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LABOR MIGRATION IN THE EUROPEAN UNION: THE CASE OF CENTRAL AND EASTERN EUROPE

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Labor Migration in the European Union: The case of Central and Eastern Europe

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Abstract:
This paper examines migration trends in the European Union since the enlargements of 2004-2007, which brought 100 million citizens of eleven Central and Eastern European countries into the EU. We examine country- and regional-level data on migration trends and show how European integration depleted the labor force in new member countries. Several of them lost 10% of their population since 2006, most of it via negative net migration. In 2019, 18% of Romanians, 14% of Lithuanians, 13% Croats, and Bulgarians lived in another EU country. The quantitative analysis shows that migration contributed positively to regional convergence, as every percentage point of net migration increased GDP per capita by roughly 0.01% and reduced unemployment by 0.1-0.2 percentage points. Further analysis will be needed to disentangle aggregate migration effects to quantify its impact on regions that lose their population via migration.

JEL: F22, F66, J61, O15, R11, R23
Keywords: migration, labor markets, convergence, European Union

1 Introduction

With borders closed and movements complicated by medical tests and concerns about incompatible health care systems, migration in 2020 has collapsed across Europe and the world. And yet, as recently as in January 2020, Ivan Krastev declared (out)migration as Eastern Europe's biggest problem.[1] Migration was blamed for the rising popularity of fringe political parties in eastern Europe, but also in France, Sweden, or Italy. Indeed, the decision to leave the EU by Great Britain was motivated by the desire to "take back control" over migration mainly.[2]

The real impact of migration is multifaceted and difficult to assess properly. There are economic effects on growth, wages, unemployment, social aspects as overwhelmed healthcare facilities, schools with rising share of children not speaking the official language, and perhaps most importantly, cultural effects when people may fear threatened by unknown languages and traditions of immigrants.

This paper focuses on the economic aspects of migration, namely its effects on economic growth and labor markets. We use a natural experiment that was the EU enlargement of 2004-2007, which expanded the EU labor market by including more than 100 million citizens of eleven Central and Eastern European countries (CEE: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia). We show that the migration effects in these countries were often overwhelming. Lithuania and Latvia lost 10% of their respective populations since 2004, while 18% of Romanians now live outside their country.

We further examine how the massive reallocation of the labor force affected the convergence of living standards across the EU. There are several channels through which migration works: a more effective allocation of labor to high-productivity regions should raise the total EU's growth rate, limit wage increases, while its impact on unemployment depends on the labor market structure, skill mismatch of local labor markets and migrants. However, a careful analysis of these effects requires more granular data than country-level migration numbers. To that end, we gather and use data from 268 NUTS2 regions – regions defined by the European Union for statistical purposes. While these regions are heterogeneous in size, population density, income and skills, they allow quantitative analysis of migration effects on a much more detailed level than country-level data.

Using models for real income convergence and unemployment rates, we show that net migration contributes to income convergence by as much as 0.1% per each percentage point in net migration. These estimates are higher than in most of the literature from the 2000s, mostly owing to a larger sample. Similarly, our estimates affirm that unemployment is strongly path-dependent. Most importantly, net migration impact on unemployment rate

[1] Ivan Krastev: Depopulation is eastern Europe's biggest problem, Financial Times, January 27, 2020.

[2] We include the UK in our study, as it had been an EU member during the period, and it had been major receiving country of net migration.

seems consistently negative, while previous studies mostly were unable to find a statistically significant effect.

The rest of the paper is organized as follows: Section 2 discusses the literature on labor migration effects on economic convergence with particular attention to the European Union. Section 3 then analyzes models of economic convergence that use migration as an explanatory variable. Section 4 presents our data asset, while section 5 illustrates the main migration trends on the country level. Section 6 then demonstrates NUTS2 regional data and shows the main characteristics of the data. We discuss the quantitative models of migration and main econometric results in Section 7 and conclude with some general observations in Section 8.

2 Economic Convergence and Labor Mobility

An extensive literature exists on the effects of migration among regions either within a country (US) or a single market (EU). Most of the literature attempts to estimate to what extent migration alleviates regional disparities. Barro and Sala-i-Martin (1992) provide a simple framework with homogeneous labor in a neoclassical growth model. Migration to high-income regions lowers capital intensity in the rich regions, and as the labor has the same characteristics and there are no barriers to factor mobility in their model, the labor moves from low-income to high-income regions and accelerates income convergence. The receiving region's capital-to-labor ratio initially decreases, reducing productivity. However, as the Harberger model shows, lower wages will lead to higher returns to capital, and it will attract more investments which restore the capital-to-labor ratio and productivity. As both labor and capital stocks have increased, the receiving regions have achieved a higher steady state.

Once the assumption of homogeneous labor is relaxed, however, the effects of migration are more ambiguous. Etzo (2008) suggests that heterogeneous labor may offset the scale effect of migration through the change in the ratio between skilled and unskilled workers. As a result of increased migration, disparities in income per capita at the regional level may increase, although migration allows workers to maximize their individual utility (Fratesi and Riggi, 2007). Docquier and Rapoport (2012) show that if migrants possess higher human capital and skills than stayers in the sending regions, their exit lowers the steady-state in the sending regions: lower human capital available requires a lower investment rate in these regions and the adverse effects of a lower investment may dominate positive effects of outmigration on wages. The emigration then may slow down wage growth and overall growth rate may decrease in the sending regions. Indeed, Docquier and Rapoport show that more than 40% of migrants from the sub-Saharan region and 45% of migrants from all low-income countries in the decade to 2000 were highly skilled, significantly diminishing potential growth rates in the countries they left.

Kaczmarczyk (2010) illustrates the same phenomena on the migration of high-skilled Poles to Great Britain after the EU enlargement in 2004 that extended the freedom of movement to Central and Eastern European countries. While migration before the enlargement was predominantly low-skilled (and highly concentrated in poorer eastern regions of Poland), the share of migrants with tertiary education increased by a third to 20% of a much higher

number of migrants. Ostbye and Westerlund (2006) identified a similar 'brain drain' effect when they estimated the growth effects of migration in Norway and Sweden. Migration from the sending country (Norway in this case) seemed to dampen convergence, while its effects in Sweden were inconclusive.

Kaczmarczyk (2010) even argues that rather than 'brain drain' emigration from CEE countries achieved a 'brain waste' whereby highly skilled workers (admittedly measured by graduating a university with no data on the actual quality of the education achieved) ended up in low skilled jobs in western Europe, primarily Great Britain.[3] This may decrease GDP growth both in the sending country (by lowering its average human capital) and in the receiving country. Freideberg (2001) studied the effects of emigration from the Soviet Union to Israel and found a similar effect whereby emigrants concentrated on low-skilled jobs that did not correspond to their education level.

Changes in productivity, however, may result from an endogenous change in the technology used by an industry employing recent migrants. Dustmann (2008) argues that an increase in the supply of unskilled workers might stimulate labor-intensive production methods (as agriculture specializing in more labor-intensive crops). He estimates that about two-thirds of labor market adjustments are affected by technological change.

As this brief discussion suggests, the ultimate effect of migration on unemployment, growth and productivity depends on a number of factors, including the human capital distribution, elasticity of labor supply in receiving and in sending countries, the elasticity of substitution between native and migrant workers, national wage determination institutions and possibly many more (Huber, 2012; Borjas, 2003). With no firm analytical conclusions, we need to turn to empirical studies to find out the likely effects of increased migration.

Empirical studies

The empirical literature on the effects of migration was originally concerned with internal migration in the US, as it represents a large labor market with significant migration flows. Longhi et al. (2006) conclude that, on average, a 1% increase of immigration to a state within the US reduces native employment by only 0.02%. In an extensive meta-analysis of the literature, Ozgen, Nijkamp and Poot (2010) concluded that an increase in the net migration rate of one percentage point increases the GDP per capita growth rate by 0.13% on average, but that the effects of migration remain 'an ongoing research issue.' They summarized their meta-study around the most common econometric specification of the migration effects on economic growth and convergence:

$$\ln(y_{i,t}) = \alpha + (1-\beta)\ln(y_{i,t-1}) + \gamma(migration_{i,t}) + \delta\ln(X_{i,t}) + \varepsilon_{i,t} \qquad (1)$$

The dependent variable $y_{i,t}$ is the annual growth rate of per capita in a region *i* in year *t*. In this specification, β is the annual rate of beta convergence at which a region converges to its own

[3] However, the data on education profile of emigrating Poles and other central and eastern Europeans may be misleading, as the determining factor in the decision to leave seemed to be (young) age rather than qualification. Younger cohorts tend to have higher share of graduates from tertiary education institutions.

long-run steady-state, and γ is the annual net migration rate coefficient. The coefficient of the net migration variable γ estimates the impact net migration makes on the convergence. Mankiw et al. (1992) used investment rate and education profile as in the Solow model, while Fidrmuc et al. (2019) added the natural population growth rate plus the sum of technological progress and depreciation in their analysis of the regional convergence in the EU.[4]

According to the Sala-i-Martin et al. (2004) paper in which they estimate growth regressions separately for the US, Japan and five European countries during 1950–1990, the lower capital intensity results in a lower growth rate in the destination regions and faster growth in the sending regions. However, according to their results, migration plays only a marginal role in the convergence process. Similarly weak or insignificant effects of migration were found by Cardenas and Ponton (1995) for Colombia, and Gezici and Hewings (2004) for Turkey in the 1990s. Inconclusive estimators may be a consequence of the non-linear impact of migration. Migration can play a role as an adjustment mechanism from which all regions benefit, but it can also favor the economy of only the recipient region. Ozgen (2009) lists two major impacts of labor migration: the scale (size) effect and the composition effect. Along with Docquier and Rapoport (2012) he argues that an intensive outward migration of skilled labor diminishes productivity in the sending regions while benefiting the receiving regions by an upward shift in productivity.

