ECONOMIC INTEGRATION AND MANUFACTURING LOCATION IN EU ACCESSION COUNTRIES*

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ABSTRACT
This paper investigates patterns of manufacturing location in the context of increased economic integration in European Union accession countries. Using regional data for the period 1990-1999, we identify and compare patterns and determinants of manufacturing location in five countries: Bulgaria, Estonia, Hungary, Romania and Slovenia. Our research results indicate that factor endowments and geographic proximity to large markets determine the location of manufacturing in these countries.

Key Words: Economic integration, manufacturing location, EU accession countries

INTRODUCTION
Over the past decade, Central and Eastern European countries (CEECs) have experienced increased economic integration via trade and foreign direct investment, particularly with the European Union (EU). Their EU entry prospects have fostered international business linkages due to the opening of new markets for trade and foreign investment. Furthermore, increased economic integration has led to a more efficient allocation of resources across sectors and space through structural changes and adjustment. While the reallocation of resources across space has been more often

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analyzed (Landesmann and Stehrer 2002), changes in production structures within these countries at regional levels have so far seldom been investigated. Where is economic activity located? What are the main driving forces explaining the economic geography in EU accession countries?

These questions are important and policy relevant. First, the spatial distribution of economic activity has implications for the overall welfare. Second, the benefits and costs resulting from increased integration are not evenly distributed across space leading to relative winners and losers. Third, increased specialization and concentration of activities may heighten the vulnerability of certain regions to sector-specific shocks.

In this paper, we investigate manufacturing location patterns in five EU accession countries, namely: Bulgaria, Estonia, Hungary, Romania, and Slovenia. These countries differ with respect to the speed of structural change and adjustment which has taken place following the transition from central planning to market economies and opening to the world economy, their size and geographical position. The industrial restructuring has been faster in Estonia, Hungary and Slovenia while in Bulgaria and Romania the speed of economic change has been slower. Estonia and Slovenia are small economies, Hungary and Bulgaria are medium-size countries while Romania is relatively larger. Hungary and Slovenia are close to the EU core while the other three countries have a peripheral position in North-Eastern Europe (Estonia) and South-Eastern Europe, respectively (Bulgaria and Romania). Bulgaria, Estonia, Romania and Slovenia have sea access while Hungary is landlocked. Estonia, Hungary, and Slovenia have become EU members on 1 May 2004 while Bulgaria and Romania have signed Accession Treaties with the EU and are expected to join in 2007.

We use data at regional level for the period 1990-1999 to identify determinants of manufacturing location in these countries. The results of our econometric analysis indicate that factor endowments and proximity to large markets explain the economic geography of manufacturing in the five countries analyzed.

The remainder of this paper is organized as follows. In the next section we give an overview of the theoretical framework. We continue with the description of our data and empirical methodology. The results of our empirical analysis are discussed in Section 4. Section 5 concludes.

THEORETICAL FRAMEWORK

The starting point for analyzing determinants of production structures in the context of increased integration is international trade theory. Depending on the underlined explanations for specialization and location patterns, three groups of models can be distinguished.

The *neo-classical trade theory* (Heckscher 1919, Ohlin 1933) focuses on differences in factor endowments as explanations for specialization patterns. In a world of perfect competition, homogeneous products, and constant returns to scale, economic activity will locate according to relative production costs, termed comparative advantages. In particular, industry location is explained by a combination of factor endowments and factor intensities. In other words, an industry which makes intensive use of a specific factor will locate where this factor is abundant relative to alternative locations.

Although relevant for a significant proportion of trade, comparative advantage does not explain all trade patterns. In particular, the neo-classical trade theory fails to explain the trade between countries with similar economic structures and endowments, as well as the uneven industrial development in developing countries (Venables 1996).

Recent models, known as the *new trade theory* (Krugman 1980, Helpman and Krugman 1985, Krugman and Venables 1990), were developed during the 1980s to account for the intra-industry trade, the trade with differentiated products within the same product category. These models underline the geographical advantage of large markets in attracting industries with increasing returns to scale. This result is obtained from modeling trade between two countries (regions) which differ in their initial endowments: one is typically large (the "core") as measured by its labor force and the other one is small (the "periphery"). Labor is assumed to be immobile. Two sectors are considered: one producing with constant returns to scale and trading its products without cost (typically agriculture), and the other one producing with increasing returns to scale and trading its products at a positive cost (manufacturing). When trade barriers fall, the sector with increasing returns to scale will locate in the large country (region) in order to take advantage of economies of scale and minimize transport costs and thus total trade costs. Thus, the large country (region) will become specialized in increasing returns activity, while the small country (region) will specialize in agriculture. This result depends, however, on the degree of integration reflected in the level of total trade costs. When trade costs are sufficiently low, congestion and factor costs considerations come into the play in the core and drive some firms to move back to the periphery, where they can benefit from lower production factor costs.

