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The migration response to local labour market shocks: Evidence from EU regions during the global economic crisis

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Abstract: The global economic crisis has strongly affected Europe’s economic geography. This study investigates the role of local labour market disparities in determining regional net in-migration rates. While only a weak link is detected in the pre-crisis period, the local labour market context of migration grows significantly stronger during the crisis. Decompositions of the estimation results show that changes in migration rates are firstly a result of widened disparities across European regions throughout the crisis. However, also behavioural adjustment processes occur, e.g. an orientation of migrants towards urban areas and away from regions with persistently high long-run unemployment rates.

JEL: C23, C26, F22, J61, R23

Keywords: Internal migration, local labour markets, global economic crisis, Bartik instrument, structural breaks, decomposition analysis

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The migration response to local labour market shocks: Evidence from EU regions during the global economic crisis

Abstract: The global economic crisis has strongly affected Europe’s economic geography. This study investigates the role of local labour market disparities in determining regional net in-migration rates. While only a weak link is detected in the pre-crisis period, the local labour market context of migration grows significantly stronger during the crisis. Decompositions of the estimation results show that changes in migration rates are firstly a result of widened disparities across European regions throughout the crisis. However, also behavioural adjustment processes occur, e.g. an orientation of migrants towards urban areas and away from regions with persistently high long-run unemployment rates.

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I. Introduction
A central question in labour and regional economics is whether and how local labour market disparities affect internal migration (e.g. Kennan and Walker, 2011). In this paper, I present new evidence on this question by investigating the case of EU regions from 2000 to 2012, which importantly includes the years of the global economic crisis of 2008. As local labour market disparities have significantly widened during the crisis (Crescenzi et al., 2016), I take this economic shock as a source of exogenous variation in local labor markets to test which factors have caused regional migration rates to rise or fall. Surprisingly, empirical evidence on this matter is still largely missing for the EU (with the exception of Jauer et al., 2014) and the growing literature on US internal migration is yet inconclusive (Mian and Sufi, 2014, Yagan, 2014, 2017, Monras, 2015, Cadena and Kovak, 2016). Particularly EU policy makers have traditionally been concerned about internal migration because Europeans appear to be less mobile than their US counterparts (Faini, 1999, Bonin et al., 2008, Molloy et al., 2011, OECD, 2016). This makes the present study highly policy relevant.

To carry out the analysis, I estimate a dynamic migration model utilizing data on net in-migration rates, labour market indicators, and other regional economic variables measured at different spatial scales (NUTS2 and NUTS3). Splitting the overall sample into a pre- and post-crisis period, I estimate the relative contribution of local labour disparities in explaining the variations in regional in-migration rates over time. I also implement a decomposition analysis to disentangle the estimated labour market effects into two components. The first component relates to the degree to which changes in net in-migration rates are driven by widened labour market disparities. The second component relates to the extent to which changes in the migrants’ behavioural response take place when holding labour market disparities constant at their pre-crisis values.

A fundamental challenge in the conduct of this empirical analysis is that labour market conditions, such as income levels and (un-)employment rates, are determined simultaneously with the evolution of net

1 See also Moretti (2011) for a more general treatment of the causes and the consequences of differences in labour market outcomes across local labour markets within a country. Related to this literature, recent studies in international economics have also shown a reinforced interest in studying local labor market dynamics, i.e. the response to exogenous demand changes caused by international import competition to local manufacturers (Autor et al., 2013) and trade liberalization (Dix-Carneiro and Kovak, 2017).
migration rates at the local level. For this reason, I apply an instrumental variable (IV) approach using Bartik-type shift-share instruments which seeks to isolate local labour demand shocks as source of exogenous variation in driving interregional migration. In addition to shift-share instruments, information on the importance of the construction sector prior to the crisis is used as a complementary measure for the unexpectedness of the crisis (Monras, 2015).

The empirical results from baseline fixed effects (FE) and structural IV estimation show a significant link between regional net in-migration rates and local labour market conditions during the global economic crisis. In comparison, I find that the local labour market context is less important for determining regional migration rates prior to the crisis. That is, while variations in local labour market conditions only account for roughly 11% of the total variation in regional migration rates across NUTS3 regions prior to the crisis, their explanatory power increases to 32% in the post-crisis period. At the NUTS2 level, the local labour market context even accounts for roughly 40-50% of the observed overall variations in regional net in-migration rates during the crisis.

The decomposition of the estimation results further shows that changes in the migration response over time are first and foremost attributable to widening local labour market disparities. However, for some variables, such as the population density and components of the unemployment rate, significant behavioural adjustment processes are observed as well. That is, for instance, structurally weak regions with high long-run unemployment rates experience significant lower net in-migration rates in the post-compared to the pre-crisis period. Moreover, I observe an increased orientation of migrants towards urban areas with a high population density. This indicates that migrants not only respond to amplified labour market disparities but also re-evaluate signals emanating from labour market indicators for their migration decision during the crisis.

The study is organized as follows: Section 2 starts with a data description and a presentation of stylized facts on the evolution of regional net in-migration rates in the EU. Section 3 reviews the empirical literature on local labour markets and interregional migration during the global economic crisis and outlines key conceptual issues linked to the estimation strategy. Thereafter, Section 4 reports the empirical results together with robustness checks. Section 5 discusses the policy relevance and concludes the paper.
II. Variables and Data Description

The key outcome variable for the empirical analysis is the net in-migration rate of region $i$ defined as

$$\text{Net in-migration rate}_{i,t} = \left( \frac{NM_{i,t} + Pop_{i,t-1}}{Pop_{i,t-1}} \right),$$

where $NM_{i,t}$ denotes net in-migration flows defined as the difference between gross in-migration to region $i$ and gross out-migration from region $i$ at time $t$, and $Pop_{i,t-1}$ is the region’s population level in period $t-1$ (see Puhani, 2001, Jauer et al., 2014, and Mitze and Dall Schmidt, 2015, for similarly defined outcome variables). If a region’s net in-migration flow ($NM_{i,t}$) is zero, the net in-migration rate takes a value of one and is accordingly larger than one for positive net in-migration flows to region $i$ in period $t$ and smaller than one for negative net in-migration flows. The (log transformed) variable can hence be read as an annualized measure for the migration-induced population growth rate of region $i$ between $t-1$ and $t$.

The evolution of regional net-in migration rates in the EU can be studied at different spatial scales. Here, a decision has been made to build two complementary data sets, namely one data set for 255 NUTS2 regions and a second data set comprising 1,246 NUTS3 regions.\(^2\) In general terms, the NUTS ('Nomenclature of Statistical Territorial Units') classification contains three hierarchical levels ranging from the country level (NUTS0) to lower administrative divisions. NUTS3 and NUTS2 regions are defined by minimum and maximum population thresholds of 150 to 800 thousand and 800 thousand to 3 million inhabitants, respectively. For both data sets the sample period covers the years 2000-12.\(^3\) Data on regional net in-migration rates are linked to local labor market indicators collected along the lines of contemporary migration theories (see Section III for a theoretical motivation of variable selection). The set of core labour market indicators includes per capita income growth, employment and self-

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\(^2\) Data for the EU-27 excluding Croatia are collected.

