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Does economic integration affect the structure of industries? Empirical evidence from the CEE[1]

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In this paper we study how European integration would affect the industry location and sectoral specialisation of local economies in the CEE accession countries. The theoretical framework of our study is based on the new economic geography, which allows us to predict not only the post-integration specialisation patterns, but captures also other general equilibrium effects, such as transition to market economy, which turn out to be highly significant in CEE. Our empirical results suggest that the CEE specialisation pattern would be distinct from the old EU member states. First, the EU integration would reduce regional specialisation in CEE. Second, the bell-shaped specialisation pattern predicted by the underlying theoretical framework is inverse in CEE. We could explain a large portion of these differences by CEE-specific processes, such as integration of the CMEA. These distortions are higher in those regions, which were more integrated in the CMEA. Our simulation results also suggest a convergence in the specialisation across the CEE regions.

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Introduction

The EU enlargement is one of the most important opportunities for the European Union at the beginning of the 21st century. Although, the potential for aggregate welfare gains from closer economic integration in the enlarged EU is undisputed, economists also acknowledge that European integration might significantly transform the economic geography of the Central and Eastern European (CEE) accession economies.[2] Findings of previous research suggest that sectoral restructuring caused by transition to a market economy as well as by integration-induced changes in the macrogeographic environment will likely lead to re-organisation of economic activities across CEE, both within countries and between countries (*Traistaru et al* 2003, *Crozet* and *Soubeyran* 2004, *Brülhart* and *Koenig* 2006).

Both integration processes - integration of the Council on Mutual Economic Assistance (CMEA) and integration into the European Union (EU) - will trigger diverse changes in the location of economic activities in CEE. As noted by *Baldwin* and *Wyplosz* (2006), regional integration does not affect the location of economic activities directly. Instead, it changes the determinants and incentives for industry location in space. For example, economic integration may reduce diseconomies of trade costs and increase economies of agglomeration and specialisation. The theory of regional integration (*Balassa* 1961) suggests that when regions and countries specialise their production structures and trade for the rest of goods and services, the production factors are allocated more efficiently which leads to welfare gains. Thus, an efficient reallocation of resources would increase the aggregate welfare.

The main goal of our study is to assess how European integration would affect the relocation of economic activities in CEE. Would European integration induce a horizontal or vertical clustering of economic activities? These results would allow to quantify welfare gains arising from European integration in CEE. Thus, rather than predicting the general development of regional economies after EU integration, this study investigates the relationship of key variables of European integration and the location of economic activities

[2] In the context of our study the term Central and Eastern Europe (CEE) refers to Bulgaria, Czech Republic, Estonia, Hungary, Latvia,

in CEE.

The adjustments in the spatial location pattern triggered by European integration can be considered as a force majeure in the next decades. Given that the spatial reformation of CEE production and employment structures is heavily affected by the CEE integration of the CMEA, we also will need to account for integration of the CMEA. While such questions have already been studied in the literature, this study differs from previous studies in several respects. First, by adopting the economic geography approach, we are able to predict not only integration-induced changes, but also to capture other general equilibrium effects, such as transition to market economy, which turn out to be highly significant in CEE. Second, we study internal geography of the CEE regions, which is often left beyond the scope of the analysis by solely focusing on impacts for the old EU member states. Last, our sample consists of all NUTS II regions and a full set of NACE rev.1 industries in CEE. Most CEE studies are based on data, which does not cover all industries or all locations. We aim at filling these research gaps by providing a comparative and representative analysis for all CEE regions.

The rest of the paper is structured as follows. Section 2 provides an overview of historical specialisation patterns and institutional settings determining industry location in the CEE accession countries. After reviewing regional specialisation and sectoral concentration patterns in the past, section 3 presents the theoretical framework, which will be used in the empirical analysis. In order to assess integration-induced impacts on the CEE's economic geography, section 4 empirically implements the theoretical economic geography model and simulates the European integration by reducing inter-regional transaction costs in CEE. Using the obtained simulation results section 5 calculates regional specialisation and sectoral concentration indices in the CEE accession countries. Next, we compare the pre-integration values of regional specialisation and sectoral concentration with simulated post-integration values. Given that not all results are consistent previous studies for the old EU member states, in section 6 we investigate determinants, which could have caused these differences. Section 7 concludes and offers policy recommendations.

Lithuania, Poland, Romania, Slovakia and Slovenia.

Economic geography of the CEE

In this section we review historical experience of industry location and regional specialisation patterns in CEE. In particular, we are interested in regional specialisation and sectoral concentration patterns beginning from the Soviet period, as the spatial location patterns of economic activity during this period might provide useful information about likely development in the period after integration with the EU.

The CMEA period

We start with the Soviet period (1945-1990). In the Soviet period the economic geography of the CEE was largely determined by the Council on Mutual Economic Assistance (CMEA). The council was responsible for both specialisation of regions and industry location within the bloc. According to *Traistaru et al* (2003), during the CMEA period the Central and Eastern Europe was a highly specialised area in terms of manufacturing production and sectoral employment. The rather high regional specialisation in the Soviet bloc was a direct consequence of the CMEA, according to which the CEE economies had to specialise in some few industries and trade (within the bloc) for the rest of manufacturing goods. For example, Bulgaria was chosen as a major centre for mechanical engineering and electronics, Czechoslovakia produced machinery and consumer goods, while the USSR provided raw materials and energy in exchange for manufactures (*Traistaru et al* 2003).

From the location theory's perspective, the centrally planned pattern of regional specialisation is particularly interesting, because most of the Soviet-system planned economies completely disregarded regions' economic geography advantages, when planning regional specialisation and geographic location of industries. Instead of considering regions' economic geography advantages, the CMEA planning process was guided by non-economic principles. First, the Soviet planning process was largely influenced by political power, which was largest for the biggest manufacturing firms and their politically nominated directors. Second, given the post-war ideologically-driven confidence in heavy industry and economies of scale, the Soviet-system had a tendency towards concentration of economic activities and specialisation of regions (and countries). As a result, the CMEA system led to a high and arbitrary degree of regional division of labour and regional specialisation often making whole regions completely dependent on one large enterprise (*Traistaru et al* 2003).

Findings of this section can be summarised as follows: (i) specialisation pattern of the CEE regions was heterogenous in terms of industry composition; (ii) the specialisation level was rather homogenous in CEE - the specialisation was considerably higher than in the old EU member states; and (iii) within the CMEA the specialisation pattern was chosen arbitrarily (usually industry location decisions were politically motivated).

The transition period

The Soviet system collapsed in late eighties, partially because of totally neglecting region and country comparative advantages. In the early nineties, after collapse of the Soviet system, the CEE accession countries started to gradually restructure their economies, which induced a wave of industrial relocation and sectoral restructuring within and among CEE regions. Changing policy preferences and the started economic restructuring gave rise to the rapid growth of a few sectors while most other previously subsidised manufacturing sectors declined. The growth industries, such as electrical, optical and transport equipment as well as furniture sectors, have managed to maintain their cost advantages vis-à-vis the Newly Independent States (NIS) and, more importantly, the EU-15. However, the majority of manufacturing industries, such as food, beverages and tobacco, textiles, leather, wood products and chemicals, lost their competitiveness and had, despite lower wage costs, even higher unit production costs than in the EU-15 (*European Commission* 2005). In addition, these industries suffered from growing tariff-free imports from the EU-15 and lost their competitiveness on domestic markets in most CEE regions. Consequently, regional specialisation has decreased in those regions, which were specialised in the declining branches and vice versa.

The induced re-specialisation of regions and re-location of industries in the nineties was largely driven by geographical advantages of regional economies in CEE and region-specific responses to market forces. The sizeable heterogeneity in the geographical advantages of CEE economies and region-specific responses to market forces across the CEE gave rise to emergence of highly heterogeneous pattern of industry location and regional specialisation. From the most recent empirical data for the CEE we can identify three groups of countries with similar regional re-specialisation and sectoral concentration patterns: the Visegrád (the Czech Republic, Hungary, Poland and Slovakia), the Balkans (Bulgaria and Romania) and the Baltics (Estonia, Latvia and Lithuania). We now consider explicitly these three groups starting with the Visegrád.

In Hungary the economic transition process was accompanied by a large restructuring of spatial production structure. Machinery, both electrical and non-electrical, dominated domestic production and exports. GDP share of the automotive industry increased from 1.8% in 1990 to 7.2% in 2004 (*European Commission* 2005). In these sectors the quality improvements were most noticeable. While in 1990 the majority of these sectors produced low-quality goods, in 2004 the major part of them exhibited a comparable or better quality compared to the rest of CEE. In contrast, the production and exports of traditional goods, such as meat, clothing, furniture, iron and steel, fuels, chemicals and plastics lost their output and market shares (*European Commission* 2005). The re-specialisation pattern in Slovenia was rather similar to Hungary. The same three product categories dominated the manufacturing output structure and greatly increased their output and employment shares during the nineties. They gained market shares, which were lost by traditional manufacturing industries in Slovenia, such as clothing, wood products, iron and steel, rubber and footwear. Most of these products succeeded in improving their competitiveness vis à vis the CEE and EU (*European Commission* 2005). Czech and Slovak production and employment witnessed a similar process of concentration on the three manufacturing industries mentioned above. As in Hungary and Slovenia, the traditional manufacturing production lost market shares. In several regions the traditional manufacturing industries suffered from removal of state subsidies, growing energy and transport costs and increasing competition from the EU. As a result, those regions, which during the CMEA period specialised in the heavy subsidised manufacturing industries, lost their specialisation profile (*European Commission* 2005). Similar to other Visegrád countries in Poland the specialisation increase in the same three manufacturing industries: electrical and non-electrical machinery and automotive sector, tended to be matched by specialisation decrease in other sectors. In many other sectors, such as textiles, regional specialisation decreased. According to the *European Commission*'s (2005) data, Poland recorded the highest dispersion in the production structure among all CEE countries in our sample.

