Industrial Localization and Countries' Specialization in the European Union

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Abstract

The development of Industrial Localization and Countries' Specialization Patterns in the European Union, the driving forces behind and dynamic tendencies will be investigated in this paper making use of EU-KLEMS data. New Trade Theory and New Economic Geography can explain both Industrial Concentration and Countries' Specialization in the EU best. Results of co-integration analysis show that imbalances in European Countries' Specialization are being set off at a rate of about 63 to 79 percent within the next period. Adjustment rates for Denmark, France, Germany, Spain and Sweden are lower than for the EU as a whole.

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Keywords: New Economic Geography, Concentration, Specialization, European Integration, Co-integration

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1 Introduction

The European Union experienced a great bunch of stages of integration over time. This process of integration meant a reduction of protectionism reinforced with the legal validity of the Single European Act in 1987 and therewith the implementation of the Single European Market Program. Further trade liberalization also occurred under the GATT and with the establishment of the WTO in 1995. The question arises whether ongoing integration exerts an influence on European countries' specialization and industrial agglomeration. It is important for many branches of European politics to know about agglomeration and specialization processes in the EU. If countries become more specialized, asymmetric shocks might damage single countries a lot.

This view is supported by Bayoumi and Eichengreen (1992) who found that European countries show less coherence of aggregate supply and demand shocks across countries than do US regions. Also European countries' adjustment to aggregate shocks was slower than for the US. Only a group of core European countries taken for analysis, that is Germany, France, Belgium, the Netherlands and Denmark, resemble the US in coherence of shocks. But there is also contradicting evidence concerning the relevance of asymmetric shocks existing in the literature. Frankel and Rose (1998) find that increasing trade liberalization would foster European business cycle synchronization, which makes a common currency feasible. This is primarily due to intra-industrial trade and thus equalizing economic structures across countries. On the other hand, a common currency will also lead to higher trade and thus higher business cycle correlation, therewith the authors could derive the important result of optimum currency area criteria being endogenous. In fact, taking a look at recent developments, intra-industrial trade has experienced an increase over time, staying at quite a constant level from 1995 to 2005 ranging about 75 to 76 percent over all industry activity in the EU.[1] The constancy of intra-industrial trade, however, might indicate that in case of growing specialization countries' economic structures would become more and more unequal to each other, making them subject to asymmetric shocks again.

Because of European common monetary policy, one important tool in smoothing crises has become absent, European countries are not able to conduct a monetary policy themselves, any more. Mundell (1961), in his theory on optimal currency areas, pointed to the following problem for countries having a common currency. If there is a shift of demand from country B to country A, then country A will suffer from inflationary pressure and country B from unemployment. If the common central bank decides to take care of the unemployment issue, then money supply would have to be increased, which would aggravate the inflation problem in country A even further. Or, taking the other way round, taking care of stability in price levels, the central bank would have to agonize unemployment in country B. Alternatively, in case of flexible exchange rates, country B's currency would have to depreciate and country A's currency to appreciate in order to correct external imbalances. Mundell further explains that a set of countries introducing a common currency should possess a high degree of factor mobility because only then in the absence of flexible exchange rates across countries having this common currency, imbalances like unemployment or inflation can be reduced.[2] However, mobility of labor, for example, in the EU is not as high as in the US, for example. This is known to be due to differences in languages, cultural habits and preferences, etc., between the European Union's member countries. Consequently, a higher degree of specialization and fewer labor mobility would make the EU not a good candidate for a currency union.

The aim of this study, now, is to investigate the development of industrial localization and countries' specialization in the European Union from 1970 to 2005 and to find evidence for the driving factors of both localization and specialization. Existing research work is extended by using a new data set, covering a longer period of time and by applying several econometric methods in order to explain both localization and specialization. The focus will be on evaluating the importance of Traditional Trade Theory, New Trade Theory and the New Economic Geography in explaining localization and specialization. Further, dynamic tendencies of localization and specialization will be investigated by applying co-integration and error correction modeling methods. To the best of my knowledge this is the first study that explicitly considers stationarity properties of regression variables in studying agglomeration issues. In regard of the ongoing process of integration in the European Union this study gives valuable insight into the evolution of industrial structures in Europe. In fact, it will be possible to show different European countries' adjustment rates to their long-run equilibrium state of specialization (as measured by employment shares). That way one can gain information on how quickly economic structures can change, on how much employment and as such the labor market adjust to deviations from long- run equilibrium.

This paper is organized as follows. In the second chapter the theoretical background and literature review will be addressed. The third chapter deals with the empirical analysis. In the first part of the Empirics section I will describe how to compute measures of agglomeration and specialization. Data issues will be addressed. Localization and specialization patterns over time will be shown in part two and three. The fourth part investigates potential driving factors of localization, the fifth part does so for specialization tendencies in the European Union. In the sixth part I present some robustness checks and in the seventh part I seek after dynamic changes both in localization and specialization in the European Union and make use of co-integration and error correction modeling techniques. The fourth chapter concludes.

2 Theoretical Background

Trade theories give different explanations for countries' specialization. Whereas Ricardo predicts that countries specialize according to their comparative advantage, Heckscher-Ohlin tells us that a country specializes in producing and exporting that good that is produced relative intensively with the factor the country is relatively well endowed with.

New Trade Theories emphasize that economies specialize because of making use of scale economies in production. Using scale effects firms can reduce costs of production. Either they can produce more output at a given cost or they can reduce costs producing a given output. Thinking about a homogeneous good, countries would specialize in the good they have the higher market share in, initially. Further integration, thereby seizing international trade, would make countries' industrial structures become even more unequal. If we assume goods to be heterogeneous within a sector, however, free trade would make consumers getting access to a greater variety of products. Free trade in turn, would seize intra-industrial trade, leading to equalized industrial structures across countries.

New Economic Geography, elaborated in particular by Paul Krugman, argues that further integration would make countries become more different (Krugman (1991 b), Krugman and Venables (1995), Krugman and Venables (1996)). One has to differentiate between different stages of transport costs, however. High transport costs between countries would make them still keep the full range of industries guaranteeing a fair level of subsistence. There is no agglomeration at place. According to Krugman/ Venables (1995) with falling transport costs producers of final and intermediate goods would tend to move together, each industry would concentrate in one country only. Firms for intermediate goods (upstream firms) making use of economies of scale will locate at sites where demand is high, usually this will be in the larger market (backward linkage). They can minimize transport costs this way. Demand in turn will be high in places where firms for intermediate goods are already located in, because final goods (by downstream firms) can then be produced at lower costs (forward linkage). The interaction between transport costs and trade in intermediates might lead to agglomeration. As Krugman and Venables (1995) point out, a core-periphery pattern emerges. But if transport costs continue to fall the importance of being close to markets and suppliers might decline. Lower labor costs in the periphery could make firms remove again, core and periphery regions would converge.

There exists a vast body of literature measuring and explaining agglomeration and specialization patterns. I am not going to give an exhaustive review on all of that work being done so far. I would like to point to Brülhart (1998) who gives a good review on trade and location theory and considers various studies up to the year his study was published. Further, Redding (2010) reviews some of the recent empirical studies on New Economic Geography. Here instead, only some of the relevant literature will be reported, the one that gave me most of the inspiration for the research conducted I will talk about in detail in section 3.

Summarizing, there exist studies that give evidence for the validity of Traditional Trade Theory in explaining agglomeration or specialization (Brülhart (2001), Kim (1995)), some find support for New Trade Theory (Amiti (1998), Amiti (1999), Kim (1995), Paluzie, Pons, Tirado (2001)) others see New Economic Geography as a main explanatory force (Amiti (1998), Amiti (1999), Ezcurra, Pascual, Rapun (2006), Davis and Weinstein (1999), Midelfart-Knarvik et al. (2000)). Whereas most studies agree with growing agglomeration tendencies, there is discordance about tendencies of specialization. Some studies find out that specialization in the EU increased (Amiti (1998, 1999)) some others find that specialization decreased over time (Paluzie, Pons, Tirado (2001), Ezcurra, Pascual, Rapun (2006)).

The following studies investigate localization and specialization tendencies in the European Union. Amiti (1998, 1999) investigates both industrial localization and countries' specialization in the EU for the period from 1968 to 1990. She finds evidence for increasing specialization in the EU, involving all countries especially between 1980 and 1990. She explains this through increasing trade liberalization in the European Union. But over the period from 1968 to 1990 there is a fall or no significant change in specialization for Portugal, Spain and the UK. According to Amiti this might be due to structural adjustment these countries had to face being late joiners to the EU. Furthermore, she can show that industries agglomerated because of scale economies and high intermediate goods intensity. This supports the validity

of New Trade Theory and New Economic Geography in explaining agglomeration.
Brülhart (2001) finds evidence for growing industrial concentration in the EU from 1972 to 1996. Especially, labor intensive industries showed the highest increase in concentration. The author argues that Traditional Trade Theory might exhibit some explanatory power for industrial concentration, still. Further, he can show that concentration increased after 1986–the time the European Single Market program was implemented–for some industries which are being highly sensitive to abolishing intra-EU non-tariff barriers. These industries comprise beverages, pharmaceuticals, office and computing and shipbuilding.

Midelfart-Knarvik et al. (2000) find out that most European countries converged in regard of their manufacturing structures until the 1980s but then diverged. Industrial concentration became less until the 80s but then increased. The authors show that some industries initially concentrated (basically high returns to scale industries like motor vehicles, aircraft, electrical apparatus, chemical products, petroleum and coal) stayed concentrated, other industries (high technology, high skill, fast growing industries like office, computing, machinery, radio) got more dispersed. Industries being initially dispersed (lower returns to scale, low tech, the slower growing, less skilled labor intensive ones like textiles, leather, furniture, transport equipment) got more concentrated especially in low wage and low skill abundant countries. Running regressions the authors find that forward and backward linkages are important for localization and since the importance of economies of scale is declining they state that a very low level of transport costs seems to be reached. The authors could further find that there was a steady decrease in US specialization from 1970 until 1997 whereas EU specialization decreased until 1983 and then slightly increased. They show that especially electronics (office, computing, radio, tv, communication), machinery and instruments foster dispersion in the US and in Europe.

