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Determinants of Manufacturing Location in EU Accession Countries

Iulia Traistaru[a] Peter Nijkamp[b] and Simonetta Longhi[c]

[a] Center for European Integration Studies, University of Bonn, Walter Flex Str., 3 D-53113 Bonn, e-mail: traistar@united.econ.uni-bonn.de

[b] Department of Spatial Economics, Free University of Amsterdam, De Boelelaan 1105, 1085 HV Amsterdam, e-mail: pnijkamp@feweb.vu.nl

[c] Department of Spatial Economics, Free University of Amsterdam, De Boelelaan 1105, 1085 HV Amsterdam , e-mail: slonghi@feweb.vu.nl

Abstract

Since 1990, Central and East European economies have increased their integration with the European Union via trade and foreign direct investments. The spatial implications of this process have not been investigated in-depth so far. Has a relocation of manufacturing activity taken place? Have patterns of regional specialization and industrial concentration changed over the last decade? How does regional specialization relate to economic performance? What are the determinants of industrial location patterns? This paper identifies and explains the effects of economic integration on patterns of regional specialization and the geographic concentration of manufacturing in Bulgaria, Estonia, Hungary, Romania and Slovenia. Using a specially created data base, we find evidence of regional relocation of industries, leading to higher average regional specialization in Bulgaria and Romania and lower average regional specialization in Estonia. In Hungary and Slovenia the average regional specialization has not changed significantly. Our results indicate that both factor endowments and geographic proximity to European markets determine the location of manufacturing in accession countries.

Keywords: Sectoral specialization, Location of industrial activity, Accession countries

JEL classification: F15, R11, R12

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1 Introduction

The emerging economies in accession countries will most likely exhibit a high degree of spatial economic dynamics in the years to come, especially if they are increasingly exposed to market forces. The question is whether various regions or industries in these countries have anticipated this transformation, and whether they are already showing the first signs of a shift in their spatial-economic base. Thus, industries may demonstrate a different pattern of regional localization, or alternatively, specific regions may be able to attract new industries. This would mean a drastic change in the location patterns of industries, reflected in changes in the spatial concentration of sectors or firms and in the regional concentration of various industries. The available theoretical frameworks on location of industrial activity and regional growth are not always conclusive, nor are individual country reports from the accession countries. Additional empirical research is therefore needed for a better understanding of the patterns and changes of regional specialization and location of industrial activity in the accession countries.

How specialized/diversified are regions in accession countries? How concentrated/dispersed are industries? Have patterns of regional specialization and geographical concentration of industries changed over the period from 1990-1999? What are the determinants of patterns of industrial location?

The aim of this paper is to identify, explain and compare patterns of regional specialization and location of manufacturing activity in five accession countries, namely, Bulgaria, Estonia, Hungary, Romania and Slovenia.

This paper is the first comparative analysis of patterns of regional specialization and geographical concentration of manufacturing activity in accession countries. Our research results suggest that, in the five accession countries included in

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this study, regional relocation of industries has taken place, leading to increasing regional specialization in Bulgaria and Romania and decreasing regional specialization in Estonia. Regional specialization has not changed significantly in Hungary and Slovenia. We find empirical evidence indicating that both factor endowments and geographic proximity to European markets determine the location of manufacturing in accession countries.

The remainder of this paper is organized as follows. Section 2 discusses the theoretical framework and existing empirical evidence on specialization of countries and regions and geographical concentration of industries. Section 3 gives an overview of the data set and measures used for our analysis. Section 4 analyses patterns of regional specialization in the five accession countries, while Section 5 discusses the geographical concentration of manufacturing in the same countries. Section 6 presents the results of our econometric analysis on determinants of the location of manufacturing activity in the five accession countries included in this study. Section 7 concludes.

2 Analytical Framework

2.1 Theoretical Background

Existing international trade theory about the impact of economic integration on specialization and location of industrial activity could be grouped into three strands of literature.[1] While offering different explanations of patterns of specialization, all three theoretical approaches predict increasing specialization as a result of trade liberalization and economic integration. Neo-classical trade theory explains patterns of specialization on the basis of differences in productivity (technology) or endowments across countries and regions while new trade theory and, more recently, new economic geography models underline increasing returns in production, agglomeration economies and cumulative processes as explanations for the concentration of activities in particular countries and regions.

Neo-classical trade theory explains specialization patterns through differences in relative production costs termed ‘comparative advantages’ resulting from differences in productivity (technology) (Ricardo, 1817) or endowments (Heckscher, 1919; Ohlin, 1933) between countries and regions. The main features of these models are: perfect competition, homogeneous products and constant returns to scale. The neo-classical theory predicts that trade liberalization and economic integration will result in production re-location and increasing specialization according to comparative advantages. The consequent changes in demands for factors of production will tend to equalize factor prices across countries and regions. A large portion of inter-industry specialization can be explained by neo-classical trade models (see Leamer and Levinsohn, 1995). While relevant,

[1] Recent surveys of theoretical literature include: Amiti (1998a), Venables (1998), Brülhart (1998), Aiginger et al. (1999), Hallet (2001) and Puga (2002).

comparative advantage is, however, not sufficient as the sole explanation for specialization. In reality, different production structures are found in regions and countries with similar factor endowments and production technologies. Trade between industrialized countries consists mainly of goods in the same product category, i.e., it is intra-industry trade.

During the 1980s, new trade theory models were developed, mainly for explaining intra-industry trade (Krugman, 1979, 1980, 1981; Helpman and Krugman, 1985; Krugman and Venables, 1990). The main assumptions in these models are increasing returns to scale, product differentiation and imperfect (monopolistic) competition. The new trade theory models focus on the interactions between firms with increasing returns in product markets and explain patterns of specialization and location of industrial activity in terms of the geographical advantage of countries and regions with good market access. When trade barriers fall, activities with increasing returns will locate in countries/regions with good market access ('the center') moving away from remote countries/regions ('the periphery'). Krugman and Venables (1990) suggest that geographical advantage will be greatest at some intermediate trade cost, i.e., the relationship between trade costs and the location of activity has an inverse U-shape. When trade barriers and transport costs are small enough, the geographical advantage of the regions with good market access becomes less important. At this stage, factor production costs will motivate firms to move back to peripheral regions.

The prediction of new trade theory regarding the distribution of economic activity between the core and periphery is relevant in the case of the accession of Central and East European countries to the European Union. The current economic integration situation could be seen as one with 'intermediate trade costs'. Further integration could result in the relocation of manufacturing towards these countries due to factor costs considerations (Hallet, 1998).

The new economic geography models assume that the geographical advantage of large markets is endogenous and suggest that specialization patterns may be the result of the spatial agglomeration of economic activities (Krugman, 1991a, 1991b; Krugman and Venables, 1995, Venables, 1996). The main assumptions of these models are the presence of pecuniary or technological externalities between firms, monopolistic competition and increasing returns to scale. Krugman's analysis focuses on a two sector-two region model similar to that of Krugman and Venables (1990). Unlike in the latter model, the two regions are identical in terms of initial factor endowments and the factor specific to manufacturing (industrial workers) is mobile across regions. Relocation of firms and workers from one region to the other triggers agglomeration via the cumulative effects of demand linkages. With no barriers to the movement of firms or manufacturing workers (like in the Krugman, 1991b model), a bleak scenario could be imagined: the manufacturing sector in the 'donor' region would collapse and manufacturing would concentrate in the 'receiving' region. This scenario could develop gradually following the lowering of trade costs. Initially, when trade costs are high, manufacturing is evenly split between regions (each region produces for its own local market). If trade costs are sufficiently low, demand linkages bring about the agglomeration of activities. Regions with an initial scale advantage in particular sectors would attract more manufacturing activity and thus reinforce their advantage in those sectors. Krugman and Venables (1995) extend these models to include firms with 'supply-side linkages'. Manufacturing firms locate in a region where they benefit from access to suppliers providing specialized inputs.

These new economic geography models imply that, in sectors where supply-side and demand-side linkages are important, European integration would bring massive specialization and concentration. Given the extremely low inter-EU country mobility, this result seems, however, unrealistic (Eichengreen, 1993; Obstfeld and Peri, 1998). Agglomeration effects might still be present if there is sufficient labor mobility within EU countries. In this case, we could observe agglomeration effects emerging around border regions similar to those identified by Hanson (1996, 1997a) for the case of US - Mexican economic integration.

2.2 Empirical Evidence

Empirical literature on the impact of economic integration on production specialization and geographic concentration of industries is still scarce. The most interesting studies have focused on the United States (US) and the European Union (EU) and have established the following stylized facts:

a) Regional specialization and industrial concentration are higher in the US than in the EU (Krugman, 1991a; Midelfart-Knarvik et al, 2000).
b) Production specialization has increased in EU Member States while trade specialization has decreased (Sapir, 1996; Amiti, 1997; Haaland et al, 1999; Aiginger et al, 1999; Midelfart-Knarvik et al, 2000, Brülhart, 1996, 2001).
c) Slow-growing and unskilled labor-intensive industries have become more concentrated in the EU (Midelfart-Knarvik et al, 2000).
d) Medium and high technology industries have become more dispersed in the EU (Brülhart, 1998, 2001).
e) Industries with large economies of scale were concentrated close to the European core during the early stages of European integration but have become more dispersed during the 1980s (Brülhart, 1998, Brülhart and Torstensson, 1996).

