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NEW ECONOMIC GEOGRAPHY OF MARKET POTENTIAL – INNOVATION INTENSITY AND LABOR STRUCTURE IN EU REGIONS

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ABSTRACT: In the present study, we ask how economic integration affects the location of economic activities, and spatial distribution of market potential, in Europe. The theoretical framework is based on the new economic geography approach in trade analysis literature. Empirical analysis transforms data into a synthetic free trade area (SFTA) that is constructed by standardizing the values of each variable to a comparable level in each country. Then SFTA is compared with the real trade area (RTA). The comparison offers insights into how "extreme" integration within countries (SFTA) has affected the location of economic activities and how this integration differs from the spatial structures among countries (RTA).

The empirical results suggest that regional innovation intensity has affected the spatial market potential within countries but not among the same countries. This has important implications for the discussion about regional development during the economic integration process. The results imply that if international integration gets forms similar to those that "extreme" integration has had within countries, lower international trade barriers will lead to geographic concentration in the region with high innovation intensity. The conclusions of the results change in some respects when we use different data subgroups. Innovation intensity does not seem to be a relevant driver in all the subgroups formed. However, the labor share of agriculture remains a powerful predictor of geographical concentration in all the subsets and models.

Key words: economic integration, location, monopolistic competition, sunk costs, trade.

1 Introduction

The economic and political integration process has been recently deepening globally. European countries in particular have integrated relatively rapidly and the plans for the expansion of the EU have been widely discussed. There has been much discussion on how the deepening integration affects the regional distribution of economic activities. Theoretical developments in trade analysis, in particular, have advanced rapidly in recent years. Krugman (1991a, 1991b) set the basis for the new economic geography by applying the monopolistic competition framework *ála* Dixit and Stiglitz (1977). Krugman and Venables (1995) and Venables (1996) extended the framework to the use of intermediaries in manufacturing. Puga (1999) solved the model analytically. Fujita, Krugman, and Venables (1999) concluded the theoretical contributions of the time. Ottaviano (2001) endogenized capital inputs in the models. Martin and Rogers (1995), Baldwin, Forslid, Martin, Ottaviano, and Robert-Nicoud (2003), and Forslid (2003) considered the role of regional policy in the framework. However, there are few empirical studies published in the field (e.g. Hanson 1998; Davis and Weinstein 1999; Redding and Venables 2000; Midelfart-Knarvik, Overman, Redding and Venables (2000)).

The present study aims to analyze how economic integration affects the location of economic activities and spatial distribution of market potential in Europe. The theoretical framework behind the empirical analysis in this paper employs an approach called new economic geography, which takes into consideration the interrelation between market structure and the spatial structure of economic activities. The independent variables for the analysis are chosen in accordance with the theory.

The empirical section presents a regression analysis of the inner areas of 12 EU countries. The inner area of each country is assumed to have integrated extensively. In contrast, there have been relatively high trade barriers on the international level between these countries. The concept and the analytical tool, called the Synthetic Free Trade Area (SFTA), is constructed in order to compare the spatial structures both within the countries and between them. The SFTA is constructed first by standardizing all the variables within single countries. Second, all the data is pooled together to form a SFTA aggregate, which is, in turn, used in regression analysis.

International economic structures are compared with the internal spatial economic structures of traditional states. International trade is here assumed to have higher trade barriers and higher trade costs than intra-state trade. Therefore, we can compare SFTA and the actual data of Real Trade Area (RTA) in order to obtain more information about spatial agglomerations in highly integrated regions (within countries) and among less integrated regions (among countries).

In other words, if the form of economic integration between is similar to that of intra-state areas, then economic integration might have a similar impact on the international structure of spatial market potential as individual countries have had on intra-state trade. In order to make such an analysis possible, the actual area, including 187 regions, and the corresponding synthetic area of the same size are presented on the NUTS2 level. Changes of cross-sectional regression coefficients are investigated over time. The SFTA analysis is also benchmarked by using a more conventional panel data analysis.

The remainder of the study is as follows. Chapter 2 presents the theoretical model that describes how market structure affects the location of economic activities. Empirical methodology and variable construction appears in Chapter 3. Chapter 4 discusses on empirical results and last section concludes the study.

2 The theoretical model

The theoretical model used in this study is based on the monopolistic competition model by Dixit and Stiglitz (1977). The spatial framework relies mainly on Krugman (1991a, 1991b).

2.1 Consumption structure

Let us assume that there are two production sectors in two economies. Sector A produces identical goods under perfect competition and constant returns to scale (CRS). This sector is referred to as a local agricultural sector. Sector M produces differentiated goods under monopolistic competition and increasing returns to scale (IRS). It is often referred to as a manufacturing sector. [1] The theoretical presentation focuses here on the latter sector.

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[1] For example Krugman 1991, Krugman and Venables 1995.

Consumer preferences can be presented as a Cobb-Douglas function between the two sectors.

(1) $$U = C_M^{\pi} C_A^{(1-\pi)}, 0 < \pi < 1 .$$

The consumption aggregate C_M of sector M is consumed share of π (per cent) of the total consumption and the consumption of product C_A of sector A is then, share of 1-π (per cent). Manufactures are consumed as the constant elasticity to substitution (CES) aggregate function implies:

(2) $$C_M = \left[\sum_i c_i^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}, \sigma > 1,\ i = 1,..., N .$$

The term c_i in equation above is a single manufacturing good. The number of goods (N) produced in the sector is large, although all the possible varieties are not produced. The elasticity of substitution is simply σ (sigma), according to the CES preferences of the consumer:

(3) $$\frac{d(c_j / c_k)}{c_j / c_k} \cdot \frac{d(p_k / p_j)}{p_k / p_j} = \sigma, j \neq k .$$

Consumer preferences are presented by a constant elasticity to scale (CES) function within industrial sector goods. The terms j and k denote differentiated product variations. This preference type implies the symmetrical but imperfect substitutability of the goods. The larger the value of sigma, the more substitutable the goods are with each other, and vice versa.

2.2 Production structure

Increasing returns to scale are introduced in the model through fixed (sunk) costs. Sunk costs are denoted as α. Marginal costs are denoted as β. The production volume of a single manufacturing firm is measured by x_{Mi}. The production function is of the linear form:

(4) $$L_{Mi} = \alpha + \beta x_{Mi} ,$$

where L_{Mi} is the labor used to produce x_{Mi} goods output. Sunk costs can be regarded as costs caused by research and development (R&D) activities or marketing and advertising activities which are related to consumer preferences. And *vice versa*, the consumer preferences are directly related to the scale economies of the production process. When new firms are allowed to enter the market, then no firm can capture abnormal profits in the long run. This implies the following link between the cost structure of a firm and the consumer preferences:

(5) $$p_i = \frac{\sigma}{\sigma - 1}\beta w$$

A term w denotes wage level. The interpretation of σ is related to elasticity of substitution and consumer preferences (see eq. 2 and 3). The price of a single product is a mark-up over marginal costs. The mark-up is related to the elasticity of substitution. Accordingly, the average unit costs of the production must also be covered when the production process contains not only marginal costs, but also sunk costs.

We can solve the quantity of goods produced by a manufacturer with the help of a price equation (eq. 5) and by using a zero-profit assumption. The assumption is related to the long-run definition: market entry is free in the long run and, therefore, the profit margin drops. The production quantity is then:

(6) $$x_i = \frac{\alpha(\sigma - 1)}{\beta}$$

The higher the sunk costs, the more a single firm produces. On the other hand, the consumer preferences limit the sunk cost effect.