Ezcurra, Pascual and Rapun (2006) show that overall regional specialization in the EU decreased from 1977 to 1999. Smaller regions displayed higher reductions. These are the regions that had a high specialization level in the beginning of the investigated time period and converged towards the European average over time. However, since the 1990s there is an increase in specialization evident. The authors further find out that market potential and regional size influence specialization, therewith pointing to New Economic Geography models' relevance.

Paluzie, Pons and Tirado (2001) show in a country study for Spain that there is no specialization tendency for Spanish provinces from 1979 to 1992. A reduction in trade costs did not affect industrial localization. The authors can show that Heckscher-Ohlin theory and New Economic Geography do not explain industrial concentration but scale economies do.

Duranton and Overman (2005) investigate firm localization in the UK by assessing the departure of actual distribution of distances between firms from distances of randomly generated counterfactuals. They find that most localized are textile or textile-related industries and media-based industries, most dispersed are food-related industries and industries with high transport costs or dependence on natural resources. Publishing, chemicals, computers and radio and TV point to localization driven by small establishments. In textiles and petroleum and other non-metallic mineral products, smaller establishments are more dispersed.

For the USA Kim (1995) argues that both resource use and scale economies could explain specialization and localization best. External economies, however, cannot explain the developments. The author thus states that Heckscher-Ohlin type arguments should not be neglected in explaining specialization trends. His results on specialization and agglomeration in the US are the following: Regional specialization in manufacturing declined slightly from 1860 to 1880 then increasing until the first world war, flattening until the second world war and falling again until 1987. Agglomeration shows about the same trend over time. The author explains that specialization occurred until the second world war because firms at that time increasingly used large-scale production methods and resources which were immobile. After the second world war decreasing scale economies and resource endowments becoming more mobile and thus regionally similar caused tendencies of despecialization. Tobacco, textiles and apparel got more regionally concentrated all over time, whereas food, paper, printing and publishing and chemicals got more dispersed from 1860 to 1947 and then remained at their respective level. Kim is being criticized for his operationalization of Heckscher-Ohlin theory by raw material intensity: theory would not predict that resource intensive industries are more agglomerated than labor- or capital-intensive ones (see Amiti (1999)).

The next two studies consider localization issues for Japan. Davis and Weinstein (1999) tested the relevance of comparative advantage versus increasing returns to scale for regional production in Japan. Investigating the effects of New Economic Geography they took a look at the home market effect described by Krugman (1980): when increasing returns and transport costs exist, production would tend to locate close to the largest market. This is because locating in one place a firm can benefit from scale economies and minimize transport costs.[6] The large demand would lead to concentration of firms which will then export that good. In contrast, according to Heckscher-Ohlin theory–assuming decreasing returns to scale in production–the highly demanded good would have had to be imported. Davis and Weinstein first run regressions controlling for base level of production, demand and factor endowments. This way they could not detect any explanatory power of the New Economic Geography. However, when separating regressions on the one hand for industries being monopolistic competitive and on the other hand for industries being non-monopolistic competitive, they found significant effects of New Economic Geography for sectors producing under increasing returns to scale, that is a coefficient for demand higher than one. These sectors comprise general machinery, electrical machinery, transportation equipment and precision instruments, textiles, paper and pulp, iron and steel, chemicals and non-ferrous metals. A further important result is that they cannot confirm the explanatory power of New Economic Geography for international specialization but only for regional data. Their explanations for this result are on the one hand lower transport costs between regions of a country, thus fostering regional location of production, on the other hand greater factor mobility across regions again fostering regional localization.

Davis and Weinstein (2002) use the bombing of Japan in World War II as a natural experiment to test for the relevance of increasing returns, random growth and fundamental locational characteristics for redistribution of Japanese population. They hypothesize that a shock would lead to permanent effects concerning city size according to random growth theory, whereas when locational characteristics were important and the shock was only temporary, then there are no permanent effects due to the shock. Increasing returns would feature both recovery and possible catastrophes changing city sizes permanently. Since Japanese population recovered to its pre-war level within about 15 years, the authors argue that locational elements determine population densities and increasing returns are also important explaining increasing population in various regions over time, especially over the industrialization period.

In the following section I will talk about my own results on disentangling the importance of the different trade theories and the New Economic Geography in explaining agglomeration and specialization in the European Union.

3 Empirical Analysis

3.1 Measuring Industrial Localization and Countries' Specialization

In accordance with Krugman (1991 a) and Amiti (1998, 1999) Gini coefficients are used for measuring both localization and specialization. This method reaches back to Hoover (1936), who measured localization of US manufacturing industries from 1900 to 1930.

One has to differentiate between measurement of countries' specialization in their manufacturing production and industries' geographical concentration. The first measure relates to changes in industrial structures in countries whereas the last measure relates to concentration of industries. In the following I will talk about countries' specialization when changes in countries' industrial structures are addressed. Further, I will employ the terms industrial localization, agglomeration and concentration as synonyms relating to industries' geographical concentration.[3]

In addition, one has to differentiate between industries and firms. Industries comprise firms as single units, plants and establishments will be used as synonyms for the term *firms*. Industries are given by the OECD ISIC Rev. 3 classification, branches and sectors will be used as synonyms for *industries*.[4]

The Gini coefficients are calculated as follows. First compute the Balassa index

$$B_{ic,t}^{S} = \frac{\frac{e_{ic,t}}{e_{c,t}}}{\frac{e_{i,t}}{E_t}} \tag{1}$$

for countries' specialization and

$$B_{ic,t}^{C} = \frac{\frac{e_{ic,t}}{e_{i,t}}}{\frac{e_{c,t}}{E_t}} \tag{2}$$

for industries' geographical concentration.

Here $e_{ic,t}$ denotes industry i's employment in country c, $e_{c,t}$ is total manufacturing employment in country c, $e_{i,t}$ denotes total industry i employment in the European Union, and E_t is total manufacturing employment in the European Union, all taken for one point in time t. The Balassa index can be thought of as a kind of relative specialization. Let's think about it in the case of industries' geographical concentration. The denominator denotes the share of total manufacturing employment in country c to total manufacturing employment in the EU. This share measures the magnitude in terms of total manufacturing employment of a country. The nominator consists of the share of industry i's employment in country c to total industry i employment in the European Union. This share measures the magnitude of an industrial sector in a country. Now, if a country possesses a low magnitude in total manufacturing employment (small value of denominator) but a high magnitude in an industrial sector's employment, the Balassa index will show up a high value indicating a country's strong specialization in the given industry. The Balassa index will be equal to one if a country's industrial employment relative to the EU equals the country's total employment share relative to the EU.

The Gini coefficient is calculated by first ranking the Balassa index in descending order. Then one constructs a Lorenz-curve, that is plotting the cumulative of the numerator on the vertical axis and the cumulative of the denominator on the horizontal axis (cumulating over countries for calculation of $gini_{it}$ that is the Gini for industrial agglomeration, and cumulating over industries for calculation of $gini_{ct}$ which addresses countries' specialization). The Gini coefficient is equal to twice the area within a 45 degree line and the Lorenz curve. This procedure yields a Gini coefficient for one point in time and one industry i in case of measuring industrial agglomeration, and for one point in time and one country c in case of measuring countries' specialization. Computations were repeated for all time points t, industries i and countries c, for I calculated both industry and country Gini coefficients. The Gini coefficient equals zero if an industrial sector or a country is totally equally distributed across countries or across industries, respectively. Agglomeration or specialization then will be low. The Gini coefficient approaches one the more the Balassa indexes differ from one, agglomeration or countries' specialization will be high.

Taking the Gini coefficient for measuring agglomeration is criticized for the following reasons. Amiti (1999) explains that at a more aggregated level of industries fewer specialization would be detected. This effect can be easily understood thinking about what happens to the area between the Lorenz curve and the 45 degree line when industries are merged: the area gets smaller, thus the Gini coefficient will become lower. Amiti (1999) further addresses a special drawback of the Gini coefficient: most weight is attributed to changes in the middle values of the distribution, that is those industries changing that are closest to the European average will mostly make up the Gini coefficient. Here, in one of the later sections for checking robustness of results another index measuring agglomeration, which is not driven by the problems related with the Gini coefficient will also be calculated.

The data stem from the EU KLEMS Database (2008) and can be downloaded online. EU KLEMS is a data collection project funded by the European Commission.

The data collection has been done and supported by the OECD, several statistical offices, national economic policy research institutes and academic institutions in the EU. I have chosen EU KLEMS data because they seem to be most comprehensive, the OECD database was having several gaps instead. For computation of Gini coefficients national employment data were extracted. The variable taken was *number of persons engaged*. Data covering 14 European countries were taken. Luxembourg had to be discarded from the sample since data were missing for many industries. In the end I could make use of 20 industries. A further disaggregation of industries was prevented by lack of data. Employment data were available for the period from 1970 to 2005. Most of the country variables were available for this time period, however, for several industries data on value added, output and compensation (variables needed for explaining concentration and specialization) were available from 1995 to 2005 only. Furthermore, an openness index was taken from Penn World Table (2006) and an index for trade costs from Dreher (2006).

Since data on explanatory variables for Italy (that is labor compensation, capital compensation, intermediate inputs, value added, gross output as volume and as value) were missing in the EU KLEMS database, I decided to take data for explanatory variables for Italy from the OECD STAN database. Further, values given in national currency for Denmark, Sweden and the UK were converted to values in euros, using the respective exchange rates at January 4th 1999.[5] Lastly, all values for explanatory variables for all countries were deflated using the price index for gross output (1995=100). This has been done in order to cancel out trends in values over time just being caused by inflation. Using several price indices for various variables (like a special price index for developments in values of labor compensation, another one for developments in values of capital compensation etc.) was prevented by lack of data. Using either deflated or non-deflated data, however, did not change the regression results qualitatively.[6] This is corresponding to results by Amiti (1998, 1999).

The evolution of European localization and specialization will be shown in the next section.

3.2 Industrial Localization

Industrial concentration tendencies over time will be shown, first.[7] The results are given in table 1.

Insert table 1 here.