Mattoo (2008) and Huber (2012) analyzed the effects of migration in the receiving country. They argue that a pool of labor increased by migration should positively affect productivity and that the different skills that migrant labor possesses enhance technology adoption. Mas et al. (2008) show a small positive impact of labor (in)flows to the growth rate in the UK and a significantly negative impact of outflow of workers in Spain during the 1990s and early 2000s.

The EU Experience

The European experience became more relevant after the Maastricht Treaty of 1992 established freedom of movement for the EU citizens and as the poorer countries in central and eastern Europe began to integrate with the EU (Haas et al., 2019). East-West migration has become the primary concern after the 2004-2007 EU enlargement that brought ten central and eastern countries into the EU, followed by an eleventh in 2013.[5] The first papers focused on the UK experience. The UK was one of the three EU countries that liberalized their labor markets for immigrants from CEE in 2004 and witnessed a significant increase in inflows soon afterward.

[4] Most studies follow Mankiw (1992) and use 0.05 as the sum of technological progress and depreciation. Fidrmuc (2019) uses 0.06 for technical reasons, as to offset negative population growth of 5% in several regions during the 2000's.

[5] Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia joined the EU in 2004 (along with Cyprus and Malta), followed by Bulgaria and Romania in 2007, Croatia then joined in 2013. We refer to these 11 countries as the CEE group in the text.

Dustman et al. (2005) and Lemos and Portes (2008) find a small negative effect on unemployment of semi-skilled, young and old-age employed in Great Britain as immigrants typically compete with incumbents only at marginal labor market segments. Dustman was among the first who used a fixed-effects IV estimation to account for the endogeneity of migration. Blanchflower et al. (2007) estimated that more than 0.5 million migrants from the CEE region moved to Great Britain in two years after the first wave of enlargement in 2004. He claimed that the generally lower wage demands of recent migrants helped contain inflation in the UK. At the same time, they expected that more than half of these migrants would return to their home countries, which mostly did not happen.

Apsite, Krisjane and Berzins (2012) illustrate the scope of emigration on the example of Latvia, where emigration from Latvia to the UK more than doubled in 2009 when real GDP declined by a staggering 14% in Latvia. The structure of departing workers changed as well, as younger, more educated and more urban were more likely to leave after the crisis than before. More than 40% of emigrants from Latvia had tertiary education; however, only 20% could find a job in non-manual or low administrative positions. This conclusion is supported by Simionescu (2016) and by Mihi-Ramirez (2013), who show that migration flows are highly sensitive to the domestic growth rates both in the CEE regions and in Spain.

Barrel et al. (2010) demonstrated that net migration depends on GDP per capita (inversely) and unemployment rates. They used data from the early years of the enlargement and limit their contribution to a qualitative analysis. Anacka and Okolski (2010) showed that age is an important determinant of migration, as younger people tend to be more mobile than older ones. Marques (2010) approached migration much more vigorously, estimating a gravity model with fifteen exogenous variables. She showed that the EU membership leads to an increase in migration from new member states to 'old' Europe.

While there is substantial country evidence of the effects of migration on unemployment and wages, literature with a broader European perspective remains limited. Brücker (2009) argues that migration from the new member states yields substantial gains for the GDP of an enlarged EU in the long run and that migrants themselves are the main winners of free movement. He states further that the effects on the natives in sending and receiving countries are ambiguous and, in general, relatively small. The most comprehensive is a study in convergence in the EU by Huber and Tondl (2012), where three models are estimated: income growth, unemployment, and productivity. While no significant effect of migration was found for unemployment rate convergence, Huber identified a significant and positive impact of migration on GDP per capita and on productivity growth both in receiving and in the sending regions. They estimate that a 1% increase in immigration increases GDP per capita by 0.02% and labor productivity by about 0.03% in the immigration regions, while estimates for the emigration regions were similar. Authors argue that migration can be viewed as a transfer of human capital to immigration regions that happen to have above the average GDP per capita. In this sense, migration seems to contribute to regional divergence.

In a later paper, Huber (2018) analyzed migration flows during and after the 2008-2009 recession and showed that the labor markets helped mitigate the impact of the recession, but the heterogeneity across countries and demographic groups has increased. According to

Huber, there seems to be a significant decline in migration impact to regional labor market adjustment after the crisis (2011 to 2014)[6]. The pre-crisis period, therefore, seems to have been an exceptional period in terms of labor market adjustment in the EU when new member states' labor markets were integrated in the EU-wide migration flows.

King and Okolski (2018) look at recent migration flows in Europe in a long-term context and argue that the current intra-EU migration among member states amounts to only 0.3% of the entire population. It is a fraction of the US inter-state migration of 2.4%. They show, however, that (e)migration from the six most active countries - Bulgaria, Croatia, Latvia, Lithuania, Poland and Romania - have been consistently high, reaching a cumulative 9% for Romania. As our discussion in the following chapters shows, the proportion of emigrants increased further until 2019, reaching double digits in five CEE countries: Bulgaria, Croatia, Latvia, Lithuania and Romania.

Kahanec and Zimmermann (2009) focus on the effects of the 2004 and 2007 enlargements of the EU and shows that while increased migration flows had a significant impact on migration flows from new to old member states, any adverse effects on the labor market on wages or employment in the receiving countries were insignificant. Economic migration should result in a more efficient allocation of production factors, thus improving economic growth prospects. Migration also contributes to the knowledge and technology transfer which may lead to a one-way 'brain drain' from less developed to richer countries. In a more benign scenario, migration may be two-sided 'brain circulation' between the host country and the country of emigration. The authors were among the first, however, who highlighted rising labor market pressures in sending regions quoting labor shortages in Lithuania and Poland.

Literature seems to converge on a view that while the migration is favorable for both the sending and receiving region when brain drain is limited, and migration is not one-way but mutual. Whether or not the total outcome is positive remains an empirical issue that needs to be estimated carefully.

3 Growth Models with Migration

Labor flows within the European Union have become one of the main instruments of improving the individual well-being of migrants from new member states. To analyze the impact of migration on the convergence in real GDP, unemployment rates, and productivity, we follow a standard setup suggested by many studies, including Borjas (1999), Ozgen (2010), Huber (2012) or Wolszczak-Derlacz (2009). We test whether migration significantly impacted changes in these three variables on the level of NUT2 regions in the European Union. Our data cover the 2006-2018 period for which net migration rates are available.

[6] Our analysis seems to confirm this view – see Chapter XY.

$$\ln\left[\frac{GDPPC_{i,t}}{GDPPC_{i,t-1}}\right] = \alpha + \beta \ln(GDPPC_{i,t-1}) + \gamma(migration_{i,t}) + \delta \ln(X_{i,t}) + \varepsilon_{i,t}$$
$$\ln\left[\frac{U_{i,t}}{U_{i,t-1}}\right] = \alpha + \beta \ln(U_{i,t-1}) + \gamma(migration_{i,t}) + \delta \ln(X_{i,t}) + \varepsilon_{i,t} \quad (2)$$
$$\ln\left[\frac{PROD_{i,t}}{PROD_{i,t-1}}\right] = \alpha + \beta \ln(PROD_{i,t-1}) + \gamma(migration_{i,t}) + \delta \ln(X_{i,t}) + \varepsilon_{i,t}$$

The dependent variables are $GDPPC_{i,t}$ - the growth rate of per capita GDP in purchasing power parity, $U_{i,t}$ - the unemployment rate, and $PROD_{i,t}$ productivity approximated by GDP per active workers. The $migration_{i,t}$ variable measures net migration to/from the region. We employ a set of control variables $X_{i,t}$ that typically include demographic and educational variables, labor market characteristics, and the investment rate in the case of income (*GDPPC*) and productivity (*PROD*) equations. All variables are annual and structured by NUTS2 regions as balanced panel data - more on the data in the next section.

