10		YSM11+	
Low GDP ($\beta1$)	0.862	**	0.768	**	0.117		0.421	0.108		0.228		0.716	**	0.276	**
	(0.397)		(0.323)		(0.148)		(0.267)	(0.160)		(0.217)		(0.298)		(0.121)	
High GDP ($\beta1+\beta2$)	0.353		0.398		0.189		-0.048	0.097		0.117		0.258		0.189	
	(0.344)		(0.358)		(0.129)		(0.221)	(0.126)		(0.287)		(0.183)		(0.147)	
Low unempl. rate ($\beta1$)	0.622	**	0.596	**	0.178	*	0.201	-0.055		-0.151		0.52	**	0.353	***
	(0.279)		(0.302)		(0.097)		(0.195)	(0.125)		(0.168)		(0.223)		(0.124)	
High unempl. rate ($\beta1+\beta2$)	0.614		0.61		0.096		0.094	0.366	**	0.718	*	0.503		0.068	
	(0.5)		(0.406)		(0.21)		(0.352)	(0.178)		(0.372)		(0.309)		(0.127)	
Low welfare spending ($\beta1$)	0.87	*	1.014	***	0.152		0.468	0.17		0.748	**	0.649	**	0.292	**
	(0.446)		(0.367)		(0.158)		(0.299)	(0.159)		(0.304)		(0.306)		(0.123)	
High welfare spending ($\beta1+\beta2$)	0.35		0.224		0.14		-0.058	0.013		-0.494	***	0.348	**	0.17	
	(0.247)		(0.319)		(0.121)		(0.202)	(0.126)		(0.163)		(0.166)		(0.144)	

Source: Based on EU-SILC, EU-LFS, and Eurostat data.
Note: See note to Table 1. Estimates are obtained from separate regressions. Presented are calculated effects from interactions with skill shortage. See Table A5 for the partition of countries.

4.3 Immigration history and policy

European countries differ greatly as to the characteristics of their immigrant population and their immigration policy. In this section we use three variables to test how the relative responsiveness of immigrants to skill shortages is affected by the scale of immigration and the composition of immigrant stock. Based on the EU-LFS we calculate (i) the share of foreign-born individuals in the working age population, denoted migration rate; (ii) the share of immigrants from non-EU27 countries in the immigrant working age population; and (iii) 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 restrictiveness of migration policies from the DEMIG POLICY database (DEMIG 2015).[18] These variables are described in Tables A5 and A6 in the Appendix. 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 as in the previous section.

Our findings, presented in Table 3, show that immigrants are more responsive to skill shortages than natives in countries with below-the-median migration rate. This indicates that a smaller immigrant population provides for greater mobility of immigrant workforce, possibly

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[18] Migration policy indicator is based on 423 policy changes identified in DEMIG data in the EU15 countries over the period 2004-2012 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 (implying the restrictiveness or liberalization respectively) and weighted by the level of policy change (on the scale from 1 to 4). See Table A5.

due to less competition between immigrant groups in the labor market. Our estimates further imply that immigrants respond to labor imbalances more flexibly than the natives in countries with a higher share of immigrants from non-EU origins among all immigrants.[19] While this finding may result from the nature of labor market competition between non-EU and EU immigrants, the results for EU and non-EU groups do not clearly support such interpretation. On the one hand, a positive significant result for EU12 immigrants and non-significant results for Africans, Asians and Americans could hint at the role of complementarity of non-EU and EU12 immigrants. On the other hand, European immigrants are about as responsive relative to the natives as EU12 immigrants. A more plausible interpretation may be that a larger share of non-EU immigrants indicates a greater openness to immigration, and picks up countries with colonial history as well.

