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Labour Migration in the Enlarged EU: A New Economic Geography Approach*

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Abstract

The present paper studies how European integration might affect the migration of workers in the enlarged EU. Unlike the reduced-form migration models, we base our empirical analysis on the theory of economic geography à la *Krugman* (1991), which provides a general equilibrium framework for endogenising the migration pull and push factors. Parameters of the theoretical model are estimated econometrically using historical migration data. Our empirical findings suggest that European integration would trigger selective migration in the Member States of the enlarged EU. In the Baltics, Lithuania's total work force would increase by about 7%, whereas in the Visegrád, the share of mobile labour force would increase in Hungary. It is estimated that 3.6%-5.4% of the East European labour force would emigrate to the EU richer Member States. What our simulation results show, is that migrants are attracted by market potential, but also that their mobility is sufficiently low to make the emergence of a core-periphery pattern through migration in the enlarged EU not very likely.

Keywords: Labour Migration, European Regions, Economic Integration, New Economic Geography, Market Potential.

JEL classification: F12, L11, R12, R23.

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1 Introduction

During the first two decades after the fall of the Wall, the context and assumptions around immigration, have changed significantly. Starting from the early nineties, when the centrally planned Central and Eastern European (CEE) countries started to transform their economies to market oriented, to a time, when most of the EU Member States face an economic shock – a global economic crisis – potentially the most serious one that Europe has ever faced, both migration push and pull drivers have changed.[1] In the first years after the fall of the Wall, due to sizeable income differences between the East and the West, there was an enormous migration pressure in the East, which was opposed by a similarly strong pressure in the West to prevent mass immigration. During the first decade, the relative economic conditions improved significantly in the CEE transition economies, as a result of which the pressure to migrate decreased. The migration flows from the East started to increase in the middle of the second decade, when the new Member States joined the EU and it became possible to work legally in several old Member States. Due to the global economic crisis, the context and assumptions around immigration, changed again in the last two years. Whereas in the new EU sending countries the migration push drivers are increasing again, in the old EU receiving countries the pressure to limit immigration is growing for the second time since the fall of the Wall (*Kancs* and *Kielyte* 2010, *Papademetriou et al* 2009).

There is a large body of literature that attempts to predict the size and impacts of potential labour migration in the enlarged EU. The predictions of early migration studies, most of which were based on reduced-form migration models, are rather high, predicting emigration between 10.5% and 15% of the NMS's population (*Straubhaar* and *Zimmermann* 1993, *Boeri* and *Brücker* 2005). Confronting these predictions with the observed migration flows during the first two decades since the fall of the Wall, we note that the NMS were indeed characterised by sizable migration flows of several millions of persons over the last twenty years. However, most of these migration flows took place within Eastern Europe, and it is estimated that less than 5% of the total NMS's population has emigrated to Western Europe during the first 20 years since the fall of the Wall (*European Commission* 2010). The huge discrepancy between the model-based predictions and the observed migration is not surprising, given that most of the early migration studies were based on reduced-form models, where ex-ante values of key explanatory variables, such as wages and employment, have to

[1] In this paper EU-15 are referred as old EU Member States (OMS) and CEE-8 accession countries as new EU Member States (NMS), which include the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia.

be set by the researcher a priori. According to *Faini et al* (1999), a priori fixing of explanatory variables (drivers of migration) in small open economies, such as the CEE transition countries, where these variables are subject to dynamic changes, is both empirically and theoretically problematic. Fundamentally, in making such predictions it needs to be recognised that migration itself affects wages, income, employment, and cost of living (*Borjas* 2001, *Krugman* 1991). This implies that, without a general equilibrium feedback mechanism, it is hardly possible to predict when the relocation of labour force will stop or even reverse. For example, GDP per capita, which is one of the main explanatory variables in empirical migration models, has increased in most NMS considerably faster than was typically assumed in reduced form models. Econometrically, the reverse causality and the related endogeneity issues makes it difficult to obtain unbiased estimates (*Faini et al* 1999).

These notable deviations between the reduced form model predictions and the observed migrations patterns in the CEE transition countries suggest that the reduced-form approach is not a reliable tool for studying migration behaviour in small open economies in transition, which dynamically adjust to changes in factor and product market conditions. Instead, a methodological framework is required, which does not rely on ex ante predetermined values of migration drivers.

In order to account for the deficiencies of the reduced form approach to small open economies undergoing dynamic transition, we follow *Crozet* (2004), *Kancs* (2005), *Pons et al* (2007), *Hering* and *Paillacar* (2008) and *Paluzie et al* (2009) and adopt an alternative - economic geography - approach for studying the direction and size of potential labour migration in the CEE accession countries. According to the NEG literature (*Krugman* 1991), migrants not only follow market potential, they also affect market potential. Given that the NEG approach incorporates important general equilibrium feedback mechanisms, which interacting with labour migration determine the equilibrium distribution of labour force, it has been empirically more successful than the reduced form approach (*Kancs* 2005).

The general equilibrium approach of the NEG framework is considerably more demanding than that of the reduced-form approach, however, as it requires one additional step. In a first step, we derive an empirically verifiable migration equation from the theoretical economic geography model, where inter-regional migration is driven by real wage differentials (section 3), and estimate the migration model using data for historical migration patterns in the CEE accession countries, which provides estimates of key parameters of the theoretical economic geography model (section 4). In a second step, we supply the theoretical economic geography model with statistical data and the estimated parameters, and perform simulations of integration-induced impact on labour migration in the enlarged EU (section 5).

2 Migration in Europe after the fall of the Wall

2.1 Migration policy in the EU

During the first two decades after the fall of the Wall, the immigration policy in the old Member States was very restrictive. The two enlargements of the EU to East in 2004 and 2007 have significantly expanded the political geography of the free-movement area. Nationals from the CEE countries, on becoming citizens of the EU, have obtained rights of movement through the European Union and partner states (e.g. EFTA countries) that are broader than those available to other groups of migrants in Eastern Europe.

In the light of concerns that a massive influx of workers from the NMS would negatively affect the local wages and employment in the EU-15, the Accession Treaties allow for transitional arrangements restricting the free movement of workers from most of the NMS. The transitional arrangements can be applied for up to seven years, with the policy reviewed after two and five years (*European Commission* 2007).

Only three Member States – Ireland, Sweden and the United Kingdom – opened their labour markets to the NMS's workers from the date of accession. At the end of the first two-year period, four more Member States – Spain, Finland, Greece and Portugal – opened their labour markets, later followed by Italy, the Netherlands, Luxembourg, and France. Belgium and Denmark still apply some restrictions, while in Austria and Germany the inflows of workers from the NMS are regulated by national law (mainly through seasonal work-permit schemes operating under bilateral agreements). However, a number of exemptions have opened labour markets for high skilled workers and specific categories in these countries (*Kancs* and *Kielyte* 2010).

Transitional arrangements for the NMS from Bulgaria and Romania are in their second phase (from 1 January 2009 to 31 December 2011). In the first phase, all Member States except Finland and Sweden opted to restrict access to their labour markets for Bulgarian and Romanian workers. At the beginning of the second phase, Greece, Spain, Hungary and Portugal lifted the restrictions. Denmark stopped applying restrictions for workers from Bulgaria and Romania from 1 May 2009, when it also ended all restrictions for workers from the NMS. Against the background of the global economic downturn with rising unemployment in the EU, some Member States, which had earlier hinted at eliminating restrictions, chose to maintain them (*European Commission* 2010).

2.2 Migration in the Baltics

After the fall of the Wall, the Baltics experienced significant migration outflows, mostly of the "Russian speaking" population returning to their countries of origin. In Estonia about 100 thousand have returned to their 'homelands', with the majority leaving to Russia. As a consequence, these countries became net emigration countries. At the end of the 1990s, emigration flows weakened considerably and the net outflows became slightly positive in Estonia and Lithuania for several years.

In around the same time, the migration to the Western countries started to increase, e.g. the net emigration from Latvia to the West increased from nearly zero to 1500 in 1996. The major destinations for migrants from the Baltics were Finland and Germany for Estonia, and Israel, the US and Germany for Latvia and Lithuania. Nevertheless, with 15 thousand Estonians, 8 thousand Lithuanians and 7.5 thousand Latvians the number of legal Baltic countries' residents living in the EU-15 countries was relatively low at the end of the 1990s (*Kancs* and *Kielyte* 2002).

After the accession to the EU in 2004, the emigration from the Baltic States to the EU-15 increased substantially (*Traser* and *Venables* 2005). In all three Baltic countries the largest outflow of emigrants occurred in the years after the accession (2004-2005), when the share of emigrants increased substantially. Due to improving income possibilities in the Baltics relative to the EU-15, it started to diminish in 2006 and 2007. The weakening of worker outflow after 2005 was also related to the domestic labour market tightening in the Baltics in 2006-2007. During this time Latvia, Lithuania and Estonia experienced the highest increases in wage rates among all EU member states and relatively low unemployment levels. On average, during 2002-2007, the largest gross flows of emigration were from Lithuania, followed by Latvia and Estonia. The average annual level of gross emigration was around 40 thousand people from Lithuania, 20 thousand from Latvia and 7 thousand from Estonia (*European Commission* 2007). As before, there were significant differences between the three countries in terms of destination countries. While the largest number of emigrants from Estonia went to Finland, followed by the UK and Ireland, the main destination country for emigrants from Latvia and Lithuania was the UK, followed by Ireland and Germany. Furthermore, while the annual emigration to most of the countries fluctuated in different years, it was relatively stable to Germany. In addition, the cross country differences are notable. Whereas the emigration flows increased fourfold from Lithuania and Latvia after the EU enlargement (compared to 2002-2003), they only doubled from Estonia. Twenty years after the fall of the Wall, the highest worker mobility rate among all EU member states was in Lithuania, with around 3% of the total population having moved to other EU member states since the EU enlargement *European Commission* (2010).