As can be seen average industrial agglomeration in the EU increased from 1970 to 2005 by about 25 percent. Some industries show a sharp increase in industrial concentration over time, among these are the textile industry (182 percent), leather and footwear (about 123 percent), wood industry (about 98 percent) and motor vehicles (about 96 percent). Agglomeration declined in the branches of food, beverages, tobacco, pulp and paper, basic metals, fabricated metals, rubber and plastics and other transport equipment.

The OECD classifies industries according to ISIC Rev. 3 into four main sectors: low technology industries (comprising food, beverages, tobacco, textiles, leather, footwear, wood, cork, pulp, paper, printing and publishing and manufacturing not elsewhere classified and recycling), medium-low technology industries (comprising basic metals, fabricated metals and non-metallic mineral products, coke, refined petroleum, nuclear fuel, rubber, plastics and building and repairing of ships and boats)[8], medium-high technology industries (comprising chemicals excluding pharmaceuticals, machinery and equipment, electrical machinery, motor vehicles, trailers, semi-trailers, railroad equipment and transport equipment)[9] and high technology industries (comprising pharmaceuticals, office, accounting, computing machinery, radio, television, communication equipment, medical, precision and optical instruments).[10] Table 2 lists the results.

Insert table 2 here.

Low-technology industries have agglomerated the most over time. In 1970 low technology industries had a Gini coefficient of 0.1692. In 2005 low-technology industry's Gini coefficient is about 0.27 compared to 0.22 for the European industries' average. Agglomeration of low-technology industries therewith increased by about 61 percent. Medium-low technology industries deagglomerated over time by about 4 percent, whereas medium-high technology industries showed a significant increase in agglomeration of about 12 percent.

Grouping industrial sectors according to their use of labor, research, resources or level of scale economies, one might gain a better insight into agglomeration forces.[11] Sectors are grouped into labor- (comprising fabricated metals, textiles, leather and footwear), research- (comprising coke, petroleum, rubber, plastics, machinery equipment, motor vehicles, other transport equipment, recycling, chemical industry, office, accounting, computing machines, electrical machinery, radio, tv, communication, medical, precision and optical instruments), scale- (comprising printing, publishing, rubber, plastics, chemical industry, motor vehicles, and other transport equipment) and resource-intensive (comprising basic metals, non-metallic mineral products, wood, cork, paper, pulp, coke, refined petroleum, nuclear fuel) industries:

Insert table 3 here.

Labor intensive industries show a sharp increase in agglomeration over time, about 114 percent, supporting evidence from Brülhart (2001) and Kim (1995). This increase is much more than the increase of average European industries' concentration from 1970 to 2005 by about 25 percent. Thinking about reasons for this kind of development one should take a closer look at the countries that record a big increase in industrial concentration. The Balassa index for industries such as textiles, leather and footwear is especially high for Italy, Greece, Portugal and Spain. The argumentation behind could be that labor intensive industries have concentrated in these countries because of lower labor costs. This argumentation would support Traditional Trade Theory.[12] However, this deserves further investigation. The importance of Traditional Trade Theory will be explicitly tested for in one of the later sections.

The other industries show only moderate increases in industrial concentration over time. Resource intensive industries showed an increase of about 17 percent, scale intensive industries of about 15 percent and research intensive industries of about 12 percent, respectively. The reasoning for developments in resource intensive industries might be that agglomeration in this sector has occurred in the years before the investigation period of 1970-2005.[13] Availability of resources plays an important role in this sector. Transport costs for this sector are high because of the need to produce in the vicinity of resources. Interestingly, after a slight decline in concentration until 1990, agglomeration of these industries increased to a remarkable amount (about 18 percent) until 2005.

Scale intensive industries show a slow increase in industrial concentration over time. Research intensive industries display only a slight increase in industrial agglomeration over time. Obviously, this industry needs highly skilled labor. Traditional Trade Theory would argue that this kind of industry will agglomerate in countries that are highly endowed with high-skilled labor. Theses issues will be clarified in one of the later sections.

3.3 Countries' Specialization

Specialization and agglomeration are closely related to each other as has been shown by Kim (1995) for example. A growing specialization of European countries would indicate that industrial structures of European countries have become more unequal to each other.

Insert table 4 here.

Taking a look at country Gini coefficients given in table 4 one can see that it is Germany, France, Greece, Portugal, Italy and Ireland that show a significant increase in specialization during the time period from 1970 to 2005. However, specialization shows only slight changes compared to agglomeration tendencies. It becomes evident that those countries exhibiting middle-high specialization states in the 70s tended to despecialize a little until 2005. Highly specialized countries in 1970 like Greece, Ireland and Portugal show a sharp increase in specialization until 2005 as well as those countries being only little specialized in 1970 (Germany, France and Italy, also). Besides, countries lying in the periphery of Europe like Ireland, Greece and Portugal and two important European core countries, namely Germany and France, exhibit high increases in specialization from 1970 to 2005. I can confirm results of Amiti (1998,1999) for Spain and the UK but not for Portugal which experienced an increase in specialization from 1970 to 1990.

3.4 Explaining Industrial Localization

In the following I will focus on the investigation of driving factors of industrial concentration in the European Union. To address this issue an estimation equation containing variables that are supposed to excess an influence on industrial localization will be set up. Explanatory variables are taken from the two trade theories and the New Economic Geography discussed in more detail above. Amiti (1999) has specified and estimated an regression function explaining industrial agglomeration, as well. I will draw on the variables for Traditional Trade Theory and New Economic Geography taken and operationalized by her in this section. My measure for scale intensity differs from hers. For explaining specialization tendencies, which is being done in the next section, I will add further variables to the estimation function.

First, I consider Traditional Trade Theory. According to Heckscher-Ohlin, countries will specialize in producing and exporting a good that they produce relative intensively with the factor they are relatively abundant with. This is being captured by the following measure:

$$fact_{it} = |\frac{w_{it}L_{it}}{VA_{it}} - \frac{\overline{w_t L_t}}{\overline{VA_t}}|. \tag{3}$$

Here $w_{it}L_{it}$ denotes labor compensation in millions of euros in industry i at time point t and VA_{it} is gross value added in industry i at current basic prices in millions of euros at time t. The measure consists of the deviation of the share of labor compensation in value added to industries' average share of labor compensation in average value added. The absolute value of this measure is taken. The idea behind is that industries exhibiting either a high labor or a high capital intensity (represented by either high or low labor compensation compared to the European average) will show up a high level of industrial concentration. Thus a positive influence of *fact* on industrial concentration can be expected.

New Trade Theories postulate the relevance of scale economies. I try to capture this by the following measure:

$$scale_{it} = \frac{\frac{w_{it}L_{it}+Cap_{it}+Int_{it}}{Q_{it}}}{Q_{it}}. \tag{4}$$

It shall represent how per unit costs (the fraction in the nominator) evolve with output (the denominator), decreasing unit costs per given output indicating increasing economies of scale.[14] $w_{it}L_{it}$ again denotes labor compensation in millions of euros, Cap_{it} is capital compensation in millions of euros, Int_{it} is intermediate inputs at current purchasers' prices in millions of euros and Q_{it} is gross output as a volume index (1995=100). I expect a negative relationship between concentration and scale intensity, supported by the literature (see Krugman/ Venables (1995, 1996)).

New Economic Geography's influence is going to be modeled in the following way:

$$intermediate_{it} = \frac{P_{it}Q_{it} - VA_{it}}{P_{it}Q_{it}}. \tag{5}$$

Here $P_{it}Q_{it}$ denotes gross output at current basic prices in millions of euros and VA_{it} is gross value added at current basic prices in millions of euros. Industries that use a lot of intermediate inputs are expected to have stronger input-output linkages and thus show a higher concentration than other industries. Therefore a positive relationship between concentration and intermediate goods intensity can be expected. This is just representing the relationships which have already been explained in chapter 2.

In the following, a regression function using OLS including time and industry dummies will be estimated:

$$lngini_{it} = \alpha + \beta_1 lnfact_{it} + \beta_2 lnscale_{it} + \beta_3 lnintermediate_{it} + \gamma_i + \delta_t + u_{it}. \quad (6)$$

The Gini coefficient $lngini_{it}$ is regressed on factor intensity $lnfact_{it}$, scale economies $lnscale_{it}$, intermediate goods intensity $lnintermediate_{it}$, time dummies δ_t and industry dummies γ_i, u_{it} is the disturbance term. Time dummies are taken relative to 1995, industry dummies are taken relative to fabricated metals. Further, the logs of variables are taken such as to better interpret (percentage) changes in variables. The results are given in table 5.[15]

Insert table 5 here.

The results show that New Economic Geography can explain agglomeration tendencies in the EU best. A one percent increase in intermediate goods intensity increases industrial concentration by about 1.46 percent. The coefficient for scale is less significant not bearing the expected sign. Almost all of the industry effects are significant pointing towards the importance of further unobservable industry characteristics. Time effects are only significant for 2003 and 2004, probably indicating some influence of growing integration and liberalization in the EU. However, a check for multicollinearity of variables was considered being adequate. Important results occurred: regressions including industry effects produce high variance inflation factors (VIF). Therefore, regressions with industry effects might bias estimators. Via industry effects, however, industry specific unobserved effects for agglomeration can be measured, thus they are important. Leaving out these effects should only be done if there is another variable capturing across industry variation, sufficiently. This is what the variables $fact$, $scale$ and $interm$ do. So, with some caution on interpretation, another regression function discarding industry effects was estimated. In the literature one can find analyses using industry effects, time effects, both or none of them. My results are given in the following table:

Insert table 6 here.

As can be seen, both New Trade Theory and New Economic Geography show strong explanatory power. This way, I can confirm the results obtained by Amiti (1999). A one percent increase in intermediate goods intensity increases industrial concentration by about 1.69 percent and a one percent increase in scale intensity increases industrial concentration by about 0.33 percent. Surprisingly, factor intensity appears to be significant but does not show the expected sign. The negative sign would mean that industries get more concentrated the more factor abundance in a country equals the European average. This is in sharp contrast to Traditional Trade Theory assumptions. Traditional Trade Theory therefore does not seem to be able to explain industrial concentration very well.

Before making a final conclusion, however, I took into account the four different industrial sectors classified by the OECD and checked for influential factors of agglomeration in all of these sectors separately (I considered sectors obtained by both the ISIC Rev. 3 and reconstructed ISIC Rev. 2 classification). The results are shown in table 7.