In a series of papers, Hanson has assessed the locational forces identified by the new economic geography models in the context of US - Mexican integration. Hanson (1996) finds evidence that agglomeration is associated with increasing returns, and shows that integration with the US has led to a relocation of Mexican industry away from Mexico City and towards states with good access to the US market. This is reflected in the falling importance of distance from the capital and the rising importance of distance from the border in explaining interregional wage differentials (Hanson, 1997a, 1997b, 1998). Employment has grown more in regions that have larger agglomerations of industries with buyer/supplier relationships, suggesting that integration has made demand and cost linkages important determinants of industrial location.

Ellison and Glaeser (1997) analyze the geographic concentration of US manufacturing industries. Using a model that controls for industry characteristics, they find that almost all industries seem to be localized. Many industries are, however, only slightly concentrated and some of most concentrated industries are related to natural advantages.

With respect to Europe, Brülhart (1996) and Brülhart and Torstensson (1996) study the evolution of industrial specialization patterns in 11 EU countries (all except Luxembourg and the more recent member states of Austria, Finland, and Sweden) between 1980 and 1990. They find support for the U-shaped relationship between the degree of regional integration and spatial agglomeration predicted by the theoretical models when labor mobility is low: activities with larger scale economies were more concentrated in regions close to the geographical core of the EU during the early stages of European integration, but concentration in the core fell during the 1980s.

Using production data in current prices for 27 manufacturing industries, Amiti (1999) finds that there was a significant increase in specialization between 1968 and 1990 in Belgium, Denmark, Germany, Greece, Italy, and the Netherlands; no significant change occurred in Portugal; and a significant fall in specialization occurred in France, Spain and the UK. There was a significant increase in specialization between 1980 and 1990 in all countries. With more disaggregated data (65 industries) the increase in specialization is more pronounced: the average increase is two per cent for all countries except Italy, compared to one per cent in the case with 27 manufacturing industries. Other evidence of increasing specialization in EU countries in the 1980s and 1990s based on production data is provided by Hine (1990), Greenway and Hine (1991), Aiginger et al. (1999), and Midelfart-Knarvik et al. (2000). However, analyses based on trade data indicate that EU Member States have a diversified rather than specialized pattern of manufacturing exports (Sapir, 1996; Brülhart, 2001).

In terms of the geographic concentration of industries, Amiti (1999) finds that 17 out of 27 industries experienced an increase in geographical concentration, with an average increase of three per cent per year in leather products, transport equipment and textiles. Only six industries experienced a fall in concentration, with paper and paper products and 'other chemicals' showing particularly marked increases in dispersion. Brülhart and Torstensson (1996) compare industry Gini coefficients with the industry centrality indices proposed by Keeble et al. (1986) and find a positive correlation between scale economies and industry bias towards the central EU in both 1980 and 1990. Brülhart (1998) finds that industries such as chemicals and motor vehicles that are highly concentrated and located in central EU countries are subject to significant scale economies. Midelfart-Knarvik et al. (2000) find that many industries have experienced significant changes in their location across EU Member States during the period 1970-1997. Slow-growing and unskilled labor-intensive industries have become more concentrated, usually in peripheral low wage countries. During the same period, a number of medium and high technology industries have become more dispersed.

With respect to accession countries, existing evidence based on trade statistics suggests that these countries tend to specialize in labor- and resource-intensive sectors, following an inter-industry trade pattern (Landesmann, 1995). Despite the dominance of the inter-industry (Heckscher-Ohlin) type of trade, intra-industry trade has also increased, most evidently in the Czech Republic and Hungary (Landesmann, 1995, Dobrinsky, 1995). This increase, however, may be associated with the intensification of outward processing traffic. It has been claimed that the processes of internationalization and structural change in transition economies tend to favor metropolitan and western regions, as well as regions with a strong industrial base (Petrakos, 1996). In addition, at a macro-geographical level, the process of transition is expected to increase disparities at the European level, by favoring countries near the East-West frontier (Petrakos, 2000). Increasing core-periphery differences in Estonia are documented in Raagmaa (1996). Using the 'new economic geography' approach, Altomonte and Resmini (1999) have investigated the role of foreign direct investment in shaping regional specialization in accession countries.

Yet to date, there has been no comprehensive study of the impact of economic integration with the European Union on regional specialization and geographic concentration of industrial activity in accession countries.

3 Data and Measurement

In this paper we analyze patterns of regional specialization and concentration of manufacturing and their determinants using regional manufacturing employment data and other variables at the NUTS 3 level for Bulgaria, Estonia, Hungary, Romania and Slovenia. The employment data and the other regional variables are part of a specially created data set called REGSTAT.[2] Apart from employment, other variables at the regional level used in our analysis include: geographic and demographic variables, average earnings (wages), Gross Domestic Product (GDP), measures of infrastructure, research and development (R&D), and public expenditures.

The period covered is 1990-1999. In most cases, data have been collected from national statistical offices. In the case of Estonia, employment data at the regional level has been estimated using labor force surveys. In Slovenia, employment data at the regional level has been estimated using the information provided in the balance sheets of companies with more than ten employees.

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

Box 1. Indicators of regional specialization and geographical concentration of industries[3]

E = employment
s = shares
i = industry (sector, branch)
j = region

s_{ij}^{S} = the share of employment in industry i in region j in the total employment of region j
s_{ij}^{C} = the share of employment in industry i in region j in the country employment of industry i
s_i = the share of country employment in industry i in total country employment
s_j = the share of the total employment in region j in country employment

$$s_{ij}^{S} = \frac{Eij}{Ej} = \frac{Eij}{\sum_i Eij} \qquad s_{ij}^{C} = \frac{Eij}{Ei} = \frac{Eij}{\sum_j Eij}$$

$$s_i = \frac{Ei}{E} = \frac{\sum_j Eij}{\sum_i \sum_j Eij} \qquad s_j = \frac{Ej}{E} = \frac{\sum_i Eij}{\sum_i \sum_j Eij}$$

The dissimilarity index

Specialization measure

$$SPEC_j = \sum_i \left| s_{ij}^{S} - s_i \right|$$

Concentration measure

$$CONC_i = \sum_j \left| s_{ij}^{C} - s_j \right|$$

Regional specialization and geographical concentration of industries are defined in relation to production structures[4]. In absolute terms, a region j is 'specialized' in a

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[3] The indicators used in this paper to analyze regional specialization and concentration of industries are defined in a way that is similar to Aiginger, K. et al. (1999). The dissimilarity index is a modified version of the index proposed in Krugman (1991b).

[4] Overviews of different measurements for specialization and geographic concentration of industries include Ellison and Glaeser (1997), Aiginger et al. (1999), Devereux et al. (1999) and Hallet (2000).

specific industry *i* if this industry has a high share in the manufacturing activity of region *j*. The manufacturing structure of a region *j* is 'highly specialized', if a small number of industries have a large combined share in the total manufacturing of region *j*. In relative terms, regional specialization is defined as the distribution of the shares of an industry *i* in total manufacturing in a specific region *j* compared to a benchmark.

In absolute terms, a specific industry *i* is 'concentrated', if a large part of its production is carried out in a small number of regions. In relative terms, geographical concentration of industries is defined as the distribution of the shares of regions in a specific industry *i* compared to a benchmark.

Several absolute and relative measures of specialization and concentration are proposed in the existing literature, each having certain advantages as well as shortcomings. For our analysis we have selected a relative measure (a dissimilarity index derived from the index proposed by Krugman, 1991a). Notations and definitions are given in Box 1.

4 Specialization of Regions

How specialized/diversified are regions in accession countries? Have patterns of regional specialization changed during the 1990s? What is the relationship between regional specialization and economic performance?

Increasing economic integration with the EU and the world economy are likely to result in the relocation of industrial activity and changing specialization patterns across regions in accession countries. In order to check whether regional specialization has changed significantly in the countries under analysis, we have estimated the following trend model:

$$SPEC_{jt} = \alpha + \beta * t + \varepsilon_{jt} \qquad (1)$$

where the dependent variable $SPEC_{jt}$ is regional specialization in region *j* at time *t* measured by means of the dissimilarity index (see Box 1) using employment data on manufacturing branches at the NUTS 3 regional level. The independent variable *t* is the year to which the data refers, α and β are the parameters to be estimated, and ε_{jt} is the remaining error term.

The trend model has been estimated separately for each country. The results of the OLS estimation with regional fixed effects are shown in Table 1.

Table 1 Regional specialization in accession countries, 1990-1999

	Bulgaria	Estonia	Hungary	Romania	Slovenia
t	0.0068 ***	-0.0073 **	-0.0019	0.0074 ***	-0.0023
	(0.0011)	(0.0033)	(0.0019)	(0.0012)	(0.0061)
Intercept	0.4488 ***	0.4756 ***	0.4638 ***	0.5405 ***	0.7050 ***
	(0.0067)	(0.0202)	(0.0132)	(0.0077)	(0.0462)
Number of obs.	280	50	160	369	48
R-sq: within	0.1383	0.1029	0.0074	0.1086	0.0039

* significant at ten per cent; ** significant at five per cent; *** significant at one per cent.
Standard errors in parentheses.

The above table shows that, on average, regional specialization in the 1990s increased in Bulgaria and Romania, and decreased in Estonia. The estimated coefficient for *t* is not significantly different from zero for Hungary and Slovenia.