We can also count the number of firms in a market:

(7) $$n = \frac{L_M}{\alpha + \beta x_i} = \frac{L_M}{\alpha\sigma}$$

The smaller the number of firms, the higher the sunk costs. The market structure is then affected considerably by sunk costs (for instance R&D activities) and also by consumer preferences. These simplifications play an important part when we determine how the market structure is related to the firms' decisions about the location of their activities.

2.3 Two-region model

The present study follows Krugman (1991a, 1991b) to construct the two-region model. The only essential modification is made in the numeric simulation presentations. In addition, some corrections are made to partial derivations in the end of the analysis. This model describes a situation where manufacturing has agglomerated in the other region, whereas the agricultural workers are evenly distributed between both regions. The trade barriers, or trade costs, between the two regions are presented by Samuelsonian iceberg costs. The simplest example of trade barriers is transport costs due to the distance between the regions. According to the iceberg costs part of the goods exported to another region “melts away” during the transportation.

In the present study, wage level of agriculture sector is chosen to be unity. We also assume that total production of both regions, and amount of total labor, equals unity. There are π (per cent) of workers employed in the manufacturing activities. The term π is at the same time the proportional share of manufacturing labor out of the total labor and manufacturing production out of total production. Because region 1 (labeled with the subscript one) is a core region, its gross regional product, and income, (Y) is:

(8) $$Y_1 = \frac{1+\pi}{2}.$$

The regional income of the peripheral area, region 2, is presented in equation 9:

(9) $$Y_2 = \frac{1-\pi}{2}.$$

We form the ratio of regional incomes between regions 1 and 2:

(10) $$\frac{Y_1}{Y_2} = \frac{1+\pi}{1-\pi}.$$

When all the manufacturing goods are produced in region 1, the sales (V) of a single manufacturing firm in region 1 is:

(11) $$V_1 = \frac{\pi}{n}.$$

The wage levels (*w*) can vary between the regions.

(12) $$\frac{w_2}{w_1} = (\frac{P_2}{P_1})^{\pi} = (\frac{1}{\tau})^{\pi}$$

The competitive wage level must equal the price index (*P*) ratio between the regions weighted by manufacturing labor share. This in turn depends on trade costs (τ) between the regions. The larger the trade costs between the core and periphery, the higher the wage level offered in the periphery must be when labor is mobile between the regions as assumed. The imported manufacturing goods are more expensive in the periphery than in the core region due to the trade costs between the regions. This implies also a higher price level and the demand of higher wages in order to achieve the same utility level in both regions.

The sales of a potential entrant manufacturer in the periphery are shown in equation 13.

$$(13) \qquad V_2 = \frac{\pi}{n}\left[\ \left(\frac{w_2}{w_1\tau}\right)^{-(\sigma-1)} Y_1 + \left(\frac{w_2\tau}{w_1}\right)^{-(\sigma-1)} Y_2\ \right]$$

$$= \frac{\pi}{n}\left[\ \frac{1+\pi}{2}\left(\frac{w_2}{w_1\tau}\right)^{-(\sigma-1)} + \frac{1-\pi}{2}\left(\frac{w_2\tau}{w_1}\right)^{-(\sigma-1)}\ \right].$$

From equations 11 and 13 we get the manufacturer's sales ratio between the regions:

$$(14) \qquad \frac{V_2}{V_1} = \frac{1}{2}\tau^{\pi(\sigma-1)}\left[(1+\pi)\tau^{\sigma-1} + (1-\pi)\tau^{-(\sigma-1)}\right].$$

The sales ratio exceeds the wage ratio:

$$(15) \qquad \frac{V_2}{V_1} > \frac{w_2}{w_1} = \frac{1}{\tau^{\pi}}.$$

The outcome can be derived from the zero-profit assumption. The sunk costs must be covered by operating incomes and the sales must exceed the wage ratio.

2.4 Theoretical results

A keystone of the theoretical analysis is based on equation 16. We get the market potential of a region by multiplying both sides of equation 14 by the result of the wage ratio in equation 15.

$$(16) \qquad \upsilon = \frac{1}{2}\tau^{\pi\sigma}\left[(1+\pi)\tau^{\sigma-1} + (1-\pi)\tau^{-(\sigma-1)}\right].$$

Equation 16 presents the market potential index. When the market potential index is lower than 1, it is not profitable to set up a firm in the peripheral region. When the value is greater than 1, it is profitable to start manufacturing also in the periphery. The market potential index emphasizes three drivers, which affect the firms' choices about where to locate their production activities according the model. These three drivers are 1) trade costs, 2) the labor share of manufacturing, and 3) the increasing returns to scale in manufacturing. To note, the increasing returns to scale are related to the sunk costs as well as consumer preferences in this model.

We take partial derivatives from equation 16 in order to analyze how the central parameters affect the location decisions of firms, and, therefore, the spatial agglomeration of economic activities.

First, we check how the market potential index is affected when the labor share of manufacturing alters, other things being equal:

$$\frac{\partial \upsilon}{\partial \pi} = \upsilon\sigma(\ln \tau) + \frac{1}{2}\tau^{\sigma\pi}\left[\tau^{\sigma-1} - \tau^{-(\sigma-1)}\right]. \tag{17}$$

The result of equation 17 is simulated also numerically in Figure 1.

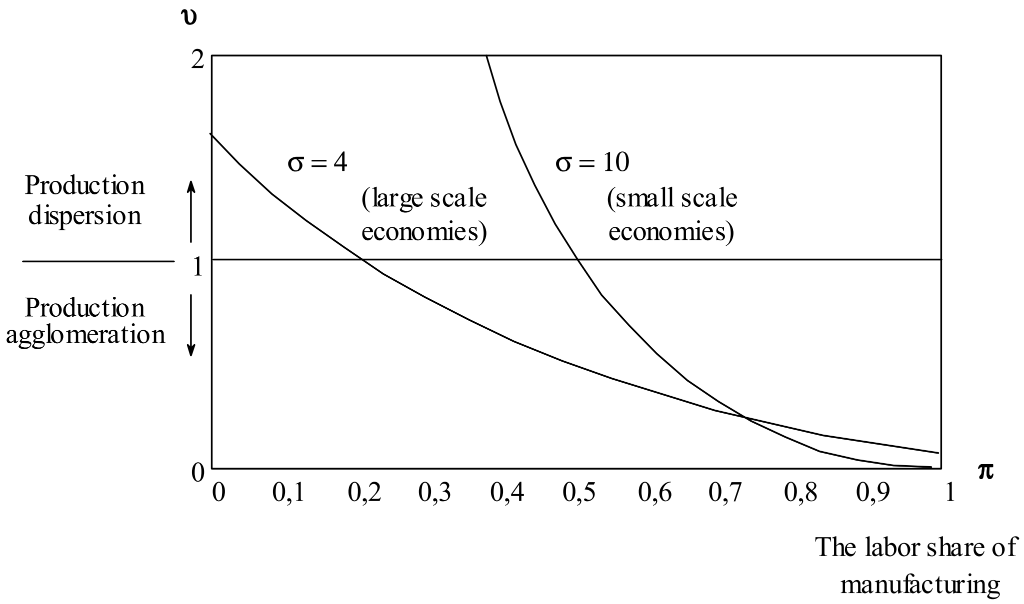

Figure 1. Determing the location of production activities by changes in labor share of manufacturing.

The labor share of the sector experiencing scale economies (here: manufacturing) has a straightforward impact on the spatial agglomeration. If the labor share is relatively low, it is profitable to start production also in the periphery. And if the labor share is relatively high, staying in the core region is the profitable choice. Sunk costs implying increasing returns to scale in manufacturing affect, in a parallel manner, the profitable location choices. Enhancing scale economies lowers the dispersion boundary of spatial agglomeration.