This additional contribution of the new trade theory in explaining location of economic activity does not cover the situation when two countries (regions) with similar initial conditions develop different economic structures. This case is analyzed by the more recent models of the *new economic geography* (Krugman 1991a, 1991b, Krugman and Venables 1995, Venables 1996). These models point out that the advantage of large countries (regions) is essentially endogenous. Location of economic activity is explained through cumulative causation and spatial agglomeration. In contrast with *new trade* models, the *new economic geography* modeling framework includes two countries (regions) with similar initial endowments. In this framework labor is mobile between the two countries (regions). The driving forces of agglomeration are labor mobility and input-output linkages of firms using intermediate products. Due to labor mobility, agglomeration will drive up wages, and firms and workers will therefore concentrate in the country (region) with an initial small scale advantage. Because of perfect labor mobility, the concentration of increasing returns activities in one country (region) will become permanent. However, centrifugal forces will prevent this polarization scenario to materialize. Upon reaching a certain threshold in the integration process, re-dispersion of activity for factor cost considerations will balance the distribution of economic activity between the two countries (regions).

The theoretical models reviewed in this section allow us to derive the following hypotheses to be tested in our empirical analysis:

1) Industries intensively dependent on a specific factor will locate to regions where that factor is abundant;
2) Industries with increasing returns to scale will locate close to large markets.

In addition to trade, foreign direct investment can also trigger the relocation of manufacturing by fostering linkages with domestic firms and agglomeration patterns through technological and pecuniary externalities (Scitowsky 1954, Hirschman 1958, Rodríguez-Clare 1996, Markusen and Venables 1999). In particular, as well documented in the international business literature, (Caves 1971, Dunning 1973, Buckley and Casson 1976) foreign direct investment can act as a vehicle for technology transfers, especially from advanced to less developed countries and result in technological and productivity spillovers to the local economy (Blomström and Kokko 1997, Görg and Strobl 2002). With respect to Central and Eastern European countries, Altomonte and Resmini (2002) provide empirical evidence on linkages between multinational enterprises and domestic firms in Poland and Javorcik (2004) finds evidence on positive productivity spillovers from FDI taking place through contacts between foreign affiliates and their local suppliers in upstream sectors in the case of Lithuania.

This paper investigates determinants of manufacturing location patterns using the analytical framework provided by the trade theories discussed above. In the next section we illustrate the data set and the empirical methodology.

THE DATA AND EMPIRICAL METHODOLOGY

The Data Set

In this paper we analyze the determinants of manufacturing locations in five EU accession countries – Bulgaria, Estonia, Hungary, Romania and Slovenia – using data at NUTS 3 level classification[1], which is part of a specially created data set called REGSTAT[2].

The variables available are: employment; unemployment; average earnings; indicators of research and development (R&D); population; and other geographic and demographic variables. The period covered is 1990-1999, though certain variables are available for a shorter period. In most cases, data were collected from national statistical offices. In the case of Estonia, employment data at the regional level were obtained using labor force surveys. In Slovenia, employment data at the regional level were obtained using the information provided in the balance sheets of companies with more than ten employees.

The classification of manufacturing activities was made according to the Eurostat's NACE Rev1[3] (two-digit classification) for Estonia, Romania, and Slovenia. Employment data were collected according to existing national classifications in Hungary and Bulgaria. For these two cases, we aggregated the data to get them as close as possible to the NACE classification.

Model Specification

Our analysis of the determinants of manufacturing location in the five EU accession countries is based on specific characteristics of industries and regions following Midelfart-Knarvik et al. (2002). Industries may differ in the way they combine production factors in order to obtain their final output. For example, they may employ different technologies, they may be subject to different levels of scale economies, etc. On the other hand, regions may differ in size, population, factor endowments, geographic position (core or peripheral), and so on. As a consequence, when deciding on their location, firms from industries with different characteristics will evaluate the same regional characteristics differently. Firms that aim to locate as close as possible to the place where their most important inputs are available will be over-represented in those locations where these inputs are abundant, and will therefore be under-represented in those locations where these inputs are scarce.