2.3 Migration in the Visegrád

Before EU enlargement, nearly 300 thousand persons from the Visegrád were legally employed in the EU, accounting for 0.2% of the EU workforce or around 6% of total non-EU foreign workers (*European Commission* 2007). Germany and Austria hosted 70% of Visegrád workers in the EU. Broken down by home country, 55 thousand were from Bulgaria, 35 thousand from the Czech Republic, 20 thousand from Slovakia, 77 thousand from Hungary, 435 thousand from Poland, 155 thousand from Romania, and 20 thousand from Slovenia. As a result of closed labour markets but unrestricted travel, it was estimated that, in addition to legal workers, there were around 600 thousand undocumented workers from the Visegrád countries. The total number of legal immigrants, both working and non-active persons, from the Visegrád was approximately 830 thousand in the beginning of 2000s (*European Commission* 2007).

Simultaneously to outflows to the West, the Visegrád itself developed into a migrant-receiving area. The Czech Republic, a regional leader, hosted as many as 150 thousand migrant workers or foreign entrepreneurs in 2002, the majority of whom came from Slovakia and Ukraine. Also Hungary and Slovenia (and to lesser extent Poland) received substantial numbers of immigrants. Most of the countries recorded also large inflows of asylum seekers; e.g. between 1996 and 2003 the Czech Republic 63 thousand, Hungary 45 thousand, Poland 35 thousand and Slovakia 33 thousand (*European Commission* 2008).

The emigration to the West increased substantially after the enlargement in 2004. In 2004 the number of the residents from these countries stood at around 900 thousand. Although, the exact scale of post-enlargement migration flows are difficult to determine, population statistics and Eurostat's Labour Force Survey (LFS) data suggest that the total number of people from the Visegrád, living in the EU-15 has increased by around 1.1 million since the enlargement in 2004 (*European Commission* 2010). Ireland has been by far the largest receiving country in the Visegrád relative to its population size, with around 5% of its current working age population from the Visegrád, followed by the UK (1.2%). Also Austria and Luxembourg host significant proportions of the recent arrivals from the Visegrád, albeit much fewer than in the UK and Ireland. In all other EU-15 the population share of the recent Visegrád arrivals is very small, even in Sweden, which never applied restrictions to the free movement of workers, and in those MS, which have opened their labour markets since

2006.

As already noted, the mobility of labour force is different across the Visegrád countries. Polish citizens accounted for 25% of all EU citizens, who changed their residence to another EU member state in recent years. Around 60% of intra-EU Polish emigrants went to the UK, while the second destination was Ireland. In total, around 2% of total Polish and Slovak population have moved to other EU member states since the EU enlargement in 2004. The Czech Republic and Hungary showed rather low mobility rates, which are similar to those of EU-15.

3 Theoretical framework

3.1 The setup

The reduced form approach, which is the standard approach in the empirical studies of international labour migration, has been often rejected in the literature, because the fixing of the determinants of migration is not justifiable in small open economies (*Massey et al* 1993, *Gallup* 1997, *Fertig* and *Schmidt* 2001). In order to account for the deficiencies of the reduced form approach to small open economies undergoing dynamic transition, we follow *Crozet* (2004), *Kancs* (2005), *Pons et al* (2007), *Hering* and *Paillacar* (2008) and *Paluzie et al* (2009) and adopt an alternative - the NEG approach - where both the migration flows and the drivers of migration are determined endogenously.

Following *Kancs* (2005), the world consists of R regions, each of which is endowed with two factors of production, an immobile factor, L, and a mobile factor, H. Regional supplies of the immobile factor are exogenous to the model and fixed: each region contains L_r units of the immobile factor. As in *Krugman* (1991), the mobile factor (labour) is inter-regionally mobile. The world hosts H units of labour, where $H = \sum_{r=1}^{R} H_r$ with $r \in \{1, .., r, .., R\}$. Workers may relocate between regions maximising their utility, which implies that the inter-regional distribution of labour will change in the course of integration. H_r captures the region initial endowment of labour, and $\hat{H}_r$ - regions' labour endowment after the integration-triggered adjustment. Hence, H_r is an exogenous variable, whereas $\hat{H}_r$ will be calculated within the model.

Each region hosts two types of industries: 'traditional' industries, A, and 'manufacturing' industries, X. Both types of goods, A and X, are traded among all regions. The traditional sector is perfectly competitive, it produces a homogenous good under perfect competition, it is spatially immobile, because it only uses the immobile factor in producing goods. Traditional goods are traded at zero trade costs both inter-regionally and internationally, they serve as a numeraire in the model. The monopolistically competitive manufacturing industries, which represent all increasing-returns and mobile production activities in the economy, produce horizontally differentiated goods, which are traded between regions at *iceberg*-type cost T_{od}.

3.2 The model

Workers, which are the only consumers, consume both types of goods according to a two-tier utility function. The upper tier determines consumer division of expenditure between the traditional good, A, on the one hand, and manufacturing goods, X, on the other hand. The second tier determines consumer preferences over the differentiated manufacturing varieties. The functional form of the upper tier utility is quasi-linear (constant sectoral expenditure shares) and constant elasticity of substitution (CES) of the lower tier is.

First consumers divide their disposable income between the traditional and manufacturing good according to the following quasi-linear utility function:

$$U = \alpha \ln C_x + C_A \tag{1}$$

with $\alpha > 0$, C_x is the composite consumption index of manufacturing goods and C_A denotes consumption of the traditional good. The manufacturing goods' composite consumption index, C_x, is defined by the following CES function:

$$C_x = \left[\sum_{j=1}^{N} x_j^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{2}$$

where x_j represents consumption of variety j of manufacturing good x, N_r is the number of available varieties in region r, and σ is the elasticity of substitution between manufacturing varieties ($\sigma > 1$). Given the workers' disposable income, Y, each consumer maximises his utility subject to the budget constraint, $Y = C_A p_A + C_x p_x$, where p_{jod} represents the price of variety j of manufacturing good x and p_A represents price of the traditional good: $p_x = \left(\sum_j p_j^{1-\sigma} \right) \frac{1}{1-\sigma}$ and $p_A = 1, \forall r$.[2]

Combining equations (1) and (2), yields the demand emanating from consumers in region d consuming goods produced by producer j located in region o:

[2]By choosing units such that the price of the traditional good equals to the wage rate in the traditional sector ($p_A = r_A$) in each region, and choosing the traditional good as a numeraire, the price of the traditional good is unitary in all regions, $p_{Ar} = 1, \forall r$.

$$x_{jod} = p_{jod}^{-\sigma} \frac{\alpha}{\sum_j p_{jod}^{1-\sigma}} \tag{3}$$

Traditional goods are assumed to be traded at zero trade costs both inter-regionally and internationally,[3] implying that their prices equalise everywhere: $p_{A1} = p_{Ar}$. The cross-border trade of manufacturing goods is subject to positive trade costs, which are region-specific. As usual in economic geography models, manufacturing varieties produced in region r are sold by firms at mill price and the entire cross-border transaction cost is borne by consumers. Inter-regional trade costs of manufacturing goods are of 'iceberg' type implying that when one unit is shipped, only $1/T$ actually arrives at the destination region d. Therefore, in order for one unit to arrive, T units have to be shipped, increasing the manufacturing good's price to pT.[4] Hence, iceberg trade costs imply that the c.i.f. price, p_{jod}, of variety j produced in region o and sold in region d contains the mill price and a trade cost component: $p_{jod} = p_o T_{od}$. Because of the symmetry of all varieties produced in the same region, we henceforth omit the variety subscript j.

As in *Krugman* (1991), combining equations (2) and (3) yields the industrial price index for each region d:

$$P_d = \left[\sum_{o=1}^{R} N_o \left(p_o T_{od} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{4}$$

Using the industrial price index from equation (4), the individual demand of manufacturing goods (3) can now be expressed as:

$$x_{od} = \frac{\alpha \left(p_o T_{od} \right)^{-\sigma}}{P_d^{1-\sigma}} \tag{5}$$

Manufactured goods are produced in a monopolistically competitive industry that employs both the immobile and the mobile factor. Immobile factor is the only variable input. Labour enters only the fixed cost. The total cost of producing x units by a firm located in region r is $TC_r(x) = W_r H + L_r x$, where W_r represents the compensation of labour supply in region r. Hence, manufacturing firm's total cost, $TC_r(x)$, contains a fixed cost component that corresponds to one unit of labour input, and a marginal cost component in terms of the immobile factor, which is rented at a rent that is set

[3] Equally we could also assume positive trade costs for the traditional goods. The qualitative results would however not change (*Baldwin et al* 2003).

[4] We use T_{od} as a general expression of all cross-border transaction costs. We assume that trade costs are symmetric for any pair of regions, i.e. $T_{od} = T_{do}$, where o is the origin region and d is the destination region; and that intra-regional trade costs are zero, i.e. $T_{oo} = 1$.

equal to one. The fixed cost gives rise to increasing returns to scale.