The re-specialisation pattern of the two Balkan countries (Bulgaria and Romania) appeared to be somewhat different from the rest of the CEE, where the traditional labour and capital-intensive products accounted for considerably higher output and employment shares. Therefore, the transition process induced different specialisation and industrial concentration patterns in the two Balkan economies. In Bulgaria production shares of both electrical and non-electrical machinery decreased (vehicles not being significant), while clothing, footwear, iron and steel, fertilisers, copper, inorganic chemicals increased their output and employment concentration and their quality level. The re-specialisation pattern was more skewed in Romania, where in 1990 clothing represented alone 35 percent of total manufacturing production, with another 11 percent taken by iron and steel and 8 percent by furniture. Here traditional production and exports mostly underwent a downgrading process, while machinery and vehicles (10 percent of the total) increased both their output and employment shares (*European Commission* 2005).

Finally the three Baltic countries exhibited a rather different re-specialisation pattern compared to the rest of the CEE, with considerably higher output and employment shares of wood products and mineral fuels. During the nineties, these industries became considerably less concentrated than they used to be in the CMEA period. Similar to Visegrad countries electrical machinery has increased regional specialisation during the nineties. Skilled labour supply contributed to increasing specialisation particularly in IT sectors (*European Commission* 2005).

Findings of this section can be summarised as follows: (i) specialisation patterns of the CEE regions became more similar in terms of industry composition; (ii) the specialisation pattern became increasingly heterogenous in terms of specialisation levels; and (iii) regions specialised increasingly according to their comparative advantages.

Theoretical framework

Findings of the previous two sections suggest that the CMEA importance is decreasing and that regional specialisation is increasingly determined by comparative advantages of regions. Depending on how strong each CEE region was integrated in the CMEA, the adjustment processes are different across the CEE. These findings determine choice of theoretical framework for the empirical analysis - they suggest a framework, which is able to simultaneously account for both processes: integration of the CMEA and integration into the EU.

Following *Ottaviano* and *Robert-Nicoud* (2006), in order to account for these processes we base the theoretical framework of our study on both traditional trade theory (*Krugman* 1980) and on more recent models of economic geography (*Krugman* and *Venables* 1995, *Venables* 1996). Doing so we are able to capture both comparative advantages of regions as well as agglomeration effects of changes in macroeconomic environment, such as integration of the CMEA and integration into the EU. The former is implied by the empirical data, the latter we impose exogenously.

In our model the world consists of R regions. Each of the R regions is endowed with three factors of production: labour, H, capital, K, and land, L. Labour and capital are mobile between industries within a region, but immobile between regions. Regional endowment with labour is assumed to be exogenous. Capital supply is endogenously determined by the steady state condition.

Each region hosts two types of industries: 'traditional-type' industries, A, and 'manufacturing-type' 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 constant returns to scale. In addition to the two inter-sectorally mobile factors, the traditional sector, A, uses sector-specific natural resources (land). Hence, the traditional sector exhibits decreasing returns to scale with respect to the mobile factors. Traditional goods are assumed to be traded at zero trade costs both inter-regionally and internationally.

As usual, the traditional good serves as a numeraire in our model.

Monopolistically competitive manufacturing industries, which represent increasing returns and mobile production activities in the economy, produce horizontally differentiated goods. In each differentiated industry we assume Chamberlinean monopolistic competition with free entry and exit of firms. Hence, output prices are equal to marginal costs plus a mark-up (determined by model parameters). As usual in the monopolistic competition framework, the mark-up depends on the elasticity of substitution between varieties of differentiated goods. The consumer 'love of variety' (*Dixit* and *Stiglitz* 1977) ensures that there is demand for each variety of each differentiated good in every region. Sales within a region incur zero trade costs. However, inter-regional sales of differentiated manufacturing goods are subject to positive trade costs of the '*iceberg*' type.

Consumption

There are two types of consumers in our model: workers and industries. First we consider the consumption decision of final goods. A typical consumer in region d has a two-tier utility function. The upper tier determines consumer division of expenditure between all industries. The second tier determines consumer preferences over the differentiated manufacturing varieties. The specific functional form of the upper tier is Cobb-Douglas, implying that the sectoral expenditure shares are constant. The functional form of the lower tier is CES (constant elasticity of substitution). Consumer demand, X_{id}, of good i consumed in region d is given by:[3]

$$X_{id} = \gamma_{id} \frac{Y_d}{P_{id}} \qquad (1)$$

where X_{id} is total consumer demand of good i in region d, Y_d is consumer income in region d, P_{id} is price index for good i in region d and γ is consumer demand parameter.

[3]Notation: we use Latin letters for variables and Greek letters for parameters. Small Latin letters refer to varieties, capital letters denote goods (sectors). Indices o and d denote **o**rigin and **d**estination regions. Indices i and j denote **i**ndustries.

Regional income, Y_o, is composed of income from all primary factors: $Y_o = \sum_{f=1}^{F} w_{fo} F_{fo}$. Thus, we implicitly assume that factor owners spend their income in the same region, where the factors are employed.[4] As usual, regional price index, P_{id}, is CES:

$$P_{id} = \left[\sum_{r=1}^{R} N_{io} \theta_i \left(p_{io} \tau_{od} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}} \tag{2}$$

where N_{io} describes the mass (number) of firms in origin region o, p_{io} is the output price and τ_{od} are *iceberg* transport costs of shipping goods produced in origin region o to destination region d. Iceberg transport costs, τ_{od}, imply that $(1+\tau_{od})$ units of good i have to be shipped from origin region o, in order for one unit to arrive at destination region d (see equation 11).

Using the regional price index from equation (2), consumer demand for each variety of differentiated good i can be expressed as:

$$x_{iod} = \alpha_{id} Y_d \theta_i \frac{\left(p_{io} \tau_{od} \right)^{-\sigma}}{P_{id}^{1-\sigma}} \tag{3}$$

where x_{iod} is region d 's demand for variety x of good X_i produced in region o.

Production

Each firm uses two types of inputs for producing goods: intermediate goods and primary factors. Each industry uses all produced goods as intermediate inputs, the use of which is determined by relative prices. As usual, the price index for intermediate goods, $\mathbf{P}_{jd}$, is CES:

[4] This simplifying assumption is required to keep the model analytically tractable and empirically implementable. Given that before the CEE integration with the EU owners of both land and labour usually lived within the region, this assumption is uncritical in the context of our study.

$$\mathbf{P}_{jd} = \left[\sum_{i=1}^{I} \theta_j P_{id}^{1-\sigma} \right]^{\frac{1}{1-\sigma_Q}} \tag{4}$$

where P_{id} is the same price index as for consumer goods, i.e. we implicitly assume that consumers and industries demand goods in the same proportions.[5] The use of intermediates from own as well as other industries implies the existence of inter-industry and intra-industry cost linkages. The presence of these linkages, together with trade costs, implies that the number of firms producing in the region affects production costs, i.e. they generate pecuniary externalities - firms located in a region with a large number of suppliers of important intermediates, will have lower costs, higher profits and attract more firms to the region.

As above, the price index of primary production factors takes the CES form:

$$W_{io} = \left[\sum_{f=1}^{F} \theta_f w_{fo}^{1-\sigma} \right]^{\frac{1}{1-\sigma_W}} \tag{5}$$

where W_{io} is the aggregate price for all primary factors used in the production by sector i 's firms in region o and w_f is factor wage (rental rate).

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 firms in sectors with imperfect competition:

$$p_{io} = \frac{\sigma}{\sigma - 1} MC_{io} \tag{6}$$

[5]This simplifying assumption is required because of limited data availability in the CEE transition economies. Modelling different consumer and industry demand shares would solely shift within industry demand ratio, which, however, does not affect our empirical results.

where MC_{io} is the marginal cost of industry i producing in region o. The restriction $\sigma > 1$ ensures that the output price, p_o, is always positive. According to equations (4) and (5), the marginal cost, MC_{io}, is specified as a nested CES function with two arguments: primary factors and intermediate inputs:

$$MC_{io} = \varphi_{io} \left[\delta_{io}^{\sigma_{MC}} \mathbf{P}_{jd}^{1-\sigma_{MC}} + (1-\delta_{io})^{\sigma_{MC}} W_{io}^{1-\sigma_{MC}} \right]^{\frac{1}{1-\sigma_{MC}}} \tag{7}$$

where σ_{MC} is elasticity of substitution between intermediate goods and primary factors and δ_{io} determines input shares of intermediate goods and primary factors.

