A Structural Regional Trade and Migration Framework for Policy Evaluation: Quantifying the Regional Effects of the 2004 EU Enlargement

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Abstract

We quantify the subnational effects of supranational trade and migration policy within and across European Union (EU) countries. To this end, our multi-country, multi-region general equilibrium framework incorporates migration between subnational regions into a multi-country gravity model of regional trade. Using data on bilateral regional trade and migration flows in the EU, we estimate the effects of the 2004 enlargement of the EU and conduct a general equilibrium analysis, assessing the regional trade, migration, and welfare implications of the policy change. Our results suggest that the EU enlargement increased regional trade by about 40% and regional migration by about 71%. We find positive welfare effects across the EU, with more heterogeneities across but also within countries. Accounting for migration decisions, we find that workers migrating to a different region due to the EU enlargement experience a welfare increase of about 40% on average.

JEL Classification Codes: F13, F14, F15, F16, F22, R13, R23.

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1 Introduction

In 2004, ten New Member States (NMS) joined the European Union (EU). This historic enlargement, the largest expansion in the history of the EU in terms of the number of acceding countries and population, had far-reaching political and economic implications.[1] The enlargement aimed at fostering stability, democracy, and economic growth across Europe. At the same time, it immediately increased disparities among EU Member States, since the NMS entered the EU with substantially lower income levels than the fifteen incumbent member states (EU15). Figure 1 shows GDP per capita in 2004 for NUTS2 regions by country, expressed as a percentage of the EU25 average. The figure reveals substantial regional income heterogeneities both between and within countries. Regions in the NMS, on the right of the figure, generally exhibit lower income levels than regions in the EU15, shown on the left. At the same time, substantial within-country heterogeneity exists, with some poorer regions in the EU15 exhibiting income levels comparable to those observed in the NMS. These patterns highlight the importance of considering regional, rather than solely country-level dimensions of economic inequality.

The enlargement fundamentally deepened the economic integration within Europe via trade and migration. The NMS gained full access to the EU Single Market and became part of the Common Commercial Policy, the Customs Union, and the EU's international trade agreements. Moreover, the enlargement expanded opportunities for labour mobility by granting NMS citizens the right to live and work in any member state. While these policies were implemented at the supranational level, their effects need not be distributed uniformly across countries or regions. Focusing on the subnational level is particularly important given the regional disparities that existed both between and within member states at the time of accession.

In this paper, we study how the 2004 EU enlargement affected trade, migration, and welfare across European subnational regions. In particular, we examine whether and to what extent the trade and labour market integration associated with the enlargement by itself contributed to reducing the initial regional economic disparities observed at the time of accession. Understanding these effects is crucial for evaluating the role of economic integration as a tool for reducing regional disparities, a core objective of the EU's Cohesion Policy.

While country-level frameworks can plausibly abstract from labour mobility, our theoretical framework accommodates for the fact that in a subnational setting, workers are mobile across regions. Hence, our model includes both interregional trade and interregional migration, within and across national borders. Workers make migration decisions subject to migration costs, making the regional labour supply endogenous. Trade and

[1] The 2004 enlargement increased the EU's geographic area by about 23%, its population by about 20%, and its GDP (2001 at PPP) by about 9% (Kohler, 2004).

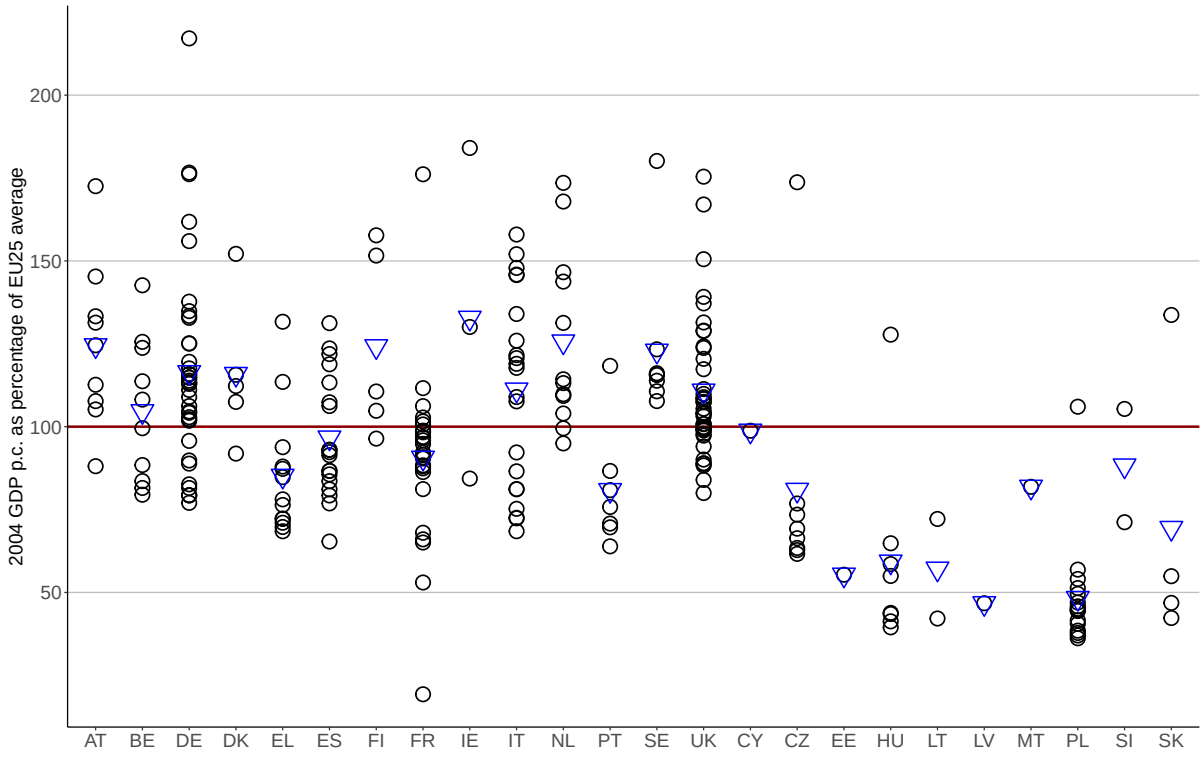


Figure 1: Regional GDP per Capita in 2004 within EU25 Countries.

Notes: The black circles represent GDP per capita (in 2004 EUR PPS) in individual regions in the respective country as percentage of the EU25 average in 2004. The EU15 countries (excluding Luxembourg) are on the left and the NMS are on the right. Blue triangles represent the mean regional GDP per capita in the country. Three regions are excluded as outliers: Brussels, Luxembourg, and Inner London West, with a regional GDP per capita of 52,815; 52,851; and 115,806 EUR, respectively.

migration are linked via regional real wages, which determine the allocation of labour across regions as well as regional production and trade.

We use data on bilateral trade and migration flows between and within 193 subnational regions in 24 EU countries for the period 2000–2010. Estimating gravity equations of trade and migration, we find that the 2004 EU enlargement increased bilateral trade by around 40% and bilateral migration by around 71%. Applying the trade and migration cost reductions implied by our gravity estimates, we quantify the regional general equilibrium effects of the 2004 EU enlargement. Our results show positive welfare gains for all regions across the EU, which are more pronounced for regions in the NMS than in the EU15. Accounting explicitly for migration decisions reveals considerable heterogeneity in these gains. While the average stayer, defined as a worker who remains in the same region before and after enlargement, experienced a welfare increase of 0.15%, the average counterfactually induced (CI) migrant, who chooses to relocate as a consequence of the enlargement, experienced a welfare increase of nearly 40%. These large differences are only possible to uncover in our regional framework which combines trade integration and labour mobility.

The vast and recent literature in quantitative spatial economics studies the spatial distribution of economic activity with trade and labour mobility across subnational locations (Allen and Arkolakis, 2014, 2025; Redding, 2016; Redding and Rossi-Hansberg, 2017). Quantitative spatial frameworks studying the effects of regional shocks have been developed and applied to US states, such as Caliendo, Parro, Rossi-Hansberg, and Sarte (2018); Monte, Redding, and Rossi-Hansberg (2018); Kleinman, Liu, and Redding (2023). Within this literature, Caliendo, Dvorkin, and Parro (2019) and Rodríguez-Clare, Ulate, and Vásquez (2025) develop quantitative trade and migration frameworks to study the dynamic general equilibrium effects of the rise in Chinese trade on US states. The link between immigrants and trade with a subnational perspective is studied by Bonadio (2026) for US states and by Bratti, De Benedictis, and Santoni (2014) for Italian provinces.

Other countries have also been the focus of quantitative spatial analyses, such as Dix-Carneiro (2014) who studies the distributional effects of trade policy in Brazilian labour markets. Another set of papers has developed and applied quantitative spatial models with trade and migration to Chinese regions, such as Tombe and Zhu (2019); Cai, Caliendo, Parro, and Xiang (2022); Egger, Faber, Li, and Lin (2025).

Whereas much of the quantitative spatial literature studies the distribution of economic activity within a single country, often abstracting from international interactions, we analyse international economic integration at the European multi-country regional level. Our study combines interregional trade, migration, and supranational policy changes for 193 regions across Europe. A closely related study on the country level is Caliendo, Opromolla, Parro, and Sforza (2021), who study the effects of the 2004 EU enlargement in a country-level dynamic framework with trade and migration. We shift the focus from countries to subnational NUTS2 regions, allowing us to quantify the regional distribution of gains and losses within and across member states, and explicitly take migration decisions into account when quantifying the welfare gains for different groups of migrants, especially the counterfactually induced migrants.

More broadly, the literature on the integration effects of the EU Enlargement often focuses on trade, such as Baldwin (1994); Baldwin, Francois, and Portes (1997); Papazoglou, Pentecost, and Marques (2006); Bussière, Fidrmuc, and Schnatz (2008); Levchenko and Zhang (2012) for countries and Brülhart, Crozet, and Koenig (2004) for regions. Early studies on the general equilibrium effects of EU integration with Eastern European countries include Keuschnigg and Kohler (2000, 2002); Bröcker and Schneider (2002), and Kohler (2004). Migration flows between countries in the context of the EU enlargement have been studied by D'Auria, Morrow, and Pichelmann (2008) and De La Rica, Glitz, and Ortega (2015), while Dennett (2014); Sardadvar and Rocha-Akis (2016), Fischer and Pfaffermayr (2018), and Bredtmann, Nowotny, and Otten (2020) focus on migration between subnational EU regions. Focusing on trade at the regional level, Shevtsova, Díaz-Lanchas, Persyn, and Mandras (2025) study the regional trade

and welfare effects of the transport cost reductions associated with EU Cohesion Funds, using a structural gravity analysis for EU regions. Similar to our findings, Magerman and Palazzolo (2024) document regional inequalities in the European Union in the light of trade policy. Their multi-sector, multi-region general equilibrium framework with governmental policies shows that raising trade barriers reduces EU welfare, with substantial variation across EU NUTS2 regions. Some studies have analysed the effects of the EU enlargement on both trade and migration. On the country level, Iranzo and Peri (2009) use a two-country model of trade and international migration to explain the patterns of trade and migration following the removal of barriers to trade and migration between Eastern and Western Europe before 2004. On the regional level, Henkel and Seidel (2019) use data on German inter-regional trade flows to calibrate a general equilibrium model with trade and labour mobility between regions in the EU to assess EU integration. We contribute by using a regional general equilibrium framework with trade and migration. Our data on bilateral regional trade for different sectors and bilateral regional migration flows allow us to estimate the reduction in trade and migration costs due to the EU enlargement as well as to implement these cost reductions in our counterfactual analysis.

The remainder of the paper is structured as follows. Section 2 explains the institutional background of the EU enlargement. In Section 3 we develop our model of regional trade and migration. Section 4 introduces our data. In Section 5 we derive the estimating equations and present results of our gravity estimations, quantifying the partial effects of the 2004 EU enlargement on trade and migration flows. Section 6 shows the results of our GE analysis, quantifying the general equilibrium effects of the enlargement on EU regions. Section 7 offers concluding remarks.

2 Background

The ten New Member States that joined the European Union on 1 May 2004 were Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia. From that day onwards, these countries were part of the EU single market, allowing trade to freely cross country borders within the EU. This step followed some previous steps taken to extend EU integration to Central and Eastern European countries, such as the Association Agreements (also known as Europe Agreements), signed in the 1990s, establishing bilateral free trade between the EU and each individual country.

For labour markets, there was a transitional period of seven years, during which Member States were allowed to restrict the right to move freely to another state to work. This transitional arrangement allowed Member States a gradual adjustment of their labour markets to avoid disturbances of a sudden inflow of workers. Therefore, the EU15 members opened their labour markets at different stages to citizens from the NMS, as described in Table 1. Ireland, Sweden, and the United Kingdom were the first

Table 1: Stages of Labour Market Access for NMS Citizens.

Phase	Year	Countries Opening Labour Market
Phase 1	2004	Ireland, Sweden, United Kingdom
	2005	
Phase 2	2006	Finland, Greece, Italy, Portugal, Spain
	2007	Luxembourg, Netherlands
	2008	France
Phase 3	2009	Belgium, Denmark
	2010	
	2011	Austria, Germany

EU15 members who allowed migrants from the NMS starting in 2004, while Austria and Germany used the entire seven-year transitional period to restrict access to their labour markets. Some NMS, such as Hungary, Poland, and Slovenia, imposed reciprocal measures. More details can be found in Barker (2021).

3 The Model

In our multi-country, multi-region model of trade and migration each country $i \in C$ consists of a set of subnational regions R_i. Regions are indexed by k and r, and the total set of regions in all countries is denoted by R. Each region is inhabited by workers, who supply labour inelastically and derive utility from consumption. On the trade side, workers have constant elasticity of substitution (CES) preferences over goods differentiated by region of origin (Armington, 1969), yielding a gravity equation of regional trade (Anderson and van Wincoop, 2003). On the migration side, workers make discrete location choices based on the utility attainable in each region (McFadden, 1974), taking into consideration bilateral migration costs and idiosyncratic mobility shocks (e.g. Artuç, Chaudhuri, and McLaren, 2010; Tombe and Zhu, 2019; Caliendo, Opromolla, Parro, and Sforza, 2021). This yields a migration gravity equation (e.g. Anderson, 2011). The migration decision determines where workers live, work, and consume, thereby linking the trade and migration sides of the model. Notably, migration endogenises the regional labour force, our only factor of production, and central to our counterfactual analysis of the EU enlargement, trade and migration both affect and are affected by real wages.

3.1 Bilateral Trade Flows

There are two sectors s, goods G and services S, $s \in \{G, S\}$, and each region produces its variety in each sector, using labour as the only factor of production, where one unit of labour produces one unit of output. Assuming perfect competition, the factory gate price of the sector-s product produced in region r equals the sectoral wage in the same

region, $p_r^s = w_r^s$. We assume iceberg trade costs $t_{rk}^s \geq 1$ for sector-s products shipped from region r to region k (Samuelson, 1952), such that t_{rk}^s units of a product must be shipped from region r for one unit to arrive in region k. This implies that the consumer price of a sector-s variety from region r in region k is $p_{rk}^s = p_r^s t_{rk}^s$.

A representative worker in region k derives utility from consumption according to

$$U_k = \prod_s (U_k^s)^{\gamma^s} = \prod_s \left(\left[\sum_{i \in C} (c_{ik}^s)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s}, \tag{1}$$

where c_{ik}^s is the quantity of sector-s products the representative worker in region k purchases from country i. $\sigma_s > 1$ is the elasticity of substitution in consumption between sector-s products from different countries and γ^s are shares with $\sum_s \gamma^s = 1$.

Consumption of sector-s products from country i by the representative worker in region k, c_{ik}^s, is the aggregate of sector-s products from all regions r in country i purchased by the representative worker in region k, c_{rk}^s:

$$c_{ik}^s = \left[\sum_{r \in R_i} (c_{rk}^s)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}}, \tag{2}$$

where $\sigma_s > 1$ is the elasticity of substitution between sector-s products from different regions. Imposing a common elasticity of substitution across goods from different regions and countries simplifies the nested CES structure into the following utility function:[2]

$$\begin{aligned} U_k = \prod_s (U_k^s)^{\gamma^s} &= \prod_s \left(\left[\sum_{i \in C} (c_{ik}^s)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s} \\ &= \prod_s \left(\left[\sum_{i \in C} \left(\left[\sum_{r \in R_i} (c_{rk}^s)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s} \\ &= \prod_s \left(\left[\sum_{i \in C} \sum_{r \in R_i} (c_{rk}^s)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s} \end{aligned}$$

[2]In Appendix A.8, we show a variant of our model with differing elasticities of substitution between products from different countries and products from different regions within a country. In this case, the nested CES structure does not aggregate into one CES nest. Upholding the nested CES structure, the expression for trade flows includes a price index with a bilateral dimension, P_{ik}^s, the price aggregate over all sector-s regional varieties of country i that are consumed in region k. Estimation of the trade gravity equation would require exporting-country-importing-region-time (ik, t) fixed effects. Although the variation of regional bilateral trade flows would allow for this strict set of fixed effects, it would not allow identification of an EU effect, as the EU dummy variable varies at the country-pair-time level.

$$= \prod_s \left(\left[\sum_{r \in R} \left(c_{rk}^s \right)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s}. \tag{3}$$

The total labour force in region k is denoted by L_k. It is allocated across the two sectors such that $L_k = \sum_s L_k^s = L_k^G + L_k^S$. Assuming homogeneous workers, aggregate utility in region k is given by the utility of the representative worker, U_k, multiplied by the total number of workers, L_k.

For each sector, workers in region k maximise U_k^s from Equation (3) subject to the budget constraint

$$L_k \sum_{r \in R} c_{rk}^s p_r^s t_{rk}^s = E_k^s.$$

That is, total expenditure of region k on sector-s products is equal to the sum of its expenditure (i.e. the aggregate spending of workers in k) on sector-s products from all regions in all countries. This yields the value of aggregate sector-s sales from region r to region k

$$X_{rk}^s = L_k c_{rk}^s p_r^s t_{rk}^s = \left(\frac{p_r^s t_{rk}^s}{P_k^s} \right)^{1-\sigma_s} \gamma^s E_k, \tag{4}$$

where $P_k^s = \left[\sum_{r \in R} \left(p_r^s t_{rk}^s \right)^{1-\sigma_s} \right]^{\frac{1}{1-\sigma_s}}$ is the price index for sector-s products consumed in region k and we replaced the sectoral expenditure by the share of total expenditure, $E_k^s = \gamma^s E_k$.[3] Expressing the spending of region k on sector-s products from region r in country i as share of spending of region k in sector s yields

$$\pi_{rk}^s = \frac{X_{rk}^s}{\gamma^s E_k} = \left(\frac{p_r^s t_{rk}^s}{P_k^s} \right)^{1-\sigma_s}. \tag{5}$$

We follow Dekle, Eaton, and Kortum (2007, 2008) and formulate the framework in changes, which has the advantage that we do not need to specify trade costs in levels. The change, denoted by a hat, of π_{rk}^s between the baseline (denoted with superscript b) and the counterfactual (denoted with superscript c) is given by[4]

$$\widehat{\pi}_{rk}^s = \frac{(\pi_{rk}^s)^c}{(\pi_{rk}^s)^b} = \frac{\left(\widehat{p}_r^s \widehat{t}_{rk}^s \right)^{1-\sigma_s}}{\sum_{r \in R} (\pi_{rk}^s)^b \left(\widehat{p}_r^s \widehat{t}_{rk}^s \right)^{1-\sigma_s}}. \tag{6}$$

Market clearing implies that total output of each region in sector s is equal to sales to all destination regions, including domestic sales in the home region, $Y_r^s = \sum_{k \in R} X_{rk}^s$.

[3] A derivation is given in Appendix A.1.

[4] A derivation is given in Appendix A.2.

Using Equations (4) and (5), we can express output as

$$\begin{aligned} Y_r^s &= \sum_{k \in R} \left(\frac{p_r^s t_{rk}^s}{P_k^s} \right)^{1-\sigma_s} \gamma^s E_k \\ &= \sum_{k \in R} \pi_{rk}^s \gamma^s E_k. \end{aligned} \tag{7}$$

The counterfactual value of Y_r^s can be stated as

$$(Y_r^s)^c = \sum_{k \in R} (\pi_{rk}^s)^c (E_k^s)^c = \sum_{k \in R} \widehat{\pi}_{rk}^s (\pi_{rk}^s)^b \widehat{E}_k^s (E_k^s)^b = \sum_{k \in R} \widehat{X}_{rk}^s (X_{rk}^s)^b. \tag{8}$$

With labour being the only factor of production and full employment, we can express regional output in sector s by total factor income in sector s, $Y_r^s = w_r^s L_r^s$. Expenditures on sector s products are related to output in sector s by

$$E_r^s = Y_r^s + D_r^s = w_r^s L_r^s + D_r^s, \tag{9}$$

where D_r^s captures trade imbalances for sector s. Sectoral trade imbalances occur naturally, as spending on products from one sector can be financed by output from a different sector. Aggregating over sectors yields trade imbalances at the regional level, D_r, such that total expenditures are related to total output by

$$E_r = \sum_s E_r^s = \sum_s (Y_r^s + D_r^s) = \sum_s Y_r^s + \sum_s D_r^s = Y_r + D_r = w_r L_r + D_r. \tag{10}$$

We allow for trade imbalances at both the sectoral and regional levels, as these are observed in the data. In the counterfactual analysis, we retain sectoral trade imbalances while imposing balanced trade at the regional level. To do so, we first compute a baseline scenario in which trade imbalances at the regional level are eliminated, as described in more detail below.

3.2 Bilateral Migration Flows

In our model, workers can move both between sectors and regions. While we assume frictionless mobility across sectors, migration across regions is costly and modelled as a discrete choice over the set of all regions R. A worker's decision to migrate crucially depends on the net utility attainable in every alternative. We therefore derive the indirect utility of a representative worker in region k, U_k^*, by substituting the optimal consumption

from Equation (4), $c_{rk}^s = \left(\frac{1}{P_k^s}\right)^{1-\sigma_s} (p_r^s t_{rk}^s)^{-\sigma_s} \frac{E_k^s}{L_k}$, into Equation (3), yielding

$$U_k^* = \prod_s \left(\frac{E_k^s}{L_k P_k^s}\right)^{\gamma^s}. \tag{11}$$

With frictionless sectoral mobility within a region, workers move freely across sectors, equalising wages between sectors within a region, $w_k^s = w_k \; \forall \; s$. Expressing sectoral expenditure as the share of total expenditure, accounting for trade imbalances, and using the Cobb-Douglas shares and price index over sectoral varieties, we obtain

$$U_k^* = \frac{w_k + \frac{D_k}{L_k}}{P_k}. \tag{12}$$

Hence, the decision to migrate will crucially depend on the real wage differences between a region k and potential destination regions.[5]

As mentioned above, we allow for trade imbalances to exist, since they are observed in the data. Trade imbalances affect workers' spending possibilities and, therefore, indirect utility, as in Equation (12). Since this channel is not central to our analysis, we first compute a baseline equilibrium, in which regional trade is balanced, while retaining observed imbalances between sectors. Specifically, we compute our baseline equilibrium with $D_k = 0$. In this case, indirect utility corresponds directly to real wages, $U_k^* = \frac{w_k}{P_k}$.

Following the discrete choice literature (see, e.g. Artuç, Chaudhuri, and McLaren, 2010 and especially the presentation of Anderson, 2011), workers choose to live and work in the region that yields the highest utility. We assume that migration costs comprise bilateral region-pair specific costs, reducing utility in an iceberg-type manner, as well as worker-specific mobility-cost shocks, which are drawn from a type I extreme value distribution.[6] A worker h in region k decides to migrate to region r if migrating yields a utility at least as large as the utility obtained by staying in region k, accounting for bilateral migration costs, $\delta_{kr} \geq 1 \; \forall \; r \neq k$ and $\delta_{kk} = 1$, and the worker's realised mobility-cost shocks, $\epsilon_{kr,h}$ and $\epsilon_{kk,h}$. Formally this can be expressed by

$$\frac{U_r^* \epsilon_{kr,h}^{\rho}}{\delta_{kr}} \geq U_k^* \epsilon_{kk,h}^{\rho}, \tag{13}$$

where ρ is the dispersion of the stochastic component.

The worker-specific mobility-cost shocks generate heterogeneous migration decisions

[5] Derivations are given in Appendix A.3.

[6] In difference to some existing studies, we interpret the idiosyncratic shock commonly used in discrete choice models as a cost component, rather than a preference component, and follow Anderson (2011), p. 152: "We may think of an idiosyncratic cost component as plausibly associated with a fixed cost, but in the migration decision, the distinction between fixed and variable cost plays no important role because the decision to migrate has no volume decision accompanying it."

at the level of the individual worker. Specifically, two workers originating from the same region k and facing the same bilateral migration costs δ_{kr} to all destinations $r \in R$ may choose different destination regions because of differences in their mobility-cost shocks.

Note that workers can choose to migrate to any region in any country. They may stay in their region of origin, migrate to another region within the same country, or migrate to a region in a different country. While the model does not explicitly distinguish between intra-national and international migration, bilateral migration costs do account for such differences and affect workers' decisions. For instance, international migration may involve additional barriers such as language or cultural differences, or greater distance from social networks, making it, ceteris paribus, more costly than migration within a country. Such factors are captured by the migration-cost measures used in the estimation.

In our multi-region setting, taking logs, and separating the deterministic and stochastic components of Equation (13), we can write the decision probability of worker h to migrate from k to r or to stay in region k, that is $r = k$, $Pr_{kr,h}$, as

$$\begin{aligned} Pr_{kr,h} &= \text{Prob}(V_{kr} + \rho\varepsilon_{kr,h} > V_{kl} + \rho\varepsilon_{kl,h} \; \forall \, l \neq r), \\ Pr_{kr,h} &= \text{Prob}(\frac{V_{kr}}{\rho} + \varepsilon_{kr,h} > \frac{V_{kl}}{\rho} + \varepsilon_{kl,h} \; \forall \, l \neq r), \\ Pr_{kr,h} &= \text{Prob}(\varepsilon_{kl,h} < \varepsilon_{kr,h} + \frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho} \; \forall \, l \neq r), \end{aligned} \tag{14}$$

where $V_{kr} = \ln(U_r^*) - \ln(U_k^*) - \ln(\delta_{kr})$ and $\varepsilon_{kr,h} = \ln \epsilon_{kr,h}$. Assuming each $\varepsilon_{kr,h}$ to be independently, identically distributed type I extreme value, the multinomial-logit probabilities following McFadden (1974) are given by[7]

$$Pr_{kr,h} = \frac{\left(e^{V_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l \in R} \left(e^{V_{kl}}\right)^{\frac{1}{\rho}}}. \tag{15}$$

$Pr_{kr,h}$ gives the probability of a randomly drawn worker h to migrate from region k to region r. In the aggregate, this probability coincides with the share of workers originating from region k who migrate to region r. Multiplying this share with the number of natives originating from region k, N_k , we obtain the aggregate migration flow from k to r,

$$M_{kr} = Pr_{kr,h} N_k. \tag{16}$$

[7] A derivation is given in Appendix A.4.

Combining Equations (12), (15), and (16), bilateral migration flows can be written as

$$M_{kr} = \frac{\left(\frac{w_r+\frac{D_r}{L_r}}{w_k+\frac{D_k}{L_k}}\frac{P_k}{P_r}\frac{1}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{w_l+\frac{D_l}{L_l}}{w_k+\frac{D_k}{L_k}}\frac{P_k}{P_l}\frac{1}{\delta_{kl}}\right)^{\frac{1}{\rho}}}N_k$$
$$= \frac{\left(\frac{w_r+\frac{D_r}{L_r}}{P_r}\frac{1}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{w_l+\frac{D_l}{L_l}}{P_l}\frac{1}{\delta_{kl}}\right)^{\frac{1}{\rho}}}N_k. \tag{17}$$

Abstracting from per-capita trade imbalances, the migration flow from an origin region k to a destination region r increases with the real wage in the destination region, with bilateral costs of migrating from the origin region to other potential destination regions, and with the number of natives in the origin region. The migration flow decreases with bilateral costs of migrating from the origin to the destination, and with real wages in all other potential destination regions. Worker heterogeneity is captured implicitly by the idiosyncratic utility component underlying the multinomial logit probabilities of Equation (15).

Equation (17) is similar to the migration flow expression from Equation (15) in Anderson (2011). In addition, we used the trade system to determine real wages, which correspond with the indirect utility. This link between the trade and migration systems enables us to explore the general equilibrium nature of the model and the interdependence between interregional trade and interregional migration. We do this in more detail in section 3.3.

Defining $\omega_r \equiv \frac{w_r+\frac{D_r}{L_r}}{P_r}$, Equation (17) can be written as a migration gravity equation,

$$M_{kr} = \frac{\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}N_k, \tag{18}$$

where $\frac{1}{\rho}$ can be interpreted as migration elasticity (see Caliendo, Dvorkin, and Parro, 2019). Define μ_{kr} as the share of the total population of natives in k, N_k, that migrate to region r,

$$\mu_{kr} = \frac{M_{kr}}{N_k} = \frac{\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}. \tag{19}$$

The change of μ_{kr} between the baseline and the counterfactual is given by[8]

$$\hat{\mu}_{kr} = \frac{\mu_{kr}^c}{\mu_{kr}^b} = \frac{\left(\frac{\hat{\omega}_r}{\hat{\delta}_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\mu_{kl}^b\left(\frac{\hat{\omega}_l}{\hat{\delta}_{kl}}\right)^{\frac{1}{\rho}}}. \tag{20}$$

Real per capita expenditure changes can be written as

$$\hat{\omega}_r = \frac{\frac{w_r^c+\frac{D_r}{L_r^c}}{P_r^c}}{\frac{w_r^b+\frac{D_r}{L_r^b}}{P_r^b}} = \frac{\frac{w_r^c+\frac{D_r}{L_r^c}}{w_r^b+\frac{D_r}{L_r^b}}}{\hat{P}_r} = \frac{\frac{\frac{1}{L_r^c}(w_r^c L_r^c+D_r)}{\frac{1}{L_r^b}\left(w_r^b L_r^b+D_r\right)}}{\hat{P}_r} = \frac{\frac{\frac{1}{L_r^c}E_r^c}{\frac{1}{L_r^b}E_r^b}}{\hat{P}_r} = \frac{\hat{E}_r}{\hat{L}_r\hat{P}_r}.$$

The labour force available in region r is obtained by summing bilateral migration flows over all origin regions:

$$L_r = \sum_{k\in R} M_{kr} = \sum_{k\in R}\left(\frac{\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}\right) N_k = \sum_{k\in R}\mu_{kr}N_k. \tag{21}$$

The counterfactual value of the labour force is given by

$$L_r^c = \sum_{k\in R}\mu_{kr}^c N_k = \sum_{k\in R}\hat{\mu}_{kr}\mu_{kr}^b N_k = \sum_{k\in R}\hat{M}_{kr}M_{kr}^b. \tag{22}$$

The number of natives originating from region k is obtained by summing bilateral migration flows over all destination regions, $N_k = \sum_{r\in R} M_{kr}$. The overall labour supply is given by $N^w \equiv \sum_{k\in R} N_k = \sum_{r\in R} L_r$, that is, the total population is distributed over all regions and sums up.[9]

3.3 The Link Between Trade and Migration

We take into account that the uniform wage across the sectors within a region implies uniform regional producer prices, $w_r = p_r$, and note the changes of the sectoral expenditure and the price index are given by

$$\begin{aligned}
\widehat{E}_k^s &= \frac{\gamma_s E_k^c}{\gamma_s E_k^b} = \widehat{E}_k, \\
\widehat{P}_k &= \frac{\prod_s\left(\frac{(P_k^s)^c}{\gamma^s}\right)^{\gamma^s}}{\prod_s\left(\frac{(P_k^s)^b}{\gamma^s}\right)^{\gamma^s}} = \prod_s\left(\frac{\frac{(P_k^s)^c}{\gamma^s}}{\frac{(P_k^s)^b}{\gamma^s}}\right)^{\gamma^s} = \prod_s(\widehat{P}_k^s)^{\gamma^s}.
\end{aligned}$$

[8] A derivation is given Appendix A.5.