This location choice is modeled by Midelfart-Knarvik et al. (2002). In that paper, the authors analyze how factor endowments, trade costs and geographical distribution of demand interact to determine international specialization patterns across countries in the European Union. The model is based on two strands of the literature: on the one hand, the work on the effect of industrial characteristics on trade (Baldwin 1971),

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[1] NUTS is the European Union's common classification of territorial units for statistical purposes. This classification subdivides each member states into three hierarchical levels: NUTS levels 1, 2, and 3. The second and third levels are subdivisions of the first and second levels respectively.

[2] This data set has been generated in the framework of the PHARE ACE Project P98-1117-R.

[3] NACE is the statistical classification of economic activities in the European Union

and, on the other hand, the literature on the effect of country characteristics (endowments, technology, etc) on trade (Leamer 1984, Harrigan 1995, 1997, Davis and Weinstein 1998, 1999).

We follow Midelfart-Knarvik et al. (2002) and estimate the following model to uncover the determinants of manufacturing location patterns within the five analyzed countries:

$$s_{ir} = \alpha + \Sigma_k \beta[k] (y[k]_r - \gamma[k]) (z[k]^i - \varkappa[k]) + \varepsilon_{ir}, \quad (1)$$

where s_{ir} is the share of industry i's employment in region r in the industry i's total employment at country level. The term $y[k]_r$ is the level of the k^{th} region characteristic in region r, and $z[k]^i$ is the level of the k^{th} industry characteristic of industry i. These two terms capture the influence of, respectively, region and industry characteristics on the location decisions of manufacturing firms. As it is clear in (1), the k^{th} region characteristic is matched with the k^{th} industry characteristic. The interaction terms enable us to capture the influence of the combination of region characteristics and industry characteristics on manufacturing location. Finally, α, $\beta[k]$, $\gamma[k]$, and $\varkappa[k]$ are the coefficients to be estimated, while ε_{ir} is the remaining error term.

In this paper, we estimate this model separately for each country under analysis in order to identify the determinants of manufacturing location. The data that we use to identify region and industry characteristics will be explained in more detail in the next section.

Region and Industry Characteristics

On the basis of our data set, we identify a number of region and industry characteristics that can be matched in order to test the determinants of manufacturing location. The selected region and industry characteristics are listed in the upper part of Table 1.

Table 1. Region and industry characteristics

Variable Name	Description
Regional Characteristics	
Market Potential (MP1)	Average regional earnings (deflated at national level) divided by the distances to the country capital (in km)
Market Potential (MP2)	Average regional earnings (deflated at a national level) divided by a proxy of the distance to EU markets (1, if the region borders the EU: 2, if the region does not border the EU)

R&D (RD)	R&D personnel divided by the number of persons employed for Bulgaria; R&D expenditures divided by the value added in manufacturing for Slovenia; too many missing values prevent us from using this variable for Estonia, Hungary and Romania
Labor Abundance (LA)	Sum of employment and unemployment, divided by the population of working age (15-65 years)
Industrial Characteristics	
Scale Economies (SE)	1 = High; 0 = Low or Medium (on the basis of the definition by Pratten, 1988)
Research-Oriented (RO)	1 = almost all industries of the sector are defined as research-oriented; 0 = only a few of the industries of the sector are defined as research oriented (on the basis of the OECD (1994) definition)
Technology Level (TL)	1 = High technology; 0 = Low or Medium technology (on the basis of the OECD, 1994) definition
Labor Intensity (LI)	Labor Intensity dummy (on the basis of the OECD, 1994) definition)

The market potential (MP) characteristic is an indicator measuring the proximity of each region to the core (large) market, and is computed by dividing average regional earnings[4] by the distance of the region to the most important market. Depending on the degree of openness of the country, we compute the indicator in two different ways. The first market potential indicator (MP1) compares regions inside the same country in the context of a closed economy, where the most important market is assumed to be located in the country's capital. The second indicator (MP2), in the context of the increasing integration between accession countries and European countries, assumes that the largest market for the accession countries is the EU. MP1 and MP2 are therefore useful in order to get insights into the consequences of the increasing integration between each country and the EU.

By reducing trade barriers, the "Europe Agreements" between the EU and accession countries have probably led to a reduction of the cost of trade with the EU, while the costs of trading within the country have probably remained unchanged. We believe that these agreements might have favored regions bordering the EU in comparison with central regions, which, instead, had a favorable position before the EU accession agreements. The variables MP1 and MP2 can, therefore, be used to verify whether increasing integration with the EU has led to a reallocation of activity (industries) from central regions to regions bordering the EU.