The equations can be transformed to a linearized form (3) that allows an estimate of the convergence speed:

$$\ln(GDPPC_{i,t}) = \alpha + (1-\beta)\ln(GDPPC_{i,t-1}) + \gamma(migration_{i,t}) + \delta \ln(X_{i,t}) + \varepsilon_{i,t}$$
$$\ln(U_{i,t}) = \alpha + (1-\beta)\ln(U_{i,t-1}) + \gamma(migration_{i,t}) + \delta \ln(X_{i,t}) + \varepsilon_{i,t} \quad (3)$$
$$\ln(PROD_{i,t}) = \alpha + (1-\beta)\ln(PROD_{i,t-1}) + \gamma(migration_{i,t}) + \delta \ln(X_{i,t}) + \varepsilon_{i,t}$$

The specifications (3) may suffer from an endogeneity problem as migrants are attracted to regions with higher income (GDP) and/or with lower unemployment (Borjas, 2001). In the first approximation, this problem is dealt with the panel data analysis with fixed and random effects (Ozgen, 2009). This may lead to reverse causality and unrealistic high estimators for migration coefficients in a panel data regression with fixed effects across the regions, so-called Nickell bias (Nickell, 1981). The endogeneity problem is typically mitigated by implementing instrumental variables in the form of lagged migration rates, using dynamic panel estimates with fixed/random effects. The Hausmann test excluded the random effects method as potentially inconsistent and biased, so we report only the fixed effects results (Hausman, 1978).[7]

Additionally, we were unable to distinguish between international and internal migration, as was done by Huber (2012). In his paper, Huber showed that international migration tends to give more consistent and higher estimators, while domestic migration within a country has typically little effect on dependent variables. Eurostat, however, does not provide the migration data separated into international and internal migration, which may lead to lower estimators in our specification.

[7] To check for remaining endogeneity Blundell and Bond (1998) recommend the generalized moments method (GMM) with lagged levels and differences as instruments. In our setting, the GMM method proved to be unstable, due to extremely high number of instrumental variables.

4 Data

Our data set includes data for 2005-2018 in all 28 countries that were members in 2019 (i.e., including the UK and all countries that joined in 2004-2013). We use annual data structured by the European Union's NUTS2 level regions that provides a much more granulated and richer view of the convergence process in the EU than a national level analysis. The NUTS2 standard was formally adopted in 2003 and was revised in 2006, 2010, 2013 and 2016, representing a challenge for creating consistent data series. There were 281 NUTS2 regions in the EU, including the UK, between 2006 and 2018, the final year of our sample, with several adjustments, most prominently in France.

Most of the regional data is available at the Eurostat (Regional Statistics by NUTS Classification), with additional data from the Annual Regional Database of the European Commission's Directorate-General for Regional and Urban Policy (ARDECO). Eurostat data include GDP data in nominal, real, per capita and purchasing power parity terms, gross fixed capital formation, employment, and compensation are available from Eurostat. Additional labor market variables available at Ardeco are used as well. Demographic data, including crude rates of total population change, natural change, and net migration, are published by Eurostat. Labor market data is available in the regional detail at Eurostat, and we use its data on total employment, unemployment rate, the share of long-term unemployed, and hourly wage. To approximate skill level at the regional level, we use data on the share of workers with tertiary and secondary education, available at Eurostat.

The data availability has improved significantly from papers published in 2009-2012, but several gaps persist. First, we excluded five French extraterritorial departments and two Spanish regions located in North Africa, as all these are too small and too distinctive from the remaining regions. Data was also insufficient to include the smallest Finnish region Swedish-speaking Aland Island (roughly 30,000 inhabitants). Two NUTS2 regions in former Eastern Germany - Leipzig and Chemnitz did not provide migration rates until 2011, so we had to exclude them from the sample as well. In the UK, London was split into five NUTS2 regions that did not provide migration and unemployment data until 2012. Still, we were able to use data from the two original NUTS2 regions instead. In Slovenia and Croatia, the unemployment rate was not reported by the countries' two NUTS2 regions, so we used the national level for Croatia until 2008 and for Slovenia until 2010. Denmark defined its NUTS2 regions only in 2007 and did not report data on the share of tertiary and secondary education by NUTS2 regions. Instead, we used national data for the country's educational stratification, and we approximated migration data for 2006.

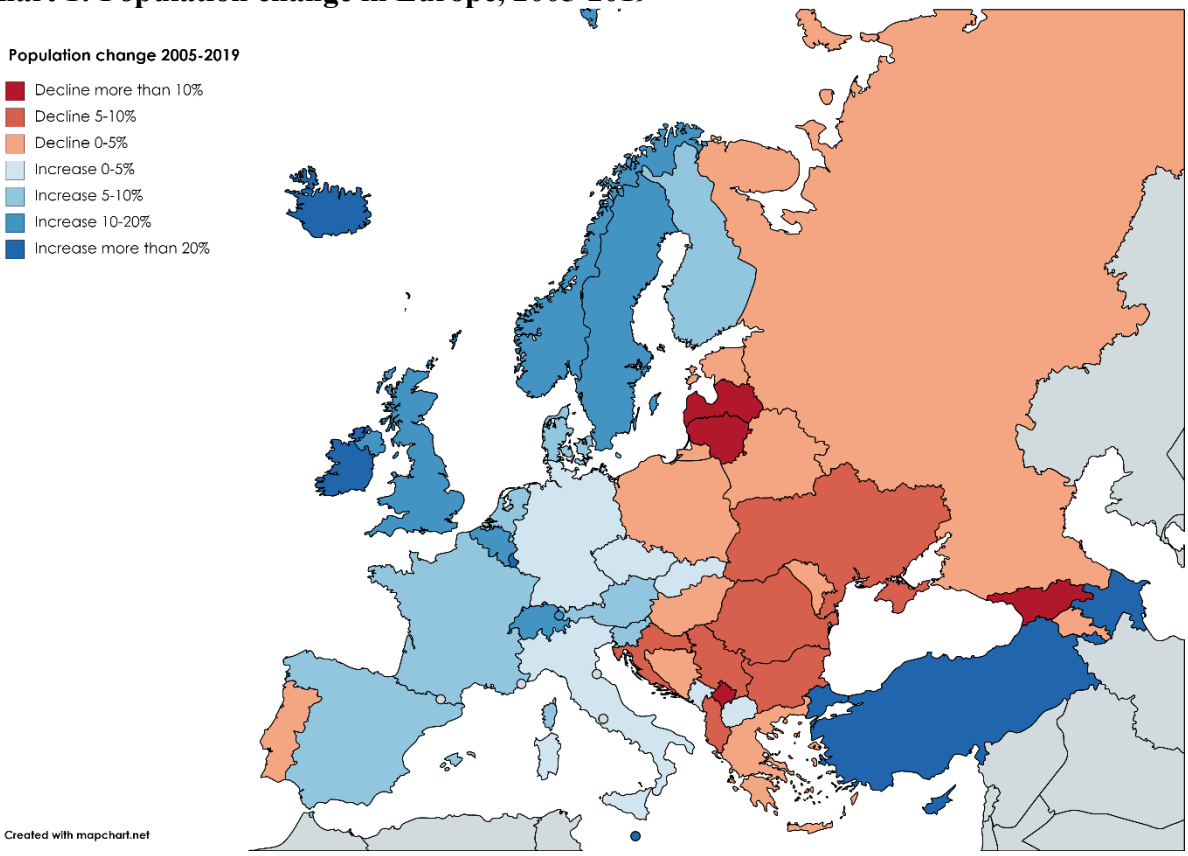
Compared to the most extensive analysis of regional convergence, Huber (2012), our data set is more than two times larger, as we use 3,752 observations for the 2005-2018 period. The migration data are available for 2006-2018 period only, limiting our sample to 3,484 observations. Due to insufficient data, Hubner excluded all regions from Bulgaria and the UK, i.e., the two most active migrant countries, each on the pole of migration. In many regressions, he was limited to 1,700 observations due to gaps in data in Germany, France, Greece, Ireland, and Portugal (Hubner, 2012, p.11). Inclusion of the poorest EU country

(Bulgaria) and the country that received the most migrants among all EU countries (UK) should have a significant effect on our results.