Table 3: Immigrant responsiveness to skill shortages in the immigration context

	EU12		Europe		Africa	Asia		America		YSM 1-5		YSM 6-10		YSM 11+	
Low migration rate (β1)	0.974	**	0.752	**	0.176	0.473		0.154		0.141		0.852	***	0.417	***
	(0.433)		(0.337)		(0.147)	(0.295)		(0.163)		(0.228)		(0.325)		(0.131)	
High migration rate (β1+β2)	0.328		0.438		0.117	-0.03		0.056		0.211		0.193		0.053	
	(0.313)		(0.332)		(0.135)	(0.206)		(0.13)		(0.261)		(0.18)		(0.129)	
Low share of non-EU (β1)	0.276		0.318		0.107	-0.104		0.04		0.004		0.238		0.09	
	(0.324)		(0.334)		(0.124)	(0.217)		(0.121)		(0.269)		(0.175)		(0.137)	
High share of non-EU (β1+β2)	0.977	**	0.884	**	0.178	0.504	*	0.154		0.348		0.77	**	0.372	***
	(0.416)		(0.352)		(0.153)	(0.277)		(0.164)		(0.227)		(0.321)		(0.127)	
Small immigrant network (β1)	0.268		0.253		0.157	0.273		0.046		-0.271	*	0.35	**	0.252	**
	(0.222)		(0.250)		(0.199)	(0.280)		(0.103)		(0.152)		(0.150)		(0.123)	
Large immigrant network (β1+β2)	0.797	**	0.699	**	0.141	0.139		0.13		1.129	**	0.705	**	0.221	*
	(0.365)		(0.292)		(0.11)	(0.206)		(0.144)		(0.45)		(0.35)		(0.132)	
Restrictive migration policy (β1)	0.299		0.23		0.135	0.073		0.201		0.25		0.34		0.134	
	(0.431)		(0.443)		(0.175)	(0.257)		(0.159)		(0.367)		(0.233)		(0.136)	
Liberalizing mig. policy (β1+β2)	0.887	***	0.892	***	0.16	0.279		0.068		0.215		0.679	**	0.316	**
	(0.337)		(0.296)		(0.132)	(0.231)		(0.14)		(0.195)		(0.266)		(0.128)	

Source: Based on EU-SILC, EU-LFS, Eurostat and DEMIG (2015) data.
Note: See note to Table 1. Estimates are obtained from separate regressions. Presented are calculated effects from interactions with skill shortage. See Table A5 and A6 for the partition of countries.

These findings are further corroborated by the importance of social networks – 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. Finally, our results imply that immigrants are particularly responsive to skill shortages relative to natives in countries that introduced more liberal migration policies.[20]

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[19] The group of countries with low migration rates includes Denmark, Finland, France, Germany, Greece, Italy, the Netherlands and Portugal. The group with high the share of non-EU immigrants includes France, Greece, Italy, the Netherlands, Portugal, Spain, and the United Kingdom.
[20] France, Germany, Greece, Italy, the Netherlands, Portugal and Sweden introduced changes towards less restrictiveness in the country's migration regime over the studied period.

4.4 Immigrant integration policies

The theoretical model developed above implies that institutions and policies lowering the costs of adjustment, requalification, or occupational mobility should, in general, increase workers' responsiveness to skill shortages. Indeed, Kogan (2007) and Ruhs (2011) argue that various barriers prevent immigrants from switching jobs, obtaining permanent residence or reuniting with their families; all of these hinder their professional mobility and career advancement. In this paper we evaluate the impact of national integration policies on immigrants' responsiveness to skill shortages using the Migrant Integration Policy Index (MIPEX). This index is based on a wide range of 148 policy sub-indicators determined on the basis of expert surveys (Huddelston et al., 2011) and consistently measures the quality of migrant integration policies across the EU since 2007. The sub-indicators are summarized as an overall score in seven fields: labor market mobility, family reunion, education, long-term residence, political participation, access to citizenship, and anti-discrimination.