Insert table 7 here.

New Economic Geography appears to be the main explanatory power for all of the sectors considered. The most surprising result perhaps is that intermediate goods intensity is the main driving force for agglomeration in labor intensive industries. The results indicate that a one percent increase in intermediate goods intensity increases industrial concentration in this sector by about 12.25 percent. Economies of scale are important for almost all of the sectors. Thus, New Trade Theory bears an overall strong importance. Factor intensity appears to be significant for medium-low technology and research intensive industries only. Interestingly, for resource intensive, scale intensive, medium-low and high-technology industries time effects are important from about 2000 on. The negative signs of time effects, however, suggest that industries' concentration became less over time.

Another way of looking at agglomeration would be to consider single time series of countries or for the aggregated EU. Problematically, I do have eleven data points only, a far too small sample to conduct plausible estimation. It would be worthwhile to reestimate a regression equation for explaining industrial concentration using more observations in the future.

3.5 Explaining Specialization

Finding out the driving factors of countries' specialization in the EU the same explanatory variables are taken up as has been done for explaining industrial concentration. This undertaking is justified by the incentive to disentangle the importance of different trade theories and New Economic Geography for countries' specialization. Furthermore, a strong correlation between specialization and agglomeration has been found out in the previous literature (see for example Kim (1995)). In addition, two more variables are added to the regression framework: country's openness and trade costs, aiming to cover further aspects of New Economic Geography.

The openness index is taken from the Penn World Table (2006) and defined as follows:

$$openness_{ct} = \frac{IM_{ct} + EX_{ct}}{GDP_{ct}}. \tag{7}$$

This measure is made up of imports plus exports divided by real GDP (base year 2000). It yields country c's total trade as a percentage of GDP at time point t. A positive relationship between openness and countries' specialization can be expected, liberalizing of markets, thus more trade, should go hand in hand with more specialization.

Trade costs are taken from Dreher (2006). They are operationalized by the component *restrictions* out of his index of economic globalization. The measure is composed of mean tariff rate, hidden import barriers, taxes on international trade and capital account restrictions. Dreher used principal component analysis in order to derive the indexes for globalization, the procedure can be reread in his paper. I would like to point to some drawbacks of this measure. Severe bias is to be expected since most of the time at the margins of a data series missing observations are substituted by the last available data value. Further, missing values within a time series are gained by linear interpolation, thus again, not the real world values are taken. Although there are several disadvantages in taking Dreher's index, this measure has nevertheless been taken within my regressions since better data could not be found for addressing trade costs so far. Proxies for trade costs could be considered, however, using the most common proxy, that is distance between countries, is not feasible here, since I do not make use of bilateral data.[16] A higher value of *trade costs* indicates fewer trade costs. I expect a positive relationship between trade costs and countries' specialization to appear. The measure trade costs could be formalized as follows:

$$tradecosts_{ct} = f(MT_{ct}, HIB_{ct}, TIT_{ct}, CAR_{ct}), \tag{8}$$

where MT denotes mean tariff rate, HIB hidden import barriers, TIT taxes on international trade, CAR capital account restrictions and f denotes a linear combination using a principal component, respectively.

Applying OLS using country and time effects I estimate the following equation:

$$\begin{aligned} lngini_{ct} &= \alpha + \beta_1 lnfact_{ct} + \beta_2 lnscale_{ct} + \beta_3 lninterm_{ct} \\ &\quad + \beta_4 lnopen_{ct} + \beta_5 lntrade_{ct} + \gamma_c + \delta_t + u_{ct}. \end{aligned} \tag{9}$$

The Gini coefficient $lngini_{ct}$ is regressed on factor abundance $lnfact_{ct}$, overall industries' scale economies in country c $lnscale_{ct}$, overall industries' intermediate goods intensity in country c $lnintermediate_{ct}$, openness $lnopen_{ct}$, trade costs $lntrade_{ct}$, time dummies δ_t and country dummies γ_c, u_{ct} is the disturbance term. Time dummies δ_t are taken relative to 1970, country dummies γ_c are taken relative to Germany. Further, logs of variables are taken. The results are shown in table 8.

Results suggest that New Economic Geography explains countries' specialization in the EU best. Intermediate goods intensity and trade costs are the main driving factors of specialization. Heckscher-Ohlin theory is important only to a slight extent with quite a low coefficient. Interestingly, the openness variable remained insignificant. Country effects point to the relevance of some unexplained country variation, time effects become significant with the beginning of the 1980s.[17] This indicates that ongoing integration and liberalization in the EU exerts an influence on countries' specialization. Further, it is worthwhile noting that time effects are bearing a negative sign. The negative sign would mean that the more liberalization proceeds the lower will be countries' specialization. This, however, can be explained neatly by Krugman's model. Liberalization in the European Union has proceeded so far and transaction costs have declined so much that specialization in the EU became less. Suppliers settle down in both core and peripheral regions again, dispersion among countries occurs again.

Insert table 8 here.

However, multicollinearity was supposed to be a severe problem in the regressions (since R^2 is pretty high and the variable for *scale* for example is not significant). Checking for multicollinearity, I found that including country effects will increase VIFs. Redoing regressions, leaving out country effects, I got the results shown in table 9.

Insert table 9 here.

Controlling for multicollinearity it can be seen that all of the explanatory variables attain significance. This way New Economic Geography, New Trade Theories and Traditional Trade Theory are able to explain countries' specialization. Heckscher-Ohlin theory, however, bears a small importance for countries' specialization only. Openness' and trade costs' influence is not so clear. Openness is significant in one specification, only, trade costs change signs in two of four regressions. This seems to be due to the inclusion or exclusion of time effects. When no time effects are included the coefficient for trade costs captures the lower specialization of countries emerging, whereas in specifications with time effects this is captured by time effects themselves. Averaging variables over all European countries and looking for time series properties I get the following results shown in table 10.

Insert table 10 here.

Results indicate that all of the variables are significant in most regression frameworks. Openness enters the regression equation with a positive sign, transport costs, however, with a negative sign. This is indicating that the lower are transport costs, that is the more liberalization has proceeded, the lower will be countries' specialization. Again, this is in favor of Krugman's model. However, I found that including openness and/or trade costs into the regressions leads to severe multicollinearity problems. Therefore, at best only the first column of values in table 10 might give valid information on the explanatory power of variables. Still, this means New Economic Geography can explain specialization best. Another trouble becomes evident looking at Durbin Watson statistics. Autocorrelation of error terms might be an important point in explaining the results here, too. Therefore one has to think about further remedies, which is what I will do in section 3.7.

3.6 Robustness Analysis

Further robustness checks shall be conducted in order to test for the relevance of the results. In a first step I considered using a different dependent variable, the so called Krugman concentration (specialization) index. This index based on Krugman's work (1991 a) has been reformalized by Midelfart-Knarvik et al. (2000). The measure is constructed as:

$$K_{i,t} = \sum_{c=1}^{C} |\frac{e_{ic,t}}{e_{i,t}} - \frac{1}{I-1}\sum_{i=1}^{I-1}(\frac{e_{ic,t}}{e_{i,t}})|. \tag{10}$$

It measures the deviation of employment in industry i in country c as a share of employment of industry i in the EU from the mean of these employment shares for the other (I-1) industries. The drawbacks of Gini coefficients (see chapter 3.2) can thus be circumvented. The results are given in table 11.

Insert table 11 here.

As can be seen the same industries appear to be most or least agglomerated, as is the case for employing the Gini coefficient. Especially, leather, textiles and motor vehicles are most agglomerated, whereas fabricated metals, food and pulp are least agglomerated in 2005.

Next, I added a further explanatory variable, measuring growth, to the regression equation as:

$$growth_{it} = \frac{Q_{it} - Q_{i(t-1)}}{Q_{i(t-1)}}. \tag{11}$$

Q_{it} denotes gross output as a volume index (1995=100) at time point t. Martin and Ottaviano (2001) explain that growth leads to higher agglomeration. This happens because forward and backward linkages between production and innovation exist which make firms locating closer to a region of high growth caused by innovation processes therewith leading to agglomeration. However, it can be expected that growth is endogenous. Martin and Ottaviano explain that a clustering of firms might well reduce costs of innovation therewith fostering economic growth. Dealing with this kind of endogeneity issue is left out for further research.[18]

Regression results are shown in table 12.

Insert table 12 here.

As can be seen, intermediate goods' intensity is significant and best in explaining agglomeration in the EU. The coefficient for Heckscher-Ohlin theory is either not significant or not bearing the expected sign. Scale economies have a small and negative influence on agglomeration when industry effects are included.[19] In regressions without industry effects scale economies are significant and bear the expected sign. Growth shows the expected positive relationship with agglomeration only when industry effects are included in regressions. Overall, the evidence for New Economic Geography to be important in explaining agglomeration in the EU appears to be robust.

3.7 Considering Dynamics

As has been seen above, regressions of time series point towards a problem: the Durbin-Watson statistics indicate autocorrelation of error terms. This problem might occur because non-stationarity properties of variables have not been adequately considered. In this section I will consider stationarity properties of regression variables. The idea behind is that if non-stationary variables are regressed on each other one might obtain significant results that are not meaningful, however. It's a spurious regression only. In order to handle this problem it is worthwhile to check for non-stationarity of the variables first. If a co-integration relationship between non-stationary variables can be established, that is if a linear combination of non-stationary variables appears to be stationary, one will be able to estimate an error correction model. This will enable one to differentiate between short-run and long-run influences of variables and to estimate the error correction term which can show by how much deviations from the long-run state equilibrium will be adjusted within the next period.

Due to data constraints I was able to consider dynamics for countries' specialization only. It would be worthwhile to redo this kind of analysis for industrial concentration once data will be available. I will show results for the aggregated EU first, results for European countries themselves can be found in the appendix.

In a first step I tested variables for being non-stationary. This was done by using an Augmented Dickey Fuller test and a Phillips-Perron test applying trend and intercept estimation. The results are given in table 13.

Insert table 13 here.