In equation 18 we analyze how interregional trade costs affect the location decisions of the firms:

(18) $$\frac{\partial \upsilon}{\partial \tau} = \frac{\pi\sigma\upsilon}{\tau} + \frac{\tau^{\pi\sigma}(\sigma-1)\left[(1+\pi)\tau^{\sigma-1}-(1-\pi)\tau^{-(\sigma-1)}\right]}{2\tau}$$

Figure 2 presents a numeric solution for the partial derivative.

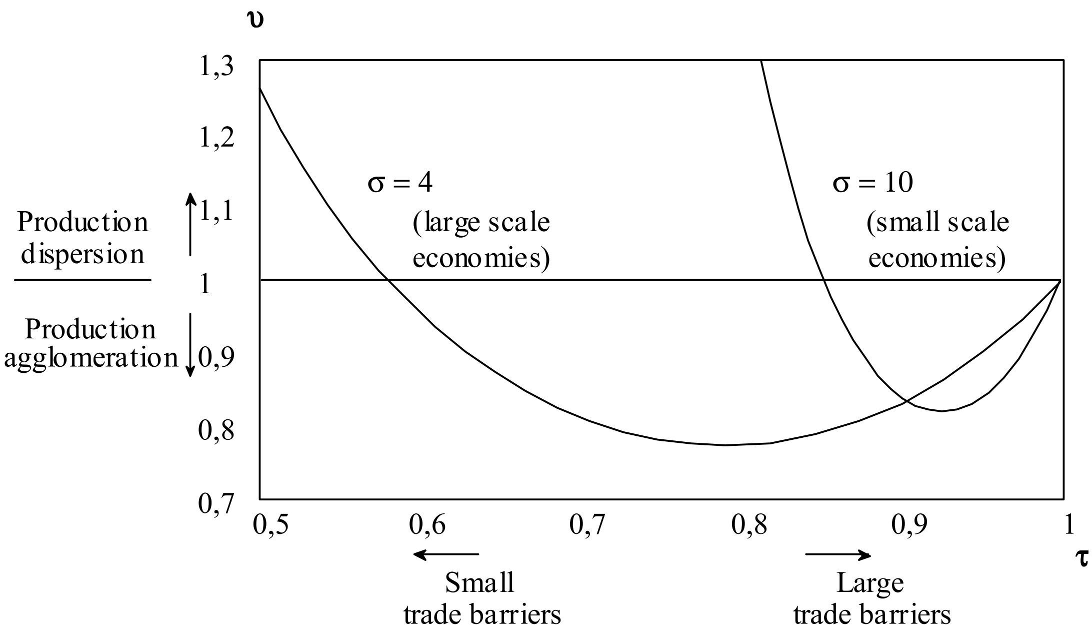

Figure 2. Determing the location of production activities by changes in trade barriers [costs].

The change in trade costs (or trade barriers) affects the profitability of the location of the manufacturing firm. When the trade costs diminish, the spatial agglomeration becomes the profitable way to organize the business. However, if the scale economies are relatively low (e.g. for small R&D activities), the geographical concentration occurs only when the trade costs are very low.

Lastly, we control the changes of scale economies. The effect has been captured in the two previous figures:

(19) $$\frac{\partial \upsilon}{\partial \sigma} = \ln(\tau)\left\langle \pi\upsilon + \frac{1}{2}\tau^{\pi\sigma}\left[(1+\pi)\tau^{\sigma-1}-(1-\pi)\tau^{-(\sigma-1)}\right]\right\rangle$$

$$= \ln(\tau)(\frac{\tau}{\sigma})(\frac{\partial \upsilon}{\partial \tau}).$$

The partial derivative of equation 19 states that high scale economies imply high spatial agglomeration. The trade costs work in the same direction as presented above in Figure 2.

The theoretical results contribute to the empirical investigation of the economic reasoning behind the location of economic activities. The results of the model can be generalized from equations 16-19 and presented as a function of the labor share of agriculture, increasing returns to scale and trade costs:

(20) $$\text{Market potential} = a\left(\overset{-}{\text{labor share of agriculture}}, \overset{+}{\text{sunk costs}}, \overset{(-)+}{\text{trade costs}}\right).$$

The market potential index, ν in equation 16, is denoted as market potential below and in equation 20. There are three main independent variables derived from the model. First, market potential is affected by labor share of agriculture, $1-\pi$, which is a reciprocal variable of the labor share of manufacturing, π, presented in the model above. Second, in the model, high sunk costs imply increasing returns to scale in production and parallelly changes in consumer preferences, $\sigma/(\sigma-1)$. The relation between increasing returns to scale and sunk costs is ensued to the condition for the optimal price setting in equation 5. Accordingly, the firms set a sufficient mark-up over marginal costs in order to cover also sunk costs. Third, there are trade costs, τ which affect to the market potential.

3 Empirical analysis

3.1 Background

The present study examines the regional distribution of the market potential, or “density” of economic activities, the market structure and the labor structure of an economy in accordance with the model by Krugman (1991a). The effect of trade barriers is taken into account in a novel way. We compare the spatial structure of the intra-country trade costs with the international spatial structure of the trade costs, which are conventionally assumed to be greater internationally than within the countries. A close example of statistical regression analysis is Hanson’s (1998) analysis of the distribution of regional demand shocks in the United States. Hanson estimates the effect of the distance between the regions on the demand for labor force and on changes in the wage level in different regions.

The regional market potential is specified on the NUTS2 level of European regions.[3] The data is described with the help of statistical and geographical information.[4] In the present study, an object of interest is whether there appear to be geographic agglomeration advantages on the level of NUTS2 regions and how the existence of such regional agglomeration advantages can be explained.

According to Hanson (1998) the question concerning the reasons for the formation of spatial agglomeration, was theoretically undefined earlier, but Krugman (1991b) derived the causal relation of market structure and spatial agglomerations theoretically. Hanson here takes advantage of the concept of market potential. The market potential of a region is determined by its size and relative location. With the help of the market potential estimates obtained from the regional data of the United States, Hanson simulates how strongly a demand shock that has occurred in one region affects the wage levels of other regions. Hanson uses numerical geographical information and computer-assisted maps to demonstrate the results.

The mobility of the labor force was emphasized in the theoretical model presented earlier. Hanson's hypothesis is that a high wage level explains the density of economic activities, that is, the market potential. Hermans (2000) uses innovation intensity as an instrument variable to explain income level. The result of the 2SLS cross-section model is that the wage level significantly affects both the international and the intranational distribution of economic activities. In the present study, innovation intensity is used directly as a theory-based depiction of increasing returns to scale in production.

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[2] Literature of Economic geography (initially Harris 1954; Hanson 1998, 9) presents market potential as follows: $MP_j = \sum_{k \in K} Y_k f(d_{jk}),$ in which MP_j depicts the market potential of region j, Y_k the production level of region k and d_{jk} the distance between the regions j and k. Function f( ) is a monotonically decreasing function, which presents how geographic distance affects the transport or trade costs. Here we simplify the definition of market potential to the form GDP / km^2 and transport / trade costs are analysed by Real Trade Area and Synthetic Free Trade Area analysis.

[3] NUTS is an abbreviation for the nomenclature of Territorial Units for Statistics. According to the NUTS classification, Eurostat has sought to form a division of member countries for the collection of coherent statistical data from the regions of the EU. Cultural differences have also been taken into account, due to which the differences between the sizes of some regions are notable. (European Commission 1994, 172).