We apply a similar approach to that used in the previous sections, introducing interactions of the skill shortage variable with an indicator variable that equals 1 for countries with a favorable integration policy (as before, the median score defines a threshold) and 0 otherwise.[21] Table A7 in the Appendix shows each country's average MIPEX score over 2007-2012, and the figures in bold indicate values above the median in the respective category. The quality of legislation towards immigrants differs to a great extent, both across the countries and between the categories. Only two countries (Sweden and Portugal) operate favorable policies in all seven categories (see Table A7).

The results reported in Table 4 are mixed. The results for the overall MIPEX index convincingly show that immigrants are generally more responsive to skill shortages than natives in countries with below-the-median quality integration policies. The findings obtained for sub-indices however reveal different patterns. An important finding is that policies improving labor mobility and reducing discriminatory practices help immigrants to realize their potential and increase their responsiveness to skill shortages. Interestingly, favorable policies supporting immigrants' mobility in the labor market help also established immigrants (YSM 11+) and EU12 immigrants; although these two groups potentially deal with fewer barriers in the labor market relative to other groups. These results imply that labor market mobility and antidiscrimination measures have more profound effects in the society, affecting broader categories of immigrants.

As EU12 immigrants enjoy the benefits of free movement within the EU and an equal position in the labor market to that of natives – policies that may be expected to override the role of general integration policies – we expected integration policies to have a larger impact on immigrants of non-EU origin. Table 4 indeed shows some differences in the responsiveness coefficients for the EU12 and Europe groups. The latter group attains higher responsiveness to skill shortage in countries with favorable family-reunion and long-term residence policies.

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[21] The partition of countries based on average MIPEX value is equivalent to the partition based on the maximum MIPEX value during 2007-2012 or when the countries are split around the threshold of 60 points.

Table 4: Immigrant responsiveness to skill shortage under different MIPEX scores

	EU12	Europe	Africa	Asia	America	YSM 1-5	YSM 6-10	YSM 11+
Overall (β1)	0.834 **	0.715 **	0.285 **	0.363	0.001	0.25	0.791 ***	0.351 ***
	(0.371)	(0.350)	(0.127)	(0.245)	(0.126)	(0.271)	(0.280)	(0.123)
Overall (β1+β2)	0.217	0.416	-0.037	-0.122	0.235	0.073	0.104	0.07
	(0.228)	(0.258)	(0.162)	(0.215)	(0.177)	(0.167)	(0.178)	(0.129)
Labor mobility (β1)	0.643	0.585	0.261	0.181	-0.004	0.49	0.646 **	0.094
	(0.402)	(0.405)	(0.159)	(0.264)	(0.097)	(0.338)	(0.277)	(0.130)
Labor mobility (β1+β2)	0.598 *	0.614 **	0.069	0.178	0.171	-0.068	0.41 *	0.354 ***
	(0.309)	(0.284)	(0.13)	(0.22)	(0.156)	(0.168)	(0.234)	(0.121)
Family reunion (β1)	0.674 *	0.37	0.264 *	0.093	0.031	0.136	0.595 **	0.217 *
	(0.351)	(0.356)	(0.143)	(0.237)	(0.097)	(0.299)	(0.242)	(0.118)
Family reunion (β1+β2)	0.554	0.86 ***	0.049	0.259	0.161	0.22	0.43	0.26 *
	(0.351)	(0.323)	(0.143)	(0.243)	(0.167)	(0.191)	(0.264)	(0.134)
Education (β1)	0.667 *	0.609 *	0.235	0.344	0.125	0.118	0.71 **	0.348 ***
	(0.372)	(0.339)	(0.144)	(0.259)	(0.145)	(0.265)	(0.281)	(0.122)
Education (β1+β2)	0.533 ***	0.585 **	0.031	-0.048	0.075	0.27 *	0.201	0.06
	(0.205)	(0.247)	(0.136)	(0.206)	(0.157)	(0.163)	(0.148)	(0.129)
Political participation (β1)	0.862 **	0.692 **	0.163	0.391	0.037	-0.075	0.871 ***	0.346 ***
	(0.357)	(0.340)	(0.138)	(0.240)	(0.145)	(0.211)	(0.296)	(0.126)
Polit. participation (β1+β2)	0.214	0.438	0.125	-0.156	0.185	0.516 *	0.021	0.087
	(0.368)	(0.271)	(0.147)	(0.245)	(0.157)	(0.294)	(0.167)	(0.127)
Long-term residence (β1)	0.789 *	0.587	0.332 *	0.14	0.118	0.309	0.717 **	0.168
	(0.464)	(0.475)	(0.194)	(0.327)	(0.107)	(0.396)	(0.332)	(0.152)
Long-term resid. (β1+β2)	0.513 *	0.609 **	0.063	0.195	0.097	0.108	0.402 *	0.278 **
	(0.282)	(0.257)	(0.117)	(0.195)	(0.14)	(0.165)	(0.212)	(0.109)
Citizenship (β1)	0.903 **	0.8 **	0.163	0.371	0.141	0.121	0.826 ***	0.358 ***
	(0.414)	(0.389)	(0.161)	(0.291)	(0.158)	(0.298)	(0.318)	(0.135)
Citizenship (β1+β2)	0.25	0.361 *	0.131	-0.002	0.067	0.239	0.167	0.102
	(0.21)	(0.217)	(0.123)	(0.187)	(0.14)	(0.162)	(0.137)	(0.115)
Anti-discrimination (β1)	0.351	0.561	0.121	0.292	0.18	0.021	0.778 **	0.307 *
	(0.421)	(0.449)	(0.214)	(0.305)	(0.169)	(0.284)	(0.345)	(0.157)
Anti-discrimination (β1+β2)	0.774 **	0.628 **	0.158	0.137	0.074	0.258	0.372 *	0.197 *
	(0.306)	(0.261)	(0.109)	(0.199)	(0.126)	(0.212)	(0.201)	(0.106)