The increasing integration of accession countries with the EU may have decreased the importance of internal regions in favor of regions bordering the EU and other accession countries, which were probably less favored in the past. In order to validate this hypothesis, we have classified the regions into the following groups: internal regions (INT), regions bordering the EU (BEU), regions bordering other accession countries (BAC), and regions bordering countries outside the EU enlargement (BEX)[5].

Tables A1 - A5 show summary statistics for the five accession countries for the specialization of regions as well as economic performance for each of the above groups of regions scaled by the national averages[6] at the beginning and end of the analyzed period.

We find that regions bordering the EU are less specialized than the national specialization average in countries closer to the EU accession such as Estonia, Hungary and Slovenia, while they are more specialized in Bulgaria. Regions bordering other accession countries are found more specialized compared to the national averages in Hungary, while in Estonia, Bulgaria and Romania these type of regions are less specialized. Regions bordering countries outside the EU enlargement area are more specialized, with the exception of Romania. Internal (non-border) regions are less specialized in Bulgaria and Hungary and more specialized in Romania and Slovenia.

With a few exceptions, high specialization is associated with inferior economic performance, while regions with low specialization perform better than the national averages. High specialization is associated with superior economic per-

[5] This classification is based on Eurostat (1999). Also see chapter 10 of this book.
[6] National averages are calculated without the capital regions.

formance in regions bordering countries outside the EU enlargement area in Bulgaria and Slovenia, while lower specialization is associated with inferior economic performance in regions bordering countries outside the EU enlargement area in Romania and in internal regions in Bulgaria.

In summary, our findings suggests that highly specialized regions show an economic performance that is inferior to national averages, while less specialized regions have better economic performance. Over the last decade, regional specialization has increased significantly in Bulgaria and Romania, has decreased in Estonia, and has not changed significantly in Hungary or Slovenia. Proximity to the EU is associated with low specialization in advanced accession countries (Estonia, Hungary and Slovenia) and high specialization in countries lagging behind with the accession (Bulgaria). Proximity to other accession countries is associated with low specialization in Bulgaria, Estonia and Romania, and with high specialization in Hungary. Proximity to countries outside the EU enlargement area is associated with high specialization in Hungary, Bulgaria and Slovenia and with low specialization in Romania. Internal regions have high specialization in Romania and Slovenia and low specialization in Hungary and Bulgaria.

5 Geographical Concentration of Manufacturing

On the basis of the concentration indices calculated for manufacturing branches in Bulgaria, Estonia, Hungary, Romania and Slovenia, we have grouped the industries according to the following characteristics: scale economies, technology levels, and wage levels. The definitions of high-medium-low technology levels, and of high-medium-low wage levels are based on OECD (1994); the definition of high-medium-low levels of scale economies is based on Pratten (1988). The manufacturing classification is according to the Eurostat NACE Rev1 (two-digit classification) for Estonia, Romania, and Slovenia. Employment data have been collected according to national classifications in Hungary and Bulgaria. For these two cases, aggregations have been made to bring these classifications as close as possible to the NACE classification.

Table A6 shows the concentration indices, normalized with the national averages of geographical manufacturing concentration for each of the six industry groups and identified according to the above classifications for Bulgaria, Estonia, Hungary, Romania and Slovenia. We find that industries with low economies of scale had a level of concentration that was stable and very close to the national average in Bulgaria and Romania. In Estonia these sectors were less concentrated than the national average, while in Hungary and Slovenia they were slightly more concentrated than the national average. Slovenian industries belonging to this group were also experiencing a decrease in their level of concentration. The industries with medium economies of scale were below the national average in Bulgaria, Hungary and Slovenia, while they were slightly above the average in Estonia and Romania. In all cases, the level of concentration of these industries seemed to be stable or slightly increasing. Finally, the industries with high economies of scale were much more concentrated than average in all countries. Concentration of these industries seemed to be decreasing slightly, with the exception of Slovenia, in which it seemed to be increasing. In Romania all industries seemed to have the same level of concentration (around the national average); the differences among groups of industries were much more evident for the other countries.

Industries defined as low-tech were usually less concentrated than the national average in all countries, although their level of concentration seems to have increased. The industries defined as medium tech seem to be more concentrated than the average and stable or slightly decreasing in Bulgaria, Estonia and Hungary. In Romania and Slovenia, these industries were as concentrated as the national average, and their level of concentration was stable (in Romania) or increasing (Slovenia). Finally, high-tech industries were less concentrated than the national average in Bulgaria, Hungary and Slovenia. Their level of concentration seemed to be stable or to be increasing (Bulgaria). In Estonia and Romania these industries were more concentrated than the national average. They seemed to become even more concentrated in Estonia, while their level of concentration seemed to be stable or slightly decreasing in Romania.

Industries with the lowest level of wages were the most dispersed ones. Their level of concentration seemed to be stable or slightly increasing. On the other hand, the industries with the highest level of wages were more concentrated than the national average, and their level of concentration seemed to be stable or slightly decreasing. In conclusion, the evidence seems to be in favor of a convergence of concentration levels. The medium-wage industries had a level of concentration that was not far from the national average. Our results suggest that their concentration has increased in Hungary, decreased in Bulgaria and remained stable in the other countries.

Our analysis has been based on the available data for ten years for Bulgaria and Estonia, nine years for Romania, eight for Hungary and only four for Slovenia. We might not, therefore, be able to capture the impact of regional business cycles on concentration patterns.

At the aggregate level, increasing economic integration with the EU is expected to change patterns of location and concentration of industrial activity in accession countries. In order to check whether patterns of manufacturing concentration have changed significantly, we have estimated the following model:

$$CONC_{it} = \alpha + \beta * t + \varepsilon_{it} \qquad (2)$$

where the dependent variable $CONC_{it}$ is the level of concentration of manufacturing activity in industry i at time t, calculated by means of the dissimilarity index using employment data on manufacturing branches at the NUTS 3 regional level. The independent variable t is the year to which the data refers, α and β are the parameters to be estimated, and ε_{it} is the remaining error term.

The model has been computed separately for each country, using an OLS with industry fixed effects estimation method. The results shown in Table 9.2 indicate that concentration of manufacturing did not change significantly in these countries, with the exception of Bulgaria, in which it increased.

Table 2 Geographical concentration of manufacturing in accession countries, 1990-1999

	Bulgaria	Estonia	Hungary	Romania	Slovenia
t	0.0092***	0.0037	-0.0003	0.0015	-0.0011
	(0.0014)	(0.0037)	(0.0275)	(0.0017)	(0.0061)
Intercept	0.4945***	0.4481 ***	0.4690 ***	0.6342 ***	0.6367 ***
	(0.0090)	(0.023)	(0.0189)	(0.0111)	(0.0465)
Num. of obs.	120	130	64	108	48
R-sq: within	0.2773	0.0083	0.0002	0.0077	0.0010

* significant at ten per cent; ** significant at five per cent; *** significant at one per cent.
Standard errors in parentheses.

In summary, highly concentrated industries are those with large economies of scale, medium and high technology and high wages. Industries with low technology levels and low wages are dispersed. Geographical concentration of manufacturing has increased significantly in Bulgaria and has not changed significantly in the rest of the accession countries analyzed here.

6 Determinants of Manufacturing Location

As pointed out in Midelfart-Knarvik et al. (2000), regional specialization and industrial concentration patterns are determined by the interaction of regional and industry characteristics. Regions differ in size, factor endowments and their geographic position (core or peripheral). Industries differ with respect to economies of scale and factor intensities. The reason for evaluating the interaction between regional and industry characteristics lies in the fact that firms evaluate the same kind of production factors differently (Fujita et al., 1999). Industries will try to locate as close as possible to the place where their most important inputs are available, and will therefore be over-represented in that location. Industries for which the same production factor is less important will instead be under-represented.

To uncover determinants of manufacturing location and explain regional manufacturing production structure differentials in the five accession countries, we estimate a model similar to the model estimated in Midelfart-Knarvik et al. (2000) for EU Member States. We analyze determinants of manufacturing location by regressing the log share of industry *i* in region *j* (s_{ij}^{S}) on regional and industry characteristics, after controlling for the size of regions by means of the log share of the population living in region *j* (pop_j) and of the log share of total manufacturing employment located in region *j* (man_j). We use the following specification:

$$ln\ (s_{ij}^{S}) = c + \alpha\ ln\ (pop_j) + \beta\ ln\ (man_j) + \Sigma_k\ \beta\,[k]\ (y[k]_j - \gamma\,[k])\ (z[k]^i - \kappa\,[k]) \quad (3)$$

where $y[k]_j$ is the level of the k^{th} region characteristic in the j^{th} region and $z[k]^i$ is the level of the k^{th} industry characteristic of industry *i*. As is clear in (3), the k^{th} region characteristic is matched with the k^{th} industry characteristic. Finally, α, β, $\beta\,[k]$, $\gamma\,[k]$, and $\kappa\,[k]$ are the coefficients to be estimated. We have computed the share of industry *i* in region *j* (s_{ij}^{S}) using employment data.