As usual in the monopolistic competition framework, we assume that each region contains a large number of manufacturing firms, each producing a single product. Hence, we obtain the following constant mark-up equation for profit maximising manufacturing firms:

$$p_o = \left[\frac{\sigma}{\sigma - 1}\right], \forall r \tag{6}$$

where p_o is the price of a variety of manufacturing good produced in region o. The restriction $\sigma > 1$ ensures that price, p_o, is always positive. The equilibrium output of a manufacturing firm producing in region o is given by the market clearing for each variety. Using equation (5) and unit costs, we can derive the aggregate manufacturing output for region o:

$$X_o = \sum_{d=1}^{R} (H_d + L_d) T_{od} x_{od} \tag{7}$$

and the profit function of a representative firm located in region r is then given by:

$$\Pi_r = p_r X_r - X_r - W_r \tag{8}$$

The number of manufacturing varieties produced in region r equals the number of firms located in region r, which is linked one to one to the number of workers. The zero-profit condition in equilibrium implies wage, W_r, adjustment. Using equations (6) and (8), and imposing zero profit condition we obtain the aggregate manufacturing output of region r:

$$X_r = W_r (\sigma - 1) \tag{9}$$

According to equation (9), manufacturing output, X_r, is increasing in wage rate, W_r, and elasticity of substitution, σ.

The inter-regional equilibrium can be described by vectors of manufacturing output, X_r, regional price index, P_r, wage rate, W_r, workers' indirect utility, V_r, and inter-regional distribution of mobile workers, H_r. In the short run workers are immobile between regions, implying that there is no adjustment in inter-regional distribution of mobile workers, H_r. The manufacturing price index, P_o, in region o can be expressed using equations (4) and (6):

$$P_o = \frac{\sigma}{\sigma - 1}\left[\sum_{o=1}^{R} H_o T_{od}^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \tag{10}$$

with $\sigma > 1$.[5] For a given distribution of workers across regions, H_r, we use equations (5), (9) and (10) and derive the equilibrium value of the nominal wage rate, W_o:

$$W_o = \frac{\alpha}{\sigma}\sum_{d=1}^{R}\left[\frac{(H_d + L_d)\, T_{od}^{1-\sigma}}{\sum_o \left(H_o T_{od}^{1-\sigma}\right)}\right] \tag{11}$$

In the long run, workers are mobile between regions. They relocate to regions, where the maximal attainable utility is higher than in the home region. By moving between regions, workers equalise real wages, prices of manufacturing goods, and utilities across regions. The long-run equilibrium is achieved when any inter-regional differences in the attainable utility are equalised.

From equation (1) the utility maximisation yields the following indirect utility function:

$$V_r = -\alpha \ln(P_r) + Y_r + \alpha \ln(\alpha - 1) \tag{12}$$

where Y_r is worker income in region r. Worker income, Y_r is defined as an increasing function of wage rate, W_r. Subtracting equation (12), we can derive the inter-regional utility differential , $\triangle V_{od}$, between destination region d and origin region o:

$$\triangle V_{od} = V_o - V_d = \alpha \ln(\frac{P_d}{P_o}) + (W_o - W_d) \tag{13}$$

According to equation (13), the inter-regional utility differential, $\triangle V_{od}$, only depends on the parameters of the model, and d's share of mobile workers, H_d, which is given by:

$$H_d = H_d\left(\triangle V_{od}\right) \tag{14}$$

Although, the presented NEG model can be solved analytically for the share of mobile workers in each region, H_r, the equilibrium expressions for cases where $R > 2$ are rather involved and, therefore, not presented here.[6]

[5] Alternatively, in region d: $P_d = \frac{\sigma}{\sigma-1}\left[\sum_{d=1}^{R} H_d T_{od}^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$.

[6] Given that there are $4 \times R$ unknowns and $3 \times R$ equations would imply the insolvability

3.3 Integration, migration and agglomeration

This simple NEG model allows us to investigate the central question, what drives the mobile workers and industries to spread across locations, and what drives the mobile workers and economic activity to locate in one or few regions? To answer this question, consider a country that consists of two symmetric regions o and d. Assume that workers migrate rapidly between regions in response to differences in real wages and that manufacturing firms enter or leave the industry sluggishly in response to profits or losses.

Starting from an inter-regional equilibrium, we assume that regional integration induces some manufacturing firms from origin region o to move to destination region d. How does this affect the incentives of firms and workers for further relocation between regions? If profits in region d (which are initially zero) fall relative to region o, the diversified equilibrium is stable: the new firms are encouraged to exit and the initial equilibrium is restored. However, if the relative profits in region d rise, the initial equilibrium is unstable. More firms are encouraged to enter and the country moves towards an equilibrium with agglomeration: region d attracts manufacturing activity which is over-proportional to its endowment.

The relocation of a firm from o to d induces three effects. The first arises from the *price-index effect*. An additional firm entering the region lowers the manufacturing goods' price index, which in turn reduces the demand facing each existing firm (demand and marginal revenue curves shift downwards). This competition effect, captured through the number of firms, reduces manufacturing firms' profits. The competition effect contained in equation (15) discourages the entrance of firms, facilitating in such a way the establishment of a new diversified equilibrium.

$$P_d = \frac{\sigma}{\sigma - 1} \left[\sum_{d=1}^{R} H_d T_{od}^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{15}$$

The second effect is the so-called *demand or backward linkage*. An extra firm raises the demand for labour in region d. This puts incipient pressure on local wages, which encourages o's workers to migrate to d. Additional workers immigrating into region d raise the demand for local varieties. As a result, local demand and marginal revenue

of the system. However, according to our definition of the long-run equilibrium, the inter-regional utility differences, $\triangle V_{do}$, must be zero between any pair of regions in the long-run equilibrium (13). Thus, we may impose $\triangle V_{do} = 0$, $\forall od$ for each origin-destination pair instead of solving for endogenous values of V_r. This additional restriction has two benefits: (i) the guarantee that the achieved solution is indeed a stable equilibrium ($\triangle V_{do} = 0 \Rightarrow$ no incentives to migrate); and (ii) the solvability of the model is achieved (the number of endogenous variables = the number of equations).

increase, which in turn raises the profitability of manufacturing firms encouraging more firms to follow. Hence, the demand or backward linkage contained in equation (16) contains an important source of firm and worker agglomeration, the so-called demand or backward linkage.

$$X_d = \sum_{d=1}^{R} (H_d + L_d)\, T_{od} x_{od} \tag{16}$$

According to equation (15), entry by a new firm lowers the price index of region o, which induces the third effect, the so-called *cost or forward linkage*. Given that the entry of additional firms lowers price index in region d, the declining workers' cost of living tends to raise real wages and worker utility. More workers are encouraged to immigrate into region d, because it has higher utility. In the long-run, the resulting immigration of workers restores the inter-regional equality of real wages, implying that the nominal wage must fall, which shifts the average and marginal cost curves downwards. Falling wages in turn raise the profitability of manufacturing firms encouraging additional firms to enter. Hence, equation (17) contains an important source of firm and worker agglomeration, the so-called cost or forward linkage.

$$W_d = \frac{\alpha}{\sigma} \sum_{d=1}^{R} \left[\frac{(H_d + L_d)\, T_{od}^{1-\sigma}}{\sum_o \left(H_o T_{od}^{1-\sigma} \right)} \right] \tag{17}$$

To summarise, in our model the three forces of agglomeration/dispersion are realised through worker migration and firm relocation. Workers move to regions, where the utility, V_d, is higher than in the home region, V_d, and firms relocate to regions where profits are higher.

$$\begin{aligned} \triangle H_d &= \triangle H_d \left(\triangle V_{od} \right) \\ \triangle V_{od} &= V_o - V_d = \alpha \ln(\frac{P_d}{P_o}) + (W_o - W_d) \end{aligned} \tag{18}$$

By moving between regions, workers equalise real wages, prices of manufacturing goods, and utilities across regions. The long-run equilibrium is achieved when inter-regional utility differences, $\triangle V_{od}$, are equalised. Given that the share of mobile workforce, H_d, is A function of regional utility and hence a function of inter-regional utility differences, $\triangle V_{od}$, equation (18) contains circular causality forces (*Krugman* 1991).

Equations (15), (17) and (18) describe the long-run equilibrium relationship with four endogenous variables: P_r, W_r, V_r and H_r. The main advantage of the underlying NEG approach is the ability to endogenise both the RHS explanatory and the LHS dependent variables, i.e., our approach allows the drivers of migration to adjust to economic integration and migration-induced changes, which is not possible in reduced form models in a consistent way. As shown above, in the underlying NEG framework an integration policy shock is absorbed through adjustments in relative prices, wages, quantities produced and consumed. Because of adjustments in the drivers of migration, the utility is no longer equal among regions, which gives workers and firms an incentive to relocate toward regions with a higher utility/profit. Firms' entry (workers' immigration) in turn actuates further adjustments in regional economies. Depending on the characteristics of regions and the relative strength of the three agglomeration/dispersion forces, a regional integration shock may induce either agglomeration of economic activities and mobile labour in one region or result in a more even distribution between regions.

4 Parameter estimation

4.1 Specification of an estimable trade model

One of the key variables in the underlying economic geography model is inter-regional trade cost. Given that the true trade costs are unobservable, we follow *Head* and *Mayer* (2004), which propose that trade costs can be empirically approximated by the trade openness. According to *Head* and *Mayer*, the index of trade openness, ϕ_{od}, reflects the easiness with which two countries participate in reciprocal trade and is defined as $\phi_{od} = \tau_{od}^{1-\sigma}$.[7] Because $\sigma > 1$, trade openness is inversely related to trade costs.

Empirical estimation of the trade openness index, ϕ_{od}, is extremely data demanding and often cannot be performed even for countries with developed statistical data base. To get around the data issues, *Head* and *Mayer* (2004) propose that the calculation of the trade openness index, ϕ_{od}, can be considerably facilitated by making two simplifying assumptions: assuming zero trade costs within countries ($\phi_{rr} = 1$) and symmetric trade costs for external trade ($\phi_{od} = \phi_{do}$).