Inputs

As usual, the demand for primary factors and intermediate inputs are obtained by taking partial derivatives of the marginal cost function (equation 7) with respect to input price indexes (equations 4 and 5) according to Shephard's lemma:

$$F_{fo} = \sum_{i \in I} \varphi_{io}^{1-\sigma_{MC}} \delta_{io} \left[\frac{MC_{io}}{W_{io}} \right]^{\sigma_{MC}} \left[\frac{W_{io}}{w_{f,o}} \right]^{\sigma_W} N_{io} (X_{io} + FC_{io}) \tag{8}$$

where FC_{io} is fixed cost in increasing returns to scale industries. The fixed cost is set to zero and the number of firms to one in perfectly competitive industries. Primary factor demand, especially labour, is of particular interest in our study, as industry labour demand will be used for assessing regional specialisation and sectoral concentration in the following sections.

Capital supply in each region is determined endogenously by adjusting the regional capital stock such that the real rate of return to capital equals the steady state rate of return: $\frac{W_{ko}}{P_o} = \rho$, where P_o is the price level in region o and ρ is the steady state rate of return.

Factors are region-specific and immobile between regions. The regional endowment with labour and land is exogenous. Factor market equilibrium is achieved through wage adjustment, implying that all factors are fully employed at the equilibrium.[6] As usual, factor markets are assumed to be perfectly competitive.

The demand for intermediate inputs is derived analogously to factor demand by applying Shephard's lemma:

$$X_{jd} = \sum_{j=1}^{I} \theta_{jd}^{1-\sigma^{MC}} \left(\alpha_{jd} \right) \left[\frac{MC_{jd}}{\mathbf{P}_{jd}} \right]^{\sigma^{MC}} \left[\frac{\mathbf{P}_{jd}}{P_{id}} \right]^{\sigma^{Q}} N_{jd} \left(\mathbf{x}_{jd} + FC_{jd} \right) \tag{9}$$

Industry demand for individual variety x of good X_j is analogous to consumer demand in equation (3):[7]

$$x_{jod} = X_{jd}\, \beta_i \frac{\left(p_{jo}\, \tau_{jod} \right)^{-\sigma}}{P_{jd}^{-\sigma}} \tag{10}$$

Equation (10) contains demand linkages between firms in imperfectly competitive sectors. The larger is the domestic demand for intermediate goods, the larger are firm sales compared to foreign competitors. Because of higher domestic demand, larger market attracts more firms than smaller market (market size effect).

Equilibrium

Total demand for good i produced in origin region o is given by the sum of demand for final consumption and demand for intermediate use:

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[6] This simplifying assumption is required to keep the model analytically tractable and empirically implementable. Considering both labour demand and wage adjustments would unnecessary complicate the empirical analysis without providing any additional insights in specialisation of regions and concentration of industries.

[7] Given that workers consume only final goods, consumer demand function, X_{id}, is less involved than X_{jd}, in equation (3) we have already substituted for X_{id}.

$$X_{iod} = \sum_{r=1}^{R} \left(\alpha_{iod} \cdot x_{jod} \right) \cdot \left(\delta_d \right) \tag{11}$$

The long-run equilibrium also requires that the number of firms in each region is no longer changing in response to short-run profits, which implies zero profits wherever there is a positive number of firms and negative profits (for potential, if not for actual, firms) wherever the number of firms is zero.

$$MC_{id}(X_{id}) + FC_i \geq p_{id} X_{id} \tag{12}$$

As usual, firm entry and exit is free in all imperfectly competitive sectors. The number of manufacturing varieties produced in region r equals the number of firms located in region r, which is defined from the zero profit condition:[8]

$$\pi_{id} = \left(p_{id} X_{id} - MC_{id}(X_{id}) - FC_j \right) N_{id} = 0 \tag{13}$$

The number of manufacturing firms in each region, N_d, is determined by comparative advantages and inter-industry and intra-industry linkages. The existence of these positive market linkages allows for pecuniary externalities, which in turn encourage concentration of manufacturing firms and industrial agglomeration. Comparative advantages of regions appear through differences in relative factor endowments and productivity. Scale economies, product differentiation and imperfect competition give rise to intra-industry trade, while input-output linkages and trade costs capture industrial agglomeration. According to *Krugman* and *Venables* (1995), backward and forward linkages between imperfectly competitive sectors together with positive trade costs cause agglomeration of firms and industries. The task of the empirical analysis will be to identify these agglomeration economies in CEE and determine their potential impact on specialisation.

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[8] In the perfectly competitive industry, A, the fixed cost is set to zero and the number of firms is equal to one.

Empirical implementation and simulations

In this section we empirically implement the theoretical economic geography model, which we presented in the previous section. First, we define the sectoral and regional scope of the empirical analysis. Both sectoral and regional dimensions determine the model's data requirements, which together with data sources are discussed next. In section 4.2 we plug statistical data and parameter estimates in the theoretical economic geography model and solve it for the long-run equilibrium. Finally, we present two equilibrium solutions - the base run and a hypothetical post-integration equilibrium, when inter-regional trade costs have declined through integration.

Regions and sectors

Given that the regional and sectoral disaggregation are two key dimensions in empirical analysis of regional specialisation and geographic concentration, we start by defining the sectoral and regional scope. In the context of our study, two issues will determine regional and sectoral disaggregation. First, we recognise that the methodology which we use (Herfindahl index) is sensitive to spatial scale and sectoral breakdown. Second, in the CEE transition economies the two data dimensions need to be traded off against each other, as sectorally specific regional data is scarce for the CEE. Less regional detail allows us to consider more sectors and vice versa.

The first key dimension is regional coverage. Our analysis covers ten CEE accession countries (Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia) as well as the EU-15. The ten CEE accession countries are further disaggregated according to the Nomenclature of Territorial Units for Statistics (NUTS) into 53 regions, which correspond to NUTS II classification. In the context of our analysis, the EU-15 is not further broken down, although, this might be considered in future research. The inclusion of EU-15 is motivated by two empirical facts. First, important trade relations - EU-15 together with intra-CEE trade account for more than 85% of the CEE external trade (*European Commission* 2005). Second, European Union is a large market with a huge market potential, which according to the underlying economic geography theory, might affect firm location decisions within CEE.

Sectoral disaggregation is the other key dimension for the empirical analysis. In addition to data availability, sectoral disaggregation study depends also on the classification system, which we will use. Given that the empirical analysis of our study requires input-output data for the CEE regions, we have to follow the General Industrial Classification of Economic Activities (NACE/CLIO) in the European Communities.[9]

In the context of our study the NACE/CLIO classification system offers three relevant levels of sectoral disaggregation: three sectors (R3), six sectors (R6) and seventeen sectors (R17). The sectoral data at NUTS II regional disaggregation which we have for CEE allows us to disaggregate each regional economy into nine sectors (see Table 1). Sectors B01, B06, B30, B53, B68 and B86 correspond to NACE/CLIO R6. The service sector B68 can be further disaggregated into six sub-sectors: B58, B60, B69 and B86. Although, from the economic geography perspective, we are interested in studying the integration impacts on different manufacturing industries with different intensities of scale and different transport costs, data limitations do not allow further sectoral disaggregation at NUTS II regional level for the CEE economies.

Empirical implementation

Empirical implementation of the theoretical economic geography model requires two types of data: data for exogenous variables in the base year and numerical values of behavioural parameters. Data requirements for obtaining the latter depend largely on the particular technique which is used for parameterising the model. Econometric estimation of behavioural parameters requires time-series data only for selected variables. Calibration of model parameters requires a complete cross-section data of both exogenous and endogenous variables.

[9]NACE - General Industrial Classification of Economic Activities in the European Communities (Nomenclature générale des Activités économiques dans les Communautés Européennes). As its name implies, it is an industry classification covering the whole range of economic activity. NACE/CLIO - version used for the input-output tables (European System of Accounts 1979). It is fully compatible with NACE Rev. 1.

The first type of data which is required for empirical implementation of the theoretical economic geography model are data for exogenous and endogenous variables. In particular, we require base year values for three variables: input-output coefficients, inter-regional trade costs and regional endowments with production factors. Calibration of position parameters requires statistical data of three endogenous variables: bilateral gross trade flows, production and employment shares at NUTS II level.

The required statistical data are drawn from several sources. Input-output data is taken from GTAP 5.4 data set (*Dimaranan* and *McDougall* 2002).[10] It was updated from 1997 to 2004 using Eurostat's New Cronos Theme 2 - Economy and Finance, Domain - Accession countries non-financial accounts (NAMNAG). Inter-regional trade costs are proxied by trade freeness, which has been estimated for all CEE accession countries by *Kancs* (2006). Regional endowment data for labour are drawn from the New Cronos Theme 3 - Population and social conditions, Domain Employment (EMPLOY). This data is readily available for all 53 NUTS II regions in CEE. Bilateral gross trade flow data is taken from GTAP 5.4 data and updated as above. Regional production and employment shares are drawn from the Eurostat's New Cronos Theme 1 - General statistics, Domain - Regional Statistics (REGIO).