[9] Further accounting identities are given in Appendix A.6

Collecting all relevant equations yields our system of trade and migration, expressed in changes, where equations with superscript s hold for each sector:

$$\widehat{\pi}^s_{rk} = \frac{\left(\widehat{w}_r \widehat{t}^s_{rk}\right)^{1-\sigma_s}}{(\widehat{P}^s_k)^{1-\sigma_s}}, \tag{23}$$

$$\widehat{X}^s_{rk} = \widehat{\pi}^s_{rk} \widehat{E}_k, \tag{24}$$

$$(\widehat{P}^s_r)^{1-\sigma_s} = \sum_{l \in R} (\pi^s_{lr})^b \left(\widehat{w}_l \widehat{t}^s_{lr}\right)^{1-\sigma_s}, \tag{25}$$

$$\widehat{Y}^s_r (Y^s_r)^b = \sum_{k \in R} \widehat{X}^s_{rk} (X^s_{rk})^b, \tag{26}$$

$$\widehat{Y}_r (Y_r)^b = \sum_s \widehat{Y}^s_r (Y^s_r)^b, \tag{27}$$

$$\widehat{E}_r (E_r)^b = \widehat{Y}_r (Y_r)^b + (D_r)^b, \tag{28}$$

$$\widehat{w}_r = \frac{\widehat{Y}_r}{\widehat{L}_r}, \tag{29}$$

$$\widehat{\omega}_r = \frac{\widehat{E}_r}{\widehat{L}_r \left(\prod_s (\widehat{P}^s_r)^{\gamma_s}\right)}, \tag{30}$$

$$\widehat{\mu}_{kr} = \frac{\left(\frac{\widehat{\omega}_r}{\widehat{\delta}_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l \in R} (\mu_{kl})^b \left(\frac{\widehat{\omega}_l}{\widehat{\delta}_{kl}}\right)^{\frac{1}{\rho}}}, \tag{31}$$

$$\widehat{M}_{kr} = \widehat{\mu}_{kr}, \tag{32}$$

$$\widehat{L}_r (L_r)^b = \sum_{k \in R} \widehat{M}_{kr} (M_{kr})^b. \tag{33}$$

The general equilibrium system shows that both trade and migration affect and are themselves affected by real wages. A change in trade or migration costs, $\widehat{t}^s_{rk}$ or $\widehat{\delta}_{kr}$, directly affects the trade or migration shares, $\widehat{\pi}^s_{rk}$ or $\widehat{\mu}_{kr}$, but also triggers general equilibrium adjustments in the entire system, such that trade cost changes also spill over into the migration side of the model and migration cost changes spill over into the trade side of the model. We determine the strengths of these effects for the EU enlargement in the following. In a first step, we quantify the partial effects of the trade cost change on trade flows and of the migration cost change on migration flows. These partial effects allow us to compute the trade and migration cost changes, $\widehat{t}^s_{rk}$ and $\widehat{\delta}_{kr}$, which we use in the subsequent step of quantifying the general equilibrium effects of the EU enlargement.

4 Data

We obtain bilateral regional trade flows between EU NUTS2 regions for the period 2000–2010 from interregional trade-linked supply and use tables, assembled by PBL Netherlands Environmental Assessment Agency and published at the Dutch government open data website (see Thissen, Lankhuizen, van Oort, Los, and Diodato, 2018; Thissen, Ivanova, Mandras, and Husby, 2019). The tables include EU NUTS2 regions, as well as 16 additional countries and a rest-of-world aggregate.[10] The underlying input-output data do not rely on a predefined spatial structure or trade model, making them a suitable basis for deriving inter- and intraregional trade flows. The data have also been employed by Brakman, Garretsen, and Kohl (2023) to study the effects of Brexit using regional trade flows between UK regions and 42 countries, and by Shevtsova, Díaz-Lanchas, Persyn, and Mandras (2025) to analyse the effects of EU Cohesion Policy on regional trade integration.

As a consistency check, we compare total regional exports in 2005 from our bilateral trade data with regional production data from the ARDECO database for the same year.[11] The correlation between the sum of all exports in the trade matrix (including domestic sales) and the regional production data is 0.97. Figure 2 shows a scatter plot of total exports and regional production with a dashed 45-degree line. The strong correlation and close alignment of the observations with the 45-degree line provide reassurance that the trade data are economically plausible and broadly consistent with observed regional production levels.

We aggregate the sectors given in the regional supply and use tables into the broad sectors of goods (agriculture; mining, quarrying, and energy supply; food, beverages, and tobacco; textiles and leather, etc.; coke, refined petroleum, nuclear fuel and chemicals, etc.; electrical and optical equipment and transport equipment; other manufacturing) and services (construction; distribution; hotels and restaurant; transport, storage, and communication; financial intermediation; real estate, renting, and business activities; non-market service).

Bilateral regional migration flows are derived from the European Union Labour Force Survey (EU LFS). Respondents report their current region of residence and, if they resided in the same country one year earlier, their region of residence in the previous year. For respondents who resided in a different country one year earlier, only the previous country of residence is observed. To obtain regional origins for these international migrants, we allocate them across regions within the origin country according to the regional popu-

[10] The additional countries are: Japan, Brazil, Australia, Mexico, Russia, Bulgaria, Romania, India, Indonesia, Cyprus, Canada, China, South Korea, Turkey, the United States, Taiwan.

[11] As a proxy for regional production, we use GDP at current market prices, which is a measure of total domestic production, i.e. the monetary value of all the goods and services produced within a region during the specific year. Our data source is https://urban.jrc.ec.europa.eu/ardeco/explorer?lng=en. More details can be found at https://urban.jrc.ec.europa.eu/dataset/ARDECO-SUVGD/metadata?lng=en.

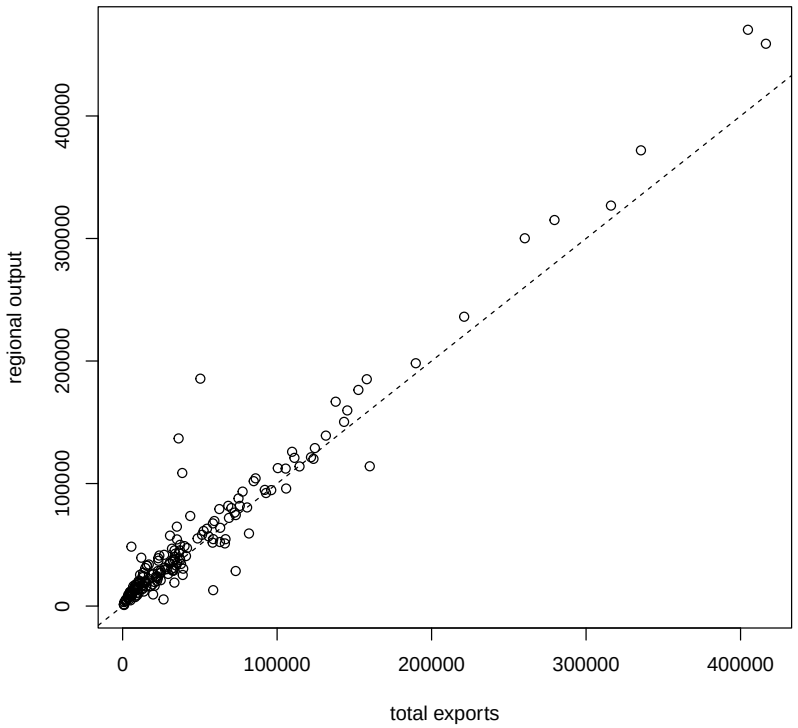


Figure 2: Total regional exports (including domestic sales) and regional output, in million Euros, for 2005. The dashed line is a 45-degree line.

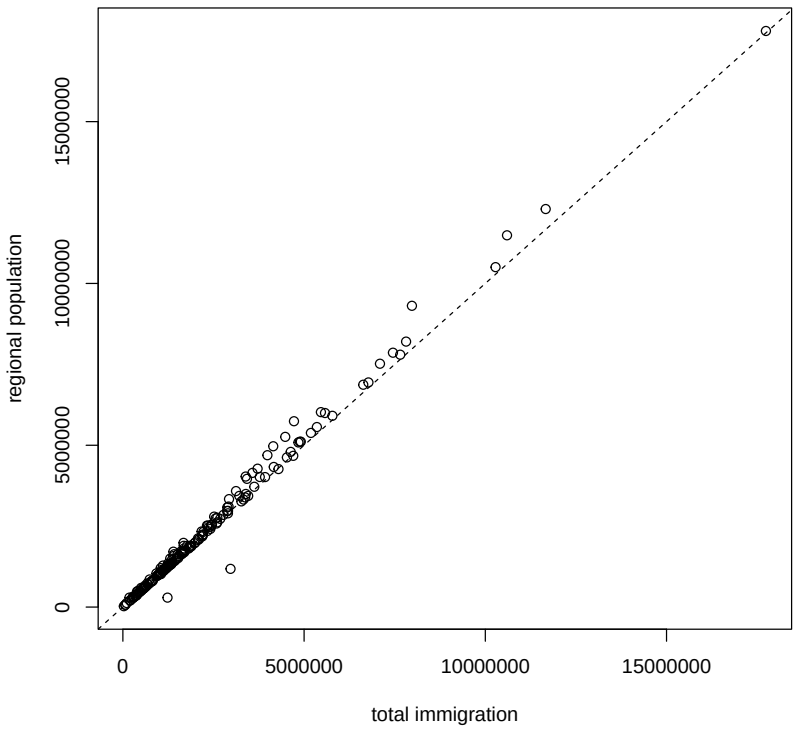


Figure 3: Total regional immigration (including stayers) and regional population, in persons, for 2005. The dashed line is a 45-degree line.

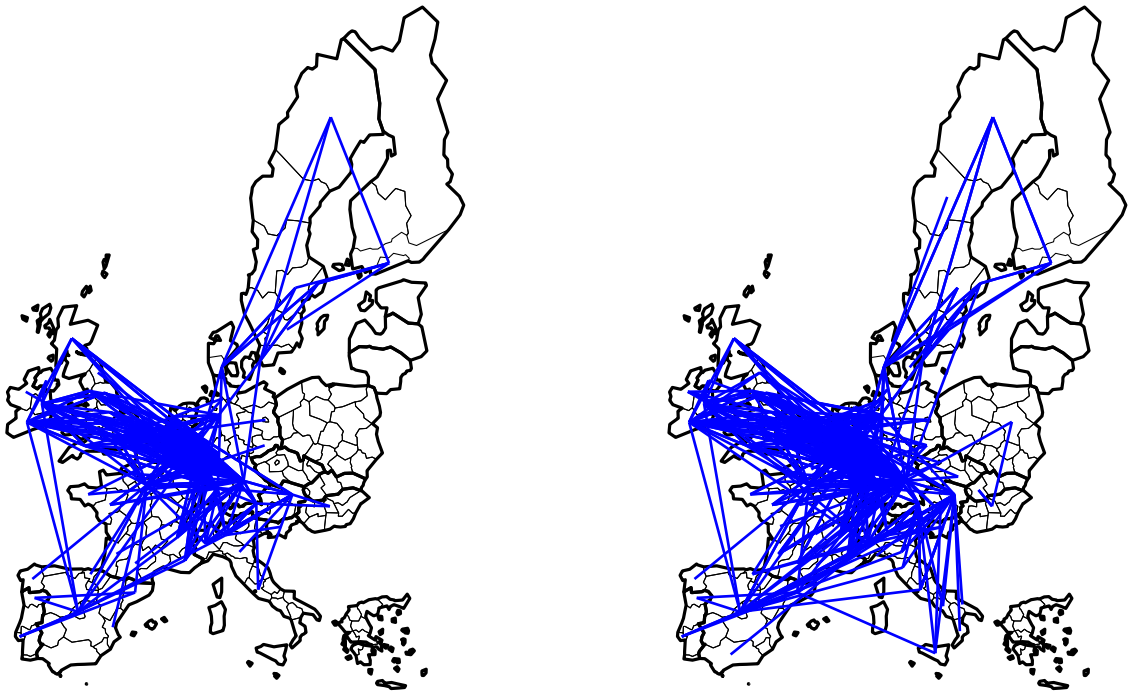
lation distribution. This procedure yields migration flows between EU regions for both intra-national and international migration. As a consistency check, we compare total regional immigration in 2005 from our bilateral migration data with regional population data from the ARDECO database for the same year.[12] The correlation between the sum of all immigrants (including persons who stay in the same region) in the migration matrix and the regional population data is 0.995. Figure 3 shows a scatter plot of total immigration and regional population with a dashed 45 degree line. The strong correlation and close alignment of the observations with the 45-degree line provide reassurance that the migration data are consistent with regional population statistics.

Our dataset includes 193 regions in 24 EU countries, mostly at the NUTS2 level, while, for some countries (Austria, Germany, United Kingdom), the regions are at the NUTS1 level, as the EU LFS data is reported at this higher-aggregated level.[13] We do not rely on the EU ESPON database, which provides trade and migration flows between EU subnational regions, since the time period covered in ESPON is 2010–2018, while we require the time period including the 2004 EU enlargement.

Descriptively, trade and migration flows between regions in the EU increased after the 2004 EU enlargement. Figure 4 shows that in 2002, major trade flows, of more than 600 million Euros, between regions of different countries within the EU were mostly observed among regions in EU-15 countries. This changed by 2010, where major trade flows are also observed between regions from NMS and EU-15 members, such as between regions from Poland or the Czech Republic and regions in Germany. Also major trade links between regions among the NMS were formed. These developments, however, do not appear to outweigh the strong trade links between regions among the EU-15 countries. Turning to the major international regional migration flows of more than 300 persons in Figure 5, it appears that there were already established migration links between regions from NMS and EU-15 countries. This network becomes much denser in 2010, the year in which nearly all EU-15 countries had opened their labour markets to citizens of the NMS.

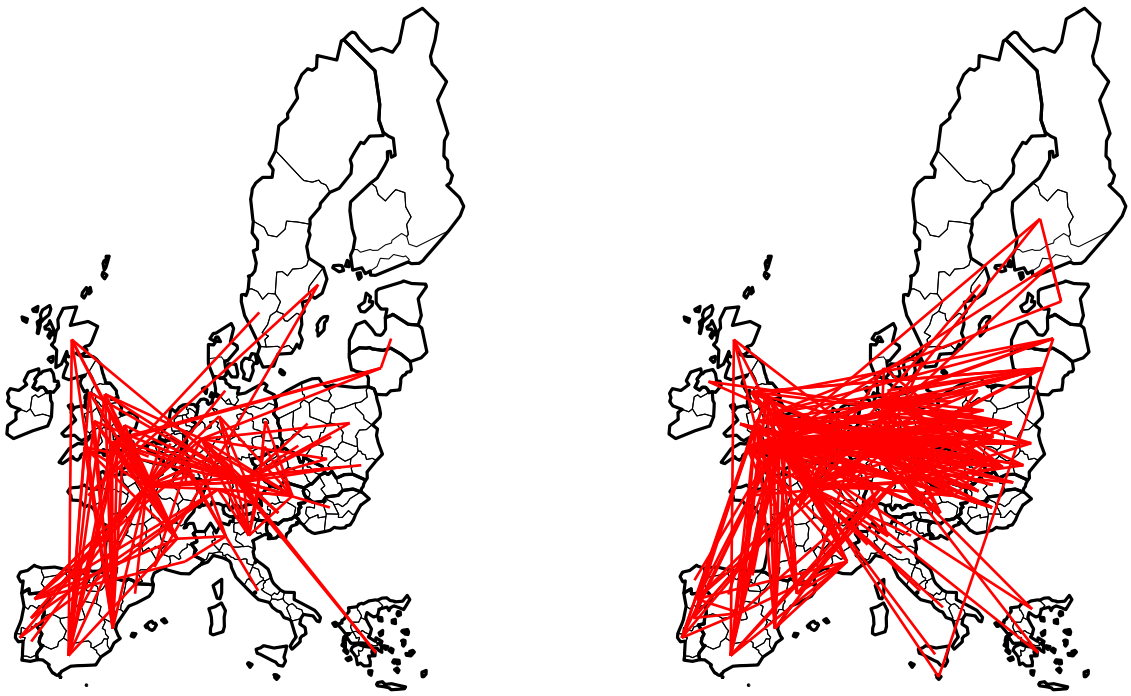
[12] We use average annual regional population. Our data source is https://urban.jrc.ec.europa.eu/ardeco/explorer?lng=en. More details can be found at https://territorial.ec.europa.eu/dataset/ARDECO-SNPTD/metadata?lng=en.

[13] The 24 countries include the EU15 countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom) and 9 NMS (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia; Cyprus is missing due to data availability).



(a) 2002 (b) 2010

Figure 4: International regional trade flows (> 600 million Euros) in 2002 (prior to EU enlargement) and 2010 (after EU enlargement).



(a) 2002 (b) 2010

Figure 5: International regional migration flows (> 300 persons) in 2002 (prior to EU enlargement) and 2010 (after EU enlargement).

For our estimation of the effects of joint EU membership on trade and migration flows, we use our panel from 2000 to 2010. For the GE analysis we focus on a baseline of the pre-enlargement years in our data. That is, we create averages of our bilateral trade and bilateral migration matrices over the period 2000–2003.

The values used for the elasticities of substitution between goods or between services from different regions are taken from Egger, Larch, and Staub (2012), with $\sigma_G = 8$ for goods and $\sigma_S = 6$ for services. The dispersion of the worker-specific mobility-cost shocks is set to $\rho = 2$, in line with previous studies, such as Caliendo, Opromolla, Parro, and Sforza (2021).

We obtain values for the Cobb-Douglas sectoral shares for goods and services, γ_G and γ_S, from our data, aggregating the trade flow matrix for goods and for services and dividing by total trade, yielding $\gamma_G = 0.33$ and $\gamma_S = 0.67$.

5 Estimation

The sectoral trade gravity Equation (4) can be transformed into the following:

$$X^s_{rk,t} = \exp\Big((1-\sigma_s)\ln\left(p^s_{r,t}\right) + (1-\sigma_s)\ln t^s_{rk,t} - (1-\sigma_s)\ln P^s_{k,t} + \ln\left(\gamma^s E_{k,t}\right)\Big),$$

where t denotes years. We estimate the trade gravity equation separately for each sector $s \in \{G, S\}$ by including exporting-region-year fixed effects $\phi^s_{r,t}$, importing-region-year fixed effects $\chi^s_{k,t}$, to control for the standard gravity terms, as well as asymmetric bilateral pair fixed effects λ^s_{rk}. With this set of fixed effects, our estimating equation becomes

$$X^s_{rk,t} = \exp\left(\mathbf{T}^s_{rk,t}\boldsymbol{\theta} + \phi^s_{r,t} + \chi^s_{k,t} + \lambda^s_{rk}\right)\zeta^s_{rk,t}, \tag{34}$$

where $\mathbf{T}^s_{rk,t}$ is a vector collecting the bilateral time-varying explanatory variables approximating trade costs $t^s_{rk,t}$, among which we include joint EU membership, trade agreements, and tariffs, while the time-constant trade cost components (such as distance, contiguity, common language) are captured by the pair fixed effects.[14] $\boldsymbol{\theta}$ is a corresponding trade-cost parameter vector. For our analysis of the EU enlargement, interest lies in estimating the coefficient for joint EU membership, θ_{EU_trade}. $\zeta_{rk,t}$ is an error term.

[14] With the trade data including 16 additional countries and a rest-of-world aggregate alongside the EU regions, controlling for trade agreements other than joint EU membership and tariffs becomes relevant, as explained in more detail below.

The migration gravity equation (18) can be transformed into the following:

$$M_{kr,t} = \exp\left(\frac{1}{\rho}\ln\omega_{r,t} - \frac{1}{\rho}\ln\delta_{kr,t} - \ln\left(\sum_{l\in R}\left(\frac{\omega_{l,t}}{\delta_{kl,t}}\right)^{\frac{1}{\rho}}\right) + \ln N_{k,t}\right),$$

where we include origin-region-year, destination-region-year, and asymmetric bilateral pair fixed effects as well as an error term to obtain the estimating equation

$$M_{kr,t} = \exp\left(\mathbf{D}_{kr,t}\boldsymbol{\xi} + \phi_{k,t} + \chi_{r,t} + \lambda_{kr}\right)\zeta_{rk,t}, \tag{35}$$

where $\mathbf{D}_{kr,t}$ is the vector collecting all bilateral time-varying explanatory variables (such as joint EU membership) approximating migration costs $\delta_{kr,t}$, while the time-constant migration cost variables (such as distance, contiguity, common language, cultural differences) are captured by the pair fixed effects. $\boldsymbol{\xi}$ is a corresponding parameter vector and interest lies in estimating the coefficient for joint EU membership, ξ_{EU_mig}.

We estimate Equations (34) and (35) using the Poisson-Pseudo Maximum Likelihood estimator (PPML). Our aim is to obtain an estimate for the effect of common EU membership on trade and migration flows. The variables of interest are, hence, EU_trade and EU_mig, which are dummy variables taking a value of 1 if the corresponding trade or migration flow is among members of the EU and zero else. For migration, the variable takes into account the stages at which countries opened their labour markets, from Table 1 and using details from Barker (2021). Further time-varying control variables are interactions of two different border dummy variables with time dummy variables. We differentiate between regional borders within the same country and international borders between regions from different countries, where we define the border dummy to take a value of 1 for flows crossing a regional or international border, respectively, and 0 for intra-regional and international or intra-national and intra-regional flows. By differentiating between these different types of borders, we account for preferences for goods and services from regions within and across countries, as well as for the fact that migration across regional borders within countries may appear less costly than migration across international borders. We cluster our standard errors pairwise, in the same way as our pair fixed effects are specified.

The PBL data of regional supply and use tables also includes further (mostly non-EU) countries, allowing us to use trade of these countries with the EU regions, with each other, and domestically in our estimations. This gives us a control group in the data that never joins the EU. Additionally, we add a dummy variable for Regional Trade Agreements (RTA) to account for RTAs among these additional countries as well as between these countries and the different EU countries.[15] Cyprus (EU member since 2004) as well as

[15]We define the RTA and EU_trade variables as mutually exclusive, that is, the RTA variable takes the value 0 if EU_trade takes the value 1.

Bulgaria and Romania (EU members since 2007) are included as further countries in the trade data, without regional detail. In the trade gravity estimation, we adjust the EU_trade dummy to switch to one in the year in which they joined the EU.

We include tariffs in the trade cost vector as $\ln(1+\tau_{rk,t})$, where $\tau_{rk,t}$ is the ad valorem tariff rate in year t between the countries to which regions r and k belong. Consistent with the institutional setting in the EU, we do not model tariff revenues at the regional level. The largest part of tariffs collected in the EU are transferred to the EU budget, while only a small fraction is retained by member states to cover the administrative costs of tariff collection. Accordingly, tariffs affect trade costs but not regional budget constraints.

Formally, the EU enlargement abolished any remaining trade barriers between EU15 countries and the NMS, including tariffs. In the quantitative analysis of Caliendo, Opromolla, Parro, and Sforza (2021), the trade cost change of the EU enlargement by is modelled as an elimination of remaining tariffs. However, Figure 6 shows that tariffs imposed by EU15 countries on imports from NMS countries were already zero from 2000 onwards, i.e. prior to the EU enlargement. This pattern is in line with the Association Agreements (so-called Europe Agreements) signed between the EU and the Central and Eastern European countries in the 1990s, establishing bilateral free trade between the EU and each individual country and increasing goods trade, as reported by Egger and Larch (2011). Reported tariffs on exports from the EU15 to NMS remained positive, which may reflect different utilisation rates. Since we control for bilateral tariff rates in our trade gravity estimation, the estimated coefficient for the EU enlargement dummy variable is identified from changes in trade costs beyond tariff reductions. We therefore interpret this coefficient as capturing the additional trade-facilitating effects associated with integration into the enlarged EU Single Market, such as reductions in non-tariff barriers or improvements in regulatory harmonisation.

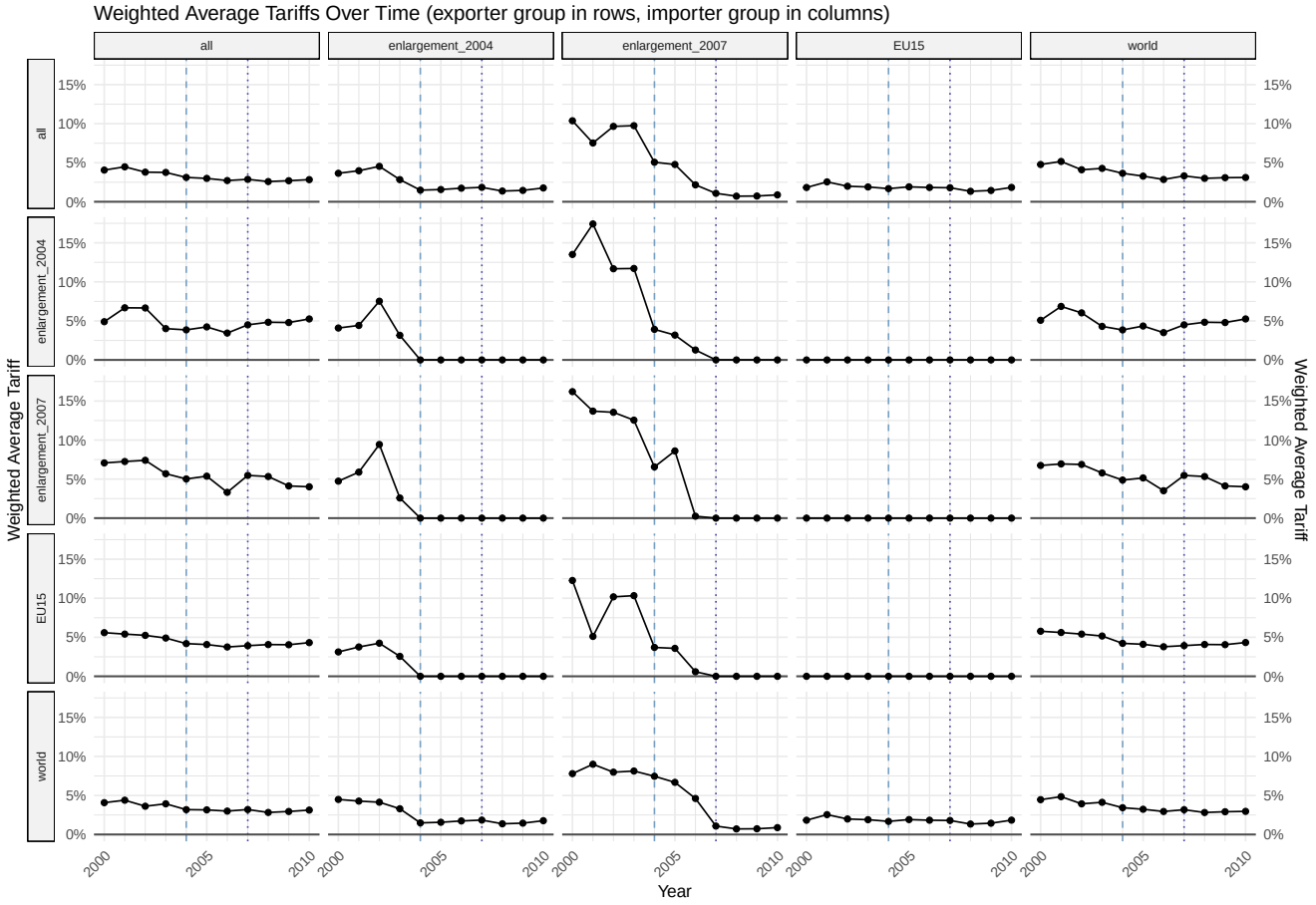


Figure 6: Weighted average tariffs over time between different country groups (exporter groups in rows, importer groups in columns). The country group "all" refers to all countries aggregated, while "world" refers to the group of non-EU27 countries. The countries in the 2004-enlargement group are the 10 NMS in our analysis, who joined the EU in 2004. The countries in the 2007-enlargement group are Bulgaria and Romania, who joined the EU in 2007. The vertical lines show the EU enlargement years, 2004 (dashed) and 2007 (dotted). Data source: WITS. More detailed data description in Appendix A.10.

Table 2 shows the results from estimating Equations (34) and (35) with PPML. In column (1) the dependent variable is total trade aggregated over sectors, while in columns (2) and (3) trade flows are split into goods and services. The coefficients estimated for EU_trade suggest that joint EU membership increases aggregate trade among European regions by about 39.78%[16], while the effect is more pronounced for goods (45.40%[17]) than for services (21.20%[18]). The stronger effect for goods than for services may appear unexpected, given that the Association Agreements (or Europe Agreements) had established bilateral free trade between the EU15 countries and the Central and Eastern European countries already in the 1990s. It shows that effective trade integration requires more than simply the removal of tariffs. The EU enlargement was a much broader and deeper

[16] $[\exp(0.3349) - 1] \times 100 = 39.78$
[17] $[\exp(0.3743) - 1] \times 100 = 45.40$
[18] $[\exp(0.1923) - 1] \times 100 = 21.20$

Table 2: Gravity Estimation Results.

Dependent variables:	(1) Aggregate trade	(2) Goods trade	(3) Services trade	(4) Migration
EU_trade	0.3349***	0.3743***	0.1923***	
	(0.0973)	(0.0918)	(0.0655)	
RTA	0.1819*	0.1710*	0.0445	
	(0.0948)	(0.0890)	(0.0567)	
Tariffs	-2.963***	-3.049***		
	(0.5596)	(0.5180)		
EU_mig				0.5336***
				(0.0679)
Border-year dummies (within-country vs international borders)	Yes	Yes	Yes	Yes
Exp-year, imp-year FE	Yes	Yes	Yes	Yes
Asymmetric-pair FE	Yes	Yes	Yes	Yes
ROW countries included	Yes	Yes	Yes	
Observations	472,608	472,608	485,067	207,297
Pseudo R^2	0.99938	0.99856	0.99944	0.99938

Notes: PPML estimations. Standard errors clustered by (asymmetric) pair in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

integration than the Association Agreements. For example, the alignment of regulations to a Pan-European level may have facilitated trade after 2004. The alignment of regulations, such as product standards, may have particularly helped facilitate goods trade, while, at the same time, the relevant rules and regulations for services trade remained in the power of individual states, making it comparably harder to deliver services across borders.

Estimation of the migration gravity equation in column (3) suggests that joint EU membership increases migration among European regions by about 70.51%[19]. We use our estimates to implement the counterfactual trade and migration cost changes in the following section. Specifically, the ratios that are used as counterfactual trade and migration cost changes are calculated by $\widehat{t}^G_{rk} = \exp(0.3743)^{\frac{1}{1-\sigma_G}} = 0.9479$, $\widehat{t}^S_{rk} = \exp(0.1923)^{\frac{1}{1-\sigma_S}} = 0.9623$, and $\widehat{\delta}_{kr} = \exp(0.5336)^{-\rho} = 0.3440$.

6 General Equilibrium Analysis

What were the general equilibrium effects of the 2004 EU enlargement on trade, migration, and the distribution of economic activity across subnational regions in the EU? To

[19] $[\exp(0.5336) - 1] \times 100 = 70.51$

answer this question, we solve the system of equations (23)–(33), using the trade and migration cost changes $\widehat{t}^G_{rk}$, $\widehat{t}^S_{rk}$, and $\widehat{\delta}_{kr}$, described above.

As a starting point, we use bilateral goods and services trade flows and bilateral migration flows averaged over the pre-enlargement period in our sample. We compute a baseline equilibrium in which trade imbalances are set to zero, leaving trade and migration costs unchanged. To obtain the counterfactual equilibrium, we implement the EU enlargement policy by changing the trade and migration costs for trade and migration between regions from NMS and EU-15 countries as well as between pairs of regions among the NMS.[20] We normalise the system by expressing trade flows relative to aggregate world output, such that changes in trade flows, output, and expenditure are interpreted as a changes in the shares of world output.[21] As the system given by Equations (23)–(33) is homogeneous of degree zero in prices, we use world output as the numéraire and normalise its change to unity. Consequently, all changes in nominal variables are measured relative to world output.

The results shown in this section use the calibration method Dingel and Tintelnot (2026) call the covariates-based approach, where we use the bilateral trade and migration flow data to estimate the gravity equations (34)–(35) and obtain estimates for trade and migration costs. Based on our estimates, we compute baseline trade and migration flows that are consistent with the costs, which we average over the pre-enlargement period in our data, 2000-2003. In Appendix A.11 we also show results using the so-called calibrated-shares method, where we obtain our baseline matrices by averaging the observed data for trade and migration flows over 2000-2003. An advantage of the covariates-based approach is that it eliminates the sparsity of the baseline migration matrix. Whereas the calibrated-shares approach produces a matrix with 73% zero entries, the covariates-based approach yields a fully populated matrix, with very small positive instead of zero migration flows. Despite the substantial difference in sparsity, the two approaches generate remarkably similar aggregate migration patterns: the average bilateral migration flow equals 11,256 for the covariates-based approach and 11,252 for the calibrated-shares approach. A comparison of the general equilibrium effects of the EU enlargement does not show strong differences.

[20] Starting from the pre-enlargement baseline equilibrium, which represents the trade- and migration-share averages over our pre-enlargement sample period 2000–2003 without trade imbalances, we simultaneously implement the estimated trade- and migration-cost reductions for all countries. While our estimation of the partial effects in Section 5 takes into account the different stages of the labour market opening of different countries, our counterfactual analysis evaluates the resulting transition from the pre-enlargement to the post-enlargement equilibrium in a single step. This differs from the historical sequence of policy implementation but is the most appropriate approach within our framework. An alternative sequential implementation would require strong assumptions regarding the separability of the different stages. Since migration and trade responses are likely to overlap and interact through general-equilibrium effects, we instead evaluate the impact of enlargement by simultaneously imposing the cost changes.

[21] We refer to world output as the aggregate output of all regions in our analysis.

6.1 General Equilibrium Results for 2004 EU Enlargement

Regional general equilibrium effects of the 2004 EU enlargement are presented in Figures 7 to 17. The maps indicate that a large part of the overall variation in the effects occurs across countries, with clear differences between the EU15 and the NMS. This pattern is not unexpected, given that the EU enlargement is a supranational policy, which we implement with the same reductions in trade and migration costs for the two country groups at once. However, examining only country-level averages masks non-negligible regional variation. To highlight the within-country heterogeneity, Appendix A.12 reports regional deviations from country-level average effects. The results uncover considerable dispersion of regional effects, particularly within the NMS. Regional heterogeneity in the effects for a selection of individual countries (UK, France, Germany, Czech Republic, Hungary, Poland) are shown in Appendix A.13.