Head and *Mayer* (2004) show that assuming frictionless intranational trade and symmetric trade costs between countries, the index of bilateral trade openness, ϕ_{od}, can be calculated as follows:

[7] This trade cost measure, which *Baldwin et al* (2003) cunningly refer to as the 'phi-ness' of trade, is often employed in economic geography models as a proxy for trade costs.

$$\phi_{od} = \sqrt{\frac{M_{od} M_{do}}{M_{oo} M_{dd}}} \tag{19}$$

where M_{od} is the import of goods and services from origin region o to destination region d and M_{oo} (M_{dd}) measures the intranational trade. The numerator in equation (19) requires only trade value data expressed in Euros. The denominator factors are each region's 'imports from self'. They can be calculated as the value of all shipments of an industry minus the sum of shipments from all other countries (imports).

Given that the trade cost data is not available for the NMS, in this study we can only calculate this 'reduced form' of trade openness index, ϕ_{od}. The former assumption is not critical for countries of our sample, because none of the included CEE countries has a significant geographical advantage or disadvantage, which would asymmetrically affect external trade. The latter assumption might become critical under certain circumstances. In particular, internal trade costs usually increase with size of the country. Consequently, when trade costs arise only for cross-border transactions, trade with foreign countries is estimated to be less free than the domestic trade, suggesting lower levels of trade integration. Thus, from the geography's point of view, the obtained estimates might potentially be upward biased for geographically large countries. In the context of our study, however, the physical (and economic) size of countries in our sample is rather similar, suggesting that the latter assumption will unlikely bias the trade openness estimates.

Two-way parameter restrictions need to be imposed, when estimating equation (19) - trade openness estimates, $\hat{\phi}_{od}$, need to be bounded both from above and from below. These restrictions imply that the estimated trade openness can only take values between zero and one, $0 < \phi_{od} < 1$, with 0 denoting prohibitive trade costs and 1 denoting free trade.[8]

4.2 Specification of an estimable migration model

Following *Davies*, *Greenwood* and *Li* (2001), we model workers' migration by assuming that mobile worker i from region o has a location choice among R regions. The migration function results from utility maximising choices of individuals, where workers' migration choice results from a comparison of the perceived quality of life among R locations. Worker i from region o derives positive utility, U_{iod}, from migrating to region d, where workers' utility is a linear function of all relevant economic conditions

[8] Theoretically, the trade freeness index could be larger than 1, if the external trade of both trading partners is larger than internal trade. However, this is not an issue in the CEE trade.

pertaining to origin region o and destination region d , captured by V_{iod}:

$$U_{iod} = \beta_i V_{iod} + \epsilon_{iod} \tag{20}$$

where β_i is a vector of utility coefficients corresponding with the elements of V_{iod}, which may vary depending on the identity of the worker, and ϵ_{id} is a stochastic component (random disturbance) capturing i's personal perception of region d's characteristics. Given that there are R alternative destination regions, migration choices are determined from comparing the maximum attainable utility, U_{iod}, across R regions. Worker i chooses to migrate to region d, if the maximum attainable utility, U_{iod}, in region d is the highest among all R choices (i.e. $U_{iod} > U_{ior}$ for all $r \neq d$). Consequently, the statistical model of the probability that worker i from region o moves to region d can be represented as follows:

$$\Pr\left(\Omega_r = d\right) = \Pr\left(U_{iod} > U_{ior}\right), \forall r \neq d \tag{21}$$

where Ω_r is a random variable that indicates the choice made. The statistical migration model is made operational by a particular choice of the distribution of disturbances. According to *McFadden* (1973), if random disturbances, ϵ_{iod}, are independent and identically distributed according to the Weibull distribution, then the probability of individual i from region o choosing region d (where $r = d$ for non-movers) can conditionally be written as a logit model:

$$\Pr\left(\Omega_r = d\right) = \frac{e^{\beta_i V_{iod}}}{\sum_{r=1}^{R} e^{\beta_i V_{ior}}} \tag{22}$$

where $\Pr\left(\Omega_r = d\right)$ is the probability of choosing region d. It is convenient to rewrite equation (22) in terms of individuals, who move to region d as a share of those, who stay in region o:

$$\frac{\Pr\left(\Omega_r = d\right)}{\Pr\left(\Omega_r = o\right)} = e^{\beta_i (V_{iod} - V_{ioo})} \equiv e^{\beta_i \triangle V_{ido}} \tag{23}$$

Equation (23) states that the likelihood of individual i from region o migrating to region d compared to staying in region o is a function of the differentiated expected utility between migrating and staying. Assuming that all workers in region o have the same indirect utility function, V_{or}, yields the following migration equation:

$$\frac{H_{od}}{H_{oo}} = \frac{\Pr\left(\Omega_r = d\right)}{\Pr\left(\Omega_r = o\right)} + \epsilon_{od} = e^{\beta_i \triangle V_{ido}} + \epsilon_{od} \tag{24}$$

where H_{od}/H_{oo} is the ratio of workers, H_{od}, from region o choosing to migrate to region d over the number of workers, H_{oo}, choosing to stay in region o. Applying a logarithmic transformation to equation (24), we obtain the following equation of the bilateral migration rate, M_{od}:

$$\ln M_{od} = \beta_i \bigtriangleup V_{iod} + \epsilon_{od} \tag{25}$$

On the basis of equation (25), we are able to calculate bilateral place-to-place migration flows, M_{od}, for each pair of regions. Using equations (10), (11), (13) and (25), the number of people moving from origin region o to destination region d can be expressed as a function of the cost of living (proxied by the manufacturing price index, P_r), regional wage rate, W_r, and parameters of the model (α, σ, T_{od}).

Using the definition of $\triangle V_{do}$ and substituting equation (13) into equation (25) yields an estimable model of labour migration:

$$\ln M_{od} = \beta W_d - \beta W_o + \beta \ln P_o - \beta \ln P_d + \epsilon_{od} \tag{26}$$

According to equation (26), worker migration, M_{od}, from region o to region d is increasing in origin region o's manufacturing price index, P_o, decreasing in destination regions d's price index, P_d, increasing in destination regions d's wage rate, W_d, and decreasing in origin region o's wage rate, W_o. The empirical estimation of equation (26) gives rise to several complications. In particular, we identify three econometric issues: the problem of missing data, potential endogeneity of the right-hand side explanatory variables and omitted variables bias.

The missing data issue concerns both right-hand side explanatory variables: regional price indices, P_r, and wages, W_r. The manufacturing price index, P_r, is available in statistical data, but its definition is not consistent with the underlying theoretical model.[9] Wage data is available for all CEE economies in our sample, but its quality is poor, because a considerable part of wages is still being paid in 'envelopes'. Thus, equation (26) requires further transformations before it can be empirically estimated. First, using equation (10), we substitute out the manufacturing price index, P_r. Next we define two new variables, θ_d and θ_o as follows: $\theta_d \equiv \sum_{d=1}^{R} H_d \phi_{od}$ and $\theta_o \equiv \sum_{o=1}^{R} H_o \phi_{od}$, which capture the remoteness from the rest of the world (in our study EU). It is similar to the 'multilateral resistance variable' of *Anderson* and *Wincoop* (2003).[10] Second, we use equation (9) to substitute out wage rate, $W_r = \frac{1}{\sigma-1} X_r$,

[9] The consumer price index (CPI) is readily available in statistical data. However, because the way how the CPI is constructed differently from the price index in the theoretical NEG model (10), it is not model-consistent and hence cannot be used in the estimations.

[10] Although, at this stage we still do not know the numerical values of T_{od} (in order to

with $\sigma > 1$, which yields the following linearly estimable migration equation:

$$\ln M_{od} = \beta_1 + \beta_2 \ln \theta_o + \beta_3 \ln \theta_d + \beta_4 X_d + \beta_5 X_o + \epsilon_{od} \qquad (27)$$

where $\beta_2 = \frac{\alpha_o}{1-\sigma_o}$, $\beta_3 = -\frac{\alpha_d}{1-\sigma_d}$, $\beta_4 = \frac{1}{\sigma_d - 1}$, $\beta_5 = -\frac{1}{\sigma_o - 1}$ are the estimable coefficients, and $\theta_o = \sum_{o=1}^{R} H_o \phi_{od}$, $\theta_d = \sum_{d=1}^{R} H_d \phi_{od}$, X_o and X_d are the explanatory variables and ϵ_{od} is a random prediction error. Given that the coefficient of manufacturing output, X_r, contains the elasticity of substitution, σ_r, we are able to separate α_r from σ_r in coefficients β_2 and β_3.

The estimation of equation (27) gives rise to the problem of endogeneity. In the underlying economic geography model, the endogeneity of explanatory variables might be caused by at least two sources. First, we note that migration flows might potentially give rise to adjustments in the explanatory variables (reverse causality). According to the underlying theoretical framework, labour migration across regions creates a tendency for firms and workers to cluster together, when regions integrate and inter-regional trade costs decline. Because of the price-index effect and of the demand and cost linkages, the relocation of firms and workers affects region's manufacturing price index, production costs, firms' productivity and workers' wages, implying that these (explanatory) variables depend on the relative size of regions' labour force and, hence, on the labour migration. Second, we note that in the CEE transition economies there may exist confounding factors, such macroeconomic shocks and structural adjustments, which might contemporaneously affect manufacturing output, price index, wages and labour migration. For instance, a negative demand shock may drive down manufacturing output and, at the same time, increase emigration from the region.