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

Note: See note to Table 1. Estimates are obtained from separate regressions. Presented are calculated effects from interactions with skill shortage and the MIPEX overall indicator and its sub-indices of labor market mobility, family reunion, education, political participation, long term residence, access to citizenship, anti-discrimination (see Table A7). The β_1 is the calculated estimate of skill shortage in countries with unfavorable policy and $\beta_1 + \beta_2$ in countries with favorable policy.

In effect, although better integration policies may lower some of the costs of migration (e.g. recognition of qualifications), they may increase some other migration costs, for better-integrated immigrants (e.g. the psychological costs of leaving a familiar environment and social networks). For example in countries with *less* developed family or education integration programs, immigrants remain more responsive to skill shortages than natives, which may seem counterintuitive. However, this result may also indicate that better integration policies

assimilate immigrants into host societies such that they are more strongly tied to their host environment and thus behave more similarly to natives. These effects are consistent with the notion that integration policies lowering immigrants' migration costs facilitate immigrants' mobility and those increasing the pool of dependent immigrants or facilitating integration in local social networks or environments decrease their mobility.

Similarly, legislation providing better access to citizenship keeps non-EU immigrants in their chosen location more permanently, so that they behave more like natives, whereas in countries with less favorable rules governing citizenship acquisition immigrants remain more mobile than natives. This finding is consistent with the argument above: as obtaining citizenship is a measure of formal integration into the host society, in countries with better access to citizenship migrants may be hesitant to move to another member state so as not to jeopardize their possibility of acquiring their host country's citizenship. Immigrants are then more likely to invest in host-country-specific human and social capital, which locks them into their host country. Citizenship of a EU member state itself may then enable immigrants to be more mobile.