Table 3. Regional and industry characteristics

Variable name	Description
	Regional characteristics
Market Potential (MP1)	Average regional wages (deflated at national level) divided by the distances from country capital (in km.)
Market Potential (MP2)	Average regional wages (deflated at a national level) divided by a proxy of the distance from EU markets (one if the region borders the EU, two if the region does not border the EU)
R&D (RD)	R&D personnel divided by the number of persons employed for Bulgaria and Hungary; R&D expenditures divided by the value added in manufacturing for Slovenia; no information is available for Estonia and Romania
Labor Abundance (LA)	Sum of employment and unemployment, divided by the population of working age (15-65 years)
	Industry characteristics[7]
Scale economies (SE)	1 = low, 2 = medium, 3 = high (definition by Pratten, 1988)
Research Oriented (RO)	1 = almost none of the industries of the sector are defined as research oriented; 2 = some industries of the sector are defined as research oriented; 3 = almost all industries of the sector are defined as research oriented (definition by OECD, 1994)
Technology Level (TL)	1 = Low technology; 2 = Medium technology; 3 = high technology (definition by OECD, 1994)
Labor Intensity (LI)	Labor Intensity dummy (definition by OECD, 1994)

The first two variables appearing on the right hand side (ln (pop_j) and ln (man_j)) capture regional size effects and are therefore needed to correct for the differences in the size of regions. The remaining terms capture the influence of regional and industry characteristics and their interactions. Details of regional and industry characteristics are shown in Table 3.

After having defined the regional and the industry characteristics, we interacted them as shown in Table 4.

[7] Since the available classification of industries is quite aggregated we were sometimes forced to 'average' the qualitative characteristics proposed by Pratten (1988) and by the OECD (1994).

The market potential (MP) characteristic – which has been interacted with the level of scale economies (SE) – may be interpreted as an indicator of proximity to markets. We computed two market potential indicators: the first one (MP1) intends to compare regions inside the same country in the context of a closed economy, while with the second indicator (MP2), we try to get some insights into the consequences of the increasing relationship between each country and the EU. It is plausible that the association agreement with the EU has led to a reduction of the cost of transport into the EU by reducing trade barriers, while transport costs within the country have probably remained unchanged. This had probably favored regions bordering the EU in comparison to central regions, which had had a favorable position before the EU accession agreements. The MP2 variable is used to verify whether increasing integration with the EU has led to a reallocation of activity (industries) from central regions to those bordering the EU. We introduced the two market potential variables (MP1 and MP2) in two different models in order to keep the two hypotheses (closed versus open economy) separated.

The labor abundance (LA) and the research and development (RD) characteristics are used to identify the relative regional abundance of these different input factors. The RD characteristic is then alternatively interacted with the technology level (TL) and with the importance of R&D inputs in each industry (RO), while the labor abundance (LA) characteristic is interacted with the importance of labor as a production factor (LI).

Table 4. Interaction variables

	Variable name	Regional characteristic	Industry characteristics
J=1	MP1SE	MP1 Market Potential (distances from country capital)	SE Scale economies
J=2	MP2SE	MP2 Market Potential (distances with EU markets)	SE Scale economies
J=3	RD1RO	RD1 RD2 = RD R&D personnel or expenses	RO Research oriented
J=4	RD2TL		TL Technology level
J=5	LALI	LA labor abundance	LI Labor intensity

The two industry characteristics associated with the R&D regional characteristic – research orientation (RO) and technology level (TL) – may in principle seem very similar. However, the industries listed as RO are not the same industries listed as TL. Furthermore, their significance level did not change when we tried to set one of them aside in our estimations.

The interaction variables MP1SE and MP2SE should be interpreted on the basis of the idea that industries with higher economies of scale may tend to concentrate in relatively central locations (Krugman, 1980; Midelfart-Knarvik et al., 2000). Since we expect the central location to be identified as the country capital in the early nineties and as the EU market in the most recent years, we expect the MP1SE and MP2SE variables to capture these changes.

The interaction variables RDRO, RDTL and LALI should be interpreted on the basis of the idea that industries that highly value some production factors (R&D for research-oriented firms and firms with a high technology level; labor abundance for labor-intensive firms) tend to locate in areas in which these production factors are abundant.

After this short illustration of the variables introduced in our estimations, we may now briefly discuss some estimation issues. First of all, since the data collected in the different countries are quite heterogeneous, we estimated equation (3) separately for each country using OLS with White's heteroskedasticity consistent standard errors. The main findings are summarized in Table 5. Detailed estimation results are shown in Tables A7 - A11.

Table 5 Summary of the estimations' findings

		Bulgaria		**Estonia**		**Hungary**		**Romania**		**Slovenia**	
	lnpop	0	0	0	pos.	pos.	pos.	pos.	0	pos.	pos.
	lnman	pos.	pos.	neg.	pos.$^{+}$	0	0	pos.	pos.	0	0
Regional	MP1	0	/	neg.	/	neg.	/	neg.	/	neg.	/
characteristics	MP2	/	0	/	neg.	/	neg.	/	neg.	/	0
-β[k]κ[k]	RD	0	0	/	/	/	/	/	/	0	0
	LA	0	0	pos.	pos.	neg.	neg.	neg.	pos.	/	/
Industry	SE	neg.	0	0	neg.	pos.	0	neg.	neg.	0	0
characteristic	RO	pos.	pos.	/	/	/	/	/	/	neg.	neg.
-β[k]γ[k]	LI	0	0	0	0	0	0	0	0	/	/
	TL	pos.	pos.	/	/	/	/	/	/	pos.	pos.
Interaction	MP1SE	pos.	/	0	/	pos.	/	pos.	/	pos.	/
variables	MP2SE	/	0	/	pos.	/	pos.	/	pos.	/	0
β[k]	RDRO	0	0	/	/	/	/	/	/	pos.	pos.
	LALI	0	0	pos.	pos.	pos.	pos.	pos.	pos.	/	/
	RDTL	0	0	/	/	/	/	/	/	neg.	neg.

The first column represents the results for the model using MP1 for market potential and the second column using MP2 for market potential.
(pos.) indicates that the estimated coefficient is significant and positive; (neg.) indicates that the estimated coefficient is significant and negative. (/) the variable was not available (or was not used) for the model estimation; (0) the variable was never significant; (+) the variable was significantly negative in the first period and significantly positive in the last period.

We estimated our models using yearly data. The first reason for this choice is the limited time period covered by our data set. Secondly, regional differences in business cycles are smaller than differences that may be observed among countries. Finally, this approach may enable us to better identify structural breaks that may occur in our data set (e.g., we may be better able to distinguish between trends before and after certain EU agreements).

As shown in Table 5, the first two independent variables of the model (ln(pop) and ln(man)), which capture the effect of the analyzed regions' different sizes, are higher than zero or are not significant (with the exception of the results for Estonia which are significantly negative), confirming that larger regions have larger shares of industrial activity.

The regional characteristics have, in general, the expected signs. We find that the market potential variables – MP1 and MP2 - are positively and significantly related to industry shares (s_{ij}^{S}). Since MP1 and MP2 are decreasing with distance from the core markets, this result suggests that industry shares (s_{ij}^{S}) are higher in regions that are located near the core.

The labor abundance (LA) regional characteristic has negative coefficients, confirming that labor abundant regions have larger shares of industries. In Estonia, the LA coefficient is, however, significantly positive, while in Romania, the co-efficient of LA is negative when we use MP1 and positive when we use MP2.

Industry characteristics (see Table 5) have, in general, the expected signs. With the exception of Hungary, industries with economies of scale are positively and significantly correlated with the shares of industries. Research-oriented industries seem to be concentrated in Slovenia but dispersed in Bulgaria. The technology level (TL) coefficient is either not significant or is positive, although its significance level seems to decrease. Finally, the labor intensity (LI) coefficient is, in general, not significant.

The coefficients of the market potential variables interacted with scale economies are either positive or not significant. While in Hungary and Romania, both MP1SE and MP2SE seem to be significantly higher than zero, in Bulgaria and Slovenia only MP1SE is significantly positive. In Estonia the only coefficient that seems to be positive is MP2SE. Theory predicts that market forces induce industries with high returns to scale to locate near the core, and that these forces are stronger with intermediate levels of transport costs. Although, as mentioned above, more research is needed to better identify the variables influencing the location of manufacturing in EU accession countries, the fact that these forces are not weakening in the countries and over the period of our analysis supports the idea that the transport costs are still at an intermediate level.

The coefficients of the interacted variables RDRO and RDTL have been estimated only for Bulgaria and Slovenia. While for Bulgaria both coefficients do not seem to be significantly different from zero, for Slovenia RDRO becomes significantly positive and RDTL becomes (slightly) significantly negative in the last year (1997). The positive coefficient points out the importance of the supply of researchers in determining the location of research-oriented (RDRO) industries, and is more relevant than for high technology (RDTL) industries. Finally, the coefficient of the interaction variable LALI is either zero (Bulgaria) or positive

(Hungary, Romania and, to a lesser extent, Estonia). In Hungary and Romania the coefficient was increasing its significance level during the last periods of observation. We may interpret this finding as support for the idea of country specialization in more labor-intensive industries.

Location shifts take place very slowly and a long time series' worth of data is usually necessary in order to appreciate real changes in industrial relocation and regional specialization. Given the 'young' age of the five accession countries and their data sets, more research is still needed to be able to assess the changes in relocation that their 'transition' is implying.

7 Concluding Remarks

Since 1990, Central and East European economies have experienced increasing economic integration with the world economy, in particular with the EU via trade and foreign direct investments. The spatial implications of this process have not been investigated in-depth so far. In this paper, we have analyzed regional specialization and manufacturing concentration patterns in Bulgaria, Estonia, Hungary, Romania and Slovenia.