\(^3\) To avoid confounding the global economic crisis effect on regional migration rates with large-scale in-migration flows in the course of the refugee crisis of 2015, the sample period has been limited to 2012. Compared to the strong growth of refugee inflows after 2014, the number and growth rate of first-time asylum applications is still moderate in 2000-12 and should thus not affect the estimation results (EUROSTAT, 2015e).
employment rates, unemployment, long-term unemployment and youth unemployment rates. Moreover, population density as a measure for agglomeration economies and the regions’ industry mix, proxied by employment shares for one-digit NACE (Nomenclature statistique des activités économiques dans la Communauté Européenne) industries, are included among the regressors.

The choice of using both NUTS2 and NUTS3 territories as units of analysis is twofold: first, given differences in the size of regions within and across NUTS categories, this dual approach can be seen as an implicit robustness check when the goal is to proxy local labour markets as economically integrated ‘microregions’ with similar productive characteristics and underlying internal interactions (e.g. through commuting). NUTS2 and NUTS3 regions are used as upper and lower bounds for these microregions since no official definition of commuting zones exists for the EU. Second, while smaller NUTS3 regions are particularly well-suited to investigate phenomena, such as the role of agglomeration economies in driving migration (as the NUTS3 level allows to better separate urban centers from their respective hinterlands), not all relevant local labour market conditions are recorded at the NUTS3 level. For instance, while information on per capita income as well as the employment and self-employment rate is available at the NUTS3 level, harmonized EU data on the unemployment rate and particular structural sub-components thereof are only available at the NUTS2 level.

Finally, one should note that analyses at the NUTS3 and NUTS2 level are bound to some common data restrictions: as such, only data on net flows are available, which prevents the analysis from working with gross flows, i.e. studying regional in- and out-migration separately (EUROSTAT, 2015a). It is also important to note that the data only record the region’s overall net in-migration balance so no decomposition into internal (i.e. national and/or other EU residents) and external migratory movements (i.e. residents with third-country nationality) can be done. An overview of variables used in the empirical migration model.

The use of income growth rather than income levels can be motivated with the non-stationarity of the latter variable (see Appendix A for details) and associated econometric problem of running a mixed regression setup with I(0)/I(1) variables. In terms of the underlying economic interpretation, income growth puts a stronger emphasis on the forward-looking element of utility maximizing individuals compared to income levels. Since region-fixed effects are included in the empirical model, differences in income levels are implicitly captured as well. See Section III and Appendix B for further details on the theoretical foundation of the empirical migration model.
Table 1. Descriptive statistics for these variables can be found in Appendix A in the online supplementary data and research materials. In this appendix, I also report the results of pre-estimation tests for time-series properties (panel unit root tests) and cross-sectional dependence in the data, which are used to guide the empirical modelling strategy.

Figure 1 visualizes the spatial distribution of NUTS3 regions with positive (>1) and negative (<1) net in-migration rates. Panel A shows for the average net in-migration rate in 2008–12 that particular clusters of regions facing a migration-induced population decline (such as in Ireland, most of Spain, Northern France and Eastern Europe) can be contrasted with macro-regions experiencing migration-induced population growth (e.g., Northern Italy, South-East England and Southern France). Further, for several regions (e.g. in Spain and Ireland) net in-migration rates have strongly declined as compared to their pre-crisis average values in 2003–07 (Panel B).  

III. Conceptual Issues

III.1. Related Literature

There is a growing body of empirical research – mainly for the U.S. – that evaluates the role of local economic disparities in explaining interregional migration and tests for the balancing properties of migration in terms in alleviating negative local economic shocks as predicted by the conventional spatial

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5 The appendix provides further graphs on the temporal evolution of migration balances for country averages and the associated regional heterogeneity within countries (Figure A.1), the spatial distribution of per capita income growth rates (Figure A.2) and employment rates (Figure A.3) at the NUTS3 level as well as net in-migration rates (Figure A.4) and unemployment rates (Figure A.5) at the NUTS2 level.
equilibrium view of labour economics. Using the global economic crisis of 2008 as source for increasing disparities in local labour market conditions, Mian and Sufi (2014) and Yagan (2014) find that US internal migration did little to extenuate negative consequences of local economic shocks as would otherwise be expected by the conventional spatial equilibrium view of labour economics. Yagan (2017) provides additional evidence for hysteresis effects of local employment shocks during the global economic crisis, which are mainly a result of persistent demand rather than supply side adjustments.

The empirical results from these short-run analyses are also supported by recent long-run studies such as Saks and Wozniak (2011), Molloy et al. (2011) and Cooke (2013), concluding that US internal migration rates are declining and strongly pro-cyclical in the postwar period. Similar evidence in opposition to the conventional spatial equilibrium view is also reported in Howard (2017) indicating that higher in-migration to US metropolitan areas leads to a decline in regional unemployment rates rather than an increased supply-side pressure on local labor markets in migration receiving regions.

However, Monras (2015) reports that internal migration flows between US metropolitan areas have been important in mitigating negative local economic shocks. Using an IV approach that exploits pre-crisis information on the importance of the construction sector in the metropolitan area and the indebtedness of households as measures for the unexpectedness of the crisis, the author finds that net in-migration rates are positively correlated with per capita GDP and wage levels, while net in-migration rates are found to be negatively related to increases in the unemployment rates among US metropolitan areas. According to Monras, interregional migration has helped to alleviate up to one third of the effects of the crisis on income levels in most affected locations.

This supportive evidence for the spatial equilibrium view of labour economics fits in with the very few available studies on European regional population dynamics during the global economic crisis. Here, Jauer et al. (2014) find that regional population growth rates of EU NUTS2 regions are significantly correlated with local labour market disparities in per capita income (GDP) levels and unemployment rates in the post-crisis period, while only a weak correlation is found for the pre-crisis period. In terms of the magnitude of the effect, the authors calculate that up to one-fifth to one quarter of the initial la-

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6 See Appendix B.1 for a description of the neoclassical migration model as theoretical foundation of the conventional spatial equilibrium view of labour economics.
bour market shock induced by the global economic crisis is absorbed by changes in regional population within one year, which the authors interpret to be mainly driven by migratory movements.\textsuperscript{7} Different from the IV approach in Monras (2015), however, Jauer et al. only run OLS estimates disregarding the simultaneity of income, (un-)employment and population dynamics (i.e. they do not provide causal evidence for the role of local economic conditions in determining regional population dynamics).