It is interesting to observe that access to citizenship and long-term residency appear to relate differently to established immigrants' responsiveness to skill shortages. Whereas citizenship creates a lock-in effect, as we have described above, access to long-term residency seems to come with rights that enable immigrants to be more mobile across occupation-industry groups and countries. Those rights 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. Furthermore, the quality of immigrant integration seems to be of little relevance for labor market responsiveness of African and Asian immigrants. This might be due to the profiles of these immigrant groups and their immigration pathways (student mobility or prevailingly low-skilled irregular immigration), which we cannot control for or differentiate. The impact of integration policies on migrants' responsiveness to skill shortages may however be of more complex nature, and further study would be needed in order to establish causal links and nuances in terms of differential effects of various policy subfields in this area.

4.5 The role of welfare state institutions

As the role of welfare state in workers' migration decisions and their labor market outcomes is widely discussed, we further test this aspect, beyond the single-dimensional measure of the welfare spending in the country's GDP presented above. Welfare state institutions play complex roles in determining the responsiveness of immigrants and natives to skill shortages. These effects may arise through immigrants' integration into welfare state institutions and the transferability of their social welfare entitlements and rights, but also through the welfare state's impact on their reservation wages. In this context Giulietti et al. (2013) show that immigrants are not particularly attracted to European countries with more generous welfare spending while Kureková (2013) argues that advanced economies often restrict immigrants' access to welfare. Varieties of capitalism literature argues that more

generous welfare and social policy positively impacts the functioning of the labor markets by providing insurance and assistance in labor market transitions, effectively improving labor market outcomes (Hall and Soskice, 2001; Hancké, Rhodes and Thatcher, 2007).

Access to welfare, either in the form of services (education, healthcare) or social insurance (social assistance, unemployment benefits, pensions) is regulated differently across the EU countries, resulting in systematic variation. Moreover, the use of social rights is a function of a number of factors, such as the length of presence on the labor market, the history of contributions, age, marital status, or citizenship. These factors affect the dynamics of inclusion, or exclusion, such that migrants and their families face different barriers across countries and over time (Hemerijk et al. 2013). To test how welfare state institutions shape the relative responsiveness of immigrants and natives to skill shortages, we adapt welfare regime typology developed by Esping-Andersen (1990) and extended by Ferrera (1996). Essentially, we group the 15 countries in our study according to the following typology of welfare-state regimes: *conservative* countries, including Austria, Belgium, France, Germany, Luxembourg and the Netherlands; *Mediterranean* countries, including Greece, Italy, Portugal, and Spain; *social-democratic* countries, including Denmark, Finland, and Sweden; and *liberal* countries, including Ireland and the United Kingdom.

Welfare regimes in conservative countries are characterized by having scaled-up efforts in recent years to integrate immigrants, but continue to implement more restrictive policy on migrant entry. This is in contrast to the Mediterranean group in which the countries in relative terms implement fewer barriers on entry and access to the have varied ease of and barriers to access to their labor markets. The conservative group is characterized by relatively high levels of immigrant segregation in the labor market.[22] The liberal and social-democratic welfare states are both characterized by high integration efforts at rather different levels of economic migration (high in liberal welfare states and low in social-democratic welfare states) (Guzi et al. 2014; Kahancová and Szabó, 2015).

To test whether these institutional contexts have any relationship with immigrant responsiveness to labor market shortages, we amend Equation 6 to account for the diversity of welfare states in the EU and estimate it including the interaction terms of skill shortage with all welfare state types described above. The estimates reported in Table 5 imply that immigrants show varied patterns of responsiveness across welfare states.

Mediterranean welfare states facilitate the responsiveness of most types of immigrant groups: European, Asian, fresh and well-established immigrants. The explanation for conservative welfare states is less straightforward while results are mixed (the negative estimate obtained for fresh immigrants but positive for African immigrants). The social-democratic and liberal types only marginally shape the responsiveness of immigrants to skill shortages relative to natives. Positive estimates on skill shortage are obtained in the welfare generous social-democratic states for EU12 immigrants while the same result arises for African immigrants in the least generous liberal states. Hence, the results reported in Table 5 shed

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[22] For a comprehensive review see Table 1 in Guzi et al. (2014).

additional light on the findings presented in Table 2 in that more generous welfare states do not necessarily inhibit immigrants' mobility. Rather, these results provide support for the notion that the role of the welfare state, and that of 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 forms of access.