[4] total earnings per employee at regional level

The labor abundance (LA) variable, computed by dividing the sum of the number of people employed and unemployed by the working age population, was included in the models in order to identify the relative regional abundance of labor. Similarly, the research and development (RD) characteristic, computed on slightly different data for each country, was included in the models in order to identify the relative regional abundance of R&D opportunities/spillovers.

The industry characteristics analyzed in our models are all defined as dummies, and are summarized in the bottom part of Table 1. The choice of the relevant industry characteristics is mainly motivated by the region characteristics that we were able to evaluate and match with each industry characteristic. Therefore, the industry characteristics considered are the following: the level of scale economies (SE); the degree to which each industry might be defined as research-oriented (RO); the technology level (TL); and the intensity to which industries use labor in their production process (LI). While the definition of RO, TL and LI is based on OECD (1994), the definition of SE is based on Pratten (1988).[5]

After defining region and industry characteristics, we define the interaction variables included in equation (1) by matching industry and region characteristics, as illustrated in Table 2.

Table 2. Interaction variables

	Variable name	Region characteristics	Industry characteristics
K=1	MP1SE	MP1 (Market Potential) (distances from country capital)	SE (Scale Economies)
K=2	MP2SE	MP2 (Market Potential) (distances with EU markets)	SE (Scale Economies)
K=3	RDRO	RD (R&D personnel or expenses)	RO (Research-Oriented)
K=4	RDTL		TL (Technology Level)
K=5	LALI	LA (Labor Abundance)	LI (Labor Intensity)

Firms from industries with a high level of scale economies are likely to highly evaluate regions that are located near the core (large) market (Krugman 1980). For this reason, we made the market potential (MP1 and MP2) characteristics interact with the level of scale economies (SE).

Firms that are based on a high technology level (TL) or firms that are research-oriented (RO) will highly evaluate regions in which the RD indicator has a higher

[5] We analyzed the sensitivity of our results to changes in the industry taxonomies by substituting the OECD (1994) for the classification of the Austrian Institute of Economic Research (WIFO) (Peneder, 1999). These different definitions of the LI and TL industry characteristics did not change our results and conclusions significantly.

value. We then let the RD characteristic interact with the technology level (TL), and with the importance of R&D inputs in each industry (RO). These two industry characteristics (TL and RO) may, in principle, seem very similar. However, they comprise different industries, meaning that they are based on different underlying industry characteristics.

Finally, firms for which labor is a very important production factor (LI) will tend to highly evaluate the availability of labor, and will consequently tend to locate in regions with a high abundance of labor (LA)[6].

The next sections describe the econometric methodology and results of the model presented above.

EMPIRICAL ANALYSIS

Estimation Issues

Our dependent variable is the share of employment in industry *i* in region *r* in the country's employment of industry *i*:

$$s_{ir} = \frac{E_{ir}}{\sum_r E_{ir}} \qquad (2)$$

Such a dependent variable is a number ranging from 0 (when no industries of type *i* are located in region *r*) to 1 (when all industries of type *i* are located in region *r*).

In order to remove fluctuations due to the business cycle, Midelfart-Knarvik et al. (2002), computed 4-year moving averages of their data. Since the length of our time series is extremely short, we estimated the model using data on levels, and added time dummies in order to capture the effect of year-specific conditions. In order to analyze the sensitivity of our results to this choice, we estimated the model on 3-years-averaged data, and we compared its outcome with the model estimated on levels data. Although the R^2 – as expected – drops when we pass from the time-averaged data to the data on levels, the coefficients and standard errors of the two estimations are very similar.

Since the dependent variable (s_{ij}) can only have values between 0 and 1,[7] while the explanatory variables of the model are either dummies or real numbers, an estimation

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[6] In this case we assume a homogeneous pool of workers, and we do not take into account the possibility of a mismatch between skill/education levels required by firms and skill/education levels of the population living in a certain region. Another possible problem with this variable might be that firms that make intense use of labor might also locate in those areas in which wages are comparatively lower. However, details on wages are already embedded in the two MP variables.

of equation (1) by means of OLS would lead to biased results. The solution to this problem consists in rescaling either the dependent variable or the independent variables by means of a logistic transformation, in order to make all variables comparable. We rescale our dependent variable in the following way:

$$s_{ir} = ln\ (s_{ir}\ /\ (1 - s_{ir})) \qquad (3)$$

Finally, the dependent variable in (1), which is the share of industry *i* in region *r* in the total employment of industry *i* in country *c* observed over time, has an implicit multilevel structure. The best option would be to use estimators able to exploit the multilevel structure of the data, as suggested by Hsiao (2003). Unfortunately, since our data set is unbalanced, the estimation would become quite complicated. On the other hand, estimation by OLS would lead to consistent, though inefficient, estimators, characterized by standard errors downwardly biased (Hsiao 2003). We therefore analyze the determinants of interregional industry location separately for each country by estimating equation (1), in which the dependent variable is transformed on the basis of (3) with a Least Squares Dummy Variable (LSDV) estimator.[8] The results are shown and compared in the next section.