III.2. Baseline Model

The starting point for the empirical analysis is a baseline migration equation as shown in eq.(2). The dependent variable is the net in-migration rate in region \(i\) at time \(t\) specified as a function of local labour market conditions in region \(i\) relative to the average labour market conditions in the EU:

\[
\log \left( \frac{NM_{i,t} + Pop_{i,t,k-1}}{Pop_{i,t,k-1}} \right) = \rho_i + u_{i,t}.
\]

With regard to the included local labour market conditions, \(yg_{i,t-k}\) and \(emp_{i,t-k}\) denote lagged per capita income growth and the (un-)employment rate in region \(i\), while \(yg_{EU,t-k}\) and \(emp_{EU,t-k}\)

\textsuperscript{7} The finding is accompanied by a growing literature on country-level evidence for the EU: Huart and Tchakpalla (2015) find for the Eurozone that the response of net migration flows to unemployment differentials has been particularly strong in the time period following the global economic crisis. Using data from the European Labour Force Survey, Galgóczi et al. (2012) observe that intra-EU labour mobility during the crisis has become much more reactive to changes in the macroeconomic environment than was the case for previous migration waves.
are EU averages for the same variables.\textsuperscript{8} The ratio of region $i$ to EU values as shown in eq.(2) can be interpreted as a measure for relative deviations of local labour market conditions from the respective EU average and can thus be read as the aggregated formulation of a simple two-region random utility model of migration between region $i$ and the rest of the EU (see Appendix B.2 in the supplementary data and research materials for further details).

Besides core labour market indicators, I also include other socio-economic control variables ($\mathbf{x}$), such as industry and settlement structures, in the migration equation (see Partridge et al., 2016 for an overview of commonly used measures). As eq.(2) shows, all regressors enter with a distributed time lag up to $k=1,\ldots,K$ periods to allow for delays in the dissemination of labour market (economic) signals to the migration response. Ruyssen et al. (2014) point out that a distributed lag structure can be motivated by the fact that prospective migrants compare not only utility differences in the present time period $t$ but also the net present value of all future utility differences when forming expectations about future utility streams out of past utility differences. While $\vartheta_k, \tau_k$ and $\varphi_k$ are variable coefficients to be estimated, $\rho_t$ are region-specific fixed effects and $u_{i,t}$ is a stochastic term.

III.3. Pre- and Post-Crisis Effects

To test whether (and to what extent) local labour market disparities have heterogeneous effects on regional net in-migration rates in the pre- and post-crisis period, I construct a binary dummy variable ($D_{\text{crisis}}$), which splits the entire sample period into a pre-crisis and a post-crisis period:

$$D_{\text{crisis}} = \begin{cases} 
1 & \text{if year } \geq 2008 \\
0 & \text{otherwise.}
\end{cases}$$

Regarding the timing of the crisis, I follow Crescenzi et al. (2016) stating that the global economic crisis hit the EU in the first quarter of 2008. As Lane (2012) further points out, the evolution of the global economic crisis in the EU is highly interwoven with the subsequent European sovereign debt crisis.

\textsuperscript{8} As outlined in Section II, not all variables are available at different spatial scales. That is, at the NUTS3 level only data on employment and self-employment are available, while at the NUTS2 level both data on employment and unemployment are available.
starting in late 2009. The progress of this ‘double’ crisis is captured by $D_{\text{crisis}}$, which is used to construct interaction terms for the right-hand-side regressors as:

$$
nmr_{i,t} = \sum_{k=1}^{K} \tau_k^1 \times \log \left( yg_{i,t-k} / yg_{EU,t-k} \right) + \sum_{k=1}^{K} \tau_k^2 \times \left[ D_{\text{crisis}} \times \log \left( yg_{i,t-k} / yg_{EU,t-k} \right) \right]
+ \sum_{k=1}^{K} \theta_k^1 \times \log \left( emp_{i,t-k} / emp_{EU,t-k} \right) + \sum_{k=1}^{K} \theta_k^2 \times \left[ D_{\text{crisis}} \times \log \left( emp_{i,t-k} / emp_{EU,t-k} \right) \right]
+ \sum_{k=0}^{K} \phi_k^1 \times \log \left( x_{i,t-k} / x_{EU,t-k} \right) + \sum_{k=0}^{K} \phi_k^2 \times \left[ D_{\text{crisis}} \times \log \left( x_{i,t-k} / x_{EU,t-k} \right) \right] + \rho_l + u_{i,t}. \quad (3)$$

The extended regression specification in eq.(3) can be interpreted as a regime switching model (Quandt, 1958, 1972), where coefficients $\tau_k^1$, $\theta_k^1$ and $\phi_k^1$ estimate the average response of the net immigration rates in the pre-crisis period, while $\tau_k^2$, $\theta_k^2$ and $\phi_k^2$ measure the additional migration response to local labour market disparities in the (post)-crisis period. The overall effect on the net migration rate in the post-crisis period is then, for instance, calculated as $\tau_k^1 + \tau_k^2$ for income growth and analogously for the other variables. Standard errors for these overall post-crisis effects are obtained using the delta method.

I then use the estimated coefficients from the regime switching model in eq.(3) as input for a decomposition analysis in the spirit of Oaxaca (1973) and Blinder (1973). This shall enhance the economic interpretation of the obtained regression output. The decomposition analysis has two dimensions: First, I calculate time-specific squared correlations (univariate $R^2$) between average values of the outcome variable in the pre- and post-crisis period, $\overline{nmr}_{i,t}^{pre}$ and $\overline{nmr}_{i,t}^{post}$, and the associated model predictions, $\overline{nmr}_{i,t}^{pre} = (\hat{M}_{i,t}^{pre}) \hat{\Psi}^{pre}$ and $\overline{nmr}_{i,t}^{post} = (\hat{M}_{i,t}^{post}) \hat{\Psi}^{post}$. where bars indicate time averages, $\hat{\Psi}$ are estimated coefficients for $\Psi^{pre} = [\tau_k^1, \theta_k^1, \phi_k^1]$ and $\Psi^{post} = [(\tau_k^1 + \tau_k^2), (\theta_k^1 + \theta_k^2), (\phi_k^1 + \phi_k^2)]$, and $\hat{M}_i$ is a variable vector containing average values of local labour market and further economic characteristics in region $i$. The comparison of the two time-specific correlation coefficients allows assessing whether the contribution of local labour market conditions in determining a region’s net in-migration rate has increased or decreased over time, i.e. between the pre- and post-crisis period.
The second dimension of the decomposition analysis splits the change in the predicted net in-migration rates \( \left( \overline{nmr}_i^{post} - \overline{nmr}_i^{pre} \right) \), averaged for the pre- and post-crisis period, into three components:

\[
\overline{nmr}_i^{post} - \overline{nmr}_i^{pre} = \left( \overline{M}_i^{post} - \overline{M}_i^{pre} \right) \overline{\Psi}^{pre} + \overline{M}_i^{pre} \left( \overline{\Psi}_i^{post} - \overline{\Psi}_i^{pre} \right) + \left( \overline{M}_i^{post} - \overline{M}_i^{pre} \right) \left( \overline{\Psi}_i^{post} - \overline{\Psi}_i^{pre} \right). \tag{4}
\]