5 Some Stylized Facts: Country Level

The EU population increased to 513.5 million in 2019 from 501 million at the outset of the great recession in 2009 and 490 million at the eve of enlargement in 2004. However, while the population was increasing in 18 countries since 2004, it declined in 10 countries during the same time. Only two out of the latter ten were "old" member states: traditionally labor exporting Portugal and crisis ravaged Greece.[8] Eight countries with declining populations are from the CEE region: Bulgaria, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, and Romania. Only three out of eleven CEE countries - Czechia, Slovakia, and Slovenia - increased their respective populations, and only by a modest 2-3%. In relative terms, Latvia and Lithuania (and also non-EU Ukraine) were most affected, losing almost a fifth of their respective populations since 2004, with Bulgaria and Romania losing 10% - see Chart 1.

Chart 1: Population change in Europe, 2005-2019



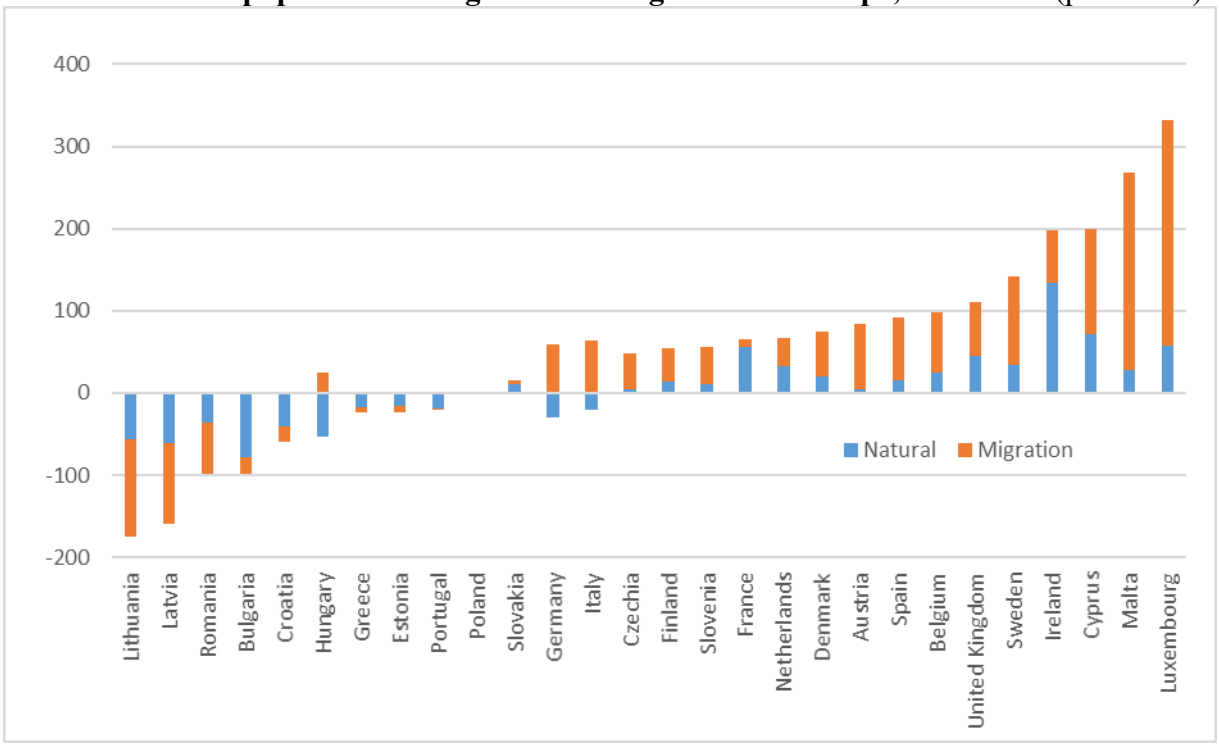
Source: Eurostat database, Annual Regional Database, author's calculations.

[8] For the purpose of our discussion, we include Cyprus and Malta that joined the EU in 2004 among "old" members. Their combined population of 1.2 million represents 0.2% of the EU population and thus does not impact our conclusions.

Migration flows within the European Union have become of the defining characteristics of post-crisis 2010s.[9] In the CEE countries, migration has been blamed for labor shortages and the rise of extremism. At the same time, it is blamed for intensifying anti-EU feelings in the UK that contributed to Brexit (Blinder, Richards, 2020). De-population in the CEE region (and generally in Eastern Europe) is, of course, driven both by natural population change as well as by net migration. Still, the migration effect was particularly strong in the Baltic region and the Balkans (Chart 2). Positive net migration in Czechia, Hungary, Slovakia and Slovenia mainly came from other CEE countries and/or from Ukraine that lost more than 5.5 million inhabitants since 2004, with most moving to Poland, Slovakia, Hungary and Czechia. The natural change was mildly positive only in Czechia, Poland, Slovakia, and Slovenia during 2004-2019.

The population increased in all "old" EU member countries and Cyprus and Malta with natural change positive in 13 out of 17 countries and net migration positive even in 15 out of 17. Excepting three small countries with a net migration cumulative rate above 10% (Cyprus, Luxembourg and Malta), Sweden and Austria received most migrants.

Chart 2: Natural population change and net migration in Europe, 2005-2019 (per milles)



Source: Eurostat database, Annual Regional Database, author's calculations.

The three enlargement waves increased the EU's population by 25%, i.e., 100 million people. In terms of the labor force, the EU increased by a fifth, to roughly 250 million. However, only three out of 15 original EU member countries - the UK, Ireland and Sweden - opened their labor markets from the outset of enlargement, with other countries imposing restrictions on

[9] Migration from non-EU countries as Ukraine and Moldova is even larger in relative terms, see Chart 1 in the text, but regional data for these countries are much less accurate so we focus on the EU member countries only.

their labor markets for a maximum of seven years. The European Commission had initially reported that the enlargement should have a relatively limited impact on labor markets within the EU (European Commission, 2008). Inflows of workers from the EU-8 countries, as it was then, increased from around 1 million in 2004 (0.2% of the total EU-28 population) to 2.3 million in 2010 (0.5% of the EU-28 population). In 2011, the Commission was relaxed about future migration. It expected that the total stock of nationals from EU-8 countries living in EU-15 countries would increase to 3.3 million in 2015 and 3.9 million in 2020 (EU Press Release, 2011).