The second type of data which is required are parameter values. Parameter estimation turns out to be infeasible in full multi-sectoral and multi-regional setting. On the one hand, time-series data that is disaggregated both regionally and sectorally are not available for all CEE economies in our sample. Moreover, structural breaks in the CEE data for the nineties do not allow a consistent estimation of model parameters. On the other hand, calibration technique adds a lot of randomness in the empirical results. In order to minimise the randomness implied by parameter calibration while accounting for data availability issues, we follow a two way approach. In particular, we combine parameters from GTAP data and *Kancs* (2006), where several behavioural parameters have already been estimated econometrically for the CEE economies. The remaining parameters are calibrated within the economic geography model.

[10]The GTAP 5.4 data base covers 57 sectors and 78 countries (regions) including Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia (*Dimaranan* and *McDougall* 2002).

According to the underlying economic geography model, technologies of firms and preferences of consumers are represented by constant elasticity of scale (CES) functions. The CES cost and utility functions contain two types of parameters: elasticities (also called responsiveness parameters) and position parameters (also called share parameters). The former define how input and output quantities adjust to changes in input and output price ratios. They are drawn from estimates reported in *Kancs* (2006). The latter fix input-output coefficients, given input and output prices. In other words, they shift input and output demand functions to the position implied by the data. They are calibrated within the economic geography model.

A major part of the endogenous variables which are required for parameter calibration is not available in statistical data for the CEE (e.g. regional wages and regional prices for each sector). Therefore, in the theoretical model we had to assume that elasticities of substitution and transformation are equal. This assumption implies that consumers and producers of the same region respond to changes in relative prices in the same way. This assumption ensures that the underlying economic geography model is consistent with the econometric model applied for estimating model parameters in *Kancs* (2006). As a result, we can use the same elasticities, which have been estimated by *Kancs* (2006). Using parameter estimates from *Kancs* (2006) has two advantages: it gives us addition degrees of freedom for calibrating the remaining parameters, and reduces randomness implied by calibrated parameters.

Share parameters cannot not be drawn from the literature, they need to by calibrated within the economic geography model. In particular, we need to calibrate the following share parameters: ✞$_i$ entering equations (2), (3) and (10), ✞$_j$ and ✞$_f$ in equations (4) and (5), and ☠$_{jd}$ entering equations (7) - (9). Parameter ✞$_i$ is calibrated from the final demand data for good i in each region. Parameters ✞$_j$, ✞$_f$ and ☠$_{jd}$ are calibrated from the use of good i as intermediate input in the production of industry j in country o. All parameters are calibrated using the GTAP version 5.4 input-output data such that the values of inter-industry trade flows and primary inputs, when aggregated over regions of a country for the benchmark equilibrium, exactly add up to the values observed in the national account data.[11] Hence, numerical values of these parameters are fully determined by the data.

Base run

In this section we empirically implement the theoretical economic geography model, that is, we use statistical data for exogenous variables and the estimated model parameters to compute the long-run equilibrium solution. The long-run equilibrium is defined as a stationary state, where firms do not have any further incentives to relocate (enter or exit markets). This requires zero profits wherever there is a positive number of firms and negative profits wherever the number of firms is zero. Thus, in the long-run equilibrium, firms make zero profits, demand and supply are equalised in each good and factor market.

In the context of the present study we are primarily interested in sectoral output and labour demand in each region. These variables are endogenous and are captured in equations (8) and (11). Given that the two equations contain further endogenous variables (prices, regional price indices, wages and the number of firms), we need to solve for all these variables too. Considering the dimension of our analysis (53 regions and 9 sectors), this turns out to be impossible without appropriate algorithms. Therefore, the economic geography simulation model is operationalised using the General Algebraic Modelling System (GAMS) software and is solved using the CONOPT and MINOS solvers (*Brooke et al* 1988). Solving the model for the long-run equilibrium, we obtain predicted values for all endogenous variables: sectoral employment shares for each region, sectoral production shares for each region, inter-regional trade flows, regional prices for each sector and price indices, regional wages as well as the number of firms in each region.

In order to assess the goodness of fit of our simulation model, we compare the endogenously calculated variables with statistical data for the base year. This comparison turns out to be non-straightforward for several reasons. First, a major part of the endogenously calculated variables is not available in statistical data (e.g. regional prices for each sector, regional wages and the number of firms). Second, even if the required data is

[11]Given that in the GTAP 5.4 data base only national input-output data is available for the CEE economies, we had to assume identical technologies within each country. However, production technologies and consumer preferences differ between the CEE countries.

statistically available, the underlying definition of the statistically reported variables differs from our model (e.g. price indices). Dropping the statistically unreported and inconsistent variables we are left with two variables, which could potentially be used for assessing the goodness of fit of our model: sectoral employment shares and sectoral production shares for each region.

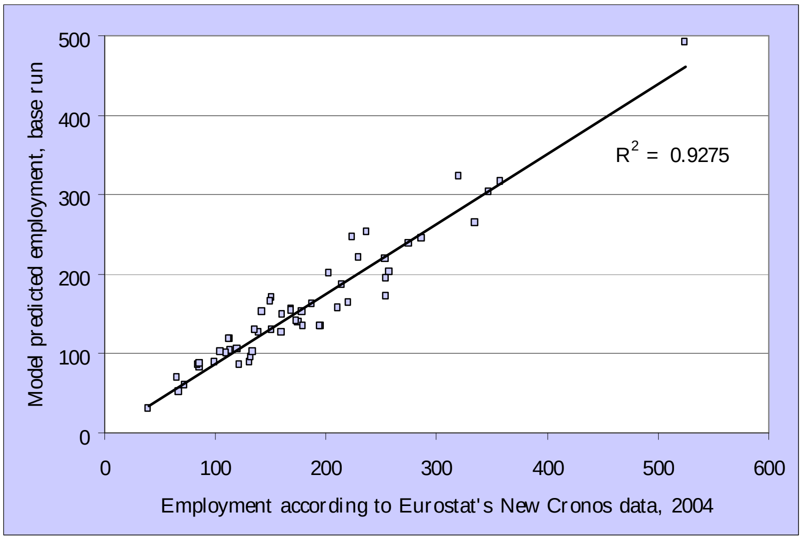

Figure 1 Correlation between model predicted employment in manufacturing sector (D30) (y) and Eurostat's New Cronos data (x)

We assess the goodness of fit of our model by regressing the endogenously calculated values of these two variables with those reported in statistical data for the base year. Figure 1 plots the correlation results for employment in manufacturing sector (B30). Units of both axis are thousands of employed workers.

In order the model simulations to fit perfectly to the true employment shares observed in the data, all dots in Figure 1would need to be on the 45% line and the correlation would need to be perfect ($R^2 = 1$). According to Figure 1, the predicted manufacturing employment approximately corresponds to statistical data ($R^2 = 0.9275$) for the base year (2004). There are two reasons, why $R^2 \neq 1$. First, some of the equilibrium relationships assumed in the model may not hold in the base year data. Second, part of model parameters are calibrated and not estimated econometrically. These findings suggest that quantitative results, which we will report in the following sections as well as the subsequently calculated regional specialisation and sectoral concentration indices, should accordingly be considered with caution. In relative terms (i.e. manufacturing employment in region o in terms of region d), however, the model results are reliable and the goodness of fit is even higher than reported in Figure 1.

Simulating European integration

In this section we simulate the CEE integration by reducing inter-regional transport cost. For setting up an integration scenario we require two types of transport cost data: (i) the magnitude of transport cost in the base year, and (ii) integration-induced changes in the inter-regional transport cost. Bilateral transport costs for the base year have already been estimated in *Kancs* (2006). Reliable estimates for transport cost changes related to CEE integration are not available in the literature. In order to overcome this data limitation, we construct several hypothetical scenarios, where transport costs are reduced in several steps up to 30%.[12]

As usual, the simulation of economic integration involves two steps. First, we exogenously change the inter-regional transport costs by reducing them up to 70 % of their initial values. The induced integration shock disturbs the long-run equilibrium, which we calculated for the base run. Therefore, we repeat calculations of the long-run general equilibrium for CEE regions (and the EU). As a result, we obtain a new equilibrium set of endogenous variables (which differs from the base run). As an illustration of the new equilibrium set in Table 2 we present model predictions for labour demand (sectoral employment) in the manufacturing sector (B30).

According to simulation results reported in Table 2, the post-integration equilibrium set, $\hat{H}_{ir}^{eu}$, deviates from the base run equilibrium, $\hat{H}_{ir}^{br}$, in several respects. Our simulation results suggest that, on CEE-average, manufacturing employment would decline by -20.19%. However, these changes are not equal across the CEE regions. Part of the CEE

[12]The main goal of our simulation exercises is not to predict the actual changes or to forecast the future economic development in the CEE. Instead, the main purpose of this study is to improve the understanding of how CEE integration may affect their internal geography.

regions would increase their production and employment in the transport-intensive manufacturing sector (B30), while others would reduce. Some regions would stay the same. Generally, our results are in line with studies of sectoral specialisation in CEE (*Aiginger* and *Davies* 2004).