3.2 Assumptions

In the statistical analysis we assume that the trade between the inner regions of a country has been free with relatively low barriers for decades. The concept of a synthetic free trade area is constructed so that we could analyze spatial structures within countries. The real situation, where proportionately high trade barriers between the countries have appeared, is compared with the synthetic free trade area. Although the trade barriers between the countries have recently become lower, for example, between European countries, it can still be thought that there have been more trade barriers between countries than within a separate country. One reason is that the trade barriers were caused by the exchange of currency and cultural and linguistic differences. Naturally, there are still trade barriers within the countries but, by and large, it is reasonable to suppose that within the countries trade barriers have historically been relatively lower than between the countries.[5]

The central assumptions of the analysis concerning the synthetic free trade area can be divided into two main parts: the nature of trade within the countries and between them. When both inputs and final products are looked at, the assumption concerning free trade within the countries and international trade barriers can be characterized with the help of the following example. In the supply of inputs, in this case labor force, it is evident that in Finland the supply and mobility of the labor force can be relatively flexible, for example, between eastern and southern Finland in comparison with, for example, the situation between Estonia and southern Finland. There has been regulation that restricts the labor mobility between the countries. Although internationalization is nowadays rapid, evidently in past decades the international markets can nevertheless be said to have been free trade in Europe concerning both inputs and final products if compared to markets within countries. On the basis of this assumption an effort is made to demonstrate how economic activity has been organized spatially within the countries in “extreme integration” over long period in comparison with the manners how economic activities have been agglomerated internationally. International development has been affected by trade barriers that are greater than under “extreme integration”.

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[4] For example, Bivand (1998) specifies the methods of spatial-economic research.

[5] For example Davis *et al.* (1999) conclude in their empirical research that the advantages of spatial agglomeration are significant between the regions within the country but not internationally. They considerthis is caused because within the countries the transport costs and other trade barriers are lower than on the international level and that the mobility of factors of production between the inner regions of the countries is greater than internationally.

Economic integration into the international economy has strengthened and widened remarkably, for example, concerning Austria, Finland, and Sweden in the 1990s. These countries joined the EU in 1995. Due to the stage-by-stage nature of integration, available time series are short-term and with their help the possible long-term effects of integration cannot be found. However, by forming a synthetic free trade area, the spatial structure within the countries can be aggregated and compared with the real trade area.

Another central assumption concerns the significance of different sectors (agriculture, industries, and services) in an economy as an independent variable. The different sectors are operationalized as an estimation of the share of agricultural labor out of the total employed labor. On the international level, the labor share of agriculture largely describes the stage of the economic development (e.g. Camm *et al* 1986). On the other hand, within the countries the share of agricultural labor out of the total employed labor is probably frequently bound to the surface area of the land, since the soil is used as an input in agriculture.

The second independent variable is the increasing returns to scale (IRS) in production processes. High sunk costs imply high increasing returns to scale in the model, *ceteris paribus*. We assume that a significant part of sunk costs are related to R&D activities. Consequently, IRS is denoted as innovation intensity measured by the region's patent applications per GDP. The theoretical model suggests that the greater the IRS, the greater is also the spatial agglomeration of market potential. The third theoretically relevant variable, trade costs (or trade barriers), is investigated by comparing the results of RTA and SFTA analysis.

3.3 Data

The data employed in this study comes from Eurostat's New Chronos Regio database. The database covers a great deal of different regional information. Unfortunately, the Regio database includes a serious problem of time series deficiencies. The selected data comprises NUTS2 regions in 12 countries. The whole set of observations covers the years 1996-1999.

The 12 countries in the study include 187 regions in the following countries: Austria, Belgium, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. The countries are selected according to the data available in the period covering 1996-1999. The subgroup of 8 countries is used in analyzing the longer period 1989-1999 containing 128 regions. The 4-country subgroup of Austria, Finland, Sweden, and the United Kingdom contains 59 regions and covers the years 1996-1999.

Figure 3 depicts the distribution of economic activities among European regions in 1999. The activities are measured by GDP per km^2. The distribution is not equal over the regions, but the densest agglomeration is located within the area reaching from Northern Italy to South-East England. The areas located on the geographic peripheries are mainly economically less active than those located near the geographic gravity centers of the EU.

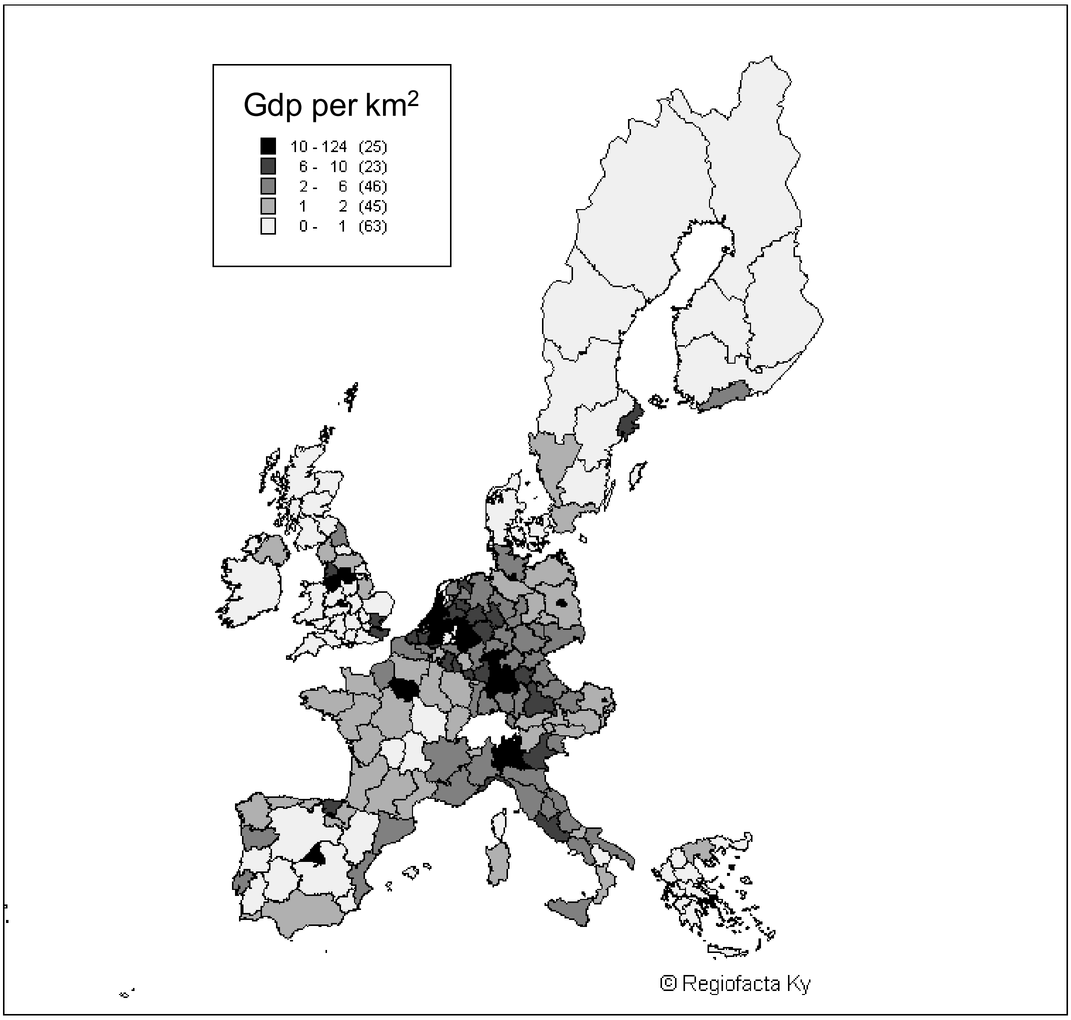

Figure 3. Geographic distribution of market potential (GDP per km^2 in Millions of Euros) in European NUTS2[6] regions.