Figures 7 and 8 show that the shares of world output exported by most regions increased in both the goods and services sectors with only very slight decreases of less than 0.2% for some regions in EU15 countries. The increase in exports from regions in NMS is more pronounced for goods than for services. On average, across the EU, the share of total exports in world output increases by 2.9% (3.8% for goods and 1.1% for services), while the effects are stronger for the NMS regions (17.6% for goods and 4.9% for services) than for EU15 regions (0.2% for goods and 0.1% for services). The strongest increases in exports are encountered by the regions of Latvia, Lithuania, and Malta for goods (33–35%) as well as for services (16–17%). These results suggest that the enlargement substantially improved market access for the NMS, particularly in the goods sectors.

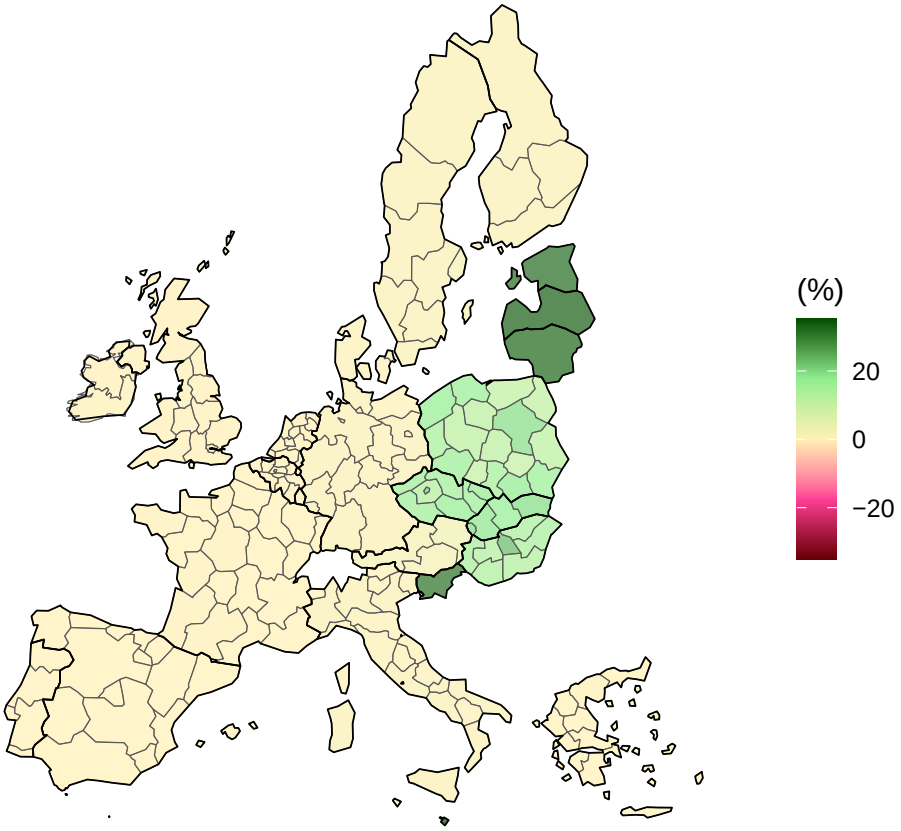
We observe similar patterns as for total goods exports for changes in total outmigration and total inmigration in Figures 9 and 10, albeit with a larger magnitude. On average, across the EU, total outmigration increases by 4.5% and total inmigration increases by 4.1%, while the effects are stronger for the NMS regions (18.1% increase in outmigration and 17.8% in inmigration) than for EU15 regions (0.9% and 0.6% respectively). The strongest increases in both outmigration and inmigration are concentrated in regions of Estonia, Latvia, Lithuania, Malta, and Slovenia. For these regions, outmigration rises by approximately 70%, while inmigration increases by approximately 71%. The simultaneous strong increases in out- and inmigration suggest that the enlargement primarily reallocates workers across regions rather than generating large changes in total regional labour supply, which is reflected in the modest changes of the aggregate labour force in Figure 11. Sectoral labour force changes are more pronounced, with employment in the goods sectors increasing in many NMS regions (see Figure 12), while employment in the services sectors decreases in these NMS regions (see Figure 13).

Figure 14 shows that nominal wages (or, equivalently, producer prices) increase in

NMS regions by up to 1.45%, while some EU15 regions encounter slight decreases of up to 0.11%. The effects on consumer prices differ by sector. While goods prices fall overall, with most pronounced decreases in regions of NMS countries of up to 1.95% (see Figure 15), benefitting consumers (workers) in all regions, services prices tend to fall slightly in some EU15 regions, while they rise by up to 1.16% in NMS regions (see Figure 16). In our framework, the increase in wages accrues to workers through higher nominal wages. To assess the extent to which workers benefit, the wage changes must be evaluated relative to changes in consumer prices. This yields changes in real wages, which are independent of the choice of numéraire and can be interpreted directly. Real wages, or, equivalently, real GDP per capita increase for all regions in the EU following the EU enlargement, as shown in Figure 17. While regions in the EU15 countries face modest increases (the Alentejo region in Portugal, PT18, faces the smallest increase with about 0.003%), real wages in NMS regions increase by up to 1.2% (regions in the Czech Republic, Malta, and Slovakia). On average, real wages increase by 0.83% in NMS regions and by 0.02% in EU15 regions, while the aggregate increase among all EU regions is 0.19%. Our average results are broadly consistent with the country-level consumption-equivalent welfare effects of the EU enlargement reported by Caliendo, Opromolla, Parro, and Sforza (2021). In their analysis, welfare increases by 1.17% in the NMS, by 0.04% in the EU15, and by 0.23% across Europe. In our framework, workers' indirect utility is determined by their real wage. Since migration is subject to bilateral migration costs as well as idiosyncratic mobility-cost shocks, equilibrium real wages generally differ across regions. Because the idiosyncratic component is part of the migration frictions rather than of regional amenities, changes in real wages correspond to changes in welfare (see, e.g. Baragwanath, Hanson, Khandelwal, Liu, and Park, 2026).

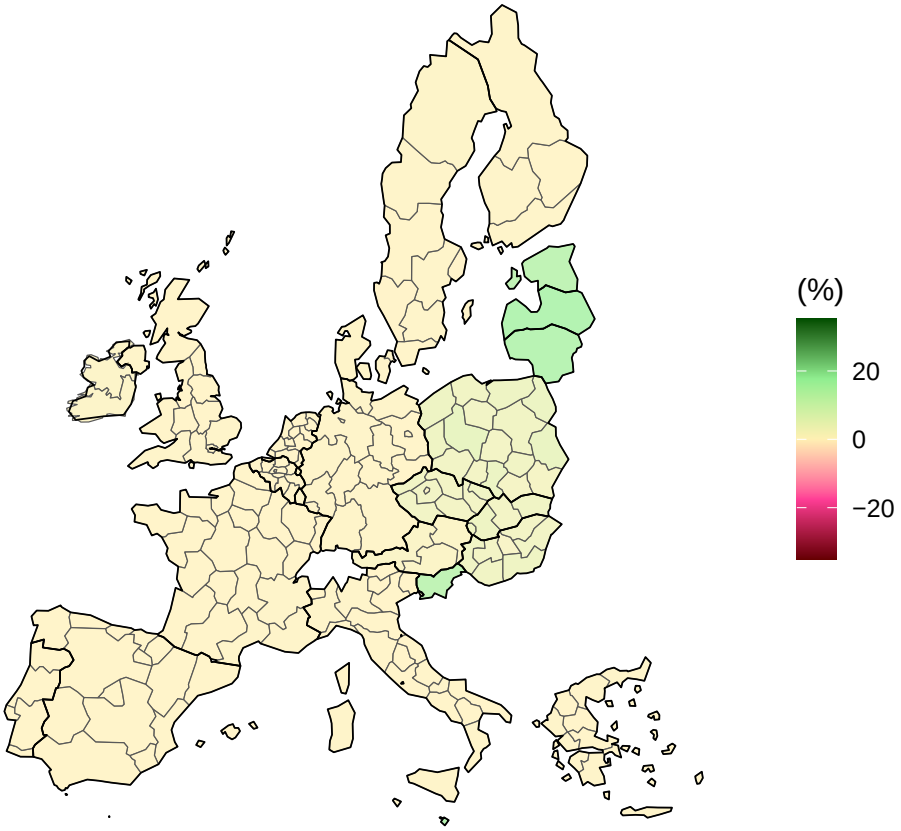
While the real wage effects in Figure 17 are the effects experienced by the stayers (i.e. the workers who stay in their origin region and decide not to migrate to another region), migrants realise different real wage effects, which we discuss in detail below.

Figure 7: GE Results of EU Enlargement: Total Exports Change (Goods)



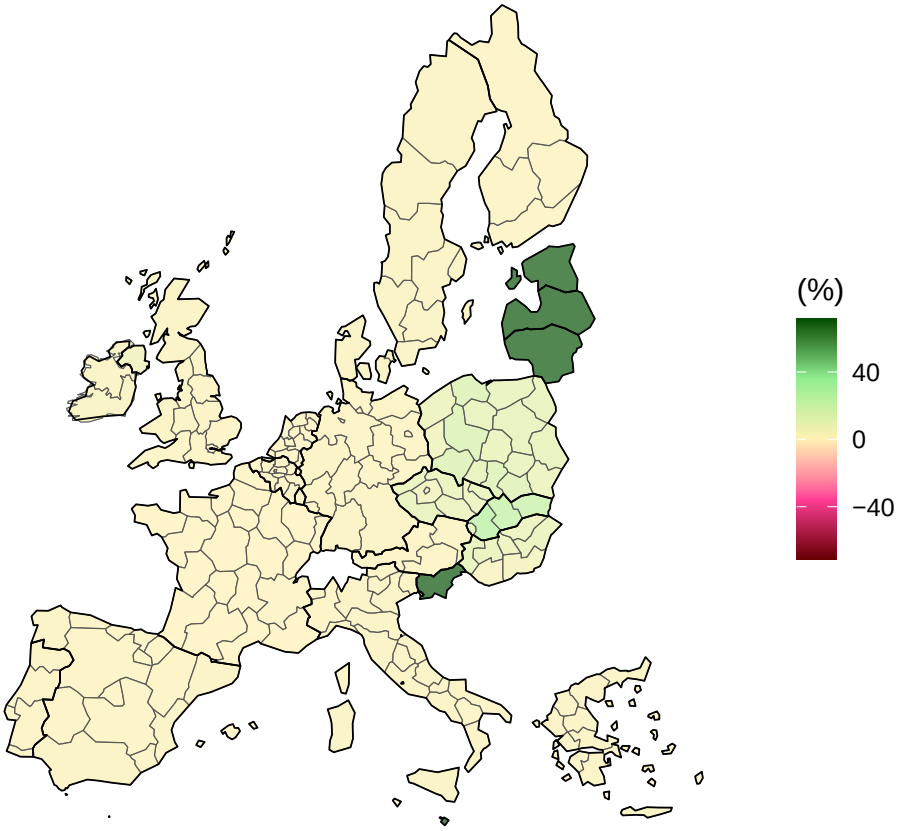
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 8: GE Results of EU Enlargement: Total Exports Change (Services)



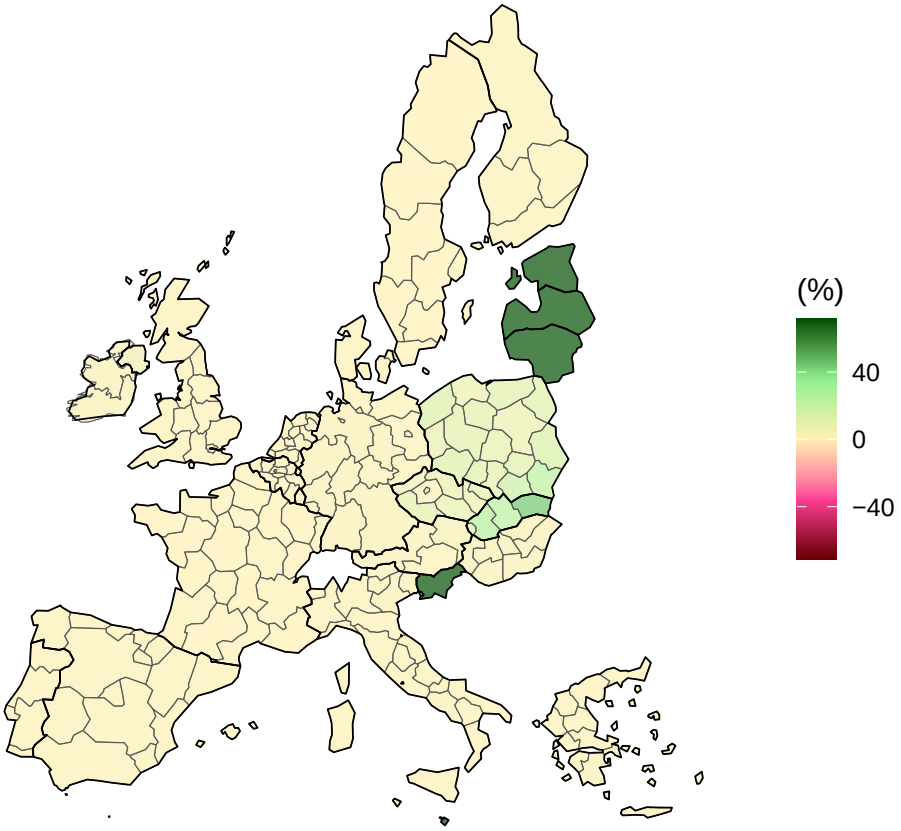
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 9: GE Results of EU Enlargement: Total Outmigration Change



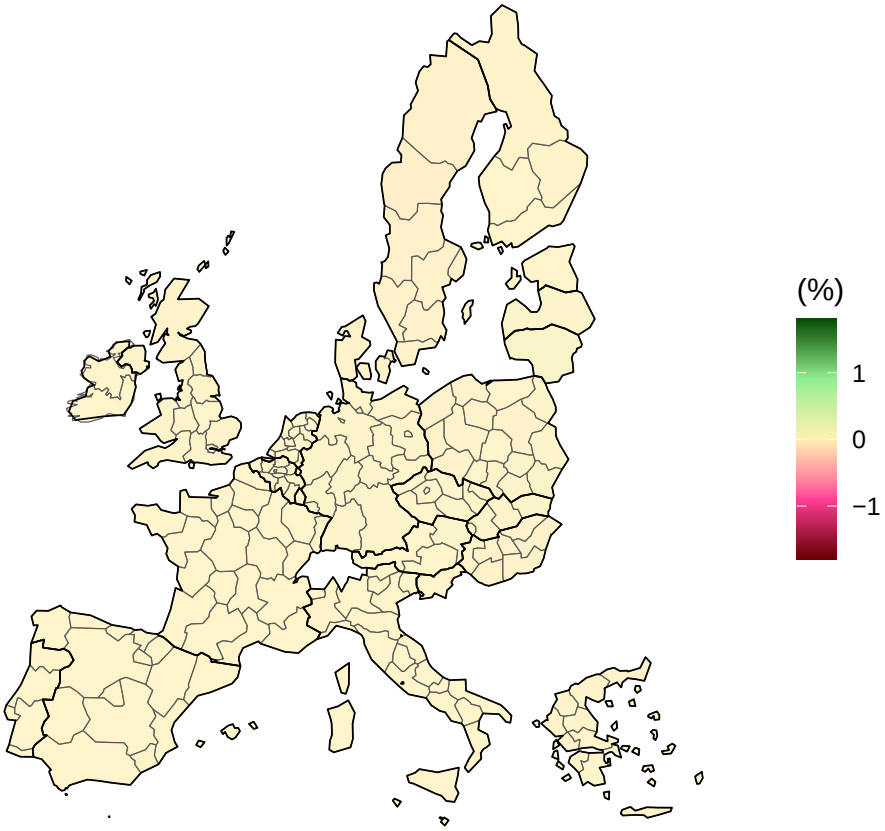
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 10: GE Results of EU Enlargement: Total Inmigration Change



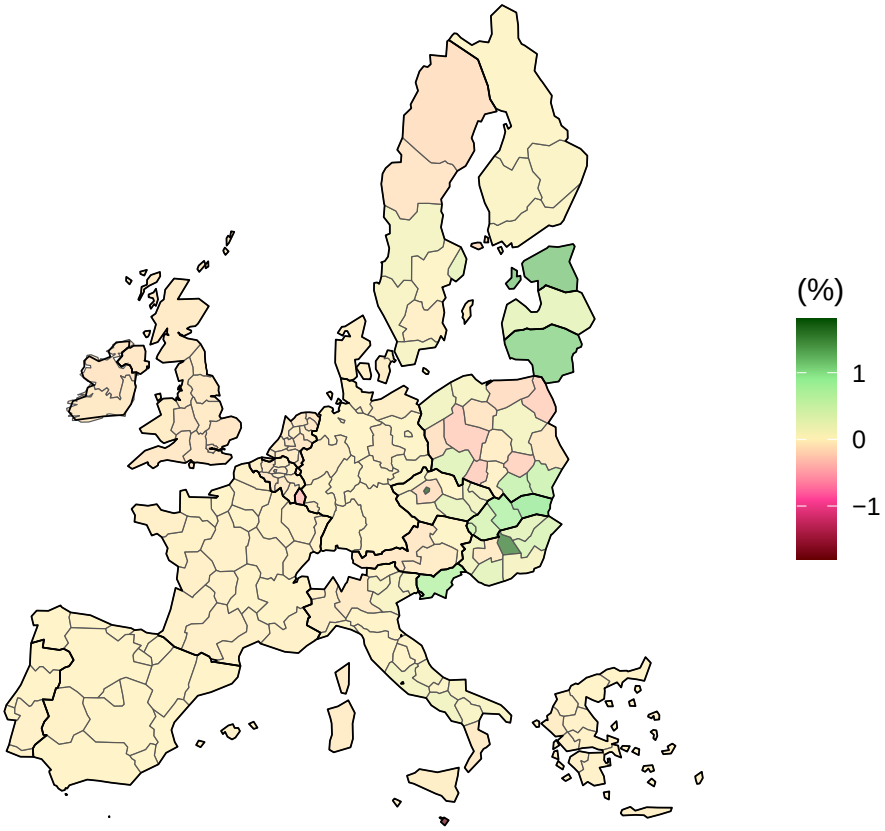
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 11: GE Results of EU Enlargement: Labour Force Change



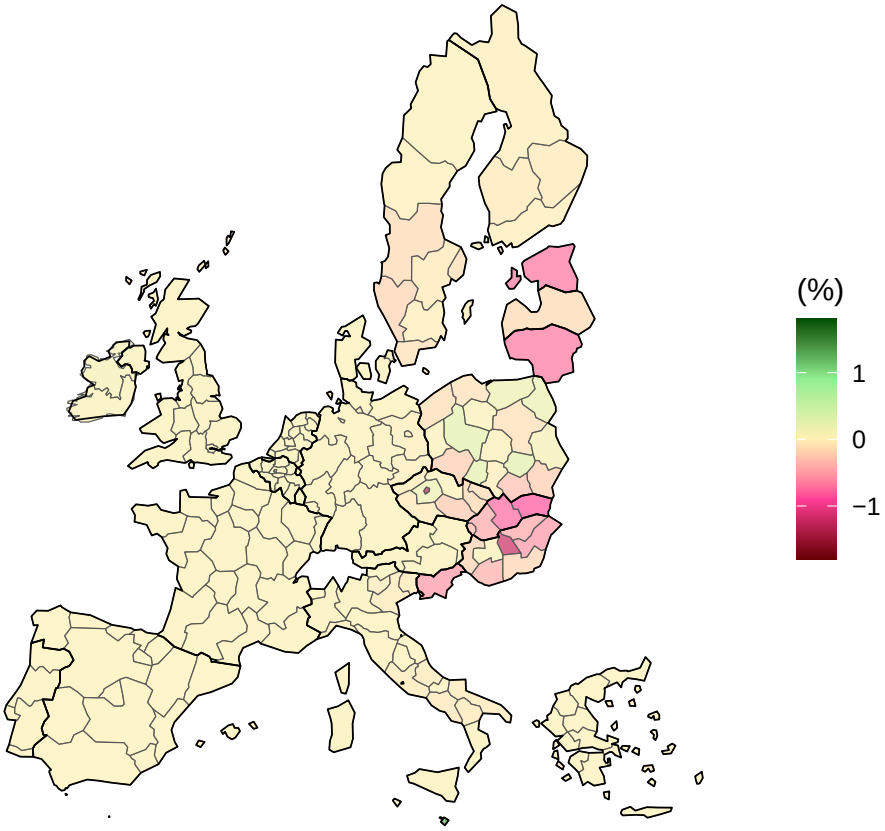
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 12: GE Results of EU Enlargement: Labour Force Change (Goods)



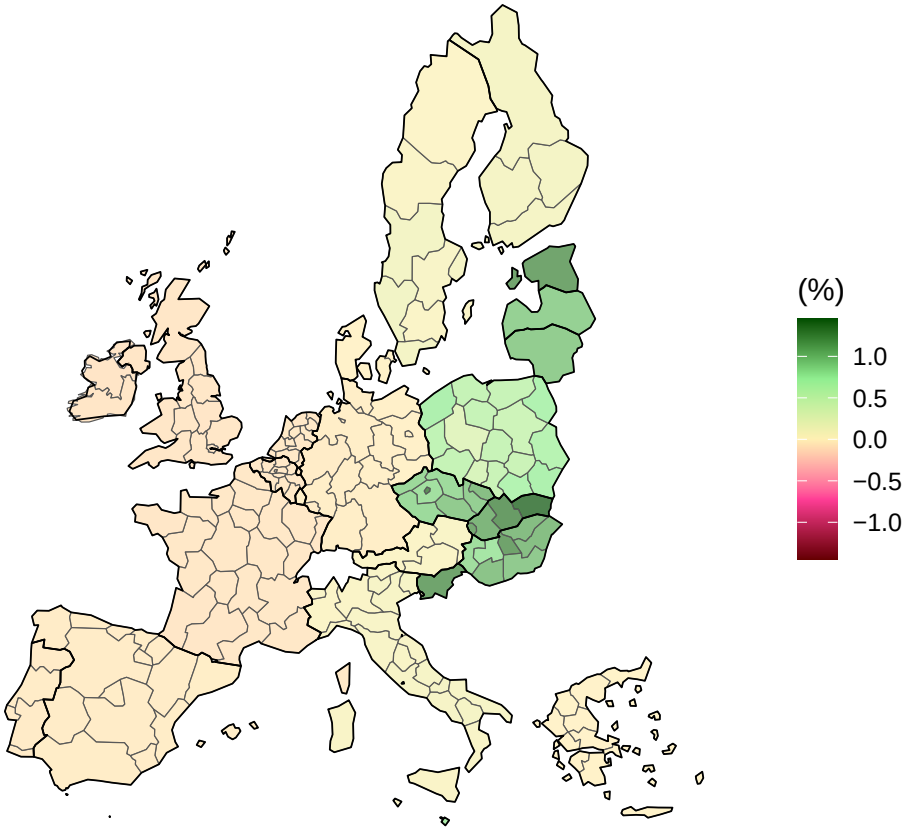
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). The labour force change for the Prague region in the Czech Republic (CZ01) with 2.8% is not coloured to scale.

Figure 13: GE Results of EU Enlargement: Labour Force Change (Services)



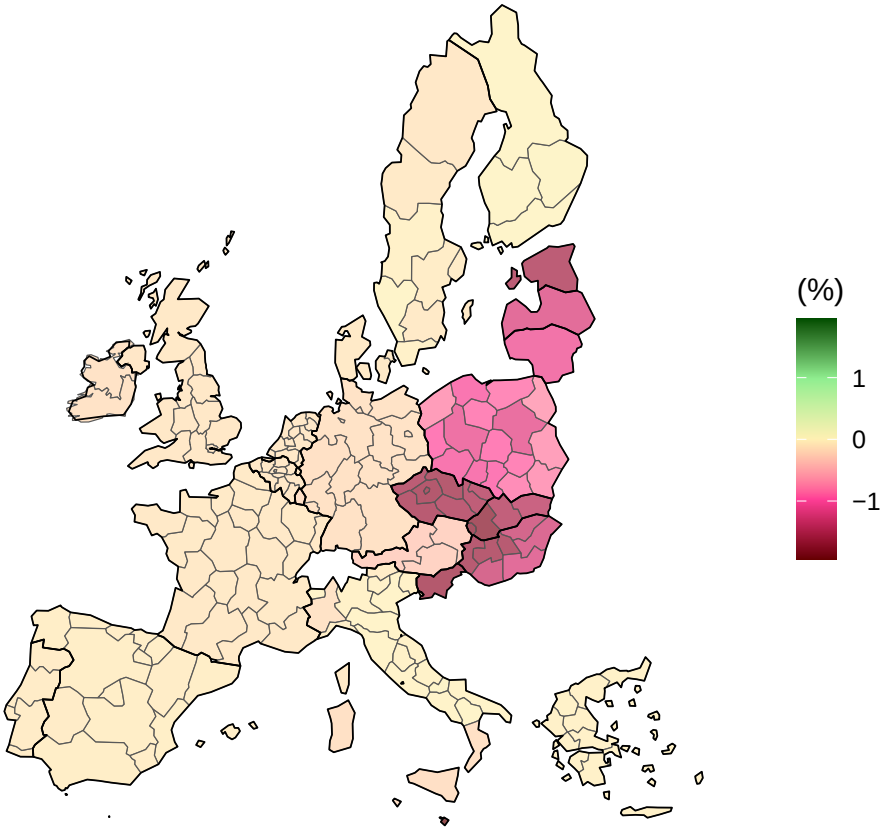
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 14: GE Results of EU Enlargement: Wages Change



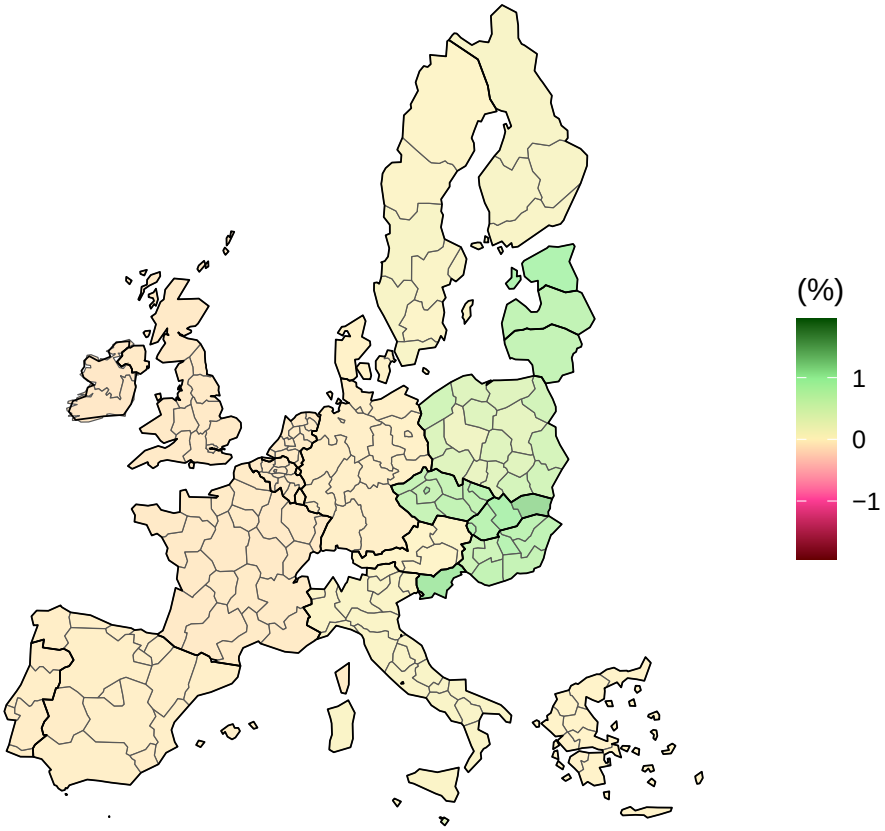
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 15: GE Results of EU Enlargement: Consumer Prices Change (Goods)



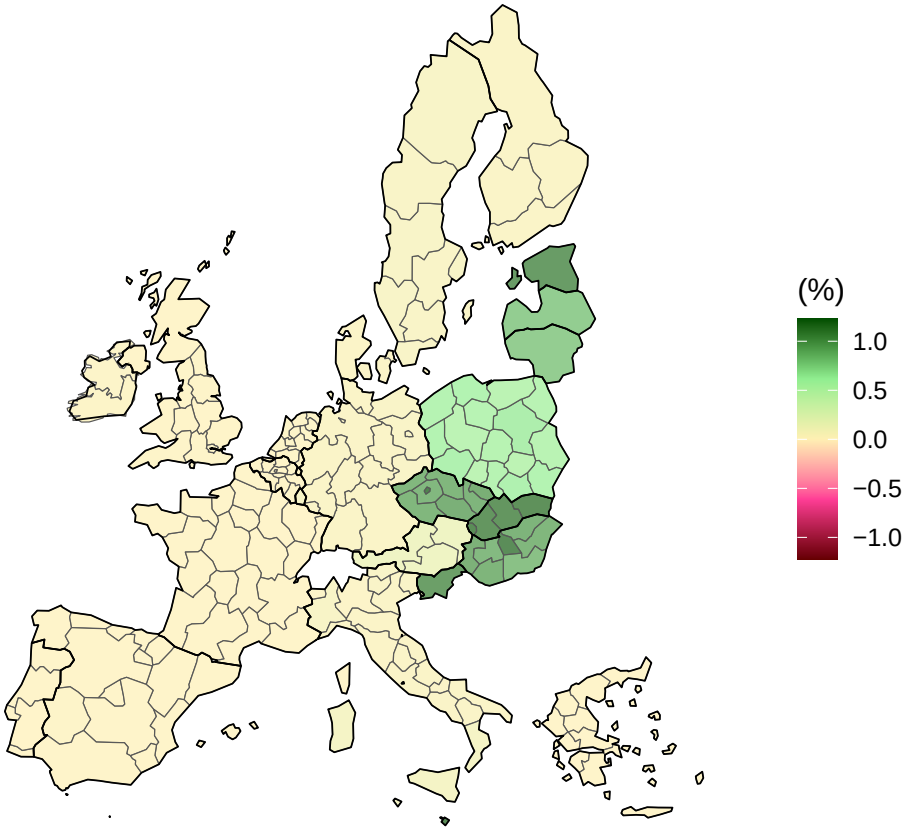
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

Figure 16: GE Results of EU Enlargement: Consumer Prices Change (Services)



Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

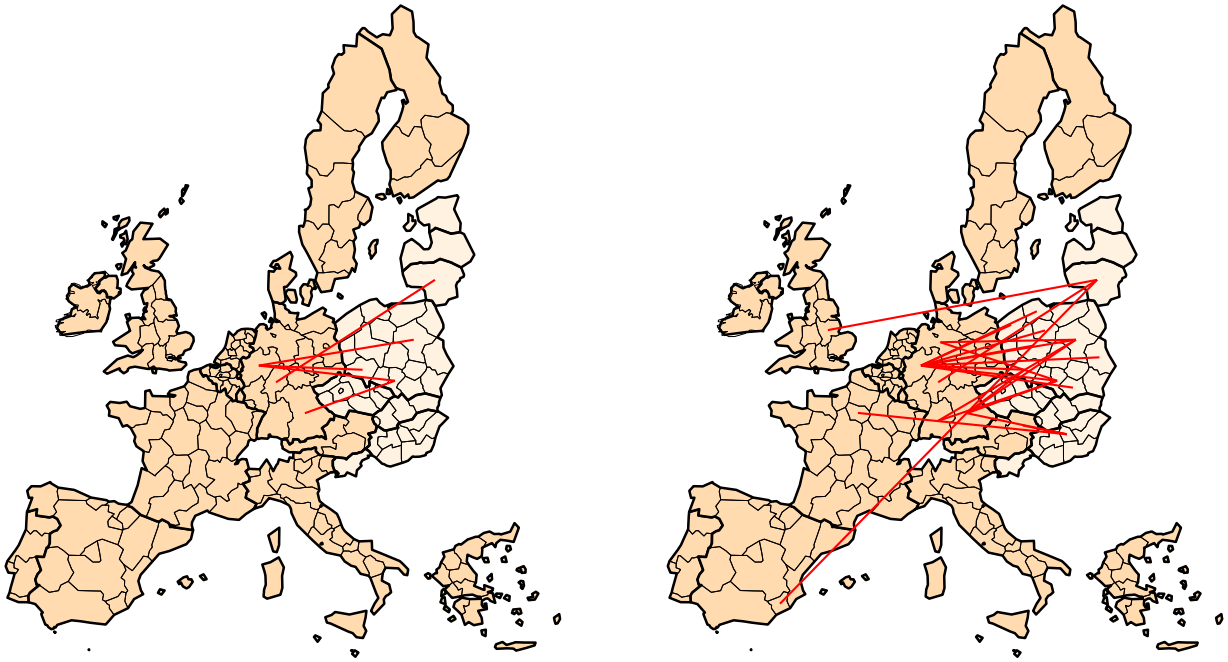
Figure 17: GE Results of EU Enlargement: Real Wages (Real GDP per Capita) Change



Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction).