Though not reported here, the simulation results for other industries suggest that European integration would trigger sizable employment losses in the agriculture, forestry and fishery sectors. On average, the agricultural employment (B01) in the CEE accession economies would decline by -54.30%. Simulation results for employment in building and construction industries (B53) suggest that on average the share of workers employed in construction services would not change significantly (+2.77%). In contrast, our simulation results suggest that European integration would trigger a significant employment increase of +31.30% in the CEE distribution services (B58). According to our simulation results, in terms of employment share, the largest winners from the EU integration would be service industries: the energy, fuel, gas, water and power sector (B06), transport and telecommunication services (B60), credit and insurance services (B69) and non-market services (B86), where on average the number of employed workers would increase by +70.33%, +103.36%, +75.82% and +56.52% respectively.

Comparing the simulated integration equilibrium, $\hat{H}_{ir}^{eu}$, with the predicted base run equilibrium, $\hat{H}_{ir}^{br}$, we can draw the following conclusions: (i) integration induces sizeable adjustments in regional production and employment structures; (ii) in many regions, initially large industries decline and initially small industries increase their production and employment shares; (iii) a common integration shock induces different regions to adjust differently - some CEE regions would increase their production in transport-intensive sectors such as energy, fuel, gas, water and power products (B06) and manufacturing and mining (B30), while some other CEE regions would increase their specialisation in industries, which primarily require the immobile factor, such as agriculture, forestry and fishery (B06). The ability to predict these integration-induced sector- and region-specific adjustments is the main virtue of the ex-ante economic geography framework, which we apply in this study.

EU integration and regional specialisation

In this section we use simulation results from the previous section and assess sectoral impacts of European integration in selected CEE accession countries. The assessment of integration induced specialisation is done using specific specialisation measures and consists of two steps. First, we calculate regional specialisation indices for the base year. These base year specialisation indices are used as a benchmark in the comparative static analysis. In a second step, using the integration simulation results from the previous section, we compute the post-integration indices of regional specialisation for each NUTS II region in CEE. Finally we compare the benchmark indices of regional specialisation with post-integration indices and discuss our results in the context of previous studies.

Measuring regional specialisation

First, we introduce the statistical measures, which we use for measuring regional specialisation and geographic concentration in the CEE accession countries. According to *Combes* and *Overman* (2004), one of the least data-demanding measures of regional specialisation is the Herfindahl gross index of absolute specialisation. Therefore, in order to assess regional specialisation in the CEE accession countries, we calculate the Herfindahl gross index of absolute specialisation.[13]

The Herfindahl index of regional specialisation describes the degree of absolute specialisation, i.e. the extent to which a given country or region is specialised in a limited number of activities. This concept of specialisation directly relates to the concept of risk exposure. The Herfindahl index is an indicator of the second moment in the distribution of the employment intensities across sectors, i.e., it measures to what extent the distribution of employment shares differs from a uniform distribution. The Herfindahl index increases with specialisation of regions or concentration of industries, implying that the higher is the index, the higher is the specialisation of regions or concentration of industries (*Combes* and

[13] Robustness of all results has been controlled for by calculating the *Krugman* index as a relative specialisation measure. Given that both specialisation measures yield qualitatively similar results, only Herfindahl indices are reported.

Overman 2004).

The Herfindahl index of regional specialisation, HIRS $_r$, is defined as follows:

$$HIRS_r = \sum_i \left(s_{ir}^h\right)^2 \qquad (14)$$

where s_{ir}^h is share of employment in industry i in the total employment of region r and H_{ir} is employment in industry i in region r : $s_{ir}^h = \frac{H_{ir}}{H_r} = \frac{H_{ir}}{\sum_i H_{ir}}$. Equation (14) indicates that data requirements for the Herfindahl index are rather moderate compared to theory-driven indices of regional specialisation and geographic concentration, such as the Ellison and Glaeser index. Only sectoral employment or production shares and the total labour demand or production in each region are required.

The downside of the Herfindahl index is that it suffers from several theoretical problems (for an overview see *Combes* and *Overman* 2004), which might affect the empirical results of our study. First, given the available data, HIRS $_r$ cannot take account of industrial concentration as a driver of location and hence concentration or specialisation. In the context of our study, this limits the comparability of specialisation across industries. Second, given that we do not know what random specialisation and location would look like, we cannot assess significance of the empirical results, which we present in this section. Third, HIRS $_r$ is biased with respect to spatial scale, which might limit its comparability across CEE regions in our sample. For our analysis this implies that cross-section comparability of the HIRS $_r$ across differently sized regions might be problematic.

Pre-integration specialisation

In this section we assess CEE specialisation in the base year using the Herfindahl index of regional specialisation (HIRS), which is the first step of our two-step approach. We use sectoral employment for each region to calculate the base year HIRS $_r^{br}$. The sectoral employment data can be drawn from two sources: (i) Eurostat's New Cronos sectoral employment data for the base year, H_{ir}^{br}, or (ii) predicted sectoral labour demand by the economic geography simulation model for the base year, $\hat{H}_{ir}^{br}$. The two data sources have different implications in the context of our study. On the one hand, Eurostat's data would allow us to more precisely describe the observed specialisation patterns in the CEE accession countries in the base year. On the other hand, the comparison of $HIRS_r^{br}$ that are calculated drawing on statistical data with $HIRS_r^{br}$ that are calculated from model predictions, might potentially bias our comparative static results. Given that we are primarily interested in relative changes in regional specialisation, both base year $HIRS_r^{br}$ and post-integration $HIRS^{eu}$ are computed using labour demand shares, which are predicted by the economic geography simulation model.

In line with the previous section, the base year specialisation is assessed on the basis of Herfindahl index of regional specialisation using sectoral labour demand, which has endogenously been predicted by the economic geography simulation model (equation 8). Given that we are using model predictions of sectoral labour demand instead of statistical employment data, our approach involves two steps. First we express the model-predicted sectoral employment, $\hat{H}_{ir}^{br}$, for each region in industry shares, $\hat{s}_{ir}^{br}$, where $\hat{s}_{ir}^{br} = \frac{\hat{H}_{ir}^{br}}{\sum_i \hat{H}_{ir}^{br}}$.[14] Next we plug the obtained regional employment shares, $\hat{s}_{ir}^{br}$, into equation (14) and calculate regional $HIRS_r^{br}$. Subsequently, we obtain the predicted specialisation for each CEE region. These results are reported in Table 3.

Simulation results reported in Table 3 suggest that specialisation levels were rather different among CEE regions already in the base year (the Herfindahl index can only take values between zero and one). According to Table 3, $HIRS_r^{br}$ ranges from 0.146 in the Latvian region LV01 to 0.388 in the Romanian region RO04, suggesting that in the base year some NUTS II regions were specialised almost three times higher than some other NUTS II regions in the CEE accession countries.

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[14] Superscript br refers to base run (pre-integration) and superscript eu refers to integration with the EU (post-integration).

These sizeable specialisation differences across the CEE regions should, however, be interpreted with caution. Given that the 53 NUTS II regions in our sample are highly heterogenous, the underlying methodological framework (Herfindahl index of regional specialisation) might limit the cross-section comparability of these results. Because the Herfindahl index is not weighted by the geographic size of regions, the presented results might potentially be downward biased for geographically large regions. Indeed, according to the results presented in Table 3, the four largest regions (LV01, PL07, LT01 and EE01) are the least specialised regions in CEE.

In order to assess robustness of these results, we also calculate the Herfindahl index of regional specialisation using Eurostat's New Cronos sectoral employment data for the base year (2004). Comparing the two specialisation indices we conclude that regional specialisation reported in Table 3 does well correspond to regional specialisation suggested by the statistical employment data for the base year ($R^2 = 0.9413$). These robustness test results allows us to draw several conclusions about the underlying simulation model: (i) regional specialisation ranks do not change significantly using either base year data; and (ii) the economic geography simulation model predicts slightly higher specialisation levels than we did observe in the base year. These findings are important for the following comparative static analysis. The former finding suggests that the economic geography simulation model performs well in relative terms. The latter finding suggests that the absolute values of regional specialisation indices should be considered with caution, when interpreting quantitative results.

Regional specialisation after EU integration

In the previous section we have calculated the pre-integration specialisation levels using the base year predictions of the economic geography simulation model. In this section we calculate post-integration specialisation of regions and integration-induced changes in regional specialisation, which is the second step in this section. In particular, we use sectoral employment predictions for the post-integration steady state, when regional economies have adjusted their production and employment structures to changed macrogeographic conditions (reduced inter-regional transport costs).

The sectoral specialisation of the CEE regions has again been assessed on the basis of equation (14). In contrast to the previous section now we use the sectoral employment shares from the predicted post-integration labour demand in each region and each sector (section 4.4). As above, we first express the predicted post-integration labour demand, $\hat{H}_{ir}^{eu}$, in industry shares, $\hat{s}_{ir}^{eu}$. Next, we plug these regional employment shares, $\hat{s}_{ir}^{eu}$, into equation (14) and calculate regional specialisation indices. As a result, we obtain post-integration specialisation indices for all CEE regions, which are reported in Table 4.