[6] Eurostat utilizes the NUTS classification in producing and combining European statistics. The abbreviation stands for Nomenclature of Territorial Units for Statistics.

The overseas regions of France have been omitted from the data for the lack of time series. Furthermore, these regions do not seem to have significant relevance for the economic integration process within Europe. The regions located in the former East Germany have been omitted from the analysis partially also for the lack of time series. In addition, the East German regions have been developed under a non-market-oriented environment during recent decades. Hence, the development of economic structures varies from the rest of the data.

3.4 Variable construction

In the theory described above the spatial agglomeration of market potential is regarded as a convenient dependent variable for empirical analysis. We measure spatial agglomeration of market potential as annual Gross Domestic Product[7] (GDP) per region's surface area in square kilometers. The independent variables in the models are the labor share of agriculture (LSA) and increasing returns to scale (IRS). The trade costs, or trade barriers, are investigated in comparing the two sets of models. Due to the different scales of regions, we construct a Metropolitan dummy variable. It is zero for the regions that are classified alike at both NUTS1 and NUTS2 levels. Each variable is logarithmized before other transformations.

Labor structure (LSA) is formed as the share of agricultural labor out of the total labor employed in the region. The labor share of manufacturing in the model is converted reciprocally into the labor share of agriculture. The theoretical model above contains only two sectors, manufacturing and agriculture. However, some service activities have also tended to agglomerate spatially. Thus, we measure the labor share of agriculture ($1-\pi$ in the model) instead of the manufacturing share. It is arguable that agriculture is a proper measure for the empirical analysis because agriculture uses land intensively as an input in its production.

Increasing returns to scale in production activities are linked with the firms' cost structure in the model. There is an absence of sunk cost figures available in our data. In the present study, the number of patent applications is hold as the outcome of R&D activities and sunk costs. Accordingly, the increasing returns to scale in the model are measured by innovation intensity that is patent application per population.

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[7] GDP is purchasing power parity stabilized in each country.

The trade costs in the previous model are investigated empirically in comparison of two models. We form Real Trade Area (RTA) and Synthetic Free Trade Area (SFTA) for analyzing the effects of the different levels of trade costs, or trade barriers. All the annual values are standardized by reducing the annual mean of the same variable in the entire data. Then each outcome is divided by the respective standard errors. In this manner we form the RTA, which describes actual data but is strictly comparable with the following SFTA transformation.

The Synthetic Free Trade Area (SFTA) is constructed by standardizing each variable separately in each country according to Hermans (2000). The standardization is then done by reducing the country-specific means and dividing them by country-specific standard errors. Then we pool the data and analyze one entity (SFTA). SFTA describes a synthetic area, in which the spatial structures have been developed under “extreme” economic integration, in intra-country conditions.

Table 1. Definition of variables.

Theoretical model	Basic variable for empirical analysis	Real trade area (RTA)	Synthetic free trade area (SFTA)
Agglomeration of market potential index (dependent variable)	Regional market potential *GDP per km*^{2} (log)	*GDP / km*^{2} of a region subtracted by its average of entire data and then divided by standard deviation of entire data	*GDP / km*^{2} of a region subtracted by its average in a country and then divided by standard deviation in a country
Labor share of non-agriculture	*Labor share of agriculture*	*Labor share of agriculture* of a region subtracted by its average of entire data and then divided by standard deviation of entire data	*Labor share of agriculture* of a region subtracted by its average in a country and then divided by standard deviation in a country
Increasing returns to scale	Innovation intensity measured as *patent applications per population*	*Patent applications per population* of a region subtracted by its average of entire data and then divided by standard deviation of entire data	*Patent applications per population* of a region subtracted by its average in a country and then divided by standard deviation in a country
Trade barriers	Benchmarking the results of RTA and SFTA models		

Table 1 concludes the construction methods and definitions of variables included to empirical analysis below.

4 Empirical results

The statistical analysis is divided into two parts. First, the data is analyzed by a regression model based on the evolution of the cross-sectional regressors of RTA and SFTA. Secondly, the conventional panel data analysis is used as a benchmark for the first phase results.

4.1 Results of Synthetic Free Trade Area (SFTA) analysis

We employ OLS as a basic regression method. Each year's parameters are estimated separately as cross sections. The RTA describes drivers affecting the spatial agglomeration of economic activities among the countries and the SFTA within the countries. Table 2 presents the results of the 12-country model.

Table 2. Regression analysis (OLS) of 12 countries[8] 1996-1999.

Dependent variable: Agglomeration of market potential (GDP per km^2), 12 countries

Real Trade Area

Year	Descriptives	Constant	Labor structure effect, LSA (labor share of agriculture)	Increasing returns to scale effect, IRS (patents per population)	Metropolitan area (NUTS1)
1996	$R^2 = 0.658$				
	F=106.512***	**-.037**	**-.704*** **	**0.004**	**1.043*** **
	N = 170	**(.044)**	(.057)	(0.050)	(0.260)
1997	$R^2 = 0.617$				
	F=89.245***	**-.040**	**-.696*** **	**-.005**	**.871** **
	N = 170	**(.047)**	(.062)	(.053)	(.285)
1998	$R^2 = .649$				
	F=107.869***	**-.045**	**-.723*** **	**-.010**	**1.045*** **
	N = 179	**(.045)**	(.057)	(.051)	(.274)
1999	$R^2 = .607$				
	F=76.081***	**-.035**	**-.718*** **	**.035**	**1.025*** **
	N = 152	**(.054)**	(.070)	(.056)	(.287)

Standard errors are in parentheses. The asterisk labels (*) stand for:

* 5 per cent risk level.
** 1 per cent risk level.
*** 0.1 per cent risk level.

The results of the 12-country model emphasize the difference between the agglomeration forces in the RTA and SFTA. Spatial agglomeration in the RTA is affected solely by the labor share of agriculture. This implies that the high international distribution of economic activities

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[8] The 12 countries include the same countries as the 8-country analysis, but Austria, Finland, and Sweden are also included. The countries are selected according to the data available in the period covering 1996-1999.

cannot be explained by the IRS effect, or innovation intensity. According to the theory, this might be due to high international trade barriers.

Instead, the SFTA model seems to imply that IRS affects relatively strongly the agglomeration of market potential (table 3). In 1996-1999, the IRS effect is significant. Because there are some changes in the level of significance, this may imply multicollinearity problem. However, the SFTA model implies that the IRS effect, or innovation intensity, is parallel with the spatial distribution of market potential over the entire period investigated here.

Table 3. Regression analysis (OLS) of 12 countries[9] 1996-1999.

Dependent variable: Agglomeration of market potential (GDP per km^2), 12 countries

Synthetic Free Trade Area

Year	Descriptives	Constant	Labor structure effect, LSA (labor share of agriculture)	Increasing returns to scale effect, IRS (patents per population)	Metropolitan area (NUTS1)
1996	R^2 = .708				
	F=134.160***	**-.032**	**-.700*** **	**.094***	**.932*** **
	N = 170	(.040)	(.046)	(.043)	(.233)
1997	R^2 = .687				
	F=121.592***	**-.017**	**-.689*** **	**.091***	**.833*** **
	N = 170	(.041)	(.047)	(.044)	(.245)
1998	R^2 = 0.714				
	F=145.314***	**-.054**	**-.693*** **	**0.154*** **	**1.095*** **
	N = 179	(.040)	(0.045)	(0.042)	(0.235)
1999	R^2 = .703				
	F=116.687***	**-.043**	**-.700*** **	**.124** **	**.930*** **
	N = 152	(.045)	(.052)	(.046)	(.239)

Standard errors are in parentheses. The asterisk labels (*) stand for the level of the statistical risk of denying incorrectly the null hypothesis: the regression coefficient is zero.