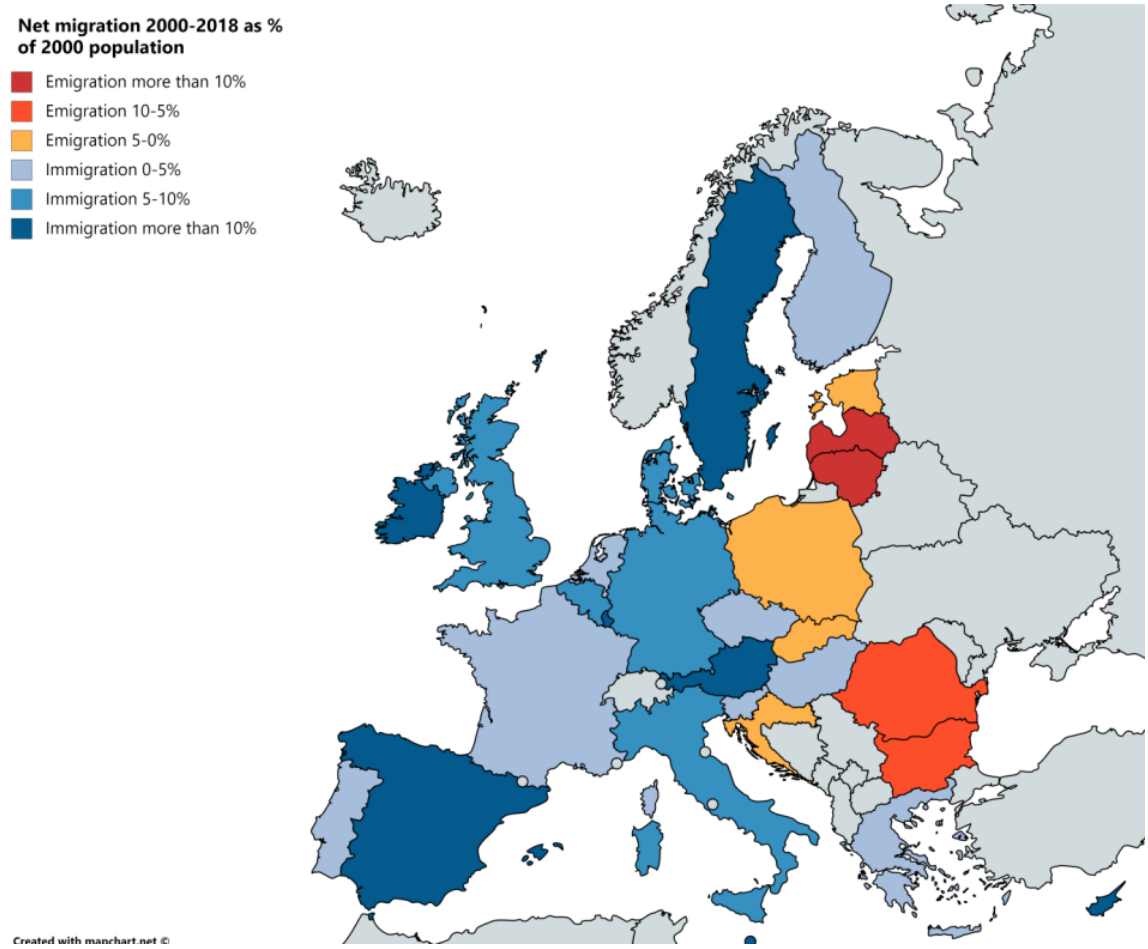
Table 1: Summary statistics: Countries

	Population (January 2019)	Number of citizens living in another EU country (2018)	As % of total population	Citizens of other EU countries living in the country	As % of country's population
Bulgaria	7,000,039	872,326	12.5%	13,696	0.2%
Czechia	10,649,800	163,990	1.5%	232,511	2.2%
Estonia	1,324,820	87,222	6.6%	20,891	1.6%
Croatia	4,076,246	523,886	12.9%	17,995	0.4%
Latvia	1,919,968	193,457	10.1%	6,433	0.3%
Lithuania	2,794,184	390,193	14.0%	7,483	0.3%
Hungary	9,772,756	446,587	4.6%	74,266	0.8%
Poland	37,972,812	2,475,906	6.5%	31,644	0.1%
Romania	19,414,458	3,533,186	18.2%	60,265	0.3%
Slovenia	2,080,908	68,008	3.3%	20,700	1.0%
Slovakia	5,450,421	342,682	6.3%	58,308	1.1%
Memo					
CEE	102,456,412	9,097,443	8.9%	544,192	0.5%
EU-28	513,471,676	17,608,436	3.4%	17,859,499	3.5%
Germany	83,019,213	889,484	1.1%	4,383,694	5.3%
France	67,012,883	776,308	1.2%	1,604,398	2.4%
Netherlands	17,282,163	563,396	3.3%	567,724	3.3%
Austria	8.,858,775	223,678	2.5%	730,209	8.2%
Portugal	10,276,617	1,195,934	11.6%	158,915	1.5%
UK	66,647,112	856,862	1.3%	3,681,859	5.5%

Source: Eurostat.

Further enlargements in 2007 and 2013 have changed the migration landscape significantly. In 2018, there were more than 9 million citizens of the EU-11 living in the old EU-15, plus Cyprus and Malta. More than half of all EU citizens living in another EU country were from CEE: Romania had the largest diaspora: more than 3.5 million Romanians - 18% of the total population - lived abroad in 2019 (Table 1). In relative terms, Latvia and Lithuania lost more than 10% of their respective populations via net migration since 2000, with Bulgaria and Romania losing 5-10% (Chart 3). Most of these migrants head to large labor markets in western Europe, namely Germany and the UK. Few of the CEE migrants live in other CEE countries: for example, only 28 thousand Bulgarians out of 870 thousand emigres (3%) lived in another CEE country.

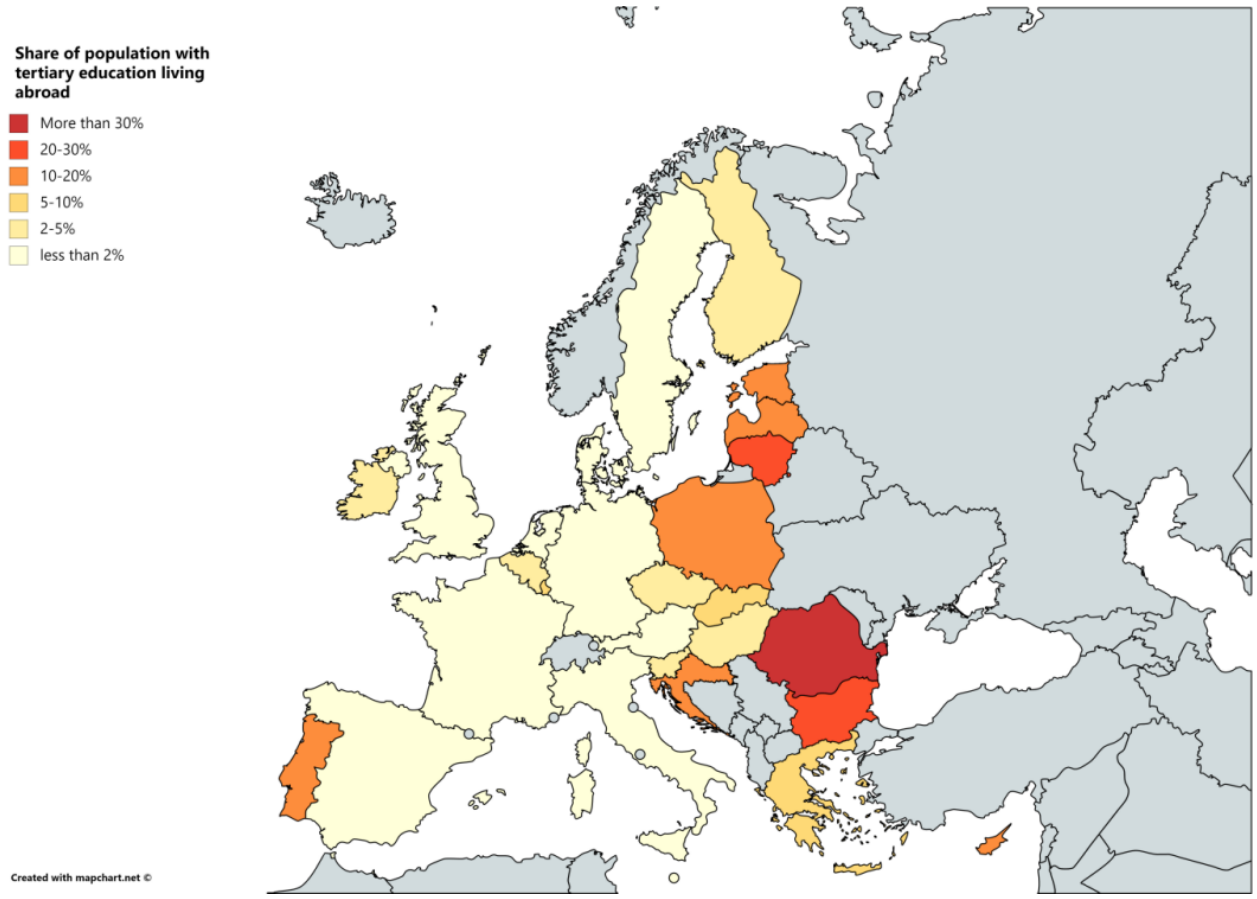
Chart 3: Net Migration in the EU, 2000-2019



Source: Eurostat database, Annual Regional Database, author's calculations.

In order to examine Kaczmarczyk and Okolski's argument that migration in the EU amounted to 'brain waste,' we also calculated the share of the population of each country with tertiary education that lives in another EU country. This number should serve as a proxy for the brain drain. Indeed, more than 30% of Romanians with a college degree left the country, and 20% of college-educated citizens of many other CEE countries lived abroad in 2017. To put these numbers in context, the share is typically less than 2% in most western European countries, except for Portugal (Chart 4).

Chart 4: Share of Tertiary Education Diploma Holders Living Abroad (2018)



Source: Eurostat database, Annual Regional Database, author's calculations.

6 Stylized Facts: NUTS2 Regional Level

Eurostat's regional data combined with the Commission's Regional database allows a more granulated analysis of migration flows on the NUTS2 regional level. We use detailed data on 268 regions over a 14-year data span (2005-2018), almost 3,500 observations. Table 2 summarizes the main statistical information on our dataset.

The largest NUTS2 region (Ille de France with 12 million inhabitants) is 100 times more populous than the smallest one (Valle d'Aosta in Italy with 60,000 inhabitants). The youngest regions, as measured by the median age, are in London and Ireland. Most countries' capitals or regions around them have younger populations than the rest of their respective countries typically. The oldest regions are concentrated in former East Germany and Italy.