The first component, \( \left( \overline{M}_i^{post} - \overline{M}_i^{pre} \right) \overline{\Psi}^{pre} \), measures changes in local labour market disparities evaluated at estimated coefficients for the pre-crisis period. Along the lines of the Oaxaca-Blinder-type decomposition literature this component is the so-called ‘endowment’ effect (Jann, 2008). The second component, \( \overline{M}_i^{pre} \left( \overline{\Psi}_i^{post} - \overline{\Psi}_i^{pre} \right) \), calculates the contribution of changes in the estimated coefficients between the post- and pre-crisis periods while fixing local labour market disparities at their average values in the pre-crisis period. This component is the so-called ‘coefficient’ effect. The relative contribution of the ‘endowment’ and ‘coefficient’ components in explaining the overall predicted change in net in-migration rates provides insights on i) the degree to which changes in net in-migration rates reflect widening labour market disparities and ii) the degree to which the migration response to (constant) labour market disparities has changed over time. In other word, the latter component detects behavioural adjustment processes in regional migration rates during the global economic crisis. The third component, \( \left( \overline{M}_i^{post} - \overline{M}_i^{pre} \right) \left( \overline{\Psi}_i^{post} - \overline{\Psi}_i^{pre} \right) \), captures ‘simultaneous’ changes in endowments and coefficients. The three components add up to 100%.

**III.4. Endogeneity Concerns**

A fundamental challenge for the estimation of a migration equation as in eq.(2) or eq.(3) is the joint determination of a region’s net in-migration rate and its local labour market state. This simultaneity limits the causal interpretation of standard (panel) estimates. A common solution to this problem is to apply a structural IV approach using ‘Bartik’-type (or shift-share) instruments (Bartik, 1991). In essence, shift-share instruments isolate the exogenous variation in a regressor by linking the initial spatial (cross-sectional) variation for this variable with growth rates at the national level – either using just a single shifting factor or multiple ones. Here, the idea is to isolate
measures of local labor demand conditions that are unrelated to changes in local labor supply, i.e. not affected by migration adjustments itself.

For instance, to isolate demand-driven changes in employment levels (or rates) unaffected by supply-side (migration) adjustments at the local level, Howard (2017) uses industry-level data to construct a Bartik instrument \( z^B_{i,t} \) of the following form

\[
z^B_{i,t} = \sum_j s_{j,i,t-1} g_{j,-i,t},
\]

where \( s_{j,i,t-1} \) is an employment measure of industry \( j \) in region \( i \) in year \( t-1 \) and \( g_{j,-i,t} \) is the growth rate of employment for industry \( j \) in the rest of the economy (\( -i \)) between \( t-1 \) and \( t \). Depending on whether \( s_{j,i,t-1} \) measures absolute employment levels or shares, this gives a prediction of local employment levels or employment changes in period \( t \) calculated on the basis of the industry-specific national employment evolution weighted by the region’s (initial) sectoral employment level or share in \( t-1 \). Several modifications of this basic Bartik instrument have been proposed, for instance, Wozniak (2010) proposes the use of 5-year moving averages to ensure the exogeneity of the initial regional distribution.

For situations in which detailed industry-level data are not available, simpler versions of the Bartik instrument have been proposed: for instance, Nakamura and Steinsson (2014) build a Bartik-type instrument for regional government spending by interacting region-specific growth in national spending with the average regional level of spending in the first five sample years, hence the authors use just one shift factor rather than multiple ones. Moreover, also spatialized versions of the Bartik instrument have been proposed, typically calculated as average growth rates in the geographical environment of region \( i \) rather than national averages (Burley, 2017). The latter aggregation method is a suitable instrumentation strategy when national growth rates are only an imper-
fect indicator of local industry dynamics and thus limit the relevance of the Bartik IV approach (Goldsmith-Pinkham et al., 2018).\(^9\)

The empirical identification strategy chosen here, constructs Bartik instruments for all included labour market variables. Specifically, for income growth and the employment rate, I construct Bartik instruments with multiple shift factors as shown in eq.(5) on the basis of national employment and GVA data for one-digit industries (see Table 1 for a list of industries). I then normalize the predicted variables by the EU average \(x_{EU,t}\) as \(\bar{z}_{i,t}^B = \log(\bar{z}_{i,t}^B / x_{EU,t})\). Since no detailed industry data are available for the self-employment rate and the three unemployment rate measures, I construct simple (single shift factor) Bartik instruments \(\bar{z}_{i,t}^{SB}\) linking national growth rates to initial regional labour market conditions \(x_{i,t-l}\) as \(\bar{z}_{i,t}^{SB} = \log\left(\left(\frac{1}{P} \sum_{s=0}^{P-1} x_{i,t-l+p+s}\right) \times (1 + g_{i,t})\right) / x_{EU,t}\), where \(\frac{1}{P} \sum_{s=0}^{P-1} x_{i,t-l+p+s}\) is the P-year (arithmetic) moving average for variable \(x_i\) and \(g_{i,t}\) measures the national annual growth rate between \(t-1\) and \(t\) for the same variable. Again, I normalize the instrument by \(x_{EU,t}\).

I use moving average representations with \(P=3\) for the construction of \(\bar{z}_{i,t}^B\) and \(\bar{z}_{i,t}^{SB}\) to isolate the exogenous (initial) local labour market situation unaffected by migration.\(^{10}\)

The validity of the Bartik instrument chiefly depends on the assumption that the variable’s initial spatial distribution is exogenous, i.e. not affected by supply-side adjustments. However, this may be problematic if it takes time for labor markets to adjust to supply-side shocks (Jaeger et al., 2018) – even when moving average representations are chosen. For this reason, I combine the Bartik IV approach with an IV strategy proposed by Monras (2015). The latter strategy aims at isolating labor demand shocks by using indicators for the unexpectedness of the global economic crisis, when regressing regional gross and net migration rates on regional per capita GDP, the unemp-

\(^9\) However, Howard (2017) points out that nearby regions typically experience similar labour demand shocks, which may render the instrument endogenous. This calls for a spatial aggregation strategy, which excludes nearby neighbours but includes more distant regions to avoid biases stemming from latent cross-sectional correlation.