Estimation Results

We estimated equation (1) – in which the dependent variable is transformed using equation (3) – in order to analyze the determinants of industrial location across regions. Because of data availability and comparability, the estimates have been computed separately for each country, and the results are shown in Tables A1-A5 of the Appendix.

In column (1), we present the results of the model estimated using a complete set of time dummies, dummies for regions as well as industry dummies. In this case, it is not possible to estimate the coefficients of the industry characteristics, since these are linear combinations of the industry dummies. In column (2), we therefore substitute the industry dummies with industry characteristics. By comparing the coefficients of column (1) with the coefficients of column (2) we can assess the predictive power of the industry characteristics against the complete set of industry dummies. The adjusted R^2 and the estimated coefficients remain almost unchanged when we use industy characteristics instead of industry dummies, while the standard errors slightly increase. Yet, the estimated industry characteristics are usually not significant.

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[7] In our data set, the dependent variable is never exactly 1. When it is exactly 0, we substitute for it a very low value (0.00001) to avoid the observation being dropped from the sample.
[8] All estimations have been made with Stata 7.

The regions' dummies are likely to pick up a high portion of the variability, thus hiding the importance of the region characteristics that we have identified in the previous sections. To test this, we re-estimated our model excluding the regional dummies. We first note that the adjusted R^2 drops when we delete the regional dummies, even though this means adding degrees of freedom. Furthermore, dropping regional dummies leads to a dramatic change in the estimated coefficients; in some cases – see for example MP2, RD and LA for Bulgaria or MP1 for Estonia and Romania – slopes that were significantly positive become significantly negative, or vice-versa.

Since these results suggest the presence of omitted variable bias in the estimations of column (3), we choose the model of column (2) – which allows for region-specific intercepts – as our preferred estimation. Table 3 below summarizes the findings of the estimations of the model of column (2) shown in the country tables in the Appendix (Tables A1-A5).

Table 3. Summary of column (2) of Tables A1-A5 of the Appendix

	BG	EST	HU	RO	SLO
Ln(pop)	+ + +	+ + +		– –	
MP1		++		-	
MP2	+ + +	–			
RD	– – –	/	/	/	
LA	++			– – –	/
SE					
RO		/	/	/	
LI					/
TL		/	/	/	+ +
MP1SE					
MP2SE					
RDRO		/	/	/	
LALI					/
RDTL		/	/	/	– – –

Detailed results can be found in Tables A1-A5 of the Appendix. The plus sign means that the coefficient is significant and positive at 10% (+), 5% (+ +) or 1% (+ + +). The minus sign means that the coefficient is significant and negative at 10% (–), 5% (– –) or 1% (– – –).
/ means that the variable was not used in the estimation.

The coefficient of *Ln(pop)* is positive for Bulgaria and Estonia. As expected (recall that the dependent variable is computed using data on employment) in more populated regions of these countries, we generally find a higher concentration of industries, compared with less populated regions. In contrast, for Romania, the slope seems to be negative.

The interpretation of the region and industry characteristics has to be made on the basis of their inverted signs, since in equation (1) they have a negative sign. A positive value for the market potential variables MP1 and MP2 is therefore associated with lower values of s_{ir}. This result might indicate that industries generally tend to locate in those areas where wages, and therefore labor costs, are lower. The denominator of the MP variable is the distance of each region to the core market. A positive coefficient of MP might suggest that the lower the distance to the 'core market', the lower the share of regional employment in industry *i* compared with national employment in the same industry. On the other hand, this result is also consistent with the assumption that core regions – for example, the country's capital – are usually characterized by comparatively higher wages. These two indicators (MP1 and MP2) do not, however, allow us to disentangle the effect of wages and distances to the core market.

The coefficient of RD appears to be negative for Bulgaria, indicating that firms would tend to locate in those regions where a high number of employees work in R&D.

The coefficient of labor abundance (LA) is positive for Bulgaria and negative for Romania. While in Romania industries seem to locate in regions with a high availability of labor, in Bulgaria industries do not seem to locate in these type of regions. Since the LA indicator is computed by dividing the sum of the number of people employed and unemployed by the total population (see Table 1), the positive coefficient for Bulgaria might be due to a high number of unemployed people in those regions where industries tend not to locate. Further research might help to clarify this point.