The richest region - Inner London West - has GDP per capita in purchasing power more than 20 times higher than the poorest region - North-West of Bulgaria. Inner London West, which includes the City of London, is in many respects an outlier. Its GDP per head is between 550-600% of the EU average in the respective year, and the hour-wage is similarly inflated. Productivity, measured by GDP per active worker, averaged more than €300,000 in Inner London West during 2005-2018, more than twice as much as in the next region (Luxembourg). Bulgarian regions, except for South West that includes the capital Sofia,

averaged 50-times lower productivity than Inner London-West, suggesting that we need to use London's numbers with caution.[10]

Table 2: Summary statistics: NUTS2 Regions

3,752 observations (3,484 observations for migration data)	Minimum	Maximum	Average	Coef. of variation
GDP per capita (in PPS)	5,900	190,500*	26,446	48.2
GDP per capita (in % of EU)	23.9	628.0*	97.2	47.5
GDP per capita Annual Growth	-16.4	47.8	2.2	197.3
Productivity (GDP per active)	12,488	303,844*	51,435	42.2
Investment (% of GDP)	7.4	66.4	21.2	24.1
Unemployment rate (%)	1.3	37.0	8.6	62.4
LT Unemployment rate (%)	0.3	22.9	3.8	92.3
Employment Rate (%)	42.1	83.2	69.6	10.9
Wage (euro/hour)	1.1	44.1*	16.9	50.6
Population (thousand)	67.6	12,210.5	1,868.4	81.7
Active Population (%)	23.0	68.1	49.4	9.8
Median Age	31.4	50.7	41.7	7.5
Tertiary Education (%)	6.8	74.7*	27.3	35.7
Secondary Education	10.5	79.6	47.2	30.7
Rate of population change (‰)	-11.8	34.8	0.3	1116.1
Net migration (‰)	-25.2	55.2	2.7	193.5

Source: Eurostat database, Annual Regional Database.
Note: Minimum and Maximum are calculated from yearly regional observations.
* numbers for Inner London West.

Labor markets vary across the EU regions significantly: several Spanish regions reported unemployment above 20% for all years in our sample, while the average unemployment in Prague in the same timespan was below 3%. An apparent rift emerges between North (Scandinavia, British Isles) and South (Italy, Spain, Greece) concerning the employment activity: while 79% of eligible people are in the labor force in Sweden (77% in the Netherlands, 75% in the UK), only 61-62% work in Greece, Italy or Spain. Central and Eastern European countries are mostly somewhere between these poles. Only Czechia and Estonia record "northern" employment rates above 70%, while Hungary is firmly in the "south" camp with a 62% employment rate.

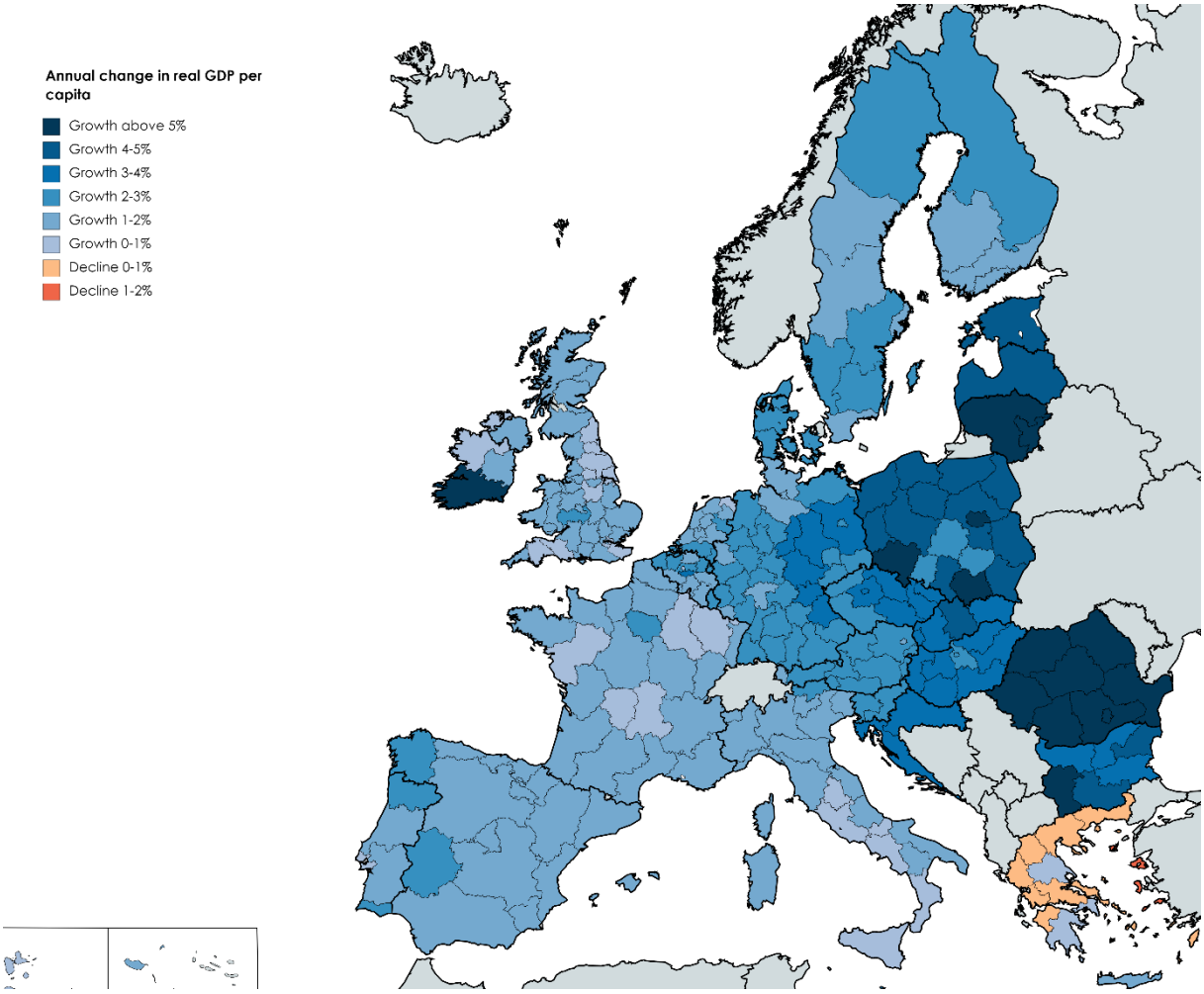
About one-quarter of all inhabitants in 268 regions had tertiary education, with London regions boasting a share above 50%, while the percentage was as low as 11% in Romania and southern Italy regions. The lowest tertiary education share - 6.8% - was recorded in the Czech South-West region in 2008 (it recovered to 14% by 2018).

The growth rate measured by a change in real GDP per capita over 2006-2018 averaged 2.2% across all the regions. The variance was immense, though: while GDP per head in purchasing power parity was lower in 2018 than in 2006 in ten Greek regions, the eight Romanian grew

[10] To control for the Inner London exceptionalism, we run all the regression with and without Inner London data, but the difference was always minimal.

at an annual rate of 7.4%. Chart 5 suggests that growth was concentrated in eastern (except for Greece) and northern regions, and it was notably weaker in western and southern regions.