\(^{10}\) In addition, spatialized versions of \(\bar{z}_{i,t}^B\) and \(\bar{z}_{i,t}^{SB}\) are constructed to test the sensitivity of instruments with regard to the chosen level of aggregation. Details on instrument construction are given in Appendix B.3.
ployment rate and average wages. Specifically, Monras (2015) runs first-stage regressions of the following type

\[ x_{i,t} = \beta \times z_{i,t}^{CONS} + \rho_i + \lambda_t + e_{i,t}, \]  

where \( x_{i,t} \) is either the (log) per capita income, the unemployment rate or average wages in region \( i \) at time \( t \), and \( z_{i,t}^{CONS} \) is defined as \( z_{i,t}^{CONS} = \log(D_{crisis} \times CONS_{i,t_0}) \) with \( CONS_{i,t_0} \) being the share of construction workers in total employment in region \( i \) for an initial (pre-crisis) sample period, \( t_0 \). Further, \( \lambda_t \) are year fixed effects and \( e_{i,t} \) is a stochastic term. The instrument thus explains the post-crisis evolution of labour market variables through variations pre-crisis employment intensities in the construction sector, which – in turn – measure the unexpectedness of the crisis at its outbreak. It can be assumed that this unexpectedness excludes supply-side adjustments. Here, I set the initial sample period \( t_0 \) used to calculate \( z_{i,t}^{CONS} \) to the average of 2000-05. Taken together, for IV estimation, I run a series of first-stage two-way fixed effect regressions as in eq.(6) using the comprehensive instrument set \( IV = [z_{i,t}^B, z_{i,t}^{SB}, z_{i,t}^{CONS}] \) to isolate the exogenous variation in local labour market conditions.\(^{11}\)

III.5. Further Econometric Issues

Recent contributions in the empirical migration literature have additionally stressed the importance of i) serial correlation and ii) cross-sectional dependence. To avoid estimation biases stemming from the omission of one of these factors, I extend the baseline migration equation (with and without interaction terms) in the following way: First, I add time lags of the dependent variable to the set of regressors to control for the different channels through which past migration may affect current migration (Ruyssen et al., 2014). Second, I include a common factor structure to account for the presence of unobserved factors stemming from latent common shocks (Sarafidis and Wansbeek, 2012). The extended empirical specification for eq.(2) reads

\(^{11}\) Instruments and local labour market conditions are correlated in a contemporaneous manner. This implies that the chosen lag structure for the IV set is determined by the lag structure of the endogenous regressors in the second-stage regression.
\[ nmr_{i,t} = \sum_{m=1}^{M} \theta_m \times nmr_{i,t-m} + \sum_{k=1}^{K} \tau_k \times \log \left( \frac{y_{g,i,t-k}}{y_{g,EU,t-k}} \right) + \sum_{k=1}^{K} \varphi_k \times \log \left( \frac{emp_{i,t-k}}{emp_{EU,t-k}} \right) + \rho_i + \lambda_i' f_t + u_{i,t}, \]

where \( \theta_m \) denote coefficients for the included lagged endogenous variable up to a lag length of \( m=1,\ldots,M; \) \( f_t = (f_{1,t}, \ldots, f_{\Lambda t})' \) is an \( \Lambda \times 1 \) vector of unobserved factors; \( \lambda_i = (\lambda_{1i}, \ldots, \lambda_{\Lambda i})' \) is an \( \Lambda \times 1 \) vector of factor-loadings, which may vary for each region \( i \); and \( u_{i,t} \) is the stochastic term.\(^{12}\)

In terms of estimation, I combine the (bootstrap-based bias corrected) dynamic FE model (Everaert and Pozzi, 2007) and the IPC estimator of Bai (2009) to run the baseline FE and structural IV regressions. While the former ensures the consistent estimation of temporal adjustment dynamics in the evolution of regional net in-migration rates, the common factor structure in the IPC estimator accounts for the presence of unobserved factors that stem from latent shocks and may result in cross-sectional dependence across regions. Further details on the estimation procedure are given in Appendix B.4.

The validity of the estimation results is tested through a battery of robustness checks. These include a comparison with alternative estimators, tests for structural breaks other than the global economic crisis (e.g. EU eastern enlargement) and subsample estimates to assess the degree of coefficient heterogeneity across country groups (e.g., excluding Germany and Austria, focusing on the Eurozone-11, Mediterranean countries, etc.). I give a motivation for the design of these robustness tests together with details on their implementation in Appendix B.5 and B.6.

IV. Empirical Results

IV.1. Baseline FE and Structural IV Estimates

Table 2 present the regression output for the dynamic migration equation as shown in eq.(7) including multiplicative interaction terms.\(^{13}\) The table is organized as follows: columns I to III report the results of

\(^{12}\) The full dynamic specification as shown in eq.(7) is also used to estimate regime switching models including multiplicative interaction terms on the basis of the binary dummy variable \( D_{\text{crisis}} \).

\(^{13}\) The full dynamic specification as shown in eq.(7) is also used to estimate regime switching models including multiplicative interaction terms on the basis of the binary dummy variable \( D_{\text{crisis}} \).
the baseline FE estimates for both NUTS3 and NUTS2 regions, columns IV to VI display comparable estimation results obtained from structural IV regressions. Regressions are carried out on the basis of the dynamic IPC estimator including a one-period lag of the endogenous variable and one- to three-period lags (k=3) for the local labour market variables. The reported coefficients sum over the individual lag-specific point estimates and, thus, cover short- to mid-run local labor market effects on regional net in-migration rates. Given the log-log specification of the migration equation, they can be interpreted as elasticities. Standard errors are calculated by the delta method. As I show in greater detail in Table A.4 in Appendix C, the included common factor structure of the dynamic IPC estimator captures all cross-sectional dependence in the data.

With regard to the quality of the structural IV specifications, Table 2 reports the results of a Kleibergen and Paap (2006) F-test for weak instruments and the Anderson-Rubin (AR) Wald test statistic for robust inference under weak instruments. The test results of the Kleibergen-Paap weak instrument test indicate that the first-stage regressions for all three sample specifications (NUTS3 and NUTS3) pass the Staiger-Stock ‘rule of thumb’ criterion of $F>10$ (Staiger and Stock, 1997). In addition, the reported AR test statistics show that the coefficients of the instrumented labour market variables are jointly

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13 I report baseline estimation results for the dynamic migration equation without interaction terms in Appendix C.

14 The coefficient for the lagged dependent variable is not explicitly reported here; see Table A.4 in the appendix for details.

15 Population density and its squared value as well as employment shares of one-digit industries enter the regression equation contemporaneously.

16 Table A.5 in the appendix shows the results for factor selection of the IPC estimator of Bai (2009). The approach increases the number of factors in a stepwise manner until the CD test (Pesaran, 2004) does not reject the null hypothesis of uncorrelated residuals.

17 Here, the simple ‘rule of thumb’ criterion for weak instrument identification is applied since Stock and Yogo (2005) critical values are not provided for the number of endogenous regressors used in the estimations.
significant in the second-stage IV regressions across all three specifications (even if instruments would be weak). Given this supportive evidence for the IV specifications, in the discussion of the empirical results I mainly focus on them and just give selective references to the baseline FE estimates.