* 5 per cent risk level.
** 1 per cent risk level.
*** 0.1 per cent risk level.

When we compare the annual values of regression coefficients between the RTA and SFTA, it seems evident that economic integration has evolving under lower trade barriers within countries (SFTA) than between them (RTA). The labor share of agriculture explains the variance of spatial agglomeration in all the cases at 0.1 per cent risk level. The IRS effect deviates from zero to at least 5 per cent risk level in all the years in the SFTA but not even once in the RTA. Accordingly, this implies different spatial structures among the countries

[9] The 11 countries include the same countries as the 8-country analysis, but Austria, Finland, and Sweden are also added. The countries are selected according to the data available in the period covering 1995-1999.

and within them. If international economic integration acquires similar forms to those of intra-national "extreme" economic integration[10], the innovation intensity can be expected to be a driving force in the relocation of economic activities. However, it is noticeable that the selected country sets have some effects on the qualitative implications.

Tables A1 and A2 in the Appendix present the results of the 8-country analysis during 1989-1999. The model is adjusted by removing the four countries with the shortest time series. Thus, the data ranges from 1989 to 1999. The labor share is still a significant predictor of spatial market potential. As in the 12-country model, the IRS effect, innovation intensity, is not a significant predictor of spatial agglomerations in the RTA. In contrast with the 12-country model, the IRS effect does not significantly expound spatial distribution of market potential in the SFTA even at the 5 per cent risk level, excluding 1998. Therefore, the difference described above in the spatial structures within the countries and internationally is no longer as significant as it is with tighter risk level requirements. According to the theory, the smaller difference between the RTA and SFTA could be explained by the fact that the integration among the countries is already quite advanced. On the other hand, it seems to be a difficult question: how to select the most plausible set of countries for the analysis. We can try to use as long as possible time series with a limited number of countries, or the highest number of countries with a limited time series. In other words, there is a trade-off between the maximum number of years and the number of countries chosen for the analysis.

Finally, the set of four countries, Austria, Finland, Sweden, and the United Kingdom, omitted in 8-country analysis, are also analyzed separately (see Tables A3 and A4 in the Appendix). The results provide parallel support to the first model with 12 countries. Though the labor share of agriculture is still the significant force of the distribution of market potential. The IRS effect is also significant in every year in the SFTA, but not in the RTA. This implies that trade barriers are lower in intra-national trade than internationally. It may tell something about specific features of Finland and Sweden, which have large sparsely populated regions. These countries have high innovation intensity but a relatively low level of market potential in general. However, market potential has agglomerated in some regions within these countries.

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[10] Intra-national development in Europe can be mostly emphasized by free trade, relatively low transport costs, and low cultural barriers during the past decades. Such an economic environment describes the "extreme" integration which has formed the economic structures within countries such as they are.

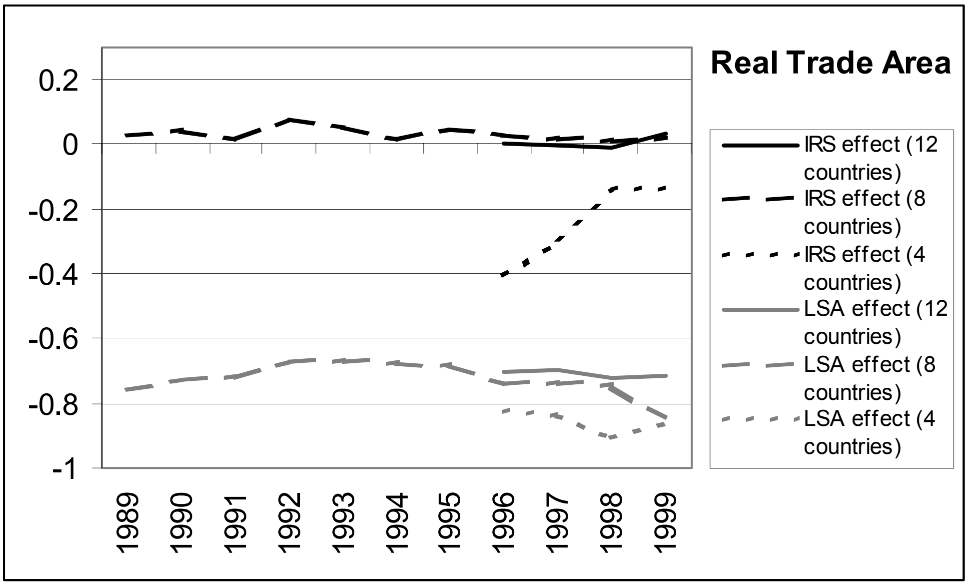

Figure 3. Real Trade Area (RTA). Innovation intensity and the labor share of agriculture explaining the regional agglomeration of economic activities among the countries.

Figures 3 and 4 congregate the information from cross-sectional regression coefficients. The evolution in the RTA seems to be similar in every subset of the data (Figure 3). The labor share of agriculture significantly limits the spatial agglomeration of economic activities and simultaneously the IRS effect does not expound the spatial market potential. As mentioned above, none of the RTA models offered confirmation for the significance of the IRS effect (innovation intensity).

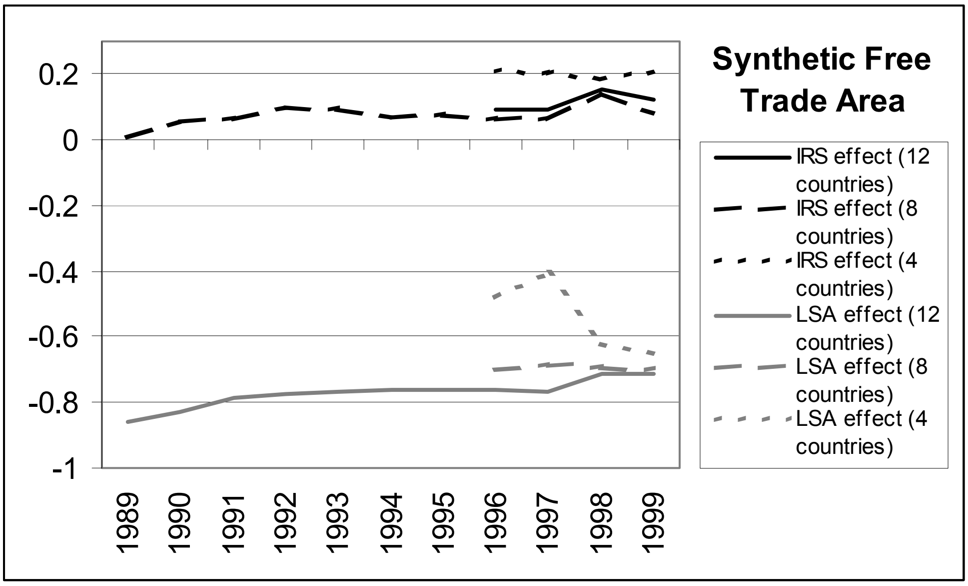

Figure 4. Synthetic Free Trade Area (SFTA). Innovation intensity and the labor share of agriculture explaining the regional agglomeration of economic activities within the countries.

Figure 4 presents the evolution of the SFTA regression parameters. The labor share of agriculture does affect the distribution of economic activities in a consistent way in different data sets (the lower part of the figure). Apart from the RTA scheme, the IRS effect seems to affect spatial market potential more consistently in the 4- and 12-country models than the entire 8-country model.