Turning to the industry characteristics, note that almost none of them seem to be significant. The positive coefficient of TL for Slovenia suggests that industries with a high technology level tend to be located in regions with lower values of s_{ir} than industries with a low technology level. We may interpret this result as evidence that high technology industries seem to be more dispersed than low technology industries. However, the coefficient of TL is significant only for Slovenia, which is a small country, where distances between regions might be not very relevant.[9]

Similar to the variables identifying the industry characteristics, almost none of the interaction terms are significant. The only exception is the slope of RDTL for Slovenia, which appears to be negative, suggesting that the RD region characteristic has a lower effect for TL industries. This counterintuitive result might be due to data

[9] It might even be argued that location of industries across regions is not a relevant issue in such a small country.

collection problems: the R&D expenses are imputed to the regions where the headquarters of the firm is located, which does not necessarily coincide with the region where the majority of the workers are located.

In conclusion, our results are consistent with the hypothesis that industrial location decisions are due to specific region characteristics. On the other hand, there seem to be no striking differences among the location decisions of different types of industries. One reason for this result might be due to our crude industry classification, which does not allow us to identify more than ten economic sectors, and might therefore be too aggregated for the purposes of such specific analysis.

Time-Specific Slopes

In order to analyze the presence of structural breaks, and therefore slopes that change over time, we split our estimations into sub-periods, on the basis of data availability. The results are shown in columns 4-6 of Tables A1-A5 in the Appendix. Estimations for Bulgaria, Hungary and Romania have been split into three sub-periods each covering three years, but it has only been possible to split the estimations for Estonia into two sub-periods, and the Slovenian time series are too short to be split into any sub-periods.

In Bulgaria, the coefficient of MP2 becomes insignificant in the second period, after having been significantly positive in the first period. In the third period, the coefficient is negative. These results suggest that, in the period 1991-1993, industries were mainly located far away from the EU borders. In contrast, in the period 1994-1996, when costs of trading with EU countries became lower, regions bordering the EU increased their relative share of employment, first by reaching the average national level (second period), and finally by gaining comparative advantage over other regions in the last period[10].

In Hungary, the coefficient of MP1 is negative in the period 1992-1993, positive in the period 1994-1996, and again negative in the period 1997-1999. Even if the meaning of these changes over short periods is not always unambiguous, it is interesting to note that the changes in the slopes of MP2 are opposite to the changes in the slope of MP1. This is consistent with the hypothesis of the existence of some sort of competition between the internal core market, represented by the country capital, and the core international market, represented by the EU. This is not necessarily inconsistent with the results for Romania.

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[10] In EU accession countries, no specific regional policy was adopted before the end of the 1990s. In Romania and Bulgaria, specific regional development Acts were passed in 1998 and 1999, respectively (Horváth, 2002). As a consequence, our results concerning the behavior of border regions compared with central regions should not be affected by such regional-specific policies.

In Romania MP1, is positive in the first period, and negative in the second and third periods. The MP2 indicator is negative only in the second period. Since no Romanian regions border the EU, the regional variation of MP2 is only due to regional wage disparities and does not depend on distances to the EU market.

Industry-Specific Slopes

The model proposed and estimated by Midelfart-Knarvik et al. (2002) implicitly assumes a selective interaction between industry and country characteristics. Indeed, up to now, we included only region characteristics that we could match with industry characteristics and the interaction terms consistent with the identified match (see Table 2).

As a sensitivity analysis, given the region and industry characteristics that we chose in the previous sections, we re-estimated our model, adding all sorts of interaction terms by multiplying each region characteristic with each industry characteristic. The results of these estimations should coincide with the results that we would obtain by estimating the model separately for each industry group (identified by the industry characteristics: high versus low economies of scale industries and so on).

The results of these further estimations showed almost no significant slope of the interaction terms, and therefore we do not report the results here. One reason for these non-significant results might be the use of data sets that are too small compared with the number of explanatory variables that we tried to estimate.

CONCLUSIONS

In this paper we have investigated patterns of manufacturing location across regions – defined at a NUTS 3 level – in the case of five EU accession countries: Bulgaria, Estonia, Hungary, Romania and Slovenia, over the period 1990-1999.

We examine determinants of manufacturing location by estimating with our regional data an adapted model in the vein of the model proposed and estimated by Midelfart-Knarvik et al. (2002) using EU country data. The model aims to uncover the impact that specific industry and region characteristics have on the regional distribution of manufacturing employment. Our results indicate that manufacturing location patterns are determined by factor endowments and proximity to large markets, in line with the predictions of classical and new trade theories.