All of the tested variables are I(1).[20] This enabled me to check for a co-integration relationship in a second step. The regression functions including openness and openness and trade in addition to the three trade theory variables appeared to be co-integrated. So in a third step I conducted an error correction model estimation for these two regression frameworks using the following equation:

$$Dlngini_{ct} = \alpha + \beta_k D\mathbf{X} + \tau Dlngini_{c(t-1)} + \delta resid_{c(t-1)} + u_{ct}. \tag{12}$$

The first difference (D) of the logarithm of Gini is regressed on the first differences of a set of k explanatory variables $\mathbf{X}$, the Gini of the previous period and the lagged residual emerging from estimating the long term regression function $lngini_{ct} = \alpha + \beta_k\mathbf{X} + u_{ct}$. $\mathbf{X}$ is a vector containing explanatory variables $lnfact_{ct}$, $lnscale_{ct}$, $lninterm_{ct}$, $lnopen_{ct}$ and $lntradec_{ct}$. u_{ct} is the disturbance and δ here is the error correction term.

As can be seen in table 13, New Economic Geography serves as the best explanatory power, being highly significant. In the short-run intermediate goods intensity exerts an influence of about 0.26 to 0.28 per cent on countries' specialization. These values are lower than those I estimated before for the long-run using a simple OLS procedure, only. The error correction term is highly significant and ranges from -63 to -79 percent, respectively. This means that deviations from the long-run equilibrium state of specialization in the EU as a whole are being set off by about 63 to 79 percent within the next period (1 year).

Investigations for the European countries themselves delivered distinct results. In order to test for a co-integration relationship, variables have to be integrated of the same order. This is something I could establish for Belgium, France, Germany, Ireland, Italy, Spain, Sweden and the UK only: all of the tested variables appeared to be I(1).[21] For Denmark and Finland only the variable transport costs clearly deviates from being I(1). This seems to be mostly due to the problems related with the trade cost measure as has been explained in chapter 3.5. The artificially constructed series of the trade cost index leads to several time points–especially in the beginning of a time series–carrying the same values whereas for later time points real, increasing values continue. Therefore, I decided that all of the regression functions excluding transport costs can be further considered for Denmark and Finland, as well. Co-integration, could be established for Denmark, France, Germany, Spain and Sweden. The results are shown in the appendix.[22] For Denmark factor intensity appears to be significant and the coefficient for scale intensity bears a positive sign. The error correction term ranges between 58 and 59 percent. For France openness and trade costs are highly significant and the coefficient of economies of scale does not bear the expected sign. The error correction term ranges between 16 and 17 percent. Regressions for Germany reveal the influence of scale economies. Coefficients for intermediate goods intensity are not consistent with theory. The error correction term is in the range of 37-40 percent. For Spain the coefficient for scale intensity does not show the expected sign. The error correction term ranges between 36 and 43 percent. For Sweden factor intensity seems to be important

for specialization. The error correction is about 33 percent. All in all, investigations show that adjustments for Denmark, France, Germany, Spain and Sweden are slower than for the EU as a whole. This means if specialization is higher/ lower than the levels of factor abundance, overall scale economies and intermediate goods' flows would suggest, it will be corrected within one year to a lower extent than it would be the case for the EU on average or for some other European countries. So the speed returning to equilibrium after a deviation occurred is lower for Denmark, France, Germany, Spain and Sweden than for the EU on average. Specialization, as measured by employment shares, is not able to change that quickly. So this study's results offer important insights for regional, structural, economic and social politics in the EU. In fact, my results are backed by research on labor market rigidities in Europe (see Nickell (1997) and OECD (2008)). Spain, France and Germany score higher than the average of the OECD's employment protection index, for example, indicating strong regulations of hiring and firing being present in these countries. Consequently, employment might not change that quickly in these countries. Sweden and Denmark on the other hand possess a strong system of labor unions which will serve as a force of employment protection in these countries, also being able to make employment structures more stable in these countries.
Further, results show that lowering trade costs made France specialize more. France's level of trade costs does not seem to be as low as is the case in the third stage of the Krugman/ Venables model, where very low transport costs would induce fewer specialization.

It would be nice to have further research going on in the future on econometric dynamics of several European countries for more disaggregated industries or a larger amount of time periods such that clearer evidence might be gained about European countries' short-run and long-run driving forces of specialization.

4 Conclusion

My aim was to disentangle the developments and various factors influencing industrial concentration and countries' specialization in the European Union. I found out that industrial agglomeration in the European Union grew by about 25 percent from 1970 to 2005. Especially textiles, leather, footwear, wood and motor vehicles showed a large increase in agglomeration. It's basically labor intensive or low-technology industries that displayed a huge increase in concentration. In contrast, countries' specialization remained rather low. However, I found that peripheral European countries like Ireland, Greece, Portugal and two core European countries, namely Germany and France exhibited high increases in specialization.

Regression results indicate on the one hand that one has to consider multicollinearity problems. If this is not being done results become biased and are hardly interpretable. New Trade Theory and New Economic Geography can explain agglomeration best. Traditional Trade Theory did not appear to be significant. It might play a small role for research and medium-low technology industries, though. Regarding countries' specialization I found evidence for the validity of New Economic Geography, especially. Since growing liberalization and declining trade costs influence specialization negatively, one could argue that this gives evidence for what Krugman and Venables (1995) described for the case of ongoing reduction of trade costs. Liberalization in the European Union seems to have proceeded so far and trade costs have declined so much that specialization in the EU became less. Suppliers settle down in both core and peripheral regions again, dispersion among countries occurs. This study appears to be the first one that considers stationarity properties of variables explaining agglomeration and specialization in the European Union. Regression results indicate that New Economic Geography is best in explaining specialization. Furthermore, for the EU as a whole I can disentangle the effect of adjusting to the long-run equilibrium state of specialization which amounts to about 63 to 79 percent (depending on which regression framework is being taken) within the next period. I could establish further valid co-integration relationships and error correction modeling frameworks for Denmark, France, Germany, Spain and Sweden, only. The results indicate that adjustments rates to long-run equilibrium for these countries are lower than for the EU as a whole. Thus, specialization–as measured by employment shares–adjusts more slowly in these countries. These tendencies are backed by evidence on labor market rigidities in the European Union.

It would be worthwhile to intensify research in the future for these countries' specialization and agglomeration patterns making use of more disaggregated industry data employing econometric methods as being shown in this paper. Since agglomeration of European industries increased considerably over time and seems to increase even further, the probability for asymmetric shocks to occur is and remains quite high. One further extension of research could thus be to model asymmetric shocks in a framework of growing industrial concentration in the European Union.

Appendix

Insert tables 14 to 24 here.

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Tables

Table 1: Industrial concentration over time

	1970	*1980*	*1990*	*2000*	*2005*	**Change 1970-2005**	Trend Test
All industries	0.1762	0.1862	0.1925	0.2095	0.2207	0.2525	0.0012**
Food, beverages, tobacco	0.1294	0.1224	0.1337	0.1075	0.1132	-0.1251	-0.0005**
Textiles, textile products	0.145	0.2169	0.2902	0.3667	0.4091	1.8213	0.0077**
Leather, footwear	0.246	0.3348	0.4389	0.5236	0.5481	1.2281	0.0092**
Wood, wood products	0.1791	0.2423	0.2763	0.3431	0.3538	0.9755	0.0051**
Pulp, paper, paper products	0.2111	0.2135	0.206	0.1484	0.1461	-0.3078	-0.002**
Printing, publishing	0.15	0.1543	0.1407	0.1639	0.1694	0.1294	0.0006**
Basic Metals	0.2083	0.1853	0.1407	0.1223	0.1501	-0.2796	-0.0026**
Fabricated Metals	0.091	0.0963	0.0835	0.077	0.0756	-0.1663	-0.0009**
Non-metallic mineral products	0.1129	0.1046	0.1156	0.1308	0.1563	0.384	0.0011**
Coke, refined petroleum, nuclear fuel	0.2368	0.2189	0.2007	0.2564	0.2989	0.2622	0.0015**
Rubber, plastics, plastics products	0.1254	0.1215	0.1225	0.1071	0.1203	-0.041	-0.0003**
Machinery equipment	0.16	0.143	0.1712	0.1539	0.1491	-0.0685	-0.0001
Motor Vehicles, trailers, semitrailers	0.1442	0.1606	0.2169	0.2652	0.2825	0.9598	0.0045**
Other transport equipment	0.2593	0.2537	0.2207	0.1917	0.1928	-0.2565	-0.0025**
Manufacturing, nec recycling	0.1236	0.1154	0.1169	0.1442	0.1624	0.3137	0.0012**
Chemical industry	0.1071	0.1194	0.1336	0.136	0.1376	0.2844	0.0009**
Office accounting, computing machines	0.3565	0.3627	0.2999	0.3485	0.3358	-0.0582	-0.002
Electrical machinery apparatus	0.1725	0.1638	0.1751	0.1608	0.1823	0.057	0.0002
Radio, TV, communication equipment	0.148	0.1609	0.1338	0.2234	0.1998	0.3501	0.0019**
Medical, precision, optical instruments	0.2182	0.2335	0.2326	0.2188	0.2307	0.0571	0.0000

Source: Own calculations based on EU KLEMS data (2008).
Note: This table displays Gini coefficients measuring industrial concentration for different sectors over time. Further the change in concentration over 1970-2005 and a linear trend test for significance of changes in concentration are given.

Table 2: Changing agglomeration in industrial sectors–OECD classification according to ISIC Rev. 3

	1970	*1980*	*1990*	*2000*	*2005*	**Change 1970-2005**	Trend Test
All industries	0.1762	0.1862	0.1925	0.2095	0.2207	0.2525	0.0012**
Low technology industries	0.1692	0.1999	0.229	0.2568	0.2717	0.6062	0.0139**
Medium low technology industries	0.1722	0.1634	0.1473	0.1475	0.1657	-0.0382	-0.0038**
Medium high technology industries	0.1686	0.1681	0.1835	0.1815	0.1889	0.12	0.0035**
High technology industries	0.2075	0.2191	0.2	0.2317	0.226	0.0892	0.0009

Source: Own calculations based on EU KLEMS data (2008).
Note: This table displays Gini coefficients measuring industrial agglomeration for different groups of industries over time. The OECD's classification ISIC Rev. 3 and grouping industries according to low-, middle-low, middle-high or high technology has been applied. Further the change in concentration over 1970-2005 and a linear trend test for significance of changes in concentration are given.