4.2 Results of panel data analysis

We also benchmark the results of the RTA and SFTA analyses by using the more conventional panel data analysis[11]. Panel data is analyzed in two ways. First, the data is investigated using fixed effect models in within-countries and between-countries frameworks. Secondly, we introduce dummies for each country and each year in the entire panel data. The results are presented in Table 4.

In the fixed effect (within-countries) model, both the labor share of agriculture and IRS effect are significant drivers affecting the market potential. Furthermore, the IRS effect is not a significant driver of spatial agglomerations in the between-countries model. The dummy model implies that both of the basic regressors are significant and that market potential levels are systematically higher in most of the countries than in Sweden, which is selected to be the base. Sweden and Finland score the lowest average market potential. At the same time, there are no significant agglomeration variations over the years in the model.

The results are consistent with the RTA and SFTA comparison at the 5 per cent risk level. The IRS effect seems to be parallel with the spatial market potential within the countries but not between them. And as mentioned above, if international integration is as deep as the intra-country has been, we can expect that the IRS effect will become an important driver of the relocation of economic activities.

[11] Panel data contains the data of the 8 countries covering the period of 1989-1999.

Table 4. Results from regression analysis of the panel data.

Dependent variable: Agglomeration of market potential (GDP per km²)			
Variable	**Fixed effect**	**Between-countries[12]**	**OLS with dummies**
Constant	-1.940***	-4.528	-4.152***
	(.078)	(2.273)	(.127)
Metropolitan area (NUTS1)	1.269***		1.268***
	(.090)		(.090)
Labor structure effect, LSA	-.981***	-1.443*	-.980***
(labor share of agriculture)	(.020)	(.563)	(.020)
Increasing returns to scale effect, IRS	.031*	-.296	.030*
(patent appl. per GDP)	(.013)	(.239)	(.013)
Belgium			2.202***
			(.101)
Germany			2.279***
			(.094)
Greece			2.530***
			(.121)
Spain			1.971***
			(.105)
France			1.782***
			(.097)
Italy			2.649***
			(.010)
The Netherlands			2.920***
			(.010)
Austria			2.020***
			(.118)
Portugal			2.347***
			(.133)
Finland			.259
			(.155)
The United Kingdom			1.833***
			(.099)
Year 1999			0.056
			(0.067)
Year 1998			0.056
			(0.064)
Year 1997			0.086
			(0.064)
Year 1996			0.051
			(0.064)
Year 1995			0.028
			(0.066)
Year 1994			0.074
			(0.068)
Year 1993			0.040
			(0.068)
Year 1992			0.068
			(0.068)
Year 1991			0.070
			(0.069)
Year 1990			0.077
			(0.070)
Number of observations	1509	1509	1509
F	1419.06	3.83	325.83
R^2 (overall)	0.6755	0.5616	0.8405

Standard errors are in parentheses. The asterisk labels (*) stand for the level of the statistical risk of denying incorrectly the null hypothesis: the regression coefficient is zero.
* 5 per cent risk level, ** 1 per cent risk level, *** 0.1 per cent risk level.

[12] When the model also contains the metropolitan area dummy variable, as a regressor, the regression coefficients of constant, metropolitan area, labor structure effect, and sunk cost effect are (standard errors in parentheses): -4.015 (2.279), -8.731 (7.625), -1.166 (0.604), and -.311 (.235), respectively. None of them deviates significantly from zero at the 5 per cent risk level.

5 Conclusions

In the present study, the research question was: How does economic integration affect the location of economic activities? First, we constructed a theoretical model of the new economic geography, from international trade literature. Secondly, we tested the theoretical model empirically using data covering 187 NUTS2 level regions in 12 European countries. The data was divided into three subsets according to the information availability over time. Data on the 8 countries covered the years 1989-1999 and data on the 4 other countries the years 1996-1999. All the countries were also pooled together in 1996-1999.

The theoretical model raised three main drivers affecting the geographical concentration of market potential. The dependent variable, market potential, was measured as GDP per km^2. The first driver, the labor structure effect was measured by labor share in non-agricultural working activities in the theoretical model. In empirical analysis, it was converted into it negation, labor share of agriculture. The second driver, increasing returns to scale in production, theoretically related to sunk costs, was measured as innovation intensity (patent application per population in a region). The third driver, trade costs or trade barriers were investigated by a comparison between Real Trade Area (RTA) and Synthetic Free Trade Area (SFTA). The RTA and SFTA framework was constructed so as to get strictly comparable coefficients over time. A dummy variable, metropolitan area, controlled for the dichotomous effect of five regions defined simultaneously as NUTS1 and NUTS2 regions. Lastly, the results, obtained from the SFTA and RTA analyses, were also benchmarked by conventional panel data analysis.

The economic integration was assumed to be very deep within countries. In other words, trade barriers were assumed to be low between the regions within the same country. This was expected to imply different spatial structures in RTA and SFTA contexts.

An important result of the comparison between SFTA and actual data was that market potential have agglomerated in different ways within the countries on the one hand and internationally on the other: market structure had strongly affected the location of economic activities within the countries, but not positively internationally among the countries during the period 1996-1999 in the entire data of 12 countries.

The results of both the RTA-SFTA analysis and the panel data analysis seem to have some consistent aspects. As expected, the labor share of agriculture was the strongest driver affecting the geographical concentration of market potential in both the RTA and SFTA models. However, the IRS effect seemed to be related to spatial agglomerations of market potential only in the within-country context. An exception to this was the 8-country set in which the IRS effect was significant only in the end of the time series. This is to say, generally speaking that business activities have not been located internationally according to the level of the IRS effect or innovation potential of regions. This implies that economic integration has not been as deep internationally as it has been within the countries.

The model was adjusted by removing the four countries with the shortest time series. Thus, the data ranged from 1989 to 1999. Then the statistical model employed involved the problem of varying results depending on the group of countries investigated. The increasing returns to scale (IRS) effect (sunk cost effect / innovation intensity) no longer predicted the agglomeration of economic activities as significantly as in the12-country case either in SFTA or in RTA. However, the four countries removed were also analyzed separately. Then the IRS effect was significant in any period in SFTA in the four-country model. Finally, we used the entire time series (1989-1999) panel data and benchmark the above results by a conventional panel data analysis. The benchmark supported the results obtained from the entire 12-country and 4-country models. The IRS effect steered the location of economic activities within the countries, but not between them.

In the present study, we scrutinized the regional structures emerging within and among the countries. Although the regional time series available were relatively short, the assumption of "extreme" integration within countries guided us in understanding the long run development. The current spatial structures have been developed over many decades. Hence, the short time series capture only the outcome of the long-run development. The small variation of the coefficients over time supports the statement: Regional effects of economic integration did not seem to alter during the period investigated. The only exception was the 8-country subset in which we observed this phenomenon only in the end of the time series.

Innovation intensity seems to be an important target for further research. Industry branches and their market structures could be analyzed in regional context. The industry-specific empirical framework could offer new insights for the discussion on regional development especially in the industries with high innovation intensity.

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APPENDIX 1. Regression analysis of 8 countries.