The potential endogeneity of explanatory variables implies that estimating equation (26), where migration rate, M_{od}, is function of other endogenous variables will likely yield biased and inconsistent estimates. To get around the endogeneity problems, we follow *Honoré* and *Kyriazidou* (2000) and use instrumental variables with lagged values of the right-hand side explanatory variables as instruments. Thus, we implicitly assume that migration choices at date t are determined from a comparison of utility across R regions at date $t-1$. We restrict the number of lags to one in order not to lose further time-series observations. For the instrumental variables estimation we had to assume that instruments are predetermined, and immigrant inflows and confounding factors in residuals only affect contemporaneous and future wages, and

calculate $T_{od}^{1-\sigma}$ we require estimates of σ), this is not an obstacle for estimating the migration equation, as we can straightforwardly plug in the estimated values of ϕ_{od} without knowing numerical values of the inter-regional trade cost parameter T_{od}.

migrant stocks. As usual, we assume that residuals are not autocorrelated, otherwise our instruments would be invalid.

Unobservable heterogeneity is the third econometric issue we have to deal with. Obviously, beyond the included explanatory variables in equation (27), unobservable economic and non-economic characteristics of regions, such as amenities, also play an important role in migration decisions. According to *Arellano* and *Honoré* (2001), there are many reasons to assume that country-specific fixed effects are relevant when push or pull effects (such as geographical, cultural and historical determinants) that could drive or hamper labour migration are present. These factors are deterministically linked to countries' specific characteristics and cannot consequently be considered as random. Failing to account for the unobserved cross-section heterogeneity translates into biased estimates, which we refer to as omitted variables bias.

Previous migration studies using panel data estimators (e.g. *Boeri* and *Brücker* 2001) suggest that instead of using one dummy variable per country, individual country pair dummies (fixed effects) should preferentially be included for obtaining efficient estimators. In the context of our study, the country-pair fixed effects capture all unobservable time-invariant factors, such as cultural and historical ties, geographical position and labour market policies, as it is unlikely that the inter-regional transport cost variable, ϕ_{od}, encompasses these factors, which are intrinsically difficult to measure in practice. Therefore, we include a time invariant constant term, ν_{od}, among the right hand side explanatory variables. Subsequently, we obtain the following econometric model of gross migration rate:[11]

$$\begin{aligned} \ln M_{odt} &= \beta_1 + \beta_2 \ln \theta_{ot-1} + \beta_3 \ln \theta_{dt-1} + \beta_4 X_{dt-1} \\ &\quad + \beta_5 X_{ot-1} + \nu_{od} + \epsilon_{odt} \end{aligned} \tag{28}$$

where M_{od} is the gross migration rate from origin region o to destination region d; t is the time span; θ_r is country r's multilateral resistance, X_r is an index of manufacturing output in each region, ν_{od} are time invariant bilateral country-pair effects and ϵ_{odt} is the error term.[12] The multilateral resistance, θ_r, is a function

[11] An alternative approach involves the interpretation of ν_{od} as a country-specific random variable that is uncorrelated with the included regressors. Under either interpretation, unless all explanatory variables are strictly exogenous, contemporaneous correlation between explanatory variables and error term will remain, and inconsistency of the estimator will continue to be problematic.

[12] Generally, the inclusion of fixed effects does not allow estimation of time-invariant explanatory variables, which enter also into the fixed effects. Due to sizable migrations and varying participation rates, labour supply, L_r, is time-variant in the CEE. The index of trade

of the origin and destination regions' share in the total supply with labour, H_r, and bilateral transport cost measure, ϕ_{od}. In order to ensure that the obtained parameters are consistent with the theoretical model, we impose parameter restrictions: $\sigma > 1$ and $1 > \alpha > 0$. These intervals correspond to the following coefficient restrictions: $\beta_2 < 0$, $\beta_3 > 0$ and $\beta_4 > 0$, $\beta_5 < 0$.

In order the fixed effects estimator to be unbiased, we need to assume that explanatory variables, θ_{rt-1} and X_{rt-1}, are strictly exogenous conditional on the time invariant constant, ν_{od}. As discussed above, this assumption will likely be satisfied in our data. In order to ensure that the fixed effects estimator is well behaved asymptotically, we need a standard rank condition on the matrix of time-demeaned explanatory variables. In order to ensure that the fixed effects estimator is efficient, we need to assume that the conditional variances are constant and the conditional covariances are zero. While heteroscedasticity in time-demeaned errors, $\ddot{\epsilon}_{odt}$, might be a potential problem, serial correlation is likely to be less important. Because of the nature of time demeaning, the serial correlation in the time-demeaned errors, $\ddot{\epsilon}_{odt}$, under the latter assumption causes only minor complications (*Arellano* and *Honoré* 2001).

4.3 Trade cost estimates

The estimation of the trade openness equation (19), which is derived by *Head* and *Mayer* (2004), requires bilateral trade data for importers and exporters, M_{od} and M_{do}, and domestic sales in each country, M_{oo} and M_{dd}. *Eurostat*'s External Trade Statistics (COMEXT) provides bilateral trade flows in the SITC and NACE classifications. The COMEXT trade data has a detailed time, country and sectoral coverage and is available for all CEE accession countries. The time period covered in the available trade data spans from 1991 to 2008. Therefore, we use the COMEXT trade data, which allows us to build eight equally sized panels each containing 144 observations (8 countries $\times$ 18 years). The obtained trade openness estimates are reported in Figure 1, where trade openness, ϕ_{od}, is on the vertical axis and time measured in years on the horizontal axis.

According to Figure 1, the intra-CEE trade openness is rather different across the

freeness, ϕ_{od}, which we use as a proxy for trade costs is also time-variant (see Figure 1 in section 4.3). According to our estimations, the trade freeness has increased significantly in the last 14 years. Given that the multilateral trade resistance, θ_d, is calculated on the basis of two time-variant variables, it is time-variant too. According to the Eurostat's New Cronos sectoral output data, X_r is also time-variant. In particular, it exhibits an upward trend (which might result in non-stationary variables). Hence, all right-hand side explanatory variables in equation (28) are time-variant.

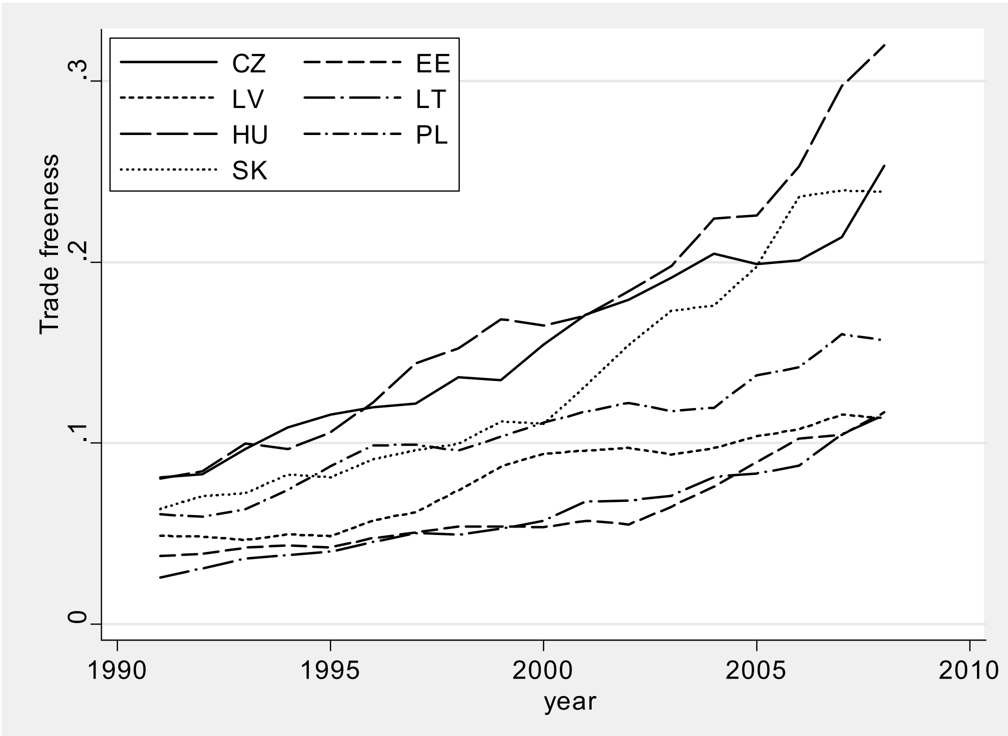

Figure 1: Trade freeness of intra-CEE trade, 1991-2008

eight CEE economies. We can identify two groups of CEE countries: three Visegrád (CZ, HU and SK) and three Baltic (EE, LT and LV). Poland is between the two groups. Generally, the estimated trade openness for the Visegrád countries is higher than for the Baltic countries throughout the whole interval. Among others, these sizeable differences in trade openness between the Visegrád and Baltic countries might be attributed to different time lines when the Visegrád and Baltic countries entered into regional free trade agreements (BAFTA - the Baltic Free Trade Agreement was established several years later than CEFTA - the Central European Free Trade Agreement). Figure 1 also indicates a clear upward trend - trade openness increases steadily in all our sample countries, although at different rates. On average, trade openness has increased by 230% (from 0.057 to 0.188) between 1991 and 2008.

Hungary has the highest trade openness among the four Visegrád countries (0.320). The Czech Republic started well but its trade openness did not increase significantly during the nineties. In fact, it declined compared to the rest of the CEE. Until 2004 the openness of intra-CEE trade was equally in the Czech Republic and Hungary. Comparing our estimates with those reported in *Brülhart* and *Koenig* (2006), we note that trade openness estimates for the Visegrád countries is in the same order of magnitude, which indicates a solid robustness of our estimates.