For the pre-crisis period up to 2008, the estimation results in the upper part of Table 2 provide only limited support for the role of local labour market conditions in determining regional migration rates and are often in opposition to the conventional spatial equilibrium view of labour economics. This result mirrors earlier evidence such as reported in Jauer et al. (2014). For instance, both the reduced-form and structural IV estimates show a negative coefficient for the impact of income growth on regional net in-migration rates. Similarly, the positive correlation between the employment rate and regional net migration rates for NUTS3 regions – as indicated by the FE model results in column I – breaks down for the structural IV estimates (column IV). The estimated coefficient signs for the overall unemployment rate and the youth unemployment rate are in line with the spatial equilibrium view of the labour economics, i.e. higher unemployment rates are negatively correlated with net in-migration rates, while the sign for the long-run unemployment rate is reversed. As it is difficult to assess the magnitude of these effects directly from the estimation output, I will do so by applying the decomposition analysis in the next section.

In contrast to this mixed pre-crisis evidence, however, the estimated coefficients for the interaction terms in the lower part of Table 2 clearly indicate statistically significant changes in the migration response to local labour market disparities in the time interval following the global economic crisis. In most cases, the direction of these add-on coefficients changes in support of the conventional spatial equilibrium view of labour economics. I observe the most striking regime shift for relative income growth: here

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<18 Results from spatial versions of the Bartik instruments are shown in Table A.6 in Appendix C. The results are very similar to the traditional Bartik instruments using national growth rates as shift factors.

<19 I also find inconclusive results when using per capita income levels rather than growth rates. Associated regression tables can be obtained upon request.>

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the estimated coefficients turn from negative/insignificant pre-crisis effects to significantly positive add-on effects in the post-crisis period (both observed at the NUTS3 and NUTS2 level).

Likewise, for the long-term and youth unemployment rate (NUTS2 sample), the reported negative add-on coefficients signal a growing importance of regional disparities in structural components of the unemployment rate as hampering factors for regional net in-migration. Particularly for the long-run unemployment rate, both the baseline FE and structural IV estimates point to a significant negative add-on effect in the post-crisis period, while the negative add-on effect for the youth unemployment rate is statistically insignificant for IV estimation. Somewhat surprisingly, I find that the estimated add-on effects for the overall unemployment rate have a reversed sign in the post-crisis period – pointing to only small negative overall effects in the post-crisis period. A potential explanation of the latter result is the underlying association between the higher unemployment rates and city size. Indeed, when I look at the role played by population density and its squared value, the results in the lower part of Table 2 indicate a nonlinear, inverted U-shaped correlation with regional net in-migration rates, thus reflecting a selective urbanization trend during the global crisis (despite the fact the large cities in the EU-27 sample have – on average – higher unemployment rates compared to smaller cities).20

Finally, when I calculate the underlying overall post-crisis effects, the above described regime shifts in the migration response to local labor market disparities can further be highlighted: for example, for the baseline FE estimates in column I the overall migration response to changes in income growth in the post-crisis period is calculated as $-0.00757+0.01108=0.0035$. This implies that a 1% increase in the income growth rate of region $i$ (relative to the EU average), leads to a 0.35% increase in the region’s net immigration rate. As I show in greater detail in Table A.7 in the supplementary data and research materials, this overall post-crisis effect is statistically significant at the 1% critical level. The associated income growth effect for the structural IV estimates is 0.00295 and likewise statistically significant at the 1% critical level. Figure 2 and Figure 3 summarize the full distribution of pre- and post-crisis effects for the

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20 Exceptions are negative migration dynamics observed for large metropolitan regions in central and southern Europe: for instance, Madrid and Barcelona have experienced strong net out-migration in the aftermath of the crisis with a net migration balance of roughly -48,900 and -39,500 persons in 2010-12. Together with the Greek NUTS3 region of Thessaloniki, the two Spanish metropolitan regions experienced the largest overall net migration outflows among NUTS3 sample regions.
IV.2. Decomposition Analysis

Although the regression tables clearly indicate the statistical significance of local labour market conditions for determining regional net in-migration rates, particularly during the global economic crisis, it is difficult to infer their economic significance. To provide some further insights, Table 3 therefore presents the results of the two decomposition exercises as outlined above. The decomposition analysis is based on the regression results from the structural IV estimation in Table 2, which are a closer approximation of causal effects than the baseline FE estimates. As outlined in Section III, columns I and II of Table 3 compare the explanatory power of the included regressors in the pre- and post-crisis periods for the three specifications. The results show that the explanatory power of the regressors significantly increases from the pre- to the post-crisis period: that is, while variations in labour market conditions account only for 11% of the total variation in regional net in-migration rates of NUTS3 regions prior to 2008, the explanatory power of included labour market and regional economic variables increases to 32% in the post-crisis period. The largest individual contribution thereby relates to income growth (12% of the total variation in regional net in-migration rates). At the aggregate NUTS2 level, the labour market context of changes in the net in-migration rate even accounts for up to 40-50% in the post-crisis period.

When I decompose the predicted change in regional net in-migration rates between the pre- and post-crisis periods, the results in columns III to V show that for most variables the effect is mainly attributable to the endowment effect, i.e. changes in the magnitude of local labour market disparities.
stance, roughly 60% of the predicted effect of the self-employment rate on net in-migrations for NUTS3 regions stem from this endowment effect, 35% for income growth etc. However, for some variables, such as the population density, I can also observe distinct behavioural adjustments in the migration response (e.g., 60% of the predicted effect for NUTS3 regions is due to coefficient changes). This may be seen as an indication for the increased role played by urban agglomerations in reducing labour market frictions and unemployment shocks in a period of economic crisis (Delgado et al., 2015). Moreover, at the NUTS2 level, I also observe significant coefficient effects for the unemployment rate (particularly long-run unemployment). Finally, as Table 3 further shows, often the two effects are not fully separable as indicated by the high share of simultaneous changes in endowments and coefficients.

<<< TABLE 3 ABOUT HERE >>>

IV.3. Robustness Checks

As a test for coefficient stability, Figure 4 plots the estimated coefficients and standard errors of the key labour market indicators using year-specific interaction terms \( (D_n) \) for \( n=2005 \) to 2012. The plotted estimation results measure the year-specific additional migration response to changes in labour market variables when year \( n \) is added to the sample.\(^{21}\) For the sample of NUTS3 regions the results in Figure 4 provide strong empirical evidence for a significant coefficient change in 2008 and do not indicate earlier structural breaks, for instance, in response to the two recent EU enlargement waves. This underlines the importance of the global crisis in affecting regional migration rates in the EU.\(^{22}\)

<<< FIGURE 4 ABOUT HERE >>>

In addition, Table A.8 in Appendix C reports a summary of different subsample results taking into account institutional frictions and macro-regional heterogeneities. The results generally support the above findings and point to some noteworthy particularities among EU countries. For instance, regarding the income growth effect, the largest additional post-crisis effects are obtained for the EU-15 and Eurozone-11 subsamples. This result reflects the advanced level of economic and labour market integration for this

\(^{21}\) See Appendix B.5 for further details on the test setup. Estimations are carried out by the dynamic IPC estimator.