Table A1. Regression analysis (OLS) of 8 countries[13] 1989-1999

Dependent variable: Agglomeration of market potential (GDP per km^2), 8 countries

Real Trade Area

Year	Descriptives	Constant	Labor structure effect, LSA (labor share of agriculture)	Increasing returns to scale effect, IRS (patents per population)	Metropolitan area (NUTS1)
1989	R^2 = .751				
	F=109.436***	**.014**	**-.758*** **	**.029**	**.351**
	N = 113	(.042)	(.059)	(.039)	(.364)
1990	R^2 = .771				
	F=112.525***	**.115*** **	**-.727*** **	**.039**	**.857*** **
	N = 104	(.043)	(.057)	(.041)	(.280)
1991	R^2 = .760				
	F=114.758***	**.011**	**-.721*** **	**.016**	**.850*** **
	N = 113	(.042)	(.057)	(.042)	(.287)
1992	R^2 = .761				
	F=120.766***	**.001**	**-.670*** **	**.078**	**1.055*** **
	N = 118	(.042)	(.055)	(.042)	(.285)
1993	R^2 = .762				
	F=123.043***	**-.017**	**-.675*** **	**.052**	**.939*** **
	N = 119	(.039)	(.052)	(.038)	(.269)
1994	R^2 = .761				
	F=122.992***	**.003**	**-.681*** **	**0.017**	**.095*** **
	N = 120	(.038)	(.053)	(.039)	(.268)
1995	R^2 = .750				
	F=115.735***	**-.004**	**-.686*** **	**.043**	**.850*** **
	N = 120	(.041)	(.057)	(.043)	(.295)
1996	R^2 = .766				
	F=131.899***	**.098***	**-.741*** **	**.027**	**1.225*** **
	N = 125	(.040)	(.058)	(.042)	(.272)
1997	R^2 = .731				
	F=108.061***	**.111***	**-.743*** **	**.017**	**1.075*** **
	N = 123	(.043)	(.064)	(.045)	(.298)
1998	R^2 = .719				
	F=100.577***	**.127*** **	**-.745*** **	**.012**	**1.261*** **
	N = 122	(.043)	(.065)	(.045)	(.347)
1999	R^2 = .746				
	F=87.267***	**.234*** **	**-.846*** **	**.016**	**.670***
	N = 93	(.047)	(.078)	(.044)	(.303)

Standard errors are in parentheses. The asterisk labels (*) stand for the level of the statistical risk of denying incorrectly the null hypothesis: the regression coefficient is zero.

* 5 per cent risk level.
** 1 per cent risk level.
*** 0.1 per cent risk level.

[13] The 11 countries include the same countries as the 8-country analysis, but Austria, Finland, and Sweden are also added. The countries are selected according to the data available in the period covering 1995-1999.

Table A2. Regression analysis (OLS) of 8 countries[14] 1989-1999.

Dependent variable: Agglomeration of market potential (GDP per km²), 8 countries

Synthetic Free Trade Area

Year	Descriptives	Constant	Labor structure effect, LSA (labor share of agriculture)	Increasing returns to scale effect, IRS (patents per population)	Metropolitan area (NUTS1)
1989	R^2 = .765				
	F=118.264***	**.016**	**-.859*****	**.009**	**.535**
	N = 113	(.047)	(.054)	(.053)	(.383)
1990	R^2 = .771				
	F=112.392***	**.007**	**-.826*****	**.058**	**.952****
	N = 104	(.049)	(.054)	(.053)	(.310)
1991	R^2 = .746				
	F=106.607***	**-.001**	**-.789*****	**.061**	**.936****
	N = 113	(.049)	(.055)	(.055)	(.330)
1992	R^2 = .740				
	F=107.899***	**-.013**	**-.775*****	**.097**	**1.051****
	N = 118	(.048)	(.053)	(.053)	(.325)
1993	R^2 = .747				
	F=112.888***	**-.005**	**-.767*****	**.092**	**1.023****
	N = 119	(.047)	(.052)	(.051)	(.321)
1994	R^2 = .743				
	F=111.901***	**.004**	**-.764*****	**.069**	**.096****
	N = 120	(.046)	(.052)	(.051)	(.318)
1995	R^2 = .721				
	F=100.008***	**-.018**	**-.762*****	**.074**	**1.065****
	N = 120	(.050)	(.056)	(.054)	(.339)
1996	R^2 = .724				
	F=106.017***	**-.029**	**-.759*****	**.060**	**1.214*****
	N = 125	(.047)	(.053)	(.051)	(.325)
1997	R^2 = .729				
	F=106.747***	**-.015**	**-.766*****	**.062**	**1.066****
	N = 123	(.047)	(.053)	(.052)	(.332)
1998	R^2 = .695				
	F=89.444***	**-.033**	**-.714*****	**.143****	**1.320****
	N = 122	(.049)	(.054)	(.053)	(.053)
1999	R^2 = .662				
	F=58.181***	**-.031**	**-.713*****	**.079**	**.970***
	N = 93	(.061)	(.069)	(.063)	(.382)

Standard errors are in parentheses. The asterisk labels (*) stand for the level of the statistical risk of denying incorrectly the null hypothesis: the regression coefficient is zero.

* 5 per cent risk level.
** 1 per cent risk level.
*** 0.1 per cent risk level.

14 The 11 countries include the same countries as the 8-country analysis, but Austria, Finland, and Sweden are also added. The countries are selected according to the data available in the period covering 1995-1999.

APPENDIX 2. Regression analysis of 4 countries.

Table A3. Regression analysis (OLS) of 4 countries[15] 1996-1999.

Dependent variable: Agglomeration of market potential (GDP per km^2), 4 countries

Real Trade Area

Year	Descriptives	Constant	Labor structure effect, LSA (labor share of agriculture)	Increasing returns to scale effect, IRS (patents per population)	Metropolitan area (NUTS1)
1996	R^2 = 0.654				
	F=25.791***	**-.354***	**-.825*****	**-.405**	**.723**
	N = 45	**(.137)**	(.117)	(.308)	(.482)
1997	R^2 = 0.637				
	F=25.177***	**-.416****	**-.841*****	**-.302**	**.449**
	N = 47	**(.131)**	(.121)	(.268)	(.510)
1998	R^2 = .732				
	F=48.224***	**-.470*****	**-.909*****	**-.142**	**.815***
	N = 57	**(.103)**	(.098)	(.224)	(.393)
1999	R^2 = .690				
	F=40.870***	**-.502*****	**-.864*****	**-.138**	**1.022***
	N = 59	**(.103)**	(.104)	(.219)	(.411)

Standard errors are in parentheses. The asterisk labels (*) stand for the level of the statistical risk of denying incorrectly the null hypothesis: the regression coefficient is zero.

* 5 per cent risk level, ** 1 per cent risk level, *** 0.1 per cent risk level.

Table A4. Regression analysis (OLS) of 4 countries 1996-1999.

Dependent variable: Agglomeration of market potential (GDP per km^2), 4 countries

Synthetic Free Trade Area

Year	Descriptives	Constant	Labor structure effect, LSA (labor share of agriculture)	Increasing returns to scale effect, IRS (patents per population)	Metropolitan area (NUTS1)
1996	R^2 = .738				
	F=38.551***	**-.075**	**-.481*****	**.211****	**1.007****
	N = 45	(.068)	(.083)	(.072)	(.312)
1997	R^2 = .649				
	F=26.494***	**-.060**	**-.405*****	**.203***	**1.060****
	N = 47	(.075)	(.093)	(.079)	(.357)
1998	R^2 = 0.767				
	F=58.053***	**-.110**	**-.621*****	**.185***	**1.146*****
	N = 57	(.067)	(.082)	(.070)	(0.301)
1999	R^2 = .778				
	F=64.304***	**-.066**	**-.652*****	**.208****	**.967****
	N = 59	(.080)	(.080)	(.068)	(.296)

Standard errors are in parentheses. The asterisk labels (*) stand for the level of the statistical risk of denying incorrectly the null hypothesis: the regression coefficient is zero.

* 5 per cent risk level, ** 1 per cent risk level, *** 0.1 per cent risk level.

[15] The 12 countries include the same countries as the 8-country analysis, but Austria, Finland, Sweden, and the UK are also added. The countries are selected according to the data available in the period covering 1996-1999.

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