Intra-CEE trade openness for the three Baltic countries with respect to the rest of the NMS has not been estimated in the literature before and hence cannot be compared directly. In our view, the estimated trade openness for the Baltic countries appears to be rather low (0.117, 0.114 and 0.116, respectively in 2008), despite the fact that these countries are known for their high levels of formal trade integration (e.g. BAFTA). The estimated trade openness is particularly low in Estonia and Lithuania, where until 2003 ϕ_{od} varies around 0.05. *Kancs* (2005) estimates the intra-Baltic trade openness for the period 1990 - 2004. His estimates are in the same range of magnitude, but with more pronounced differences between the three Baltic countries. He explains those differences among the three Baltic countries by two factors. First, the geographical location - the three countries are located along the Baltic Sea and Estonia does not have a land border with Lithuania. Second, intra-BAFTA trade between Estonia and Lithuania is not only associated with the largest average transportation distance, shipping between Estonia and Lithuania have to cross more borders.[13] Both factors are captured by intra-Baltic trade openness, ϕ_{od}, which sum up to sizeable differences.

4.4 Migration estimates

The empirical estimation of migration equation (28), requires time series cross section data of bilateral migration flows, M_{od}, sectoral output data, X_r, and multilateral trade resistance, θ_r. Migration data is drawn from the *Eurostat*'s Regional migration statistics (REG_MIG) and national statistics, which provide immigration data by education and country of previous residence. Sectoral output, X_r, data is drawn from the Eurostat's New Cronos Theme 2 - Economy and Finance, Domain - Accession countries non-financial accounts (NA_MNAG). Calculation of the multilateral resistance index requires data for trade openness, ϕ_{od}, the supply of labour force in each country, H_r, and the total labour force, H. Trade openness, ϕ_{od}, has already been estimated in the previous section. Country endowments with labour force are drawn from the New Cronos Theme 3 - Population and social conditions, Domain - Employment (EMPLOY).

The regression results for the fixed effects model are presented in Table 1. All coefficients have the expected signs, which is due to the imposed coefficient restrictions.

[13] Whereas the bilateral trade between Estonia and Lithuania involves at least two border crossing (depending on the exact route up to four borders), the bilateral trade between any other pair of regions usually involves crossing of only one border.

Generally, coefficients of manufacturing output (β_4 and β_5) are more significant that coefficients of multilateral trade resistance (β_4 and β_5). According to the estimates reported in Table 1, origin country o's multilateral resistance affects labour migration negatively, destination country d's positively. According to our estimates, origin country o's manufacturing output affects labour migration negatively, destination country d's positively. These results are in line with *Crozet* (2004), *Pons et al* (2007), *Hering* and *Paillacar* (2008) and *Paluzie et al* (2009), suggesting that migrants follow the market potential.

Table 1: Fixed effects estimates of intra-CEE migration

	CZ	EE	HU	LV	LT	PL	SK	SI
β_2	-0.482†	-0.531†	-0.625††	-0.607†	-0.579††	-0.537†	-0.499††	-0.533†
	(0.123)	(0.108)	(0.083)	(0.106)	(0.085)	(0.129)	(0.066)	(0.097)
β_3	0.254	0.323†	0.342	0.250	0.276†	0.313†	0.318†	0.333
	(0.147)	(0.077)	(0.154)	(0.138)	(0.071)	(0.090)	(0.092)	(0.148)
β_4	0.925††	0.899††	0.842††	0.945†	0.862††	0.899†	0.757†	0.901††
	(0.108)	(0.068)	(0.072)	(0.126)	(0.076)	(0.124)	(0.133)	(0.106)
β_5	-0.975†	-1.005††	-0.963††	-1.009†	-1.038†	-1.019†	-1.019†	-1.032††
	(0.139)	(0.067)	(0.079)	(0.124)	(0.100)	(0.115)	(0.151)	(0.081)
N	126	126	126	126	126	126	126	126
R^2	0.523	0.550	0.534	0.480	0.499	0.462	0.458	0.532

Notes: Dependent variable: log of migration rate, $\ln E_{od}$, (equation 28). Standard errors in parenthesis. † significant at 95% level, †† significant at 99% level.

As usual, we test the robustness with respect to the choice of the estimator and the maintained assumptions. In particular, we estimate equation (28) using contemporaneous values of θ and X. Robustness test results suggest that, when the OLS estimator or when contemporaneous values of explanatory variables are used instead, the magnitude of coefficients does not change significantly. Not controlling for the county-pair fixed characteristics increases variation of β_1 and β_2 coefficients across countries. Moreover, the magnitude of these coefficients do not change significantly. Changes in coefficients β_3 and β_4 are even smaller, suggesting that the fixed effects estimates are robust. Testing the idiosyncratic errors for serial correlation is tricky, as we cannot estimate the $\epsilon_{od,t}$. Because of the time demeaning used in fixed effects, we can only estimate the time-demeaned errors, $\ddot{\epsilon}_{od,t}$. However, given the small time dimension of our panel, we abstract from this issue in the present analysis.

Migration estimates provides us with the underlying structural parameters of the NEG model: from β_2 and β_5 ($\sigma_o = \frac{1}{\beta_5} + 1$ and $\alpha_o = \beta_2 (1 - \sigma_o)$) we calculate parameter α_o, which describes consumer preferences for manufactured goods in origin region, and parameter σ_o, which represents the constant elasticity of substitution between manufacturing varieties in origin region.[14] Table 2 reports the obtained parameter values.

Table 2: Estimates of structural parameters α_o and σ_o

	CZ	EE	HU	LV	LT	PL	SK	SI
α_d	0.495	0.528	0.649	0.601	0.558	0.528	0.490	0.516
	(0.886)	(1.613)	(1.049)	(0.856)	(0.853)	(1.121)	(0.435)	(1.201)
σ_d	2.026	1.995	2.039	1.991	1.963	1.982	1.981	1.969
	(0.139)	(0.067)	(0.079)	(0.124)	(0.100)	(0.115)	(0.151)	(0.081)

Notes: Parameter values calculated from estimates in Table 1 using the structural equations $\sigma_o = \frac{1}{\beta_5} + 1$ and $\alpha_o = \beta_2 (1 - \sigma_o)$.

Parameter values reported in Table 2 suggest that both parameters - consumer preferences for tradable goods and the elasticity of substitution between manufacturing varieties - are significantly different across the CEE accession countries, but in the same order of magnitude. The average value of σ_o is 1.993 with a standard deviation of 0.026. Compared to the literature, our estimates of σ_o are slightly lower. This deviation might be partially explained by lower income and hence higher importance of product prices, which dominate the welfare gain of additional varieties through imports. The average value of α_o is 0.546 with a standard deviation of 0.055. Also these values are lower than literature estimates for the EU-15 and OECD economies. These deviations can eventually be explained by the fact that in the CEE transition economies consumers spend a higher share on food and agricultural products (*Kielyte* 2002).

[14] Each migrating worker has eight destination choices, which are pooled together in the panel data estimation. Given that the number of destination choices is larger that one, parameters α_d and σ_d are not consistent with the theoretical model and, therefore, cannot be used for parameterisation of the model.

5 Integration-induced migration in the EU

5.1 Baseline equilibrium

The empirical implementation of the theoretical NEG model requires two types of data: a cross-section of exogenous variables and numerical values of model's parameters. Endowments with the immobile factor (land) are drawn from the New Cronos Theme 1 - General Statistics, Domain - Central European Countries. Sectoral expenditure shares are drawn from the New Cronos Theme 2 - Economy and Finance, Domain - Accession countries non-financial accounts (NA_MNAG). Base year endowments with the mobile factor (labour) are drawn from the New Cronos Theme 3 - Population and social conditions, Domain - Employment (EMPLOY).

Solving the economic geography model, we obtain short-run equilibrium values for all endogenous variables, such as prices, manufacturing output, wages, sectoral employment for each region ('base run'), which are different across the CEE regions. Inter-regional differences in the manufacturing price index and wage rate give rise to inter-regional differences in the indirect utility, V_r, and firm profits, which implies that this is not a long run equilibrium. According to the underlying economic geography model, the transition from the short-run equilibrium to the long-run equilibrium occurs through workers' migration and firm relocation. We assume that workers migrate to regions with the highest attainable utility and firms relocate to regions with the highest profits. Practically, we calculate the number of workers required to enter/leave each region in order to achieve the long run equilibrium of the regional share of mobile workers and the explanatory variables, using the short run equilibrium values of P_r, W_r and X_r and fixing the inter-regional utility differences at zero, $\triangle V_{od} = 0, \vee r$. Subtracting the short-run equilibrium values, H_r, from the long run equilibrium values, $\hat{H}_r$, and expressing these in terms of the initial labour endowment, we obtain a net migration rate for each region, $\hat{M}_r^{BR}$. This migration rate tells us how many mobile workers had to move into or out of each region in order to establish an inter-regional equilibrium.

In order to assess the robustness of the base run results, we compare the predicted net migration rate, $\hat{M}_r^{BR}$, in the base run with observed migration flows in 2004, M_r^{04}. This comparison is not straightforward, however. First, because of misspecification of the model (missing variables, specific functional forms), there are differences between the driving forces of worker migration in the model and in the reality. For example, according to the underlying economic geography model, the only way that workers can deliberately increase their utility, is to move from a low-wage region to a high-wage region. In reality, however, because of language, cultural, political and many other non-pecuniary aspects, workers might prefer to stay put or even move to low-wage regions. Second, the time-scales are different. In statistical data migration is usually expressed either as a number of migrants per year or in percent of the total population per year. Our simulation results, on the other hand, do not give any time reference, i.e. the underlying economic geography model does not provide any information about how long the transition from the short-run equilibrium to the long-run equilibrium will last.