Table 5: Immigrant responsiveness to skill shortage by the type of welfare state

	EU12	Europe	Africa	Asia	America	YSM1-5	YSM6-10	YSM11+
Consevative	-0.077	-0.034	0.296 *	0.101	-0.007	-0.459 *	0.407	0.12
	(0.494)	(0.490)	(0.159)	(0.300)	(0.127)	(0.258)	(0.264)	(0.182)
Mediterranean	0.895	0.833 *	0.117	0.736 *	0.246	0.555 **	0.674	0.336 **
	0.56	0.453	0.19	0.393	0.199	0.283	0.417	0.162
Social-democratic	0.428 *	0.391	-0.002	-0.048	0.06	-0.078	0.24	0.257
	0.245	0.331	0.164	0.246	0.195	0.202	0.19	0.209
Liberal	0.778	0.069	0.367 *	-0.086	0.06	1.015	0.22	-0.012
	0.744	0.234	0.21	0.463	0.183	0.777	0.31	0.135

Note: See note to Table 1. Coefficient estimates on skill shoratge are obtained from separate regressions for different groups of immigrants. Presented are calculated total effects on skill shortage and interactions of skill shortage with the respective welfare regime (The effect thus equals $\beta_1 + \beta_2$ for the Mediterranean, Social-democratic, and Liberal regimes, with the Conservative welfare regime being the reference group, and thus the effect for this regime equals β_1)

V. CONCLUSIONS

Since the seminal paper by Borjas (2001), immigrants have been considered a more mobile type of labor force, responding to imbalances more fluidly than natives. The literature has, however, not yet answered an important question relevant from both the academic and policy perspective: how robust is the notion of immigrant grease with respect to various economic, institutional or policy contexts?

This paper has addressed this question in the context of the EU15, a set of countries that share basic characteristics (advanced liberal market democracies), but differ in many economic, institutional and policy variables. Looking at the EU15 using the EU-LFS, EU-SILC and several other auxiliary datasets has enabled us to exploit this diversity and study how it affects the way in which natives and different types of immigrants in terms of their region of origin and the time since migration respond to labor market shortages.

Our empirical strategy, based on a model similar to Borjas (2001), but augmented to account for economic, institutional and policy diversity across the EU15, has resulted in a key finding confirming that economic, institutional and policy context matter for immigrants' relative responsiveness to labor market shortages.

Specifically, our baseline finding that immigrants are at least as much and in many cases more responsive to skill shortages than natives is robust across all the studied contexts.

In particular, excepting one or two cases, practically none of our results indicate that immigrants would be less flexible than natives in responding to skill shortages. We confirm that immigrants from EU12 and other Europe are more responsive vis-à-vis the natives and we find statistically significant positive results for African, American and Asian immigrants in specific economic, institutional or policy contexts.

Immigrants appear to be more responsive to skill shortages in poorer and low-unemployment countries (excepting recent immigrants and those from America). Our results further show that immigrant workers are particularly fluid in countries with the generally lower scale of immigration, more immigrants from non-EU origins, or more open immigration policy. Immigrants are also relatively more responsive to skill shortages in countries with more favorable labor mobility policy targeting immigrants, long-term residence and antidiscrimination integration policies, as measured by the MIPEX index. On the other hand, immigrants are more mobile in countries with *less* favorable citizenship or family-reunion policies, which is consistent with a supposed citizenship acquisition lock-in effect and the stabilizing effect of dependent immigrants.