6.2 Migration Adjustments and Real Wage Effects for Migrants

To assess the effects of the EU enlargement on bilateral migration flows between EU regions, we plot international bilateral migration flows exceeding 200 persons in the baseline and the counterfactual, i.e. before and after the trade and migration cost reductions of the EU enlargement are introduced. Figure 18 shows flows of at least 200 persons from regions in NMS to regions in EU15 countries, both in the baseline and the counterfactual scenarios. There is a clear increase in the number of flows exceeding 200 persons, especially from Polish regions to German regions, while also longer-distance migration intensifies, for example from Lithuania to England and Spain. Figure 19 shows that the number flows of at least 200 persons in the opposite direction, from regions in EU15 countries to regions in NMS, increases by 5 flows, from 9 to 14. Figure 20 shows that there is no substantial change in the number flows of at least 200 persons between regions of different EU15 countries. There are no flows exceeding 200 persons between regions from different NMS, although they do grow, with a maximum flow of 75 persons in the baseline and of 127 persons in the counterfactual.

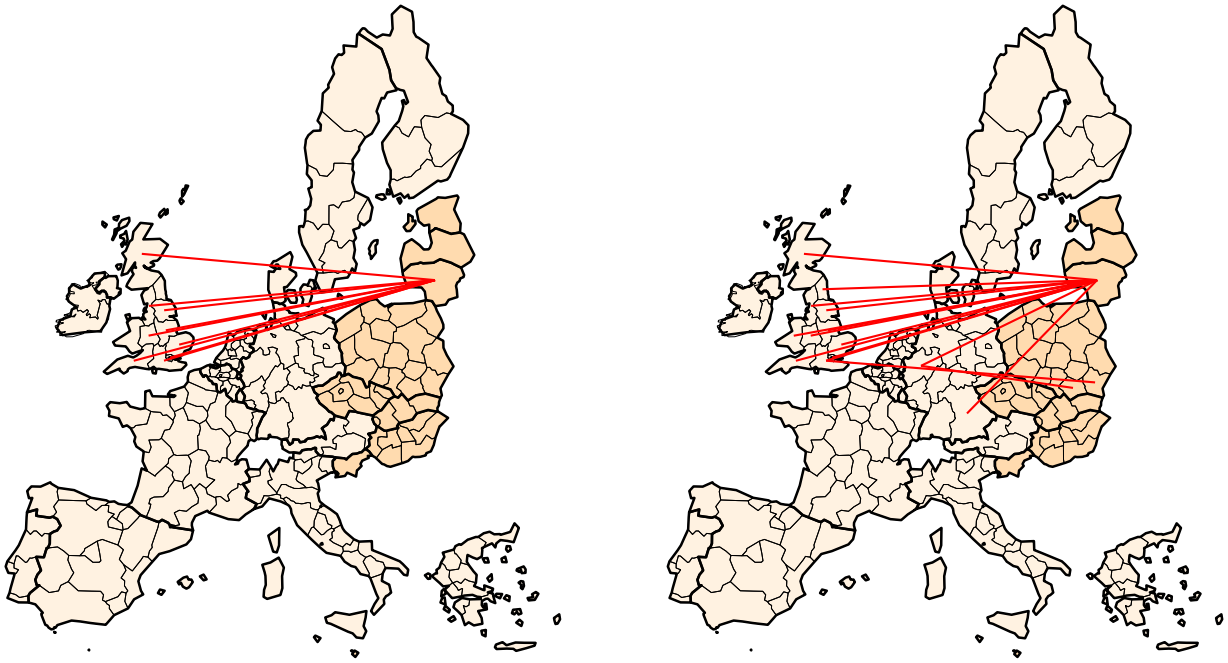


(a) Baseline (b) Counterfactual

Figure 18: International regional migration flows (> 200 persons) from New Member States to EU15 in the baseline scenario and the counterfactual scenario.

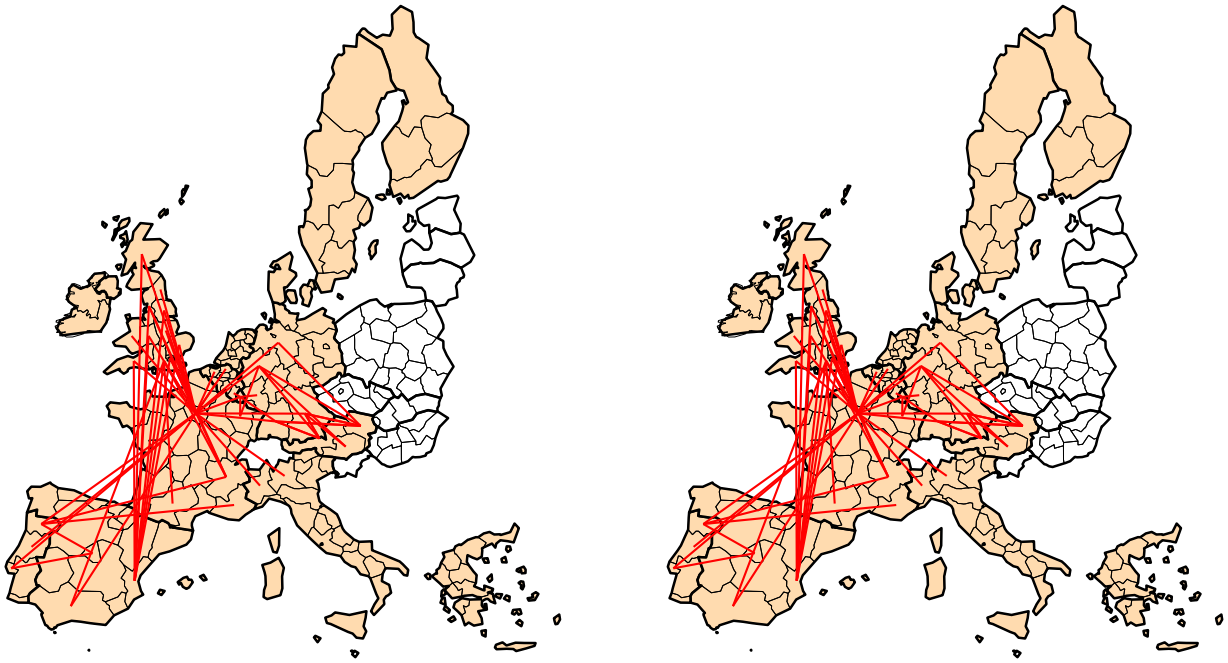
According to our theoretical framework, migration decisions are driven by real wage differences. To assess whether and to what extent workers are better off after the EU enlargement, one has to consider the change in real wages conditional on their migration decisions.[22] Importantly, the assessment must take into account endogenous migration

[22]Details on how we calculate real wages are given in Appendix A.9.



(a) Baseline (b) Counterfactual

Figure 19: International regional migration flows (> 200 persons) from EU15 to New Member States in the baseline scenario and the counterfactual scenario.



(a) Baseline (b) Counterfactual

Figure 20: International regional migration flows (> 200 persons) from regions in EU15 to regions in different EU15 countries in the baseline scenario and the counterfactual scenario.

responses, as workers' migration decisions may change following the enlargement. Table 3 illustrates an example of different worker groups with different migration decisions and corresponding real wage changes. The first group consists of persons who decide to stay in their origin region both in the baseline and in the counterfactual. In the example, those staying in the Polish region PL22 (Silesian Voivodeship) in both scenarios benefit from a real wage increase of 0.6% due to the EU enlargement. The second group decides to migrate both in the baseline and in the counterfactual. In the example, considering migration to the German destination region DE30 (Berlin), these persons encounter a smaller real wage increase of 0.04% (the same as stayers in DE30 both in the baseline and counterfactual). Third, and most interestingly, there is a group of persons who decide to stay in the origin region in the baseline and to migrate in the counterfactual, that is, their decision to migrate is induced by the EU enlargement. In the example, this group benefits from a real wage increase of 89.5%. The fourth group, which we address for completeness, consists of persons who decide to migrate to a different region in the baseline and to stay in their origin region in the counterfactual. In the example, this group encounters a real wage decrease of 46.9% (the same as baseline stayers in DE30 who decide to migrate to PL22 in the counterfactual).

Real wage changes for the third group can be interpreted as changes through endogenous migration, induced by the EU enlargement. Therefore, our interest lies in quantifying how many persons actually decide to migrate due to the EU enlargement. In our example, there are 3,950,039 persons staying in region PL22 in the baseline. In the counterfactual, 1,607 people less stay in PL22. To calculate how many more people migrated from PL22 to DE30 after the EU enlargement, we compare the bilateral migration flow from PL22 to DE30 in the baseline (65 people) to that in the counterfactual (111 people), which means that 46 more people migrated. This allows us to conclude that in this specific example about 46 people benefitted from a real wage increase of 89.5% due to the EU enlargement.[23] [24]

Overall, the EU enlargement increases migration flows between EU regions. In the counterfactual (i.e. after the EU enlargement), there are 38,180 more persons migrating between two different regions than in the baseline (i.e. before the enlargement). The real wage implications for these *counterfactually induced (CI) migrants* — who are baseline *stayers* (i.e. persons who decided to stay in their region of origin before the EU enlarge-

[23]For an exact calculation, note that also other bilateral migration flows from PL22 to other regions may decrease in the counterfactual relative to the baseline. Quantitatively, however, these flows are negligible compared with the reduction in the number of stayers. For PL22, the total reduction in outward migration to other destinations is only 3 individuals, compared with a reduction of 1,607 individuals among baseline stayers. In total, these are 280 individuals, compared with 38,180 baseline stayers who become counterfactual migrants. We therefore focus on the group of workers who are stayers before enlargement but become migrants thereafter.

[24]Due to the idiosyncratic shocks, there are also workers who migrate to a region with a lower real wage, realising a real wage decrease. However, the real wage increases dominate the aggregate effect, as described below.

Table 3: Example: Origin region PL22 (Silesian Voivodeship in Poland) and potential destination region DE30 (Berlin in Germany)

Group	Baseline (BLN)	Counterfactual (CFL)	Origin	Destination BLN	Destination CFL	Real wage change (relative to BLN)
1	Stayer	Stayer	PL22	PL22	PL22	0.6%
2	Migrant	Migrant	PL22	DE30	DE30	0.04%
3	Stayer	Migrant	PL22	PL22	DE30	89.5%
4	Migrant	Stayer	PL22	DE30	PL22	-46.9%

Notes: This table illustrates different possibilities of worker migration decisions for a worker originating from region PL22 and the associated change in real wage in the counterfactual (CFL, i.e. after EU enlargement) relative to the baseline (BLN, i.e. before EU enlargement). For illustration, the only migration-destination region shown is DE30, while in the real application, all EU regions are possible potential destination regions.

ment) and counterfactual *migrants* (i.e. persons who decided to migrate to a different region after the EU enlargement) — are illustrated in Figure 21 for all possible origin-destination migration decisions. Each cell is associated with a counterfactual origin-destination migration decision and the value represented by the colour gives the ratio of the corresponding counterfactual real wage relative to staying in the origin region in the baseline. Some regions in Sweden stand out as destinations offering large counterfactual real wage gains for migrants, especially SE33 (Upper Norrland).[25] The plot reveals the regional heterogeneity of real wage implications for the CI migrants, who decide to move due to the EU enlargement. This heterogeneity remains hidden when focussing on the real wage changes for the baseline-and-counterfactual stayers shown above in Figure 17, which lie between 0.003% and 1.2%. Weighting by the number of workers, we calculate that the average baseline-and-counterfactual stayer experiences a 0.15% real wage increase following the EU enlargement, while the average CI migrant increases her real wage by 39.63%. The average counterfactually induced migration effect (the ACI migration effect) on welfare is, hence, about 40%. The 10 flows contributing most to aggregate welfare (real wage increases multiplied by the number of CI migrants) are flows from regions in Poland and Lithuania to regions in Germany. The largest contributions come from migrants originating from the Polish region PL22 (Silesian Voivodeship) and from migrants going to the German region DEA (North Rhine-Westphalia).

[25]The northernmost Swedisch region Upper Norrland is a remote, resource-rich region. Sweden's green industrial transformation suggests substantial labour demand in the region, such that relatively strong real-wage migration incentives towards the region may not be implausible. In our results, however, we do not see strong increases in total inmigration or the labour force (see Figures 10 and 12), suggesting that high migration costs offset strong migration into the region.

Figure 21: Matrix of Real Wage Changes Depending on Region of Origin and Region of Destination



Notes: Origin regions in the rows, destination regions in the columns. The change is expressed as a ratio of the real wage in the counterfactual and the real wage in the baseline. The respective value is to be interpreted as a real wage change of the migration decision corresponding with that value compared to being a stayer (i.e. staying in the origin region) in the baseline. For example, a value of 1 for an origin-destination cell means that there is no real wage change associated with that origin-destination migration in the counterfactual relative to staying in the origin in the baseline. A value of 5 denotes a 5-fold real wage increase of the given origin-destination migration in the counterfactual relative to staying in the origin in the baseline.

6.3 Disentangling the Effects of Trade Liberalisation and Labour Market Opening

In addition to our main results, we calculate the general equilibrium effects for scenarios in which only trade liberalisation or only labour market opening are introduced as implied by the EU enlargement. Specifically, we implement a counterfactual scenario in which we only introduce trade cost changes, while migration costs stay unchanged. Equally, we implement a counterfactual scenario in which we only introduce migration cost changes, while trade costs stay unchanged. Comparing the effects of these separate counterfactual scenarios allows us to disentangle the role played by the trade cost change and by the migration cost change, respectively.

The average effect of the EU enlargement on real GDP per capita (see Figure 17) can largely be attributed to trade liberalisation, while labour market opening accounts for only a small share of the total effect. For goods, the contribution to the real output per capita gains following the EU enlargement by the trade cost change is 99.5%, while the migration cost change only contributes 0.5%. For services, the average contribution to real output per capita of the change in migration costs is 3%, which is larger, but still leaves 97% explained on average by the trade cost change. Our finding of only modest aggregate effects from migration is consistent with previous evidence. In their study on convergence across states and regions, Barro and Sala-I-Martin (1991) find that migration has only a modest effect on economic growth. Studying migration among NUTS2 regions in the EU, Fischer and Pfaffermayr (2018) document that migration has a more pronounced effect on reducing the variation in income per worker rather than making poorer regions catch up with the richer ones. Becker and Fetzer (2018) find small effects of post-2004-enlargement immigration from Eastern Europe on labour market outcomes, public services, and housing markets in the United Kingdom. The lacking empirical support of the theoretical potential of workers to alleviate regional disparities by relocating is discussed by Fischer (2019).

Several factors may explain the small contribution of labour market opening to the overall effect in our analysis. First, what matters for regional production is the size of the regional labour force, which is a composite of natives and migrants. As the model does not differentiate between these groups of workers, e.g. in terms of productivity, only the aggregate labour force in each region has economic relevance. Second, implied by the first point, what matters is net migration, the result of total outmigration and total inmigration. Figures 9 and 10 suggest that those regions encountering strong outmigration changes also face strong inmigration changes, such that net migration changes are much weaker. Indeed, the effect on aggregate labour force change in Figure 11 shows no substantial aggregate changes – where aggregation is over types of workers (natives and migrants) as well as over sectors (goods and services). Third, net migration is relatively

small relative to the domestic workers (i.e. the stayers, who stay in their region of origin), with an average of 0.263% in the baseline and of 0.267% in the counterfactual. Additionally, considering migrants between different regions, we observe that within-country migration makes up around 86% of all migration flows, leaving only 14% to international migration.

6.4 Migration Effects for Exemplary Regions

Given the modest aggregate effects of migration, we highlight the migration effects of some exemplary individual regions. Several regions stand out from Figures 9 and 10 with strong changes in outmigration and inmigration. These are small countries, which consist of only one single NUTS2 region, namely the Baltic regions of Estonia, Latvia, and Lithuania, the island of Malta, as well as Slovenia. Although Estonia faces a strong increase of 88% in net migration from the EU enlargement, the absolute numbers (increase of net migration from 54 to 102 workers) only make up a small share of stayers (0.004% in the baseline and 0.007% in the counterfactual). Similarly small numbers of migrants are at play in Latvia, Malta, and Slovenia. Lithuania, on the other hand, is a net immigration region and becomes even stronger so after the enlargement, with a net migration increase of 71%, which means that 2,905 persons more come to the region after the enlargement than before. The share of net immigration in the stayers rises from 0.12% to 0.21%.

Another interesting question is whether some regions change from being a net immigration region to a net emigration region, i.e. from receiving more migrants to seeing more migrants leave or vice versa. We only observe two such switching regions. The Bratislava region in Slovakia changes from a net immigration region to a net emigration region, meaning that in the baseline before the EU enlargement, more workers migrated to the Bratislava region than left from the Bratislava region to other regions, while after the enlargement, more people left than arrived to the region. The same switch is encountered by the region of Andalusia in Spain, while we do not observe any region switching from being a net emigration region to a net immigration region.

Also the Hungarian regions exhibit rather strong changes in net migration, albeit with a small share in the stayers. The region of Central Hungary, including Budapest, for example, encounters a net migration change of 83.6%, with baseline net migration of -673 workers (i.e. 673 more workers left the region than arrived to the region) and counterfactual net migration of -1,236 workers. The destination regions receiving larger flows from Central Hungary after the enlargement are regions in Austria (Ostösterreich), Germany (Baden-Württemberg), and France (Ile-de-France). For the regions in EU15 countries, we broadly observe expected changes in out- versus in-migration.

6.5 Does the EU Enlargement promote regional cohesion?

Finally, we discuss whether the EU enlargement promoted regional cohesion and helped reduce regional inequalities. Figure 22 plots the enlargement-induced change in real GDP per capita against each region's initial real GDP per capita level, measured as a share of the EU average. It shows that regions in the NMS, whose initial real GDP per capita levels are substantially below the EU average benefit most from the enlargement. Within the NMS, however, the largest gains accrue to central, primarily capital regions, such as Prague in the Czech Republic, the Bratislava Region in Slovakia, and Central Hungary including Budapest, which already exhibit relatively high initial income levels. The patterns suggest that the EU enlargement promotes β-convergence across Europe, with initially poorer regions tending to benefit more. Within countries, however, regions with initially stronger market access and more central locations capture larger benefits, limiting the extent to which integration translates into regional cohesion.

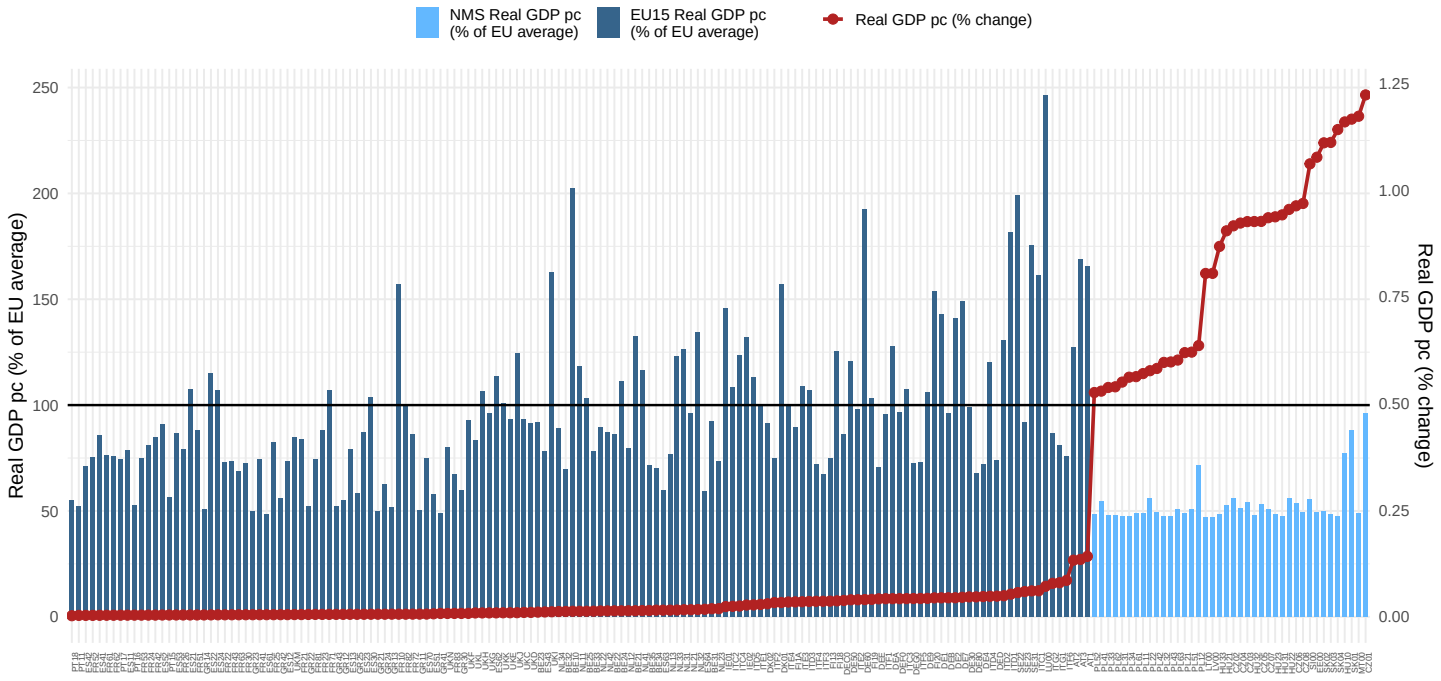
The negative association between initial income levels and enlargement-induced gains is also reflected in a simple regression of the change in real GDP per capita on pre-enlargement real GDP per capita levels. The estimated coefficient is negative and highly statistically significant, suggesting that regions with a 10% lower initial real GDP per capita experienced approximately 0.05 percentage points larger real GDP per capita gains from enlargement. While this exercise yields an estimate which is consistent with a convergence-enhancing effect of EU enlargement, its small magnitude indicates that enlargement may have contributed to regional convergence, but alone was insufficient to substantially reduce regional disparities.

7 Conclusion

We develop a structural framework which combines interregional trade and migration within and across national borders. Workers make migration decisions subject to migration costs, making the regional labour supply endogenous. Trade and migration are linked via regional real wages, which determine the allocation of labour across regions as well as regional production and trade. Our general equilibrium framework allows shocks to trade and migration costs to affect the spatial distribution of economic activity through both goods-market and labour-market adjustments.

We apply our framework to study the regional general equilibrium effects of the 2004 EU enlargement, which combined trade integration with the opening of labour markets, reducing the costs of regional trade and migration across the EU. Using data on bilateral trade and migration flows between and within 193 subnational regions in 24 countries, we estimate the effects of the EU enlargement on regional trade and migration. Our trade gravity estimation results suggest that the EU enlargement increased regional trade

Figure 22: Regional Real GDP per Capita Before EU Enlargement and Real GDP per Capita Effects of EU Enlargement



Notes: The bars indicate regional real GDP per capita averaged over the pre-enlargement period 2000-2003, consistent with the trade dataset used in our analysis. The red dots show the real GDP per capita effects from the EU enlargement, obtained in our counterfactual analysis.

flows by about 40%. The effect is more pronounced for goods trade, which increased by about 45% following the enlargement, while services trade increased by about 21%. Estimating our migration gravity equation, we find that the EU enlargement increased regional migration flows by about 71%.

The trade and migration cost reductions implied by our gravity estimates allow us to quantify the regional general equilibrium effects of the EU enlargement. Our results show strong increases in counterfactual trade and migration flows, as well as distributional effects in wages and consumer prices following the enlargement. While regional emigration and immigration tended to increase rather strongly, by up to about 70%, they did so simultaneously for the same regions in the NMS, leaving only modest changes in the regional labour force aggregated over sectors. More pronounced regional differences in the sectoral labour force changes suggest adjustments in regional sectoral specialisation after the enlargement. The real GDP per capita effects are positive for all regions, suggesting that the EU enlargement generated welfare gains across the EU. Accounting explicitly for migration decisions reveals considerable heterogeneity in these gains. While the average stayer experienced a welfare increase of 0.15%, the more than 38,000 CI migrants, who chose to relocate as a consequence of the enlargement, realised average welfare gains of nearly 40%. These large differences are only possible to uncover in our

regional framework which combines trade integration and labour mobility.

Decomposing the enlargement's effects on regional GDP per capita shows that trade liberalisation accounts for the majority of the aggregate effect, whereas labour market opening makes a comparatively small contribution. This finding should not be interpreted as evidence that migration is unimportant. Rather, it reflects the fact that regional aggregates largely capture the effects accruing to stayers, masking the substantial welfare gains for the workers who relocate. Taken together, our results suggest that trade liberalisation was the main driver of aggregate economic gains from enlargement, while labour mobility played an important role in the distribution across workers.

The 2004 EU enlargement was a policy shock implemented at the supranational level, namely between EU15 countries and NMS. Therefore, the most immediate effects are expected to arise between these two country groups. Studying outcomes at lower levels of aggregation, at the country or regional levels, can uncover distributional effects of this supranational policy. Although the effects' heterogeneity is more pronounced across countries than across regions on an EU-wide scale, examining regional effects within countries shows that the supranational policy indeed affected subnational regions differently. Our findings are consistent with overall economic convergence associated with the EU enlargement. However, among the relatively poorer NMS, central regions tended to experience larger gains than more peripheral regions, potentially reinforcing within-country disparities. This suggests that supranational integration alone may not be sufficient to address persistent regional inequalities. Complementary policies targeted at the regional level, such as the EU Cohesion Policy's Structural and Investment Funds, therefore play an important role in ensuring that the gains from integration are shared more evenly across regions.

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A Appendix

A.1 Derivation of Equation (4)

Equation (4) can be derived as follows: Consider utility obtained by workers in k from consuming sector s products, U_k^s from Equation (3) together with the budget constraint, yielding the Lagrangian for the upper nest and the resulting two first-order conditions

$$\mathcal{L} = \left(\sum_{r\in R} (c_{rk}^s)^{\frac{\sigma_s-1}{\sigma_s}}\right)^{\frac{\sigma_s}{\sigma_s-1}} - \lambda\left(L_k \sum_{r\in R} c_{rk}^s p_r^s t_{rk}^s - E_k^s\right),$$

$$\frac{\partial \mathcal{L}}{\partial c_{rk}^s} = 0 \iff \left(\sum_{r\in R} (c_{rk}^s)^{\frac{\sigma_s-1}{\sigma_s}}\right)^{\frac{1}{\sigma_s-1}} (c_{rk}^s)^{-\frac{1}{\sigma_s}} = \lambda L_k p_r^s t_{rk}^s,$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = 0 \iff E_k^s = L_k \sum_{r\in R} c_{rk}^s p_r^s t_{rk}^s.$$

From the first first-order condition, for any two regions r and r' (in countries i and i'),

$$\frac{(c_{rk}^s)^{-\frac{1}{\sigma_s}}}{(c_{r'k}^s)^{-\frac{1}{\sigma_s}}} = \frac{L_k p_r^s t_{rk}^s}{L_k p_{r'}^s t_{r'k}^s}.$$

Re-arranging and summing over all regions r', we obtain

$$L_k \sum_{r'\in R} c_{r'k}^s p_{r'}^s t_{r'k}^s = (p_r^s t_{rk}^s)^{\sigma_s} L_k c_{rk}^s \sum_{r'\in R} (p_{r'}^s t_{r'k}^s)^{1-\sigma_s}.$$

Using the second first-order condition (budget constraint) and the price aggregate for sector s products consumed in region k, $(P_k^s)^{1-\sigma_s} = \sum_{r'\in R} (p_{r'}^s t_{r'k}^s)^{1-\sigma_s}$, we obtain

$$L_k c_{rk}^s = \frac{1}{(P_k^s)^{1-\sigma_s}} (p_r^s t_{rk}^s)^{-\sigma_s} E_k^s.$$

The value of total trade is price times quantity,

$$L_k c_{rk}^s p_r^s t_{rk}^s = X_{rk}^s = \left(\frac{p_r^s t_{rk}^s}{P_k^s}\right)^{1-\sigma_s} E_k^s.$$

From the Cobb-Douglas utility specification over sectors, $U_k = \prod_s (U_k^s)^{\gamma^s}$, utility maximisation yields sectoral expenditure given by the shares γ^s,

$$E_k^s = \gamma^s E_k.$$

This finally yields trade flows of sector s products from region r to k given by

$$X_{rk}^s = \left(\frac{p_r^s t_{rk}^s}{P_k^s}\right)^{1-\sigma_s} \gamma^s E_k.$$

A.2 Derivation of Equation (6)

Equation (6) can be derived as follows:

$$\begin{aligned}
\widehat{\pi}_{rk}^s = \frac{(\pi_{rk}^s)^c}{(\pi_{rk}^s)^b} &= \frac{\left(\frac{(p_r^s)^c (t_{rk}^s)^c}{(P_k^s)^c}\right)^{1-\sigma_s}}{\left(\frac{(p_r^s)^b (t_{rk}^s)^b}{(P_k^s)^b}\right)^{1-\sigma_s}} \\
&= \left(\frac{\frac{(p_r^s)^c (t_{rk}^s)^c}{(p_r^s)^b (t_{rk}^s)^b}}{\frac{(P_k^s)^c}{(P_k^s)^b}}\right)^{1-\sigma_s} \\
&= \left(\frac{\frac{(p_r^s)^c (t_{rk}^s)^c}{(p_r^s)^b (t_{rk}^s)^b}}{\widehat{P}_k^s}\right)^{1-\sigma_s} \\
&= \frac{\left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\sigma_s}}{\left(\frac{\left[\sum_{r\in R}\left((p_r^s)^c (t_{rk}^s)^c\right)^{1-\sigma_s}\right]^{\frac{1}{1-\sigma_s}}}{\left[\sum_{r\in R}\left((p_r^s)^b (t_{rk}^s)^b\right)^{1-\sigma_s}\right]^{\frac{1}{1-\sigma_s}}}\right)^{1-\sigma_s}} \\
&= \frac{\left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\sigma_s}}{\frac{\sum_{r\in R}\frac{\left((p_r^s)^b (t_{rk}^s)^b\right)^{1-\sigma_s}}{\left((p_r^s)^b (t_{rk}^s)^b\right)^{1-\sigma_s}}\left((p_r^s)^c (t_{rk}^s)^c\right)^{1-\sigma_s}}{\sum_{r\in R}\left((p_r^s)^b (t_{rk}^s)^b\right)^{1-\sigma_s}}} \\
&= \frac{\left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\sigma_s}}{\sum_{r\in R}\frac{\left((p_r^s)^b (t_{rk}^s)^b\right)^{1-\sigma_s}}{\left((P_k^s)^b\right)^{1-\sigma_s}}\left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\sigma_s}} \\
&= \frac{\left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\sigma_s}}{\sum_{r\in R}(\pi_{rk}^s)^b \left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\sigma_s}}
\end{aligned}$$

A.3 Derivation of Equations (11) and (12)

Indirect utility in Equation (11) can be derived as follows:

$$U_k^* = \prod_s \left(\left[\sum_{r\in R}\left(\left(\frac{1}{P_k^s}\right)^{1-\sigma_s} \left(p_r^s t_{rk}^s\right)^{-\sigma_s} \frac{E_k^s}{L_k}\right)^{\frac{\sigma_s-1}{\sigma_s}}\right]^{\frac{\sigma_s}{\sigma_s-1}}\right)^{\gamma^s}$$

$$
\begin{aligned}
&= \prod_s \left(\frac{E_k^s}{L_k \left(P_k^s\right)^{1-\sigma_s}} \left[\sum_{r \in R} \left(p_r^s t_{rk}^s\right)^{-\sigma_s \frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k \left(P_k^s\right)^{1-\sigma_s}} \left[\sum_{r \in R} \left(p_r^s t_{rk}^s\right)^{1-\sigma_s} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k \left(P_k^s\right)^{1-\sigma_s}} \left[\left(P_k^s\right)^{1-\sigma_s} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k P_k^s} \right)^{\gamma^s}.
\end{aligned}
$$

With frictionless sectoral mobility within a region, workers move freely across sectors, equalising wages between sectors within a region, $w_k^s = w_k \; \forall \; s$. Expressing sectoral expenditure as the share of total expenditure, $E_k^s = \gamma^s E_k$, and accounting for trade imbalances, that is, $E_k = w_k L_k + D_k$, we obtain

$$
\begin{aligned}
U_k^* &= \prod_s \left(\frac{\gamma^s E_k}{L_k P_k^s} \right)^{\gamma^s} \\
&= \frac{\prod_s \left(\frac{w_k L_k + D_k}{L_k} \right)^{\gamma^s}}{\prod_s \left(\frac{P_k^s}{\gamma^s} \right)^{\gamma^s}} \\
&= \frac{w_k + \frac{D_k}{L_k}}{\prod_s \left(\frac{P_k^s}{\gamma^s} \right)^{\gamma^s}},
\end{aligned}
$$

where we used $\sum_s \gamma^s = 1$. With the Cobb-Douglas price index over sectoral varieties given by $P_k = \prod_s \left(\frac{P_k^s}{\gamma^s} \right)^{\gamma^s}$, we obtain

$$
U_k^* = \frac{w_k + \frac{D_k}{L_k}}{P_k}.
$$

A.4 Derivation of Equation (15)

We closely follow the standard discrete-choice logit model à la McFadden (1974) and Train (2009) to derive these logit probabilities.