\(^{22}\) Plotted estimation results for NUTS2 regions are shown in Figure A.6 and A.7 in Appendix C.
subgroup of EU countries. In comparison, income growth differences perform poorly in explaining differences in net in-migration rates for the subsamples of new member states (NMS-12) and Mediterranean countries in the post-crisis period. Similar observations can also be made for the employment rate. With regard to the role played by the unemployment rate and its components, the results particularly point to negative add-on effects for the youth unemployment rate during the post-crisis period—particularly for Mediterranean countries. The latter finding mirrors earlier empirical work showing that these countries experienced the most drastic increase in youth unemployment rates after the global economic crisis of 2008 (Scarpetta et al., 2010).

V. DISCUSSION AND CONCLUSION

In this study, I have taken a European perspective on the local labour market context of internal migration during the global economic crisis of 2008. The estimation results from different specifications and robustness tests point to the fact that the role of local labour market disparities in determining regional net in-migration rates has increased throughout the crisis. The results lend support to the conventional spatial equilibrium view of labor economics and indicate that migration flows, by reacting to increasing labour market disparities, serve as an important adjustment mechanism to absorb idiosyncratic regional shocks. Particularly regional income growth and structural components of the unemployment rate emit stronger migration signals in the post-crisis period compared to the pre-crisis situation. That is, for instance, while a stronger income dynamics attracts net in-migration into the region, a higher long-run unemployment rate drives migrants out of the region.

By decomposing the estimated effects into their pre- and post-crisis contributions I have shown that changes local labour market indicators only account for roughly 11% of the total migration response of NUTS3 regions in the pre-crisis period, while their explanatory power increases to 32% in the post-crisis period. I find that regional variations in income growth rates are the most significant individual driver of net in-migration rates at the NUTS3 level (12% of the total variation). At the NUTS2 level,
the labour market context of changes in the net in-migration rate even accounts for up to 40-50% in the post-crisis period.

The decomposition of changes in predicted regional net in-migration rates between the pre- and post-crisis periods further reveals that for most variables the increased migration response is mainly attributable to the widening of local labour market disparities. This finding underlines that migration acts as an equilibrium mechanism to mitigate labour market disparities across regions. Moreover, for some variables, such as population density and the long-run unemployment rate, I also observe behavioural adjustment processes in the migration response to economic shocks. For instance, structurally weak regions with persistently high long-run unemployment rates experience significant lower net in-migration rates in the post- compared to the pre-crisis period.

These findings come as a surprise in the sense that the majority of empirical studies for the U.S. indicate that migration did little to extenuate negative consequences of local economic shocks during the global economic crisis. This mismatch between the European and US evidence can be interpreted as the result of several influencing factors: First, while intra-European migration has traditionally been very low in the postwar period and only recently showed signs of (re-)vitalization, US internal migration has traditionally been high but experienced a steady decline throughout the last twenty years. Cooke (2013) argues that this decline in internal US migration can essentially be attributed to an increase in dual-worker couples and increased household indebtedness, two factors which are differently pronounced in the EU and U.S. (see, e.g. Christelis et al., 2017). The opposing results found for the period of the global economic crisis thus appear to mirror and, carefully speaking, potentially accentuate this long-run trend reversal in the migration-local labour market nexus between the EU and U.S.

Second, given differences in the degree of economic integration between the U.S. and the EU, intra-European mobility has been found to be seriously affected by several market imperfections (Bartz and Fuchs-Schündeln, 2012) and extensive place-based policies such as the EU Structural Funds (Schmidt, 2013) or national unemployment protection schemes (Jofre-Monseny, 2014). The significant response of regional net in-migration rates in the EU during the global economic crisis may thus help policy makers to better understand the functioning of European labour markets in the light of these imperfections and benchmark EU labor market integration vis-à-vis the U.S. For instance, while the rather low
degree of geographical mobility within and across EU member states has been a matter of great concern in the past, the results reported here point to the fact that Europeans are not immobile ‘by nature’. Rather, it appears that sufficiently large shocks to local labour market conditions are needed before migrants consider relocating out of a local labour market context.

Hence, if policy makers aim at further strengthening the link between local labour market conditions and migration in the process of EU integration, the balance between equity considerations and allocational efficiency on the labour market should be reconsidered – particularly in times of normal economic development, for which I find a weak link between local labour market conditions and migration. Although more research is needed to directly assess the role of policy, the observed difference in the migration response to local labour market disparities between the pre- and post-crisis period may point to the fact that prevailing mobility barriers obscure market signals in times of normal economic development, whereas in times of economic crisis migrants eventually react to these signals. Thus, if high internal mobility rates are the goal of EU policy makers, then one implication would be to further increase the responsiveness of migrants to labour market signals, e.g., through a reduction in redistributive measures and active labour market policies implemented through the EU Structural Funds and national policy instruments that prevent out-migration from structurally weak regions. Instead, a focus should be set on mobility-supporting policy instruments such the EU job mobility portal (EURES), mobility-oriented education and social integration programmes.

REFERENCES


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TABLE 2
Baseline FE and structural IV estimates of dynamic migration model with common factor structure

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<td>0.00018***</td>
<td>-0.00449***</td>
<td>-0.01673***</td>
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<td>-0.00042</td>
<td>-0.01719***</td>
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<tr>
<td>(S.E.)</td>
<td>(0.00006)</td>
<td>(0.00151)</td>
<td>(0.00186)</td>
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<td>(0.00044)</td>
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<tr>
<td>$D_{Criss} \times$ Income growth$_{t-k}$</td>
<td>0.01108***</td>
<td>0.00728***</td>
<td>0.01028***</td>
<td>0.00315***</td>
<td>0.00289**</td>
<td>0.01081***</td>
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<tr>
<td>(S.E.)</td>
<td>(0.00163)</td>
<td>(0.00235)</td>
<td>(0.00303)</td>
<td>(0.00073)</td>
<td>(0.00114)</td>
<td>(0.00031)</td>
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<td>$D_{Criss} \times$ Employment rate$_{t-k}$</td>
<td>0.00137***</td>
<td>0.00249***</td>
<td>0.00007</td>
<td>0.00014**</td>
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<tr>
<td>(S.E.)</td>
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<td>(0.00026)</td>
<td>(0.00050)</td>
<td>(0.00006)</td>
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<tr>
<td>$D_{Criss} \times$ Self-employment rate$_{t-k}$</td>
<td>0.00029***</td>
<td>-0.00145***</td>
<td>-0.00008***</td>
<td>-0.00003</td>
<td></td>
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</tr>
<tr>
<td>(S.E.)</td>
<td>(0.00008)</td>
<td>(0.00021)</td>
<td>(0.00003)</td>
<td>(0.00005)</td>
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<tr>
<td>$D_{Criss} \times$ Unemployment rate$_{t-k}$</td>
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<td></td>
<td>0.00325***</td>
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<tr>
<td>(S.E.)</td>
<td>(0.00062)</td>
<td></td>
<td>(0.00040)</td>
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<tr>
<td>$D_{Criss} \times$ Long-term unemp rate$_{t-k}$</td>
<td></td>
<td>-0.00271***</td>
<td>-0.00291***</td>
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<tr>
<td>(S.E.)</td>
<td>(0.00053)</td>
<td></td>
<td>(0.00040)</td>
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<tr>
<td>$D_{Criss} \times$ Youth unemp rate$_{t-k}$</td>
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<td>-0.00127</td>
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<td>0.00023*</td>
<td>0.00144***</td>
<td>-0.00001</td>
<td>-0.00001</td>
<td>0.00147***</td>
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<td>(0.00017)</td>
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<td>(0.00002)</td>
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<td>$D_{Criss} \times$ Sq. population density$_{t}$</td>
<td>-0.00004**</td>
<td>-0.00449***</td>
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<td>(0.00008)</td>
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<td>73.51***</td>
<td>1197.87***</td>
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</table>