In order to account for these limitations in the comparability of the results, instead of comparing the absolute migration rates, we also compare the relative migration rates. I.e. we express the predicted migration in region 1 in terms of migration in region 2 ($\hat{M}_1/\hat{M}_2$, where $\hat{M}_1$ and $\hat{M}_1$ are the predicted net migration rates in regions 1 and 2) and compare it with the corresponding values observed in the data (M_1/M_2). These comparisons indicate that the relative migration rates predicted by our model, are indeed of the same order of magnitude as those recorded in statistical data, which allows us to conclude that our results are robust, at least in relative terms. Differences in the absolute values of migration underline that numerical results should not be overemphasised, but have to be seen in a context of model's assumptions, which are outlined in section 3.

5.2 Integration-induced migration in the Baltics

The factor and product market integration in the CEE accession countries is modelled as declining inter-regional trade costs. For setting up integration scenarios of declining border-crossing costs, we require two types of transport cost data: (i) the magnitude of transport costs in the base year, and (ii) integration-induced changes in the inter-regional transportation costs. Trade openness has already been estimated in section 4.1. Reliable estimates of transportation cost changes related to future labour and product market integration in the CEE accession countries are not available in the literature yet. Therefore, in order to overcome this data limitation, we construct several hypothetical scenarios, which will help us to understand what type of labour market effects could be expected from the EU integration.

In order to simulate labour and product market integration and to assess integration-induced labour migration in the CEE accession countries, we proceed as follows. First, we exogenously change the level of trade costs to the peripheral regions in 10% steps up to 60%. Solving the model for the short-run equilibrium with spatially immobile labour, we obtain a solution with sizeable inter-regional differences in price indices, wages and worker utility. As explained above, this is not a stable long-run equilibrium solution, because inter-regional differences in explanatory variables give workers an incentive for relocating. Therefore, in a second step we solve the model for a new inter-regional distribution of $\hat{H}_r$, such that the indirect utility is equalised between regions. In other words, we exogenously set $\triangle V_{do} = 0$ for all pairs of regions and solve the model for new equilibrium values of $\hat{H}_r$. The net migration is then calculated as $\hat{M}_r = H_r - \hat{H}_r$,[15] where negative values stand for emigration of region r and positive values stand for migration to region r. Migration rate is obtained by normalising $\hat{M}_r$ by H_r.

Table 3 reports simulation results for six different levels of trade cost reductions: $\hat{M}_r^{20}(T_{13}^{80}), ..., \hat{M}_r^{60}(T_{13}^{40})$.[16] Columns 2-6 report the predicted migration rate as a percentage of regions' initial endowment with mobile workers. Considering the estimates reported in Table 3, we note that an asymmetric integration shock results in substantial differences in the net migration rate among the three Baltic countries. Aggregate migration flows (immigration minus emigration) do, however, sum up to zero in each period fulfilling the general equilibrium condition of the total labour supply.[17]

Table 3: Integration-induced net migration in the Baltics, share of labour force

	$\hat{M}_r^{10}$	$\hat{M}_r^{20}$	$\hat{M}_r^{30}$	$\hat{M}_r^{40}$	$\hat{M}_r^{50}$	$\hat{M}_r^{60}$
Estonia	-11.387	-11.025	-10.371	-9.069	-6.044	1.906
Latvia	-3.691	-3.911	-4.312	-5.112	-6.935	-11.755
Lithuania	7.071	7.076	7.088	7.112	7.144	7.250

Notes: $\hat{M}_r$: $(-)$ emigration, $(+)$ immigration. Source: NEG model calculations based on New Cronos data for 2004.

The simulation results reported in Table 3 also suggest that, if factor and product market integration in the Baltics would follow the particular pattern we assumed in our simulations, then the two peripheral regions would be the largest winners in terms of region's share of mobile workers (column $\hat{M}_r^{60}$ in Table 3) and manufacturing firms. As expected from the underlying economic geography framework, transport cost reduction between the two asymmetric peripheral regions, allows the largest peripheral region (Lithuania) to attract relatively more mobile workers than the smallest peripheral region (Estonia). Lithuania steadily attracts more and more mobile workers

[15] Analytically, we are able to calculate the long-run equilibrium solution for regions' share of mobile factor. Empirically, in the R-region case with region-specific parameters it turns out impossible to solve the model for the long-run equilibrium in one step.

[16] Base run migration: $\hat{M}_r^{BR} = T_{13}^{100}$.

[17] Zero net migration balance, when all regions weighted by their population are summed up.

from other regions throughout the whole interval of integration: $\hat{M}_3$, increases from 7.07% when transport costs are reduced by 10% to 7.25% when transport costs are reduced by 60% (Table 3).

Latvia, the 'core region' in the Baltics, turns out to be the largest looser from the labour market integration, if transport costs to the peripheral regions decline more rapidly than to the core region. The emigration rate from Latvia, $\hat{M}_2$, is continuously increasing from 3.69%, when transport costs are reduced by 10%, to 11.75%, when transport costs are reduced by 60% (Table 3). Given that transport costs are reduced asymmetrically favouring the two peripheral regions (Estonia and Lithuania), these results are in line with our expectations and with the underlying theoretical framework.

Estonia is eventually the most interesting country from the new economic geography perspective. According to our simulations, the relationship between market integration and Estonia's share with mobile labour, $\hat{H}_r$, is non-linear and non-monotonic. Initially, the trade cost reduction to the peripheral regions, of which Lithuania is relatively large and Estonia is relatively small, gives rise to agglomeration of workers and firms in the peripheral region with the largest internal market (Lithuania). At the beginning of the simulated integration process the peripheral region with the smallest internal market (Estonia) looses more than 11% of its mobile work force (columns $\hat{M}_r^{10}$ and $\hat{M}_r^{20}$ in Table 3). When the inter-regional transport costs fall below some critical level, Estonia starts to attract mobile workers and its share of mobile workers begins to increase.

5.3 Integration-induced migration in the Visegrád

We study the integration-induced migration in the Visegrád countries by performing the same simulation exercises as for the Baltic countries. According to Table 4, the largest winner of integration in the Visegrád is Hungary, where the immigration of labour steadily increases from 0.88% ($\hat{M}_r^{10}$) to 8.24% ($\hat{M}_r^{60}$) compared to the base run. However, Hungary reaches agglomeration peak (break point) at circa $\hat{M}_r^{50}$, from when the immigration starts to decline (from 8.35% to 8.24%). These results are consistent with the estimated trade openness for Hungary, which is the highest among all Visegrád countries (Figure 1). The two other Visegrád countries benefiting from economic integration are the Czech Republic and Slovakia. However, Table 4 indicates that the pattern of integration-induced migration is different among these two Visegrád countries. The Czech Republic first attracts mobile labour, then starts to lose, whereas Slovakia loses economic activity and labour at the beginning of integration, but starts to attract workers at around $\hat{M}_r^{30}$. Poland is the ultimate looser of integration in terms of mobile labour, although Poland has the largest internal market. These losses may be associated with the highest transport costs (lowest trade openness) relative to other Visegrád countries (Figure 1).

Table 4: Integration-induced net migration in the Visegrád, share of labour force

	$\hat{M}_r^{10}$	$\hat{M}_r^{20}$	$\hat{M}_r^{30}$	$\hat{M}_r^{40}$	$\hat{M}_r^{50}$	$\hat{M}_r^{60}$
Czech Republic	7.943	9.465	11.448	2.520	1.782	0.845
Hungary	0.889	1.265	3.120	8.008	8.358	8.240
Poland	-2.418	-3.057	-4.139	-3.167	-3.072	-2.748
Slovakia	-1.837	-1.251	-2.293	-0.092	0.548	1.285

Notes: $\hat{M}_r$: (−) emigration, (+) immigration. Source: NEG model calculations based on New Cronos data for 2004.

Similar to the Baltics, Table 4 indicates that the regional share of labour and hence migration rate is non-linear and non-monotonic in transport costs. Because these three agglomeration/dispersion forces - the price-index effect, the demand linkages and cost linkages - are region-specific, the net effect of factor and product market integration between regions on utility of workers and, hence, on inter-regional migration can go either way. The presented numerical simulations offer a useful insight in the possible relationships between migration pull and push factors in light of the ongoing factor and product market integration in the EU. The ability to predict the levels at which the net migration rate will start to decrease and reach zero are one of the key advantages of the economic geography approach, they are exogenous in reduced form models.

5.4 East-West migration

In this section we perform stylised simulation exercises of labour and product market integration between the NMS and EU-15. Ireland, the UK, and Sweden are the only old Member States, which opened their labour markets as from the first day of NMS accession. Therefore, in addition to the eight NMS, we include these three North European Member States in the set of potential destination choices for migrants.[18]

As in the previous two sections, we draw the data for regional endowment with the immobile factor (land), initial endowment with labour and income share spent on manufacturing goods from the Eurostat's New Cronos database. Parameters for the

[18] EU-North: Ireland, the UK, and Sweden.

Baltics and the Visegrád have already been estimated and are averaged by weighting according to regions' share of labour force.[19] Parameter values for the North European Member States are drawn from the literature (*Kielyte* and *Kancs* 2002). For studying the East-West migration, we assume that factor and product market integration between new and old Member States would symmetrically reduce inter-regional transaction costs.

Table 5: Integration-induced East-West net migration, share of labour force

	$\hat{M}_r^{10}$	$\hat{M}_r^{20}$	$\hat{M}_r^{30}$	$\hat{M}_r^{40}$	$\hat{M}_r^{50}$	$\hat{M}_r^{60}$
Baltics	-3.827	-5.478	-7.989	-6.208	-5.675	-5.442
Visegrád	-0.669	-1.108	-2.015	-3.755	-3.806	-3.612
EU-North	0.855	1.337	2.249	3.389	3.379	3.211

Notes: $\hat{M}_r$: $(-)$ emigration, $(+)$ immigration. Source: NEG model calculations based on New Cronos data for 2004.