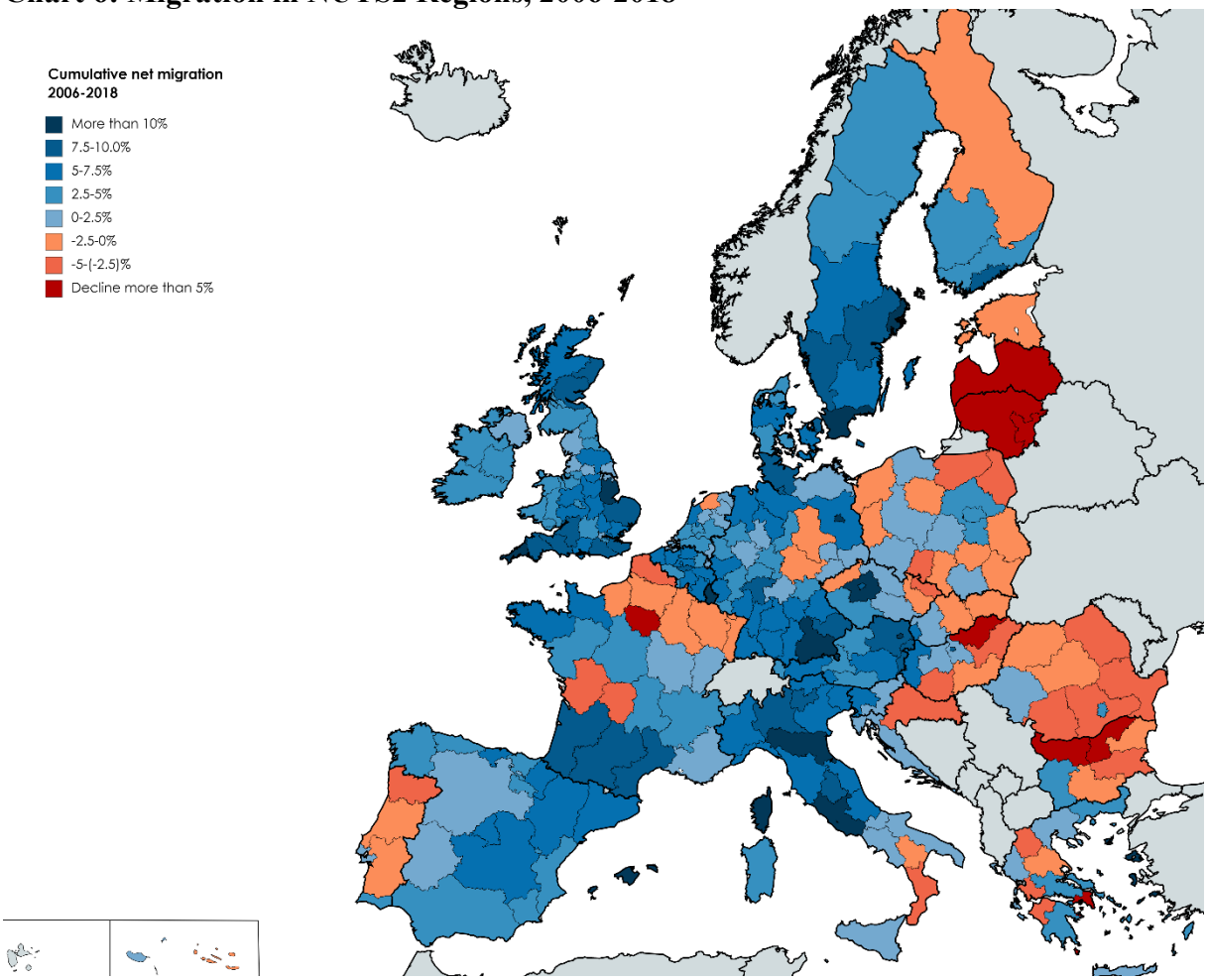
Chart 5: Real GDP per capita growth across the EU regions, 2006-2018



Source: Eurostat database, Annual Regional Database, author's calculations.

It is worth noticing that the total rate of population change is the most heterogeneous variable in the sample with the highest coefficient of variation. There were 18 instances when more than 10‰ citizens of a given region left in a given year, seven of them in Latvia or Lithuania between 2008 and 2011, two in Cyprus during the crisis 2013-14, two in Greece during its crisis 2012-13. During 2006-018, Latvia and Lithuania both lost more than 10% of their respective populations through net migration (Chart 6). Bulgaria lost 2.8% of its population via migration, but its most affected region - North-West - lost 8.5%. The worst affected region in "old" EU member countries - Greece's Attiki – lost 6% of its population due to emigration in the 2006-2018 period. Lithuania suffered from the largest emigration rate in a single year: 25‰ citizens of the Baltic republic left in 2010.

Chart 6: Migration in NUTS2 Regions, 2006-2018

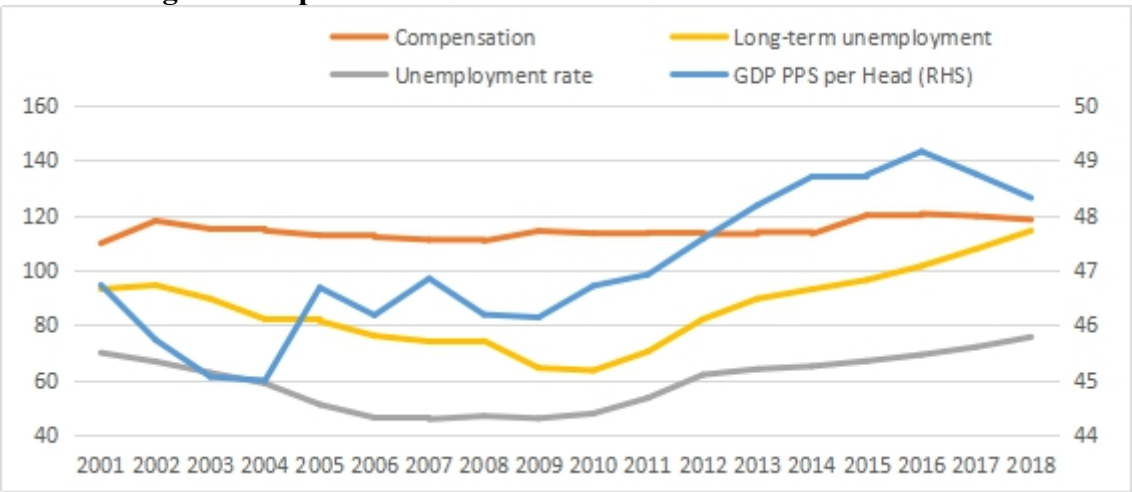


Source: Eurostat database, Annual Regional Database, author's calculations.

Following Huber (2012) we further analyzed regional disparities by calculating coefficients of variation for main economic indicators: regional per capita income, compensation and the unemployment rates (standard and long-term).[11] Disparities are by far the largest in wages (calculated as compensation per hour), followed by long-term unemployment and unemployment rate. GDP per head (in purchasing power) is the most consistent indicator across the 268 regions. Our analysis suggests that compensation disparities remain broadly constant over 2001-2018, with a small increase in 2015 negating earlier gradual decreases. Variance in GDP per capita was steadily increasing after the 2009 financial crisis until 2016 but declined thereafter. Labor market variance indicators were being reduced in 2001-2010; they re-emerged after the great financial crisis and kept widening even after it (Chart 7). Both unemployment indicators were higher in 2015 than in 2001, showing a high hysteresis effect in unemployment rates, especially in southern member states.

[11] We should stress that the variance coefficient measures only the sample's variance, it does not determine whether individual regions were converging or diverging.

Chart 7: Regional Disparities: Coefficient of Variation 2001-2015



Source: Eurostat database, Annual Regional Database, author's calculations.

7 Results

The results section presents estimates of convergence in GDP per capita and unemployment rates across 268 regions without and with migration as an exogenous variable to detect the latter impact. We also show results of basic migration equations, where migration is the endogenous variable. We report the estimators and the probabilities for each estimator in the brackets using the standard 10%, 5%, and 1% significance levels.

GDP Convergence Regression

Table 3 presents the results of four different models estimating real GDP per capita (y_t) convergence in the EU NUTS2 regions. The first specification estimates a simple convergence equation with the lagged variable of real GDP per capita (y_{t-1}) and the investment rate (inv_t). The estimated beta convergence coefficient at 0.8 is lower than in Huber (2012), suggesting a faster convergence owing most likely to a broader and more heterogeneous data sample we use. Investments (inv_t) exhibit an expected positive and highly significant impact on GDP per capita. Estimates are consistent and broadly equal across the two methods with high significance. The Arellano-Bond tests for first and second-order serial correlation in errors reject the autocorrelation hypothesis.

We examined the impact of migration on real GDP convergence in three regression models. We expanded the convergence model by adding exogenous variables net migration ($netmig_t$) and the augmented natural population growth ($popgrowth_t$).[12] We also use the share of the population with the tertiary education ($education_t$) as a measure of the education level in a given region.[13]

[12] Following Fidrmuc (2019), we add 6 percentage points to the raw natural rate of population growth to offset negative population growth in several regions during the 2000's.

[13] We tested other specification, with added long-term unemployment rate or wage, similar to Huber (2012). Our estimates, however, exhibited instability caused by strong correlation between unemployment and long term

Table 3: Regressions for real GDP per capita, dependent variable $ln(y_t)$

	Without migration	With net migration	Only immigrant regions	Only emigration regions
$\ln(y_{t-1})$	0.891***	0.821***	0.777***	0.811***
	(0.007)	(0.008)	(0.012)	(0.017)
$\ln(inv_t)$	0.009***	0.036***	0.052***	0.019*
	(0.005)	(0.005)	(0.006)	(0.010)
$netmig_t$		0.011***	0.011***	0.019***
		(0.002)	(0.002)	(0.008)
$\ln(popgrowth)_t$		-0.487***	-0.455***	-0.567 ***
		(0.046)	(0.054)	(0.105)
$\ln(education)_t$		0.049***	0.060***	0.066***
		(0.007)	(0.008)	(0.018)
Adj. R^2	0.991	0.991	0.989	0.991
Obs.	3484	3484	2458	1026
Schwarz criterion	-3.04	-3.12	-3.09	-2.57
Durbin Watson	1.853	1.877	1.893	2.007

Source: Author

** p<0.1, ** p<0.05, *** p<0.01*

The first of these expanded regressions uses data from all 268 NUTS2 regions, while the remaining two split the data into two samples: for regions gaining or losing net migrants. The 'immigration' set consists of 1846 observations, while the 'emigration' data set is smaller at 834 observations. Using the fixed effects specification, the lagged (y_{t-1}) variable effect is significant at 1 percent level and in the 0.6-0.7 range in all three models. Similarly, investment and education effects provide consistent estimators with high significance in all models. Education level appears to increase real GDP per capita by 0.1-0.2% with each percentage point of tertiary-educated inhabitants of a region. Natural population growth, not surprisingly, reduces real GDP per capita in all models, but its effect appears much stronger in the 'emigration' regions.