Notes: ***, **, * denote statistical significance at the 1%, 5% and 10% critical value, respectively; S.E. = Heteroskedasticity robust standard errors (see Appendix B for details). The number of included common factors according to Bai (2009) has been selected according to the CD-test criterion; for details see Table A.5 in the supplementary data and research materials. * = F-values larger than Staiger-Stock (1997) ‘rule of thumb’ criterion.
<table>
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<th>(I)</th>
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<th>(III)</th>
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<th>(V)</th>
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<td>$\frac{nm_{i}^{post}}{nm_{i}^{pre}}$</td>
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<td>From:</td>
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<td>$(M_{i}^{post})\hat{\psi}_{post}$</td>
<td>$(X_{i}^{post})\hat{\psi}<em>{post} - (X</em>{i}^{pre})\hat{\psi}_{pre}$</td>
<td>$(X_{i}^{post})\hat{\psi}<em>{post} - (X</em>{i}^{pre})\hat{\psi}_{pre}$</td>
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</table>

**NUTS3**

Total | 10.58% | 31.95% | | | |

- Income growth: 3.40% | 12.03% | 35.60% | 11.41% | 52.99% |
- Employment rate: 1.26% | 3.21% | 30.31% | 4.10% | 65.60% |
- Self-employment rate: 2.42% | 3.88% | 59.58% | 0.59% | 39.83% |
- Population density: 0.00% | 4.02% | 14.73% | 58.65% | 26.62% |
- Industry shares: 3.50% | 8.81% | 42.96% | 2.91% | 54.13% |

**NUTS2**

Total | 29.16% | 38.11% | | | |

- Income growth: 6.21% | 7.59% | 48.28% | 4.73% | 46.99% |
- Employment rate: 2.69% | 2.11% | 47.87% | 0.86% | 51.27% |
- Self-employment rate: 8.53% | 2.90% | 26.57% | 29.59% | 43.85% |
- Population density: 0.00% | 8.13% | 35.99% | 28.58% | 35.43% |
- Industry shares: 11.73% | 17.38% | 1.27% | 2.07% | 96.66% |

**NUTS2**

Total | 45.99% | 52.09% | | | |

- Income growth: 4.29% | 9.45% | 44.52% | 0.75% | 54.73% |
- Unemployment rate: 7.70% | 6.04% | 42.72% | 7.00% | 50.28% |
- Long-term unempl rate: 19.09% | 11.72% | 58.05% | 30.69% | 11.26% |
- Youth unempl rate: 6.38% | 4.34% | 90.07% | 8.63% | 1.30% |
- Population density: 0.00% | 10.38% | 2.60% | 1.67% | 95.73% |
| Industry shares | 45.99% | 52.09% | 33.48% | 27.37% | 39.14% |

Notes: Based on point estimates from structural IV estimates in Table 2. The percentage contribution in columns I and II is calculated as squared correlation of systematic part with dependent variable (univariate $R^2$), where the coefficient for each regressor, $x_k$, has been standardized as $\hat{\beta}_k^z = \hat{\beta}_k \left( \sqrt{s_{kk}} / \sqrt{s_{yy}} \right)$ with $s_{kk}$ and $s_{yy}$ denoting the empirical variances of regressor $x_k$ and the outcome variable $y$, respectively. The contributions in columns III to V are calculated as percentage shares in the total predicted change in the outcome variable, where the displayed endowment, coefficient and simultaneous effects sum up to 100%. See main text for further details.
FIGURE 1
Spatial distribution of net in-migration rates among NUTS3 regions

Panel A: Average 2008–2012
Panel B: Average 2003–2007

Source: Own figure based on data from Eurostat (2015a). The regional net migration rate is defined as migration-induced annual population growth (with 1 = constant population). NUTS3 regions of Croatia are included in the graphical presentation of migration rates but left out in the empirical estimations due to missing observations.

FIGURE 2
Pre- and post-crisis output effects for net in-migration rate (baseline FE estimation)

(a) Income growth (NUTS3)   (b) Employment rate (NUTS3)   (c) Self-employment rate (NUTS3)
Notes: Solid bar graphs indicate statistically significant output effects (elasticities) expressed in %; hollow bars indicate statistically insignificant results. The underlying coefficients for the post-crisis effect have been calculated using the delta method based on coefficients shown in Table 2. For further details see Table A.7. To allow for a comparison of the estimated effects between the baseline FE ad structural IV regressions, the scaling of
the y-axis for each sub-graph has been harmonized with the corresponding one from Figure 3. Note that the scaling of y-axes varies across variables in Figure 2 to ensure the readability of the displayed sub-graphs.

FIGURE 3

Pre- and post-crisis output effects for net in-migration rate (structural IV estimation)
Notes: Solid bar graphs indicate statistically significant output effects (elasticities) expressed in %; hollow bars indicate statistically insignificant results. The underlying coefficients for the post-crisis effect have been calculated using the delta method based on IV coefficients shown in Table 3. For further details see Table A.7. To allow for a comparison of the estimated effects between the baseline FE ad structural IV regressions, the scaling of the y-axis for each sub-graph has been harmonized with the corresponding one from Figure 2. Note that the scaling of y-axes varies across variables in Figure 3 to ensure the readability of the displayed sub-graphs.
FIGURE 4

Tests for structural breaks in estimated coefficients during 2005-2012 (NUTS3)

(a) Income growth    (b) Employment rate

(c) Self-employment rate    (d) Population density

Note: Dots show estimated coefficients for interaction terms based on $D_n$ together with 95% confidence interval; see main text and Appendix B.5 for further details on the underlying econometric specification.