An important finding is that high welfare spending may disincentivize the flexibility of immigrants vis-à-vis the natives in responding to skill shortages. However, we also show that the role of the welfare state may involve various institutional complementarities beyond the impact of welfare generosity measured as the share of social expenditures in GDP. More generous welfare state types, as defined by Esping-Andersen (1990) and Ferrera (1996), do not seem to have less-responsive immigrant populations than their less-generous counterparts; on the contrary, immigrants are as responsive to skill shortage as natives in welfare-generous social-democratic welfare states as they are in more frugal liberal welfare states. Mediterranean welfare states seem to positively facilitate responsiveness of a diverse set of immigrant groups in terms of origin and time since migration.

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, such reverse channels can be argued to 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 or policy contexts in the EU15. This is an important result that deserves further study. We find the role of the welfare state but also the results for the various sub-areas of immigrant integration policies especially intriguing and deserving further quantitative and qualitative investigation. Our results also indicate that policies matter, and that

whereas 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 the 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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Table A1 Definition of skill group

Occupation category (ISCO-1)	Skill group
1 Legislators, senior officials and managers	high
2 Professionals	high
3 Technicians and associate professionals	high
4 Clerks	intermediate general
5 Service workers and shop and market sales workers	intermediate general
6 Skilled agricultural and fishery workers	intermediate specific
7 Craft and related workers	intermediate specific
8 Plant and machine operators and assemblers	intermediate specific
9 Elementary occupations	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 Distribution of native and immigrant workers across industry groups

Industry group	Native	EU15	EU12	Europe	Africa	Asia	America
Manufacturing	0.18	0.17	0.17	0.23	0.14	0.13	0.10
Construction	0.08	0.08	0.16	0.15	0.09	0.03	0.10
Wholesale and trade	0.14	0.13	0.10	0.13	0.13	0.16	0.11
Transportation and food	0.11	0.15	0.17	0.16	0.16	0.25	0.16
Communication and financial	0.14	0.16	0.11	0.11	0.15	0.13	0.15
Education	0.08	0.08	0.03	0.02	0.06	0.05	0.05
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	0.20
Agriculture and fishing	0.03	0.01	0.04	0.02	0.02	0.01	0.02

Source: Own rendering based on EU-LFS 2004-2012 data

Note: Industry groups are described in Table A2 in Appendix. Sample includes individuals aged 15 to 64 in EU15 countries. Immigrants are recognized by the country of birth or nationality (Germany). Population weights are applied.

Table A4 Distribution of native and immigrant workers across occupation groups

Occupation group	Native	EU15	EU12	Europe	Africa	Asia	America
High	0.42	0.45	0.18	0.16	0.32	0.36	0.30
Intermediate general	0.27	0.23	0.23	0.21	0.25	0.30	0.28
Intermediate specific	0.23	0.21	0.32	0.38	0.22	0.16	0.18
Low	0.08	0.11	0.27	0.25	0.21	0.18	0.24

Source: Own rendering based on EU-LFS 2004-2012 data.

Note: Occupation groups are described in Table A1 in the Appendix. Sample includes individuals aged 15 to 64 in EU15 countries. Immigrants are recognized by the country of birth or nationality (Germany). Population weights are applied.

Table A5 Economic conditions and immigrant population in the EU15

Country	GDP pc	Unemployment rate	Welfare spending	Migration rate	Share of non-EU immigrants	Migration policy
LU	**73578**	4.77	21.99	**0.47**	0.12	-8
DK	**42167**	5.56	**30.66**	0.07	0.63	-4
IE	**39922**	**8.87**	20.21	**0.15**	0.23	-3
SE	**38122**	7.47	**28.80**	**0.13**	0.59	**-15**
NL	**36633**	4.97	**27.92**	0.11	**0.76**	**-16**
FI	**34267**	7.81	27.02	0.03	0.50	-5
AT	**33956**	5.00	**28.58**	**0.16**	0.58	6
BE	32267	**7.86**	**28.13**	**0.12**	0.48	-1
UK	31944	6.36	27.23	**0.13**	**0.66**	49
DE	31011	**8.16**	**28.58**	0.08	0.53	**-54**
FR	30011	**8.82**	**31.37**	0.11	**0.69**	**-28**
IT	26589	7.83	27.08	0.09	**0.64**	**-15**
ES	22667	**14.69**	22.41	**0.15**	**0.70**	-13
GR	19567	**12.28**	26.37	0.10	**0.80**	**-25**
PT	16133	**10.53**	24.57	0.09	**0.77**	**-16**