Our findings suggest that high specialization of regions is associated with proximity to accession countries and advanced accession, with proximity to EU markets and lagged accession and with proximity to countries outside the EU enlargement area. Low specialization relates to proximity to EU markets and advanced accession and to proximity to accession countries and lagged accession. Regional specialization has increased in Bulgaria and Romania, decreased in Estonia and has not significantly changed in Hungary and Slovenia. Highly specialized regions show inferior economic performance with respect to the national averages, while diversified regions perform better than the national averages.

With respect to manufacturing concentration patterns, we find that highly concentrated industries are those with large economies of scale, high technology and high wages. Industries with low technology and low wages appear to be dispersed. For the majority of industries, there seem to be no significant changes in the level of concentration. During the 1990s, geographic concentration of manufacturing increased in Bulgaria but has not changed significantly in the rest of the accession countries included in our analysis.

Both factor endowments and proximity to industry centers – capital regions and EU markets - explain the emerging economic geography in EU accession countries. Other things being equal, industries are attracted by large markets. Industries with large economies of scale tend to locate close to industry centers. Labor-intensive industries locate in regions endowed with a large labor force while research oriented industries are attracted by regions endowed with researchers.

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Appendix

Table A1. Summary statistics for specialization and economic performance of regions in Bulgaria

Type of region:		Overall	BEU	BAC	INT	BEX
Number of regions:		28	3	6	14	5
Dissimilarity index over national average	Mean	0.982-0.989	1.204-1.284	0.855-0.786	0.929-0.940	1.150-1.192
	Std. Dev.	0.294-0.326	0.042-0.215	0.336-0.315	0.279-0.286	0.285-0.345
GDP per capita over national average	Mean	1.027-1.001	0.949-0.960	0.978-1.003	1.041-0.985	1.093-1.067
	Std. Dev.	0.120-0.072	0.078-0.012	0.083-0.043	0.094-0.059	0.208-0.117
GDP per worker over national average	Mean	1.001-0.997	0.961-0.960	0.978-1.033	0.999-0.964	1.058-1.071
	Std. Dev.	0.102-0.070	0.096-0.060	0.059-0.047	0.070-0.045	0.198-0.092
Wages over national average	Mean	1.019-1.010	0.995-0.893	0.996-0.991	1.023-1.024	1.049-1.064
	Std. Dev.	0.052-0.136	0.016-0.034	0.031-0.165	0.050-0.122	0.080-0.163
Unemployment over national average	Mean	0.939-1.001	1.321-1.023	0.972-1.241	0.847-0.967	0.927-0.838
	Std. Dev.	0.233-0.325	0.041-0.315	0.119-0.179	0.194-0.376	0.289-0.197

Notes: the first figure refers to the first year for which the variable is available, while the second figure refers to the last year for which the variable is available.
BEU = regions bordering EU countries; BAC= regions bordering accession countries; BEX=regions bordering countries outside the EU enlargement area;
INT =non-border (internal regions).

Source: Authors' calculations based on the REGSTAT data set.

Table A2. Summary statistics for specialization and economic performance of regions in Estonia

		Overall	BEU	BAC	INT	BEX
Type of region:		Overall	BEU	BAC	INT	BEX
Number of regions:		5	3	2	0	0
Dissimilarity index over national average	Mean	0.892- 0.980	0.840- 0.968	0.969- 0.998	-	-
	Std. Dev.	0.261- 0.163	0.331- 0.227	0.182- 0.042	-	-
GDP per capita over national average	Mean	1.256- 1.318	1.440- 1.548	0.978- 0.972	-	-
	Std. Dev.	0.573- 0.716	0.726- 0.905	0.074- 0.119	-	-
GDP per worker over national average	Mean	1.179- 1.238	1.298- 1.389	1.000- 1.012	-	-
	Std. Dev.	0.402- 0.539	0.518- 0.696	0.074- 0.156	-	-
Wages over national average	Mean	1.031- 1.107	1.113- 1.178	0.907- 1.002	-	-
	Std. Dev.	0.170- 0.240	0.178- 0.310	0.042- 0.013	-	-
Unemployment over national average	Mean	0.904- 0.966	0.852- 1.018	0.982- 0.888	-	-
	Std. Dev.	0.322- 0.260	0.442- 0.347	0.040- 0.094	-	-

Notes: The first figure refers to the first year for which the variable is available, while the second figure refers to the last year for which the variable is available.
BEU = regions bordering EU countries; BAC= regions bordering accession countries; BEX=regions bordering countries outside the EU enlargement;
INT =non-border (internal regions).

Source: Authors' calculations based on the REGSTAT data set.

Table A3. Summary statistics for specialization and economic performance of regions in Hungary

		Overall	BEU	BAC	INT	BEX
Type of region:		Overall	BEU	BAC	INT	BEX
Number of regions:		20	2	7	8	3
Dissimilarity index over national average	Mean	0.992- 0.986	0.920- 0.774	1.023- 1.124	0.977- 0.991	1.008- 0.795
	Std. Dev.	0.249- 0.279	0.403- 0.278	0.240- 0.138	0.271- 0.368	0.263- 0.061
GDP per capita over national average	Mean	1.058- 1.065	1.248- 1.453	0.968- 0.921	1.126- 1.159	0.962- 0.890
	Std. Dev.	0.299- 0.374	0.009- 0.026	0.149- 0.164	0.442- 0.519	0.052- 0.070
GDP per worker over national average	Mean	1.016- 0.996	1.029- 1.089	0.973- 0.947	1.064- 1.040	0.981- 0.933
	Std. Dev.	0.144- 0.150	0.034- 0.033	0.071- 0.051	0.215- 0.221	0.041- 0.068
Wages over national average	Mean	1.022- 1.028	0.990- 1.078	1.000- 0.976	1.069- 1.093	0.968- 0.944
	Std. Dev.	0.110- 0.147	0.035- 0.065	0.050- 0.061	0.159- 0.207	0.036- 0.052

Table concluded

Unemployment over national average	Mean	0.952-0.966	0.395-0.543	1.055-1.155	0.990-0.882	0.980-1.032
	Std. Dev.	0.527-0.346	0.134-0.124	0.549-0.342	0.618-0.351	0.192-0.089

Note: the first figure refers to the first year for which the variable is available, while the second figure refers to the last year for which the variable is available.
BEU = regions bordering EU countries; BAC= regions bordering accession countries; BEX=regions bordering countries outside the EU enlargement;
INT =non-border (internal regions).

Source: Authors' calculations based on the REGSTAT data set.

Table A4. Summary statistics for specialization and economic performance of regions in Romania

	Type of region: Number of regions:	Overall 41	Borders EU 0	Borders AC 11	Internal 23	Border EX 7
Dissimilarity index over national average	Mean	0.993-0.987	-	0.878-0.956	1.015-0.992	1.099-1.018
	Std. Dev.	0.263-0.248	-	0.145-0.178	0.259-0.272	0.376-0.283
Wages over national average	Mean	1.001-1.011	-	0.983-1.020	1.018-1.023	0.974-0.956
	Std. Dev.	0.100-0.128	-	0.065-0.108	0.112-0.142	0.110-0.110
Unemployment over national average	Mean	0.987-0.986	-	0.861-0.754	0.942-1.056	1.333-1.123
	Std. Dev.	0.399-0.292	-	0.296-0.166	0.420-0.287	0.308-0.284

Note: the first figure refers to the first year for which the variable is available, while the second figure refers to the last year for which the variable is available.
BEU = regions bordering EU countries; BAC= regions bordering accession countries; BEX=regions bordering countries outside the EU enlargement;
INT =non-border (internal regions).

Source: Authors' calculations based on the REGSTAT data set.

Table A5. Summary statistics for specialization and economic performance of regions in Slovenia

	Type of region:	Overall	BEU	B AC	INT	BEX
	Number of regions:	12	7	0	1	4
Dissimilarity index over national average	Mean	0.954-0.971	0.847-0.864	-	1.380-1.442	1.036-1.040
	Std. Dev.	0.354-0.397	0.288-0.380	-	---	0.445-0.425
Wages over national average	Mean	1.015-1.015	0.996-0.993	-	1.048-1.018	1.038-1.053
	Std. Dev.	0.078-0.098	0.039-0.065	-	---	0.131-0.155
Unemployment over national average	Mean	0.973-0.968	0.982-0.959	-	1.222-1.321	0.895-0.896
	Std. Dev.	0.267-0.294	0.313-0.335	-	---	0.193-0.210

Note: the first figure refers to the first year for which the variable is available, while the second figure refers to the last year for which the variable is available.
BEU = regions bordering EU countries; BAC= regions bordering accession countries; BEX=regions bordering countries outside the EU enlargement; INT =non-border (internal regions).

Source: Authors' calculations based on the REGSTAT data set.