According to the HIRS $_r^{eu}$ estimates reported in Table 4, the underlying economic geography simulation model predicts moderate levels of regional specialisation after the EU integration. The post-integration HIRS $_r^{eu}$ range from 0.139 in the Bulgarian region BG03 to 0.278 in the Polish region PL04. According to *Combes* and *Overman* (2004), the average specialisation is considerably higher in the EU-15. Thus, our results deviate from previous studies for the EU-15.

The second conclusion we can draw from Table 4 is that the underlying economic geography simulation model predicts a rather heterogenous specialisation pattern across the CEE regions - the most specialised CEE regions would specialise two times more than the least specialised NUTS II regions in the CEE accession countries. These results are in line with previous studies for the EU-15, where cross-regional differences in specialisation are even more pronounced (*Hallet* 2000, *Aiginger* and *Davies* 2004).

Next, we analyse integration-induced changes in the CEE regional specialisation. In particular, we compare the pre-integration indices of regional specialisation (Table 3) with the post-integration indices, when regional economies have already adjusted to the exogenously imposed integration shock (Table 4). In order to facilitate the comparison of pre-integration and post-integration regional specialisation levels across regions, we express integration-induced changes in regional specialisation in percent. Table 5 reports percentage changes in CEE regional specialisation, which are calculated on the basis of Tables 3 and 4.

Table 5 indicates that, on average, the specialisation of CEE regions would decline. By calculating unweighted average changes from Table 5, we obtain that 30% lower inter-regional transport costs would reduce regional specialisation by 5.4%. The average index of regional specialisation has declined from 0.206 to 0.187 (Tables 3 and 4). These results contradict the EU-15 experience, where European integration has brought about increasing specialisation of regions and higher spatial concentration of industries (*Aiginger* and *Davies* 2004, *Combes* and *Overman* 2004).

Table 5 also reports that a uniform reduction of inter-regional transport costs would induce asymmetric adjustments in the specialisation level across CEE regions. In some CEE regions the level of specialisation would decline, whereas in some other increase. According to Table 5, in 28 CEE regions the level of specialisation would decline and in 25 CEE regions increase. Table 5 also reports that not only signs are different across CEE regions, the rate of adjustment differs too. While on average, the level of regional specialisation does not change more than ± 19%, the specialisation adjustment amplitude ranges from − 51.87% (region RO01) to + 30.19% (region PL0E). These region-specific responses to a common macrogeographic shock are in line with the underlying theoretical framework, according to which, specialisation changes involving regional economies depend on both sectoral characteristics of manufacturing industries and economic geography of CEE regions. This has two important implications for regional specialisation and geographic concentration of industries: (i) identically located regions might respond differently to a symmetric macrogeographic shock, if their sectoral structures are different; and (ii) regions with identical production structures might respond differently to a symmetric macrogeographic shock, if they differ by economic geography characteristics. The former are captured through comparative advantage forces, the latter are captured through economic geography forces. These effects are amplified by model parameters, which are both region and sector specific.

The integration-induced changes in the CEE specialisation which we presented in this section can be summarised as follows: (i) European integration would reduce the average CEE specialisation level; and (ii) the average specialisation in CEE is considerably lower than in the EU-15. These findings suggest that adjustments in CEE internal geography are different from empirical evidence for the old EU member states. In the next section we investigate factors, which might have caused these differences.

Integration of the CMEA

In the previous section we found that the predicted regional specialisation pattern for the CEE is distinct from regional specialisation patterns, which can be found in empirical data for the old EU member states. In this section we investigate determinants, which might have caused these differences. In particular, we investigate how integration of the CMEA might have affected our simulation results. This is done using two different approaches. First, in a comparative static framework we investigate rank correlation between the pre-integration level of regional specialisation and integration-induced changes in the level of regional specialisation. Second, we graphically analyse the predicted CEE specialisation patterns in a sequential static framework.

Comparative statics

In order to determine the impact of integration of the CMEA, in this section we study rank correlation between the pre-integration specialisation and integration-induced changes in regional specialisation. The intuition of our analysis is as follows: in the highly specialised CEE regions production and employment structures were most heavily disturbed by the central-planning during the CMEA. This specialisation pattern is partially found in the base run data. After the simulated integration, only relative advantages and economic geography forces determine industry location and regional specialisation. In order to remain competitive under the changed macrogeographic conditions, the highly specialised regions should restructure their production structures more heavily compared to less specialised regions, where production structures were less disturbed in the CMEA. As a result, the highly specialised regions should become less specialised compared to the least specialised regions, production of which was less disturbed during the CMEA.

Figure 2 plots rank correlation between the initial level of regional specialisation and integration-induced changes in the level of regional specialisation. On both axis we have 53 units, which correspond to ranks of 53 NUTS II regions in CEE. In Figure 2 we observe a negative relationship between ranks of the initial level of regional specialisation and percentage changes in regional specialisation. Neglecting the few outliners (BG03, HU04, HU07, PL04), Figure 2 reports a negative and fairly strong rank correlation ($R^2 = 0.442$). These results suggest that those regions (RO01, RO03 and RO04) which were highly specialised in the base year (x axis) turn out to be the largest losers in terms of the specialisation ranks (y axis) and vice versa.

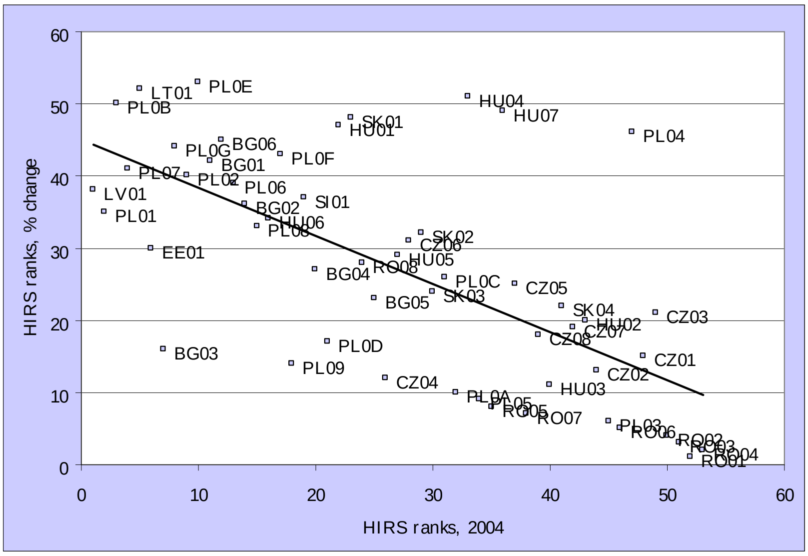

Figure 2 Rank correlation between the initial level of regional specialisation (x) and integration-induced changes in the level of regional specialisation (y)

Assuming that the base year data did indeed contain centrally planned regional production and employment structures, which were not driven by comparative advantages and economic geography forces, Figure 2 suggests a declining significance of the CMEA in CEE industry location and regional specialisation. The strong inverse rank correlation of regional specialisation before and after integration suggests that CEE regions re-specialise their production structures from the central planning to market economy. These results are consistent with previous studies on the internal CEE geography (*Crozet* and *Soubeyran* 2004, *Brülhart* and *Koenig* 2006).

Sequential statics

The comparative static analysis, which we performed in the previous section, indicates significance of CEE integration of the CMEA. The comparative static framework is advantageous, if the relationship between the explanatory variables (inter-regional transport cost) and dependent variables (industry location and sectoral specialisation) is linear. Given that the underlying economic geography theory (*Krugman* 1991, *Krugman* and *Venables* 1995) suggest a non-linear and possibly even non-monotonic relationship, in this section we apply a sequential static framework in order to gain additional insight about the CMEA significance for regional specialisation in CEE.

The sequential static framework is more involved and consists of two additional steps compared to the comparative static framework. First, we need to sequentially repeat the European integration simulations by reducing inter-regional transport costs up to 30% in small steps. We limit the step size to 5% of initial transport cost, which allows us to keep the graphical analysis tractable. Second, we again express the predicted post-integration employment, $\hat{H}_{ir}^{eu}$, for each region in industry shares, $\hat{s}_{ir}^{eu}$. Next, we plug these sectoral labour demand shares, $\hat{s}_{ir}^{eu}$, into equation (14) and calculate the post-integration indices of regional specialisation. As a result, we obtain sequential response of specialisation for each region ($T_{od}^{100}, T_{od}^{95}, \dots, T_{od}^{70}$). Finally, we graphically plot the specialisation indices against inter-regional transport cost, which we reduced in 5% steps up to 30%.

By plotting the level of regional specialisation for different values of inter-regional transaction costs, we obtain a diagram describing the specialisation response of CEE regions to changes in inter-regional transport costs. In order to increase the explanatory power of the diagrammatic analysis, we regroup all CEE regions according to their re-specialisation pattern in three groups: regions with increasing specialisation, regions with declining specialisation and regions with a bell-shaped specialisation pattern. These three groups are presented in Figures 3 – 5.