We start from Equation (14), where the unobserved parts have density

$$
f(\varepsilon_{kr,h}) = e^{-\varepsilon_{kr,h}} e^{-e^{-\varepsilon_{kr,h}}} \tag{36}
$$

and cumulative distribution

$$F(\varepsilon_{kr,h}) = e^{-e^{-\varepsilon_{kr,h}}}, \tag{37}$$

in line with the assumption of the logit model that the $\varepsilon_{kr,h}$ are distributed iid extreme value (specifically, they are type I extreme value or Gumbel distributed).
Conditional on $\varepsilon_{kr,h}$, Equation (14) is the cumulative distribution for each $\varepsilon_{kl,h}$ evaluated at $\varepsilon_{kr,h} + \frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho}$, given by Equation (37). For independent ε's we can write the cumulative distribution over all other alternatives as the product of the individual cumulative distributions. As usual, we reach the unconditional $Pr_{kr,h}$ by integrating $Pr_{kr,h} \mid \varepsilon_{kr,h}$ over all possible values of $\varepsilon_{kr,h}$ for the given density (36):

$$Pr_{kr,h} = \int \left(\prod_{l \in R, l \neq r} e^{-e^{-(\varepsilon_{kr,h} + \frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})}} \right) e^{-\varepsilon_{kr,h}} e^{-e^{-\varepsilon_{kr,h}}} d\varepsilon_{kr,h}. \tag{38}$$

Starting from this expression we can derive the typical multinomial-logit choice probability expression

$$\begin{aligned} Pr_{kr,h} &= \int_{\varepsilon_{kr,h}=-\infty}^{\infty} \left(\prod_{l \in R} e^{-e^{-(\varepsilon_{kr,h} + \frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})}} \right) e^{-\varepsilon_{kr,h}} d\varepsilon_{kr,h} \\ &= \int_{\varepsilon_{kr,h}=-\infty}^{\infty} \exp\left(-\sum_{l \in R} e^{-(\varepsilon_{kr,h} + \frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})} \right) e^{-\varepsilon_{kr,h}} d\varepsilon_{kr,h} \\ &= \int_{\varepsilon_{kr,h}=-\infty}^{\infty} \exp\left(-e^{-\varepsilon_{kr,h}} \sum_{l \in R} e^{-(\frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})} \right) e^{-\varepsilon_{kr,h}} d\varepsilon_{kr,h}. \end{aligned} \tag{39}$$

Defining $t = e^{(-\varepsilon_{kr,h})}$ such that $e^{(-\varepsilon_{kr,h})} d\varepsilon_{kr,h} = -dt$. Noting that t approaches 0 as $\varepsilon_{kr,h}$ approaches infinity, and that t is infinite if $\varepsilon_{kr,h}$ approaches negative infinity, we obtain

$$\begin{aligned} Pr_{kr,h} &= \int_{\infty}^{0} \exp\left(-t \sum_{l \in R} e^{-(\frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})} \right) (-dt) \\ &= \int_{0}^{\infty} \exp\left(-t \sum_{l \in R} e^{-(\frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})} \right) dt \\ &= \left. \frac{\exp\left(-t \sum_{l \in R} e^{-(\frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})} \right)}{-\sum_{l \in R} e^{-(\frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})}} \right|_{0}^{\infty} \\ &= \frac{1}{\sum_{l \in R} e^{-(\frac{V_{kr}}{\rho} - \frac{V_{kl}}{\rho})}} = \frac{e^{\frac{V_{kr}}{\rho}}}{\sum_{l \in R} e^{\frac{V_{kl}}{\rho}}} = \frac{\left(e^{V_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l \in R} \left(e^{V_{kl}}\right)^{\frac{1}{\rho}}}. \end{aligned} \tag{40}$$

A.5 Derivation of Equation (20)

$$\hat{\mu}_{kr} = \frac{\mu^c_{kr}}{\mu^b_{kr}} = \frac{\frac{\left(\frac{\omega^c_r}{\delta^c_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega^c_l}{\delta^c_{kl}}\right)^{\frac{1}{\rho}}}}{\frac{\left(\frac{\omega^b_r}{\delta^b_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega^b_l}{\delta^b_{kl}}\right)^{\frac{1}{\rho}}}} = \frac{\frac{\left(\frac{\omega^c_r}{\delta^c_{kr}}\right)^{\frac{1}{\rho}}}{\left(\frac{\omega^b_r}{\delta^b_{kr}}\right)^{\frac{1}{\rho}}}}{\frac{\sum_{l\in R}\left(\frac{\omega^c_l}{\delta^c_{kl}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega^b_l}{\delta^b_{kl}}\right)^{\frac{1}{\rho}}}} = \frac{\left(\frac{\hat{\omega}_r}{\hat{\delta}_{kr}}\right)^{\frac{1}{\rho}}}{\frac{\sum_{l\in R}\frac{\left(\frac{\omega^b_l}{\delta^b_{kl}}\right)^{\frac{1}{\rho}}}{\left(\frac{\omega^b_l}{\delta^b_{kl}}\right)^{\frac{1}{\rho}}}\left(\frac{\omega^c_l}{\delta^c_{kl}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega^b_l}{\delta^b_{kl}}\right)^{\frac{1}{\rho}}}} = \frac{\left(\frac{\hat{\omega}_r}{\hat{\delta}_{kr}}\right)^{\frac{1}{\rho}}}{\frac{\sum_{l\in R}\left(\frac{\omega^b_l}{\delta^b_{kl}}\right)^{\frac{1}{\rho}}\left(\hat{\omega}_l\hat{\delta}_{kl}\right)^{\frac{1}{\rho}}}{\sum_{m\in R}\left(\frac{\omega^b_m}{\delta^b_{km}}\right)^{\frac{1}{\rho}}}}$$

$$= \frac{\left(\frac{\hat{\omega}_r}{\hat{\delta}_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\frac{\left(\frac{\omega^b_l}{\delta^b_{kl}}\right)^{\frac{1}{\rho}}}{\sum_{m\in R}\left(\frac{\omega^b_m}{\delta^b_{km}}\right)^{\frac{1}{\rho}}}\left(\frac{\hat{\omega}_k}{\hat{\delta}_{kl}}\right)^{\frac{1}{\rho}}} = \frac{\left(\frac{\hat{\omega}_r}{\hat{\delta}_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\mu^b_{kl}\left(\frac{\hat{\omega}_l}{\hat{\delta}_{kl}}\right)^{\frac{1}{\rho}}}.$$

A.6 Migration Accounting Identities

$$\begin{aligned} N_k &= \sum_{r\in R} M_{kr} \\ &= \sum_{r\in R}\left(\frac{\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}\right)N_k \\ &= \frac{N_k}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}\sum_{r\in R}\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}} \\ &= N_k. \end{aligned}$$

$$L_r = \sum_{k\in R}\left(\frac{\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}\right)N_k \Rightarrow$$

$$\sum_{r\in R} L_r = \sum_{r\in R}\sum_{k\in R}\left(\frac{\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}\right)N_k \Rightarrow$$

$$\sum_{r\in R} L_r = \sum_{k\in R}\sum_{r\in R}\left(\frac{\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}}\right)N_k \Rightarrow$$

$$\sum_{r\in R} L_r = \sum_{k\in R} \frac{N_k}{\sum_{l\in R}\left(\frac{\omega_l}{\delta_{kl}}\right)^{\frac{1}{\rho}}} \sum_{r\in R}\left(\frac{\omega_r}{\delta_{kr}}\right)^{\frac{1}{\rho}} \Rightarrow$$

$$\sum_{r\in R} L_r = \sum_{k\in R} N_k.$$

A.7 Model Equations in Levels

$$w_r = \frac{Y_r}{L_r}, \tag{41}$$

$$L_r = \sum_{k\in R} M_{kr}, \tag{42}$$

$$Y_r^s = \sum_{k\in R} X_{rk}^s, \tag{43}$$

$$Y_r = \sum_s Y_r^s, \tag{44}$$

$$E_r = Y_r + D_r, \tag{45}$$

$$P_k^s = \left[\sum_{r\in R} (w_r^s t_{rk}^s)^{1-\sigma_s}\right]^{\frac{1}{1-\sigma_s}}, \tag{46}$$

$$X_{rk}^s = \left(\frac{w_r^s t_{rk}^s}{P_k^s}\right)^{1-\sigma_s} \gamma^s E_k, \tag{47}$$

$$M_{kr} = \frac{\left(\frac{w_r}{P_r \delta_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R}\left(\frac{w_l}{P_l \delta_{kl}}\right)^{\frac{1}{\rho}}} N_k. \tag{48}$$

Note that we have used $w_r = p_r$.

A.8 Model Version: Nested CES with $\sigma^s \neq \eta^s$

In our multi-country, multi-region model of trade and migration each country $i \in C$ consists of a set of subnational regions R_i. Regions are indexed by k and r, and the total set of regions in all countries is denoted by R. Each region is inhabited by workers, who supply labour inelastically and derive utility from consumption.

A.8.1 Bilateral Trade Flows

Products are differentiated by region of origin following Armington (1969). There are two sectors s, goods G and services S, $s \in \{G, S\}$, and each region produces its variety in each sector, using labour as the only factor of production, where one unit of labour produces one unit of output. Assuming perfect competition, the factory gate price of the sector-s product produced in region r equals the sectoral wage in the same region, $p_r^s = w_r^s$. We assume iceberg trade costs $t_{rk}^s \geq 1$ for sector-s products shipped from region r to region k following Samuelson (1952), such that t_{rk}^s units of a product must be shipped from region r for one unit to arrive in region k. This implies that the consumer price of a sector-s variety from region r in region k is $p_{rk}^s = p_r^s t_{rk}^s$.

A representative worker in region k derives utility from consumption according to

$$U_k = \prod_s \left(U_k^s\right)^{\gamma^s} = \prod_s \left(\left[\sum_{i \in C} \left(c_{ik}^s\right)^{\frac{\sigma_s - 1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s - 1}} \right)^{\gamma^s}, \tag{49}$$

where c_{ik}^s is the quantity of sector-s products the representative worker in region k purchases from country i. $\sigma_s > 1$ is the elasticity of substitution in consumption between sector-s products from different countries and γ^s are shares with $\sum_s \gamma^s = 1$.

Utility in Equation (49) consists of 3 nests: (i) a sectoral nest which constitutes the standard Cobb-Douglas case, (ii) a country-level nest for each sector s, U_k^s, and (iii) a regional nest for regional varieties of sector-s products for every country i, c_{ik}^s. In the lowest nest, c_{ik}^s is the aggregate of sector-s products from all regions r in country i purchased by the representative worker in region k, c_{rk}^s, given by

$$c_{ik}^s = \left[\sum_{r \in R_i} \left(c_{rk}^s\right)^{\frac{\eta_s - 1}{\eta_s}} \right]^{\frac{\eta_s}{\eta_s - 1}}, \tag{50}$$

where $\eta_s > 1$ is the elasticity of substitution between sector-s products from different regions within a country.

The total labour force in region k is denoted by L_k. It is allocated across the two sectors such that $L_k = \sum_s L_k^s = L_k^G + L_k^S$. Assuming homogeneous workers, aggregate utility in region k is given by the utility of the representative worker, U_k, multiplied by

the total number of workers, L_k.

For each country i and sector s, workers in region k maximise Equation (50) subject to the budget constraint $\sum_{r \in R_i} c^s_{rk} p^s_r t^s_{rk} = c^s_{ik} P^s_{ik}$, where P^s_{ik} is the sector-s CES price aggregate over all sector-s regional varieties of country i that are consumed in region k, given by $P^s_{ik} = \left[\sum_{r \in R_i} \left(p^s_r t^s_{rk}\right)^{1-\eta_s}\right]^{\frac{1}{1-\eta_s}}$. In the aggregate, the budget constraint implies that the sum of money spent by workers in region k on sector-s products from all regions in country i equals the expenditure of region k on sector-s products from country i. The value of aggregate sales of the sector-s product from region r in country i to region k can then be expressed as

$$X^s_{rk} = L_k c^s_{rk} p^s_r t^s_{rk} = \left(\frac{p^s_r t^s_{rk}}{P^s_{ik}}\right)^{1-\eta_s} L_k c^s_{ik} P^s_{ik}. \tag{51}$$

U^s_k from equation (49) is maximised subject to the aggregate sectoral budget constraint $\sum_{i \in C} L_k c^s_{ik} P^s_{ik} = E^s_k$, that is, total expenditure of region k on sector-s products is equal to the sum of its expenditure (i.e. the aggregate spending of the workers in k) on sector-s products from all countries. The value of aggregate sales of the sector-s products from country i to region k can then be expressed as

$$X^s_{ik} = L_k c^s_{ik} P^s_{ik} = \left(\frac{P^s_{ik}}{P^s_k}\right)^{1-\sigma_s} E^s_k, \tag{52}$$

where the aggregate CES price index for sector-s products consumed in region k is $P^s_k = \left[\sum_{i \in C} \left(P^s_{ik}\right)^{1-\sigma_s}\right]^{\frac{1}{1-\sigma_s}}$.

Substituting $L_k c^s_{ik} P^s_{ik}$ from (52) into (51), we obtain the sectoral trade gravity equation

$$X^s_{rk} = L_k c^s_{rk} p^s_r t^s_{rk} = \left(\frac{p^s_r t^s_{rk}}{P^s_{ik}}\right)^{1-\eta_s} \left(\frac{P^s_{ik}}{P^s_k}\right)^{1-\sigma_s} E^s_k. \tag{53}$$

Total expenditure is given by $E_k = \sum_s E^s_k = \sum_s \gamma^s E_k$ with $\sum_s \gamma^s = 1$, resulting from maximizing U_k in equation (49). Replacing sectoral expenditure by the share of total expenditure, $E^s_k = \gamma^s E_k$, we obtain

$$X^s_{rk} = L_k c^s_{rk} p^s_r t^s_{rk} = \left(\frac{p^s_r t^s_{rk}}{P^s_{ik}}\right)^{1-\eta_s} \left(\frac{P^s_{ik}}{P^s_k}\right)^{1-\sigma_s} \gamma^s E_k. \tag{54}$$

Expressing the spending of region k on sector-s goods from region r in country i as share of spending of region k on sector s yields

$$\pi^s_{rk} = \frac{X^s_{rk}}{\gamma^s E_k} = \left(\frac{p^s_r t^s_{rk}}{P^s_{ik}}\right)^{1-\eta_s} \left(\frac{P^s_{ik}}{P^s_k}\right)^{1-\sigma_s}. \tag{55}$$

Analogously, spending of region k on sector-s goods from country i as share of spending

of region k on sector s is defined as

$$\pi_{ik}^s = \frac{X_{ik}^s}{\gamma^s E_k} = \left(\frac{P_{ik}^s}{P_k^s}\right)^{1-\sigma_s}. \tag{56}$$

We follow Dekle, Eaton, and Kortum (2007, 2008) and formulate the framework in changes, which has the advantage that we do not need to specify trade costs in levels. The change, denoted by a hat, of π_{rk}^s between the baseline (denoted with superscript b) and the counterfactual (denoted with superscript c) is given by

$$\widehat{\pi}_{rk}^s = \frac{(\pi_{rk}^s)^c}{(\pi_{rk}^s)^b} = \frac{\left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\eta_s} \left(\sum_{r\in R_i} (\pi_{rk}^s)^b \left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\eta_s}\right)^{\frac{1-\sigma_s}{1-\eta_s}}}{\sum_{r\in R_i} (\pi_{rk}^s)^b \left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\eta_s} \sum_{i\in C} (\pi_{ik}^s)^b \left[\sum_{r\in R_i} (\pi_{rk}^s)^b \left(\widehat{p}_r^s \widehat{t}_{rk}^s\right)^{1-\eta_s}\right]^{\frac{1-\sigma_s}{1-\eta_s}}}. \tag{57}$$

Market clearing implies that total output of each region in sector s is equal to sector-s sales to all destination regions, including domestic sales in the home region, $Y_r^s = \sum_{k\in R} X_{rk}^s$ (where R denotes the entirety of all regions in all countries). Using equations (53) and (55), we can express output in sector s as

$$\begin{aligned} Y_r^s &= \sum_{k\in R} \left(\frac{p_r^s t_{rk}^s}{P_{ik}^s}\right)^{1-\eta_s} \left(\frac{P_{ik}^s}{P_k^s}\right)^{1-\sigma_s} E_k^s \\ &= \sum_{k\in R} \pi_{rk}^s E_k^s \\ &= \sum_{k\in R} \pi_{rk}^s \gamma^s E_k. \end{aligned} \tag{58}$$

The counterfactual value of Y_r^s, $(Y_r^s)^c$, can be stated as

$$(Y_r^s)^c = \sum_{k\in R} (\pi_{rk}^s)^c (E_k^s)^c = \sum_{k\in R} \widehat{\pi}_{rk}^s (\pi_{rk}^s)^b \widehat{E}_k^s (E_k^s)^b = \sum_{k\in R} \widehat{X}_{rk}^s (X_{rk}^s)^b. \tag{59}$$

With labour being the only factor of production and full employment, we can express regional output in sector s by total factor income in sector s, $Y_r^s = w_r^s L_r^s$. Expenditures on sector-s goods are related to output in sector s by

$$E_r^s = Y_r^s + D_r^s = w_r^s L_r^s + D_r^s, \tag{60}$$

where D_r^s captures trade imbalances for sector s. Sectoral trade imbalances occur naturally, as spending on products from one sector can be financed by output from a different sector. Aggregating over sectors yields trade imbalances at the regional level, D_r, such

that total expenditures are related to total output by

$$E_r = \sum_s E_r^s = \sum_s \left(Y_r^s + D_r^s\right) = \sum_s Y_r^s + \sum_s D_r^s = Y_r + D_r = w_r L_r + D_r. \tag{61}$$

We allow for trade imbalances at both the sectoral and regional levels, as these are observed in the data. In the counterfactual analysis, we retain sectoral trade imbalances while imposing balanced trade at the regional level.

A.8.2 Bilateral Migration Flows

In our model, workers can move both between sectors and regions. While we assume frictionless mobility across sectors, migration across regions is costly and modelled as a discrete choice over the set of all regions R. A worker's decision to migrate crucially depends on the net utility attainable in every alternative. We therefore derive the indirect utility of a representative worker in region k, U_k^*, by substituting the optimal consumption from Equations (50) and (53), $c_{ik}^s = \left[\sum_{r\in R_i} \left(c_{rk}^s\right)^{\frac{\eta_s-1}{\eta_s}}\right]^{\frac{\eta_s}{\eta_s-1}}$ and $c_{rk}^s = \left(\frac{1}{P_{ik}^s}\right)^{1-\eta_s} \left(p_r^s t_{rk}^s\right)^{-\eta_s} \left(\frac{P_{ik}^s}{P_k^s}\right)^{1-\sigma_s} \frac{E_k^s}{L_k}$, into Equation (49), yielding

$$U_k^* = \prod_s \left(\frac{E_k^s}{L_k P_k^s}\right)^{\gamma^s}. \tag{62}$$

Equation (62) can be derived as follows:

$$\begin{aligned}
U_k^* &= \prod_s \left(\left[\sum_{i\in C} \left(\left[\sum_{r\in R_i} \left(\left(\frac{1}{P_{ik}^s}\right)^{1-\eta_s} \left(p_r^s t_{rk}^s\right)^{-\eta_s} \left(\frac{P_{ik}^s}{P_k^s}\right)^{1-\sigma_s} \frac{E_k^s}{L_k} \right)^{\frac{\eta_s-1}{\eta_s}} \right]^{\frac{\eta_s}{\eta_s-1}} \right)^{\frac{\sigma_s-1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s-1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k (P_k^s)^{1-\sigma_s}} \left[\sum_{i\in C} \left(P_{ik}^s\right)^{(1-\sigma_s)\frac{\sigma_s-1}{\sigma_s}} \left(\frac{1}{P_{ik}^s}\right)^{(1-\eta_s)\frac{\sigma_s-1}{\sigma_s}} \left(\left[\sum_{r\in R_i} \left(\left(p_r^s t_{rk}^s\right)^{-\eta_s} \right)^{\frac{\eta_s-1}{\eta_s}} \right]^{\frac{\eta_s}{\eta_s-1}} \right)^{\frac{\sigma_s-1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s-1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k (P_k^s)^{1-\sigma_s}} \left[\sum_{i\in C} \left(P_{ik}^s\right)^{(1-\sigma_s)\frac{\sigma_s-1}{\sigma_s}} \left(\frac{1}{P_{ik}^s}\right)^{(1-\eta_s)\frac{\sigma_s-1}{\sigma_s}} \left(\left[\left(P_{ik}^s\right)^{1-\eta_s} \right]^{\frac{\eta_s}{\eta_s-1}} \right)^{\frac{\sigma_s-1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s-1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k (P_k^s)^{1-\sigma_s}} \left[\sum_{i\in C} \left(P_{ik}^s\right)^{(1-\sigma_s)\frac{\sigma_s-1}{\sigma_s}} \left(\frac{1}{P_{ik}^s}\right)^{\frac{\sigma_s-1}{\sigma_s}} \right]^{\frac{\sigma_s}{\sigma_s-1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k (P_k^s)^{1-\sigma_s}} \left[\sum_{i\in C} \left(P_{ik}^s\right)^{1-\sigma_s} \right]^{\frac{\sigma_s}{\sigma_s-1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k (P_k^s)^{1-\sigma_s}} \left[\left(P_k^s\right)^{1-\sigma_s} \right]^{\frac{\sigma_s}{\sigma_s-1}} \right)^{\gamma^s} \\
&= \prod_s \left(\frac{E_k^s}{L_k P_k^s} \right)^{\gamma^s}.
\end{aligned}$$

The remainder follows the steps of the model in the main text.

A.8.3 The Link Between Trade and Migration

We take into account that the uniform wage across the sectors within a region (due to free labour mobility across sectors) implies uniform regional producer prices, $w_r = p_r$, and note the changes of the sectoral expenditure and the price index are given by

$$\begin{aligned}\widehat{E}_k^s &= \frac{\gamma_s E_k^c}{\gamma_s E_k^b} = \widehat{E}_k, \\ \widehat{P}_k &= \frac{\prod_s \left(\frac{(P_k^s)^c}{\gamma^s}\right)^{\gamma^s}}{\prod_s \left(\frac{(P_k^s)^b}{\gamma^s}\right)^{\gamma^s}} = \prod_s (\widehat{P}_k^s)^{\gamma^s}.\end{aligned}$$

Collecting all relevant equations yields our system of trade and migration, expressed in changes, where equations with superscript s hold for each sector:

$$\widehat{\pi}_{rk}^s = \frac{\left(\widehat{w}_r \widehat{t}_{rk}^s\right)^{1-\eta_s} \left(\sum_{l\in R_i} (\pi_{lk}^s)^b \left(\widehat{w}_l \widehat{t}_{lk}^s\right)^{1-\eta_s}\right)^{\frac{1-\sigma_s}{1-\eta_s}}}{\left(\sum_{l\in R_i} (\pi_{lk}^s)^b \left(\widehat{w}_l \widehat{t}_{lk}^s\right)^{1-\eta_s}\right) \sum_{i\in C} (\pi_{ik}^s)^b \left[\sum_{l\in R_i} (\pi_{lk}^s)^b \left(\widehat{w}_l \widehat{t}_{lk}^s\right)^{1-\eta_s}\right]^{\frac{1-\sigma_s}{1-\eta_s}}}, \tag{63}$$

$$\widehat{X}_{rk}^s = \widehat{\pi}_{rk}^s \widehat{E}_k, \tag{64}$$

$$(\widehat{P}_r^s)^{1-\sigma_s} = \sum_{i\in C} (\pi_{ir}^s)^b \left[\sum_{l\in R_i} (\pi_{lr}^s)^b \left(\widehat{w}_l \widehat{t}_{lr}^s\right)^{1-\eta_s}\right]^{\frac{1-\sigma_s}{1-\eta_s}}, \tag{65}$$

$$\widehat{Y}_r^s (Y_r^s)^b = \sum_{k\in R} \widehat{X}_{rk}^s (X_{rk}^s)^b, \tag{66}$$

$$\widehat{Y}_r (Y_r)^b = \sum_s \widehat{Y}_r^s (Y_r^s)^b, \tag{67}$$

$$\widehat{E}_r (E_r)^b = \widehat{Y}_r (Y_r)^b + (D_r)^b, \tag{68}$$

$$\widehat{w}_r = \frac{\widehat{Y}_r^s}{\widehat{L}_r^s}, \tag{69}$$

$$\widehat{\omega}_r = \frac{\widehat{E}_r}{\widehat{L}_r \left(\prod_s (\widehat{P}_r^s)^{\gamma_s}\right)}, \tag{70}$$

$$\widehat{\mu}_{kr} = \frac{\left(\frac{\widehat{\omega}_r}{\widehat{\delta}_{kr}}\right)^{\frac{1}{\rho}}}{\sum_{l\in R} (\mu_{kl})^b \left(\frac{\widehat{\omega}_l}{\widehat{\delta}_{kl}}\right)^{\frac{1}{\rho}}}, \tag{71}$$

$$\widehat{M}_{kr} = \widehat{\mu}_{kr}, \tag{72}$$

$$\widehat{L}_r (L_r)^b = \sum_{k\in R} \widehat{M}_{kr} (M_{kr})^b. \tag{73}$$

A.9 Calculating Real Wages

In our analysis, we compare real wage levels across regions and for different groups of workers both before and after the EU enlargement, i.e. in the baseline and counterfactual scenarios. While our implementation directly yields real wage changes, some steps are necessary to obtain real wage levels in the baseline and counterfactual.

We calculate real wage levels in the baseline as follows. First, note that in the baseline, we have eliminated trade imbalances, $D_r^b = 0$, such that real wages are given by:

$$\omega_r^b \equiv \frac{w_r^b + \frac{D_r^b}{L_r^b}}{P_r^b} = \frac{w_r^b}{P_r^b}.$$

We obtain baseline regional output using our baseline matrix of sectoral trade flows, resulting from our baseline equilibrium computation eliminating trade imbalances:

$$Y_r^b = \sum_s \sum_{k \in R} X_{rk}^{s,b}.$$

We obtain baseline labour force using our baseline matrix of bilateral migration flows, resulting from our baseline equilibrium computation eliminating trade imbalances:

$$L_r^b = \sum_{k \in R} M_{kr}^b.$$

We calculate baseline nominal wages:

$$w_r^b = \frac{Y_r^b}{L_r^b},$$

which, considering frictionless worker mobility across sectors, are the same across sectors, such that we use $w_r^{s,b} = w_r^b \ \forall \ s$ in the following. The baseline sectoral price index is given by:

$$P_k^{s,b} = \left[\sum_{r \in R} \left(w_r^b t_{rk}^{s,b} \right)^{1-\sigma_s} \right]^{\frac{1}{1-\sigma_s}}, \tag{74}$$

where the parameters σ_s do not have a superscript b, as we assume them to be constant over time. With expenditure being equal to output in the absence of trade imbalances,

$$E_k^b = Y_k^b,$$

and with estimated trade costs $t_{rk}^{s,b}$, we can compute $P_k^{G,b}$ for goods and $P_k^{S,b}$ for services.

We calculate trade costs based on our estimated gravity equation of international

trade (34):

$$\widetilde{t}^s_{rk,t} = \exp\left(\mathbf{T}^s_{rk,t}\widetilde{\boldsymbol{\theta}} + \widetilde{\lambda}^s_{rk}\right)\widetilde{\zeta}^s_{rk,t},$$

where a tilde above a variable denotes the estimated value. For estimates of our baseline trade costs, we take the average over the estibrated trade costs $\widetilde{t}^s_{rk,t}$ for the pre-EU-enlargement years 2000-2003 for each sector. These trade costs are consistent with the fitted trade flows that we use to obtain the baseline trade shares for our counterfactual analyses. Note that for goods trade flows there are some missing observations for tariffs. The estibrated trade costs for these observations hence omit the tariff variable. For some services trade flows the asymmetric pair fixed effects lead to collinearities, such that the trade costs for these observations are estimated using symmetric pair fixed effects. The estimated baseline trade costs allow us to calculate sectoral price indices as in Equation (74).

Based on the sectoral price indices we calculate the price index over sectoral varieties:

$$P^b_k = \prod_s \left(\frac{P^{s,b}_k}{\gamma^s}\right)^{\gamma^s}.$$

This allows us to calculate baseline real wages:

$$\omega^b_r = \frac{w^b_r}{P^b_r}.$$

Having obtained the counterfactual change of real wages, $\widehat{\omega}_r$ in our implementation, we can calculate counterfactual real wage levels by multiplying:

$$\omega^c_r = \omega^b_r \widehat{\omega}_r.$$

A.10 Details on Tariff Data

As in Caliendo, Opromolla, Parro, and Sforza (2021) our tariff data source is the WITS database.[26] Under Advanced Query, we select Tariff and Trade Analysis and select the following:

- **Importers/Reporters:** Australia – AUS; Austria – AUT; Belgium – BEL; Bulgaria – BGR; Brazil – BRA; Canada – CAN; China – CHN; Cyprus – CYP; Czech Republic – CZE; Germany – DEU; Denmark – DNK; Spain – ESP; Estonia – EST; Finland – FIN; France – FRA; United Kingdom – GBR; Greece – GRC; Hungary – HUN; Indonesia – IDN; India – IND; Ireland – IRL; Italy – ITA; Japan – JPN; Korea, Rep. – KOR; Lithuania – LTU; Luxembourg – LUX; Latvia – LVA; Mexico – MEX; Malta – MLT; Netherlands – NLD; Poland – POL; Portugal – PRT; Romania – ROU; Russian Federation – RUS; Slovak Republic – SVK; Slovenia – SVN; Sweden – SWE; Turkey – TUR; Taiwan, China – TWN; United States – USA; All countries All – All
- **Products:** ISIC 3 Revision 3; ALL1 – Heading (2-digit)
- **Exporters/Partners:** Australia – AUS; Austria – AUT; Belgium – BEL; Bulgaria – BGR; Brazil – BRA; Canada – CAN; China – CHN; Cyprus – CYP; Czech Republic – CZE; Germany – DEU; Denmark – DNK; Spain – ESP; Estonia – EST; Finland – FIN; France – FRA; United Kingdom – GBR; Greece – GRC; Hungary – HUN; Indonesia – IDN; India – IND; Ireland – IRL; Italy – ITA; Japan – JPN; Korea, Rep. – KOR; Lithuania – LTU; Luxembourg – LUX; Latvia – LVA; Mexico – MEX; Malta – MLT; Netherlands – NLD; Poland – POL; Portugal – PRT; Romania – ROM; Russian Federation – RUS; Slovak Republic – SVK; Slovenia – SVN; Sweden – SWE; Turkey – TUR; Taiwan, China – TWN; United States – USA; All countries All – All
- **Years:** 2000–2010
- **Tariffs:** Include Effectively Applied rates

Note that the Rest of World (ROW) is handled as residual trade of the not-included countries. Using the country-world / world-country tariffs and the respective individual country pair tariffs, the averages which yield the world tariffs can be disentangled and ROW-country / country-ROW tariffs can be constructed.

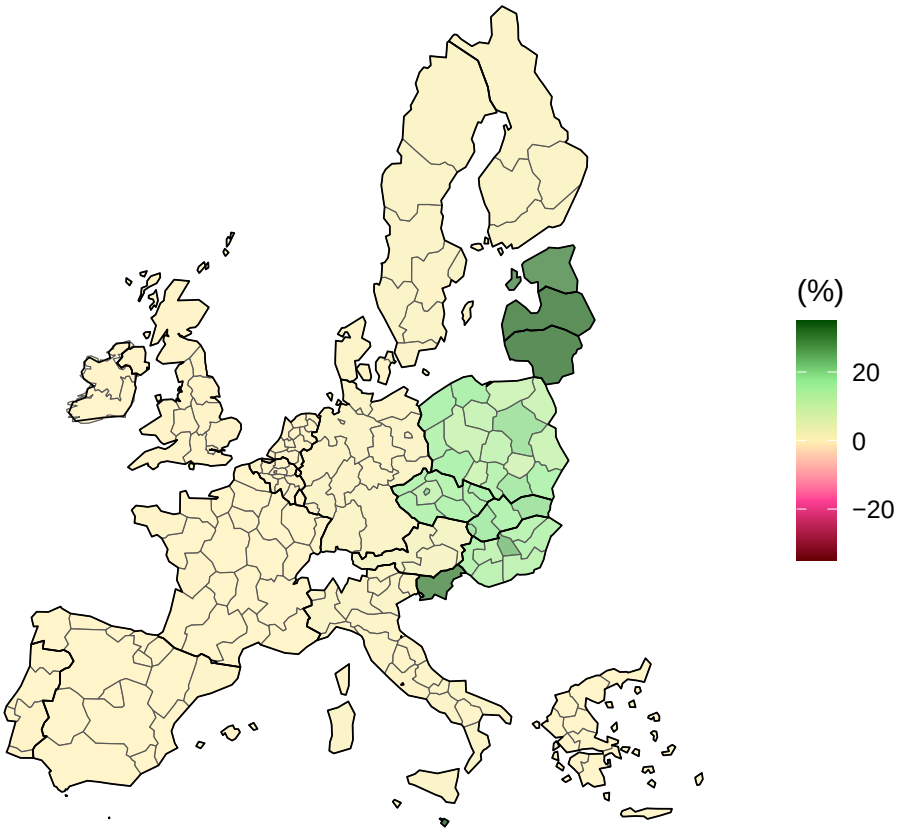
In our analysis, we use weighted average tariffs, which are averaged over products by import values.