Table A6. Geographical concentration of manufacturing in EU accession countries*

Industry Characteristic		Economies of scale			Technology level			Wages		
	Period	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*	*Low*	*Medium*	*High*
Bulgaria	1990	0.999	0.685	1.213	0.965	1.088	0.645	0.801	1.028	1.429
	1999	0.986	0.735	1.210	0.997	1.045	0.742	0.873	0.959	1.421
Estonia	1990	0.822	1.169	1.302	0.834	1.073	1.394	0.695	1.028	1.693
	1999	0.810	1.386	1.186	0.946	0.822	2.342	0.739	1.066	1.487
Hungary	1992	1.018	0.755	1.401	0.861	1.168	0.745	0.867	1.000	1.401
	1999	0.997	0.836	1.344	0.880	1.162	0.711	0.840	1.034	1.344
Romania	1991	0.977	0.972	1.073	0.918	0.999	1.415	0.850	1.015	1.338
	1999	0.973	1.046	1.032	0.928	0.998	1.369	0.893	1.015	1.231
Slovenia	1995	1.070	0.686	1.046	1.067	0.969	0.853	0.946	0.969	1.210
	1998	0.993	0.700	1.217	0.965	1.054	0.849	0.876	0.960	1.410

Note: * Dissimilarity index for geographical concentration normalized with the national averages of manufacturing concentration.

Source: Authors' calculations based on the REGSTAT data set.

Table A7. Estimation results for Bulgaria using MP1

		1991	1992	1993	1994	1995	1996	1997	1998
	lnpop	-1.35268	-1.24944	-0.89529	-0.70441	0.50344	-1.22611	-0.23625	-0.51362
		(0.87926)	(0.77628)	(0.69412)	(0.78905)	(1.06674)	(0.99183)	(0.76045)	(0.50758)
	lnman	1.53699	1.39967	1.11534	0.95395	0.66021	1.62795	0.92407	0.66672
		(0.79054)*	(0.69653)*	(0.59878)*	(0.54174)*	(0.53304)	(0.87201)*	(0.48177)*	(0.36593)*
Regional	MP1	-0.00048	-0.00040	-0.00031	-0.00037	0.00062	-0.00007	0.00012	-0.00046
Characteristics		(0.00032)	(0.00027)	(0.00029)	(0.00050)	(0.00088)	(0.00068)	(0.00078)	(0.00065)
-β[k]κ[k]	RD	8.79373	6.39989	1.94433	3.24824	-95.68082	-58.58978	-52.14031	28.86050
		(17.99799)	(16.60407)	(18.54258)	(46.81467)	(94.94032)	(58.82676)	(51.55912)	(51.04526)
	LA	-0.71955	-3.09087	-1.20177	-0.54226	10.92969	3.60899	5.56922	1.87620
		(4.63843)	(6.69052)	(5.57837)	(6.34130)	(9.04646)	(8.49821)	(9.76348)	(8.83097)
Industry	SE	-0.89164	-0.95406	-0.92877	-0.99675	-0.85850	-1.06818	-0.99533	-0.78143
Characteristics		(0.48222)*	(0.47682)*	(0.47736)*	(0.48733)*	(0.45078)*	(0.48956)**	(0.48015)**	(0.45625)*
-β[k]γ[k]	RO	0.79635	0.89223	0.92491	1.00548	0.93947	0.33380	0.95957	0.86416
		(0.43470)*	(0.42606)**	(0.42110)**	(0.44402)**	(0.43051)**	(0.60142)	(0.43040)**	(0.35048)**
	LI	2.58505	-0.72105	-0.44881	-0.15157	2.96279	2.66157	1.05223	1.52030
		(3.38116)	(4.29987)	(4.09176)	(4.24372)	(5.68027)	(7.46265)	(5.88270)	(5.48159)
	TL	0.27512	0.22931	0.11265	0.05815	-0.07803	0.06388	0.01386	-0.02601
		(0.11960)**	(0.11358)*	(0.12281)	(0.13209)	(0.14753)	(0.14252)	(0.13755)	(0.15232)
Interaction	MP1SE	0.00034	0.00031	0.00032	0.00041	0.00036	0.00055	0.00063	0.00047
Variables		(0.00016)**	(0.00013)**	(0.00015)**	(0.00019)**	(0.00021)*	(0.00027)**	(0.00029)**	(0.00026)*
β[k]	RDRO	-5.95924	-6.65474	-5.90694	-9.63171	-6.86913	18.81931	-3.53431	-7.40478
		(6.96319)	(6.67893)	(7.03622)	(14.37030)	(16.30997)	(31.85540)	(16.71871)	(16.09887)
	LALI	-1.60266	3.41842	2.95648	2.72694	-2.42657	-0.83628	1.20705	0.18726
		(4.74261)	(6.23502)	(5.88712)	(5.90236)	(8.18044)	(10.68105)	(8.39692)	(7.99241)
	RDTL	0.00000	0.00000	0.00000	0.00001	0.00003	0.00001	0.00002	-0.00001
		(0.00001)	(0.00001)	(0.00001)	(0.00002)	(0.00003)	(0.00003)	(0.00002)	(0.00003)
	Constant	19.07523	18.95655	12.34570	8.92646	-14.50561	15.74142	-1.06487	3.73866
		(15.29625)	(14.50658)	(12.14646)	(14.02950)	(19.35580)	(15.58004)	(15.70568)	(11.57168)
	Observations	336	336	336	324	324	324	324	324
	R-squared	0.07899	0.08861	0.09215	0.10749	0.08595	0.11273	0.11873	0.09975

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

Table A7-bis. Estimation results for Bulgaria using MP2

		1991	1992	1993	1994	1995	1996	1997	1998
	lnpop	-1.31498	-1.53356	-1.03066	-1.16250	-0.59309	-1.30392	-0.79866	-0.36706
		(0.88700)	(0.85704)*	(0.62082)	(0.72709)	(0.84069)	(0.82809)	(0.75482)	(0.49549)
	lnman	1.51115	1.61667	1.19377	1.19721	1.18145	1.64451	1.16521	0.60054
		(0.77882)*	(0.73213)**	(0.53664)**	(0.51894)**	(0.63022)*	(0.71317)**	(0.50328)**	(0.34955)*
Regional	MP2	0.00114	0.00057	0.00032	0.00048	0.00087	0.00148	-0.00022	0.00242
Characteristics		(0.00129)	(0.00110)	(0.00118)	(0.00166)	(0.00178)	(0.00412)	(0.00313)	(0.00265)
-β[k]κ[k]	RD	-1.85919	-5.07460	-5.23401	-1.03928	-33.67704	-51.15512	-25.08612	-2.54295
		(15.26793)	(13.89556)	(14.71321)	(31.15263)	(50.08295)	(53.21409)	(39.78772)	(33.81603)
	LA	-0.68607	-4.48753	-1.90149	-2.22738	4.87750	1.64565	1.10288	-0.01154
		(4.89226)	(6.76978)	(5.42543)	(5.72449)	(7.77817)	(7.75938)	(8.51478)	(6.96871)
Industry	SE	0.00212	-0.61784	-0.69229	-0.82400	-0.51773	-0.25416	-0.88843	0.96884
Characteristics		(1.20550)	(1.22962)	(1.24925)	(1.30033)	(1.22991)	(2.12511)	(1.36656)	(1.31817)
-β[k]γ[k]	RO	0.74754	0.83189	0.87115	0.93348	0.87844	0.25298	0.89802	0.80240
		(0.41307)*	(0.40488)**	(0.40052)**	(0.41745)**	(0.40913)**	(0.60027)	(0.41075)**	(0.33557)**
	LI	2.71308	0.01365	0.30478	0.76442	3.60678	3.46171	1.70954	3.14625
		(3.35462)	(4.34892)	(4.05052)	(4.54662)	(6.20878)	(8.34625)	(6.51841)	(6.42474)
	TL	0.26137	0.21296	0.09741	0.04514	-0.08148	0.05005	0.00884	-0.04843
		(0.11716)**	(0.11134)*	(0.12088)	(0.13087)	(0.14557)	(0.14076)	(0.13750)	(0.14532)
Interaction	MP2SE	-0.00075	-0.00021	-0.00015	-0.00012	-0.00034	-0.00115	-0.00009	-0.00268
Variables		(0.00102)	(0.00090)	(0.00101)	(0.00137)	(0.00143)	(0.00335)	(0.00248)	(0.00214)
β[k]	RDRO	0.16887	0.99943	1.47098	4.30914	6.63000	38.76178	11.84684	9.58402
		(4.30971)	(4.21971)	(4.44394)	(10.25510)	(11.82172)	(33.43869)	(13.80109)	(12.79504)
	LALI	-1.79553	2.33413	1.86311	1.40899	-3.38773	-2.03429	0.23139	-2.26371
		(4.67767)	(6.28777)	(5.78093)	(6.29577)	(8.94937)	(11.99178)	(9.33621)	(9.37464)
	RDTL	0.00001	0.00001	0.00001	0.00002	0.00003	0.00002	0.00003	0.00002
		(0.00001)	(0.00001)	(0.00001)	(0.00002)	(0.00003)	(0.00003)	(0.00003)	(0.00003)
	Constant	17.21576	23.48202	14.41083	16.19554	4.12577	17.08083	9.82104	1.46601
		(15.29553)	(15.54226)	(10.88751)	(13.17006)	(16.12968)	(13.95709)	(15.33573)	(11.22490)
	Observations	336	336	336	324	324	324	324	324
	R-squared	0.08028	0.08625	0.08909	0.10446	0.07818	0.11050	0.11298	0.12315