Most importantly, net migration impact on real GDP per capita is significant and positive in all three models. One percentage point increase in net emigration should increase GDP per capita by 0.04-0.05 percent, by even 0.14 percent in the emigration regions. These estimates are higher than in Huber (2012), primarily due to a longer time period and larger sample. We include years after the recession 2009 that increased volatility in GDP growth and intensified migration flows. Also, our sample comprises more extreme regions, as Bulgarian and Romanian regions that lost 10% of their population between 2006 and 2015, or London that was gaining substantial immigration flows throughout the decade.

Unemployment Rate Convergence Regression

unemployment rates and between education and wages, respectively. For these reasons, we report only short specifications that should be more robust.

The effects of migration on the unemployment rate are presented in Table 4. We again show four models, a straightforward convergence model based on wage differentials, and three models incorporating net migration flows. First, we estimated a simple convergence model whereby the unemployment rate (un_t) was estimated on the lagged variable (un_{t-1}) and the wage rate per hour ($wage_t$). Our results confirm convergence in unemployment rates among the EU regions with the lagged coefficient at 0.78. Wages do contribute to higher unemployment, as expected.

The three migration regressions - one on the full sample and one for each 'immigrant' and 'emigrant' regions - extend the simple model by adding the net migration variable ($netmig_t$) and the augmented natural population growth ($popgrowth_t$).[14] The models provide consistent estimates of the unemployment hysteresis, with the lagged coefficient at 0.6-0.7. The wage coefficient is similarly consistent and significant across the models at approximately 0.1. The wage effect is significantly stronger in 'emigration' regions suggesting a stronger pull effect of higher wages in richer regions. The population growth effect is insignificant in all models, which is in line with previous research (Huber, 2012). Most importantly, net migration impact on the unemployment rate is consistently negative across all models, reducing unemployment by approximately 0.1 percentage point per each pp of net migration.

Table 4: Regressions for unemployment rates, dependent variable *ln(un_t)*

	Without migration	With net migration	Only immigrant regions	Only emigration regions
ln(un_{t-1})	0.780***	0.697***	0.696***	0.625***
	(0.012)	(0.015)	(0.018)	(0.028)
ln($wage_t$)	0.096***	0.128***	0.094*	0.276***
	(0.037)	(0.039)	(0.053)	(0.061)
netmigrat		-0.112**	-0.102***	-0.191***
		(0.009)	(0.051)	(0.036)
ln(pop. growth)		-0.007	-0.001	0.005
		(0.006)	(0.008)	(0.009)
Adj. R^2	0.891	0.897	0.873	0.896
Obs.	3484	3484	2458	1026
Schwarz criterion	0.01	-0.05	0.13	0.24
Durbin Watson	1.609	1.580	1.714	1.558

Source: Author.

** p<0.1, ** p<0.05, *** p<0.01*

Migration Regression

Reversing the causality, we finally estimate migration flows on economic factors. We simplify Marques's (2010) model in order to avoid multicollinearity and endogeneity issues and estimate migration flows on only four exogenous variables: unemployment rate (un_t), wage level lagged one year ($wage_{t-1}$) and the lagged migration variable.

[14] Strong correlation between education and wages excluded the education variable in this model.

We begin again with a simple migration model, with unemployment and wages as only exogenous variables. Our estimates in Table 5 confirm Marques finding that the unemployment rate impacts migration negatively. The wage effect is much weaker and significantly significant only at the 10% level. The full migration model exhibits strong path-dependency with the coefficient of $migration_{t-1}$ higher than 0.5 and highly significant. Higher unemployment rates are uniformly negative for migration, even in the CEE region (672 observations) and the wage effect is statistically insignificant when the sample is split into two subsets.

Our results confirm that it is statistically difficult to find robust and consistent estimators of the role economic factors play in migration flows within the European Union. While our qualitative analysis clearly shows that it flows from east to west and north, the regression results with respect to wages are ambiguous.

Table 5: Migration equations (dependent variable=net migration)

	Simple	With net migration	Only non-CEE regions	Only CEE regions
ln(un)	-0.545 ***	-0.183 ***	-0.218***	-0.070***
	(0.022)	(0.022)	(0.027)	(0.027)
$\ln(wage_{t-1})$	-0.111*	-0.057	-0.057	-0.024
	(0.057)	(0.055)	(0.086)	(0.047)
$Migration_{t-1}$		0.550***	0.544***	0.496***
		(0.016)	(0.018)	(0.036)
Adj. R^2	0.500	0.680	0.590	0.770
Obs.	3484	3216	2544	672
Schwarz criterion	1.41	1.09	1.22	0.01
Durbin Watson	0.927	2.010	2.022	1.752

Source: Author.

** p<0.1, ** p<0.05, *** p<0.01*

8 Conclusions

This paper investigated the current migration trends within the European Union, with special attention to the uneven changes in the population of eleven new member states that have become members of the EU since 2004. We have illustrated momentous changes in some of these countries, namely the poorer states in the south and eastern Europe. The scope of de-population in Bulgaria, Romania or the Baltic countries has no parallel in peacetime and may undermine these countries' long-term growth and indeed viability. Loss of population nearing 10% in the decade to 2015 reflects a low natural rate of population change, but our analysis suggests that outmigration from eastern Europe contributed to the phenomena.

We analyzed the main driving forces behind migration and to what extent migration contributes to convergence in incomes and unemployment rates. Our data sample contains data on 286 NUTS EU regions for the years 2005-2015. We were able to significantly extend the data sets used in previous research by adding volatile data from the 2008-09 crisis and the

post-crisis years 2010-2015. We were also able to include data on regions in Bulgaria, Croatia, Romania, and the United Kingdom. Our econometric analysis suggests that migration positively impacts convergence in GDP per capita.

We specified three models using the sample of almost 3,000 observations and two subsets, and using the fixed-effects method, we estimated coefficients of net migration. They suggest that each percentage point in migration increases GDP per capita by 0.04-0.1%. These estimates are higher than in most of the literature from the 2000s, mostly owing to a longer time period and larger sample.

We also estimated the effects of migration on unemployment rates in the EU regions. Our estimates affirm that unemployment is strongly path-dependent and that wages higher by one percentage point typically increase the unemployment rate by roughly 0.2. Most importantly, our regressions suggest that the net migration impact on the unemployment rate is consistently negative, while previous studies were mostly unable to find a statistically significant effect. Our more robust estimates are due to an extended sample, with more regions and more observations.

While we were able to determine the effects of net migrations on main economic variables - GDP per capita and unemployment rate - we were less successful in estimating the inverse relation. Estimated effects of the unemployment rate and wages on migration are either insignificant or counterintuitive. As previous researchers noted, migration decision is a complex one, rooted in one's characteristics that are only marginally captured by macroeconomic variables.

Appendix

Table A1: National statistics

	Minimum	Maximum	Average	Coef. of variation
GDP per capita (in PPS)	6,138	171,006*	25,625	46.2
GDP per capita (in % of EU)	24.8	599.7*	97.3	45.8
GDP per capita Annual Growth	-16.4	35.9	2.1	219.0
Productivity (GDP per active)	12,488	303,844*	51,435	42.2
Investment (% of GDP)	8.4	65.8	21.8	24.7
Unemployment rate (%)	1.9	37.0	8.9	59.3
LT Unemployment rate (%)	0.4	22.9	3.9	87.7
Employment Rate (%)	42.1	83.2	69.6	10.9
Wage (euro/hour)	1.1	105.5*	16.6	57.1
Population	123,598	12,106,455	1,863,246	81.6
Active Population (%)	23.0	68.1	49.4	9.8
Median Age	31.4	50.1	41.3	7.3
Tertiary Education (%)	6.8	69.8*	26.1	35.7
Secondary Education	10.5	79.6	47.2	30.7
Rate of population change (‰)	-11.8	34.8	0.3	1116.1
Net migration (‰)	-25.2	55.2	2.7	196.5
Memo				

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