[26] See https://wits.worldbank.org/WITS/WITS/Default-A.aspx?Page=Default

As shown in Figure 6, the tariffs we observe between the EU15 and the NMS prior to the 2004 EU enlargement are either zero for imports into the EU15 or below 5% for imports into the NMS. These tariff levels differ markedly from those reported by Caliendo, Opromolla, Parro, and Sforza (2021), whose Figure 1 implies substantially larger tariff rates immediately before the EU enlargement. One possible explanation for this discrepancy is that we download tariffs from the WITS database selecting the individual EU member states as reporting countries, whereas Caliendo, Opromolla, Parro, and Sforza (2021) treat the EU25 as a single reporting entity.

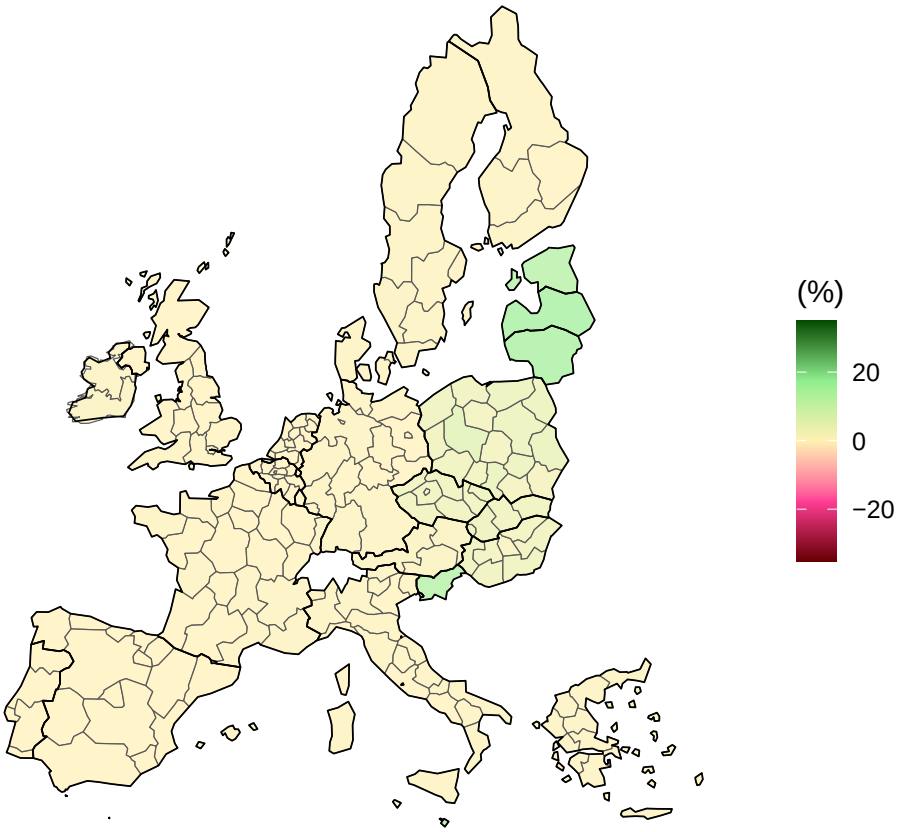
A.11 Additional Results: GE Results for Calibrated Shares

Figure 23: Calibrated Shares: GE Results of EU Enlargement: Total Exports Change (Goods)



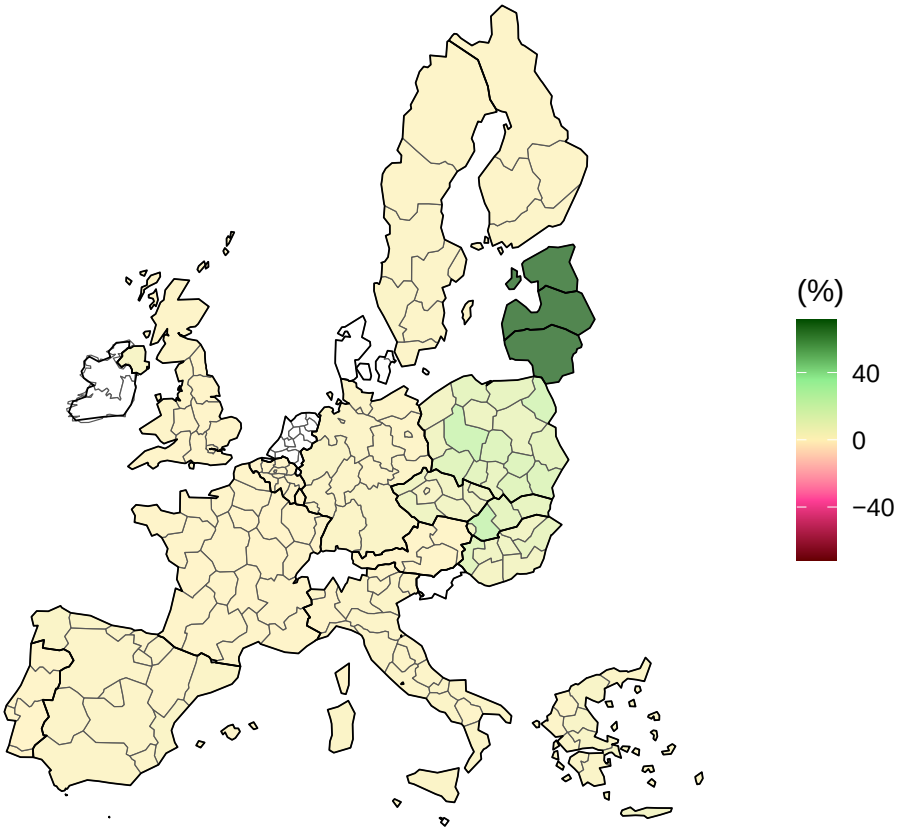
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

Figure 24: Calibrated Shares: GE Results of EU Enlargement: Total Exports Change (Services)



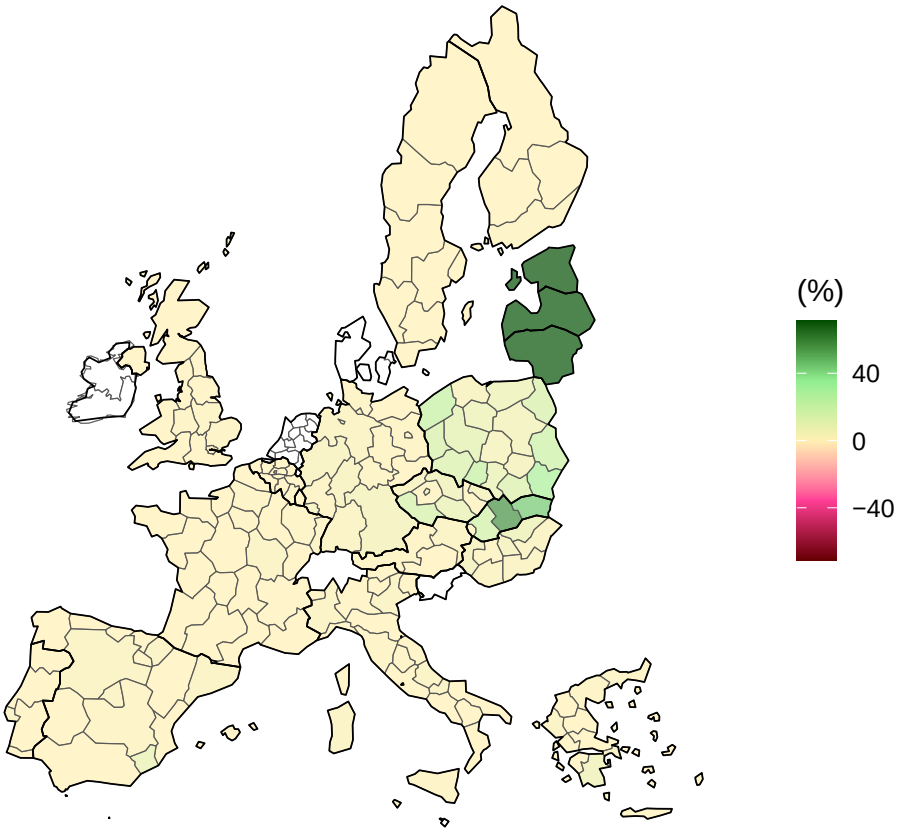
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

Figure 25: Calibrated Shares: GE Results of EU Enlargement: Total Outmigration Change



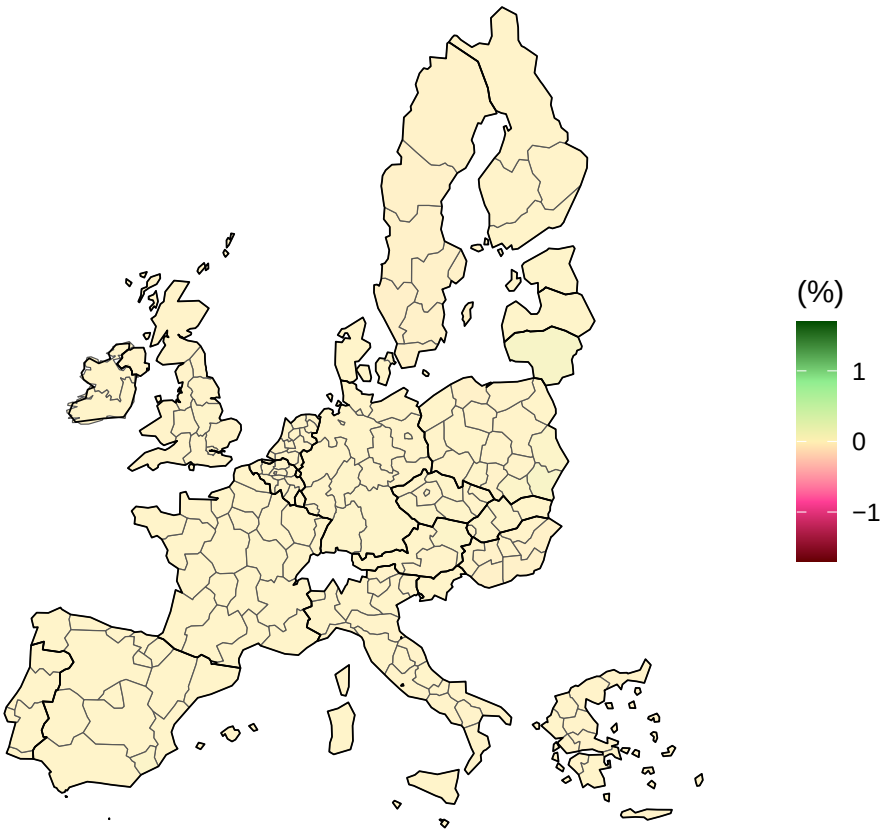
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data. Due to missing migration data, no results are reported for regions in Denmark, Ireland, Malta, the Netherlands, and Slovenia.

Figure 26: Calibrated Shares: GE Results of EU Enlargement: Total Inmigration Change



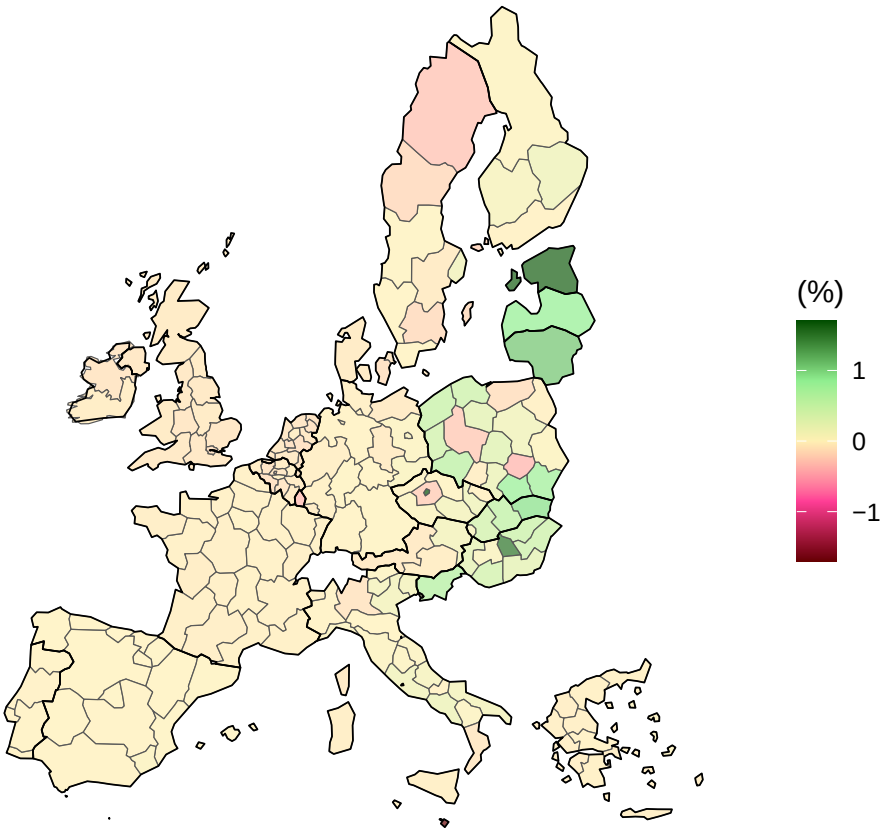
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data. Due to missing migration data, no results are reported for regions in Denmark, Ireland, Malta, the Netherlands, and Slovenia.

Figure 27: Calibrated Shares: GE Results of EU Enlargement: Labour Force Change



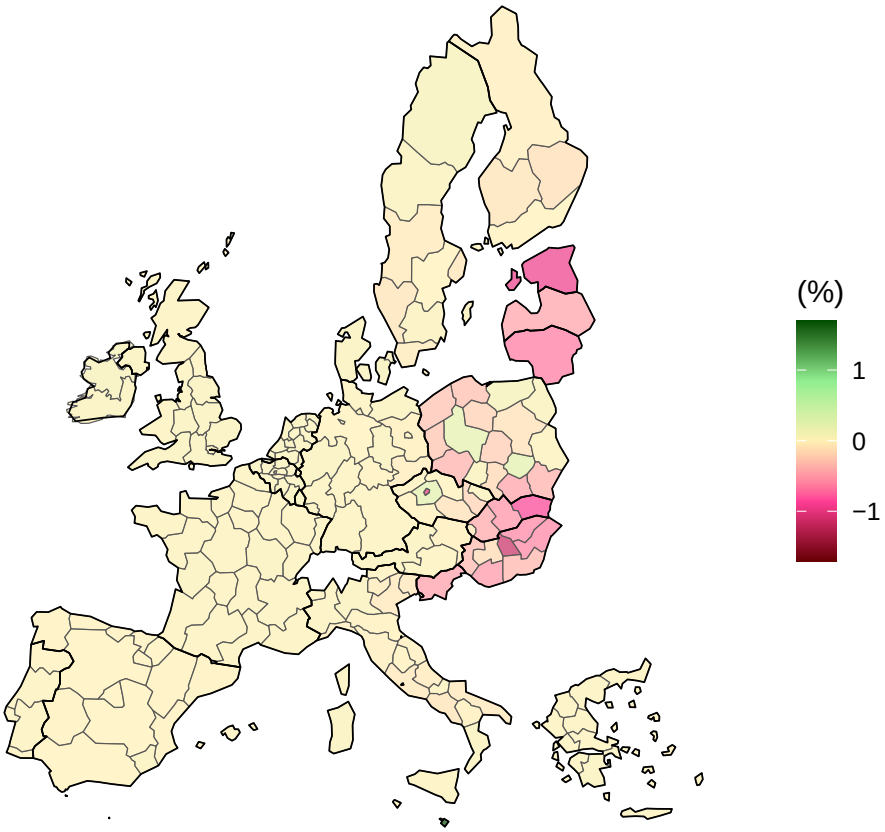
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

Figure 28: Calibrated Shares: GE Results of EU Enlargement: Labour Force Change (Goods)



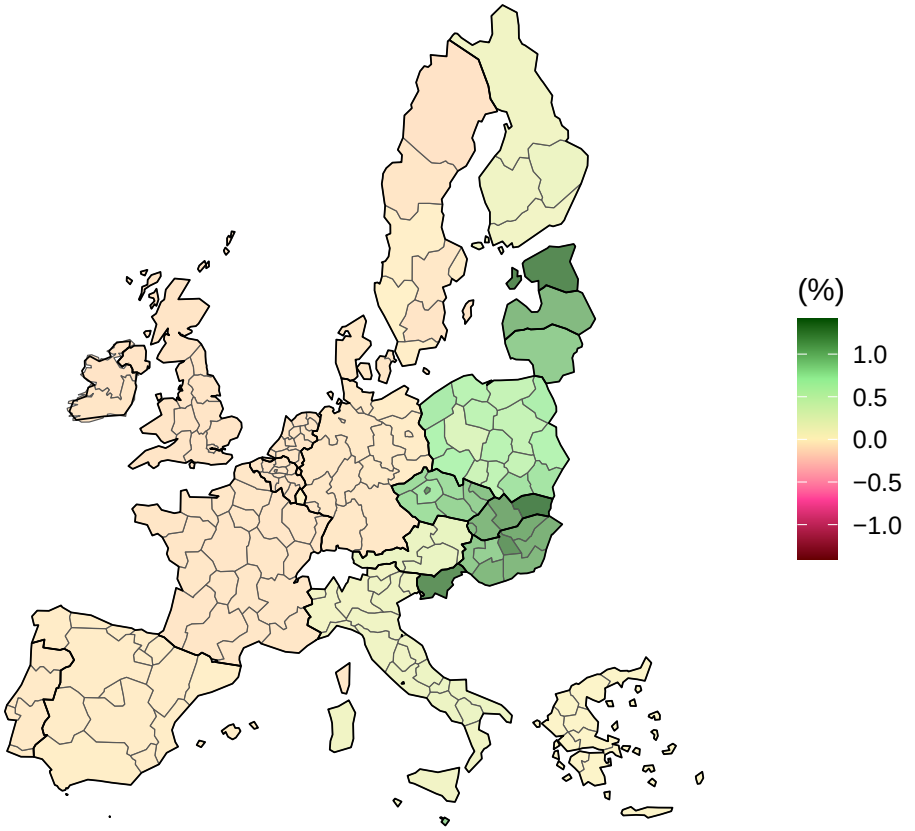
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data. The labour force changes for the Prague region in the Czech Republic (CZ01) with 2.3% and for Malta (MT00) with -2.6% are not coloured to scale.

Figure 29: Calibrated Shares: GE Results of EU Enlargement: Labour Force Change (Services)



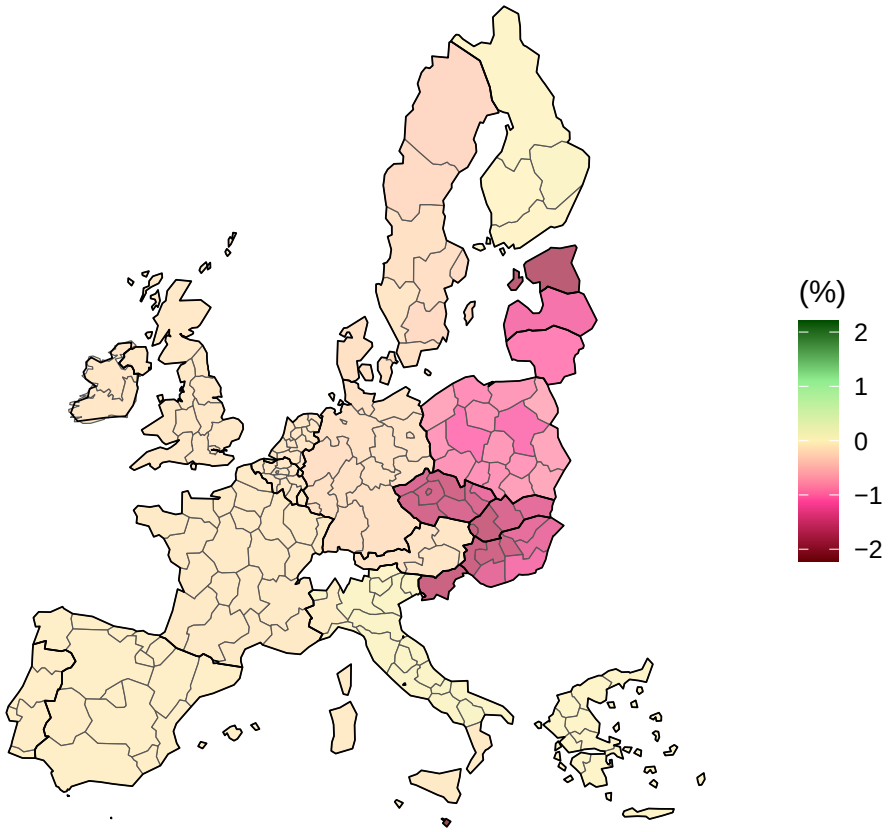
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

Figure 30: Calibrated Shares: GE Results of EU Enlargement: Wages Change



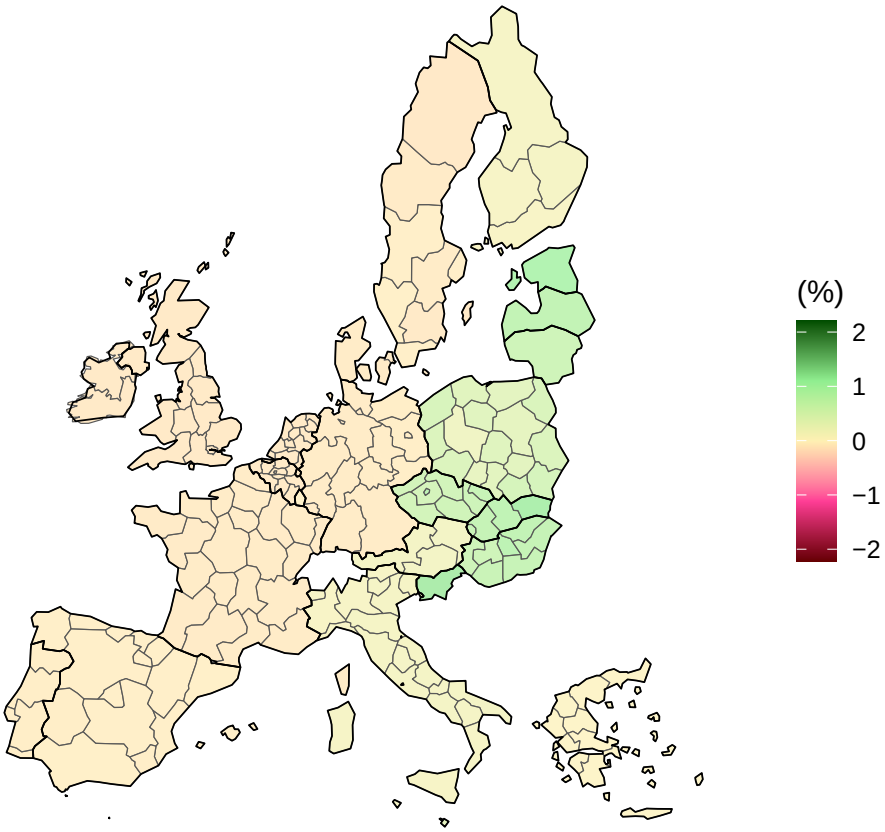
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

Figure 31: Calibrated Shares: GE Results of EU Enlargement: Consumer Prices Change (Goods)



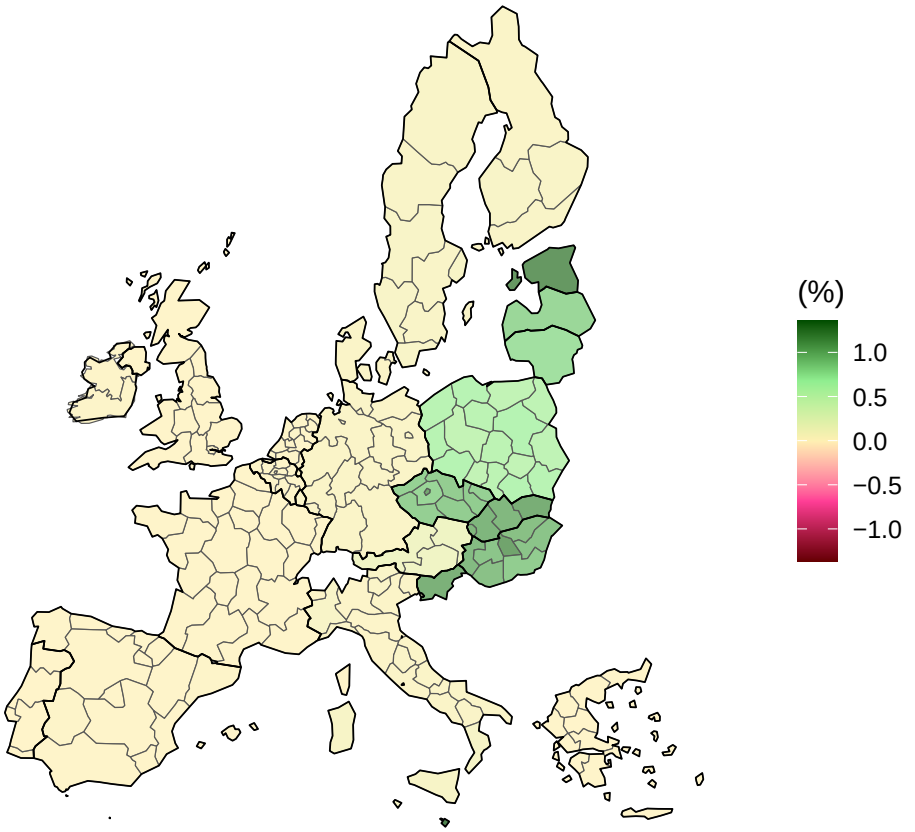
Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

Figure 32: Calibrated Shares: GE Results of EU Enlargement: Consumer Prices Change (Services)



Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

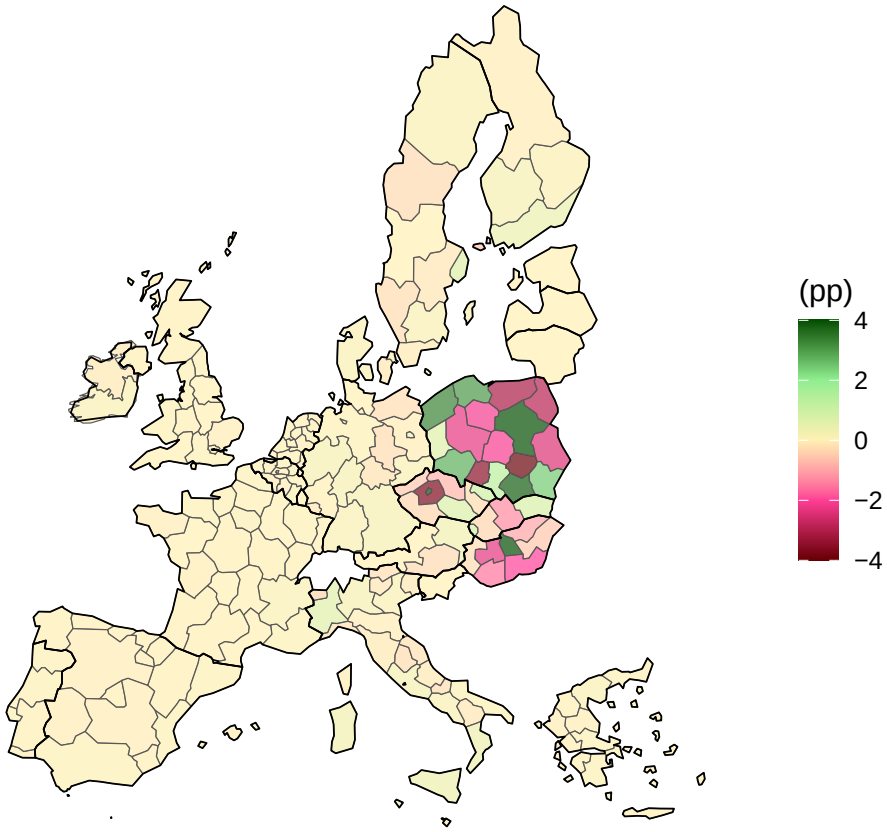
Figure 33: Calibrated Shares: GE Results of EU Enlargement: Real Wages (Real GDP per Capita) Change



Notes: Percentage changes for EU regions induced by EU enlargement (trade and migration cost reduction). Calibrated-shares calibration method, where the trade and migration shares are used from the observed data.

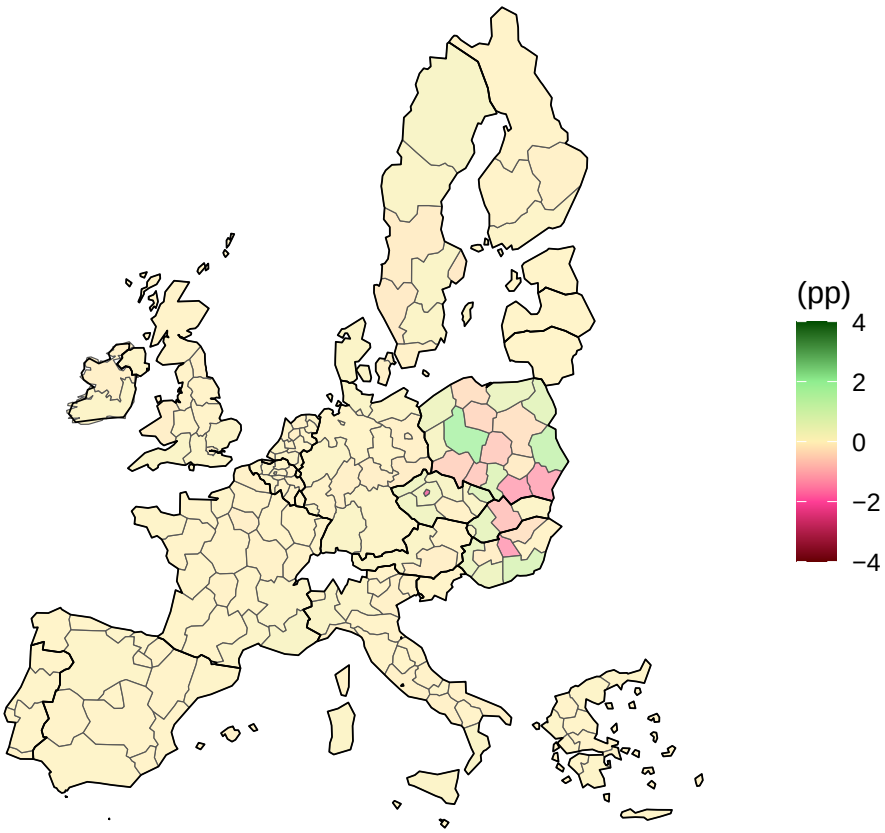
A.12 Additional Results: GE Effects as Regional Difference from Country Average

Figure 34: GE Results of EU Enlargement: Regional Difference in Total Exports Change (Goods) from Country Average



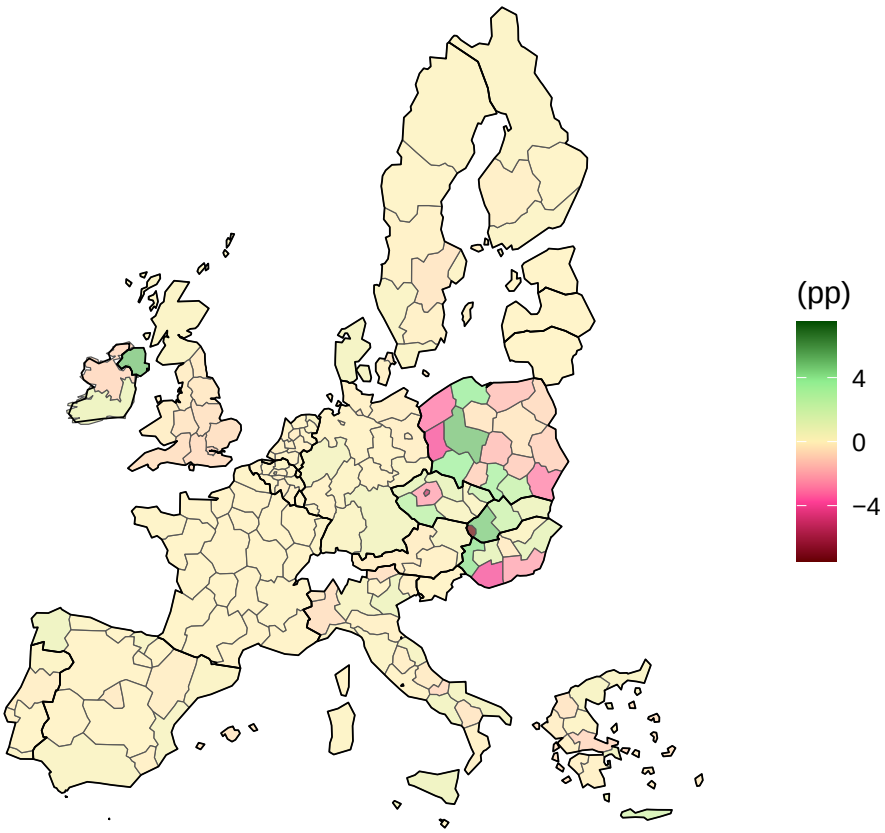
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method. The regional deviations for Central Hungary (HU10) with 7.7% and for the Masovian Voivodeship in Poland (PL12) with 5.2% are not coloured to scale.