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APPENDIX

Table A1. Estimations for Bulgaria

	(1)	(2)	(3)	(4)	(5)	(6)
	1991-1998	1991-1998	1991-1998	1991-1993	1994-1996	1997-1998
Ln(pop)	10.067***	10.067***	0.151***	14.891***	67.918***	26.667***
	(2.797)	(2.816)	(0.043)	(2.692)	(10.728)	(8.127)
MP1	0.000	0.000	0.000	-0.001	-0.001*	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MP2	0.002***	0.002***	-0.000*	0.003***	-0.001	-0.001***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)
RD	-21.409***	-21.409***	23.355***	-4.768	96.276*	-74.979
	(6.704)	(6.549)	(3.140)	(55.925)	(50.036)	(53.492)
LA	3.650***	3.650***	-7.895***	1.518	5.449*	-0.495
	(1.360)	(1.359)	(0.797)	(1.614)	(3.226)	(3.070)
SE		0.013	-0.124	-0.098	-0.093	-0.093
		(0.168)	(0.205)	(0.234)	(0.297)	(0.289)
RO		-0.125	-0.118	-0.097	-0.222	-0.222
		(0.131)	(0.157)	(0.127)	(0.209)	(0.207)
LI		0.201	-4.822***	-1.399	0.879	0.879
		(1.019)	(1.197)	(1.054)	(1.689)	(1.662)
TL		-0.189	-0.210	-0.115	-0.214	-0.214
		(0.118)	(0.142)	(0.099)	(0.178)	(0.175)
MP1SE	0.000	0.000	0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MP2SE	-0.000	-0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
RDRO	6.094	6.094	2.964	6.160	11.779	11.779
	(6.248)	(6.210)	(7.464)	(6.094)	(11.487)	(11.364)
LALI	-0.186	-0.186	7.224***	2.088	-1.095	-1.095
	(1.483)	(1.500)	(1.762)	(1.540)	(2.496)	(2.461)
RDTL	8.798	8.798	7.861	4.794	15.692	15.692
	(6.046)	(6.022)	(8.409)	(6.810)	(10.835)	(10.063)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	No	No	No	No	No
Regional Dummies	Yes	Yes	No	Yes	Yes	Yes

Nr. of obs.	2628	2628	2628	1008	1296	1296
Adj. R^2	0.91	0.91	0.87	0.96	0.90	0.90

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All models include time dummies.

Table A2. Estimations for Estonia

	(1)	(2)	(3)	(4)	(5)
	1995-1999	1995-1999	1995-1999	1995-1996	1997-1999
Ln(pop)	52.880*	53.377*	-0.611***	1112.924	478.086**
	(29.334)	(29.112)	(0.107)	(700.794)	207.745)
MP1	2.847**	2.861**	0.190***	243.570	13.215***
	(1.334)	(1.308)	(0.066)	(172.284)	(2.872)
MP2	-2.703*	-2.719*	0.018	-72.768	-16.276***
	(1.464)	(1.439)	(0.084)	(46.660)	(3.502)
LA	-0.039	-0.039	0.017	-0.008	-0.198
	(0.040)	(0.038)	(0.021)	(0.114)	(0.142)
SE		-0.972	-1.084	0.033	-1.611
		(0.727)	(0.745)	(0.568)	(1.240)
LI		0.393	0.176	0.237	0.487
		(0.616)	(0.646)	(0.664)	(0.875)
MP1SE	-0.077	-0.074	-0.081	-0.037	-0.093
	(0.051)	(0.052)	(0.053)	(0.045)	(0.074)
MP2SE	0.124	0.120	0.134*	0.017	0.176
	(0.077)	(0.078)	(0.081)	(0.062)	(0.126)
LALI	-0.008	-0.008	-0.003	-0.007	-0.009
	(0.015)	(0.015)	(0.016)	(0.015)	(0.023)
Time Dummies	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	No	No	No	No
Regional Dummies	Yes	Yes	No	Yes	Yes
Nr. of Obs.	298	298	298	120	178
Adj. R^2	0.69	0.70	0.67	0.78	0.72

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All models include time dummies.