Source: Own rendering based on EU-LFS 2004-2012, Eurostat and DEMIG (2015).

Note: Reported values are average values across the period 2004-2012. GDP per capita, total unemployment and welfare spending are taken from 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 423 policy changes identified in DEMIG POLICY database in the EU15 countries over period 2004-2012 which relate to border/land control and legal entry/stay. The indicator is calculated as the sum of policy changes coded as -1, 0 or 1 (implying the restrictiveness or liberalization respectively) and weighted by the level of policy change (on the scale from 1 to 4). Countries are sorted by GDP. Figures in bold indicate values above the median in the respective category.

Table A6 The size of social network in the EU15

Country	EU15	EU12	Europe	Africa	Asia	America	YSM 1-5	YSM 6-10	YSM 11+
LU	84	3	3	5	1	2	**31**	**21**	48
IE	49	**28**	2	5	**9**	7	**64**	**23**	13
BE	45	7	11	**27**	6	4	**22**	20	**59**
FI	36	13	**29**	9	**8**	4	**20**	**24**	56
DE	32	**15**	**37**	6	6	4	**29**	17	54
SE	31	9	**17**	**21**	**11**	**10**	13	15	**72**
DK	31	6	**17**	16	**19**	**11**	16	**26**	**59**
FR	28	3	6	**51**	**8**	4	8	12	**80**
AT	20	**22**	**44**	5	6	2	14	14	**72**
PT	20	3	6	**48**	1	**22**	19	18	**63**
NL	19	4	15	**21**	**15**	**25**	6	12	**82**
UK	19	**15**	3	**22**	**28**	**14**	**33**	20	47
IT	16	**21**	**20**	**18**	**13**	**13**	**20**	**35**	45
ES	15	**15**	3	14	3	**50**	**37**	**41**	22
GR	6	**14**	**59**	12	6	3	18	**31**	51

Source: Own rendering based on EU-LFS 2004-2012.

Note: Figures express the composition of immigrant working age population by the origin and years since immigration (YSM). Reported values are average values across the period 2004-2012. Countries are sorted by first column. Figures in bold indicate values above the median in the respective category.

Table A7 Migrant Integration Policy Index (MIPEX)

Country	Overall	Labor mobility	Family reunion	Education	Political participation	Long-term residence	Access to citizenship	Anti-discrimination
AT	47	50	49	45	38	56	27	52
GR	48	44	52	36	32	50	37	56
IE	50	39	37	30	**73**	49	58	65
DK	51	**73**	35	45	57	**64**	35	45
FR	54	52	51	33	53	48	60	**76**
IT	57	64	**75**	34	58	**64**	51	61
LU	59	38	**61**	**48**	**75**	63	**62**	49
UK	60	58	45	**60**	51	60	**62**	**84**
DE	**61**	77	58	47	**61**	60	**64**	56
ES	**61**	71	86	41	55	76	48	49
NL	**66**	86	60	**57**	71	57	**68**	73
BE	**68**	58	**75**	**60**	57	81	**62**	78
FI	**70**	75	**68**	**60**	79	70	60	74
PT	**79**	87	86	62	74	69	86	88
SE	**80**	96	79	73	71	79	73	85

Source: www.mipex.eu

Note: Reported values are average values across the period 2004-2012. Countries are sorted by the overall score. Figures in bold indicate values above the median in the respective category.