Figure 35: GE Results of EU Enlargement: Regional Difference in Total Exports Change (Services) from Country Average



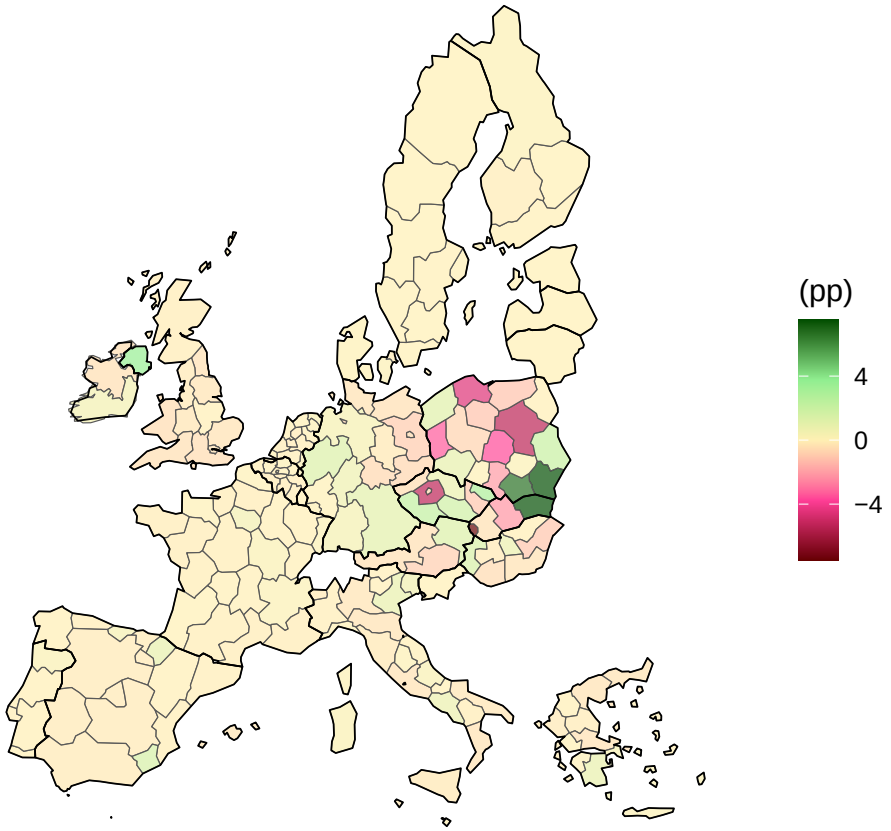
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

Figure 36: GE Results of EU Enlargement: Regional Difference in Total Outmigration Change from Country Average



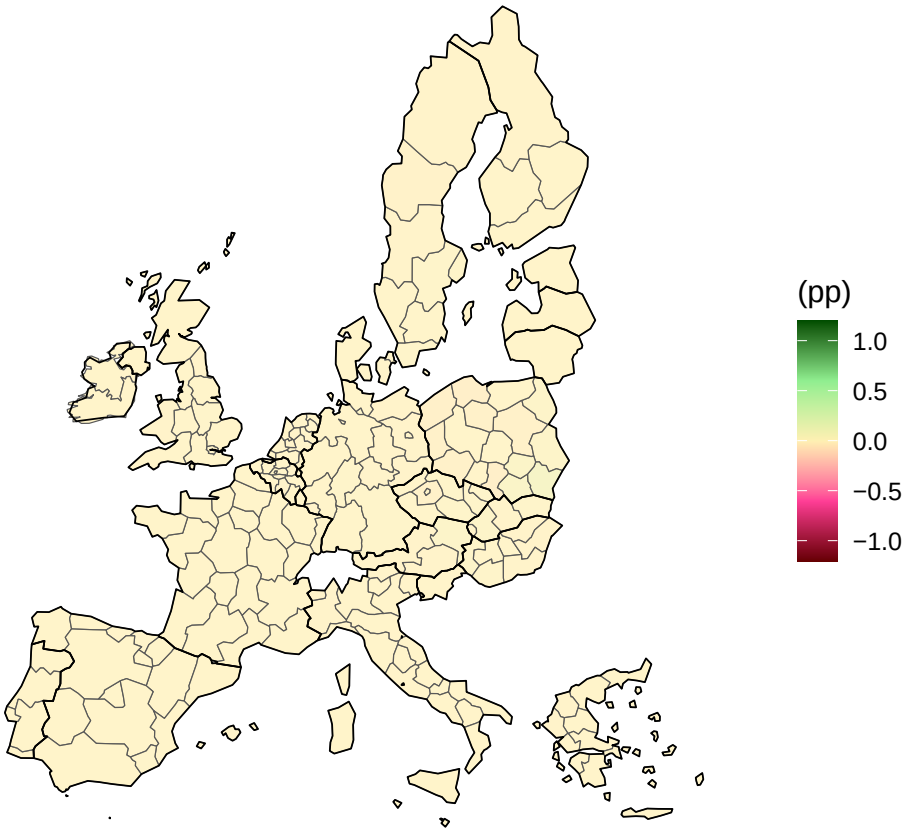
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

Figure 37: GE Results of EU Enlargement: Regional Difference in Total Inmigration Change from Country Average



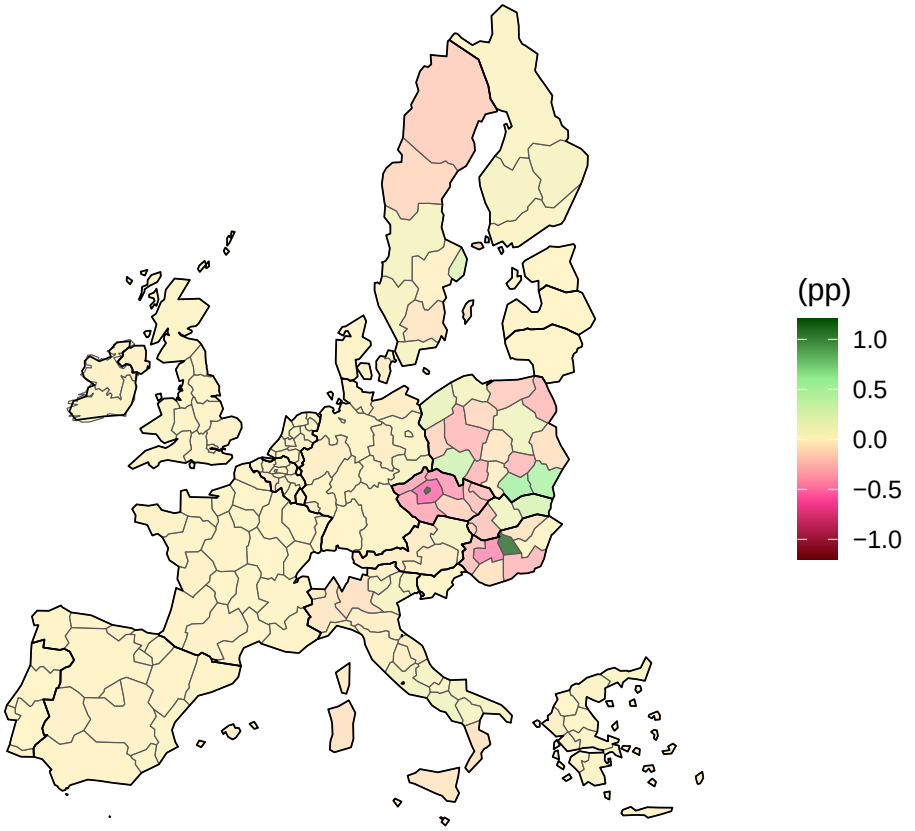
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method. The regional deviations for Eastern Slovakia (SK04) with 18.2%, for the Podkarpackie Voivodeship in Poland (PL32) with 11.2%, and for the Bratislava Region in Slovakia (SK01) with −15.6% are not coloured to scale.

Figure 38: GE Results of EU Enlargement: Regional Difference in Labour Force Change from Country Average



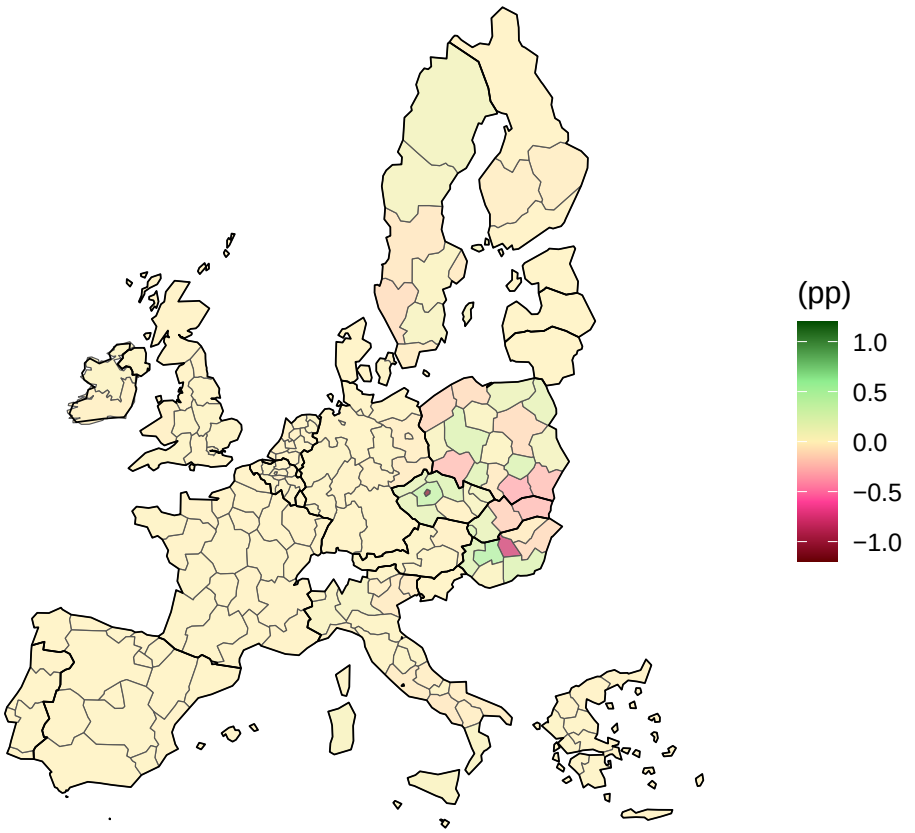
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

Figure 39: GE Results of EU Enlargement: Regional Difference in Labour Force Change (Goods) from Country Average



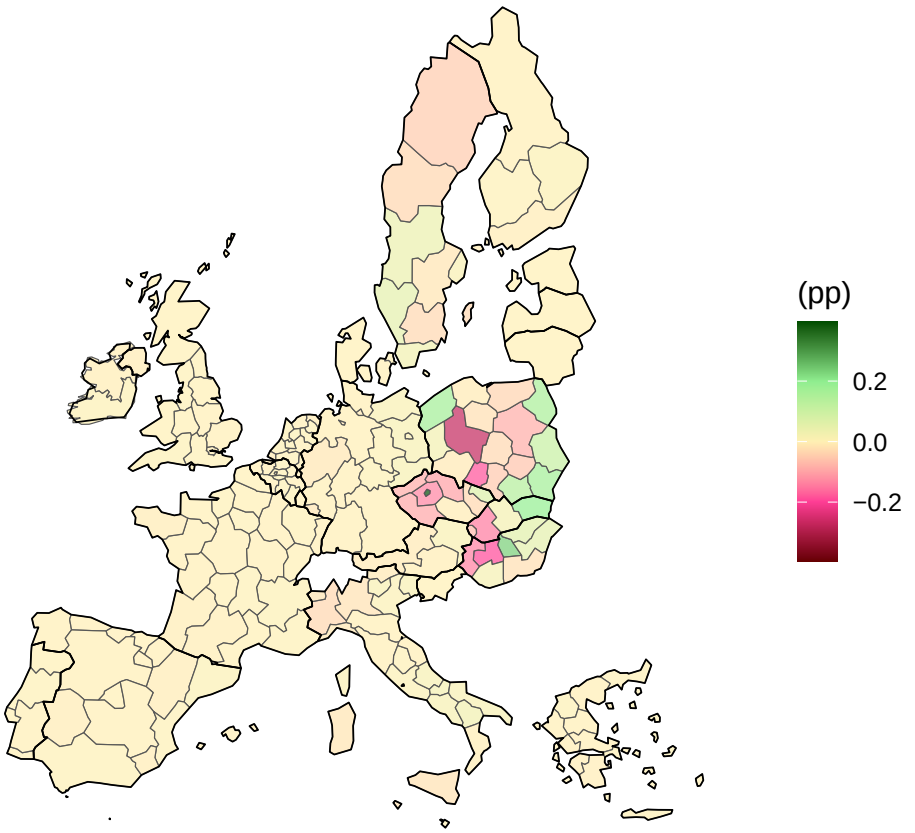
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method. The regional deviation for the Prague region in the Czech Republic (CZ01) with 2.4% is not coloured to scale.

Figure 40: GE Results of EU Enlargement: Regional Difference in Labour Force Change (Services) from Country Average



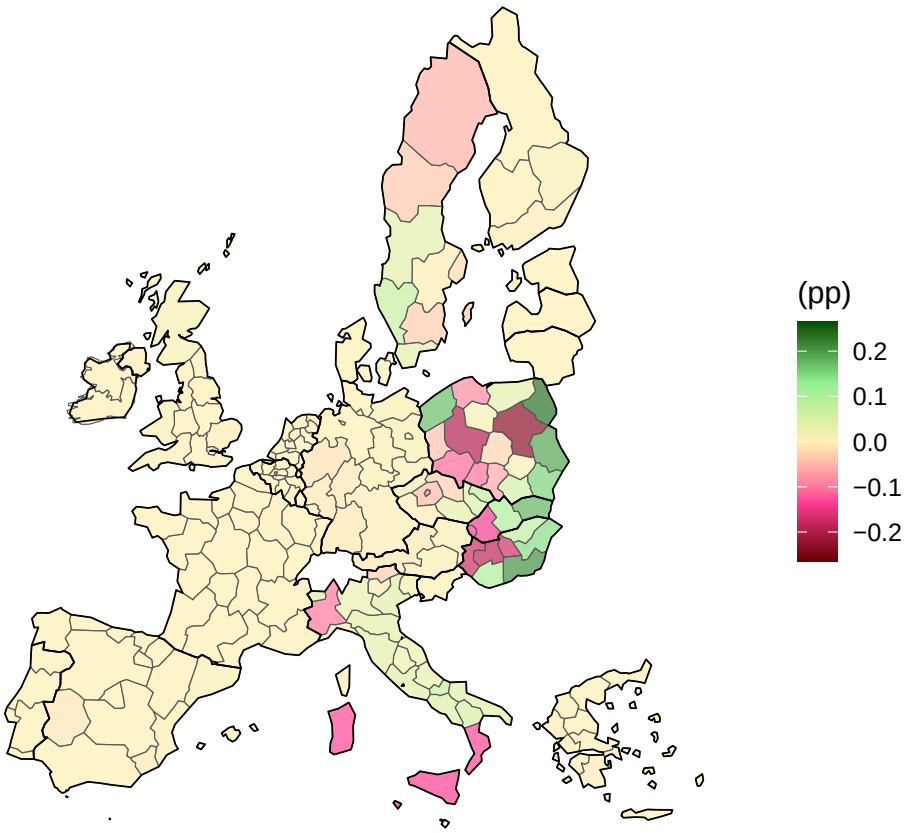
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

Figure 41: GE Results of EU Enlargement: Regional Difference in Wages Change from Country Average



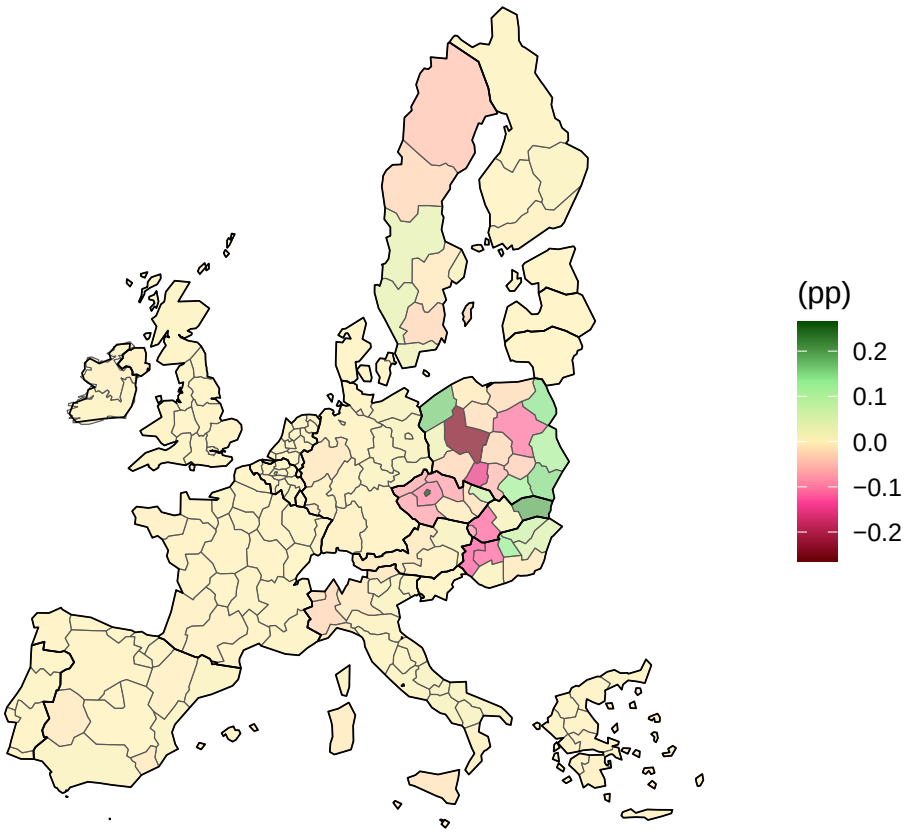
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

Figure 42: GE Results of EU Enlargement: Regional Difference in Consumer Prices Change (Goods) from Country Average



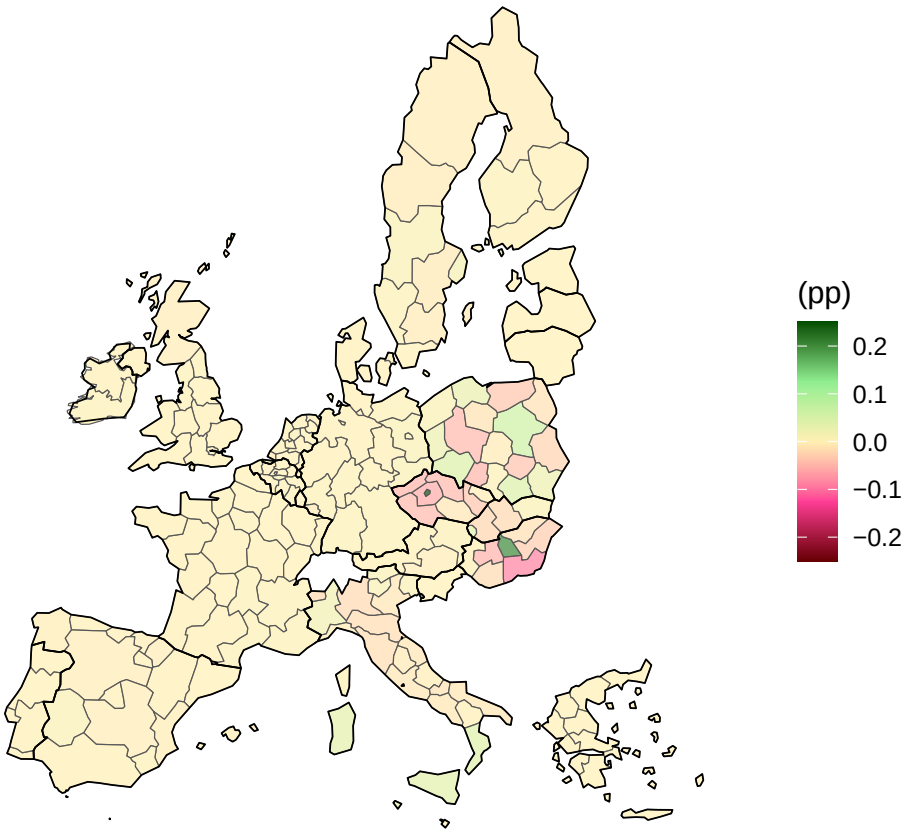
Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

Figure 43: GE Results of EU Enlargement: Regional Difference in Consumer Prices Change (Services) from Country Average



Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

Figure 44: GE Results of EU Enlargement: Regional Difference in Real Wages (Real GDP per Capita) Change from Country Average



Notes: Regional deviations from their respective country's average effect induced by EU enlargement (trade and migration cost reduction) in percentage points. Covariates-based calibration method.

A.13 Additional Results: GE Effects for Selected Countries

The most apparent EU-wide heterogeneity is at the country level. To study some within-country regional heterogeneity, we focus on some selected countries. We focus on three EU15 countries, one from each of the phases in which labour markets were opened following the EU enlargement. The UK in Figures 45 and 46, who opened its labour markets in phase 1, France in Figures 47 and 48, who was part of phase 2, and Germany in Figures 49 and 50, who was one of the last countries to open its labour markets in phase 3. We focus on those New Member States consisting of the most regions, the Czech Republic in Figures 51 and 52, Hungary in Figures 53 and 54, and Poland in Figures 55 and 56.

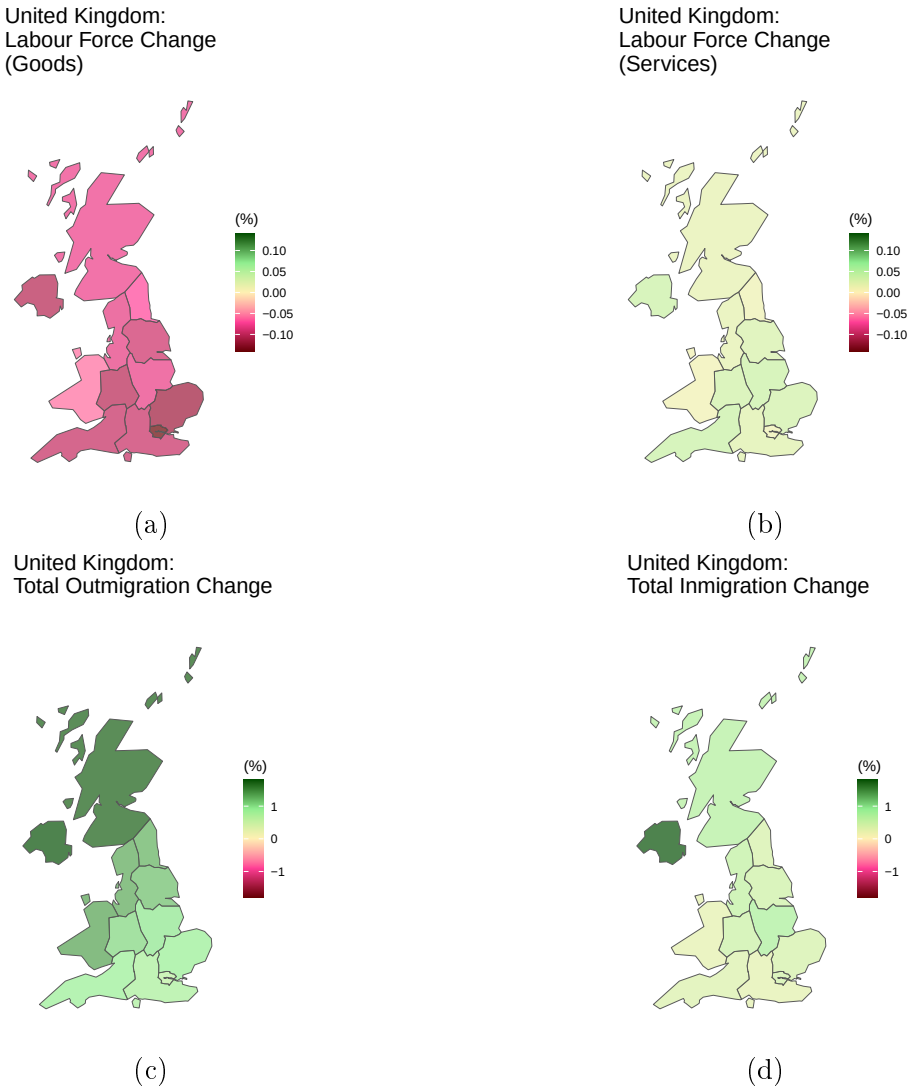


Figure 45: GE effects of the EU enlargement on UK regions' labour force and migration.
Notes: In Panels (c) and (d), for Northern Ireland (UKN), the total outmigration change with 6.3% and the total inmigration change with 4.4% are not coloured to scale.

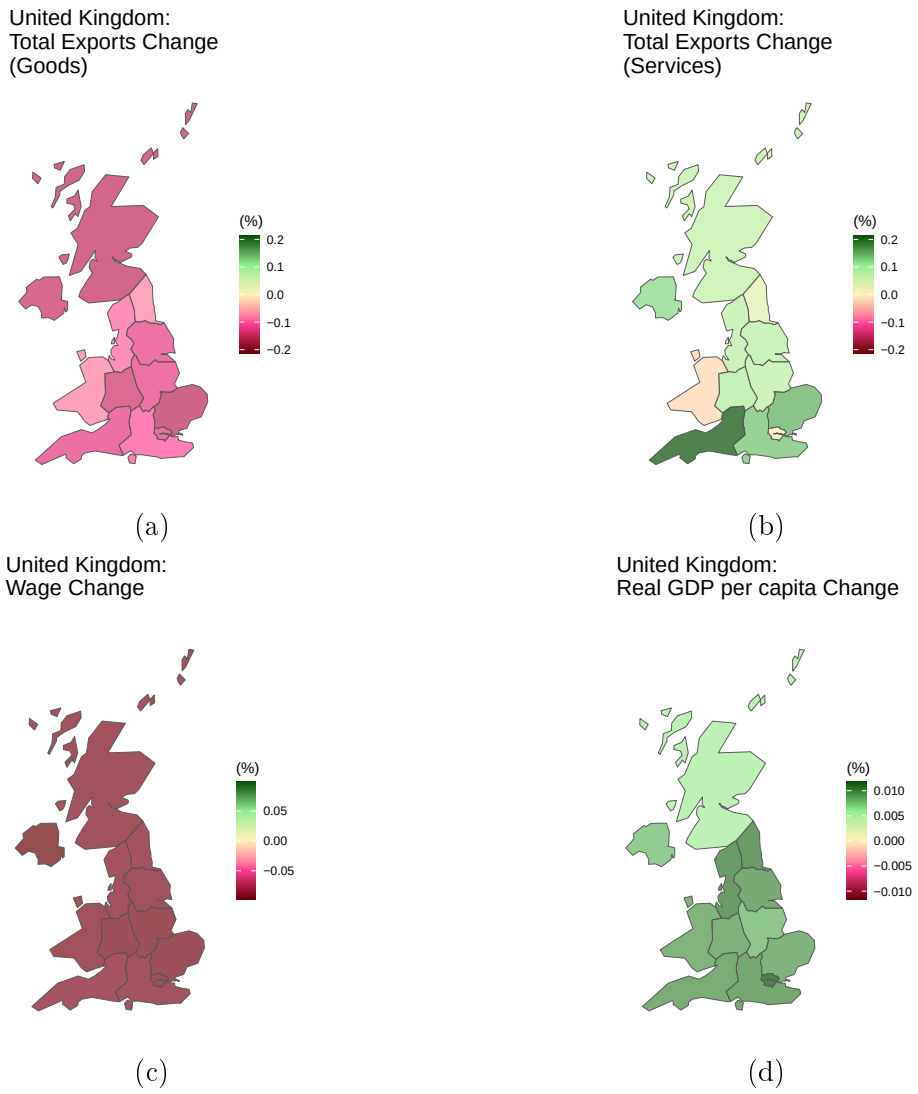


Figure 46: GE effects of the EU enlargement on UK regions' exports, wages, and real GDP per capita.

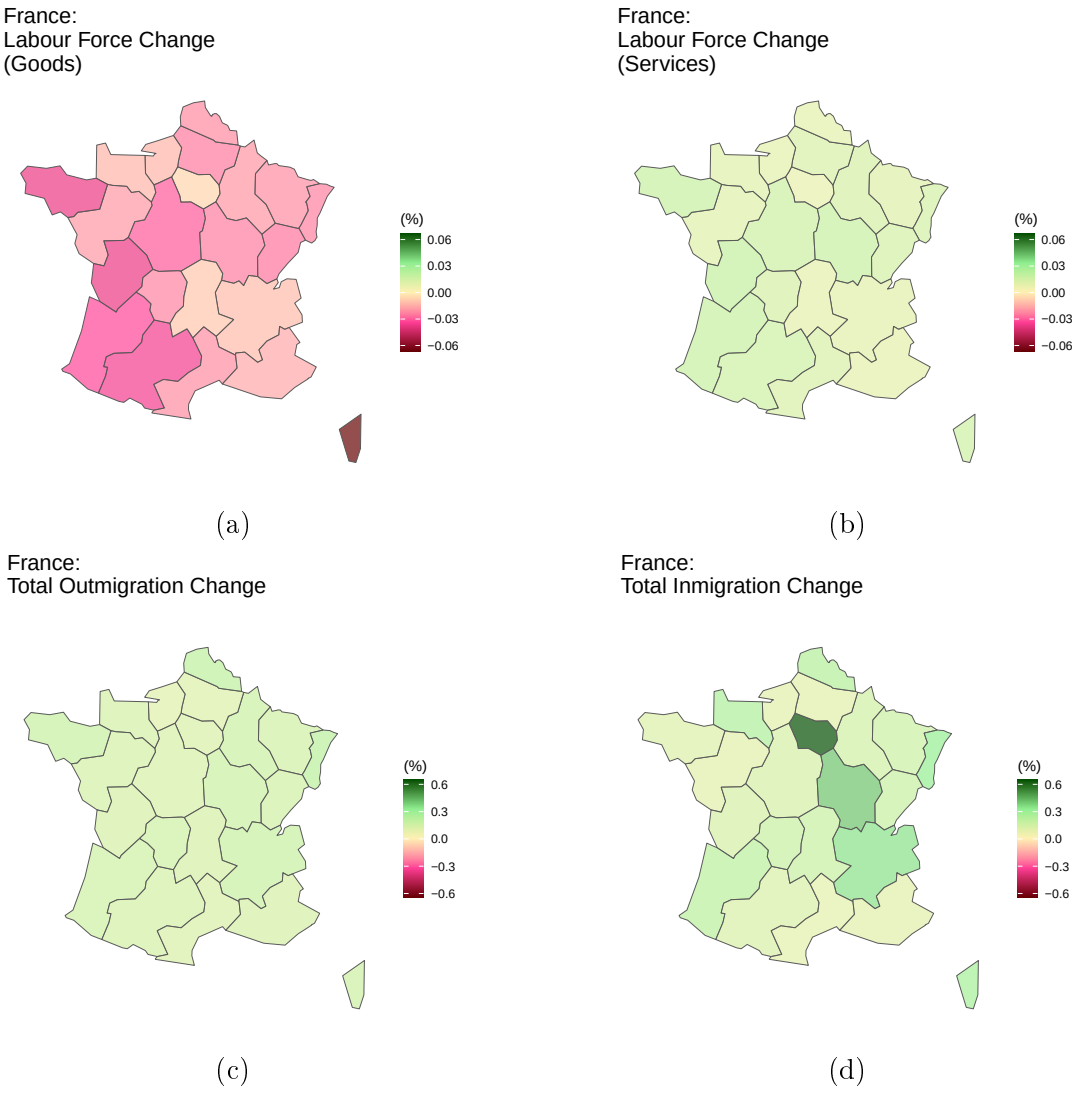


Figure 47: GE effects of the EU enlargement on French regions' labour force and migration.