Considering Figures 3 – 5 we note that these curves are not flat even at the end of the simulated integration, which implies that small changes in inter-regional transport costs would induce further adjustments in the CEE specialisation. Thus, regional specialisation might not approach the long-run equilibrium in many CEE regions, as long as there are changes in external environment, such as transport cost. These findings might help us to explain differences between the predicted regional specialisation pattern for the CEE and regional specialisation patterns found in empirical data for the old EU member states, if the true transport costs are different from the estimated ones. Any other constellation of inter-regional transport costs could potentially lead to a different specialisation pattern in CEE which might be consistent with the observed specialisation pattern in the old EU member states.

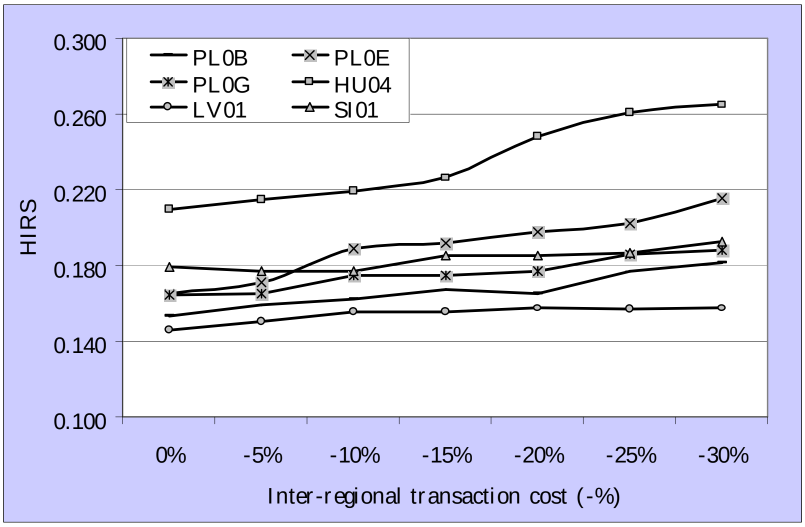

Figure 3 Inter-regional transaction costs (x) and increasing HIRS (y)

Next we consider each specialisation group separately starting with regions with increasing specialisation (Figure 3). Although, the specialisation adjustment rate is different across CEE regions and varying in transport costs, the specialisation pattern of this group is distinct from other CEE regions. According to Figure 3, specialisation is monotonically increasing throughout the whole interval of analysed transport costs in five CEE regions: LV01, PL0B, PL0G, SI01 and PL0E. Increasing regional specialisation, when inter-regional transport costs decline, is in line with empirical evidence for the old EU member states. Thus, integration of the CMEA is insignificant and does not distort the 'natural' specialisation of these regions.

These results are valuable, but the approach required to obtain these results is rather involved. Derivation of ex-ante policy recommendations could be considerably simplified, if we could identify this specialisation group from regional and sectoral characteristics. Therefore, next we investigate common characteristics of these regions. Comparing Figures 2 and 3 we find that all regions belonging to this group were specialised below the national and CEE average in the base year (before the simulated CEE integration).[15] At the end of the simulated integration ($T_{od}^{-30\%}$) the specialisation level was slightly higher than the national and CEE average in two Polish regions PL0E (Warminsko-Mazurskie) and PL0G (Zachodniopomorskie), while it was still below the average in PL0B (Pomorskie) region. These results lead to a conclusion that regional specialisation will likely increase in those regions, which were less specialised in the CMEA.

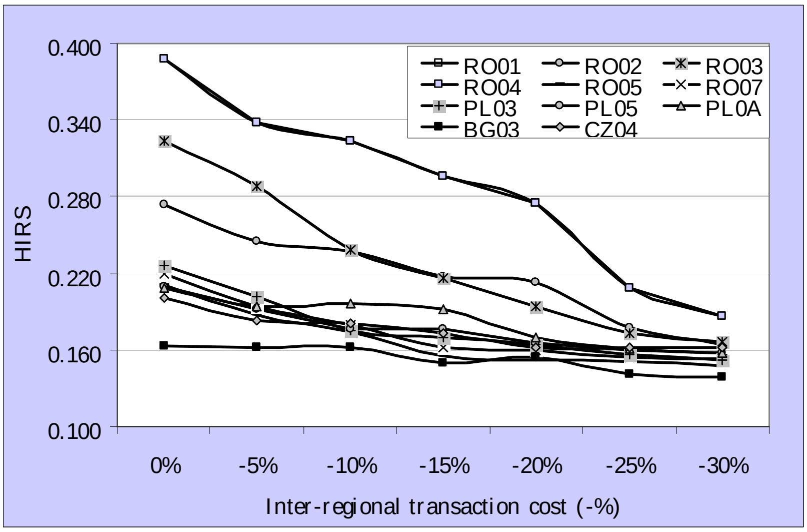

Figure 4 Inter-regional transaction costs (x) and decreasing HIRS (y)

The second specialisation group we identify are regions, where production and employment structures become less specialised when inter-regional transport costs decline. The specialisation's response of regions belonging to this group is reported in Figure 4, according to which, in five Romanian regions (RO01, RO02, RO03, RO05 and RO07),

[15]The only exception was HU04 (Del-Dunantul) region, which had a level of specialisation that was above the national average already in

three Polish regions (PL0A, PL03 and PL05), one Czech region (CZ04) and one Bulgarian region (BG03) regional specialisation would decrease. Again, the specialisation response signs are uniform, but the adjustment rates are different across regions belonging to this group.

As above, in order to identify common characteristics of regions belonging to this group, we compare Figures 2 and 4. We find that all regions of the decreasing specialisation group have had an above-average specialisation level in the base year, before the CEE integration started. These results are in line with previous studies, which report that regions belonging to this group were at the core of the CMEA during the Soviet period (*Crozet* and *Soubeyran* 2004, *Brülhart* and *Koenig* 2006). Thus, our results are consistent with previous studies, which suggest a convergence in the level of specialisation across CEE regions.

The third specialisation group we identify are regions, where the specialisation response to declining inter-regional transport costs is both non-linear and non-monotone (Figure 5). In this group the specialisation of regions declines, when inter-regional transport costs are reduced. According to the Herfindahl indices of regional specialisation reported in Figure 5, at same level of reduced inter-regional transport costs (mostly in the range of $T_{od}^{-10\%}$ and $T_{od}^{-20\%}$), the regional specialisation starts to increase and regional production structures become increasingly specialised. We note that, on average, the specialisation index decreased by 20 - 25% of its initial value before it started to increase. Recovery of the initial specialisation level has been predicted differently successful across CEE regions of this group. Despite the initial loss of specialisation, several regions would increase their specialisation compared to the base run. At the end of the simulated integration the specialisation level would be even higher than in the base year in four CEE regions (PL01, BG01, BG06 and PL0F). In three CEE regions it would be still lower than in the base year (CZ03, CZ08 and SK03). However, in most regions of this group (PL0C, CZ06, SK02, PL08 and HU06) the specialisation level would not significantly change compared to the base year.[16]

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the benchmark.

[16] We include all CEE regions in this subgroup, where the specialisation level has changed less than 5% compared to the base year.

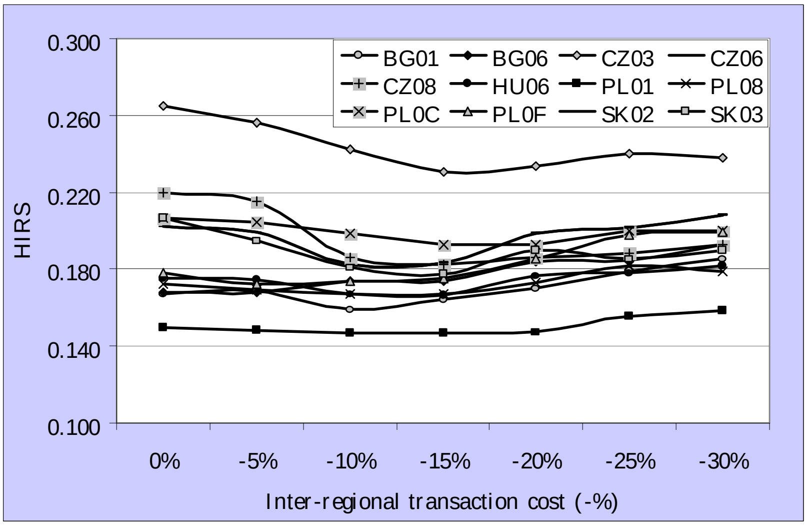

Figure 5 Inter-regional transaction costs (x) and bell-shape HIRS (y)

Given that the underlying theoretical framework (*Krugman* 1991, *Krugman* and *Venables* 1995) a priori suggested a non-linear and non-monotone relationship between industry location and transport costs, this group is the most interesting from the theoretical perspective. However, in contrast to results reported for the old EU member states (*Aiginger* and *Davies* 2004, *Combes* and *Overman* 2004), we found an inverse bell-shape in the CEE specialisation pattern. According to findings from the previous section, integration process of the CMEA might have distorted the relationship between economic integration and regional specialisation. These distortions are larger in those regions which were more integrated in the CMEA, such as Romanian regions.

Conclusions

In this paper we investigate how European integration might affect the location of economic activities in CEE. Our analysis consists of three main steps. First, we assess the current regional specialisation and sectoral concentration patterns in CEE. In a second step, using a multi-regional economic geography model we simulate the specialisation patterns for the period after integration with the EU. Finally, comparing the two states before and after integration we analyse how European integration would have affected the spatial location of economic activities in CEE.