Table 3: Changing agglomeration in industrial sectors–classified by labor, resource, research use and extent of scale economies, based on ISIC Rev. 2

	1970	*1980*	*1990*	*2000*	*2005*	**Change 1970-2005**	Trend Test
All industries	0.1762	0.1862	0.1925	0.2095	0.2207	0.2525	0.0012**
Labor intensive industries	0.1606	0.216	0.2709	0.3281	0.3443	1.1442	0.0054**
Research intensive industries	0.1865	0.1867	0.184	0.2005	0.2084	0.1172	0.0005**
Scale intensive industries	0.1572	0.1619	0.1669	0.1728	0.1805	0.1484	0.0007**
Resource intensive industries	0.1896	0.1929	0.1879	0.2002	0.221	0.1655	0.0006**

Source: Own calculations based on EU KLEMS data (2008).
Note: This table displays Gini coefficients measuring industrial agglomeration for different groups of industries over time. The OECD's classification ISIC Rev. 2 and grouping industries according to their use of labor, scale economies, research and resources has been applied. Further the change in concentration over 1970-2005 and a linear trend test for significance of changes in concentration are given.

Table 4: Specialization of countries

	1970	*1980*	*1990*	*2000*	*2005*	**Change 1970-2005**	Trend Test
Europe	0.2269	0.2304	0.2286	0.2349	0.2384	0.0507	0.0003**
Austria	0.194	0.1873	0.1746	0.176	0.1671	-0.1385	-0.0004**
Belgium	0.2161	0.2096	0.2098	0.202	0.2024	-0.0633	-0.0004**
Denmark	0.2519	0.2545	0.2322	0.2159	0.2166	-0.14	-0.0014**
Finland	0.3147	0.2828	0.2545	0.2982	0.2983	-0.0519	0.0000
France	0.0944	0.083	0.0913	0.102	0.1183	0.2537	0.0004**
Germany	0.1282	0.1414	0.1723	0.1763	0.1852	0.444	0.0016**
Greece	0.3398	0.3647	0.3888	0.4	0.3874	0.1402	0.0017**
Ireland	0.322	0.3135	0.2933	0.3503	0.368	0.1427	0.001**
Italy	0.1666	0.1675	0.1755	0.1849	0.1917	0.1511	0.001**
Netherlands	0.2532	0.2903	0.2717	0.241	0.2468	-0.0255	-0.001**
Portugal	0.3386	0.367	0.4167	0.4097	0.4132	0.2202	0.0024**
Spain	0.188	0.1803	0.1739	0.1556	0.1448	-0.2298	-0.001**
Sweden	0.2498	0.2633	0.253	0.2537	0.247	-0.0114	-0.0005**
United Kingdom	0.119	0.1198	0.0928	0.1226	0.1506	0.2651	0.0003

Source: Own calculations based on EU KLEMS data (2008).
Note: This table displays Gini coefficients measuring countries' specialization over time. Further the change in specialization over 1970-2005 and a linear trend test for significance of changes in specialization are given.

Table 5: Regression results industrial concentration

Dependent variable ln(gini) for industries	**OLS**		**OLS**		**OLS**
constant	-1.6707**	Coke, refined petroleum, nuclear fuel	0.7536**	1996	0.0166
ln(fact)	-0.0028	Rubber, plastics, plastics products	0.2947**	1997	0.021
ln(scale)	0.065*	Machinery equipment	0.5529**	1998	0.0215
ln(intermediate)	1.4573**	Motor Vehicles, trailers, semitrailers	0.8289**	1999	0.0132
Food, beverages, tobacco	-0.0388	Other transport equipment	0.7077**	2000	-0.0032
Textiles, textile products	1.3662**	Manufacturing, nec recycling	0.5338**	2001	0.0155
Leather, footwear	1.7239**	Chemical industry	0.3466**	2002	0.0261
Wood, wood products	1.3638**	Office accounting, computing machines	1.1479**	2003	0.0436**
Pulp, paper, paper products	0.5314**	Electrical machinery apparatus	0.7063**	2004	0.0423*
Printing, publishing	0.8132**	Radio, TV, communication equipment	0.7909**	2005	0.0324
Basic Metals	0.2022**	Medical, precision, optical instruments	1.2183**	N	220
Non-metallic mineral products	0.5347**			R^2	0.988
				F-Stat	500.959

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with $gini_{it}$ as dependent variable.

Table 6: Regression results industrial concentration without industry effects

Dependent variable ln(gini) for industries	**OLS**		**OLS**		**OLS**
constant	-2.0156**	1998	-0.0769	2004	-0.1107
ln(fact)	-0.0594*	1999	-0.1046	2005	-0.1354
ln(scale)	-0.3284**	2000	-0.1463	N	220
ln(intermediate)	1.6891**	2001	-0.1399	R^2	0.429
1996	-0.0137	2002	-0.1316	F-Stat	11.89
1997	-0.0442	2003	-0.1243		

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with $gini_{it}$ as dependent variable.

Table 7: Regression results agglomeration of industrial sectors–by groups of industries

	Labor intensive	*Scale intensive*	*Resource intensive*	*Research intensive*	*Low technology*	*Medium-low technology*	*Medium-high technology*	*High technology*
constant	4.6596**	-1.3945**	-4.35**	-1.5244**	-2.4195**	-2.5855**	-1.5441**	-2.3391**
Ln(fact)	0.0169	-0.2231**	-0.0409**	0.0447*	-0.2433**	0.0283**	-0.2704**	0.0216
Ln(scale)	0.2881**	-0.1107**	-1.1581**	-0.1966**	-0.6253**	-0.5565**	-0.1332**	-0.3255**
Ln(intermediate)	12.2513**	2.7316**	1.7055**	1.4423**	3.5531**	1.8995**	2.8635**	0.3529**
1996	0.1467	-0.0247	-0.0107	0.004	0.0034	0.0039	-0.0104	0.0098
1997	0.0156	-0.0509	-0.0749	0.0179	-0.0702	-0.013	-0.0629	0.0186
1998	0.0099	-0.0801	-0.1116**	0.0012	-0.1577	-0.018	-0.1079*	-0.0404
1999	0.0318	-0.1293	-0.169**	-0.042	-0.2785**	-0.0803*	-0.1055	-0.0928
2000	-0.1479	-0.158*	-0.2786**	-0.0901	-0.2842**	-0.172**	-0.124*	-0.1259
2001	-0.109	-0.138	-0.2234**	-0.1024	-0.1612	-0.1282**	-0.1216*	-0.1948**
2002	-0.0813	-0.1551*	-0.1631**	-0.0953	-0.1528	-0.0962	-0.0689	-0.2463**
2003	-0.0624	-0.1799*	-0.1997**	-0.0903	-0.2306	-0.0993	-0.0786	-0.2613**
2004	-0.2442*	-0.1555*	-0.2023**	-0.0796	-0.2209	-0.1474**	-0.0872	-0.2217**
2005	-0.3462**	-0.1789**	-0.3023**	-0.0895	-0.2041	-0.1798**	-0.1509**	-0.1813*
N	33	55	55	121	77	66	55	44
R^2	0.99	0.815	0.976	0.588	0.711	0.941	0.881	0.915
F-Stat	139.421	13.903	125.772	11.726	11.941	63.54	23.334	24.748

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with $gini_{it}$ as dependent variable. Different groups of industries taken as indicated in the table.

Table 8: Regression results countries' specialization

Dependent variable			OLS		
ln(gini) countries	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
constant	-1.4367**	-1.3956**	-1.635**	-2.9173**	-2.7055**
ln(fact)	0.0232**	0.023**	0.0235**	0.0242**	0.0238**
ln(scale)	-0.0098	-0.0102	0.0003	-0.0209	-0.0305
ln(intermediate)	0.6346**	0.7218**	0.7104**	0.9714**	0.983**
ln(openness)			0.0545	0.0496	
ln(tradecosts)				0.356**	0.3576**
Austria	0.0845*	0.0875*	0.09*	0.0802	0.0778
Belgium	0.2228**	0.2164**	0.1798**	0.111*	0.144**
Denmark	0.3274**	0.3283**	0.3384**	0.2829**	0.2735**
Finland	0.5094**	0.5044**	0.5247**	0.4849**	0.4663**
France	-0.5855**	-0.598**	-0.5835**	-0.5862**	-0.5991**
Greece	0.8034**	0.8014**	0.8531**	0.8257**	0.7785**
Ireland	0.6096**	0.6051**	0.5902**	0.5304**	0.5437**
Italy	0.0133	0.0091	0.0195	0.0406*	0.0311
Netherlands	0.4659**	0.4605**	0.4379**	0.3746**	0.3948**
Portugal	0.7902**	0.7728**	0.7979**	0.7634**	0.7403**
Spain	0.013	0.0102	0.0419	0.0065	-0.0224
Sweden	0.4224**	0.4195**	0.4272**	0.3839**	0.3767**
UK	-0.3747**	-0.384**	-0.3746**	-0.3771**	-0.3857**
time effects	yes	yes	yes	yes	yes
N	504	490	490	490	490
R^2	0.975	0.977	0.977	0.979	0.979
F-Stat	343.627	374.859	368.463	395.307	402.207

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with $gini_{ct}$ as dependent variable.

Table 9: Regression results countries' specialization without country effects

Dependent variable				OLS				
ln(gini) for countries	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
constant	0.112	-0.1125	-0.2005	-0.0568	-2.5463**	0.6702	-2.6208**	0.5096
ln(fact)	0.0447**	0.0488**	0.0506**	0.0476**	0.0562**	0.046**	0.0558**	0.045
ln(scale)	-0.3065**	-0.2934**	-0.2978**	-0.2953**	-0.3165**	-0.2896**	-0.3182**	-0.2938**
ln(intermediate)	1.2768**	1.1322**	1.2435**	1.1404**	1.5712**	1.0385**	1.5894**	10.803
ln(openness)			0.0808**	-0.0128	0.0114	0.0284		
ln(tradecosts)					0.6611**	-0.2164*	0.6911**	-0.1485*
country effects	no	no	no	no	no	no	no	no
time effects	yes	no	yes	no	yes	no	yes	no
N	490	490	490	490	490	490	490	490
R^2	0.672	0.646	0.677	0.646	0.6882	0.648	0.688	0.648
F-Stat	24.992	294.988	24.912	220.972	25.468	178.276	26.187	222.798

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with $gini_{ct}$ as dependent variable.