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

Table A8. Estimation results for Estonia using MP1

		1995	1996	1997	1998	1999
	lnpop	15.39278	18.30042	1.29049	1.74794	8.19440
		-8.40372e+00	-6.23742e+00	-5.67141e-01	-8.44358e-01	-2.51816e+00
	lnman	-8.40372	-6.23742	-0.56714	-0.84436	-2.51816
		(7.30191e-10)***	(8.59565e-10)***	(4.24280e-11)***	(9.03677e-11)***	(1.97468e-09)***
Regional	MP1	-0.22220	-0.39185	-0.02862	-0.03447	-0.28560
Characteristics		(0.10454)	(0.18254)*	(0.01723)	(0.01459)*	(0.08073)**
-β[k]κ[k]	LA	-0.00384	0.03076	0.02591	0.01334	0.01569
		(0.04423)	(0.03147)	(0.00342)***	(0.00145)***	(0.01026)
Industry	SE	-0.51690	-0.28152	-0.34906	-0.32293	-1.89560
Characteristics		(1.03985)	(1.98240)	(0.20831)	(0.18682)	(1.15112)
-β[k]γ[k]	LI	-6.25541	-3.57343	0.20146	-0.16756	1.51038
		(6.53039)	(4.55926)	(0.51783)	(0.24047)	(2.24095)
Interaction	MP1SE	0.05885	0.03712	0.02194	0.01799	0.08731
Variables		(0.06272)	(0.10953)	(0.01034)	(0.00875)	(0.04844)
β[k]	LALI	0.13203	0.07134	0.01282	0.01977	0.00676
		(0.17693)	(0.12589)	(0.01369)	(0.00582)**	(0.04106)
	Constant	-103.89694	-117.89905	-12.01192	-14.35607	-51.21848
		(2.86119)***	(3.78866)***	(0.31413)***	(0.27706)***	(1.89052)***
	Observations	60	60	60	60	60
	R-squared	0.08985	0.10092	0.10141	0.10515	0.19088

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

Table A8-bis. Estimation results for Estonia using MP2

		1995	1996	1997	1998	1999
	lnpop	12.95097	10.69101	1.37686	1.67156	-1.79813
		(6.03029e-08)***	(3.87005e-07)***	(1.16929e-08)***	(1.01715e-08)***	(1.94077e-07)***
	lnman	-6.14047	-0.19145	-0.70082	-0.74488	7.55412
		(6.70460e-08)***	(4.58551e-07)***	(8.34185e-09)***	(2.38184e-08)***	(1.12931e-07)***
Regional	MP2	-0.19256	-0.64446	-0.08220	-0.08821	-0.70371
Characteristics		(0.19532)	(0.39919)	(0.02940)**	(0.02517)**	(0.15069)***
-β[k]κ[k]	LA	0.01932	0.08612	0.02392	0.01553	0.01869
		(0.04300)	(0.02895)**	(0.00251)***	(0.00091)***	(0.01177)
Industry	SE	-0.31428	-1.46343	-0.87478	-0.78148	-3.79792
Characteristics		(1.72897)	(3.92059)	(0.16298)***	(0.13163)***	(1.62626)*
-β[k]γ[k]	LI	-5.83142	-3.56929	0.27246	-0.06493	2.22026
		(6.35186)	(4.14909)	(0.36862)	(0.15080)	(2.68356)
Interaction	MP2SE	0.00131	0.12968	0.05804	0.04792	0.20038
Variables		(0.11719)	(0.23951)	(0.01764)**	(0.01510)**	(0.09042)*
β[k]	LALI	0.12132	0.07124	0.01094	0.01684	-0.00833
		(0.17202)	(0.11581)	(0.01005)	(0.00365)***	(0.04710)
	Constant	-86.05118	-62.01613	-11.89513	-12.99747	28.64165
		(3.38353)***	(7.04246)***	(0.31746)***	(0.23117)***	(2.30799)***
	Observations	60	60	60	60	60
	R-squared	0.08669	0.10597	0.12443	0.12651	0.22390

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

Table A9. Estimation results for Hungary[9] using MP1

		1992	1993	1994	1995	1996	1997	1998	1999
	lnpop	0.73495	-0.22050	0.45607	0.19830	0.20699	0.25674	0.26703	0.32298
		(0.68685)	(0.62439)	(0.31831)	(0.14755)	(0.13480)	(0.12448)*	(0.11973)**	(0.15316)**
	lnman	-0.09488	0.28176	-0.04694	-0.04900	-0.09118	-0.12072	-0.14351	-0.22712
		(0.57996)	(0.34675)	(0.17948)	(0.11478)	(0.11974)	(0.14793)	(0.17565)	(0.19176)
Regional	MP1	-1.42e-07	-3.25e-08	-1.16e-07	-1.44e-07	-2.31e-07	-1.52e-07	-9.38e-08	-7.23e-08
Characteristics		(9.78e-08)	(9.53e-08)	(4.24e-08)**	(4.39e-08)***	(5.90e-08)***	(3.86e-08)***	(2.45e-08)***	(2.19e-08)***
-β[k]κ[k]	LA	0.00531	-0.00263	-0.00049	-0.00005	-0.00112	-0.00201	-0.00472	-0.00520
		(0.00667)	(0.00460)	(0.00260)	(0.00172)	(0.00140)	(0.00147)	(0.00211)**	(0.00216)**
Industry	SE	-0.30466	0.33921	0.17074	0.02652	0.10706	0.15174	0.24628	0.20570
Characteristics		(0.58040)	(0.28995)	(0.25483)	(0.19467)	(0.14671)	(0.14095)	(0.11420)**	(0.10023)*
-β[k]γ[k]	LI	0.62037	-0.17184	0.12238	0.06957	-0.07927	-0.03603	-0.36427	-0.27511
		(1.07789)	(0.45428)	(0.41159)	(0.38028)	(0.29254)	(0.29570)	(0.24557)	(0.20881)
Interaction	MP1SE	8.30e-08	3.30e-08	5.51e-08	8.84e-08	1.43e-07	8.86e-08	5.23e-08	4.07e-08
Variables		(4.58e-08)*	(3.02e-08)	(2.77e-08)*	(2.31e-08)***	(3.16e-08)***	(1.87e-08)***	(1.09e-08)***	(8.71e-09)***
β[k]	LALI	0.00326	0.00928	0.00636	0.00604	0.00732	0.00718	0.01222	0.01080
		(0.00632)	(0.00474)*	(0.00442)	(0.00424)	(0.00374)*	(0.00399)*	(0.00395)***	(0.00328)***
	Constant	-7.91446	-0.98705	-5.96494	-4.06342	-4.27621	-4.70520	-4.82819	-5.25921
		(5.95016)	(4.36784)	(2.39041)**	(1.25032)***	(1.26976)***	(1.25842)***	(1.16566)***	(1.31885)***
	Observations	160	160	160	160	160	160	160	160
	R-squared	0.03725	0.03286	0.03535	0.06496	0.07763	0.08593	0.09618	0.10843

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

[9] Although some information on R&D was available for Hungary, they are not included in these estimations, since it is available only for a limited number of years.

Table A9-bis. Estimation results for Hungary using MP2

		1992	1993	1994	1995	1996	1997	1998	1999
	lnpop	0.73110	-0.19681	0.42569	0.20339	0.21250	0.25197	0.25658	0.31053
		(0.67420)	(0.55578)	(0.27734)	(0.14548)	(0.13927)	(0.12704)*	(0.11883)**	(0.14083)**
	lnman	-0.20895	0.37484	-0.04580	-0.01861	-0.04473	-0.10100	-0.13825	-0.22468
		(0.65507)	(0.42414)	(0.21818)	(0.13321)	(0.17282)	(0.18627)	(0.20306)	(0.21691)
Regional	MP2	-2.91e-07	-2.02e-07	-2.61e-07	-4.11e-07	-7.00e-07	-4.22e-07	-2.26e-07	-1.73e-07
Characteristics		(2.74e-07)	(1.86e-07)	(1.23e-07)**	(1.34e-07)***	(2.27e-07)***	(1.31e-07)***	(6.47e-08)***	(5.50e-08)***
-β[k]κ[k]	LA	0.00573	-0.00329	-0.00035	-0.00033	-0.00131	-0.00217	-0.00474	-0.00517
		(0.00652)	(0.00486)	(0.00249)	(0.00165)	(0.00126)	(0.00143)	(0.00217)**	(0.00214)**
Industry	SE	-0.43596	0.27941	0.09871	-0.08530	-0.07178	0.04365	0.19210	0.15756
Characteristics		(0.66428)	(0.32280)	(0.30019)	(0.21788)	(0.18266)	(0.15569)	(0.12126)	(0.10603)
-β[k]γ[k]	LI	0.57081	-0.20564	0.10024	0.02114	-0.11300	-0.08134	-0.38971	-0.29494
		(1.04342)	(0.45535)	(0.40412)	(0.35158)	(0.26291)	(0.27374)	(0.23483)	(0.20097)
Interaction	MP2SE	2.17e-07	1.05e-07	1.37e-07	2.37e-07	3.96e-07	2.43e-07	1.30e-07	1.02e-07
Variables		(1.42e-07)	(7.78e-08)	(8.48e-08)	(7.45e-08)***	(1.12e-07)***	(6.59e-08)***	(3.07e-08)***	(2.49e-08)***
β[k]	LALI	0.00371	0.00962	0.00663	0.00667	0.00777	0.00780	0.01263	0.01111
		(0.00605)	(0.00479)*	(0.00435)	(0.00394)	(0.00348)**	(0.00380)*	(0.00385)***	(0.00321)***
	Constant	-8.15732	-0.62768	-5.65792	-3.77640	-3.82207	-4.41234	-4.65385	-5.09790
		(6.44168)	(4.10377)	(2.35799)**	(1.29388)***	(1.47064)**	(1.41914)***	(1.25195)***	(1.32350)***
	Observations	160	160	160	160	160	160	160	160
	R-squared	0.03855	0.03323	0.03566	0.07074	0.08450	0.09217	0.09891	0.11108