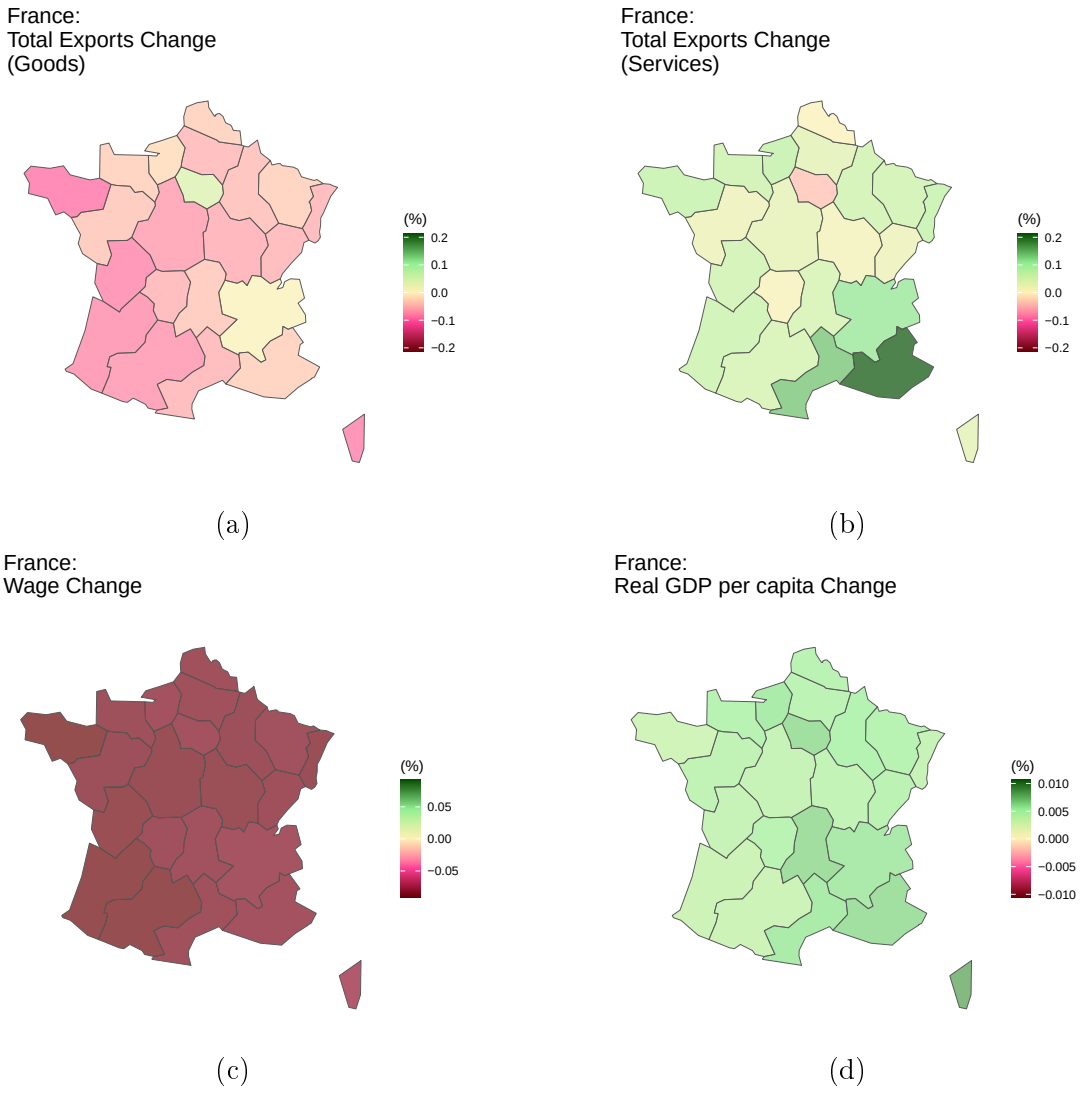


Figure 48: GE effects of the EU enlargement on French regions' exports, wages, and real GDP per capita.

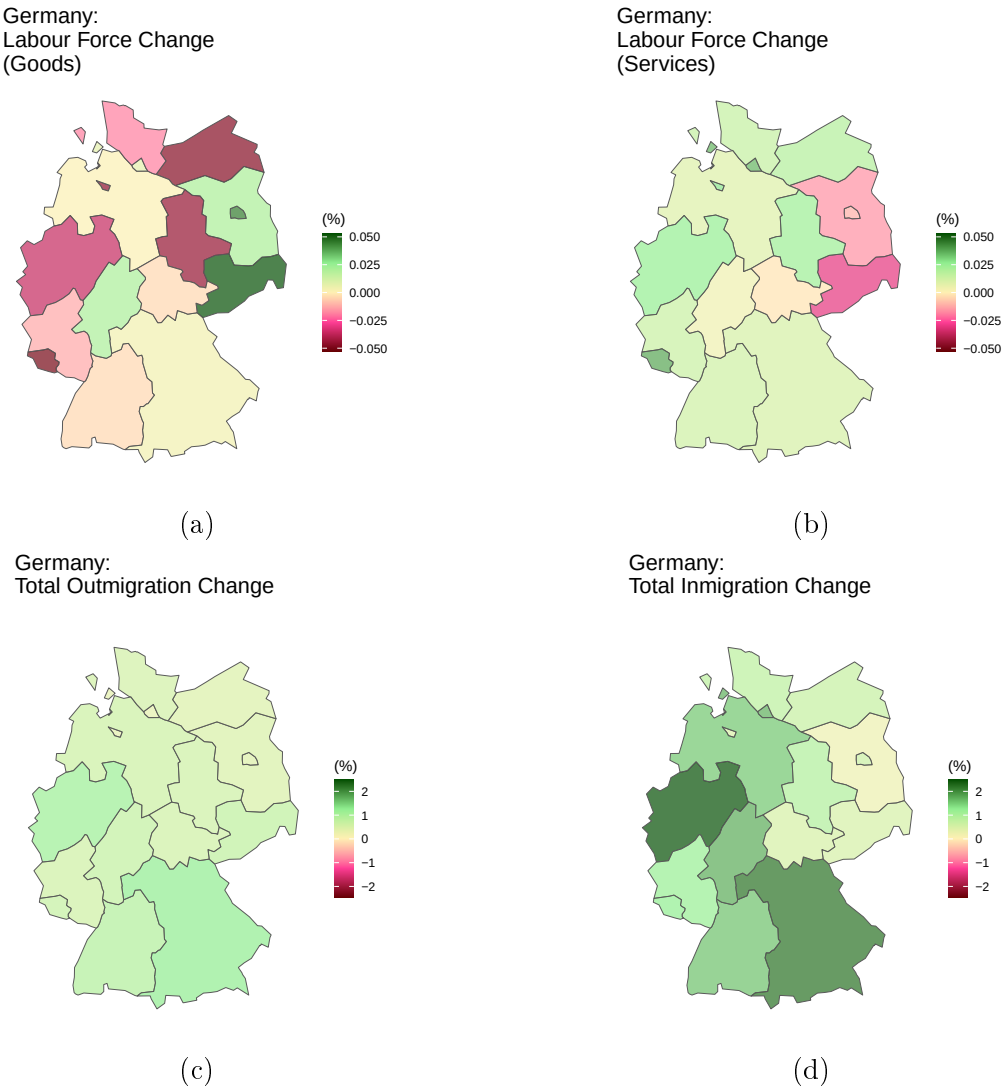


Figure 49: GE effects of the EU enlargement on German regions' labour force and migration.

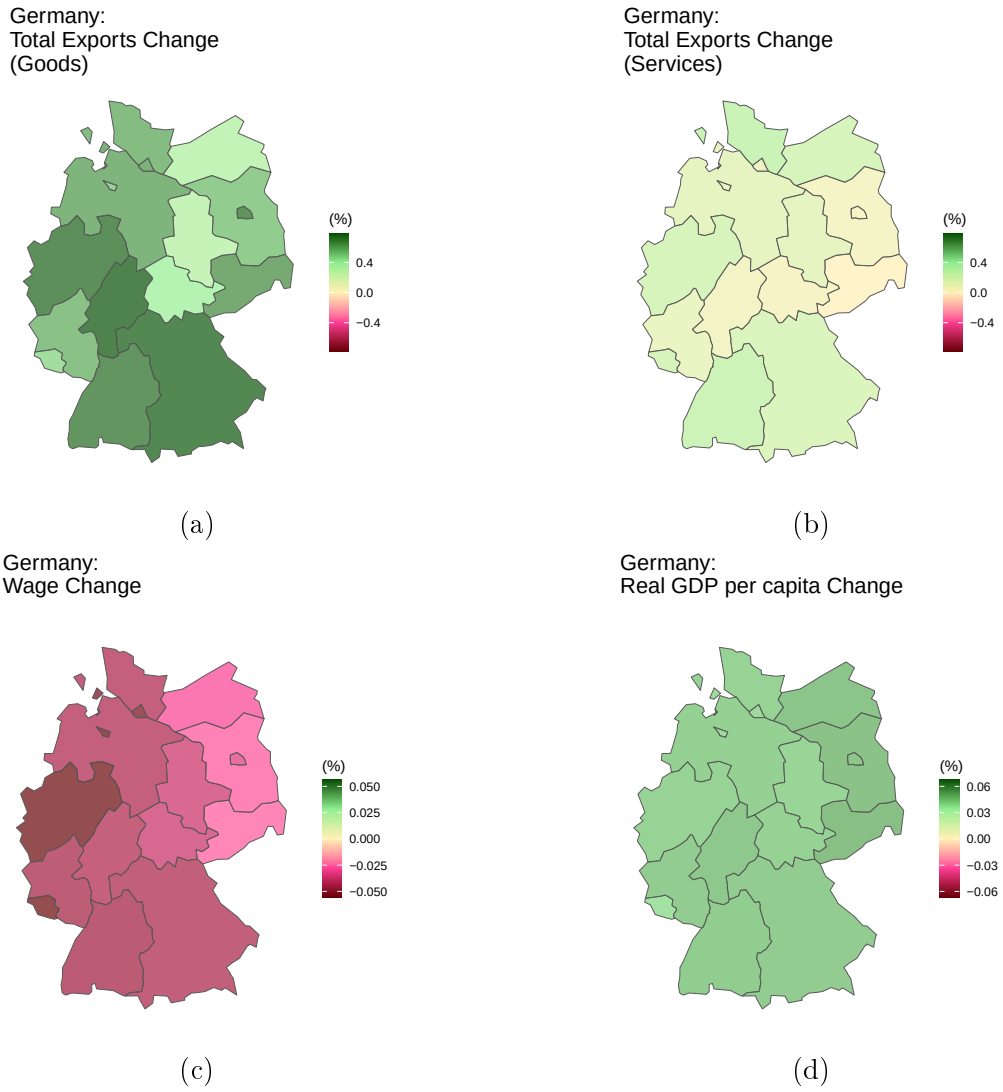


Figure 50: GE effects of the EU enlargement on German regions' exports, wages, and real GDP per capita.

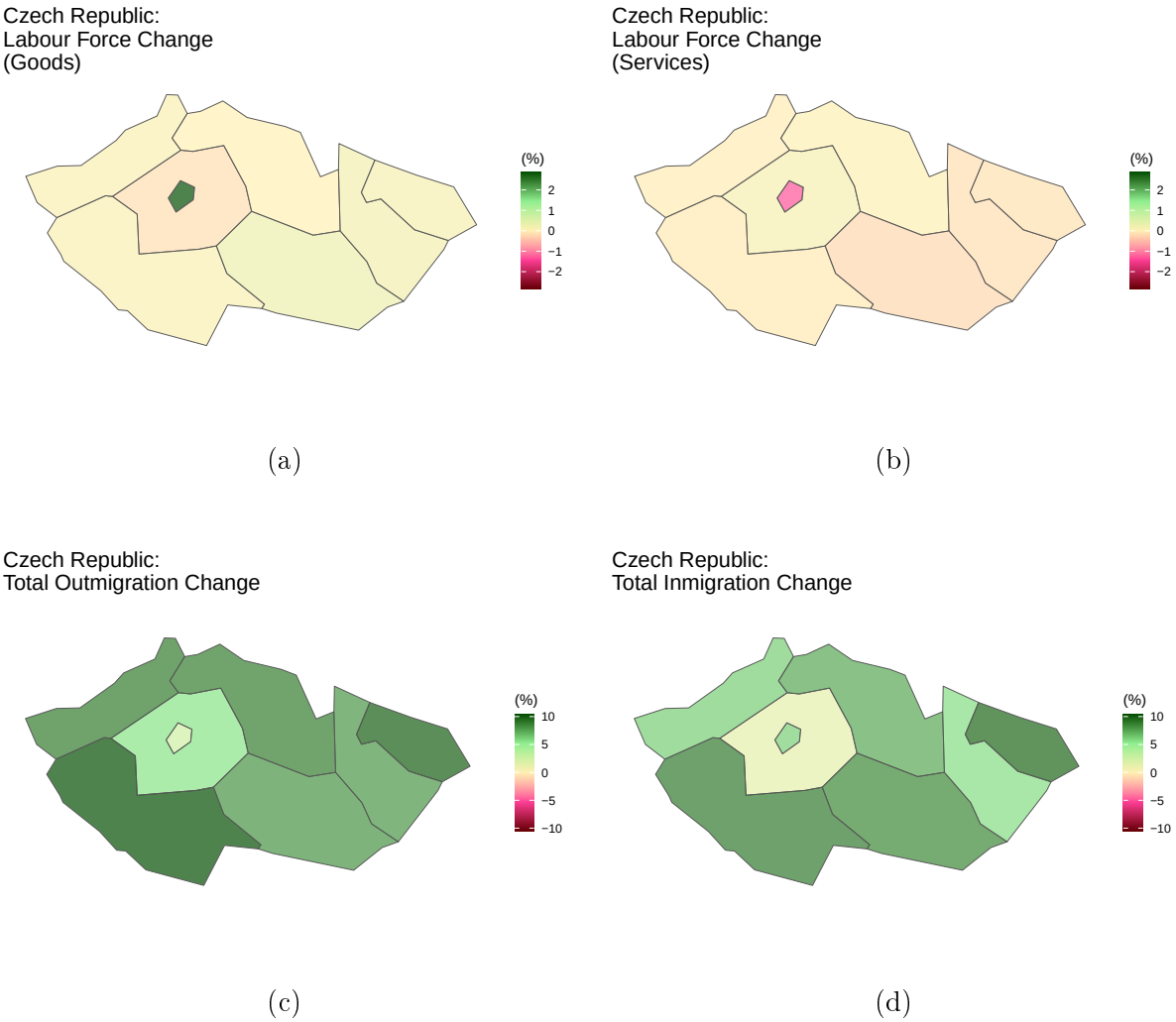


Figure 51: GE effects of the EU enlargement on Czech regions' labour force and migration.

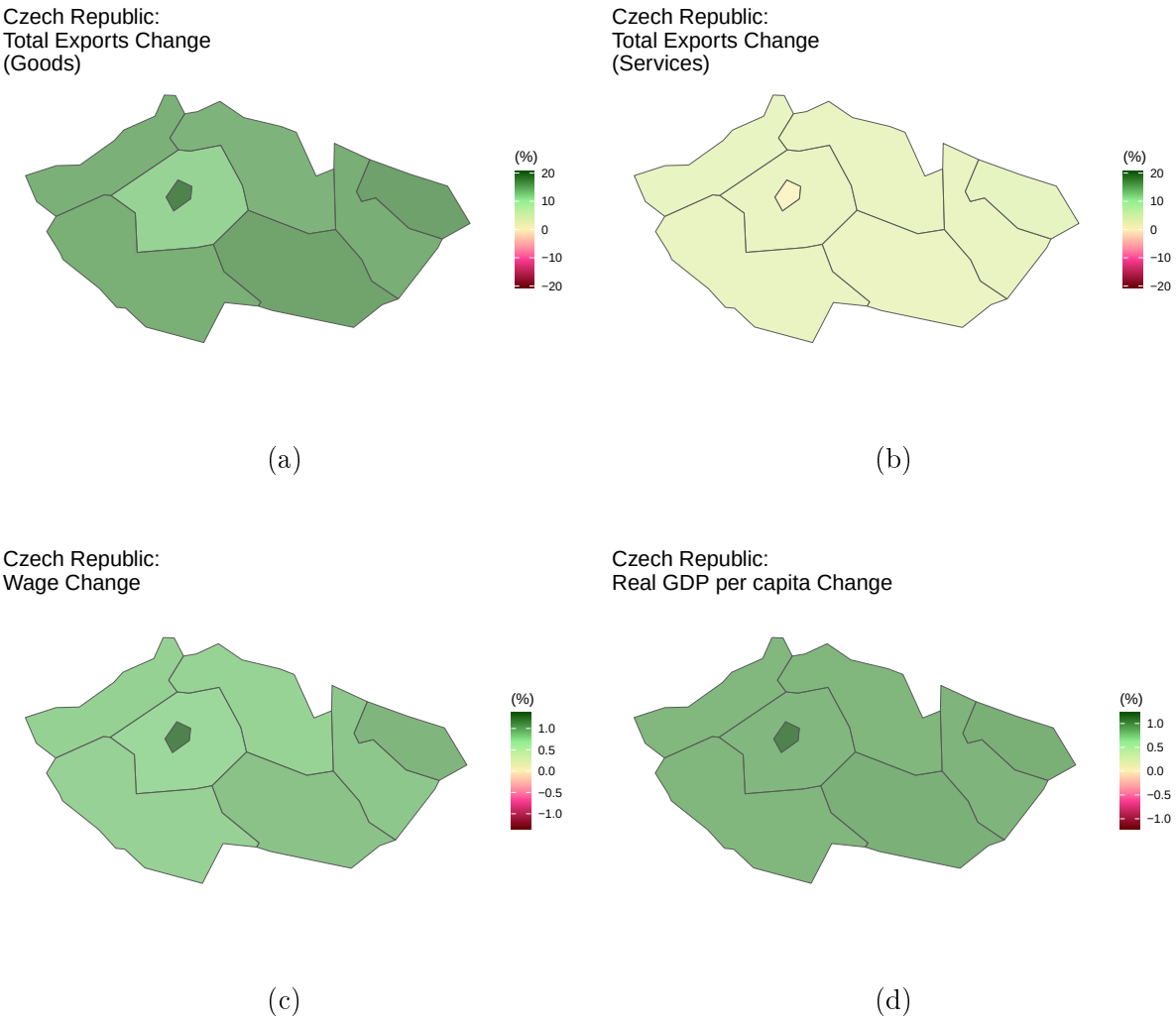


Figure 52: GE effects of the EU enlargement on Czech regions' exports, wages, and real GDP per capita.

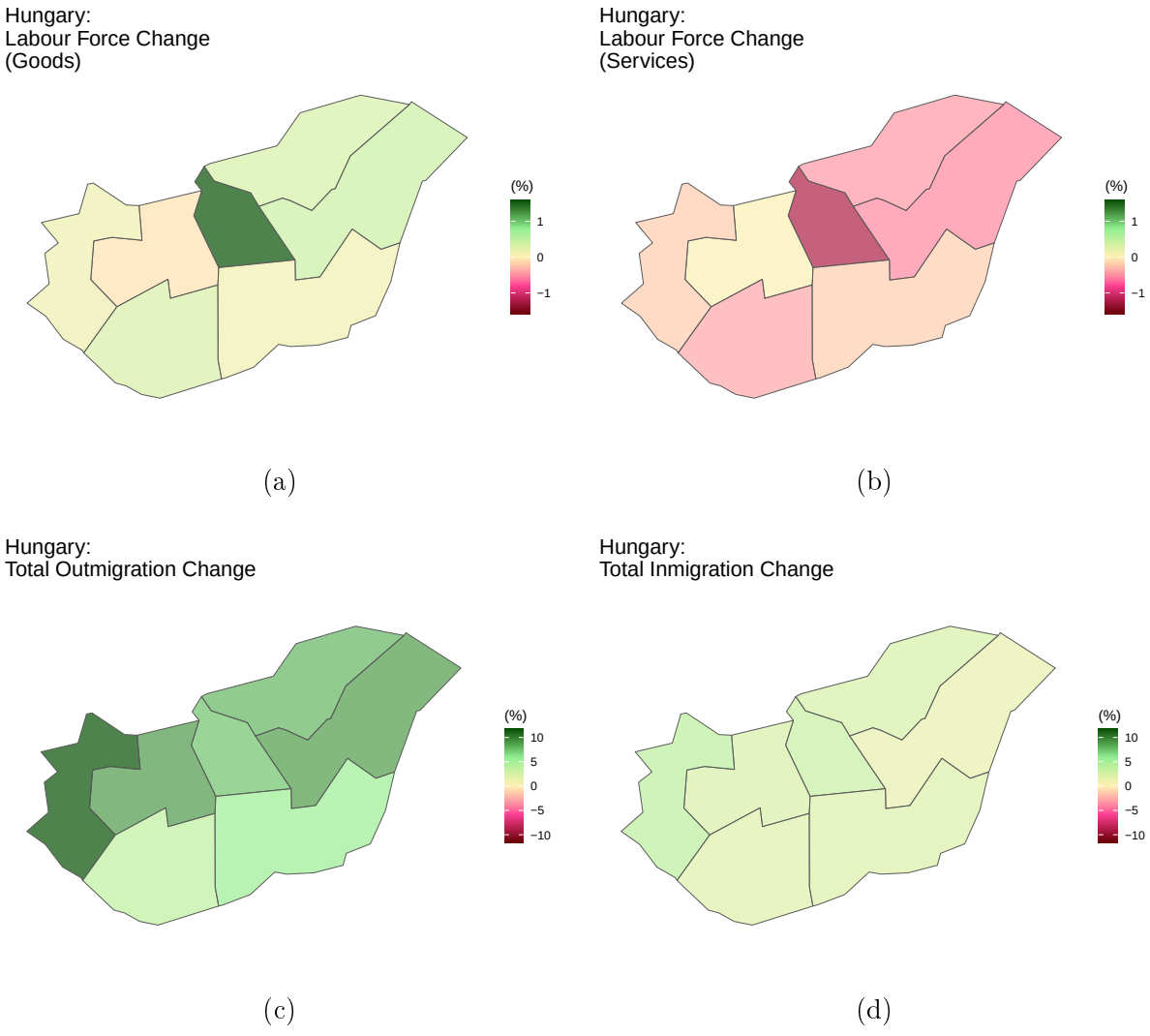


Figure 53: GE effects of the EU enlargement on Hungarian regions' labour force and migration.

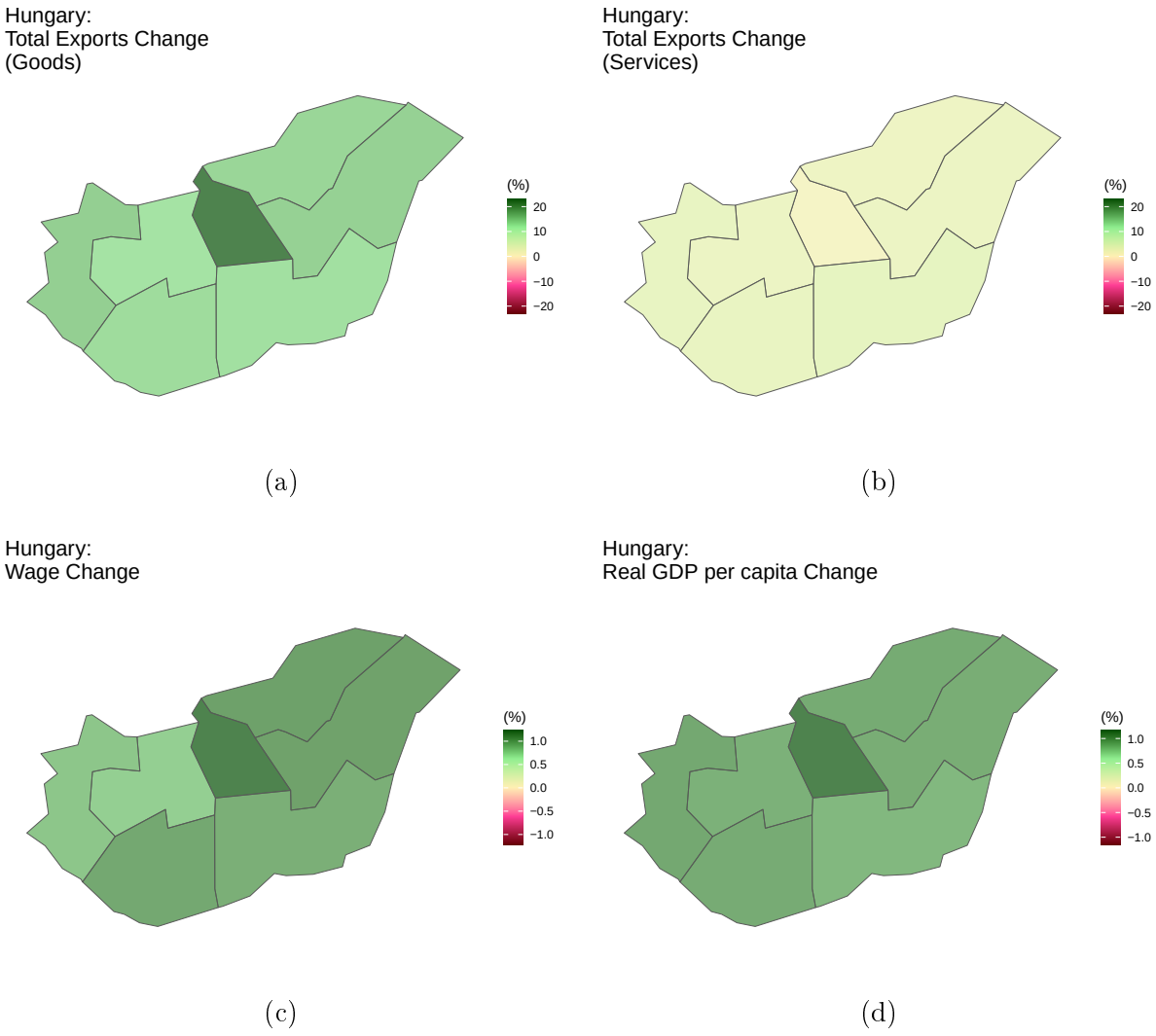


Figure 54: GE effects of the EU enlargement on Hungarian regions' exports, wages, and real GDP per capita.

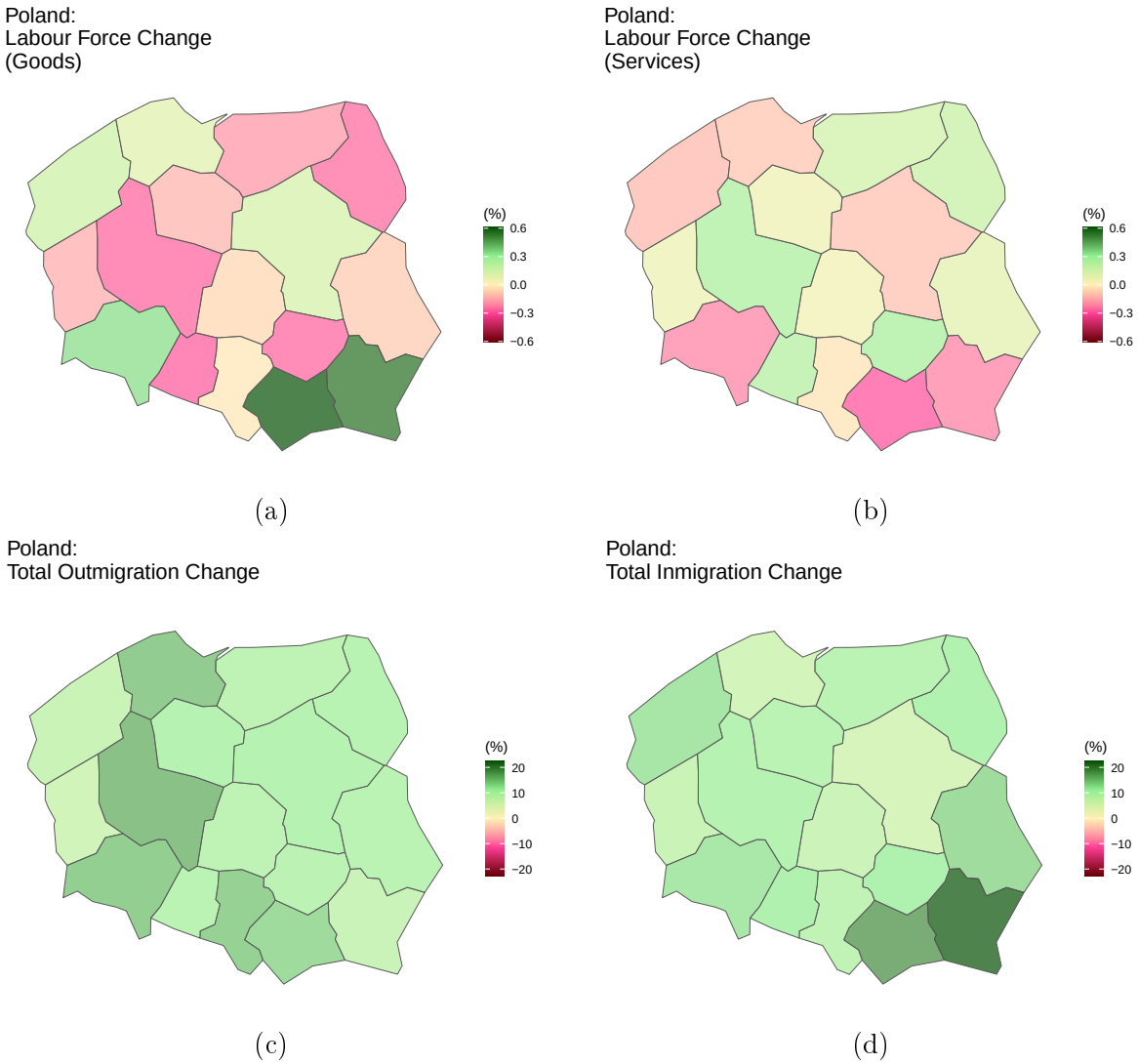


Figure 55: GE effects of the EU enlargement on Polish regions' labour force and migration.

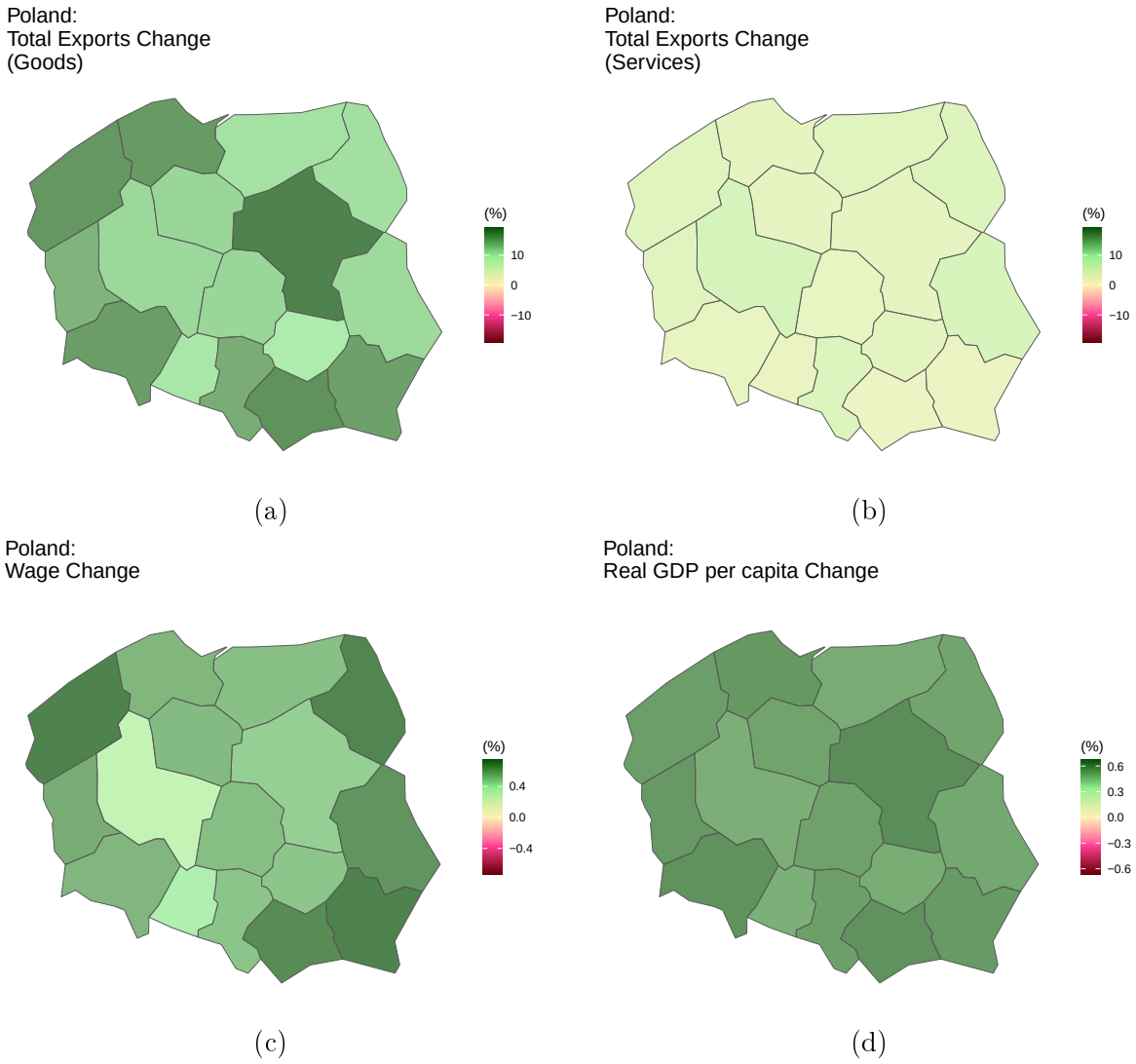


Figure 56: GE effects of the EU enlargement on Polish regions' exports, wages, and real GDP per capita.