Table 10: Regression results specialization aggregated EU

Dependent variable ln(gini) for countries	**OLS aggregated EU**			
const	-1.0369**	-1.5859**	-1.0844**	-1.0227**
ln(fact)	0.0539**	0.0547**	0.0558**	0.0245
ln(scale)	-0.0509**	0.037*	-0.0467	0.0036
ln(intermediate)	0.3172**	0.3752**	0.3256**	0.26**
ln(openness)		0.0669**		0.0938**
ln(tradecosts)			0.0093	-0.1537**
N	35	35	35	35
R^2	0.803	0.863	0.803	0.885
F-Stat	42.212	47.252	30.66	44.641
DW	1.123	1.532	1.129	1.75

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with $gini_t$ as dependent variable, aggregated over all countries and industries.

Table 11: Agglomeration according to Krugman index of industrial concentration

Industry	Krugman Index 2005	Industry	Krugman Index 1970
Most agglomerated			
Leather, footwear	0.9639	Office, accounting, computing machines	0.5286
Textiles, textile products	0.6847	Wood, wood products	0.4469
Motor vehicles, trailers, semitrailers	0.4856	Other transport equipment	0.4243
Office, accounting, computing machines	0.4751	Leather, footwear	0.4027
Coke, refined petroleum, nuclear fuel	0.4421	Medical, precision, optical instruments	0.3418
Most dispersed			
Fabricated Metals	0.1161	Fabricated Metals	0.1357
Food, beverages, tobacco	0.1561	Chemical Industry	0.1568
Pulp, paper, paper products	0.1948	Radio, TV, communication	0.1993
Rubber, plastics, plastics products	0.2208	Rubber, plastics, plastics products	0.2083
Manufacturing, nec recycling	0.2507	Motor vehicles, trailers, semitrailers	0.213

Source: Own calculations based on EU KLEMS data (2008).
Note: This table displays the Krugman Index of industrial concentration. It measures the deviation of employment in industry i in country c as a share of employment of industry i in the EU from the mean of these employment shares for the other (I-1) industries.

Table 12: Robustness checks

	agglomeration					
Dependent Variable	Krugman-I	Krugman-I	Gini	Gini	Krugman-I	Krugman-I
lnfact	-0.0231	0.0038	-0.0597**	0.0005	-0.0241	0.0091
lnscale	-0.2443**	0.1047**	-0.3477**	0.0868**	-0.2649**	0.1244**
lninterm	1.4442**	2.3899**	1.7231**	1.2145**	1.481**	1.9967**
growth			-1.7773**	0.1645**	-1.807**	0.1629
const	-1.3744**	-0.5626**	-2.0099**	-1.7398**	-1.3626**	-0.7148**
Time effects	yes	yes	yes	yes	yes	yes
Industry effects	no	yes	no	yes	no	yes
N	200	200	200	200	200	200
R^2	0.289	0.982	0.459	0.99	0.325	0.984

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken. OLS regression with $gini_{it}$ or $K_{i,t}$ as dependent variable.

Table 13: Co-integration test and error correction modeling for the aggregated EU

Co-integration Test and error correction model for the EU	**Unit root test trend and intercept**	**Error correction model**	**Unit root test trend and intercept**	**Error correction model**
ln(gini)	I(1)**		I(1)**	
ln(fact)	I(1)**		I(1)**	
ln(scale)	I(1)**		I(1)**	
ln(intermediate)	I(1)**		I(1)**	
ln(openness)	I(1)**		I(1)**	
ln(tradecosts)			I(1)**	
co-integrated	yes*		yes**	
D(ln(fact))		0.0096		0.0014
D(ln(scale))		0.0182		0.0353
D(ln(intermediate))		0.2774**		0.2579**
D(ln(openness))		-0.0146		0.0379
D(ln(tradecosts))				0.013
$D(ln(gini_{t-1}))$		-0.0875		-0.018
$Resid_{t-1}$		-0.6281**		-0.7876**
const		0.0019		0.0007
N		35 (33)		35 (33)
R^2		0.418		0.474
DW		1.741		1.671

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. Unit-root tests, co-integration tests and error correction modeling is conducted.

Table 14: Country analysis part I

		OLS	*Unit root (at 5 %value) trend and intercept*	*Co-integrated*	*Error correction model*
Austria	Ln(gini), ln(fact), ln(scale) ln(intermediate)	Fact: -0.0268** Scale: 0.1236**, Interm: 0.5775** R^2: 0.703, DW: 0.831	Ln(fact)=I(0), PP I(2) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(1) Ln(trade costs)=I(1) Ln(openness)=I(1)	yes*	Fact: -0.0206** Scale: 0.1827* Interm: 0.8994** Error correction term: -0.6166** R^2: 0.498, DW: 2.007
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Fact: -0.0258** Scale: 0.2625** R^2: 0.717, DW: 0.898		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Fact: -0.0151** Scale: 0.4652** Interm: 1.0248** Openness: 0.1949** Trade costs: 0.3539** R^2: 0.8, DW: 1.173		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: -0.017** Scale: 0.2818** Interm: 1.1809** Trade costs: 0.3351** R^2: 0.778, DW: 0.989		no	
Belgium	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Scale: 0.0716** R^2: 0.736, DW: 0.862	Ln(fact)=I(1), PP I(0) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(1)	no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 15: Country analysis part II

		OLS	***Unit root (at 5 %value) trend and intercept***	***Co-integrated***	***Error correction model***
Belgium	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Scale: 0.0455** R^2: 0.744, DW: 0.859	Ln(trade costs)=I(1), PP I(2) Ln(openness)=I(2), PP I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	R^2: 0.76, DW: 0.907		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Scale: 0.224* R^2: 0.751, DW: 0.936		no	
Denmark	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.0384** Scale: 0.266** Intermediate: 0.5038** R^2: 0.918, DW: 1.315	Ln(fact)=I(0), PP I(1) Ln(scale)=I(0), PP I(1) Ln(intermediate)=I(1) Ln(gini)=I(1) Ln(trade costs)=I(2)	yes*	Scale: 0.2507** Error correction term: -0.5944** R^2: 0.355, DW: 1.841
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Fact: 0.0421** Scale: 0.4017** Intermediate: 0.5319** Openness: 0.1058* R^2: 0.925, DW: 1.499	Ln(openness)=I(1)	yes*	Fact: 0.024** Scale: 0.2733** Error correction: -0.5842** R^2: 0.41, DW: 1.824

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 16: Country analysis part III

		OLS	*Unit root (at 5 %value) trend and intercept*	*Co-integrated*	*Error correction model*
Denmark	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Fact: 0.0406** Scale: 0.4001** Intermediate: 0.4898* Openness: 0.1151* R^2: 0.925, DW: 1.446		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.0414** Scale: 0.2878** Intermediate: 0.5755** R^2: 0.918, DW: 1.418		yes*	Scale: 0.2329** Error correction term: -0.6668** R^2: 0.414, DW: 1.926
Finland	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.0501** Scale: 0.0652** R^2: 0.381, DW: 0.872	Ln(fact)=I(1), PP I(0) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Scale: 0.6177** Openness: 0.8514** R^2: 0.822, DW: 0.615	Ln(trade costs)=I(2) Ln(openness)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Scale: 0.6437** Openness: 1.1491** Trade costs: -0.5392** R^2: 0.867, DW: 0.957		no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 17: Country analysis part IV

		OLS	*Unit root (at 5 %value) trend and intercept*	*Co-integrated*	*Error correction model*
Finland	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.041** Scale: 0.2486** Trade costs: 0.5916** R^2: 0.5, DW: 0.782		no	
France	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Intermediate: 2.0182** R^2: 0.391, DW: 0.185	Ln(fact)=I(1) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(2), PP I(1) Ln(trade costs)=I(1) Ln(openness)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Scale: 0.8346** Intermediate: 1.1834* Openness: 0.8607** R^2: 0.613, DW: 0.294		yes*	Scale: 0.4863** Openness: 0.5091** Error correction term: -0.1652** R^2: 0.454, DW: 2.21
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Scale: 0.8324* Intermediate: 1.4076* Openness: 0.7852** R^2: 0.615, DW: 0.291		yes*	Scale: 0.4435** Openness: 0.4448** Trade costs: 0.4284** Error correction term: -0.1558** R^2: 0.538, DW: 2.089
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Scale: 0.3913** Intermediate: 2.8862** Trade costs: 0.89** R^2: 0.514, DW: 0.293		no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 18: Country analysis part V

		OLS	*Unit root (at 5 %value) trend and intercept*	*Co-integrated*	*Error correction model*
Germany	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Scale: -0.7459** Intermediate: -1.6252** R^2: 0.91, DW: 0.724	Ln(fact)=I(1) Ln(scale)=I(0), PP I(1) Ln(intermediate)=I(1) Ln(gini)=I(1) Ln(trade costs)=I(1) Ln(openness)=I(1)	yes**	Scale: -0.2293* Intermediate: -0.9133** Error correction term: -0.388** R^2: 0.461, DW: 1.98
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Scale: -0.5301** Intermediate: -1.625** R^2: 0.914, DW: 0.603		yes*	Scale: -0.2996* Intermediate: -0.9956** Error correction term: -0.4004** R^2: 0.468, DW: 1.861
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Scale: -0.5165** Intermediate: -1.578** R^2: 0.918, DW: 0.6		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Scale: -0.6064** Intermediate: -1.5669** R^2: 0.917, DW: 0.651		yes*	Intermediate: -0.7976** Error correction term: -0.3688** R^2: 0.426, DW: 1.839
Greece	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Scale: -0.1545** Intermediate: 1.2877** R^2: 0.8858, DW: 1.1032	Ln(fact)=I(1) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(2)	no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 19: Country analysis part VI