Our simulation results suggest that the sectoral specialisation of CEE regions is strongly related to the state of economic integration. This result complements previous findings from the literature (*Crozet* and *Soubeyran* 2004, *Brülhart* and *Koenig* 2006). In addition, we find several characteristics in the CEE specialisation pattern, which are distinct from the old EU member states (*Hallet* 2000, *Aiginger* and *Davies* 2004, *Combes* and *Overman* 2004): (i) in contrast to empirical evidence for the old EU member states we find that, on average, EU integration would reduce regional specialisation in CEE; and (ii) the bell-shaped specialisation pattern predicted by the underlying theoretical framework is inverse in CEE.

In order to identify determinants, which might have caused these differences between the predicted specialisation pattern in our study and literature findings for the old EU member states, we investigate role of the CMEA. We find a strong inverse rank correlation of regional specialisation before and after integration, which might be triggered by the re-specialisation of production structures from the central planning to market economy. We conclude that regional specialisation pattern in CEE is heavily distorted by the integration of the CMEA. These results are consistent with past location and specialisation patterns, which we studied in section 2 of this paper. These findings are new and have not been reported in the literature before.

In view of potential welfare gains from regional specialisation these results are not particularly encouraging for the CEE accession countries. Our findings suggest that the short- to medium-term gains from regional specialisation might be offset by the CMEA leftover pains. However, in the medium to long run, a more efficient factor allocation and activity-specific knowledge accumulation might lead to sizable welfare gains in CEE.

Region-specific results suggest that European integration would asymmetrically affect regional economies in CEE. Based on the simulation results we identify three groups of CEE regions: regions with increasing specialisation, regions with declining specialisation and regions with a bell-shaped specialisation pattern. On average, European integration would trigger increasing regional specialisation in Bulgaria and Poland and decreasing specialisation in Romania. In contrast, European integration would not significantly affect regional specialisation in Hungary, the Czech Republic, Slovakia and the three Baltic states. We also find some evidence in favour of specialisation convergence across the CEE regions, which is in line with previous studies for the old EU member states.

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Appendix

Table 1 Classification of industries

No	Sector in the model	Industry code	Market form
1	Agriculture, forestry and fishery products	B01 ✎	CRS
2	Energy, fuel, gas, water and power products	B06	IRS
3	Manufacturing, mining etc	B30	IRS
4	Building and construction	B53	IRS
5	Wholesale and retail trade, recovery, repair	B58	IRS
6	Transport and telecommunication services	B60	IRS
7	Credit and insurance services	B69	IRS
8	Lodging and catering services	B74	IRS
9	Non-market services	B86	IRS

CRS--constant returns to scale, IRS--increasing returns to scale. ✎ Sectoral classification according to NACE/CLIO R6-R17.

Table 2 Simulation results: manufacturing employment [a] (B30)

Region	$\hat{H}_{ir}^{br}$	$\hat{H}_{ir}^{eu}$	Region	$\hat{H}_{ir}^{br}$	$\hat{H}_{ir}^{eu}$	Region	$\hat{H}_{ir}^{br}$	$\hat{H}_{ir}^{eu}$	Region	$\hat{H}_{ir}^{br}$	$\hat{H}_{ir}^{eu}$
BG01	40	34	CZ08	196	96	PL03	120	119	PL0G	122	53
BG02	114	136	EE01	160	96	PL04	112	99	RO01	224	222
BG03	99	62	HU01	254	187	PL05	84	154	RO02	254	179
BG04	203	176	HU02	179	87	PL06	237	266	RO03	321	327
BG05	188	149	HU03	140	122	PL07	348	309	RO04	150	149
BG06	66	53	HU04	86	65	PL08	105	101	RO05	174	188
CZ01	114	95	HU05	132	87	PL09	133	133	RO06	220	248
CZ02	169	142	HU06	137	112	PL0A	73	57	RO07	334	199
CZ03	215	141	HU07	152	145	PL0B	142	166	RO08	286	186
CZ04	175	117	LT01	230	185	PL0C	525	471	SI01	275	244
CZ05	258	145	LV01	160	166	PL0D	86	107	SK01	67	49
CZ06	131	58	PL01	194	87	PL0E	111	81	SK02	254	112
CZ07	211	103	PL02	170	141	PL0F	359	245	SK03	178	122
									SK04	152	106

[a] Thousands of workers, $\hat{H}_{ir}^{br}$ = base run labour demand, $\hat{H}_{ir}^{eu}$ = labour demand after EU integration. Source: NEG model-predictions of sectoral labour demand (equation 8).

Table 3 Predicted CEE specialisation for the base year

Region	HIRS_r^{br}	Region	HIRS_r^{br}	Region	HIRS_r^{br}	Region	HIRS_r^{br}
BG01	0.167	CZ08	0.220	PL03	0.227	PL0G	0.164
BG02	0.172	EE01	0.158	PL04	0.241	RO01	0.388
BG03	0.164	HU01	0.188	PL05	0.210	RO02	0.274
BG04	0.181	HU02	0.223	PL06	0.169	RO03	0.324
BG05	0.196	HU03	0.220	PL07	0.155	RO04	0.388
BG06	0.168	HU04	0.210	PL08	0.173	RO05	0.210
CZ01	0.265	HU05	0.201	PL09	0.178	RO06	0.231
CZ02	0.223	HU06	0.175	PL0A	0.209	RO07	0.219
CZ03	0.265	HU07	0.214	PL0B	0.153	RO08	0.194
CZ04	0.201	LT01	0.157	PL0C	0.206	SI01	0.179
CZ05	0.218	LV01	0.146	PL0D	0.186	SK01	0.188
CZ06	0.203	PL01	0.150	PL0E	0.165	SK02	0.203
CZ07	0.223	PL02	0.165	PL0F	0.178	SK03	0.206
						SK04	0.221

HIRS_r^{br} = Herfindahl index of regional specialisation for the base year, calculated from NEG model-predictions of sectoral labour demand (equation 8).

Table 4 Predicted CEE specialisation after EU integration

Region	$HIRS_r^{eu}$	Region	$HIRS_r^{eu}$	Region	$HIRS_r^{eu}$	Region	$HIRS_r^{eu}$
BG01	0.185	CZ08	0.193	PL03	0.152	PL0G	0.188
BG02	0.183	EE01	0.159	PL04	0.278	RO01	0.187
BG03	0.139	HU01	0.218	PL05	0.158	RO02	0.164
BG04	0.177	HU02	0.199	PL06	0.182	RO03	0.166
BG05	0.179	HU03	0.171	PL07	0.171	RO04	0.187
BG06	0.193	HU04	0.266	PL08	0.179	RO05	0.148
CZ01	0.220	HU05	0.202	PL09	0.145	RO06	0.151
CZ02	0.180	HU06	0.182	PL0A	0.158	RO07	0.154
CZ03	0.238	HU07	0.251	PL0B	0.182	RO08	0.192
CZ04	0.162	LT01	0.199	PL0C	0.200	SI01	0.192
CZ05	0.205	LV01	0.157	PL0D	0.159	SK01	0.218
CZ06	0.208	PL01	0.159	PL0E	0.215	SK02	0.208
CZ07	0.199	PL02	0.182	PL0F	0.199	SK03	0.190
						SK04	0.202

$HIRS_r^{eu}$ – Herfindahl index of regional specialisation after EU integration, calculated from NEG model-predictions of sectoral labour demand (equation 8).

Table 5 Integration-induced changes in regional specialisation, %

Region	$\Delta HIRS$	Region	$\Delta HIRS$	Region	$\Delta HIRS$	Region	$\Delta HIRS$
BG01	10.55	CZ08	-12.32	PL03	-32.77	PL0G	14.56
BG02	6.60	EE01	0.79	PL04	15.38	RO01	-51.87
BG03	-14.89	HU01	16.31	PL05	-24.74	RO02	-40.06
BG04	-2.01	HU02	-10.87	PL06	7.82	RO03	-48.75
BG05	-8.66	HU03	-22.16	PL07	10.39	RO04	-51.87
BG06	14.65	HU04	26.57	PL08	3.65	RO05	-29.62
CZ01	-16.90	HU05	0.14	PL09	-18.54	RO06	-34.72
CZ02	-19.37	HU06	3.89	PL0A	-24.52	RO07	-29.92
CZ03	-10.39	HU07	17.14	PL0B	18.71	RO08	-1.04
CZ04	-19.40	LT01	26.79	PL0C	-3.18	SI01	7.17
CZ05	-5.90	LV01	7.76	PL0D	-14.88	SK01	16.31
CZ06	2.83	PL01	6.10	PL0E	30.19	SK02	2.83
CZ07	-10.87	PL02	10.37	PL0F	11.96	SK03	-7.94
						SK04	-8.90

$\Delta HIRS$ - percentage changes in Herfindahl index of regional specialisation, calculated from Tables 3 and 4:

$$\Delta HIRS_r = \left[HIRS_r^{br}/HIRS_r^{eu} \times 100 \right] - 100$$