Table 5 reports simulation results for the three EU regions: the Baltics, the Visegrád and the EU-North. According to Table 5, workers from the Baltics and the Visegrád would migrate to the EU North, if the three European regions would symmetrically reduce inter-regional transaction costs by the same percentage between all regions: the mobile labour share declines in the Baltics and in the Visegrád, while it increases in the EU-North. At some lower level of inter-regional transport costs (which are region-specific), the agglomeration (net migration) stabilises. The share of mobile labour force starts to increase in CEE and decline in EU North. In that sense these results are similar to intra-Baltic and intra-Visegrád migration results reported in the two previous sections, and are in line with *Krugman* (1991).

5.5 Comparison with previous studies and limitations

In order to explore whether migrants do follow the market potential, a growing number of migration studies rely on the economic geography framework (*Crozet* 2004, *Kancs* 2005, *Pons et al* 2007, *Hering* and *Paillacar* 2008, *Paluzie et al* 2009). *Crozet*, *Pons et al*, and *Paluzie et al* estimate quasi-structural economic geography models relating workers' location choices in Europe to market access. The results of all three studies suggest that the economic geography framework provides a promising framework for studying migrant behaviour in small open economies. *Hering* and *Paillacar*

[19] A consistent parameter estimation would require estimation based on aggregate data, which is beyond scope of the present study.

analyse bilateral migration between Brazilian states using regional differences in access to international markets. They find that workers choose to migrate to states with higher market access. *Kancs* (2005) uses a new economic geography model to predict migration flows in the Baltics. Simulating European integration as a reduction in trade costs, he finds that, depending on the integration scenario, between 3.5% and 6.2% of workers would change their country of residence. Hence, the results presented in this study are in line with the NEG literature, suggesting that migrants follow the market potential.

Comparing our predictions with the reduced form models, we note that our calculations are different from the estimates in the conventional migration literature, which are much less conclusive. For more than a decade, the general assumption was that the common EU labour market would initiate massive labour migration from the CEE accession countries, with peak levels arising during the first years after EU enlargement. Accordingly, between 10.5 and 15.0% of the current CEE population was predicted to migrate to the EU-15 in the medium and long run (10-30 years) (*Straubhaar* and *Zimmermann* 1993). This was corroborated by a wide range of reduced form estimates. The range is wide because especially in reduced form models all assumptions about country developments and response to integration, migration and development are based on the a priori and fixed estimates of the economic differences between economies. Instead, our results predicting that between 5.44% (from the Baltics) and 3.61% (from the Visegrád) of the total labour force would move, allow for the endogenous narrowing of differences one predict.

Deviations among previous studies and our calculations might be caused, among other things, by misspecification of the model (missing variables, specific functional forms), differences in the data used, differences in source and destination countries studied, and differences between the underlying conceptual frameworks. One particular feature that sets the framework employed in our study apart from the traditional reduced-form specifications is implied by differences in the treatment of explanatory variables. According to the underlying economic geography model, the relocation of workers not only absorbs market distortions caused by short-run transitory shocks, it also induces changes in explanatory variables, such as wage rate, utility and profits. For example, if the net wage (indirect utility) is a positive function of region's size of labour force, as in the underlying economic geography model, then migration will induce circular causality forces in the economy. These circular causality forces are captured in the underlying economic geography model, but missed out in reduced form models (*Massey et al* 1993, *Gallup* 1997, *Fertig* and *Schmidt* 2001). As a result, in our model labour migration converges to zero endogenously, whereas in reduced form models it is exogenous.

6 Conclusions

The present paper analyses how factor and product market integration might affect labour migration in the CEE accession countries. First, from the theoretical economic geography model we derive estimable trade cost and migration equations. Estimating these equations based on historical data for the Baltic and Visegrád countries yields parameter estimates, which we use to empirically implement the theoretical NEG model. Finally, we perform simulation exercises of European integration and assess impacts on labour migration in the Baltics, the Visegrád and three North European countries.

The theoretical framework adopted in this study is different from the conventional migration studies, which usually rely on the reduced form models. Given that the traditional reduced-form approach, where explanatory variables are exogenous and fixed a priori, has serious drawbacks for studying migration in small open economies undergoing a dynamic transition process, we rely on an alternative approach, which is based on the economic geography theory à la *Krugman* (1991). The economic geography framework applied in this study allows us to cope with several problems of reduced-form models, such as wrong assumptions, endogeneity and reverse causality of the right-hand side explanatory variables, which is a particularly critical issue in the CEE transition economies. A potential downside of the economic geography approach is that a structural model *per se* does not guarantee a better fit - certain reduced-form specifications might still perform better in terms of explanatory power and forecasting performance. Therefore, we urge for more research, both methodological and empirical, be devoted to estimating and testing of economic geography models in predicting location of firms and workers. Future expectations may also play a significant part in migration decisions - expecting improvements in the home country's economy may delay migration decision or ultimately erase the idea of migration. This issue has not been considered in the current study and is a promising avenue for future research.

Our empirical findings predict a selective migration between the CEE accession economies, if market integration would advance. However, according to our empirical results, labour migration is sufficiently low to make a swift emergence of a core-periphery pattern very unlikely in both the Baltics and Visegrád. These results are in line with previous studies of labour migration in the CEE.

Simulation results for the Baltics suggest that the peripheral regions would be the largest winners in terms of the share of workers and manufacturing activity. According to our simulation results, Lithuania steadily attracts more and more mobile workers from Estonia and Latvia: the immigration rate to Lithuania increases from 7.07% if transport costs decline by 10% to 7.25% if transport costs are reduced by 60%. Latvia, the core region, turns out to be the largest looser from integration in the Baltics. The emigration rate from Latvia is continuously increasing from 3.69% to 11.75%. Given that transport costs are reduced asymmetrically favouring the two peripheral regions (Estonia and Lithuania), these results are in line with our expectations and with the underlying economic geography framework. The results for Estonia are particularly interesting, as they suggest that the relationship between market integration and the share of mobile labour force is non-linear and non-monotonic.

The results for the Visegrád suggest that the largest winner of economic integration would be Hungary, where the share of mobile labour would increase by 8.35% compared to the pre-integration state. However, Hungary reaches the agglomeration peak soon, and its share of mobile labour starts to decline after that. The two other winners from integration in Visegrád would be the Czech Republic and Slovakia. Whereas the Czech Republic first attracts mobile labour, then starts to loose, Slovakia looses mobile workers at the beginning of integration and starts to attract them at more advanced levels of integration. Poland, which has the largest internal market in the Visegrád, turns out to be the ultimate looser of integration in terms of labour force and economic activities. Similarly to the results for the Baltics, these results suggest that the local share of mobile labour, and hence migration, is both non-linear and non-monotonic in transport costs.

Simulation results for the East-West migration are rather stylised and need to be interpreted particularly cautious, because the international migration costs, which we neglect in the model, are important in reality. They suggest that workers from the Baltics and Visegrád would migrate to EU North, if market integration would symmetrically increase between the three European regions, implying that the share of mobile labour would decline in the Baltics and in Visegrád, while it would increase in the EU-North. However, our results also suggest that at some lower levels of inter-regional transport costs (which are region-specific), the share of mobile labour force starts to increase in the CEE and decline in the EU North. This prediction is in line with the recent empirical migration literature relying on the NEG framework, which looking forward note that, the economically motivated migration, which largely depends on differences in the level of prosperity between home and destination regions, will likely become less marked as Europe becomes more integrated.

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7 Appendix

7.1 Robustness and sensitivity analysis

The simulation results presented in section 5 depend to a large extent on the numerical values of the key parameters, notably on σ and α. Given that these parameters are estimated using a relatively small sample, they might be misestimated. This, however, might affect our simulation results depending on how sensitive is the model with respect to parameter values. In order to quantify the potential misestimation's impact, in this section we perform robustness tests. The results of parameter sensitivity tests for σ are summarised in Table 6, which reports regional shares of the mobile labour force $\hat{H}_r$ for different values of σ.[20] These results are obtained by exogenously changing the numerical values of σ from 1.3 to 5.8 and subsequently calculating the resulting regional shares of the mobile labour force $\hat{H}_r$.

[20] A full set of sensitivity analysis results is available from the author upon request.

Table 6: Sensitivity analysis: the impact of σ on $\hat{H}_r$, changes in percent

σ_r	1.3	1.8	2.8	3.8	4.8	5.8
Estonia	0.290	0.239	0.186	0.148	0.112	0.078
Latvia	0.187	0.213	0.204	0.172	0.138	0.106
Lithuania	0.523	0.548	0.609	0.680	0.750	0.817

Notes: Results for $\hat{H}_r^{30}$ inter-regional transport costs reduced by 30%.

The results reported in Table 6 suggest that the location decision of workers and, hence the inter-regional migration, indeed depends on numerical values of the elasticity of substitution, as σ enters both price and wage equations in the model. These results highlight the downside of the underlying new economic geography framework: the empirical results depend on some few parameters of the model. Second, the results reported in Table 6 also suggest that the regional share of mobile labour force $\hat{H}_r$ is affected stronger at high values of σ compared to low values of σ. The second key parameter in the underlying NEG model is α_r, which captures consumers' preferences for manufactured goods. We investigate model's response for six different values of α_r ranging from 0.50 to 0.85. The obtained results suggest that simulation results are not sensitive with respect to different values of α_r.

Based on these sensitivity analysis results we may conclude that our simulation results, which we presented in section 5, are sensitive but not oversensitive to alternative parameter values. Although, different parameter values would imply different migration flows, they would not affect the order of magnitude and, more importantly, they would not change the direction of migration flows in our model. These results suggest that our simulation results are rather robust with respect to the estimated parameter values.