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

Table A10. Estimation results for Romania using MP1

		1992	1993	1994	1995	1996	1997	1998	1999
	lnpop	2.44492	3.05416	3.64506	2.78830	3.02419	2.15876	0.87294	0.44899
		(1.44033)*	(1.29742)**	(1.14413)***	(0.89428)***	(0.85100)***	(0.89524)**	(0.86413)	(0.51677)
	lnman	0.22683	-0.18155	-0.58198	0.20091	0.17931	0.48492	0.56208	1.04845
		(0.67725)	(0.68036)	(0.65615)	(0.47520)	(0.51175)	(0.48804)	(0.56628)	(0.33505)***
Regional	MP1	-0.00173	-0.00200	-0.00178	-0.00134	-0.00134	-0.00183	-0.00125	-0.00091
Characteristics		(0.00050)***	(0.00053)***	(0.00042)***	(0.00036)***	(0.00029)***	(0.00042)***	(0.00031)***	(0.00024)***
-β[k]κ[k]	LA	-13.19671	-11.54755	-7.42266	5.38638	-5.07042	-26.97905	-21.39108	-13.65652
		(15.96815)	(13.05472)	(13.05709)	(12.44673)	(12.12712)	(10.12390)**	(8.29598)**	(10.41864)
Industry	SE	-0.97699	-1.07162	-1.02553	-0.74905	-0.66631	-0.84225	-0.66243	-0.21687
Characteristics		(0.37512)**	(0.42452)**	(0.41174)**	(0.38835)*	(0.42287)	(0.39085)**	(0.27742)**	(0.26248)
-β[k]γ[k]	LI	1.25668	1.36306	1.92922	2.12304	1.40401	0.21399	-0.12761	0.19180
		(1.10668)	(1.05585)	(1.25277)	(1.23420)*	(1.05754)	(0.99772)	(0.72441)	(0.94750)
Interaction	MP1SE	0.00042	0.00050	0.00040	0.00028	0.00026	0.00043	0.00037	0.00018
Variables		(0.00011)***	(0.00015)***	(0.00012)***	(0.00010)***	(0.00010)**	(0.00013)***	(0.00009)***	(0.00008)**
β[k]	LALI	21.74397	17.25071	7.91541	2.14488	14.69070	37.91617	25.14814	13.00172
		(16.12046)	(11.83211)	(12.79539)	(13.71379)	(17.27490)	(15.06529)**	(9.75939)**	(12.63318)
	Constant	-33.68671	-43.19325	-52.75840	-40.00209	-42.70569	-28.54603	-11.12252	-4.50527
		(21.06474)	(19.05440)**	(17.04682)***	(13.12164)***	(12.77993)***	(13.32461)**	(13.07024)	(7.75086)
	Observations	533	533	533	533	533	533	533	533
	R-squared	0.11977	0.11749	0.11332	0.08801	0.08027	0.09456	0.06566	0.06664

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

Table A10-bis. Estimation results for Romania using MP2

		1992	1993	1994	1995	1996	1997	1998	1999
	lnpop	0.28018	0.85446	1.77269	0.49467	1.31977	0.72512	0.05723	-0.35193
		(1.20347)	(1.15234)	(1.16608)	(0.87837)	(1.03137)	(0.92136)	(0.83394)	(0.54741)
	lnman	1.39911	1.01135	0.26894	1.37889	0.83967	1.10405	0.93338	1.36437
		(0.65619)**	(0.73997)	(0.72671)	(0.56180)**	(0.60098)	(0.52088)**	(0.64523)	(0.35914)***
Regional	MP2	-0.00082	-0.00123	-0.00131	-0.00098	-0.00139	-0.00203	-0.00164	-0.00098
Characteristics		(0.00055)	(0.00072)*	(0.00070)*	(0.00067)	(0.00072)*	(0.00071)***	(0.00062)**	(0.00051)*
-β[k]κ[k]	LA	-1.79335	-2.69961	1.76966	21.14353	7.21032	-13.80292	-15.16610	-6.97509
		(15.46175)	(13.44980)	(15.18287)	(11.90744)*	(14.05542)	(11.52911)	(10.22635)	(10.87262)
Industry	SE	-2.91058	-3.19479	-2.97368	-2.94412	-2.97410	-3.34169	-2.50402	-1.43103
Characteristics		(0.88395)***	(0.98579)***	(0.84035)***	(0.77158)***	(0.87157)***	(0.74685)***	(0.61282)***	(0.58505)**
-β[k]γ[k]	LI	0.96440	1.13665	1.61817	1.73108	1.01763	-0.47472	-0.54220	-0.10677
		(1.13672)	(1.05772)	(1.26938)	(1.27120)	(1.10092)	(1.06018)	(0.78783)	(0.97027)
Interaction	MP2SE	0.00107	0.00139	0.00126	0.00126	0.00120	0.00167	0.00126	0.00085
Variables		(0.00031)***	(0.00042)***	(0.00036)***	(0.00032)***	(0.00035)***	(0.00035)***	(0.00034)***	(0.00028)***
β[k]	LALI	26.18945	19.99971	11.61064	7.86482	23.24057	49.17808	30.88415	16.80988
		(16.95083)	(12.16447)	(13.02173)	(14.63482)	(18.82200)	(16.68523)***	(10.52954)***	(13.15115)
	Constant	-0.04085	-8.58780	-23.69403	-4.73212	-15.72471	-5.18391	2.91992	8.04545
		(17.15426)	(16.65845)	(16.85268)	(12.89433)	(14.96872)	(13.43646)	(12.63942)	(7.91028)
	Observations	533	533	533	533	533	533	533	533
	R-squared	0.13720	0.13591	0.12673	0.11120	0.09570	0.11342	0.08053	0.07592

* significant at 10%; ** significant at 5%; *** significant at 1%; robust standard errors in parentheses

Table A11. Estimation results for Slovenia using MP1

		1995	1996	1997
	lnpop	3.20622	3.46189	2.49112
		(1.02466)***	(1.56455)**	(1.87178)
	lnman	-0.69920	-0.90422	-0.35655
		(1.08138)	(1.21725)	(1.68144)
Regional	MP1	-0.31573	-0.31972	-0.30335
Characteristics		(0.08512)***	(0.09606)***	(0.07719)***
-β[k]κ[k]	RD	-24.99003	-52.58730	-35.65038
		(76.93151)	(65.41670)	(49.29207)
Industry	SE	-0.27865	-0.30546	-0.38584
Characteristics		(0.24045)	(0.24473)	(0.19937)*
-β[k]γ[k]	RO	-3.78016	-4.83261	-5.71808
		(1.28015)**	(1.60061)**	(1.02469)***
	TL	2.58538	3.38564	3.86484
		(1.11000)**	(1.43891)**	(1.10604)***
Interaction	MP1SE	0.10861	0.11599	0.11717
Variables		(0.03214)***	(0.03816)**	(0.03526)***
β[k]	RDRO	33.46864	76.47009	104.94158
		(69.51438)	(68.56802)	(44.14264)**
	RDTL	-31.76779	-61.17505	-74.33164
		(51.57103)	(53.64013)	(39.38974)*
	Constant	-19.50988	-20.58208	-14.56367
		(7.86975)**	(10.26284)*	(12.92564)
	Observations	168	168	168
	R-squared	0.19288	0.20354	0.22525

* significant at 10%; ** significant at 5%; *** significant at 1%;
robust standard errors in parentheses

Table A11-bis. Estimation results for Slovenia using MP2

		1995	1996	1997
	lnpop	2.69214	3.02591	2.01254
		(0.93231)**	(1.50101)*	(1.72352)
	lnman	-0.58153	-0.86357	-0.14844
		(0.95082)	(1.30407)	(1.57250)
Regional	MP2	-0.08055	0.13288	0.15428
Characteristics		(0.21849)	(0.21900)	(0.18230)
-β[k]κ[k]	RD	-44.26235	-79.92927	-51.93411
		(74.26717)	(65.73853)	(48.52253)
Industry	SE	-0.58693	0.47470	0.78827
Characteristics		(1.06643)	(1.15070)	(0.79933)
-β[k]γ[k]	RO	-4.01515	-5.30281	-6.12510
		(1.27333)***	(1.77936)**	(1.02944)***
	TL	2.66055	3.53604	3.99503
		(1.11473)**	(1.48983)**	(1.11505)***
Interaction	MP2SE	0.04659	-0.06495	-0.11127
Variables		(0.11191)	(0.12344)	(0.08117)
β[k]	RDRO	49.13316	99.90941	124.29908
		(68.84351)	(76.60867)	(45.14372)**
	RDTL	-36.77833	-68.67248	-80.52344
		(51.62353)	(56.26688)	(40.11368)*
	Constant	-16.05070	-19.52004	-13.14851
		(7.40840)*	(10.72794)*	(11.85207)
	Observations	168	168	168
	R-squared	0.18655	0.19781	0.22228

* significant at 10%; ** significant at 5%; *** significant at 1%;
robust standard errors in parentheses