		OLS	***Unit root (at 5 %value) trend and intercept***	***Co-integrated***	***Error correction model***
Greece	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Scale: -0.0672** Intermediate: 0.4269** Openness: 0.093** R^2: 0.933, DW: 1.113	Ln(trade costs)=I(1) Ln(openness)=I(0), PP I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Scale: -0.0515* Intermediate: 0.4286** Openness: 0.1092** R^2: 0.934, DW: 1.214		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Scale: -0.1559** Intermediate: 0.7852** Trade costs: 0.1466** R^2: 0.91, DW: 0.878		no	
Ireland	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.3729** Scale: 0.1023** R^2: 0.666, DW: 0.53	Ln(fact)=I(1) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(trade costs)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Fact: 0.3642** R^2: 0.697, DW: 0.59	Ln(gini)=I(1) Ln(openness)=I(1)	no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 20: Country analysis part VII

		OLS	***Unit root (at 5 %value) trend and intercept***	***Co-integrated***	***Error correction model***
Ireland	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Fact: 0.3469** R^2: 0.698, DW: 0.581		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.4201** Scale: 0.0759** R^2: 0.678, DW: 0.589		no	
Italy	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Scale: -0.1283** Intermediate: 0.495** R^2: 0.761, DW: 0.422	Ln(fact)=I(1) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	R^2: 0.769 DW: 0.43	Ln(trade costs)=I(1) Ln(openness)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	R^2: 0.769 DW: 0.43		no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 21: Country analysis part VIII

		OLS	***Unit root (at 5 %value) trend and intercept***	***Co-integrated***	***Error correction model***
Italy	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Scale: -0.0955** R^2: 0.767, DW: 0.436		no	
Netherlands	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.0109** Scale: 0.2551** Intermediate: 1.3892** R^2: 0.74, DW: 0.623	Ln(fact)=I(0) Ln(scale)=I(2), PP I(1) Ln(intermediate)=I(1) Ln(gini)=I(2) Ln(trade costs)=I(2), PP I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Intermediate: 1.2465** Openness: -0.2511** R^2: 0.793, DW: 0.607	Ln(openness)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Scale: 0.1476** Intermediate: 0.7717** Openness: -0.3167** Trade costs: 0.8555** R^2: 0.888, DW: 1.0258		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.0125** Scale: 0.4662** Intermediate: 1.028** Trade costs: 0.7062** R^2: 0.808, DW: 0.884		no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 22: Country analysis part IX

		OLS	***Unit root (at 5 %value) trend and intercept***	***Co-integrated***	***Error correction model***
Portugal	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.0132** Scale: -0.2563** R^2: 0.877, DW: 0.699	Ln(fact)=I(0) Ln(scale)=I(1), PP I(0) Ln(intermediate)=I(1) Ln(gini)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Fact: 0.0134** Scale: -0.2511** R^2: 0.877, DW: 0.704	Ln(trade costs)=I(2), PP I(1) Ln(openness)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Fact: 0.0061** Scale: -0.0545** Intermediate: 0.2935* Openness: -0.1286** Trade costs: 0.4826** R^2: 0.974, DW: 1.522		yes*	Fact: 0.0029** Openness: -0.0802* Trade costs: 0.3616** Error correction term: -0.7334** R^2: 0.367, DW: 2.085
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.01** Intermediate: 0.627** Trade costs: 0.3459** R^2: 0.948, DW: 0.982		no	
Spain	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.017** Scale: 0.1973** R^2: 0.889, DW: 0.956	Ln(fact)=I(1), PP I(2) Ln(scale)=I(1); PP I(2) Ln(intermediate)=I(1) Ln(gini)=I(1)	yes*	Scale: 0.1878** Error correction term: -0.3583* R^2: 0.255, DW:1.998
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Fact: 0.0156** Scale: 0.174** R^2: 0.89, DW: 0.921	Ln(trade costs)=I(1) Ln(openness)=I(1)	no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 23: Country analysis part X

		OLS	***Unit root (at 5 %value) trend and intercept***	***Co-integrated***	***Error correction model***
Spain	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Scale: 0.1251** Openness: -0.1993** Trade costs: 0.6141** R^2: 0.945, DW: 1.373		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.0176** Scale: 0.2553** Trade costs: 0.161* R^2: 0.901, DW: 1.079		yes**	Scale: 0.199** Error correction term: -0.4271** R^2: 0.268, DW: 1.98
Sweden	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.0074** Intermediate: -0.965** R^2: 0.594, DW: 0.456	Ln(fact)=I(1), PP I(0) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(1), PP I(0)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Intermediate: -0.9923** R^2: 0.596, DW: 0.471	Ln(trade costs)=I(1) Ln(openness)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Fact: 0.0067* Intermediate: -1.3513** R^2: 0.615, DW: 0.564		no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Table 24: Country analysis part XI

		OLS	***Unit root (at 5 %value) trend and intercept***	***Co-integrated***	***Error correction model***
Sweden	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.0069* Intermediate: -1.3512** R^2: 0.615, DW: 0.56		yes*	Fact: 0.0038* Intermediate: -0.5493** Error correction term: -0.3347** R^2: 0.49, DW: 2.034
UK	Ln(gini), ln(fact), ln(scale), ln(intermediate)	Fact: 0.1007** Scale: -0.4605** R^2: 0.442, DW: 0.47	Ln(fact)=I(1) Ln(scale)=I(1) Ln(intermediate)=I(1) Ln(gini)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness)	Fact: 0.0766** Intermediate: 1.357** Openness: 0.2475** R^2: 0.542, DW: 0.515	Ln(trade costs)=I(1) Ln(openness)=I(1)	no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(openness), ln(trade costs)	Fact: 0.0564** Scale: 0.5697** Intermediate: 1.8413** Openness: 0.9985** Trade costs: -1.1554** R^2: 0.75, DW: 0.989		no	
	Ln(gini), ln(fact), ln(scale), ln(intermediate), ln(trade costs)	Fact: 0.0962** Scale: -0.4612** R^2: 0.45, DW: 0.482		no	

Source: Own calculations based on EU KLEMS data (2008) and OECD STAN data.
Note: Significance checks based on p-values. ** denotes significance at a 5 percent level, * denotes significance at a 10 percent level. White standard errors are taken for OLS regression. For unit root tests significance at a 5 percent level. Co-integration is said to exist until a 10 percent level.

Footnotes

[1] This is based on own computations using sectoral data on intra-industrial trade from the OECD STAN Indicators database, averaging over 14 EU countries and 20 industrial sectors' values (see table 1 and table 4 in the paper for included countries and industrial sectors). The minimum and maximum values of intra-industrial trade range between 56 (in the year 1998 for wood industry) and 90 (in the year 2001 for electrical machinery) percent.

[2] Due to factor mobility relationships of factor prices will equalize across countries.

[3] M. Brülhart (1998) treats the terms specialization, concentration, clustering and localization as synonyms. Apart from this he refers to agglomeration when changes in sectors using very dissimilar inputs are addressed whereas specialization or concentration refers to sectors with quite similar inputs used. Brakman, Garretsen, van Marrewijk (2005) point to differences in the terms agglomeration, concentration and specialization (see pp. 129-132). Concentration would mean that–compared to another country–an industry concentrates in primarily one country. Agglomeration is that two industries–in a two industry, two country example–or overall industry activity clusters in one country. And specialization refers to the country's economic structure, that is which industry is predominant in one country.

[4] Duranton and Overman (2005) talk about industrial branches, sectors, industries and sub-industries according to the SIC two-, three-, four- and five digit categories of the Annual Respondent Database of the Annual Census of Production in the UK. They treat the terms establishments and plants as synonyms.

[5] See ECB, exchange rate statistics.

[6] Checks with non-deflated variables not shown here but available from the author upon request.

[7] In the table industry Gini coefficients are shown for the time points 1970, 1980, 1990, 2000 and 2005. Furthermore the change of Gini coefficients from 1970 until 2005 is presented, as well as the results applying a linear trend test over time.

[8] I took the whole sector *other transport equipment* since data for just building and

repairing of ships and boats were missing for many countries.

[9] I had to take the whole chemical industry sector, and could not discard pharmaceuticals, since data were lacking. Also, I took the whole sector *other transport equipment* instead of just railroad equipment and transport equipment not elsewhere classified for the same reasons.

[10] Here I used the whole chemical industry sector instead of just chemicals.

[11] This is also done by the OECD, see OECD (1987). I had to reconstruct the grouping with ISIC Rev. 3 (instead of ISIC Rev. 2) data, unfortunately, with only 20 industries at hand, this might be less precise than a higher disaggregation of industries would allow for.

[12] Midelfart-Knarvik et al. (2000), pp. 12-16, find that industrial structures of France, Germany, UK are characterized by strong economies of scale, a high technology and highly educated workers. Greece and Portugal, however have low technology, low returns to scale and low educated workers. This would be giving evidence for the lower-skilled cheaper labor in southern European countries.

[13] See also Kim (1995), who explains that specialization tendencies in the US were due to resources being immobile.

[14] Amiti (1998, 1999) uses the fraction employment by number of firms, however, since data on number of firms were not available I decided to use an alternative modeling of scale economies. I also used a fraction of employment over output – not shown here– which is the inverse of labor productivity. This measure is highly correlated with the measure for scale used here, which is not surprising since both measures describe relationships between changes in input and output. Also, the results for trade theories' and New Economic Geography's importance using that measure are basically similar to results here.

[15] A White test indicated heteroskedasticity of error terms such that White's heteroskedasticity-consistent standard errors were calculated.

[16] Bosker and Garretsen (2010) find that modeling of trade costs matters for market access which in turn influences spatial wage differences. They offer an alternative modeling of bilateral trade costs based on imports and goods produced and con-

sumed in the home country.

[17] Not shown here but available from the author upon request.

[18] Instrumental variable regression might be done, one has to bear in mind that here the coefficient for growth thus might be estimated inconsistently.

[19] Remember that a positive coefficient of scale indicates that higher scale economies lead to fewer agglomeration.

[20] I(1) means that a variable is non-stationary and integrated of the rank 1, that is differencing the variable one time makes it become stationary.

[21] Using the ADF-test or Phillips-Perron test. Last test's results are abbreviated by PP.

[22] I checked for co-integration for all of the regression frameworks where variables were integrated of the same order and conducted error correction estimation whenever a co-integration relationship was significant up to about a 0.10 p-value. Therefore I run ADF tests and used MacKinnon's critical values for co-integration tests (MacKinnon (2010)).