Table A3. Estimations for Hungary

	(1)	(2)	(3)	(4)	(5)	(6)
	1992-1999	1992-1999	1992-1999	1992-1993	1994-1996	1997-1999
Ln(pop)	-2.301	-2.301	-0.432***	-83.407***	-47.648***	-32.918***
	(1.706)	(1.676)	(0.030)	(10.385)	(8.068)	(9.538)
MP1	0.108	0.108	-0.007	-0.911***	2.757***	-1.005*
	(0.269)	(0.250)	(0.050)	(0.147)	(0.773)	(0.539)
MP2	-0.229	-0.229	0.614***	1.292***	-4.164***	2.016*
	(0.528)	(0.530)	(0.115)	(0.348)	(1.605)	(1.079)
LA	0.003	0.003	-0.007***	0.018***	-0.043**	0.071***
	(0.005)	(0.005)	(0.001)	(0.004)	(0.018)	(0.022)
SE		0.016	-0.127	-0.009	-0.040	0.077
		(0.140)	(0.164)	(0.119)	(0.302)	(0.169)
LI		-0.013	-0.316	0.043	0.069	-0.053
		(0.168)	(0.205)	(0.128)	(0.356)	(0.250)
MP1SE	0.013	0.013	-0.093	-0.019	0.001	0.046
	(0.106)	(0.106)	(0.135)	(0.087)	(0.236)	(0.159)
MP2SE	-0.034	-0.034	0.196	0.035	0.005	-0.112
	(0.229)	(0.229)	(0.289)	(0.193)	(0.531)	(0.341)
LALI	-0.000	-0.000	0.003	-0.000	-0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.001)	(0.005)	(0.003)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	No	No	No	No	No
Regional Dummies	Yes	Yes	No	Yes	Yes	Yes
Nr. of Obs.	1280	1280	1280	320	480	480
Adj. R^2	0.93	0.93	0.92	0.99	0.93	0.95

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All models include time dummies.

Table A4. Estimations for Romania

	(1)	(2)	(3)	(4)	(5)	(6)
	1992-1999	1992-1999	1992-1999	1992-1993	1994-1996	1997-1999
Ln(pop)	-10.297**	-10.297**	-0.230***	63.805**	-100.482***	-14.094
	(4.709)	(4.716)	(0.031)	(32.193)	(18.302)	(13.757)
MP1	-0.001*	-0.001*	0.001***	0.004***	-0.002***	-0.005***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.001)
MP2	0.000	0.000	-0.001**	0.001	-0.005***	0.001
	(0.001)	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)
LA	-7.683***	-7.683***	-10.622***	-16.489***	-2.205	-46.544***
	(2.326)	(2.331)	(1.571)	(5.846)	(4.233)	(8.735)
SE		-0.049	-1.346***	0.029	0.373	-0.173
		(0.457)	(0.512)	(0.818)	(0.598)	(1.167)
LI		0.151	-0.119	0.116	-0.070	0.693*
		(0.159)	(0.178)	(0.306)	(0.178)	(0.372)
MP1SE	0.000	0.000	-0.000	0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MP2SE	0.000	0.000	0.001***	-0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
LALI	-2.062	-2.062	1.303	1.719	0.212	-11.071**
	(2.303)	(2.302)	(2.513)	(4.168)	(2.597)	(5.438)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	No	No	No	No	No
Regional Dummies	Yes	Yes	No	Yes	Yes	Yes
Nr. of Obs.	4264	4264	4264	1066	1599	1599
Adj. R^2	0.88	0.88	0.84	0.93	0.91	0.87

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All models include time dummies.

Table A5. Estimations for Slovenia

	(1)	(2)	(3)
	1994-1998	1994-1998	1994-1998
Ln(pop)	16.565	16.565	-1.281***
	(93.099)	(98.002)	(0.156)
MP1	-0.456	-0.456	0.251***
	(0.647)	(0.561)	(0.035)
MP2	-0.733	-0.733	0.118*
	(0.681)	(0.697)	(0.064)
RD	-4.946	-4.946	54.915***
	(19.530)	(21.073)	(15.776)
SE		-0.775	-3.462***
		(1.023)	(1.143)
RO		0.938	0.516
		(0.574)	(0.649)
TL		1.174**	0.287
		(0.493)	(0.513)
MP1SE	0.051	0.051	0.110**
	(0.047)	(0.042)	(0.045)
MP2SE	-0.038	-0.038	0.209**
	(0.090)	(0.093)	(0.105)
RDRO	2.840	2.840	25.413
	(18.180)	(18.087)	(20.977)
RDTL	-48.733***	-48.733***	-14.581
	(17.814)	(18.641)	(20.901)
Time Dummies	Yes	Yes	Yes
Industry Dummies	Yes	No	No
Regional Dummies	Yes	Yes	No
Nr. of Obs.	504	504	504
Adj. R^2	0.77	0.76	0.66

Robust standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All models include time dummies.